JEE Main 2024 Paper 2B (B.Planning) Apr 12 Single sitting Question Paper with Solutions PDF

Question Paper with Solutions

Conducted by the National Testing Agency (NTA)

Time Allowed: 3 Hours **Maximum Marks: 400**

General Instructions

(i) This paper is Paper 2B (B.Planning.) of JEE (Main) 2024, Session 2 (April), conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 12 April 2024, Shift 1. The total duration is 3 hours.

(ii) The paper has 105 questions: Mathematics (30), Aptitude Test (50), Planning (25), in that order. Maximum marks: 400.

(iii) Mathematics has two sections. Section A has 20 multiple choice questions (MCQs) with four options, of which only one is correct. Section B has 10 numerical value questions; attempt any 5 of them. The answer to each numerical value question is a number.

(iv) Marking scheme (multiple choice questions): $+4$ for a correct answer, -1 for an incorrect answer and 0 for an unanswered question.

(v) Marking scheme (numerical value questions): $+4$ for a correct answer, -1 for an incorrect answer and 0 for an unanswered question.

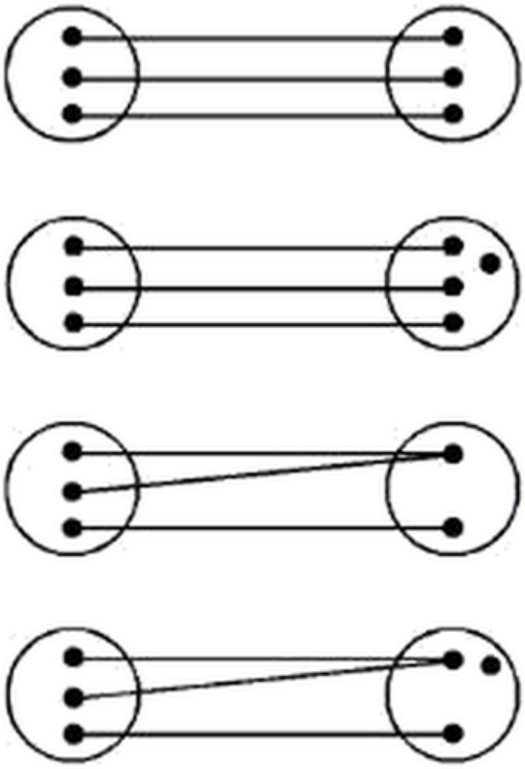
(vi) Calculators, log tables, slide rules and electronic gadgets are not allowed.

Mathematics – Section A: Multiple Choice Questions (80 marks)

1. Match List I with List II. The four mappings A, B, C and D in List I are shown below in that order.

List II	Type of mapping
I	Neither surjective nor injective
II	Surjective but not injective
III	Injective but not surjective
IV	Injective and surjective

Choose the correct answer from the options given below: [4 marks]



(A) A-IV, B-II, C-III, D-I

(B) A-I, B-II, C-IV, D-III

(C) A-IV, B-III, C-II, D-I

(D) A-IV, B-III, C-I, D-II

Correct Answer: (C) A-IV, B-III, C-II, D-I

Solution:

Concept:

- A function is injective (one-one) when distinct domain elements have distinct images: $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$. Thus no two arrows may end at the same codomain point.
- A function is surjective (onto) when every codomain element is the image of some domain element. A point with no incoming arrow disproves surjectivity; unused space inside the oval has no

relevance.

Step 1: Classify mappings A and B In A, the three domain points map to three different codomain points, and every codomain point receives an arrow. A is therefore both injective and surjective, giving A–IV. In B, the three arrows again have different endpoints, but the additional codomain point on the right receives no arrow. B is injective but not surjective, giving B–III. The extra unhit point must be counted because surjectivity concerns the entire codomain, not merely the range.

Step 2: Classify mappings C and D In C, the upper two domain points map to the same upper codomain point, while the third maps to the lower point. The common image disproves injectivity, but both codomain points are reached, so C is surjective but not injective: C–II. D has the same repeated endpoint and also an extra unhit codomain point. It fails both tests, so D–I.

Step 3: Compare all four complete matches The complete matching is A–IV, B–III, C–II, D–I. Option (A) incorrectly calls B onto and C one-one. Option (B) incorrectly calls A neither type and C bijective. Option (D) incorrectly calls C neither type and D onto. Only option (C) agrees with all four arrow diagrams.

Step 4: Conclusion $\boxed{\text{A} - \text{IV},\ \text{B} - \text{III},\ \text{C} - \text{II},\ \text{D} - \text{I}}$. Hence, the correct option is (C).

Quick Tip to Solve: For each arrow diagram, apply two separate tests: repeated endpoints rule out one-one, and unhit codomain points rule out onto. Check dots, not the shape of the oval.

---

2. A college awarded 38 medals for cricket, 15 for tennis and 20 for football. If these medals were bagged by a total of 58 students and only 3 students got medals for all the three games, then how many students received medals for exactly two of the three games? [4 marks]

(A) 9

(B) 18

(C) 12

(D) 6

Correct Answer: (A) 9

Solution:

Concept:

- Each medal is counted in the total for its sport. Consequently a student winning in two sports contributes twice, whereas a student winning in all three contributes three times.
- If u, v, w count students receiving medals in exactly one, exactly two and exactly three sports respectively, then the number of distinct recipients is $u + v + w$.

Step 1: Count the total sport memberships The three sport totals add to

$$38 + 15 + 20 = 73.$$

This counts memberships of the cricket, tennis and football sets, not distinct students. Let v be the requested number of students in exactly two sets. The statement gives $w = 3$, and all 58 recipients

belong to at least one of the three sets. Thus

$$u + v + 3 = 58, \qquad u + 2v + 3(3) = 73.$$

No assumption that the three sports have disjoint winners is justified.

Step 2: Subtract the distinct-student count Subtracting the first equation from the second removes each student's first medal contribution:

$$v + 2(3) = 73 - 58 = 15.$$

Hence

$$v = 15 - 6 = 9.$$

A student in all three sports contributes two excess counts, so subtracting only three would incorrectly give 12. As a check, $u = 58 - 9 - 3 = 46$ and $46 + 2(9) + 3(3) = 73$. Options 18 and 6 also fail this membership equation; option 12 neglects one extra count from every triple winner.

Step 3: Conclusion Exactly 9 students received medals for exactly two games. Hence, the correct option is (A).

Quick Tip to Solve: Subtract distinct recipients from total memberships; every triple winner contributes two to that excess, not one.

3. If α and β are the roots of $ax^2 + bx + c = 0$, then the value of $\frac{1}{(a\alpha+b)^2} + \frac{1}{(a\beta+b)^2}$ is [4 marks]

(A) $\frac{b^2-2c}{c^2}$
(B) $\frac{b^2-2ac}{(ac)^2}$
(C) $\frac{b^2-2c}{c}$
(D) $\frac{b^2-2ac}{ac}$

Correct Answer: (B) $\frac{b^2-2ac}{(ac)^2}$

Solution:

Concept:

- For $ax^2 + bx + c = 0$, Vieta's relations give $\alpha + \beta = -b/a$ and $\alpha\beta = c/a$, with $a \neq 0$.
- Use $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$ to express a symmetric expression without solving for individual roots. The displayed reciprocals require nonzero denominators.

Step 1: Rewrite the two denominators From $a(\alpha + \beta) = -b$,

$$a\alpha + b = -a\beta, \qquad a\beta + b = -a\alpha.$$

Squaring removes the minus signs. Therefore the required sum is

$$\frac{1}{a^2\beta^2} + \frac{1}{a^2\alpha^2} = \frac{\alpha^2 + \beta^2}{a^2\alpha^2\beta^2}.$$

In particular, the square applies to the entire denominator; retaining only one factor of ac would change the expression.

Step 2: Apply the sum and product of roots The numerator becomes

$$\alpha^2+\beta^2=\frac{b^2}{a^2}-\frac{2c}{a}=\frac{b^2-2ac}{a^2}.$$

Also

$$a^2\alpha^2\beta^2=a^2\left(\frac{c}{a}\right)^2=c^2.$$

Dividing these results gives

$$\frac{b^2-2ac}{a^2c^2}=\frac{b^2-2ac}{(ac)^2}.$$

This formula is valid whenever the original expression is defined, in particular $c\neq 0$. Options A and C omit the factor a in the symmetric numerator, and C and D also have the wrong denominator power. Only B preserves both Vieta substitutions.

Step 3: Conclusion The value is $\frac{b^2-2ac}{(ac)^2}$. Hence, the correct option is (B).

Quick Tip to Solve: Before expanding squared denominators, replace a root plus the coefficient term using the sum of the two roots.

4. Let $A=\begin{bmatrix}1&2&3&4\\5&6&7&8\\9&9&9&9\\8&8&8&8\end{bmatrix}$**, then determinant of** $A=$ [4 marks]

(A) -1

(B) 0

(C) 1

(D) 72

Correct Answer: (B) 0

Solution:

Concept:

- A determinant is zero when two of its rows are proportional. This follows from linear dependence of the row vectors and does not depend on the other rows.
- The row replacement $R_i\to R_i+kR_j$ leaves a determinant unchanged. A matrix with an all-zero row has determinant zero by cofactor expansion along that row.

Step 1: Identify the dependent rows The third and fourth rows of the given matrix are

$$R_3=(9,9,9,9),\qquad R_4=(8,8,8,8).$$

They satisfy

$$R_4 = \frac{8}{9}R_3.$$

Thus they supply the same row direction rather than two independent directions. The first two rows do not remove this dependence: the nontrivial relation $9R_4 - 8R_3 = 0$ holds regardless of their entries. A nonzero determinant requires four independent rows for this 4×4 matrix.

Step 2: Reduce one row to zero For an explicit determinant calculation, perform

$$R_4 \longrightarrow R_4 - \frac{8}{9}R_3.$$

Every entry in the new fourth row is $8 - (8/9)9 = 0$, so

$$\det A = \begin{vmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 9 & 9 & 9 \\ 0 & 0 & 0 & 0 \end{vmatrix} = 0.$$

Expansion along the last row gives a sum of four zero terms. This is a determinant-preserving row addition, not row scaling, so no compensating multiplier is needed. The nonzero alternatives -1, 1 and 72 contradict the zero-row result; none can arise from the stated matrix.

Step 3: Conclusion The proportional third and fourth rows force $\det A = 0$. Hence, the correct option is (B).

Quick Tip to Solve: Check for proportional rows before starting a long cofactor expansion; one such dependence settles the determinant.

5. In how many ways can we select four cards from an ordinary pack of playing cards so that two of them are of the same denomination and the remaining two are of some other same denomination?

[4 marks]

(A) 78

(B) 150

(C) 715

(D) 5616

Correct Answer: The correct unordered count is 2808; none of the listed options equals it.

Solution:

Concept:

- A standard 52-card deck has 13 denominations, with four suits in each denomination. Selecting cards is an unordered choice, so a hand has no first pair or second pair.
- The required pattern is exactly two cards from each of two distinct denominations. Choose the denominations first, then independently choose two of the four suits for each one.

Step 1: Choose the two distinct denominations There are

$$\binom{13}{2} = \frac{13 \cdot 12}{2} = 78$$

unordered pairs of denominations. Using $13 \cdot 12$ instead counts each denomination pair twice: choosing kings and then aces gives the same selection category as choosing aces and then kings. The wording asks for selecting four cards, so this interchange cannot produce a new hand.

Step 2: Choose the suits and compare all options For either chosen denomination there are $\binom{4}{2} = 6$ two-card subsets. Therefore

$$N = \binom{13}{2}\binom{4}{2}\binom{4}{2} = 78 \cdot 6 \cdot 6 = 2808.$$

There is no further division by two: the factor $\binom{13}{2}$ has already removed the interchange of the two denominations, while each suit choice belongs to its own denomination. Option A, 78, counts only the rank choices and omits the suits. Neither 150 nor 715 equals the product. Option D, 5616, is exactly twice 2808 and corresponds to ordering the two pairs, which is not requested. Thus none of the four printed options gives the number of unordered four-card selections.

Step 3: Conclusion The printed selection problem gives 2808 hands, by $\binom{13}{2}\binom{4}{2}^2$. None of the listed options is correct. In particular, 5616 double-counts each hand by ordering its two denominations; the literal wording does not justify that extra factor.

Quick Tip to Solve: For two pairs, choose an unordered pair of ranks first; using 13 times 12 creates a factor-of-two overcount.

---

6. If the coefficient of x^7 and x^8 in the expansion of $\left(2+\frac{x}{3}\right)^n$ are equal, then n is [4 marks]

(A) 56

(B) 55

(C) 45

(D) 15

Correct Answer: (B) 55

Solution:

Concept:

- The coefficient of x^r in $(2+x/3)^n$ is $c_r = \binom{n}{r}2^{n-r}3^{-r}$, because the $x/3$ term is selected from exactly r factors.
- For adjacent coefficients, use $\binom{n}{r+1}/\binom{n}{r} = (n-r)/(r+1)$. Their ratio cancels the common large factorial and power factors.

Step 1: Write the two coefficients explicitly The relevant coefficients are

$$c_7 = \binom{n}{7}\frac{2^{n-7}}{3^7}, \qquad c_8 = \binom{n}{8}\frac{2^{n-8}}{3^8}.$$

The question concerns the ordinary finite binomial expansion with both terms present, so n is an integer at least 8. Equality of coefficients refers to these complete factors, not merely equality of the two binomial coefficients.

Step 2: Set their ratio equal to one Taking the eighth coefficient divided by the seventh gives

$$1 = \frac{c_8}{c_7} = \frac{\binom{n}{8}}{\binom{n}{7}} \cdot \frac{1}{2} \cdot \frac{1}{3} = \frac{n-7}{48}.$$

Thus

$$n - 7 = 48, \qquad n = 55.$$

The ratio increases with n, so this is the unique admissible integer. Checking the other options in the same ratio yields $49/48$ for 56, $38/48$ for 45, and $8/48$ for 15; none is one. The factor $1/6$ is essential because increasing the selected power of $x/3$ also removes one factor of 2.

Step 3: Conclusion Equality of the coefficients requires $n = 55$. Hence, the correct option is (B).

Quick Tip to Solve: Compare adjacent coefficients by a ratio, retaining both the constant-term factor and the coefficient of x.

---

7. The sum of all those terms of the arithmetic progression 2, 6, 10, 14, ... , 598 which are not divisible by 3, is equal to [4 marks]

(A) 30300

(B) 30000

(C) 29400

(D) 30600

Correct Answer: (B) 30000

Solution:

Concept:

- An arithmetic progression with first term a, common difference d, and n terms has last term $a + (n-1)d$ and sum $n(a+\ell)/2$.
- Find the sum of all terms and subtract the sum of the terms divisible by 3. The excluded terms themselves form an arithmetic progression.

Step 1: Sum the complete progression The progression has first term 2, common difference 4 and last term 598. Hence

$$598 = 2 + 4(n-1), \qquad n = 150.$$

Its total is

$$S = \frac{150}{2}(2 + 598) = 75 \cdot 600 = 45000.$$

This includes every term, both divisible and not divisible by 3; the requested exclusion must still be applied.

Step 2: Remove exactly the multiples of three A general term is $4k - 2$. Modulo 3 this is $k + 1$, so

divisibility by 3 occurs at $k = 2, 5, 8, \ldots, 149$. The excluded terms are therefore

$$6, 18, 30, \ldots, 594,$$

with common difference 12 and count

$$m = \frac{594 - 6}{12} + 1 = 50.$$

Their sum is

$$S_3 = \frac{50}{2}(6 + 594) = 15000.$$

Thus

$$S - S_3 = 45000 - 15000 = 30000.$$

The omitted progression ends at 594, not at 598. Options 30300, 29400 and 30600 disagree with this exact subtraction. The remaining 100 terms occur in symmetric pairs about 300, also giving $100 \cdot 300 = 30000$.

Step 3: Conclusion The sum of the terms not divisible by 3 is 30000. Hence, the correct option is (B).

Quick Tip to Solve: In an AP, divisibility exclusions often form another AP; sum that subsequence and subtract it from the total.

8. The first two terms of a G.P. are x^{-3} and x^n, respectively. If x^{42} is the sixth term of the same progression, then n^2 is equal to [4 marks]

(A) 16

(B) 9

(C) 36

(D) 25

Correct Answer: (C) 36

Solution:

Concept:

- For a geometric progression with first term a and common ratio r, its kth term is ar^{k-1}. In particular, reaching the sixth term requires five ratio multiplications.
- When all terms are given as powers of the same base, multiplication adds exponents. Determine the ratio from the second term divided by the first.

Step 1: Find the common ratio The first term is $a = x^{-3}$ and the second term is x^n. Consequently

$$r = \frac{x^n}{x^{-3}} = x^{n+3}.$$

The plus sign in $n + 3$ results from subtracting the negative first exponent. The negative power in the statement requires $x \neq 0$. We compare the indicated power expressions to obtain the parameter of this progression.

Step 2: Use the sixth term and square the parameter The sixth term is

$$T_6 = ar^5 = x^{-3}\left(x^{n+3}\right)^5 = x^{-3+5n+15} = x^{5n+12}.$$

Matching the given power x^{42} yields

$$5n + 12 = 42, \qquad 5n = 30, \qquad n = 6.$$

The quantity asked for is the square rather than n itself, so

$$n^2 = 36.$$

To verify, $r = x^9$, and the exponents of the first six terms are $-3, 6, 15, 24, 33, 42$, as required. The other offered squares 16, 9 and 25 correspond to parameter magnitudes 4, 3 and 5 and do not yield the sixth exponent 42 with this first term. Using six ratio factors would shift the indexing and give the wrong equation.

Step 3: Conclusion The progression has $n = 6$, so $n^2 = 36$. Hence, the correct option is (C).

Quick Tip to Solve: Write the exponents as an arithmetic progression; the sixth exponent lies five equal exponent steps after the first.

9. Suppose L is the line joining the points $(0, 0)$ and $(1, 2)$. If a line parallel to L meets the curve $y = 2x^2 + 3x + 1$ only at a single point P, then the point P is [4 marks]

(A) $\left(\frac{1}{4}, \frac{3}{8}\right)$
(B) $(2, 15)$
(C) $\left(\frac{-1}{4}, \frac{3}{8}\right)$
(D) $\left(\frac{-3}{4}, \frac{5}{16}\right)$

Correct Answer: (C) $\left(\frac{-1}{4}, \frac{3}{8}\right)$

Solution:

Concept:

- The slope of the line through two points is $m = (y_2 - y_1)/(x_2 - x_1)$. Parallel lines have equal slopes.
- A line meeting a parabola at just one point is tangent to it. For a differentiable curve $y = f(x)$, its tangent slope at $x = a$ is $f\prime(a)$.

Step 1: Find the required slope The line L joins $(0, 0)$ and $(1, 2)$, so its slope is

$$m_L = \frac{2 - 0}{1 - 0} = 2.$$

Every line parallel to L therefore has equation $y = 2x + c$. The required line must touch the parabola rather than cut it twice.

Step 2: Locate the point of tangency For the curve $y = 2x^2 + 3x + 1$, differentiation gives

$$\frac{dy}{dx} = 4x + 3.$$

Equating the tangent slope to 2,

$$4x + 3 = 2 \quad \Longrightarrow \quad x = -\frac{1}{4}.$$

Substituting this into the curve,

$$y = 2\left(\frac{1}{16}\right) - \frac{3}{4} + 1 = \frac{3}{8}.$$

The positive abscissa in (A) has tangent slope 4, and $(2, 15)$ in (B) has slope 11; neither is suitable. The point in (D) does not even satisfy the given curve.

Step 3: Check that the intersection is unique The tangent through the resulting point is $y = 2x + 7/8$. Its intersection with the curve gives

$$2x^2 + x + \frac{1}{8} = 2\left(x + \frac{1}{4}\right)^2 = 0.$$

This repeated root confirms that there is exactly one intersection, not two separate points.

Step 4: Conclusion The required point is $P = (-1/4, 3/8)$. Hence, the correct option is (C).

Quick Tip to Solve: For a tangent parallel to a given line, first equate the derivative to that line's slope, then substitute into the curve.

10. A manufacturer can sell x items at a price of ₹ $\left(5 - \frac{x}{100}\right)$ each. The cost price of x items is ₹ $\left(\frac{x}{5} + 500\right)$. The number of items he should sell to reach maximum profit is [4 marks]

(A) 100

(B) 240

(C) 500

(D) 480

Correct Answer: (B) 240

Solution:

Concept:

- Profit equals total revenue minus total cost. If $p(x)$ is the price of each item, revenue is $xp(x)$, not merely $p(x)$.
- An interior stationary point satisfies $P\prime(x) = 0$. If $P\prime\prime(x) < 0$, the profit is concave and the stationary point is its maximum.

Step 1: Form the profit function The unit selling price decreases as the number sold increases. Thus

the revenue from selling x items is

$$R(x) = x\left(5 - \frac{x}{100}\right) = 5x - \frac{x^2}{100}.$$

Subtract the full cost, including the fixed cost of Rs 500:

$$P(x) = 5x - \frac{x^2}{100} - \left(\frac{x}{5} + 500\right) = \frac{24x}{5} - \frac{x^2}{100} - 500.$$

The fixed cost changes the profit value but does not change the maximizing quantity.

Step 2: Maximize and verify the quantity Differentiate with respect to x:

$$P\prime(x) = \frac{24}{5} - \frac{x}{50}.$$

Hence

$$P\prime(x) = 0 \quad \Longrightarrow \quad x = 50 \cdot \frac{24}{5} = 240.$$

Also $P\prime\prime(x) = -1/50 < 0$, so this is a strict maximum. It is an integer and its selling price is positive, Rs $5 - 240/100 = 2.60$, so the quantity is feasible.

Step 3: Rule out the other choices Completing the square makes the global comparison explicit: $P(x) = 76 - (x - 240)^2/100$. The subtracted square vanishes only at 240. At 100, 500 or 480 it is strictly positive, so each of those choices gives a smaller profit. No endpoint choice can improve on the vertex of this downward-opening quadratic.

Step 4: Conclusion The manufacturer should sell 240 items to maximize profit. Hence, the correct option is (B).

Quick Tip to Solve: Multiply the per-item price by the quantity before differentiating revenue; fixed costs disappear from the derivative.

11. The value of $\int_0^1 \log_e\left(\frac{1}{x} - 1\right) dx$ is [4 marks]

(A) 0

(B) $\frac{1}{2}$

(C) 1

(D) 2

Correct Answer: (A) 0

Solution:

Concept:

- For $0 < x < 1$, $\log_e(1/x - 1) = \ln(1 - x) - \ln x$, using the logarithm of a positive quotient.
- The logarithmic singularities at the endpoints are integrable. The identity $\int_0^1 f(1 - x)\, dx = \int_0^1 f(x)\, dx$ allows the two logarithmic terms to cancel.

Step 1: Separate the logarithms on the open interval Both x and $1 - x$ are positive inside the

integration interval, so the logarithm law applies without absolute-value ambiguity:

$$I = \int_0^1 \ln\left(\frac{1-x}{x}\right) dx = \int_0^1 \ln(1-x)dx - \int_0^1 \ln x\, dx.$$

We must check convergence before subtracting these improper integrals, since the original integrand is unbounded at both endpoints.

Step 2: Evaluate the convergent endpoint integrals An antiderivative of $\ln x$ is $x\ln x - x$. Since $\lim_{x\to 0^+} x\ln x = 0$,

$$\int_0^1 \ln x\, dx = [x\ln x - x]_0^1 = -1.$$

In the other integral put $u = 1-x$, so $dx = -du$, and reverse the limits:

$$\int_0^1 \ln(1-x)dx = \int_0^1 \ln u\, du = -1.$$

Thus each improper integral has a finite value.

Step 3: Subtract and compare with the options It follows that

$$I = (-1) - (-1) = 0.$$

Equivalently the integrand changes sign under $x \mapsto 1-x$, so its positive and negative contributions have equal magnitude. The nonzero values $1/2$, 1 and 2 would contradict this cancellation and therefore cannot be the integral.

Step 4: Conclusion The integral equals 0. Hence, the correct option is (A).

Quick Tip to Solve: For a logarithm of $(1-x)/x$ on $(0,1)$, use reflection about $x = 1/2$, after confirming endpoint convergence.

12. If $(1+\cos x)\frac{dy}{dx} - (y-3)\sin x = 0$ and $y(0) = 0$, then the value of $y\left(\frac{\pi}{2}\right)$ is [4 marks]

(A) -3

(B) 3

(C) 9

(D) 6

Correct Answer: (A) -3

Solution:

Concept:

- The product rule gives $\frac{d}{dx}[(y-3)(1+\cos x)] = (1+\cos x)y\prime - (y-3)\sin x$.
- An initial condition determines the integration constant. On the interval from 0 to $\pi/2$, $1+\cos x$ is nonzero, so division by this factor is valid.

Step 1: Recognize and integrate an exact product The given equation has exactly the form of the

derivative of a product:

$$\frac{d}{dx}\left[(y-3)(1+\cos x)\right] = 0.$$

Therefore

$$(y-3)(1+\cos x) = C,$$

where C is constant along the required solution. This approach keeps the minus sign from differentiating cosine visible, and avoids any ambiguity from separating and integrating logarithms.

Step 2: Use the initial value At $x = 0$, the given condition is $y = 0$, and $\cos 0 = 1$. Thus

$$C = (0-3)(1+1) = -6.$$

Solving for y yields

$$y(x) = 3 - \frac{6}{1+\cos x}.$$

As a direct check, this expression gives $y(0) = 3 - 3 = 0$, as required.

Step 3: Evaluate at the requested argument Now $\cos(\pi/2) = 0$, hence

$$y\left(\frac{\pi}{2}\right) = 3 - \frac{6}{1+0} = -3.$$

In particular, the constant solution $y = 3$ would satisfy the differential equation but fails the initial value, so (B) is unsuitable. The positive choices 9 and 6 also disagree with the uniquely determined expression. The factor $1 + \cos x$ stays positive on the interval considered, so there is no intervening singularity.

Step 4: Conclusion The required value is $y(\pi/2) = -3$. Hence, the correct option is (A).

Quick Tip to Solve: Look for a product derivative when the coefficients are a trigonometric function and its derivative; apply the initial condition before evaluating.

13. If a straight line passing through point P $(3, -5)$ is such that its intercepted portion between the co-ordinate axes is bisected at P, then the equation of the line is [4 marks]

(A) $5x + 3y + 30 = 0$

(B) $5x - 3y - 30 = 0$

(C) $5x - 3y + 30 = 0$

(D) $-5x - 3y + 30 = 0$

Correct Answer: (B) $5x - 3y - 30 = 0$

Solution:

Concept:

- A line cutting the coordinate axes at $(a, 0)$ and $(0, b)$ has intercept form $x/a + y/b = 1$, with signed intercepts a, b.
- The midpoint of the intercepted segment is $(a/2, b/2)$. Negative intercepts must retain their signs.

Step 1: Find both signed intercepts Let the axis-intersection points be $A = (a, 0)$ and $B = (0, b)$. The given point $P = (3, -5)$ bisects the segment joining them. By the midpoint formula,

$$\left(\frac{a}{2}, \frac{b}{2}\right) = (3, -5).$$

Comparing coordinates gives

$$a = 6, \qquad b = -10.$$

Thus the line meets the positive x-axis and the negative y-axis. Replacing -10 by its magnitude would describe a different line.

Step 2: Write and simplify the equation Using these intercepts in the line equation,

$$\frac{x}{6} + \frac{y}{-10} = 1 \quad \Longrightarrow \quad \frac{x}{6} - \frac{y}{10} = 1.$$

Multiplying by 30 gives

$$5x - 3y = 30,$$

or $5x - 3y - 30 = 0$. This also contains P, since $5(3) - 3(-5) - 30 = 15 + 15 - 30 = 0$.

Step 3: Check uniqueness against the choices The two distinct intercept points determine a unique line. Option (A) has intercepts $(-6, 0)$ and $(0, -10)$, whose midpoint is $(-3, -5)$. Option (C) has midpoint $(-3, 5)$, while (D) has midpoint $(3, 5)$. None of these is the specified midpoint. Only the equation obtained above has both the correct coordinates and signs.

Step 4: Conclusion The required line is $5x - 3y - 30 = 0$. Hence, the correct option is (B).

Quick Tip to Solve: If a point bisects an axis-intercept segment, double its coordinates to obtain the signed intercepts immediately.

---

14. The intercept on the line $x = y$ by the circle $x^2 + y^2 - 2y = 0$ is AB. The equation of the circle with AB as a diameter is [4 marks]

(A) $x^2 + y^2 + x + y = 0$
(B) $x^2 + y^2 - x - y = 0$
(C) $x^2 + y^2 - x + y = 0$
(D) $x^2 + y^2 + x - y = 0$

Correct Answer: (B) $x^2 + y^2 - x - y = 0$

Solution:

Concept:

- Substitute a line equation into a circle equation to find the endpoints of its chord.
- A circle with diameter endpoints (x_1, y_1), (x_2, y_2) has equation $(x-x_1)(x-x_2)+(y-y_1)(y-y_2) = 0$, expressing a right angle at any point on the circle.

Step 1: Find the chord endpoints The chord lies on $x = y$. Substitute $y = x$ into the original circle:

$$x^2 + x^2 - 2x = 0 \quad \Longrightarrow \quad 2x(x-1) = 0.$$

Hence $x = 0$ or $x = 1$. Since $y = x$, the endpoints are

$$A = (0,0), \qquad B = (1,1).$$

These are the actual intersections, not the centre of the original circle, which is $(0,1)$.

Step 2: Use the diameter condition For a general point (x, y) on the required circle, the vectors from that point to the two endpoints are perpendicular. Their scalar product is zero:

$$(x-0)(x-1) + (y-0)(y-1) = 0.$$

Expanding,

$$x^2 + y^2 - x - y = 0.$$

Completing squares provides a separate geometric check:

$$\left(x - \frac{1}{2}\right)^2 + \left(y - \frac{1}{2}\right)^2 = \frac{1}{2}.$$

Its centre is the midpoint of AB, and its radius $1/\sqrt{2}$ is half the chord length $\sqrt{2}$.

Step 3: Eliminate the remaining equations Every candidate passes through the origin, so that endpoint alone cannot distinguish them. Substituting $(1,1)$ into (A), (C) and (D) gives 4, 2 and 2 respectively, rather than zero. They therefore fail to pass through the other endpoint and cannot have AB as a diameter.

Step 4: Conclusion The circle is $x^2 + y^2 - x - y = 0$. Hence, the correct option is (B).

Quick Tip to Solve: After finding the chord endpoints, use the diameter dot-product equation; checking both endpoints quickly rejects incorrect signs.

---

15. If the foot of the perpendicular from the point $(0,0,0)$ on the line $\frac{x+2}{5} = \frac{y+2}{2} = \frac{z+8}{3}$ is (a,b,c), then $a^2 + b^2 + c^2$ is [4 marks]

(A) 34

(B) 14

(C) 24

(D) 44

Correct Answer: (A) 34

Solution:

Concept:

- A point on a symmetric-form line can be expressed as $\mathbf{r} = \mathbf{r}_0 + t\mathbf{d}$, where $\mathbf{d}$ is its direction vector.

- At the perpendicular foot from the origin, the position vector of the foot is orthogonal to $\mathbf{d}$, so $\mathbf{r} \cdot \mathbf{d} = 0$.

Step 1: Parameterize the possible foot Set each ratio in the given line equal to t:

$$\frac{x+2}{5} = \frac{y+2}{2} = \frac{z+8}{3} = t.$$

Thus a general point is

$$(x, y, z) = (5t - 2,\ 2t - 2,\ 3t - 8),$$

and the line has direction vector $\mathbf{d} = (5, 2, 3)$. The required foot must be one of these points; perpendicularity supplies the remaining condition.

Step 2: Apply the perpendicularity condition The vector from the origin to the foot is the foot's position vector. Its dot product with the line direction must vanish:

$$5(5t - 2) + 2(2t - 2) + 3(3t - 8) = 0.$$

Expanding every term gives

$$25t - 10 + 4t - 4 + 9t - 24 = 38t - 38 = 0,$$

so $t = 1$. Consequently

$$(a, b, c) = (3, 0, -5).$$

Indeed $(3, 0, -5) \cdot (5, 2, 3) = 15 - 15 = 0$, confirming the right angle.

Step 3: Calculate the required squared distance The expression requested is the square of the distance from the origin to the foot:

$$a^2 + b^2 + c^2 = 3^2 + 0^2 + (-5)^2 = 9 + 25 = 34.$$

The question asks for the squared distance, so no square root should be taken in the final value. The distinct alternatives 14, 24 and 44 are inconsistent with the coordinates determined by both incidence and perpendicularity.

Step 4: Conclusion The value of $a^2 + b^2 + c^2$ is 34. Hence, the correct option is (A).

Quick Tip to Solve: For the foot from the origin onto a line, parameterize the line and set its position vector dotted with its direction to zero.

16. If the vectors $\overrightarrow{AB} = 3\hat{i} + 8\hat{k}$ and $\overrightarrow{AC} = 5\hat{i} - 2\hat{j} + 6\hat{k}$ are the sides of a triangle ABC, then the length of the median through A is [4 marks]

(A) $\sqrt{33}$

(B) $\sqrt{66}$

(C) $\sqrt{56}$

(D) $\sqrt{72}$

Correct Answer: (B) $\sqrt{66}$

Solution:

Concept:

- If M is the midpoint of BC, the median vector from A is $\overrightarrow{AM} = (\overrightarrow{AB} + \overrightarrow{AC})/2$.
- The magnitude of a vector $u\hat{i} + v\hat{j} + w\hat{k}$ is $\sqrt{u^2 + v^2 + w^2}$. Coordinate vectors add component by component.

Step 1: Express the midpoint relative to the vertex Take A as the reference point. Then the position vectors of B and C are exactly the two side vectors given. Because a median joins a vertex to the midpoint of the opposite side,

$$\overrightarrow{AM} = \frac{1}{2}\left[(3\hat{i} + 8\hat{k}) + (5\hat{i} - 2\hat{j} + 6\hat{k})\right].$$

The missing $\hat{j}$-component in the first vector is zero; it must not be replaced by any nonzero value.

Step 2: Add the components and find the length Adding the vectors before dividing by 2 gives

$$\overrightarrow{AB} + \overrightarrow{AC} = 8\hat{i} - 2\hat{j} + 14\hat{k},$$

and hence

$$\overrightarrow{AM} = 4\hat{i} - \hat{j} + 7\hat{k}.$$

Its length is

$$|\overrightarrow{AM}| = \sqrt{4^2 + (-1)^2 + 7^2} = \sqrt{16 + 1 + 49} = \sqrt{66}.$$

The negative middle component contributes a positive square, not a negative term.

Step 3: Check the alternatives The squared length is exactly 66, so it cannot be 33, 56 or 72, the squared values implied by the other options. Subtracting the given side vectors would instead find a vector parallel to BC, rather than the median from A. Averaging their magnitudes would also fail because vector directions matter; it is the vectors themselves that must first be averaged.

Step 4: Conclusion The length of the median through A is $\sqrt{66}$. Hence, the correct option is (B).

Quick Tip to Solve: For a median from the common starting vertex of two side vectors, add those vectors, halve, and only then take the magnitude.

17. If $\vec{a} = 6\hat{i} + 2\hat{j} - \lambda_1\hat{k}$, $\vec{b} = 3\hat{i} + (3 - \lambda_2)\hat{j} + 2\hat{k}$ and $\vec{c} = 2\hat{i} + (1 + \lambda_3)\hat{j} - 3\hat{k}$ are three vectors such that $\vec{a} = 3\vec{c}$ and $\vec{b}$ is perpendicular to $\vec{c}$ then $(\lambda_1, \lambda_2, \lambda_3)$ is [4 marks]

(A) $\left(9, 21, -\frac{1}{3}\right)$

(B) $\left(9, 3, -\frac{1}{3}\right)$

(C) $\left(\frac{1}{3}, -\frac{1}{3}, \frac{1}{3}\right)$

(D) $(3, 3, 1)$

Correct Answer: (B) $\left(9, 3, -\frac{1}{3}\right)$

Solution:

Concept:

- Equal vectors have equal corresponding Cartesian components. Thus the relation $\vec{a} = 3\vec{c}$ determines two of the unknown parameters directly.
- For two nonzero perpendicular vectors, the scalar product is zero: $\vec{b} \cdot \vec{c} = b_x c_x + b_y c_y + b_z c_z = 0$.

Step 1: Compare the components of the equal vectors Multiply every component of $\vec{c}$ by 3 before comparing it with $\vec{a}$:

$$3\vec{c} = 6\hat{i} + 3(1 + \lambda_3)\hat{j} - 9\hat{k}.$$

The $\hat{i}$ components already agree. From the remaining components,

$$2 = 3(1 + \lambda_3), \qquad -\lambda_1 = -9.$$

Consequently,

$$\lambda_3 = -\frac{1}{3}, \qquad \lambda_1 = 9.$$

The negative sign in the given $\hat{k}$ component is essential: it is $-\lambda_1$, not λ_1, that equals -9.

Step 2: Use perpendicularity and check the options Now $\vec{c} = 2\hat{i} + \frac{2}{3}\hat{j} - 3\hat{k}$. Therefore

$$\begin{aligned} 0 = \vec{b} \cdot \vec{c} &= 3(2) + (3 - \lambda_2)\frac{2}{3} + 2(-3) \\ &= \frac{2}{3}(3 - \lambda_2). \end{aligned}$$

Thus $\lambda_2 = 3$. Substitution gives $\vec{b} = (3, 0, 2)$, whose dot product with $\vec{c}$ is $6 - 6 = 0$, and $3\vec{c} = (6, 2, -9) = \vec{a}$. Option (A) has $\lambda_2 = 21$, which makes the dot product -12, so it fails. Options (C) and (D) already contradict $\lambda_1 = 9$, and also fail the required component equality.

Step 3: Conclusion The parameters are $(\lambda_1, \lambda_2, \lambda_3) = \left(9, 3, -\frac{1}{3}\right)$. Hence, the correct option is (B).

Quick Tip to Solve: Use the vector equality before the dot product: it fixes two parameters and reduces perpendicularity to one linear equation.

18. Let x_1, x_2, x_3, x_4, x_5 be observations with mean m and standard deviation s. Then, which of the following statements are correct:

A. Mean of the observations $x_1 + k, x_2 + k, x_3 + k, x_4 + k, x_5 + k$ is $m + 5k$

B. Mean of the observations $kx_1, kx_2, kx_3, kx_4, kx_5$ is km.

C. The standard deviation of the observations $x_1 + k, x_2 + k, x_3 + k, x_4 + k, x_5 + k$ is s.

D. The standard deviation of the observations $kx_1, kx_2, kx_3, kx_4, kx_5$ is $k^5 s$.

Choose the correct answer from the options given below : [4 marks]

(A) A, B, C, D

(B) A, C only

(C) B, D only

(D) B, C only

Correct Answer: (D) B, C only

Solution:

Concept:

- The mean is the sum of all observations divided by their number: $m = \frac{1}{5}\sum_{i=1}^{5} x_i$. Adding a constant shifts the mean by that constant.
- Standard deviation measures deviations from the mean: $s^2 = \frac{1}{5}\sum_{i=1}^{5}(x_i - m)^2$. Translation leaves it unchanged and multiplication by k multiplies it by $|k|$.

Step 1: Test the two statements about means For the translated observations, divide their entire sum by 5:

$$\frac{1}{5}\sum_{i=1}^{5}(x_i + k) = \frac{1}{5}(5m + 5k) = m + k.$$

Statement A incorrectly keeps the total increment $5k$ without dividing by the number of observations; it is false as a general rule. For the scaled observations,

$$\frac{1}{5}\sum_{i=1}^{5} kx_i = k\left(\frac{1}{5}\sum_{i=1}^{5} x_i\right) = km.$$

Thus B is true. These conclusions do not depend on the individual observations, so no particular data set is needed.

Step 2: Test standard deviations and select the combination The mean of the translated data is $m + k$, and each deviation is

$$(x_i + k) - (m + k) = x_i - m.$$

Hence its variance and standard deviation stay s^2 and s; C is true. For scaling, the mean becomes km, giving

$$s^2_{\text{new}} = \frac{1}{5}\sum_{i=1}^{5}[k(x_i - m)]^2 = k^2 s^2, \qquad s_{\text{new}} = |k|s.$$

The power k^5 in D does not follow from there being five observations; D is false in general. If k is positive the correct multiplier is k, and the absolute value is necessary when k is negative. Options

(A) and (B) wrongly include A, while option (C) wrongly includes D. Only option (D) lists exactly the true statements.

Step 3: Conclusion Only statements B and C are correct. Hence, the correct option is (D).

Quick Tip to Solve: For data transformed to $kx + c$, remember mean $km + c$ and standard deviation $|k|s$; the sample size does not become an exponent.

19. Let the area of the region enclosed between the two circles $x^2 + y^2 = a^2$ and $(x - a)^2 + y^2 = a^2$ be $\frac{m}{3}(4\pi - 3\sqrt{3})$ sq. units for some $a \geq 2$. If a is a root of $x^3 - 3x^2 - 6x + 8 = 0$, then [4 marks]

(A) $m^2 = a^4$

(B) $m^2 = a^3$

(C) $m^4 = a^2$

(D) $m^3 = a^2$

Correct Answer: (B) $m^2 = a^3$

Solution:

Concept:

- Factor the cubic and impose $a \geq 2$ before evaluating the geometric quantities. The two circles have equal radius a and their centres are distance a apart.
- The common lens is made of two congruent circular segments. A sector of angle θ radians has area $\frac{1}{2}a^2\theta$, and its isosceles triangle has area $\frac{1}{2}a^2 \sin\theta$.

Step 1: Determine the admissible radius The polynomial factors as

$$x^3 - 3x^2 - 6x + 8 = (x - 1)(x - 4)(x + 2).$$

Its roots are $1, 4, -2$. Only 4 satisfies the stated restriction $a \geq 2$, so the common radius and the distance between centres are both 4. Retain a in the area calculation to see how its square enters the coefficient.

Step 2: Compute the lens area The common chord lies halfway between the centres. Its distance from either centre is $a/2$, so the half-angle at that centre has cosine $1/2$, and the segment's full central angle is $2\pi/3$. Subtract the triangle from its sector, then double for both circles:

$$\begin{aligned}\mathcal{A} &= 2\left(\frac{1}{2}a^2\frac{2\pi}{3} - \frac{1}{2}a^2\sin\frac{2\pi}{3}\right)\\ &= \frac{a^2}{6}(4\pi - 3\sqrt{3}).\end{aligned}$$

Matching this with the specified $\frac{m}{3}(4\pi - 3\sqrt{3})$ yields $m = a^2/2 = 8$.

Step 3: Compare the proposed identities With $a = 4$ and $m = 8$,

$$m^2 = 64 = a^3.$$

Option (A) would require $64 = 256$; option (C) would require $4096 = 16$; option (D) would require $512 = 16$. All three fail, whereas option (B) agrees exactly with the common-region area and the admissible polynomial root.

Step 4: Conclusion We obtain $a = 4$, $m = 8$, and $m^2 = a^3 = 64$. Hence, the correct option is (B).

Quick Tip to Solve: For two equal circles with centre separation equal to the radius, use two segments of angle $120°$, then compare coefficients carefully.

---

20. Suppose $\begin{vmatrix} f'(x) & f(x) \\ f''(x) & f'(x) \end{vmatrix} = 0$**, where** $f(x)$ **is continuously differentiable function with** $f'(x) \neq 0\ \forall x \in \mathbb{R}$ **and satisfies** $f(0) = 1$ **and** $f'(0) = 4$**. If** $f(x) = e^{\lambda x} + \mu$**, where** $\lambda, \mu \in \mathbb{R}$ **then the value of** $\lambda^2 + \mu^2$ **is** [4 marks]

(A) 2

(B) 4

(C) 8

(D) 16

Correct Answer: (D) 16

Solution:

Concept:

- Expand the determinant as $(f\prime)^2 - ff\prime\prime = 0$. The proposed form $f(x) = e^{\lambda x} + \mu$ makes both initial conditions and the differential equation easy to test.
- The derivative of $e^{\lambda x}$ is $\lambda e^{\lambda x}$; a constant additive term has derivative zero.

Step 1: Apply the two initial conditions At $x = 0$, the proposed expression gives

$$f(0) = e^0 + \mu = 1 + \mu = 1,$$

so $\mu = 0$. Differentiating gives

$$f\prime(x) = \lambda e^{\lambda x}.$$

The second initial condition is therefore

$$f\prime(0) = \lambda = 4.$$

Thus the only possible parameter pair in the stated family is $(\lambda, \mu) = (4, 0)$. The exponential factor at zero is exactly 1, so the derivative condition fixes the exponent coefficient directly rather than its square.

Step 2: Verify the determinant condition With these parameters,

$$f = e^{4x}, \qquad f\prime = 4e^{4x}, \qquad f\prime\prime = 16e^{4x}.$$

Consequently the determinant is

$$(4e^{4x})^2 - e^{4x}(16e^{4x}) = 16e^{8x} - 16e^{8x} = 0.$$

Also $f\prime(x) = 4e^{4x} > 0$ for every real x, verifying the nonvanishing derivative requirement. This check ensures the initial-condition calculation is consistent with every condition in the question.

Step 3: Evaluate the requested expression and reject the distractors The required sum is

$$\lambda^2 + \mu^2 = 4^2 + 0^2 = 16.$$

The number 4 is the value of λ, not its square. Values 2 and 8 also fail the explicit parameter pair obtained above. Hence options (A), (B) and (C) cannot represent the requested sum.

Step 4: Conclusion The function is $f(x) = e^{4x}$, with $\lambda = 4$, $\mu = 0$, so $\lambda^2 + \mu^2 = 16$. Hence, the correct option is (D).

Quick Tip to Solve: When the functional form is already given, apply the initial conditions first and then verify the differential equation by substitution.

Mathematics – Section B: Numerical Value Questions (20 marks)

Attempt any 5 of the 10 questions in this section.

21. The equations $ax^2 + bx + a = 0$, $(a, b \in \mathbb{R})$ and $x^3 - 2x^2 + 2x - 1 = 0$ have two common roots. Then the value of $a + b$ is _____. [4 marks]

Solution:

Concept:

- A polynomial with real coefficients has nonreal roots in conjugate pairs. Factoring the cubic identifies its real root and its conjugate pair explicitly.
- For $ax^2 + bx + a = 0$ with $a \neq 0$, the product of its two roots is 1 and their sum is $-b/a$, by Vieta's relations.

Step 1: Factor the cubic and identify its roots Substitute $x = 1$ into the cubic to find a zero, then divide by $x - 1$:

$$x^3 - 2x^2 + 2x - 1 = (x - 1)(x^2 - x + 1).$$

The quadratic factor has discriminant $1 - 4 = -3$. Hence the three roots are

$$1, \qquad \frac{1 + i\sqrt{3}}{2}, \qquad \frac{1 - i\sqrt{3}}{2}.$$

There is only one real root, and the other two form a nonreal conjugate pair.

Step 2: Use the real coefficients of the common quadratic Because the given quadratic has real coefficients, if it shares either nonreal root then it must share the conjugate root as well. It cannot share the root 1 and just one nonreal root: conjugation would then give a third distinct root of a

nonzero quadratic. Thus its two common roots are precisely those of $x^2 - x + 1$. Equivalently, the product of 1 with either nonreal root is not 1, so those pairs also fail Vieta's product condition.

Step 3: Compare coefficients and calculate the sum Two quadratics with the same two roots are proportional. Therefore

$$ax^2 + bx + a = a(x^2 - x + 1),$$

which gives $b = -a$ and hence

$$a + b = a - a = 0.$$

The scale a need not be determined individually; it cancels from the requested sum. The zero-polynomial choice also has $a = b = 0$ and gives the same sum, although the stated quadratic equation is normally understood to have $a \neq 0$. The result is a dimensionless numerical value.

Step 4: Conclusion The common-root condition gives $b = -a$. Thus $a + b = \boxed{0}$, a dimensionless value.

Quick Tip to Solve: Factor the cubic first; real coefficients force any shared nonreal root to be accompanied by its conjugate.

---

22. Let A be a matrix satisfying $A^3 = 3A + 2I$ where A $\neq nI$, $n \in \mathbb{Z}$. If $A^2 + \alpha A + \beta I = O$, then maximum value of $|\alpha + \beta|$ is _____. [4 marks]

Solution:

Concept:

- Use the quadratic identity $A^2 = -\alpha A - \beta I$ to reduce A^3 to a linear combination of A and I.
- If A is nonscalar, A and I are linearly independent: $uA + vI = O$ implies $u = v = 0$. Scalar solutions of the given cubic are excluded by the question.

Step 1: Confirm that the matrix is nonscalar If $A = tI$, the cubic condition becomes

$$t^3 - 3t - 2 = (t - 2)(t + 1)^2 = 0.$$

Thus a scalar solution would be $2I$ or $-I$. Both are forbidden by $A \neq nI$ for integers n. Consequently A is nonscalar, and a linear identity in A and I can be compared coefficient by coefficient.

Step 2: Reduce the cubic using the quadratic identity Multiplying $A^2 = -\alpha A - \beta I$ by A gives

$$\begin{aligned} A^3 &= -\alpha A^2 - \beta A \\ &= (\alpha^2 - \beta)A + \alpha\beta I. \end{aligned}$$

Comparing with $A^3 = 3A + 2I$, and using nonscalarity, yields

$$\alpha^2 - \beta = 3, \qquad \alpha\beta = 2.$$

Eliminate $\beta = \alpha^2 - 3$:

$$\alpha^3 - 3\alpha - 2 = (\alpha - 2)(\alpha + 1)^2 = 0.$$

Step 3: Evaluate and verify the possible values The possibilities are $(\alpha, \beta) = (2, 1)$ and $(-1, -2)$. Their sums are 3 and -3, so both give

$$|\alpha + \beta| = 3.$$

The value is attainable: $A = \text{diag}(2, -1)$ is nonscalar, satisfies $A^3 = 3A+2I$, and obeys $A^2-A-2I = O$. Thus the upper value is achieved, not merely an algebraic bound. No other parameter pair survives the two coefficient equations.

Step 4: Conclusion The maximum value of $|\alpha + \beta|$ is $\boxed{3}$, a dimensionless value.

Quick Tip to Solve: Reduce the higher matrix power with the lower-degree identity; justify coefficient comparison by checking that the matrix is nonscalar.

---

23. An equilateral triangle is inscribed in the ellipse $\frac{x^2}{3} + y^2 = 1$ such that one of the vertex of the triangle is $(0, 1)$ and one of the altitude of the triangle is along the y-axis. If A is the area of the equilateral triangle. Then $625A^2$ is equal to _____. [4 marks]

Solution:

Concept:

- The altitude from the vertex $(0, 1)$ lies on the y-axis, so the opposite horizontal side has endpoints (u, v) and $(-u, v)$, with $u > 0$.
- For an equilateral triangle of side $2u$, its altitude is $\sqrt{3}u$, and its area is $\frac{\sqrt{3}}{4}(2u)^2 = \sqrt{3}u^2$.

Step 1: Express the symmetry and equilateral condition All points on the ellipse satisfy $-1 \le y \le 1$. Thus the altitude from $(0, 1)$ to the opposite side has length $1 - v$. Equating it with the altitude of an equilateral triangle gives

$$1 - v = \sqrt{3}u, \qquad u^2 = \frac{(1 - v)^2}{3}.$$

The horizontal base is centred on the y-axis because the altitude of an equilateral triangle also bisects the opposite side. This fixes the symmetric form of its other two vertices.

Step 2: Impose the ellipse equation Substitute a base endpoint into $x^2/3 + y^2 = 1$:

$$\frac{u^2}{3} + v^2 = 1.$$

Using the altitude relation,

$$\frac{(1 - v)^2}{9} + v^2 = 1,$$

so

$$10v^2 - 2v - 8 = 0, \qquad (v - 1)(5v + 4) = 0.$$

The root $v = 1$ gives $u = 0$, collapsing all vertices into one point, so it is not a triangle. Therefore $v = -4/5$, giving

$$u = \frac{1 + 4/5}{\sqrt{3}} = \frac{3\sqrt{3}}{5}, \qquad u^2 = \frac{27}{25}.$$

Step 3: Calculate the requested area expression The base is $2u = 6\sqrt{3}/5$ and the altitude is $9/5$. Hence

$$A = \frac{1}{2}\frac{6\sqrt{3}}{5}\frac{9}{5} = \frac{27\sqrt{3}}{25}.$$

Squaring before multiplying avoids rounding an irrational area:

$$625A^2 = 625\frac{27^2 \cdot 3}{25^2} = 2187.$$

The area itself is in square coordinate units, so this squared-area expression is in fourth-power coordinate units.

Step 4: Conclusion The triangle has area $A = \frac{27\sqrt{3}}{25}$ square units. Therefore $\boxed{625A^2 = 2187}$ in fourth-power coordinate units.

Quick Tip to Solve: Use the altitude as the symmetry axis, express the two base endpoints as $(\pm u, v)$, and discard the degenerate root before computing area.

24. The volume of the greatest cylinder that can be inscribed in a cone of height $\frac{3}{\sqrt[3]{\pi}}$ and semi-vertical angle 45° is _____. [4 marks]

Solution:

Concept:

- For a cylinder coaxially inscribed in a right circular cone, similar triangles relate cylinder radius r and height h: $r = R(1 - h/H)$, where R, H are the cone's base radius and height.
- The cylinder volume is $V = \pi r^2 h$. Its maximum on $0 \le h \le H$ is found from critical points together with the endpoint volumes.

Step 1: Relate the cone dimensions and cylinder radius The cone's semi-vertical angle is 45°. Hence

$$\frac{R}{H} = \tan 45^\circ = 1, \qquad R = H = \frac{3}{\sqrt[3]{\pi}}.$$

For a cylinder of height h resting on the cone's base, its upper circular rim touches the conical surface. The cone's horizontal cross-section at height h has radius

$$r = R\frac{H - h}{H} = H - h.$$

Thus increasing the cylinder height decreases its available radius, and both effects must be included when maximizing volume.

Step 2: Differentiate the volume and locate the maximum Substitute $r = H - h$:

$$V(h) = \pi h(H - h)^2.$$

Its derivative factors as

$$V\prime(h) = \pi(H - h)(H - 3h).$$

Inside $0 < h < H$, the derivative is positive for $h < H/3$ and negative for $h > H/3$. Thus the unique interior maximum occurs at $h = H/3$, with radius $r = 2H/3$. Both endpoint volumes are zero, so neither endpoint can improve this positive interior value.

Step 3: Substitute the stated cone height The maximum volume is

$$V_{\max} = \pi \left(\frac{2H}{3}\right)^2 \frac{H}{3} = \frac{4\pi H^3}{27}.$$

Since the given height has cube

$$H^3 = \left(\frac{3}{\sqrt[3]{\pi}}\right)^3 = \frac{27}{\pi},$$

we obtain $V_{\max} = 4$. The dimensions also check directly: the maximizing height is $1/\sqrt[3]{\pi}$ and the radius is $2/\sqrt[3]{\pi}$, whose substitution in $\pi r^2 h$ gives 4 cubic units.

Step 4: Conclusion The greatest cylinder has volume $\boxed{4 \text{ cubic units}}$.

Quick Tip to Solve: For a coaxial cylinder in a cone, the optimum height is one-third of the cone height; derive it from $h(H-h)^2$ to avoid reversing the ratio.

---

25. If the function $f(x)$ is defined as $f(x) = \begin{vmatrix} \frac{1}{1+e^{\sin x}} & \sin x \\ \sqrt{1-x^2} & 2 \end{vmatrix}$. Then the value of $\frac{1}{\pi}\int_{-\pi/2}^{\pi/2} f(x)dx$ is equal to _____. [4 marks]

Solution:

Concept:

- A real-valued expression containing $\sqrt{1-x^2}$ is defined only for $|x| \le 1$; the domain must cover the interval of integration.
- For a symmetric interval, an integrable odd function has zero integral. An even factor times an odd factor is odd.
- The logistic terms satisfy $1/(1+e^u) + 1/(1+e^{-u}) = 1$, which explains the value obtained by formal symmetry.

Step 1: Expand the determinant and check its domain Expanding the determinant as printed gives

$$f(x) = \frac{2}{1+e^{\sin x}} - \sin x\sqrt{1-x^2}.$$

The integration bounds are $-\pi/2$ and $\pi/2$. Since $\pi/2 > 1$, the radicand $1-x^2$ is negative on the nonempty subintervals $(1, \pi/2]$ and $[-\pi/2, -1)$. Therefore the printed expression does not define a real-valued function on the full integration interval. Its ordinary real definite integral is undefined.

Step 2: Explain the formal symmetry calculation The advertised numerical value can be traced to a symmetry argument. If the radical is given its principal complex-valued extension, $\sqrt{1-x^2}$ is an even, continuous complex-valued function of real x. Thus $\sin x\sqrt{1-x^2}$ is odd and its integral over the symmetric interval is zero. This is a conditional complex interpretation; the real-domain defect

cannot be removed just by writing down oddness. Let

$$J = \int_{-\pi/2}^{\pi/2} \frac{2}{1 + e^{\sin x}}\, dx.$$

Replacing x by $-x$, then adding the two representations, gives

$$2J = \int_{-\pi/2}^{\pi/2} \left(\frac{2}{1 + e^{\sin x}} + \frac{2}{1 + e^{-\sin x}} \right) dx = \int_{-\pi/2}^{\pi/2} 2\, dx = 2\pi.$$

Hence $J = \pi$.

Step 3: Distinguish the literal real integral from the conditional value Under the complex extension just defined, the radical contribution cancels exactly and the normalised integral equals $J/\pi = 1$. This explains the numerical key without replacing the printed radical by a different expression. In ordinary real calculus, however, a missing real domain on intervals of positive length prevents the integral from existing, so the question requires an interpretation beyond its stated real-function formula.

Step 4: Conclusion As a real definite integral, the printed expression is undefined. With the principal complex-valued radical extension, its value is $\boxed{1}$, the keyed numerical value; that extra interpretation is necessary.

Quick Tip to Solve: Check that every radical is real throughout the integration interval before applying odd-function cancellation; symmetry alone cannot repair a missing real domain.

---

26. A line touches the curve $y = y(x)$ at a point (x, y) having slope $\frac{1+y^2}{1+x^2}$, where $x > 0$. If $y(2) = 1$, $y(3) = \frac{\alpha}{\beta}$ and $gcd\{\alpha, \beta\} = 1$, then the value of $\alpha + \beta$ is _____. [4 marks]

Solution:

Concept:

- The slope of a tangent to a differentiable curve is dy/dx. Thus the given slope determines a first-order differential equation.
- Separation uses $\int dt/(1 + t^2) = \tan^{-1} t$, with the integration constant determined from the point on the curve.
- The tangent addition identity converts the inverse-tangent relation to a rational expression for y.

Step 1: Separate the dependent and independent variables The statement about the tangent gives

$$\frac{dy}{dx} = \frac{1 + y^2}{1 + x^2}.$$

Since both denominators are positive for real arguments, separation does not remove any real solution. Move the factors involving y to the left and integrate:

$$\int \frac{dy}{1 + y^2} = \int \frac{dx}{1 + x^2}, \qquad \tan^{-1} y = \tan^{-1} x + C.$$

Step 2: Determine the constant from the initial point At $x = 2$, the given value is $y = 1$. Therefore

$$C = \frac{\pi}{4} - \tan^{-1} 2.$$

It is enough to find its tangent rather than its angle numerically. Applying the tangent subtraction formula gives

$$\tan C = \frac{1-2}{1+2} = -\frac{1}{3}.$$

This also fixes the local branch of the solution through the specified initial point.

Step 3: Evaluate the required fraction Taking tangents in the integrated relation yields

$$y = \frac{x + \tan C}{1 - x \tan C} = \frac{3x-1}{x+3}.$$

The denominator is nonzero for $x > 0$, so this expression applies at both given positive arguments. It gives $y(2) = 1$, as a check, and

$$y(3) = \frac{9-1}{3+3} = \frac{8}{6} = \frac{4}{3}.$$

The integers 4 and 3 have greatest common divisor 1, so they are precisely α and β.

Step 4: Conclusion $\alpha = 4$, $\beta = 3$; hence the required dimensionless value is $\boxed{\alpha + \beta = 7}$.

Quick Tip to Solve: After integrating an equation involving $1 + y^2$ and $1 + x^2$, compute $\tan C$ directly from the initial point; this avoids evaluating inverse tangents.

---

27. The equation of the base of an equilateral triangle is $x + y = 1$ and the opposite vertex has co-ordinates $(-3, 2)$. The area of the triangle (in square units) is represented by A, then the value of $\sqrt{3}A$ is _____. [4 marks]

Solution:

Concept:

- The altitude from a vertex to its opposite side is the perpendicular distance from that vertex to the line containing the side.
- The distance from (x_0, y_0) to $ax + by + c = 0$ is $|ax_0 + by_0 + c|/\sqrt{a^2 + b^2}$.
- For an equilateral triangle of side s, altitude $h = \sqrt{3}s/2$ and area $A = \sqrt{3}s^2/4 = h^2/\sqrt{3}$.

Step 1: Find the perpendicular height above the base Write the given base equation in the standard line form:

$$x + y - 1 = 0.$$

The vertex opposite this base is $(-3, 2)$. Its perpendicular distance to the base is therefore

$$h = \frac{|(-3) + 2 - 1|}{\sqrt{1^2 + 1^2}} = \frac{|-2|}{\sqrt{2}} = \sqrt{2}.$$

The absolute value is necessary: height is a positive length even though the signed line expression at

the vertex is negative. This distance is the full altitude, not half the altitude.

Step 2: Relate the side length to that height An altitude of an equilateral triangle bisects its base and forms two right triangles. If the full side is s, Pythagoras gives

$$h^2 = s^2 - \left(\frac{s}{2}\right)^2 = \frac{3s^2}{4}.$$

Thus

$$s = \frac{2h}{\sqrt{3}} = \frac{2\sqrt{2}}{\sqrt{3}}.$$

The foot of the perpendicular lies at the midpoint of the base segment, so the infinite line in the question determines a valid equilateral base of this length.

Step 3: Calculate the area and the requested multiple Using one-half times base times height,

$$A = \frac{1}{2}sh = \frac{1}{2}\left(\frac{2\sqrt{2}}{\sqrt{3}}\right)\sqrt{2} = \frac{2}{\sqrt{3}}.$$

Equivalently, $A = h^2/\sqrt{3}$, which gives the same result immediately. The requested expression is not A alone; multiply by $\sqrt{3}$:

$$\sqrt{3}A = \sqrt{3} \cdot \frac{2}{\sqrt{3}} = 2.$$

Step 4: Conclusion The triangle has area $2/\sqrt{3}$ square units, and the requested value is $\boxed{\sqrt{3}A = 2}$.

Quick Tip to Solve: When an equilateral triangle is specified by a vertex and the opposite-side line, use $\sqrt{3}A = h^2$ after finding the point-to-line distance.

28. Let R be the point $(13, -8, 10)$ and P(α, β, λ) be the image of the point Q $(5, 2, 1)$ in the line $x - 2 = 3 - y = z + 1$. Then the square of the area of the triangle PQR is _____. [4 marks]

Solution:

Concept:

- The image of a point in a line has its midpoint with the original point on the line; the joining segment is perpendicular to the line.
- For a line $\mathbf{a} + t\mathbf{d}$, its perpendicular foot from Q has parameter $t = ((Q - \mathbf{a}) \cdot \mathbf{d})/(\mathbf{d} \cdot \mathbf{d})$.
- The square of the area of triangle PQR is $\frac{1}{4}|\overrightarrow{PQ} \times \overrightarrow{PR}|^2$.

Step 1: Find the foot of the perpendicular Put each expression in the line equation equal to t:

$$x = 2 + t, \qquad y = 3 - t, \qquad z = t - 1.$$

A point on the line is $\mathbf{a} = (2, 3, -1)$, and its direction vector is $\mathbf{d} = (1, -1, 1)$. With $Q = (5, 2, 1)$,

$$Q - \mathbf{a} = (3, -1, 2), \qquad t = \frac{3 + 1 + 2}{1 + 1 + 1} = 2.$$

Consequently the perpendicular foot is $H = (4, 1, 1)$. Indeed, $(Q - H) \cdot \mathbf{d} = (1, 1, 0) \cdot (1, -1, 1) = 0$, verifying perpendicularity.

Step 2: Reflect the point across the line The foot H is the midpoint of PQ. Thus the image is

$$P = 2H - Q = (8, 2, 2) - (5, 2, 1) = (3, 0, 1).$$

The two displacement vectors from H are opposites, as required for the reflection. Form two sides of the triangle from the same vertex:

$$\overrightarrow{PQ} = Q - P = (2, 2, 0), \qquad \overrightarrow{PR} = R - P = (10, -8, 9).$$

Step 3: Use the cross product to calculate area squared Compute the vector product component by component:

$$\overrightarrow{PQ} \times \overrightarrow{PR} = (2 \cdot 9 - 0,\ 0 - 2 \cdot 9,\ 2(-8) - 2(10)) = (18, -18, -36).$$

Its squared magnitude is

$$18^2 + (-18)^2 + (-36)^2 = 324 + 324 + 1296 = 1944.$$

This magnitude squared belongs to the parallelogram on the two side vectors. A triangle has half its area, so its area squared is one-quarter of this number:

$$A^2 = \frac{1944}{4} = 486.$$

Step 4: Conclusion The square of the area of triangle PQR is $\boxed{486}$ in fourth-power coordinate units.

Quick Tip to Solve: For reflection in a spatial line, first project onto the line, then use $P = 2H - Q$. If area squared is requested, keep the cross-product norm squared and divide by 4.

29. A hospital conducts a free eye check-up drive at 3 different locations A, B and C of a city. The number of people that came for test at A is thrice as much as that at B, and number of people that came at B is same as that at C. The results show that 4% population at A, 2% at B and 3% at C have poor eye-sight. If a person from the city goes for an army job and is found to have poor eye-sight, and the probability that he is not from location C is $\frac{p}{q}$, where $\frac{p}{q}$ is in simplest form, then value of $(p + q)$ is _____. [4 marks]

Solution:

Concept:

- Conditional probability reweights each location by both its population share and the probability of poor eyesight at that location.
- Bayes' theorem gives $P(C \mid E) = P(C)P(E \mid C)/P(E)$, where E denotes poor eyesight.
- The complementary event requested is not being from C, so its conditional probability is $1 - P(C \mid E)$.

Step 1: Translate attendance ratios into location weights The attendance at A is three times that at B, and attendance at B equals attendance at C. The relative weights supplied by the drive are therefore

$$A : B : C = 3 : 1 : 1.$$

Normalising by their sum gives

$$P(A) = \frac{3}{5}, \qquad P(B) = \frac{1}{5}, \qquad P(C) = \frac{1}{5}.$$

The percentages in the statement are conditional rates within their respective locations. They must not be averaged with equal weights because the attendance shares are unequal.

Step 2: Find the total weighted rate of poor eyesight Let E be the event that the selected person has poor eyesight. The three disjoint contributions are

$$P(A \cap E) = \frac{3}{5}\frac{4}{100} = \frac{12}{500},$$

$$P(B \cap E) = \frac{1}{5}\frac{2}{100} = \frac{2}{500}, \qquad P(C \cap E) = \frac{1}{5}\frac{3}{100} = \frac{3}{500}.$$

Adding these contributions, the law of total probability gives

$$P(E) = \frac{12 + 2 + 3}{500} = \frac{17}{500}.$$

Step 3: Condition on poor eyesight and exclude location C The probability of not being from C, among people with poor eyesight, is

$$P(C^c \mid E) = \frac{P(A \cap E) + P(B \cap E)}{P(E)} = \frac{14/500}{17/500} = \frac{14}{17}.$$

The numerator includes A and B only, while the denominator includes all three locations. Since 14 and 17 are coprime, this is already in simplest form. Hence $p = 14$ and $q = 17$, so $p + q = 14 + 17$.

Step 4: Conclusion The required conditional probability is $14/17$; therefore the dimensionless answer is $\boxed{p + q = 31}$.

Quick Tip to Solve: Multiply each location's relative attendance by its poor-eyesight percentage first. The resulting weights $12 : 2 : 3$ make the conditional probability immediate.

30. The number of pairs (x, y) satisfying the equations $\sin x + \sin y = \sin(x + y)$ and $|x| + |y| = 1$ is _____. [4 marks]

Solution:

Concept:

- The sum-to-product identity is $\sin x + \sin y = 2\sin((x + y)/2)\cos((x - y)/2)$.
- The identity $\cos u - \cos v = -2\sin((u+v)/2)\sin((u-v)/2)$ factors the given trigonometric equation.

- The condition $|x| + |y| = 1$ bounds each variable and their sum, ruling out nonzero multiples of 2π.

Step 1: Factor the trigonometric equation Using $\sin(x+y) = 2\sin((x+y)/2)\cos((x+y)/2)$, subtract the right side to obtain

$$2\sin\frac{x+y}{2}\left(\cos\frac{x-y}{2} - \cos\frac{x+y}{2}\right) = 0.$$

The cosine difference in parentheses is $2\sin(x/2)\sin(y/2)$. Therefore the original equation is equivalent to

$$4\sin\frac{x+y}{2}\sin\frac{x}{2}\sin\frac{y}{2} = 0.$$

No factor has been divided out, so cases where one of these sines vanishes are all retained.

Step 2: Use the absolute-value restriction From $|x|+|y| = 1$, we have $|x| \le 1$, $|y| \le 1$, and $|x+y| \le 1$. Thus each of $x/2$, $y/2$, $(x+y)/2$ lies in $[-1/2, 1/2]$. On this interval the only zero of sine is zero itself. Consequently every admissible solution lies on at least one of the three lines

$$x = 0, \qquad y = 0, \qquad x + y = 0.$$

There are no additional periodic solutions inside the allowed region.

Step 3: List and count the ordered pairs For $x = 0$, the absolute-value equation gives $y = \pm 1$, yielding $(0, 1)$, $(0, -1)$. For $y = 0$, it gives $x = \pm 1$, yielding $(1, 0)$, $(-1, 0)$. Finally, when $y = -x$,

$$|x| + |-x| = 2|x| = 1,$$

so the remaining pairs are $(1/2, -1/2)$ and $(-1/2, 1/2)$. These six pairs are distinct. The three lines meet at the origin, but the origin fails $|x| + |y| = 1$, so nothing has been counted twice.

Step 4: Conclusion There are exactly $\boxed{6}$ ordered pairs (x, y) satisfying both equations.

Quick Tip to Solve: Factor before dividing by a sine. The absolute-value bound then reduces all periodic sine-zero cases to three straight lines.

31. In a certain word code, EXHAUST is written as CZFCSUR. How is NETWORK written in that code ? [4 marks]

(A) LCVYQTI

(B) LGVYQTM

(C) LGRYMTI

(D) LCRYQTM

Correct Answer: (C) LGRYMTI

Solution:

Concept:

- A position-dependent letter code can be tested by comparing corresponding letters of the given word and its coded form.
- Alphabetic shifts are measured cyclically, so moving backward from A passes through Z, and moving forward from Z passes through A.

Step 1: Infer and verify the alternating shifts Compare the letters in EXHAUST with CZFCSUR. The first letter E becomes C, a backward shift of two positions. The second letter X becomes Z, a forward shift of two. Continuing confirms the same alternating pattern:

Position	1	2	3	4	5	6	7
Original	E	X	H	A	U	S	T
Shift	-2	$+2$	-2	$+2$	-2	$+2$	-2
Code	C	Z	F	C	S	U	R

Thus odd positions move two letters backward, and even positions move two letters forward. Every supplied letter agrees with this rule, rather than only the first pair.

Step 2: Apply the verified rule to NETWORK NETWORK also has seven letters, so apply the shifts to positions in the same order:

Original	N	E	T	W	O	R	K
Shift	-2	$+2$	-2	$+2$	-2	$+2$	-2
Code	L	G	R	Y	M	T	I

In particular, E moves to G, T moves to R, and O moves to M. Reading the output from left to right gives LGRYMTI. The direction of a shift depends on position, not on whether the letter is a vowel or consonant.

Step 3: Eliminate the other options Option (A), LCVYQTI, already fails at its second letter C, which should be G; it also gives V instead of R in position 3. Option (B), LGVYQTM, gets the second letter right but gives V instead of R in position 3, Q instead of M in position 5, and M instead of I at the end. The fourth alternative, LCRYQTM, again has C instead of G in position 2 and has incorrect fifth and seventh letters. Only option (C) matches all seven required substitutions.

Step 4: Conclusion NETWORK becomes $\boxed{\text{LGRYMTI}}$. Hence, the correct option is (C).

Quick Tip to Solve: Write the shifts above letter positions before coding the new word; here odd positions use -2 and even positions use $+2$.

32. In a code language, if "BRICK" is written as "CQJBL", then "CEMENT" is _____ [4 marks]

(A) DDOFOS

(B) DDODOS

(C) DDNDOS

(D) DDNFOS

Correct Answer: (C) DDNDOS

Solution:

Concept:

- An alphabetic code is found by comparing each original letter with its replacement in the same position.
- An alternating positional rule changes the shift direction between successive letters; the same positional pattern must apply to the new word.

Step 1: Identify the positional pattern in BRICK Compare BRICK with CQJBL one letter at a time. B becomes C by moving one letter forward; R becomes Q by moving one letter backward. I becomes J by moving forward, C becomes B by moving backward, and K becomes L by moving forward. Thus all five positions fit

Position	1	2	3	4	5
Original	B	R	I	C	K
Shift	$+1$	-1	$+1$	-1	$+1$
Code	C	Q	J	B	L

The code uses a forward shift in odd positions and a backward shift in even positions. A single uniform shift would fail on the second letter.

Step 2: Encode each letter of CEMENT Continue the same alternation across all six letters:

Position	1	2	3	4	5	6
Original	C	E	M	E	N	T
Shift	$+1$	-1	$+1$	-1	$+1$	-1
Code	D	D	N	D	O	S

Both occurrences of E happen to occupy even positions, so both become D. M in the third position advances to N; N in the fifth advances to O. The final T is in an even position, so it moves backward to S. Concatenating these letters gives DDNDOS.

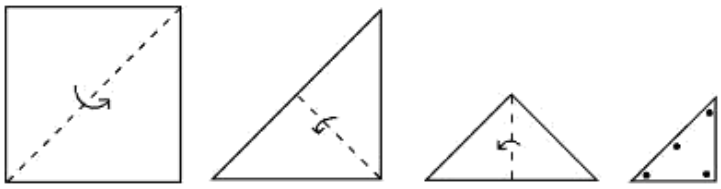
Step 3: Compare the alternatives against the complete code Option (A), DDOFOS, has O in the third position instead of N and F in the fourth instead of D. Option (B), DDODOS, agrees elsewhere but changes the third-position M to O, a forward shift of two rather than one. Option (D), DDNFOS, uses

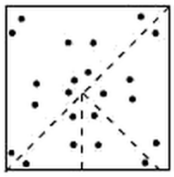
F in position 4, incorrectly shifting E forward. Option (C), DDNDOS, agrees at every position and is therefore the unique listed code produced by the verified pattern.

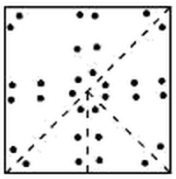
Step 4: Conclusion CEMENT is written as DDNDOS. Hence, the correct option is (C).

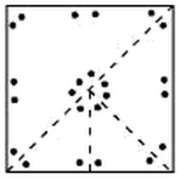
Quick Tip to Solve: For alternating letter codes, number the positions first. The two E letters here both occupy even positions and must both become D.

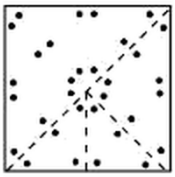
33. When the paper is folded in a given pattern and is cut at the end. Identify which pattern is formed when the paper is unfold? [4 marks]

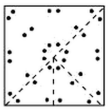


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- Unfolding reverses each fold. A hole made through a folded stack appears at its original position and at the reflected positions across the successive crease lines.
- Reflection preserves the perpendicular distance from a crease. Holes near a sloping folded edge therefore form corresponding pairs close to that diagonal when the sheet opens.

Step 1: Reverse the last fold first The square is folded along a diagonal, then along the next indicated diagonal crease, and finally along the vertical centre line of the smaller triangle. The last folded triangle shows four holes: three lie close to its sloping side at different distances from the corner, and the fourth is near the bottom of its vertical side. Open the vertical fold first. Each of these holes is mirrored into the other half of the triangle, retaining its height and its distance from the vertical crease. There are no holes exactly on this crease, so each has a distinct reflected partner.

Step 2: Reflect across the two earlier creases Open the preceding triangular fold and then the original

diagonal fold. At each opening, reflect every existing hole across the relevant crease rather than rotating or shifting it. The holes near the sloping side produce pairs near the corners, near the centre, and at intermediate positions along the diagonal directions. In particular, the intermediate pair close to the sloping edge must be reproduced in each of the four diagonal sectors of the square. The hole near the lower end of the vertical side also generates the paired holes near the middle of the outer edges. All four original holes pass through eight layers, producing the complete set of reflected positions.

Step 3: Compare the four proposed patterns Option (D) preserves both the diagonal intermediate pairs and the edge-middle pairs together with the corner and central groups. Option (A) places the intermediate holes in side-centre regions and omits the required corresponding outer-edge groups. Option (B) also moves the intermediate diagonal groups into positions beside the central horizontal and vertical directions; those positions cannot arise by reflecting the displayed holes. Option (C) retains the edge, corner and central groups but leaves out the intermediate diagonal pairs. Only (D) accounts for every hole in the folded triangle and all its reflected copies.

Step 4: Conclusion Reversing all three folds produces the pattern in option (D). Hence, the correct option is (D).

Quick Tip to Solve: Track one off-centre hole through the folds in reverse order. Its reflected partners often distinguish the options before you trace every other hole.

34. Match List I with List II

LIST I (Components/Material)		LIST II (Functions)	
A.	Cement	I.	Load Bearing
B.	Window	II.	Tensile strength
C.	Foundation	III.	Setting time
D.	Steel	IV.	Glazing

Choose the correct answer from the options given below: [4 marks]

(A) A-I, B-IV, C-III, D-II

(B) A-I, B-II, C-III, D-IV

(C) A-III, B-IV, C-I, D-II

(D) A-IV, B-III, C-II, D-I

Correct Answer: (C) A-III, B-IV, C-I, D-II

Solution:

Concept:

- Match a material or component with its characteristic property or main building function. A correct matching option must satisfy all four pairs together.
- Cement is a binding material whose setting behaviour matters; glazing belongs to windows; foundations carry building loads to the ground; steel provides high tensile strength.

Step 1: Match cement and windows Cement reacts with water to form a paste that gradually loses

plasticity and sets. Initial and final setting times govern how long the mix can be handled and when it has become sufficiently firm. Therefore cement is associated with setting time: A-III. A window is an opening fitted with a frame and, commonly, glass panes. The installation of glass in that frame is glazing, so the window matches glazing: B-IV.

Step 2: Match foundations and steel A foundation receives loads from walls, columns and the rest of the superstructure, then transfers and spreads them to the supporting soil. Thus the listed function load bearing corresponds to the foundation: C-I. Steel resists tensile forces effectively and is used as reinforcement where concrete is weak in tension. Its characteristic match in the list is tensile strength: D-II.

Step 3: Check the complete option Combining the independently established matches gives A-III, B-IV, C-I, D-II. Option (C) has exactly this combination. Option (A) interchanges the roles of cement and foundation by matching cement with load bearing and foundation with setting time. Option (B) also assigns tensile strength to windows and glazing to steel. Option (D) mismatches all four characteristic associations. A match based on one familiar pair alone would therefore be insufficient.

Step 4: Conclusion The correct matching is A-III, B-IV, C-I, D-II. Hence, the correct option is (C).

Quick Tip to Solve: Fix the most distinctive pairs first: window–glazing and steel–tensile strength. Then verify cement–setting time and foundation–load bearing before selecting the option.

35. Match List I with List II

LIST I(struchture)		LIST II(places)	
A.	**Humayun's Tomb**	**I.**	**Gujarat**
B.	**Bibi Ka Maqbara**	**II.**	**New Delhi**
C.	**Hussain Doshi Gufa**	**III.**	**Maharashtra**
D.	**Group of monuments, Mahabalipuram**	**IV.**	**Tamilnadu**

Choose the correct answer from the options given below: [4 marks]

(A) A-II, B-IV, C-I, D-III

(B) A-I, B-III, C-II, D-IV

(C) A-II, B-III, C-I, D-IV

(D) A-II, B-I, C-IV, D-III

Correct Answer: (C) A-II, B-III, C-I, D-IV

Solution:

Concept:

- A monument must be matched with the present state or territory containing its actual site, rather than the place associated with its architectural style.
- Use the city as an intermediate link: Humayun's Tomb–Delhi, Bibi Ka Maqbara–Aurangabad, Hussain Doshi Gufa–Ahmedabad, and Mahabalipuram–Tamil Nadu.

Step 1: Locate the two tombs Humayun's Tomb is the Mughal garden-tomb complex in Delhi, so A matches II, New Delhi. Bibi Ka Maqbara is at Aurangabad, now officially named Chhatrapati

Sambhajinagar, in Maharashtra. Therefore B matches III. Although both are tomb complexes associated with Mughal architectural traditions, they are not in the same state; match each site separately rather than treating the architectural resemblance as a location clue.

Step 2: Locate the cave gallery and monument group Hussain Doshi Gufa, also known as Amdavad ni Gufa, is the underground art gallery at Ahmedabad. Ahmedabad is in Gujarat, giving C-I. The Group of Monuments at Mahabalipuram is at Mamallapuram on the Tamil Nadu coast. Consequently D-IV. The word group refers to the collection of monuments at that site and does not indicate a separate state or a collection spread across the listed states.

Step 3: Eliminate the incorrect combinations The complete sequence is A-II, B-III, C-I, D-IV. Only option (C) contains all four links. Option (A) incorrectly places Bibi Ka Maqbara in Tamil Nadu and Mahabalipuram in Maharashtra. Option (B) puts Humayun's Tomb in Gujarat and the Ahmedabad gallery in New Delhi. Option (D) moves Bibi Ka Maqbara to Gujarat and gives the remaining two sites incorrect states. These location checks eliminate each competing option directly.

Step 4: Conclusion Humayun's Tomb–New Delhi; Bibi Ka Maqbara–Maharashtra; Hussain Doshi Gufa–Gujarat; Mahabalipuram monuments–Tamil Nadu. Hence, the correct option is (C).

Quick Tip to Solve: Memorise monument–city–state chains. Ahmedabad fixes Gujarat, Aurangabad fixes Maharashtra, and Mamallapuram fixes Tamil Nadu without relying on similar monument names.

36. Match List I with List II

LIST I		LIST II	
A.	Stairs	I.	Key stone
B.	Door	II.	Toothing
C.	Arch	III.	Jamb
D.	Brick work	IV.	Tread

Choose the correct answer from the options given below: [4 marks]

(A) A-IV, B-III, C-I, D-II

(B) A-II, B-I, C-III, D-IV

(C) A-I, B-III, C-IV, D-II

(D) A-III, B-IV, C-II, D-I

Correct Answer: (A) A-IV, B-III, C-I, D-II

Solution:

Concept:

- Each building element has characteristic component names. Match the specialised term to the element where that part is used.
- A tread is a stair surface, a jamb bounds a door opening, a keystone occupies the crown of an arch, and toothing provides an interlocking end to brickwork.

Step 1: Identify stair and door components The horizontal upper surface of a stair step, on which a person places a foot, is the tread. The vertical face is the riser, a different stair component. Thus stairs

match tread: A-IV. A jamb is a vertical side of a door opening or its frame. It supports or borders the door assembly and is distinct from the horizontal head above it. Therefore door matches jamb: B-III.

Step 2: Identify arch and masonry components A keystone is the central wedge-shaped masonry unit at the crown of an arch. In a traditional masonry arch it completes the ring of voussoirs, through which compression is transmitted toward the supports. This gives arch–keystone, C-I. Toothing means leaving alternate masonry units projecting at an unfinished junction or end so that later brickwork can bond into the earlier work. It is therefore associated with brickwork: D-II.

Step 3: Compare every proposed sequence Our matches give A-IV, B-III, C-I, D-II, which is option (A). Option (B) wrongly attaches toothing to stairs and keystone to a door. Option (C) preserves the door and brickwork matches but interchanges the stair tread with the arch keystone, so it still fails. Option (D) puts jamb with stairs, tread with door, toothing with arch and keystone with brickwork; it does not reproduce the component-specific associations. Every pair in the chosen option has now been checked.

Step 4: Conclusion The correct sequence is A-IV, B-III, C-I, D-II. Hence, the correct option is (A).

Quick Tip to Solve: Use function to recall the terms: feet rest on treads, doors are bordered by jambs, arch crowns contain keystones, and projecting brick teeth help bond a later wall.

---

37. Give below are two statements :

Statement I : A partition wall is defined as an internal wall whose function is to divide the space within the building.

Statement II : Partition wall could be load bearing or non-load bearing.

In the light of the above statements, choose the *most appropriate* answer from the options given below: [4 marks]

(A) Both Statement I and Statement II are correct

(B) Both Statement I and Statement II are incorrect

(C) Statement I is correct but Statement II is incorrect

(D) Statement I is incorrect but Statement II is correct

Correct Answer: (A) Both Statement I and Statement II are correct

Solution:

Concept:

- A partition wall divides the internal floor space of a building into rooms or other usable spaces. This describes the wall's spatial function.
- Load-bearing and non-load-bearing describe structural behaviour. An internal dividing wall may support imposed building loads or may only carry its own weight, depending on the construction system.

Step 1: Evaluate Statement I Statement I identifies a partition by its position and purpose: it is inside the building and divides the available space. Such a wall can separate a room, office or corridor from an adjacent area. It need not form part of the external enclosure. This is the relevant functional

description, so Statement I is correct. Materials or thickness alone do not define its space-dividing function.

Step 2: Evaluate Statement II Next ask a separate question: does the wall also transmit loads from floors or a roof to the structure below? An internal wall in load-bearing construction can perform that structural role while dividing rooms. In a framed building, an internal lightweight dividing wall may instead be non-load-bearing, with the frame supporting floors and roof. Hence the internal dividing function does not by itself determine whether the wall bears structural loads. In the broad functional terminology used in these statements, Statement II is also correct.

Step 3: Choose the truth combination Both statements are therefore correct: the first states what the wall does to the internal space, and the second recognises that the structural role depends on the building system. Option (A) expresses this combination. Option (B) rejects the valid internal-division definition as well as the structural distinction. Option (C) unnecessarily restricts all such internal dividing walls to one structural category. Option (D) rejects Statement I even though that is the wall's stated function. Avoid confusing a commonly used lightweight partition with the complete functional category described here.

Step 4: Conclusion Both Statement I and Statement II are correct. Hence, the correct option is (A).

Quick Tip to Solve: Separate the two classifications: internal partition describes division of space; load bearing describes transmission of loads. Check the structural system before deciding the latter.

---

38. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R :

Assertion A : Social integration at work place is necessary.

Reason R : There are many backward classes in society.

In the light of the above statements, choose the *correct* answer from the options given below :

[4 marks]

(A) Both **A** and **R** are true and **R** is the correct explanation of **A**

(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(C) **A** is true but **R** is false

(D) **A** is false but **R** is true

Correct Answer: (B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

Solution:

Concept:

- An assertion–reason item requires three checks: whether the assertion is true, whether the reason is true, and whether the reason actually explains the assertion.
- Social integration at work concerns inclusion, cooperation, fair participation and respectful relationships among workers. A true social observation need not be the direct explanation of a workplace requirement.

Step 1: Evaluate Assertion A Social integration at the workplace is necessary because people have to

coordinate tasks, share information, cooperate and participate without exclusion. A socially inclusive environment helps different people work toward common objectives and reduces barriers between groups. Thus the assertion that social integration is necessary at the workplace is true. It is a general requirement of effective and equitable working relationships, rather than a claim restricted to one occupation or one social category.

Step 2: Evaluate Reason R The reason says that there are many backward classes in society. In the terminology of the statement, this refers to the existence of socially disadvantaged groups. It is a true observation about social diversity and disadvantage. However, merely naming the existence of these groups does not explain the mechanism or purpose of integration in a working organisation. The reason and assertion must therefore still be tested for a logical explanatory link.

Step 3: Test whether R explains A The need for social integration follows from inclusion, equal participation and cooperation among all workers. The existence of backward classes alone is not a complete or direct explanation of that general workplace need; integration would remain important among workers of many different social backgrounds. Therefore both A and R are true, but R is not the correct explanation of A. Option (A) incorrectly treats the true observation as the explanation. Options (C) and (D) each incorrectly make one of the two true statements false.

Step 4: Conclusion Both A and R are true, but R is not the correct explanation of A. Hence, the correct option is (B).

Quick Tip to Solve: After deciding that both sentences are true, insert the word because between them. Check whether the reason actually explains the workplace requirement, rather than merely mentioning a social fact.

39. Primary colours are _____. [4 marks]

(A) Red, Blue, Yellow

(B) Red, Green, Blue

(C) Red, Violet, Yellow

(D) Red, Green, Yellow

Correct Answer: (A) Red, Blue, Yellow

Solution:

Concept:

- In the traditional artist's colour wheel used for painting and basic design, the primary colours are red, yellow and blue. They form the starting set for the usual secondary-colour relationships.
- The relevant colour model matters: mixing coloured light uses red, green and blue, whereas this visual-art question uses the traditional pigment-colour convention.

Step 1: Identify the appropriate colour convention The question occurs in the colour, texture, harmony and contrast part of visual aptitude. In the traditional art and design colour wheel, red, blue and yellow are called the primary colours. A primary in that model serves as a starting colour rather than one of the secondary mixtures. The standard pairwise relationships are red with yellow giving orange, yellow with blue giving green, and blue with red giving violet.

Step 2: Distinguish pigment and light models Red, green and blue is a familiar trio because it is the additive primary set for coloured light, including electronic displays. That does not make it the expected traditional painting set here. Likewise, modern colour printing uses a different subtractive system. A colour-model question must be interpreted in its stated or subject context; importing the display convention into a basic artist's colour-wheel question changes the model being tested.

Step 3: Check the answer choices Option (A), red, blue and yellow, gives the three traditional primaries. Option (B) replaces yellow with green and corresponds instead to additive light mixing. Option (C) replaces blue with violet, a secondary colour in the traditional wheel. Option (D) includes green, another secondary colour in that wheel, and omits blue. Thus each wrong option fails to reproduce the complete primary set relevant to this art-and-design context. The order of naming the three colours has no effect on the answer.

Step 4: Conclusion The traditional primary colours for this art-and-design question are red, blue and yellow. Hence, the correct option is (A).

Quick Tip to Solve: Associate the traditional painter's wheel with RYB and light-emitting screens with RGB. Identify the colour model before selecting a familiar-looking trio.

40. The stairs kept in motion by a revolving drum is known as a _____. [4 marks]

(A) Escalator

(B) Lift

(C) Elevator

(D) Revolving stairs

Correct Answer: (A) Escalator

Solution:

Concept:

- An escalator is a power-driven moving stairway that carries people continuously between levels. The steps circulate on a mechanically driven loop.
- A lift or elevator carries passengers in a car moving between landings. Identify the moving element: circulating steps indicate an escalator; a moving cabin indicates a lift.

Step 1: Interpret the described movement The statement describes stairs that are kept in motion by a revolving drum. This points to a mechanical stairway whose linked steps are driven around a continuous path. On the exposed run the steps provide standing surfaces for passengers; after reaching the landing, the steps continue into the return path beneath the visible portion. The passenger is transported by the moving steps rather than walking the full difference in height.

Step 2: Name the circulation device The standard architectural and building-services name for a continuously moving stairway is an escalator. The driving machinery moves the step chain, and guide tracks maintain the appropriate step orientation along the passenger-carrying run and through the landing transitions. A handrail moves alongside the steps. These features distinguish the device from a fixed staircase and agree with the revolving mechanical drive described in the question.

Step 3: Eliminate the other names Option (A) supplies the recognised technical term, escalator. A lift in option (B) carries users inside a car that moves between floors; it is not a moving set of stairs. Elevator in option (C) is another name for that car-based arrangement, so it fails for the same reason. Revolving stairs in option (D) sounds descriptive but is not the standard name of the passenger-transport device specified. The essential clue is that the stair steps themselves move continuously, which uniquely identifies the escalator among these choices.

Step 4: Conclusion The moving stairway is an escalator. Hence, the correct option is (A).

Quick Tip to Solve: Look at what carries the passenger: a loop of moving steps means escalator, while a vertically moving enclosed car means lift or elevator.

41. Which of the following structure does not have a dome? [4 marks]

(A) Gol Gumbaz

(B) Avicii Arena

(C) St. Paul's Cathedral

(D) The Shard

Correct Answer: (D) The Shard

Solution:

Concept:

- A dome is a curved roof or vault that covers a space with a rounded, approximately hemispherical or related shell. Its surface curves in more than one direction, unlike a flat or sharply tapering roof.
- Identify the characteristic overall form of each named building. The question asks for the exception, so the building without the rounded roof form must be selected.

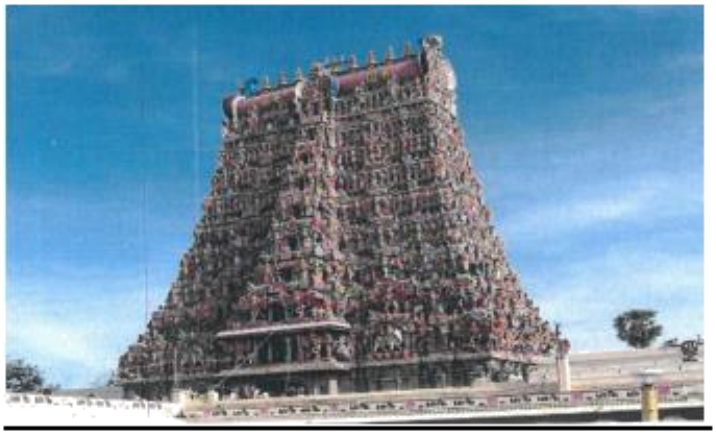
Step 1: Check the buildings with rounded forms Gol Gumbaz is recognised by the enormous dome above its main chamber. Its very name is associated with this dominant rounded roof, so option (A) cannot be the exception. Avicii Arena in Stockholm is the spherical arena formerly known as the Globe. The rounded enclosing shell is the identifying architectural feature; therefore option (B) also belongs with the domed structures.

Step 2: Identify the contrasting roof form St. Paul's Cathedral in London has a prominent central dome above its crossing, so option (C) is excluded. The Shard in London is a tall, tapering glass tower whose upper form ends in pointed, shard-like elements. It does not have the rounded roof or vault represented by a dome. Thus the form of The Shard provides the required contrast with the other three buildings. The fact that both the cathedral and The Shard are in London does not affect the comparison: it is the roof form, rather than location or building use, that decides the answer.

Step 3: Conclusion The Shard is the structure in the list that does not have a dome. Hence, the correct option is (D).

Quick Tip to Solve: For a negative identification question, first group the three buildings sharing the feature: Gol Gumbaz, the spherical Avicii Arena and St. Paul's Cathedral all have rounded forms; The Shard is the pointed exception.

42. Given below is the famous temple in India. Identify the style of temple architecture adopted in the temple. [4 marks]



(A) Nagara

(B) Dravidian

(C) Vesara

(D) Orissan

Correct Answer: (B) Dravidian

Solution:

Concept:

- Temple styles are recognised from the shape of their towers, entrances and overall architectural composition. The visible features of the photograph decide the answer, rather than the temple's fame.
- A Dravidian gopuram is a tall entrance gateway with successively smaller horizontal storeys, rich sculptural ornament and a broad, approximately rectangular base. A Nagara shikhara has a markedly different, curving upward profile.

Step 1: Identify the photographed architectural features The photograph shows a monumental entrance tower. Its base is broad, and its sides taper upward through a sequence of clearly defined horizontal tiers. Numerous figures and decorative elements cover the faces. The repeated storeys and the elongated crown at the top are characteristic features of a southern Indian gopuram. The tower is therefore identified by its actual form, without needing to assume the name of the temple.

Step 2: Compare the four architectural styles Dravidian temple complexes characteristically use such richly ornamented, tiered gopurams, making option (B) the direct match. Nagara temples are associated with curvilinear shikharas, rather than this broad, storeyed gateway, so (A) is excluded. Vesara denotes the Deccan tradition combining features of northern and southern temple design; it does not best describe the gopuram that dominates this photograph, excluding (C). Orissan temple architecture is identified by its characteristic deul and related forms, rather than the photographed southern gopuram; hence (D) is not the match.

Step 3: Conclusion The photographed tiered, sculptured gopuram represents the Dravidian style of temple architecture. Hence, the correct option is (B).

Quick Tip to Solve: Distinguish a temple entrance gopuram from the tower over the sanctum: a broad gateway with many shrinking sculptured storeys strongly indicates Dravidian architecture.

43. Match List I with List II. The four plans shown below are labelled A, B, C and D, respectively, in the order displayed.

List I (Plan)	List II (Building Name)
A. First plan	I. Taj Mahal
B. Second plan	II. Qutub Minar, New Delhi
C. Third plan	III. Matri Mandir, Auroville
D. Fourth plan	IV. Sanchi Stupa

Choose the correct answer from the options given below: [4 marks]



(A) A-IV, B-II, C-III, D-I

(B) A-II, B-III, C-IV, D-I

(C) A-III, B-II, C-IV, D-I

(D) A-IV, B-III, C-II, D-I

Correct Answer: (B) A-II, B-III, C-IV, D-I

Solution:

Concept:

- A building plan is a horizontal representation of its form. Identify characteristic outlines and the arrangement of the central space before matching a plan to a monument.
- The Qutub Minar has a fluted circular tower plan, Sanchi Stupa has a circular stupa with cardinal projections, and the Taj Mahal combines a central chamber with four corner minarets.

Step 1: Identify the distinctive tower and mausoleum plans Plan A has a small circular central space surrounded by a strongly fluted outer perimeter. This is the tower plan of the Qutub Minar, New Delhi, so A matches II. Plan D has a square outer arrangement, a central chamber and four circular corner elements. These corner elements identify the four minarets around the Taj Mahal, so D matches I. The four corner circles distinguish D from the other three predominantly circular plans.

Step 2: Distinguish the two remaining circular plans Plan B shows a circular central space enclosed by a ring of repeated radial divisions. This is the Matri Mandir at Auroville, so B matches III. Plan C shows concentric circular enclosures, a central square feature and projections at the cardinal directions. These features correspond to the Sanchi Stupa complex, so C matches IV. It is therefore necessary to use the internal arrangement as well as the circular outline: simply calling both B and C circular would not distinguish them.

Step 3: Compare the complete matching with the choices The complete correspondence is A-II, B-III, C-IV, D-I. Option (B) gives precisely this order. Option (A) incorrectly assigns A to Sanchi and B to Qutub Minar. Option (C) incorrectly assigns A to Matri Mandir and B to Qutub Minar. Option (D) incorrectly assigns A to Sanchi and C to Qutub Minar. Although all four choices associate D with the Taj Mahal, only (B) also matches the first three plans correctly.

Step 4: Conclusion A-II, B-III, C-IV, D-I. Hence, the correct option is (B).

Quick Tip to Solve: First locate the fluted tower outline of Qutub Minar and the four corner minarets of the Taj Mahal; then distinguish the remaining circular plans by their internal divisions.

44. The botanical name of "MANGO" tree is [4 marks]

(A) Azadirachita Indica

(B) Mangifera Indica

(C) Delonux Indica

(D) Delonux Regia

Correct Answer: (B) Mangifera Indica

Solution:

Concept:

- A botanical name identifies a plant by its genus followed by its specific epithet. In standard scientific writing, the genus starts with a capital letter and the specific epithet is written in lower case; both words are italicised.
- The mango tree belongs to the genus Mangifera. Its species name is indica, giving the binomial

Mangifera indica.

Step 1: Identify the mango binomial The common fruit tree called mango is botanically named *Mangifera indica*. Match these two words with the alternatives, rather than choosing a name merely because it contains the word Indica. Option (B), printed as Mangifera Indica, contains the correct genus and species. The capitalisation of the species word in the option does not change which plant name is being identified.

Step 2: Eliminate the other plant names Option (A), printed as Azadirachita Indica, points to the neem name *Azadirachta indica*; it is not the mango genus. Options (C) and (D) use Delonux rather than Mangifera, so neither gives the mango binomial. The familiar ornamental gulmohar is *Delonix regia*, corresponding to the name intended in option (D), and is a different tree. Botanical identification therefore depends on the complete binomial: sharing an epithet such as indica is insufficient when the genus is different. The mango name is the only alternative containing Mangifera.

Step 3: Conclusion The botanical name of the mango tree is *Mangifera indica*, represented by option (B). Hence, the correct option is (B).

Quick Tip to Solve: Remember the genus first: mango is Mangifera, neem is Azadirachta and gulmohar is Delonix. The common epithet indica alone cannot identify the tree.

45. Scientific study of human body measurements : [4 marks]

(A) Depth Perception

(B) Anthrology

(C) Axenometry

(D) Anthropometry

Correct Answer: (D) Anthropometry

Solution:

Concept:

- Anthropometry is the scientific measurement of the human body, including dimensions such as standing height, shoulder breadth, reach and limb lengths.
- In architecture and product design, body dimensions help determine suitable clearances, working heights, seating dimensions and reach distances. The term concerns measured human size, rather than a drawing projection or visual effect.

Step 1: Connect the definition with the technical term The phrase human body measurements directly describes anthropometry. Anthropometric data can record dimensions of a stationary person as well as the space needed for particular movements. For example, a designer may use sitting height and leg dimensions to select a chair size, or use reach measurements to position a shelf. These are measurements of human bodies, which is precisely the field asked for in the question.

Step 2: Distinguish the distractors Depth perception in option (A) is the visual ability to judge distance and the relative depth of objects; it is not the science of body measurement. Anthrology in option (B) is not the standard technical term for this measurement field. Even anthropology, the wider

study of humans, would be broader than the specific definition given here. Option (C), Axenometry, resembles axonometry, a method of representing three-dimensional objects in a drawing; a projection method does not measure human body dimensions. Anthropometry in option (D) alone matches both parts of the definition: humans and systematic measurement.

Step 3: Conclusion The scientific study of human body measurements is anthropometry. Hence, the correct option is (D).

Quick Tip to Solve: Use the roots as a memory aid: anthropo refers to humans and metry refers to measurement. Distinguish anthropometry from perception and drawing-projection terms.

---

46. FAR stands for [4 marks]

(A) Facade Area Ratio

(B) Floor Area Ratio

(C) Fire Accessible Ramp

(D) Fire Arch Ratio

Correct Answer: (B) Floor Area Ratio

Solution:

Concept:

- FAR is the abbreviation for Floor Area Ratio. It relates the total floor area counted under the applicable development rules to the area of the plot on which a building stands.
- The general relationship is $\text{FAR} = \dfrac{\text{counted total floor area}}{\text{plot area}}$. Both areas use the same units, so the resulting ratio is dimensionless. Local rules determine which areas count.

Step 1: Expand the abbreviation Read the letters as Floor, Area and Ratio. Floor area concerns the area of the building floors counted by the relevant planning regulations, while the plot area is the land area used as the denominator. The term is therefore associated with the intensity of development on a site. It is not a measure of a facade, nor is it a name for a particular fire-safety access element.

Step 2: Check the meaning against the options For example, if a plot has an area of $500\,\text{m}^2$ and the total counted floor area is $1000\,\text{m}^2$, the ratio is $1000/500 = 2$. This illustrates why the expression includes both Area and Ratio, and why the numerator is floor area rather than the building elevation. Option (A), Facade Area Ratio, substitutes facade for floor and is incorrect. Options (C) and (D), Fire Accessible Ramp and Fire Arch Ratio, do not describe the ratio of floor area to plot area. Option (B) gives the established expansion of all three letters.

Step 3: Conclusion FAR stands for Floor Area Ratio. Hence, the correct option is (B).

Quick Tip to Solve: Link FAR to site development: total counted floor area divided by plot area. This also prevents confusing floor area with facade area or a fire-access term.

---

47. On an engineer scale, 1 cm = 10 m. Identify the representative fraction (R.F.) [4 marks]

(A) 1/100

(B) 1/10

(C) 1/1000

(D) 1/10000

Correct Answer: (C) 1/1000

Solution:

Concept:

- The representative fraction is the ratio of a length on a drawing to the corresponding actual length: $\text{R.F.} = \dfrac{\text{drawing length}}{\text{actual length}}$.
- Both lengths must first be expressed in the same unit. The units then cancel, leaving a dimensionless fraction. A reducing scale has a fraction smaller than one.

Step 1: Convert the actual length to centimetres The stated scale says that $1\,\text{cm}$ on the drawing represents $10\,\text{m}$ on the ground. Since the numerator is in centimetres, convert the denominator to centimetres as well. Use $1\,\text{m} = 100\,\text{cm}$, so

$$10\,\text{m} = 10 \times 100\,\text{cm} = 1000\,\text{cm}.$$

The ratio must compare these corresponding lengths, not the two numbers written with different units.

Step 2: Form and check the dimensionless fraction Substitute the drawing and actual lengths expressed in the same unit:

$$\text{R.F.} = \frac{1\,\text{cm}}{1000\,\text{cm}} = \frac{1}{1000}.$$

As a check, multiplying the drawing length by 1000 returns $1000\,\text{cm} = 10\,\text{m}$, which agrees with the question. Option (A), $1/100$, would make 1 cm represent only 1 m. Option (B), $1/10$, incorrectly uses 10 without converting metres. Option (D), $1/10000$, would make 1 cm represent 100 m. Only option (C) gives the stated correspondence of 1 cm to 10 m.

Step 3: Conclusion The representative fraction is $\boxed{1/1000}$, equivalently a scale of $1 : 1000$. Hence, the correct option is (C).

Quick Tip to Solve: Before forming an R.F., put the drawing and actual lengths in the same unit. Here the crucial conversion is 10 m to 1000 cm, not simply the ratio 1 to 10.

48. Identify the iconic Landmark : [4 marks]



(A) Taipei 101

(B) One World Trade Center

(C) Sydney Opera House

(D) Shanghai World Financial Center

Correct Answer: (C) Sydney Opera House

Solution:

Concept:

- Identify a landmark by the silhouette and arrangement of its principal architectural forms. A building's distinctive roof can be more decisive than its height or surrounding skyline.
- The Sydney Opera House is recognised by its grouped white, curved shell-like roofs beside Sydney Harbour. These forms distinguish it from the high-rise towers listed in the other choices.

Step 1: Read the distinctive features of the photograph The photograph shows several white, curved roof shells rising in a cluster beside the water. They have pointed upper edges and sweeping curved surfaces, producing the familiar sail-like silhouette. A large harbour bridge is also visible behind the building. The principal object is a low, spreading cultural building rather than a vertically stacked skyscraper. These visible features directly identify the Sydney Opera House.

Step 2: Eliminate the alternative landmarks Taipei 101 is a tall tower with successive stacked tiers, so option (A) does not match these curved waterfront shells. One World Trade Center is a tall, tapering tower with a spire, not a cluster of sail-like roofs, eliminating (B). Shanghai World Financial Center is another skyscraper, distinguished by the opening near its top, and therefore cannot be the building in this photograph; (D) is excluded. Only option (C), Sydney Opera House, agrees with both the shell-roof architecture and the harbour setting. The curved roofs alone are sufficient for identification; the bridge provides an additional contextual check.

Step 3: Conclusion The iconic landmark in the photograph is the Sydney Opera House. Hence, the correct option is (C).

Quick Tip to Solve: For landmark photographs, first isolate the building silhouette: grouped white sail-like shells beside a harbour identify the Sydney Opera House, whereas the other three options are skyscrapers.

49. Identify the name of the Landmark : [4 marks]



(A) Crystal Palace, London

(B) The Louvre, Paris

(C) German Pavilion for World exibition, Barcelona

(D) Vitra Design Museum, Basel

Correct Answer: (B) The Louvre, Paris

Solution:

Concept:

- Architectural identification uses the combination of form, material and setting, rather than a single isolated feature. A modern insertion can be identified together with the historic buildings surrounding it.
- The Louvre in Paris is distinguished by its transparent glass-and-metal entrance pyramid in the courtyard of the older palace. Its triangular faces and the long classical palace facades form a particularly recognisable ensemble.

Step 1: Read the identifying features The photograph shows a large transparent pyramid, formed by a regular metal grid supporting glass panels. Behind it stands an ornate stone palace with classical windows and a prominent mansard-style roof. The pyramid is not a solid ancient tomb: the older palace and the modern glazed entrance must be considered together.

Step 2: Match the ensemble with the options The glass pyramid in this palace courtyard identifies the Louvre, Paris, so option (B) fits both the foreground and the setting. Crystal Palace was a large glazed exhibition hall, rather than this courtyard pyramid. The German Pavilion at Barcelona has low horizontal slabs, slender supports and planar walls, not the triangular glass entrance shown. Vitra Design Museum is recognised by its sculptural white building forms; these do not match either the transparent pyramid or the palace backdrop. Thus each competing option fails a visible feature, whereas the Louvre matches the whole composition.

Step 3: Conclusion The landmark is the Louvre, Paris. Hence, the correct option is (B).

Quick Tip to Solve: Recognise the Louvre by the glass entrance pyramid together with the historic palace courtyard; glass construction alone is not enough.

50. Identify the famous Monument in the given picture. [4 marks]



(A) Chand Baoli

(B) Stepped Pyramid

(C) Golden Lily Pond

(D) Airavates-vara Temple

Correct Answer: (A) Chand Baoli

Solution:

Concept:

- A stepwell is a deep water-storage structure reached by repeated flights of descending stairs. Its built form is a sunken enclosure rather than a building rising above the surrounding ground.
- Chand Baoli is recognised by the dense geometric pattern of stone stair flights arranged along the sides of a deep stepped well. The repeated stair terraces and the water at the bottom are useful visual identifiers.

Step 1: Identify the type of structure The photograph looks down into a deep stone enclosure. Many short stair flights repeat in a striking zigzag pattern on the retaining sides, with successive landings descending towards a small area of water. This is the spatial organisation of a stepwell: the steps make the changing water level accessible. The dominant feature is the depth of the well and its patterned stairs, not a tower, shrine or freestanding pyramid.

Step 2: Eliminate the other monuments Chand Baoli matches this stepped well, so select (A). A stepped pyramid rises in tiers above ground and does not present these inward-descending stair flights around a deep water shaft. The Golden Lily Pond is a temple tank with a different, more open basin setting; it is not the densely patterned stepwell photographed here. Airavates-vara Temple is a temple complex identified by its shrine and sculptural architecture, rather than this deep stair-lined well. The visible descending geometry therefore separates Chand Baoli from all three distractors.

Step 3: Conclusion The photographed monument is Chand Baoli. Hence, the correct option is (A).

Quick Tip to Solve: First decide whether the tiers rise as a pyramid or descend into a well. Dense stairs descending towards water indicate a stepwell.

51. A man is facing towards East and turns through 45° anti clockwise, again 180° anticlockwise and than turns through 270° clockwise. In which direction is he facing now? [4 marks]

(A) South-East

(B) South-West

(C) South

(D) North-East

Correct Answer: (A) South-East

Solution:

Concept:

- A direction can be represented by its angle measured anticlockwise from East. East is 0°, North is 90°, West is 180°, and South is 270°.
- Anticlockwise turns add to this angle, while clockwise turns subtract. Angles differing by 360° describe the same facing direction; a diagonal direction lies halfway between two adjacent cardinal directions.

Step 1: Set the initial reference Take the initial eastward direction as 0°. The first turn is 45° anticlockwise, towards North. Thus the man faces North-East, at an angle of 45° from East. These are changes of facing direction at a point, so no distance or displacement calculation is involved.

Step 2: Apply the remaining turns Add the second anticlockwise turn, then subtract the final clockwise turn, keeping the same angular convention throughout.

$$\theta = 0^\circ + 45^\circ + 180^\circ - 270^\circ = -45^\circ.$$

After the first two turns the angle is 225°, pointing South-West. Turning clockwise through 270° from there gives -45°, equivalently 315° measured anticlockwise from East. This lies halfway between East and South.

Step 3: Compare the answer directions South-East has angle 315° and matches the result. South-West would correspond to 225°, which is only the intermediate direction before the last turn. South corresponds to 270°, while North-East corresponds to 45°, the direction after only the first turn. Neither of these includes all three changes correctly.

Step 4: Conclusion The final facing direction is South-East. Hence, the correct option is (A).

Quick Tip to Solve: Use signed turns: anticlockwise positive and clockwise negative. Reduce the final angle modulo 360°, then locate it on the compass.

52. The 'lightness or darkness' of a colour is defined as : [4 marks]

(A) Hue

(B) Brightless

(C) Dullness

(D) Value

Correct Answer: (D) Value

Solution:

Concept:

- A colour is commonly described by its hue, value and saturation. Hue identifies the colour family, such as red, blue or green; it does not state how light or dark that colour appears.
- Value is the lightness or darkness of a colour. On a value scale, white is at the light end, black is at the dark end, and greys occupy intermediate positions. Colours can also be compared on this scale.

Step 1: Identify the attribute described The wording asks specifically for the attribute expressed by lightness or darkness. This is the value of a colour. A pale blue and a deep blue can share the same basic hue yet differ strongly in value: the pale blue has a lighter value and the deep blue a darker value. Value therefore remains meaningful even when two samples are recognised as belonging to the same colour family.

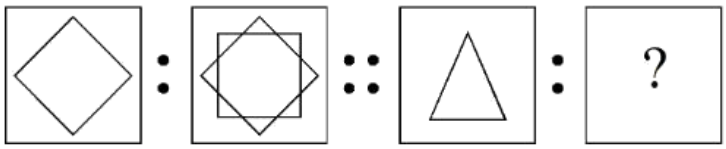
Step 2: Separate value from colour intensity Saturation or chroma describes the strength or purity of a colour relative to a neutral grey. A vivid colour and a muted colour can differ in saturation without the question being about their lightness. Similarly, adding white to a paint colour normally produces a lighter tint, while adding black produces a darker shade; these examples illustrate changes of value.

Step 3: Eliminate the other options Hue, option (A), names the colour family rather than its lightness. The printed word Brightless in option (B) is not the standard art term for the lightness-to-darkness attribute. Dullness, option (C), ordinarily describes a muted or low-intensity appearance and does not name the full light-to-dark scale. Value, option (D), is the precise term used in colour theory and directly matches both halves of the definition.

Step 4: Conclusion The lightness or darkness of a colour is its value. Hence, the correct option is (D).

Quick Tip to Solve: For colour terminology, ask three separate questions: which colour family is the hue, how light or dark is the value, and how vivid or muted is the saturation.

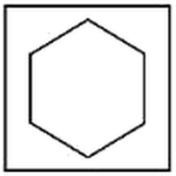
53. Select a figure amongst the answer figures which will continue the same series or pattern as established by the problem figures. [4 marks]



(A) 

(B) 

(C) 

(D) 

Correct Answer: (A) 

Solution:

Concept:

- A visual analogy applies the transformation in the first pair to the starting figure in the second pair. Preserve the surrounding frame and distinguish a change in orientation from a change in size.
- Here the first pair adds a second copy of the interior polygon in a different orientation, with the two copies overlapping at the same centre. The original polygon remains present.

Step 1: Extract the transformation from the squares Inside the first outer square is one tilted square, seen as a diamond. In the second problem figure this diamond remains, and an upright square of comparable size is added about the same centre. The result is two overlapping versions of the same four-sided polygon. The transformation does not shrink the original figure, translate it away from the centre, or replace it by a different polygon.

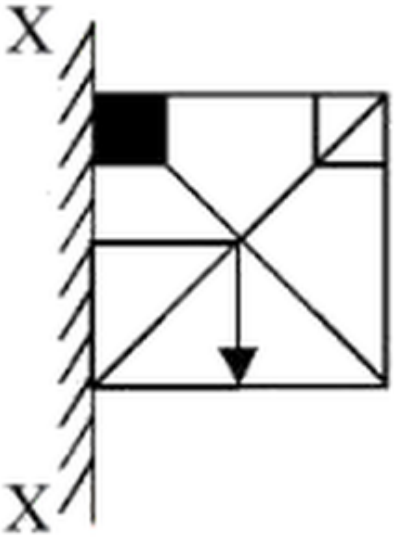
Step 2: Apply the transformation to the triangle The third figure contains an upright triangle within the unchanged square frame. Add a matching inverted triangle about the same centre while retaining the upright one. Their overlap forms the six-pointed star shown in option (A). Option (B) puts a smaller triangle inside a larger one, changing size rather than adding a differently oriented equal copy. Option (C) shifts two triangles vertically and does not reproduce the centred overlap. Option (D) replaces the triangle by a hexagon instead of retaining and duplicating it. Only the star carries over the operation seen in the square pair.

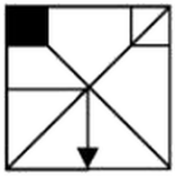
Step 3: Conclusion The required continuation is the pair of overlapping, oppositely oriented triangles. Hence, the correct option is (A).

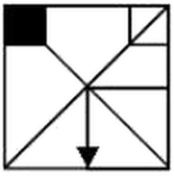
Quick Tip to Solve: Describe the first pair as an operation before inspecting the answers: retain the original polygon and add a centred rotated copy.

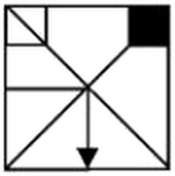
54. Identify the true mirror image of the figure amongst the answer figures with respect to-X-X

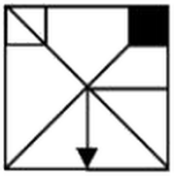
[4 marks]

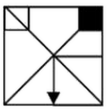


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- Reflection in a vertical mirror exchanges left and right while preserving height. A point at a given level remains at that level, and all horizontal displacements reverse.
- To test a complicated mirror figure, track several asymmetric features independently. A filled corner, a small diagonal and a horizontal segment are more decisive than the square outline alone.

Step 1: Reflect the asymmetric corner details The mirror X-X is vertical on the left of the given figure. In the reflected pattern, the filled upper-left block must appear at the upper-right. The small outlined corner subdivision originally at the upper-right moves to the upper-left, and its diagonal reverses slope. The central vertical arrow still points down, because reflection in a vertical line does not exchange up and down.

Step 2: Check the interior line and choose The horizontal line joining the left boundary to the

central junction in the original must join that junction to the right boundary in the reflection. Option (D) combines this right-hand horizontal segment with the upper-right black block, upper-left small diagonal subdivision and downward arrow. Options (A) and (B) leave the filled block on the original left side and therefore cannot be true reflections. Option (C) moves the corner blocks correctly but leaves the extra horizontal segment on the left. Checking that final segment distinguishes (D) from the tempting near-match (C).

Step 3: Conclusion Option (D) reverses every left-right feature while preserving the vertical positions. Hence, the correct option is (D).

Quick Tip to Solve: After locating the reflected black corner, check the short horizontal segment; it separates the two otherwise similar candidates.

55. Identify the mirror image of given word : [4 marks]



(A) PROGRESS

(B) SSERGORP

(C) SSERGORP

(D) SSERGORP

Correct Answer: (C) SSERGORP

Solution:

Concept:

- A word reflected in a vertical mirror has its letter order reversed and each individual letter reflected horizontally. Reversing the sequence alone is insufficient.
- The given word is PROGRESS. Its reflected sequence runs from the two terminal S shapes on the left to the initial P shape on the right; every nonsymmetric letter must face the reflected direction.

Step 1: Determine the sequence in the reflection The mirror is the vertical dotted line to the right of PROGRESS. The final S is nearest that line and appears first when the answer image is read from left to right. It is followed by the other S, then E, R, G, O, R and P, all in reflected form. The O keeps its appearance because it is horizontally symmetric, but this does not permit the other letters to remain unreversed.

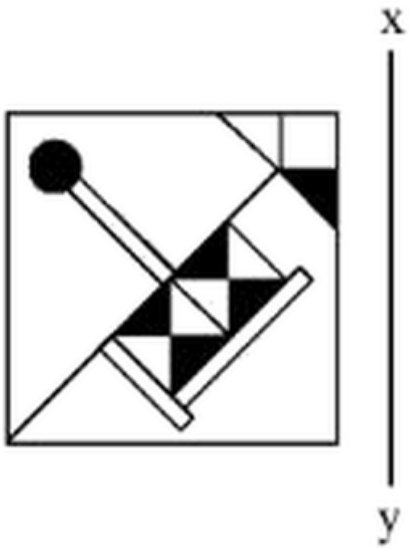
Step 2: Inspect the letter shapes in the options Option (C) has two reflected S shapes at the left and the correctly reflected remaining letters through to the reversed P at the right. Option (A) simply

retains the original normally readable word and so fails both the sequence and orientation checks. Option (B) is a close distractor, but one of its two leftmost S shapes retains the ordinary orientation; the two terminal identical letters must give identical mirrored shapes. Option (D) likewise contains letters in the wrong orientation, including its readable G. The reflection must satisfy every letter, not merely have P at the right-hand end.

Step 3: Conclusion The complete horizontal mirror image is option (C). Hence, the correct option is (C).

Quick Tip to Solve: For a word ending in two identical letters, first check that the two leading reflected letters have identical orientations; then check a distinctive G or R.

56. Identify the correct mirror image of the given figure along x-y axis : [4 marks]



(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- The x-y line shown is a vertical mirror axis. Reflection reverses left-right positions and the slopes of diagonals, while preserving top-bottom order and the shapes of corresponding pieces.
- In a composite design, use multiple landmarks: the circular end of the stem, the small corner square and black wedge, and the two unequal bars bounding the patterned triangular region.

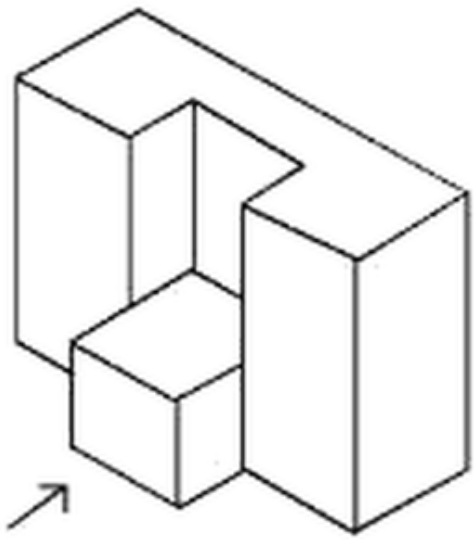
Step 1: Move the main landmarks to their reflected positions The black circle originally near the upper-left moves to the upper-right, with its slender connector sloping down towards the centre from that side. The small outlined square at the upper-right moves to the upper-left, and the black corner wedge below it follows to the left. The long diagonal running from lower-left towards upper-right reverses to a diagonal from upper-left towards lower-right.

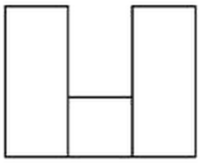
Step 2: Preserve the unequal bars and shaded pattern The long bar on the lower-right side of the original patterned region must lie on the lower-left side of the reflected pattern, while the short lower-left bar moves to the lower-right. The alternating black triangular pieces also reverse left and right without exchanging their heights. Option (D) preserves all these relationships. Options (A) and (B) retain the circle on the left and are therefore rejected immediately. Option (C) moves the circle correctly but puts the long and short boundary bars in the wrong positions. The bar-length test distinguishes (D) from that near-match; selecting only by the circle would miss this difference.

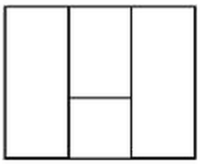
Step 3: Conclusion The figure in option (D) is the correct reflection about the vertical x-y line. Hence, the correct option is (D).

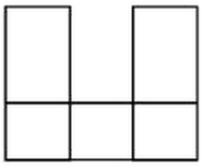
Quick Tip to Solve: Use the black circle for an initial filter, then verify which side carries the long bar. Reflection preserves the bar lengths as it swaps their sides.

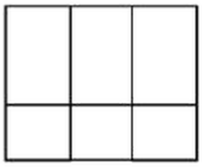
57. The question figure shows the 3D view of an object. Identify the correct view of the object looking in the direction of arrow. [4 marks]

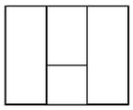


(A) 

(B) 

(C) 

(D) 

Correct Answer: (B) 

Solution:

Concept:

- A view along an indicated arrow is an orthographic projection: depth collapses along the line of sight, while heights and lateral positions remain visible.
- For this object distinguish the tall side portions, the low central block at the front and the tall connecting portion behind it. A rear surface can close the silhouette even when the front has a recess.

Step 1: Project the object in the arrow direction The arrow points towards the front of the object, into the central recessed region. The two tall side portions project as upright rectangles. Between them the low front block produces a short horizontal edge, but the higher connecting portion behind it is also visible above that edge. Consequently the middle column does not end at the height of the low block: the overall projected top boundary remains continuous.

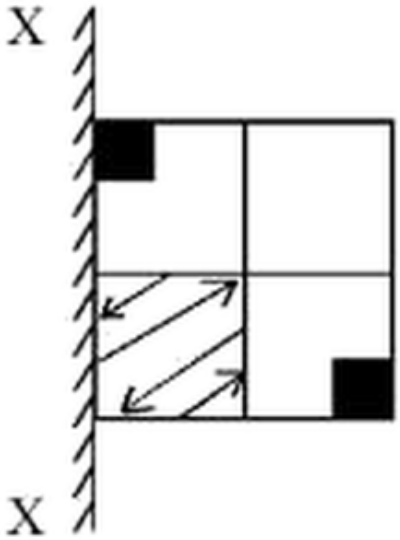
Step 2: Compare the visible edges with each answer Option (B) shows the full rectangular outline, two vertical divisions marking the side portions and a horizontal edge confined to the central lower region. This matches the visible low central block against the higher rear portion. Option (A) leaves the top of the middle open, ignoring the tall material behind the recess. Option (C) has the same open-top error and extends a horizontal division across the side columns. Option (D) closes the top, but its horizontal line crosses both side portions even though those faces have no such step. Only (B) gives the continuous silhouette together with a central-only horizontal edge.

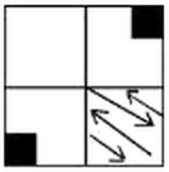
Step 3: Conclusion The correct view looking in the direction of the arrow is option (B). Hence, the correct option is (B).

Quick Tip to Solve: Project the rear connecting surface as well as the front block; a visible recess does not necessarily create a gap in the projected outline.

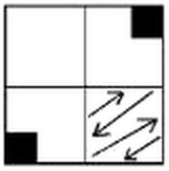
58. **Identify the true mirror image of the figure amongst the answer figures with respect to X-X :**

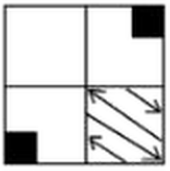
[4 marks]

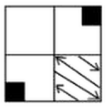


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- A reflection about a vertical X-X line swaps the left and right halves. Top and bottom remain unchanged, and every sloping arrow reverses its horizontal direction.
- The filled corner blocks locate the quadrants quickly, but the arrowheads inside the patterned lower quadrant must also be checked. Correct quadrants alone do not establish a correct reflection.

Step 1: Locate the reflected blocks and patterned quadrant The original black blocks occupy the upper-left and lower-right corners. They must occupy the upper-right and lower-left corners in the reflection. The arrow pattern in the lower-left quarter must move to the lower-right quarter, without moving above the horizontal midline. All the answer figures imitate these coarse positions, so the directions of the individual arrowheads decide the answer.

Step 2: Reflect the arrow directions individually An arrow running down-left in the original becomes

down-right after reflection, while an arrow running up-right becomes up-left. Their vertical levels and relative placements remain unchanged. Following the arrows in the original pattern and reversing only their horizontal components gives the arrangement in option (D). Option (A) has an incorrectly oriented arrow in the lower part of the patterned square. Options (B) and (C) retain arrows sloping along the original rising direction rather than the required descending reflected direction. Thus their corner blocks are plausible but their internal arrow patterns fail the mirror test. Option (D) satisfies the corner, quadrant and arrowhead checks together.

Step 3: Conclusion The true mirror image about X-X is option (D). Hence, the correct option is (D).

Quick Tip to Solve: Check one arrowhead at a time using left-right reversal; matching the black corner blocks is only the first stage of a mirror-image question.

59. 'Kuchipudi' is a unique dance from which state ? [4 marks]

(A) Madhya Pradesh

(B) Tamil Nadu

(C) Kerala

(D) Andhra Pradesh

Correct Answer: (D) Andhra Pradesh

Solution:

Concept:

- Indian classical dance traditions are associated with particular regions, although they are performed and taught throughout India.
- Kuchipudi is the classical dance tradition named after the village of Kuchipudi in Andhra Pradesh. The question asks for its state of origin, not the present location of a performer.

Step 1: Identify the named tradition The decisive association is Kuchipudi with Andhra Pradesh. Its name comes from Kuchipudi village, and its traditional dance-drama practice developed in that Telugu-speaking cultural setting. Thus the state named in option (D) matches the dance specified in the question. The association is a matter of cultural origin; popularity in other states does not change it.

Step 2: Eliminate the other state choices Option (A), Madhya Pradesh, does not identify the home state of Kuchipudi. Option (B), Tamil Nadu, is associated especially with Bharatanatyam, rather than the origin of Kuchipudi. Option (C), Kerala, is associated especially with Kathakali and Mohiniyattam. Those regional associations help distinguish the distractors without confusing different classical forms. Andhra Pradesh is the only listed state corresponding to the particular tradition asked about.

Step 3: Conclusion Kuchipudi originated in Andhra Pradesh. Hence, the correct option is (D).

Quick Tip to Solve: Remember the pair Kuchipudi–Andhra Pradesh; distinguish it from Bharatanatyam–Tamil Nadu and Kathakali–Kerala.

60. Which of the below given material is not a plaster type ? [4 marks]

(A) Gypsum

(B) Lime

(C) Cement

(D) MDF

Correct Answer: (D) MDF

Solution:

Concept:

- Plaster is a workable coating applied to walls or ceilings which sets or hardens to form a finished protective surface.
- Gypsum, lime and cement are materials used as the principal binder in named plaster types. MDF means medium-density fibreboard, a manufactured wood-fibre board.

Step 1: Classify the three coating materials Gypsum plaster uses gypsum-based material and sets to provide a smooth finish. Lime plaster uses lime as its binder, while cement plaster uses cement with suitable aggregate and water. Therefore gypsum, lime and cement each name a recognised plaster category. Their different setting mechanisms and applications do not prevent them from belonging to the plaster group.

Step 2: Identify the material outside that group MDF is made by combining wood fibres with resin and pressing them into boards. It is commonly used for furniture, cabinetry and interior panels, so its supplied form and function differ from a wet-applied plaster coating. It is not a plaster type simply because it can also be used inside a building. Options (A), (B) and (C) are ruled out because each is a plaster binder; option (D) is the manufactured board, which satisfies the negative wording of the question.

Step 3: Conclusion MDF is not a plaster type. Hence, the correct option is (D).

Quick Tip to Solve: For a negative classification question, expand unfamiliar abbreviations: MDF is a fibreboard, while gypsum, lime and cement name plaster binders.

61. Who initiated the construction of Qutub-Minar, Delhi? [4 marks]

(A) Muhammad Quli Qutub Shah

(B) Muhammad Azam Shah

(C) Qutub-Ud-din-Aibak

(D) Iltutmish

Correct Answer: (C) Qutub-Ud-din-Aibak

Solution:

Concept:

- The patron who initiates a monument can differ from the ruler who completes it or adds later portions. The word initiated is therefore decisive.

- Qutub-ud-din Aibak began construction of the Qutub Minar in Delhi. His successor Iltutmish continued the construction and added storeys.

Step 1: Separate the beginning from later construction The question asks who started the Qutub Minar, rather than who completed subsequent stages. The initial construction is credited to Qutub-ud-din Aibak, the founder of the early Delhi Sultanate dynasty. This directly selects the name printed in option (C). Later additions by other rulers do not transfer the credit for initiating the monument to those rulers.

Step 2: Check each alternative against the monument Iltutmish in option (D) is a tempting choice because he continued the tower and added to it, but continuation is not initiation. Muhammad Quli Qutub Shah in option (A) belongs to the Qutb Shahi context of Hyderabad and the Charminar, not the beginning of this Delhi tower. Muhammad Azam Shah in option (B) is not the ruler credited with initiating the Qutub Minar. The similarity of royal names is not a sufficient reason to choose an option; the construction phase and location must agree.

Step 3: Conclusion Qutub-ud-din Aibak initiated the construction of Qutub Minar in Delhi. Hence, the correct option is (C).

Quick Tip to Solve: Attach a role to each name: Aibak began the Qutub Minar, while Iltutmish continued it. Match the verb in the question before choosing.

62. When is the world Environment Day celebrated? [4 marks]

(A) 5 June

(B) 10 July

(C) 22 March

(D) 15 August

Correct Answer: (A) 5 June

Solution:

Concept:

- An annual observance is identified by its fixed calendar date. World Environment Day is observed on 5 June.
- Environmental observances with related themes may occur on different dates, so the name of the day must be matched precisely rather than inferred from its subject.

Step 1: Recall the exact date for the named observance The named event is World Environment Day, the annual occasion for environmental awareness and action. Its fixed observance date is 5 June, which is printed in option (A). The question does not ask for a particular host country or the theme of a particular year; those details may vary, while the calendar date remains the same.

Step 2: Distinguish the dates offered as distractors Option (B), 10 July, is not the date of World Environment Day. Option (C), 22 March, is associated with World Water Day, so it is a plausible environmental distractor but answers a different question. Option (D), 15 August, is the date of India's Independence Day and is also unrelated to the named observance. Since only 5 June matches

World Environment Day, no selection based merely on a general connection with the environment is needed.

Step 3: Conclusion World Environment Day is celebrated on 5 June. Hence, the correct option is (A).

Quick Tip to Solve: Keep the two environmental dates separate: World Water Day is 22 March, and World Environment Day is 5 June.

63. Visual weight is associated with : [4 marks]

(A) Emphasis

(B) Texture

(C) Balance

(D) Pattern

Correct Answer: (C) Balance

Solution:

Concept:

- Visual weight is the apparent importance or heaviness of an element in a composition. It can be affected by size, colour, contrast, texture and placement.
- Balance is the distribution of visual weight across a composition. It may be symmetrical, asymmetrical or radial without requiring equal physical masses.

Step 1: Connect the phrase to its design principle In visual design, balance concerns how the elements appear to be distributed around an axis, centre or field. An element may attract more attention because it is larger, darker or more strongly contrasted. This apparent pull is its visual weight. A balanced composition distributes these pulls so the arrangement appears stable, making balance the principle directly associated with visual weight.

Step 2: Distinguish the related alternatives Emphasis in option (A) concerns creating a focal point; a visually weighty element may create emphasis, but emphasis does not name the overall distribution of weight. Texture in option (B) is the surface quality, which can influence apparent weight but is not the principle governing its distribution. Pattern in option (D) refers to an organised repetition of motifs. Option (C), balance, precisely describes the relation among the visual weights of the different elements, rather than only a feature that can affect them.

Step 3: Conclusion Visual weight is associated with balance. Hence, the correct option is (C).

Quick Tip to Solve: When a design question mentions the distribution or equilibrium of visual weight, think of balance; a single dominant focal point instead suggests emphasis.

64. Lines those branch off of a central point are referred to as : [4 marks]

(A) Rhythm

(B) Repetition

(C) Radiation

(D) Proportion

Correct Answer: (C) Radiation

Solution:

Concept:

- Radiation is an arrangement in which lines or forms extend outward from a common central point, like spokes from a hub.
- Rhythm concerns an organised visual movement, repetition concerns recurrence, and proportion concerns relative sizes. These terms describe different design relationships.

Step 1: Identify the geometry described The defining information is that the lines branch off from one central point. Their directions differ, but their origin is shared. This outward, spoke-like arrangement is called radiation. A sunburst and the spokes of a wheel illustrate the same geometrical relationship, so the word does not require a particular number of lines or equal angles between them.

Step 2: Compare the other design terms Rhythm in option (A) is the sense of movement produced by an organised sequence of elements. Repetition in option (B) is the repeated use of an element, and repeated lines need not meet at any common centre. Proportion in option (D) describes the relative dimensions or sizes of parts. None of those definitions specifically requires lines to branch from a central point. Radiation in option (C) is therefore the exact term matching the arrangement stated, even though a radial composition can also contain repetition or create rhythm.

Step 3: Conclusion Lines branching from a central point form radiation. Hence, the correct option is (C).

Quick Tip to Solve: Look for the common origin: lines like spokes indicate radiation, whereas repeated parallel lines need not be radial.

65. V7 concept of Chandigarh city is associated with which architect? [4 marks]

(A) Patric Geddes

(B) Le Corbusier

(C) Frank O Gehri

(D) Zaha Hadid

Correct Answer: (B) Le Corbusier

Solution:

Concept:

- Chandigarh is a planned city whose master plan is associated with Le Corbusier. Its sectors and circulation network form an integrated urban design.

- The Seven Vs classify circulation routes by their function and traffic speed. The letter V refers to voie, the French word for a road or way.

Step 1: Identify the planning idea The clue is the V7 concept in Chandigarh. Read this in the context of the Seven Vs, the hierarchy of circulation used in the city plan. The system distinguishes regional links and major traffic routes from roads serving sectors and local access, rather than treating every street as having the same role.

Step 2: Connect the hierarchy with its planner Le Corbusier applied the Seven Vs in Chandigarh. Within the hierarchy, V7 is the pedestrian route through the green areas, separating walking movement from faster vehicular movement. Thus the question names a specific component of a planning system associated with Le Corbusier, rather than a building designed by another architect.

Step 3: Eliminate the remaining architects Patrick Geddes is associated with regional planning and the survey-before-plan approach, but he is not the architect associated with this Chandigarh circulation hierarchy. Frank Gehry is known for sculptural architectural forms. Zaha Hadid is associated with fluid, dynamic architectural forms. Neither of these later architects is the author of the Seven Vs of Chandigarh.

Step 4: Conclusion The V7 concept of Chandigarh is associated with Le Corbusier. Hence, the correct option is (B).

Quick Tip to Solve: Link Chandigarh to Le Corbusier first, then remember that the Seven Vs organise movement from major roads down to pedestrian paths.

66. Who is known as "Father of contemporary architecture" ? [4 marks]

(A) Le Corbusier

(B) Louis Sullivan

(C) Frank Gehry

(D) Norman Foster

Correct Answer: (B) Louis Sullivan

Solution:

Concept:

- Architectural-awareness questions often identify a pioneer by an honorific and by the ideas associated with the person.
- Louis Sullivan helped establish a modern architectural language for tall commercial buildings. His principle of form following function connects a building's expression to its use.

Step 1: Identify the intended architectural pioneer The title in this question is used for Louis Sullivan. His importance lies in the development of modern commercial architecture, particularly the expression of the tall office building. Instead of simply copying a historical palace or monument, the design had to respond to the repeated floors and practical organisation of the new building type.

Step 2: Relate the title to the underlying contribution Sullivan is associated with the Chicago School and the maxim form follows function. The point is that the building's organisation and outward

expression should arise from its purpose. This association explains why the question identifies him as a founding influence on contemporary architecture; it is a historical attribution rather than a claim that he designed every later modern style.

Step 3: Distinguish the other names Le Corbusier is a major pioneer of modernism and the architect strongly associated with Chandigarh, but is not the intended holder of the title used here. Frank Gehry belongs to a later generation and is known for sculptural, unconventional forms. Norman Foster is associated with high-tech architecture and technologically expressed structural systems. Their contributions do not match the attribution asked in this item.

Step 4: Conclusion The architect identified by the title in this question is Louis Sullivan. Hence, the correct option is (B).

Quick Tip to Solve: Remember Sullivan through the Chicago School and form follows function; keep that association separate from Le Corbusier and Chandigarh.

67. Who designed 'India Gate'? [4 marks]

(A) Edwin Luytens

(B) Raj-Rewal

(C) George Writtet

(D) Norman Foster

Correct Answer: (A) Edwin Luytens

Solution:

Concept:

- India Gate is the monumental war memorial in New Delhi, distinct from the Gateway of India in Mumbai.
- Edwin Lutyens designed India Gate. Identifying the city and monument correctly prevents confusion with other colonial-era architects.

Step 1: Identify the monument precisely The question asks about India Gate, the large memorial arch in New Delhi. Its name is easily confused with the Gateway of India, but these are separate monuments in different cities. The first step is therefore to retain the exact name in the question rather than treating every ceremonial gateway as the same building.

Step 2: Recall the correct architect India Gate was designed by Sir Edwin Lutyens. Lutyens was closely associated with the planning and monumental architecture of New Delhi. The listed spelling Edwin Luytens refers to this architect; the identifying fact is the association of Lutyens with the Delhi memorial arch.

Step 3: Check each alternative Raj Rewal is an Indian architect associated with modern projects such as the Hall of Nations and the Parliament Library, rather than India Gate. George Wittet is associated with the Gateway of India in Mumbai, making him the most tempting distractor when the two names are confused. Norman Foster is a British architect associated with much later high-tech buildings, rather than this New Delhi memorial. Only option A matches the required monument.

Step 4: Conclusion India Gate in New Delhi was designed by Edwin Lutyens. Hence, the correct option is (A).

Quick Tip to Solve: Use the pair India Gate–Lutyens for Delhi, and Gateway of India–Wittet for Mumbai; the city separates the two common distractors.

68. Who among the following architects has not won the Pritzker prize till 2019? [4 marks]

(A) B.V. Doshi

(B) I.M. Pie

(C) Arata Isozki

(D) Moshe Safdie

Correct Answer: (D) Moshe Safdie

Solution:

Concept:

- The phrase till 2019 fixes the historical cutoff. Include the 2019 laureate while checking who had already received the Pritzker Architecture Prize.
- This is an elimination question: compare each named architect with the recipients up to and including that year, rather than with the person's fame or nationality.

Step 1: Check the laureates before the cutoff I. M. Pei received the Pritzker Architecture Prize in 1983. Balkrishna Vithaldas Doshi received it in 2018. Therefore both Pei and B. V. Doshi had already won before the stated endpoint of 2019, so neither can answer a question asking who had not won by that time.

Step 2: Include the laureate for 2019 Arata Isozaki received the Pritzker Architecture Prize in 2019. The wording till 2019 includes that year itself, so his award must be counted. Excluding the cutoff year would incorrectly leave two apparent possibilities and would change the meaning of the question.

Step 3: Select the architect left after elimination Moshe Safdie had not received the Pritzker Architecture Prize by the stated cutoff. He is a distinguished architect, but prominence is not the criterion; receipt of this particular prize is. Thus option A is excluded by the 2018 award, option B by the 1983 award, and option C by the 2019 award. Option D alone satisfies the negative condition in the question.

Step 4: Conclusion Among these architects, Moshe Safdie had not won the Pritzker Architecture Prize till 2019. Hence, the correct option is (D).

Quick Tip to Solve: For a negative award-history question, mark the cutoff year explicitly; remember Pei 1983, Doshi 2018 and Isozaki 2019 before eliminating.

69. Terra cotta is a type of earthen work which is processed by : [4 marks]

(A) Burning at high temperature

(B) Mixing with lime

(C) Compacting with pressure

(D) Drying in the Sun

Correct Answer: (A) Burning at high temperature

Solution:

Concept:

- Terracotta is an earthenware material made by shaping clay and firing it. Its name refers to baked earth.
- Firing produces a durable ceramic body. Drying removes moisture, whereas heating in a kiln brings about the changes that distinguish fired clay from an unfired clay object.

Step 1: Identify the raw material and shaping stage The starting material for terracotta is suitable clay mixed with water so that it can be moulded into the required form. The shaped object is allowed to dry before firing. This preliminary drying is necessary to reduce the risk of damage during heating, but it does not by itself complete the manufacture of terracotta.

Step 2: Identify the decisive processing operation The dried clay object is fired in a kiln at high temperature. In ordinary building-material terminology, the option calls this burning, meaning firing the clay body rather than using the clay as a fuel. Heating transforms the shaped earth into the ceramic product used for tiles, ornaments, pots and architectural units. Therefore the defining processing step is option A.

Step 3: Reject operations that do not produce terracotta Mixing clay with lime is not the defining process for terracotta; lime is relevant to other binders and building mixtures. Compaction under pressure may help shape some products, but pressure alone does not make a fired ceramic. Sun drying produces an unfired earthen object and lacks the kiln-firing step. Options B, C and D therefore fail to identify the essential process.

Step 4: Conclusion Terracotta is processed by firing or burning the shaped clay at high temperature. Hence, the correct option is (A).

Quick Tip to Solve: Distinguish drying from firing: sun-dried earth remains unfired, whereas terracotta is baked clay and therefore a ceramic material.

70. Which building material is primarily used as a building material for the Great wall of China?

[4 marks]

(A) Timber

(B) Steel

(C) Brick

(D) Concrete

Correct Answer: (C) Brick

Solution:

Concept:

- The Great Wall of China is a masonry fortification with materials varying across regions and periods. Brick is the appropriate choice among the four materials listed.
- In the widely recognised built sections, brick forms a characteristic facing and masonry construction material; stone and earth also occur in the wider wall system.

Step 1: Interpret the material comparison The question asks for the principal building material from timber, steel, brick and concrete. It does not require every section of the Great Wall to have identical construction. The monument extends across varied terrain and was built in different periods, so identify the option that characterises its familiar historic masonry construction without claiming a uniform material everywhere.

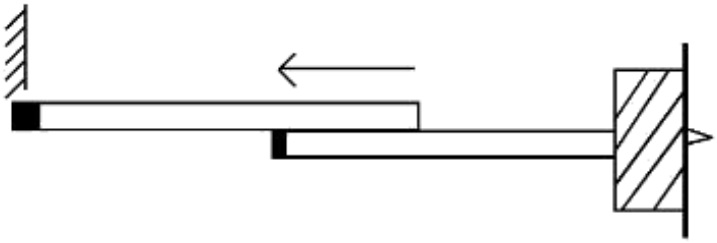
Step 2: Choose the masonry material that fits Brick is used prominently in the well-known masonry sections of the Great Wall. Individual fired units can be laid with mortar to form wall faces, parapets and associated structures. This makes brick the intended answer among the choices. The existence of stone and rammed-earth sections does not turn timber, steel or modern concrete into the correct option in this list.

Step 3: Eliminate the other materials Timber can occur in ancillary structures, but it is not the characteristic wall material being identified. Steel is associated with later metal construction and is not the primary material of the historic fortification. Modern concrete is likewise not the principal material represented by the traditional brick-built stretches. Of the four offered choices, only brick matches the expected historic construction.

Step 4: Conclusion Brick is the appropriate principal building material of the Great Wall of China among the listed options. Hence, the correct option is (C).

Quick Tip to Solve: For historic material questions, select the best listed material while allowing for regional construction differences; the familiar Great Wall masonry points to brick.

71. Identify the architectural symbol represented in the given figure. [4 marks]



(A) Window

(B) Sliding door

(C) Revolving door

(D) Rolling shutter

Correct Answer: (B) Sliding door

Solution:

Concept:

- Architectural plan symbols show both the position of a building element and the way its moving parts operate. A straight arrow parallel to a door panel indicates a sliding movement.
- A sliding door opens by translating along a straight track instead of swinging about a hinge. Its panel can overlap an adjacent panel or move alongside a wall.

Step 1: Inspect the panel arrangement The figure contains two long, thin rectangular panel outlines at slightly offset positions. They overlap near the middle, and the right end meets a hatched wall or jamb. A horizontal arrow above the left panel points to the left. Read the arrow together with these overlapping parallel panels: the indicated movement is along their length, rather than away from the wall in a curved path.

Step 2: Identify the opening mechanism The straight arrow represents one panel travelling horizontally relative to the other panel and the fixed opening. This is the plan representation of a sliding door. It needs no circular swing space because the leaf translates along its track. The overlap of the rectangular leaves is consistent with one leaf passing the other as the opening is opened or closed.

Step 3: Exclude the other symbols A window symbol identifies glazing within a wall opening; it does not account for this depicted door-panel movement. A revolving door would show a circular enclosure or rotating leaves around a central pivot, which are absent here. A rolling shutter rolls onto a barrel, normally indicated by a different shutter arrangement rather than these overlapping sliding leaves. The straight travel arrow and parallel panel outlines therefore distinguish the sliding door from all three alternatives.

Step 4: Conclusion The architectural symbol represents a sliding door. Hence, the correct option is (B).

Quick Tip to Solve: Follow the movement indicator in a door symbol: a straight arrow along overlapping panels denotes sliding, while a circular sweep indicates rotation.

72. Percentage of lime content in ordinary Portland cement is [4 marks]

(A) 30% – 40%

(B) 40% – 50%

(C) 60% – 70%

(D) 70% – 80%

Correct Answer: (C) 60% – 70%

Solution:

Concept:

- In cement composition, lime content means the proportion of calcium oxide, CaO, expressed as a percentage by mass of the cement.
- Ordinary Portland cement contains lime as its largest major oxide constituent. The commonly used approximate range is around 60 to 67 percent, lying in the offered 60 to 70 percent band.

Step 1: Identify the constituent being measured The word lime here refers to calcium oxide in the oxide composition of ordinary Portland cement. It does not mean the mass of limestone fed to the kiln or the amount of free, uncombined lime left in the finished product. Much of the calcium oxide is combined in the clinker compounds responsible for the cement's hydraulic behaviour.

Step 2: Locate the standard composition range Lime forms roughly about two-thirds of ordinary Portland cement by mass. A typical textbook range is approximately 60 to 67 percent, depending on the cement composition. This entire approximate range falls within 60 to 70 percent, so option C is the interval that matches the expected major-oxide composition.

Step 3: Compare the remaining intervals The ranges 30 to 40 percent and 40 to 50 percent are too low for the lime content of ordinary Portland cement. The range 70 to 80 percent is too high for the usual composition. Selecting an interval should follow the approximate composition rather than the numerical size of a single ingredient in the raw mix. The correct comparison is therefore between the CaO percentage in the cement and the four printed percentage bands.

Step 4: Conclusion The lime content of ordinary Portland cement lies in the 60 percent to 70 percent band. Hence, the correct option is (C).

Quick Tip to Solve: Remember CaO as roughly two-thirds of ordinary Portland cement, then choose the percentage band that contains that approximate value.

73. Sill Level is associated with [4 marks]

(A) Roof

(B) Column

(C) Window

(D) Staircase

Correct Answer: (C) Window

Solution:

Concept:

- A sill is the lower horizontal member or surface at the base of a window opening. Its level identifies the height of the bottom of that opening above the chosen floor or building datum.
- Architectural terminology distinguishes the sill below an opening from the lintel over an opening. Matching a level to its physical building element avoids confusing unrelated structural heights.

Step 1: Locate the sill in a wall opening Consider a window fitted in an external wall. The opening has two vertical sides, a top and a bottom. The horizontal lower edge is the window sill; the elevation of this edge is called the sill level. It often lies above finished floor level, leaving wall below the window. An external sill may also project or slope to shed water, but these details do not change the term. Therefore the defining association is with the window opening itself, rather than with the overall height of the building.

Step 2: Eliminate the other building elements A roof is described by roof, eaves or ridge level, depending on the surface or edge being specified; this is not what sill level denotes. A column is a vertical supporting member and is described through its base, height and connections to beams or slabs. A staircase is described through landings, flights, treads and risers. None of these alternatives identifies the lower horizontal boundary of a window opening. The window is consequently the only option that directly matches the construction term in the question.

Step 3: Conclusion Sill level is associated with a window: it is the level of the bottom of the window opening. Hence, the correct option is (C).

Quick Tip to Solve: Remember the vertical order at a window: sill below, lintel above. Link sill level to the bottom edge of the window, not to a roof or stair landing.

74. What is the terminology for the vertical portion between each tread of the stairs? [4 marks]

(A) Winder

(B) Riser

(C) Nosing

(D) Going

Correct Answer: (B) Riser

Solution:

Concept:

- A stair consists of successive horizontal walking surfaces called treads and vertical portions between them called risers. The riser supplies the vertical change in level between consecutive treads.
- Stair terminology distinguishes a vertical face or height from the horizontal going, the projecting nosing and a turning tread called a winder.

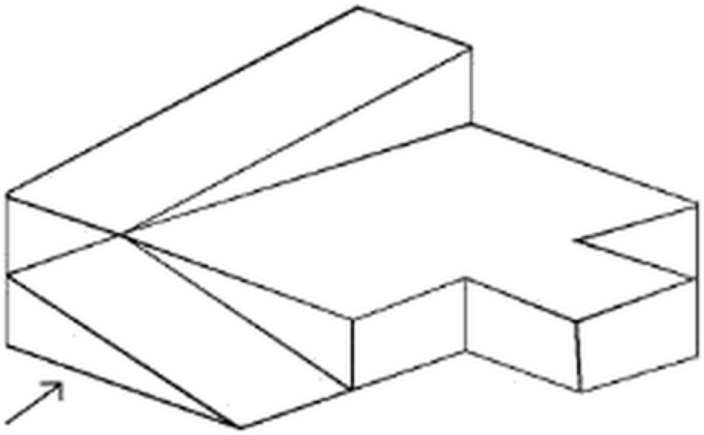
Step 1: Identify the direction named in the question The question explicitly asks for the vertical portion between successive treads. Imagine a staircase viewed from its side: each step has a horizontal top and a vertical face beneath the front edge of the next tread. That vertical face is the riser. Its height determines how far a person rises on taking a step. The wording therefore specifies the upright portion of the step, not its walking surface or the horizontal distance travelled along the stair.

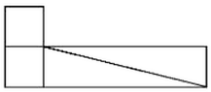
Step 2: Compare the four terms A winder is a tread that is narrower at one end, commonly used to turn a stair without a full landing; it is still a walking surface. A riser is the upright portion between consecutive treads, matching the question exactly. Nosing is the projecting front edge of a tread, extending beyond the face of the riser below it. Going denotes the horizontal distance associated with a step, conventionally measured between corresponding nosings. Thus winder concerns a turning tread, nosing concerns an edge, and going concerns a horizontal dimension. Only riser denotes the vertical portion asked for. An open-riser stair may omit a solid vertical board, but the vertical rise between its treads remains the same geometric concept.

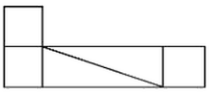
Step 3: Conclusion The vertical portion between consecutive stair treads is the riser. Hence, the correct option is (B).

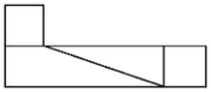
Quick Tip to Solve: Use direction to distinguish stair terms: riser is vertical, going is horizontal, and nosing is the projecting front edge of the tread.

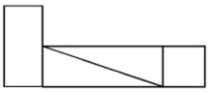
75. The question figure shows the 3D view of an object. Identify the correct view of the object looking in the direction of arrow : [4 marks]

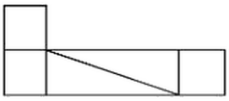


(A) 

(B) 

(C) 

(D) 

Correct Answer: (B) 

Solution:

Concept:

- An orthographic view projects all points parallel to the viewing arrow onto a plane perpendicular to that arrow. Depth along the line of sight disappears, while width and height remain.
- Visible boundaries include both the outside silhouette and the edges where visible faces change. A correct outline alone is insufficient if an internal junction is missing or added.

Step 1: Project the outline along the arrow The arrow looks along the long direction of the raised strip. The strip therefore appears as a tall rectangular portion at the left, while the lower body extends to the right. The sloping face gives a descending diagonal from the junction beside the tall strip towards the lower edge of the broad right-hand portion. Its endpoint is not the extreme right corner: the short end portion continues beyond it. This establishes the tall left block, low right block and diagonal needed in the projected view.

Step 2: Retain the visible face junctions The front face of the raised strip has a visible division at the height of the lower body. Thus the horizontal junction must continue across the left rectangular portion. The end portion of the lower body also has its own vertical boundary, so a vertical line must remain near the right end. Option B contains both these features as well as the correct diagonal. Option A omits the near-right vertical division and extends the diagonal to the outermost corner. Option C omits the horizontal division across the left block, and option D also lacks that visible horizontal division. These edge tests distinguish B even though the broad silhouettes look similar.

Step 3: Conclusion The arrow-direction projection retains the left horizontal face division and the near-right vertical division shown in option B. Hence, the correct option is (B).

Quick Tip to Solve: After matching the silhouette, trace every visible junction. Here the horizontal line across the tall left block and the short rectangular end beyond the diagonal decide the answer.

76. Complete the number sequence :

18, 27, 38, 51, ..., 83 [4 marks]

(A) 62

(B) 66

(C) 64

(D) 72

Correct Answer: (B) 66

Solution:

Concept:

- A number sequence may follow a pattern in the differences between consecutive terms. Constant second differences indicate that the first differences form an arithmetic progression.
- To fill a missing term, use the pattern on both sides of the blank. A candidate must preserve the same difference rule and also reproduce the following known term.

Step 1: Compute the consecutive differences The given sequence is $18, 27, 38, 51, \ldots, 83$. Subtract each term from the next known term:

$$27 - 18 = 9, \qquad 38 - 27 = 11, \qquad 51 - 38 = 13.$$

The differences are successive odd numbers, increasing by 2. Continuing this rule gives the next differences 15 and 17. It is the differences, rather than the original terms, that form a simple arithmetic progression. This distinction prevents an incorrect guess based only on the size of the listed terms.

Step 2: Fill the blank and verify the final term Add the next required difference to 51:

$$51 + 15 = 66.$$

Now check the subsequent given term using the following odd difference:

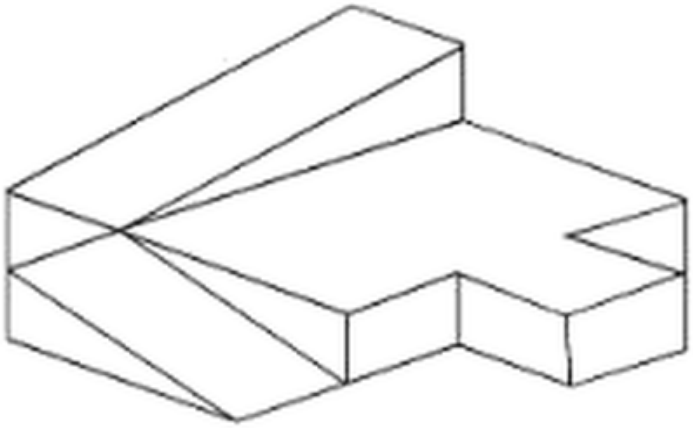
$$66 + 17 = 83.$$

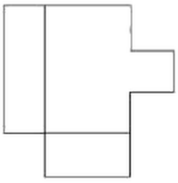
Both sides of the blank agree with the same rule. The other offered values fail this test: 62 would give adjacent differences 11 and 21; 64 would give 13 and 19; and 72 would give 21 and 11. None continues the required $9, 11, 13, 15, 17$ pattern. Thus the choice is fixed by a single consistent difference sequence, rather than by proximity to the surrounding numbers.

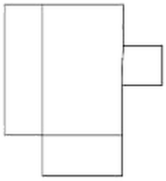
Step 3: Conclusion The missing number is 66, since $51 + 15 = 66$ and $66 + 17 = 83$. Hence, the correct option is (B).

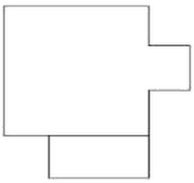
Quick Tip to Solve: For this sequence, first write the gaps 9, 11 and 13. Continue the odd gaps to 15 and 17, then check that the proposed middle term reaches 83.

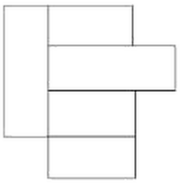
77. In the question figure a-3-D object is given, Identify the correct top view of the object amongst the answer figures. [4 marks]

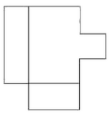


(A) 

(B) 

(C) 

(D) 

Correct Answer: (A) 

Solution:

Concept:

- A top view projects the object vertically onto a horizontal plane. Vertical height disappears from the outline, but boundaries of visible upper surfaces remain as internal lines.
- An inclined face projects to its horizontal footprint. Its boundary must be retained when it separates two upper surfaces, whereas a vertical wall below a continuous top surface does not create an extra top-view line.

Step 1: Trace the plan outline Looking straight down, the long raised strip occupies a narrow strip at the left of the plan. The main body occupies the larger adjoining area. The projecting tongue at the right and the lower projection produce the stepped outline visible in the alternatives. The line separating the raised strip from the adjoining upper surfaces remains visible in plan, even though the height of the strip itself cannot be represented by height on the page. Therefore a plain unpartitioned upper area, as in option C, cannot represent all the visible edges.

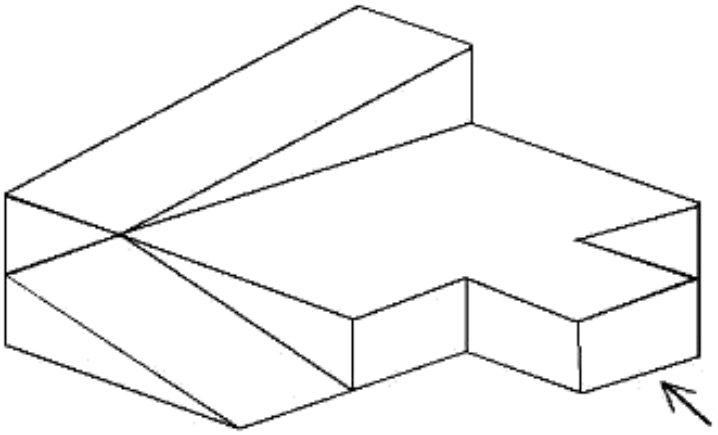
Step 2: Check the surface boundaries inside the outline The main upper surface extends into the right-hand tongue without a transverse break across the root of that tongue. Its boundary follows

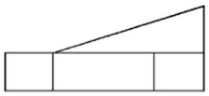
the outer stepped outline there. The inclined portion at the near side meets the main upper surface along the transverse line continuing across the width, while the narrow raised strip retains its long boundary. These features give option A. Option B adds an internal vertical line across the root of the right projection even though that region is one continuous upper face. Option D inserts additional horizontal subdivisions across the central region and therefore does not match the visible surface arrangement. Option A alone retains the necessary boundaries without introducing those extra edges.

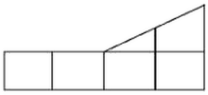
Step 3: Conclusion The correct top view is the stepped plan with the raised-strip boundary and the near-side transverse junction shown in option A. Hence, the correct option is (A).

Quick Tip to Solve: For a top view, first trace the footprint, then add only boundaries between visible upper surfaces. Do not turn every vertical side edge into a line across a continuous top face.

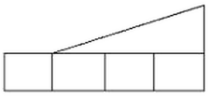
78. In question figure - 3D object is given, Identify the correct view of the object looking in the direction of the arrow, amongst the answer figures. [4 marks]

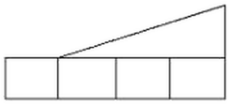


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- In an orthographic elevation, points are projected parallel to the stated viewing arrow. The vertical coordinate is retained, and depth parallel to the arrow is suppressed.
- A sloping top edge remains inclined when its two ends occur at different heights and different horizontal positions in the viewing plane. Visible vertical edges subdivide the lower band but stop where the corresponding faces end.

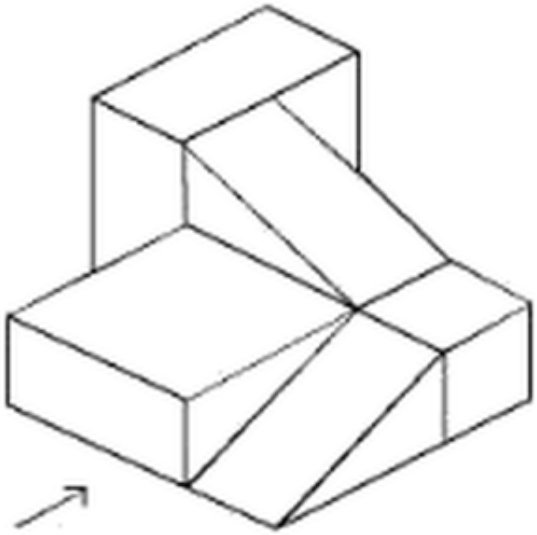
Step 1: Determine the sloping silhouette The arrow views the object from its right-hand end. From this direction the lower body forms a long rectangular band, with the raised portion reaching its greatest height at the right. The inclined edge starts near the first subdivision from the left, at the height of the top of the lower band, and rises to the tall right end. Its start is therefore not at the middle subdivision. This immediately rejects options B and C, both of which start the rising line too far to the right.

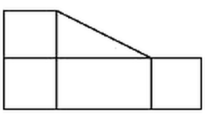
Step 2: Check the subdivisions and reject added edges The stepped body gives three internal vertical divisions in the lower rectangular band, making four adjacent regions. Those divisions describe the changes in the lower visible faces. They terminate at the horizontal top of that band; they do not continue upwards through the open triangular area below the sloping silhouette. Option D shows the correct early starting point for the incline and all three lower divisions. Option A has the rising line starting correctly, but omits the middle lower-band division. Option B additionally carries a vertical subdivision up into the triangular sloping region. Option C has the lower divisions but gives the wrong starting point for the incline. Comparing both the slope and the face divisions therefore selects D uniquely.

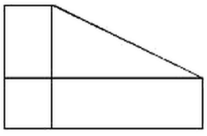
Step 3: Conclusion The elevation must have the rising edge beginning at the first internal division and three divisions confined to the lower band. Hence, the correct option is (D).

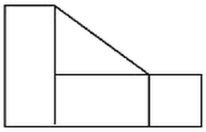
Quick Tip to Solve: Check where the sloping edge begins before counting lines. In this view its early start rejects B and C; the missing middle lower division then rejects A.

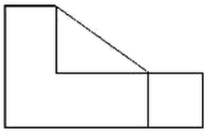
79. In question figure a 3-D object is given. Identify the correct view of the object looking in the direction of arrow, amongst the answer figures. [4 marks]

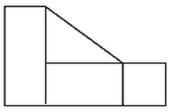


(A) 

(B) 

(C) 

(D) 

Correct Answer: (C) 

Solution:

Concept:

- An elevation is formed by projecting along the arrow and preserving heights. The correct answer must match the silhouette and the visible boundaries between the projected faces.
- An edge hidden behind an uninterrupted visible face is not drawn as a solid internal line. A visible change of face must nevertheless be retained even if adjacent regions have the same outer height.

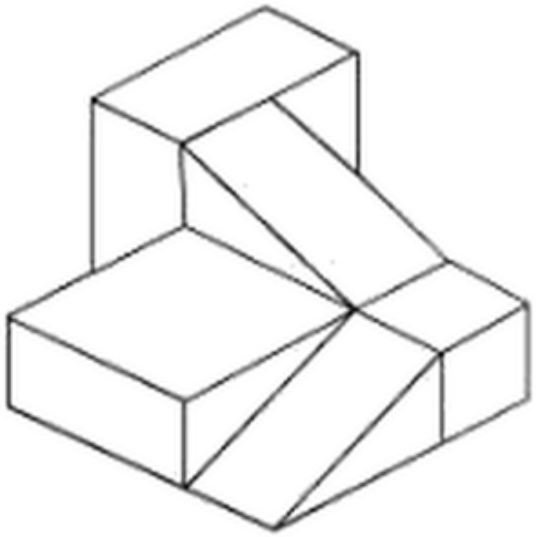
Step 1: Establish the outer contour From the arrow direction, the tall upright portion is at the left. A sloping upper edge descends from its upper-right corner to the top of the lower body. The lower body extends further to the right beyond the foot of the slope, leaving a short rectangular end portion. Thus the inclined line must stop before the extreme right edge. Option B is unsuitable because its incline runs all the way to the outermost right corner, eliminating the distinct low end portion present in the object.

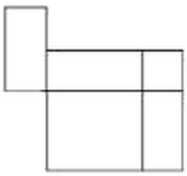
Step 2: Trace only the visible interior junctions The tall left face remains one uninterrupted vertical face in this projection; a horizontal line should not be carried through it at the lower-body height. At its right-hand side, however, the vertical edge separating it from the sloping and lower regions remains visible down to the bottom. The foot of the slope is also followed by a vertical division separating the short right end. Option C contains exactly these edges. Option A adds a horizontal division across the tall left face. Option D removes the lower continuation of the vertical boundary beside that face, merging regions that are visibly separated. Consequently C matches both the outline and the actual visible face arrangement.

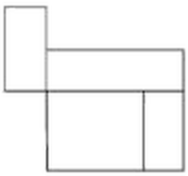
Step 3: Conclusion The view has an undivided tall left face, a full-height vertical junction beside it, and a short low end beyond the incline, as in option C. Hence, the correct option is (C).

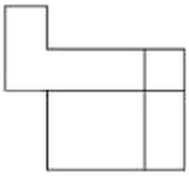
Quick Tip to Solve: Use the tall face as a check: it has no horizontal seam. Then verify that the vertical boundary beside it continues below the slope into the lower body.

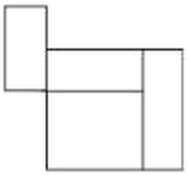
80. In the question figure a 3-D object is given. Identify the correct top view of the object amongst the answer figures. [4 marks]

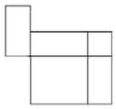


(A) 

(B) 

(C) 

(D) 

Correct Answer: (A) 

Solution:

Concept:

- A top view is the vertical projection onto a horizontal plane. Heights are suppressed, while the footprints and visible boundaries of upper faces determine the drawing.
- Inclined surfaces are represented by their plan areas and edges. Two edges meeting in a perspective image must be followed over their full projected lengths before deciding whether a line continues across an adjoining region.

Step 1: Trace the outer plan and the raised strip The footprint consists of the tall narrow portion projecting at the upper left and the broad body extending to the right and towards the near side. In the top view the height of the upright is suppressed, so it appears as the narrow left strip. Its right-hand boundary remains visible, including the part above the main body. The near-side broad rectangle and the right-hand end give the remaining outer outline. All the alternatives imitate this

outline, so the internal surface boundaries, rather than the silhouette alone, must decide the answer.

Step 2: Follow the boundaries of the sloping faces The upper sloping strip meets the adjoining visible surfaces along a transverse boundary across the main body. The right-hand end strip is separated by a lengthwise boundary that continues through the adjoining projected regions to the near edge. The boundary beside the tall left strip is also visible where it meets the body. Option A preserves these continuous junctions. Option B omits the upper part of the near-right vertical boundary, incorrectly merging two visible regions. Option C omits the lower portion of the boundary beside the left strip. Option D interrupts the transverse line at the near-right division even though the visible face junction continues to the outside edge. Only A retains all the required segments and their proper continuity.

Step 3: Conclusion The top view retaining the complete transverse junction and the continuous near-right division is option A. Hence, the correct option is (A).

Quick Tip to Solve: When top-view options share an outline, compare the ends of each internal line. Here the complete transverse line and the continuous near-right division identify A.

Planning (100 marks)

81. Urban heat island is _____ its surrounding rural areas. [4 marks]

(A) Colder than

(B) Neutral to

(C) Warmer than

(D) Having same temperature with

Correct Answer: (C) Warmer than

Solution:

Concept:

- An urban heat island is a built-up area whose temperature is higher than that of its surrounding countryside. The comparison is between urban and rural environments under comparable weather conditions.
- Buildings and paved surfaces absorb and store solar energy, while reduced vegetation limits cooling by evapotranspiration. Traffic, industry and air-conditioning also release heat.

Step 1: Identify the direction of the temperature difference A heat island is a relatively warm zone, not a cold zone. Concrete, asphalt and other urban materials store energy during the day and release it later; reduced vegetation and altered airflow can further weaken cooling. The defining comparison is therefore that the city is warmer than nearby rural land.

Step 2: Check the four expressions "Warmer than" completes the sentence correctly. "Colder than" reverses the defining temperature contrast. "Neutral to" describes no heat-island contrast, while "having same temperature with" also implies equality rather than the higher urban temperature specified by this phenomenon. These alternatives cannot express an urban heat island.

Step 3: Conclusion An urban heat island is warmer than its surrounding rural areas. Hence, the correct option is (C).

Quick Tip to Solve: Associate the word "island" with a local pocket of higher temperature surrounded by relatively cooler rural land.

82. Match List I with List II

LIST I (Cities)		LIST II (Planner)	
A.	Jaipur	I.	O. Konigsberger
B.	Gandhi Nagar	II.	Doxiadis
C.	Islamabad	III.	H.K.Mewada
D.	Bhubneswar	IV.	Vidyadhar

Choose the correct answer from the options given below: [4 marks]

(A) A-I, B-II, C-III, D-IV

(B) A-IV, B-III, C-II, D-I

(C) A-I, B-III, C-II, D-IV

(D) A-IV, B-II, C-III, D-I

Correct Answer: (B) A-IV, B-III, C-II, D-I

Solution:

Concept:

- Match each planned city to the planner associated with its original urban plan; then compare the full sequence with the answer codes.
- The relevant pairs are Jaipur–Vidyadhar, Gandhinagar–H. K. Mewada, Islamabad–Doxiadis and Bhubaneswar–O. Koenigsberger.

Step 1: Establish the four individual matches Jaipur was planned by Vidyadhar Bhattacharya, so A matches IV. Gandhinagar is associated with H. K. Mewada, so B matches III. Islamabad was planned by Constantinos Doxiadis, so C matches II. Bhubaneswar is associated with Otto Koenigsberger, so D matches I. The spelling variations in the lists do not alter these city-planner identities.

Step 2: Compare the complete code The sequence is A-IV, B-III, C-II, D-I. Only the second option gives all four matches. The first and third options incorrectly attach Jaipur to Koenigsberger. The fourth option gets Jaipur and Bhubaneswar right but exchanges the planners of Gandhinagar and Islamabad. Checking the two middle matches prevents selecting that near-match.

Step 3: Conclusion The correct matching is A-IV, B-III, C-II, D-I. Hence, the correct option is (B).

Quick Tip to Solve: First fix Jaipur–Vidyadhar and Islamabad–Doxiadis; then check Gandhinagar and Bhubaneswar to confirm the entire code.

83. Given below are two statement:

Statement I : On November 8, 2016, demonetization was declared in India.

Statement II : On that day, Prime Minister of India announced the demonetization of Rs. 500 & Rs. 1000 notes.

In the light of the above statements, choose the *correct* answer from the options given below:

[4 marks]

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

Correct Answer: (A) Both Statement I and Statement II are true

Solution:

Concept:

- Demonetization withdraws the legal-tender status of specified currency notes. The Indian announcement relevant here was made on 8 November 2016.
- The announcement concerned the then-existing Rs. 500 and Rs. 1000 banknotes. It did not mean that every denomination of Indian currency was withdrawn.

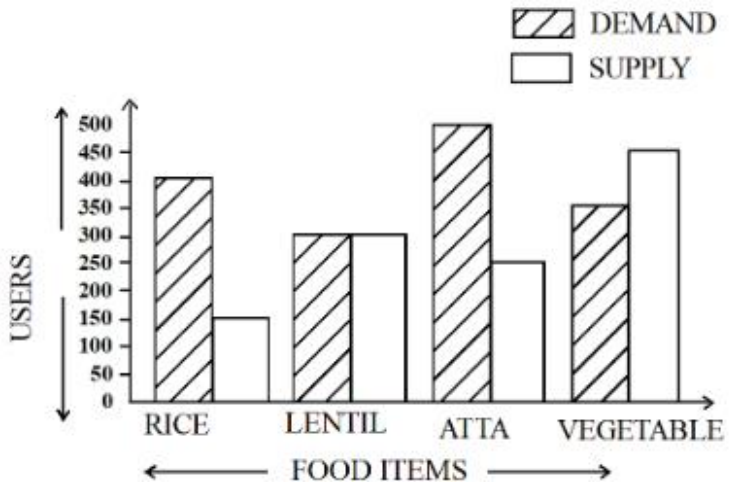
Step 1: Evaluate Statement I On 8 November 2016 the Government of India announced the withdrawal of legal-tender status of the specified high-value banknotes. Thus the date and event stated in Statement I are correct. This is the well-known 2016 demonetization announcement, distinct from earlier currency withdrawals in Indian history.

Step 2: Evaluate Statement II and select the joint verdict The Prime Minister announced the demonetization of the then-existing Rs. 500 and Rs. 1000 notes on that date. Statement II correctly identifies the denominations and the announcement. Since both statements are true, the option declaring both false is excluded, and each mixed true-false option incorrectly rejects one of the two correct statements.

Step 3: Conclusion Both Statement I and Statement II are true. Hence, the correct option is (A).

Quick Tip to Solve: Remember the 2016 event as the combination 8 November, old Rs. 500 notes and old Rs. 1000 notes; check date and denominations separately.

84. The given diagram shows the demand & supply of food items amongst users. Identify which food item was least supply among all. [4 marks]



(A) Lentil

(B) Vegetable

(C) Rice

(D) Atta

Correct Answer: (C) Rice

Solution:

Concept:

- A grouped bar chart presents two quantities for each category. Here the hatched bars represent demand and the unshaded bars represent supply, as identified by the legend.
- To find the least supplied item, compare the heights of the supply bars only. The vertical axis measures users; the shortest unshaded bar gives the smallest supply value.

Step 1: Identify the supply series Read the legend before comparing heights: diagonal hatching denotes demand, whereas a plain white bar denotes supply. Therefore the relevant bar in each food-item pair is the unshaded one. The question asks for the smallest supply, rather than the largest demand or the greatest difference between demand and supply.

Step 2: Read and compare the supply values The supply bars reach 150 users for rice, 300 users for lentil, 250 users for atta and 450 users for vegetable. Their ascending order is

$$150 < 250 < 300 < 450.$$

Thus rice has the smallest supply bar. Lentil, option (A), is not the minimum because its supply is 300; vegetable, option (B), has the largest supply at 450; and atta, option (D), has supply 250, which also exceeds rice's 150. The demand values do not alter this comparison: they describe another series and are not what the question asks us to rank.

Step 3: Conclusion Rice is supplied to the fewest users, with a supply value of 150. Hence, the correct option is (C).

Quick Tip to Solve: In a grouped bar chart, first use the legend to isolate the requested series; then compare only those bars across all categories.

85. In which five year plan period was the slogan 'Garibi hatao' given? [4 marks]

(A) First five year plan

(B) Third five year plan

(C) Ninth five year plan

(D) Fifth five year plan

Correct Answer: No option gives the literal historical period: the slogan was given in 1971 during the Fourth Plan; (D), the Fifth Plan, is the intended poverty-removal association.

Solution:

Concept:

- The Fifth Five-Year Plan, beginning in 1974, made removal of poverty and the attainment of self-reliance its central objectives. "Garibi Hatao" means "Remove poverty".
- Distinguish the plan associated with the poverty-removal objective from the earlier political use of the slogan: Indira Gandhi popularised it during the 1971 election campaign.

Step 1: Identify the plan associated with the slogan In the usual Five-Year Plan classification, Garibi Hatao is associated with the Fifth Five-Year Plan because poverty removal was a central objective of that plan. The First Plan focused strongly on agriculture and rehabilitation, and the Third Plan emphasised a self-reliant and self-generating economy. Neither is the conventional plan answer to this association.

Step 2: Compare the options and retain the historical distinction The Ninth Plan came much later and is associated with growth with social justice and equity. The slogan was given in the 1971 election campaign, during the Fourth Plan (1969–1974), which is absent from the choices. Therefore none of the four options answers the literal question about when it was given. Option (D) is the conventional association with the later poverty-removal plan and matches the key, but that association cannot change the earlier campaign date.

Step 3: Conclusion Literally, the slogan was given in 1971 during the Fourth Five-Year Plan, which is not listed, so no printed option is exactly correct. The key's option (D), the Fifth Five-Year Plan, gives the conventional plan association with poverty removal rather than the period in which the slogan was first given.

Quick Tip to Solve: For plan associations, link the Fifth Plan with removal of poverty and self-reliance; distinguish this from the slogan's 1971 campaign origin.

86. Which of the following is considered to be the first planned city of independent India? [4 marks]

(A) Gandhinagar

(B) New Delhi

(C) Chandigarh

(D) Jamshedpur

Correct Answer: (C) Chandigarh

Solution:

Concept:

- Chandigarh is conventionally identified as the first planned city of independent India. Its development was part of the post-independence programme for a new capital for Punjab.
- The phrase "of independent India" distinguishes a new post-1947 planned city from places that were planned before independence.

Step 1: Identify the post-independence project Chandigarh was conceived after independence as a new capital following the partition of Punjab. Its master-planning history is associated especially with Le Corbusier and a team of architects. In general-awareness questions, this post-independence project is the standard reference for the first planned city of independent India.

Step 2: Eliminate the other cities by their chronology New Delhi was planned and developed as a capital during British rule, so it predates independent India. Jamshedpur also developed as a planned industrial town before independence. Gandhinagar is a post-independence planned capital, but its development came later than Chandigarh. These chronological distinctions leave Chandigarh as the intended and conventional answer.

Step 3: Conclusion Chandigarh is considered the first planned city of independent India. Hence, the correct option is (C).

Quick Tip to Solve: Underline "independent India": New Delhi and Jamshedpur predate 1947, while Gandhinagar is later than Chandigarh.

87. The full form of “NITI” in NITI aayog is [4 marks]

(A) National Institution for transforming India

(B) National Institution for transferring India

(C) National Institution for training India

(D) National Institution for tourism India

Correct Answer: (A) National Institution for transforming India

Solution:

Concept:

- NITI expands to National Institution for Transforming India. It is an acronym: the identifying word for the final T is "Transforming".
- NITI Aayog is associated with policy thinking and cooperative development. The expansion is an

official institutional name, so similar-looking alternative words are not interchangeable.

Step 1: Expand the acronym in order Read the four identifying components as National, Institution, Transforming and India, with "for" joining Institution to Transforming India. The full expression is National Institution for Transforming India. Here "transforming" expresses the institution's development-oriented purpose; it is not a reference to moving something between locations.

Step 2: Compare the differing words The first option uses "transforming" and therefore gives the correct expansion. "Transferring" would change the meaning and is not part of the name. "Training" is also a different function, while "tourism" narrows the institution to an unrelated single sector. Since all options begin similarly, the distinguishing word is the one that must be checked carefully.

Step 3: Conclusion NITI stands for National Institution for Transforming India. Hence, the correct option is (A).

Quick Tip to Solve: In this acronym, remember T as Transforming; the distractors differ mainly at this one word.

88. Who was the President of Indian National Congress at the time of independence of India?

[4 marks]

(A) Jawaharlal Nehru

(B) Mahatma Gandhi

(C) J.B. Kripalani

(D) Moulana Abdul Kalam Azad

Correct Answer: (C) J.B. Kripalani

Solution:

Concept:

- J. B. Kripalani was President of the Indian National Congress when India became independent in August 1947.
- The Congress presidency is a party office. It must be distinguished from the office of Prime Minister and from the leadership roles of other prominent freedom fighters.

Step 1: Identify the office at the specified time The question asks who held the Congress presidency at independence, not who became the first Prime Minister. J. B. Kripalani held the party presidency during this period. Fixing the date, August 1947, and the exact office prevents selecting a better-known national leader solely because of his prominence in the freedom movement.

Step 2: Check the other three names Jawaharlal Nehru became independent India's first Prime Minister, but he was not the Congress President at the specified time. Mahatma Gandhi had earlier served as Congress President in 1924, not at independence. Maulana Abul Kalam Azad held the presidency during the preceding wartime period, ending in 1946. Thus none of these alternatives matches the party office and date together.

Step 3: Conclusion J. B. Kripalani was President of the Indian National Congress at the time of independence. Hence, the correct option is (C).

Quick Tip to Solve: Pair the office with the date: in August 1947, Nehru was Prime Minister and Kripalani held the Congress presidency.

89. Match List I with List II

LIST I (Vehicle)		LIST II (Manufacture)	
A.	THAR	I.	Volkswagen
B.	Yaris	II.	Mahindra & Mahindra
C.	I 20	III.	Toyota Motor
D.	Vento	IV.	Hyundai

Choose the correct answer from the options given below: [4 marks]

(A) A-II, B-III, C-IV, D-I

(B) A-III, B-II, C-IV, D-I

(C) A-IV, B-II, C-III, D-I

(D) A-I, B-II, C-III, D-IV

Correct Answer: (A) A-II, B-III, C-IV, D-I

Solution:

Concept:

- In a matching question, identify the manufacturer of each named model before choosing a combined answer. A single incorrect pair eliminates the whole combination.
- A model name is distinct from the corporate manufacturer: Thar, Yaris, i20 and Vento are vehicle models, whereas the numbered list names their manufacturers.

Step 1: Match the two first vehicle names Thar is manufactured by Mahindra & Mahindra, numbered II, so A-II. Yaris is a Toyota model, and Toyota Motor is numbered III, so B-III. These are model-to-manufacturer identifications; the nationality or body style of a vehicle does not determine the matching code.

Step 2: Complete the matching and test every option The i20 belongs to Hyundai, numbered IV, giving C-IV. Vento belongs to Volkswagen, numbered I, giving D-I. The complete sequence is therefore A-II, B-III, C-IV, D-I. Option (A) has all four pairs. Option (B) exchanges the manufacturers of Thar and Yaris. Option (C) assigns Thar to Hyundai and Yaris to Mahindra & Mahindra, and also misidentifies i20. Option (D) incorrectly assigns Thar to Volkswagen, Yaris to Mahindra & Mahindra, i20 to Toyota Motor and Vento to Hyundai. Thus only the first combination survives all four checks.

Step 3: Conclusion The correct matching is Thar–Mahindra & Mahindra, Yaris–Toyota Motor, i20–Hyundai and Vento–Volkswagen: A-II, B-III, C-IV, D-I. Hence, the correct option is (A).

Quick Tip to Solve: Fix one unmistakable pair, such as Thar–Mahindra & Mahindra, and then verify the remaining three pairs before choosing the combination.

90. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : The full form of NCR is the National Capital Region.

Reason R : 'NCR' in India is the designation for the conurbation which includes New Delhi with surrounding urban areas of neighbouring states of Haryana, Uttar Pradesh and Rajasthan.

In the light of the above statements, choose the *most appropriate* answer from the options given below: [4 marks]

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**

(B) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**

(C) **A** is correct but **R** is not correct

(D) **A** is not correct but **R** is correct

Correct Answer: (A) Both **A** and **R** are correct and **R** is the correct explanation of **A**

Solution:

Concept:

- NCR expands to National Capital Region. A capital region includes the capital and the surrounding territory linked to it through urban growth and regional planning.
- For an Assertion–Reason item, first judge each statement separately and then ask whether the reason explains the assertion, rather than merely being another true fact.

Step 1: Evaluate Assertion A The expansion National Capital Region is correct. National refers to the country, Capital refers to Delhi as the seat of the national government, and Region indicates that the designation extends beyond the central city. Assertion A is therefore true.

Step 2: Evaluate Reason R The reason correctly identifies the capital-centred urban region associated with New Delhi and neighbouring parts of Haryana, Uttar Pradesh and Rajasthan. The notified NCR has Delhi as its core and includes specified districts of those three neighbouring states; it does not mean every part of those states. The statement describes the regional extent at the level required by the question.

Step 3: Decide the explanatory connection and eliminate alternatives The reason explains why the designation is a national capital region: it is the region centred on the national capital and extending into its surrounding interstate urban area. Thus both statements are correct and the reason supplies the relevant explanation. Option (B) would deny that connection. Option (C) wrongly calls the reason incorrect, while option (D) wrongly rejects the stated expansion of NCR.

Step 4: Conclusion Both Assertion A and Reason R are correct, and Reason R explains Assertion A by describing the capital-centred region denoted by NCR. Hence, the correct option is (A).

Quick Tip to Solve: For NCR, remember Delhi as the core and Haryana, Uttar Pradesh and Rajasthan as the three neighbouring states represented in the region.

91. Most of the energy used on Earth today originally come from which of these sources? [4 marks]

(A) Sun

(B) Moon

(C) Ocean

(D) Soil

Correct Answer: (A) Sun

Solution:

Concept:

- To identify an original energy source, trace energy back through its conversions rather than stopping at the fuel or device from which we obtain it.
- Solar radiation powers photosynthesis and much of the water cycle and atmospheric circulation. Consequently, many apparently different energy resources have a common solar origin.

Step 1: Trace familiar resources to their origin Plants use sunlight in photosynthesis to store chemical energy. Food, wood and other biomass therefore store solar energy. Coal, petroleum and natural gas formed from ancient organic material, so their stored chemical energy also ultimately traces largely to the Sun. Solar heating drives evaporation and the water cycle, enabling much hydropower, and uneven heating of the atmosphere helps produce wind.

Step 2: Compare the four choices The Sun is therefore the original source behind most energy used on Earth. The Moon influences tides, but tidal energy forms a small, specialised resource rather than the origin of most energy use. Oceans store heat and support wave and tidal resources, yet much ocean heating and wave generation themselves depend on sunlight and solar-driven winds. Soil supports plants and can store heat, but it is not the primary origin of the energy captured by photosynthesis.

Step 3: Keep the scope of the statement precise The question says most energy, not all energy. Nuclear energy and geothermal energy need not be traced to sunlight, and gravitational tidal energy involves the Earth–Moon system. Those exceptions do not alter the broad conclusion asked for here: the solar contribution is the common origin of the dominant familiar resources.

Step 4: Conclusion Most energy used on Earth ultimately originates from the Sun, including energy stored in biomass and fossil fuels and much energy in wind and the water cycle. Hence, the correct option is (A).

Quick Tip to Solve: When asked for an original source, trace the chain backwards: fuel to ancient plants, plants to photosynthesis, and photosynthesis to sunlight.

92. The 74^{th} amendment of the constitution is related to _____. [4 marks]

(A) Political party changed

(B) Urban local institutions

(C) Panchayati Raj

(D) Right to education

Correct Answer: (B) Urban local institutions

Solution:

Concept:

- The Constitution (Seventy-fourth Amendment) Act, 1992 concerns urban local self-government and gives constitutional recognition to municipalities.
- The closely related Seventy-third Amendment concerns rural Panchayati Raj institutions. Distinguishing urban municipalities from rural panchayats is the decisive comparison.

Step 1: Identify the subject of the amendment The Seventy-fourth Amendment introduced Part IX-A, dealing with municipalities, and the Twelfth Schedule. It provides a constitutional framework for urban local institutions such as Nagar Panchayats, Municipal Councils and Municipal Corporations. These bodies serve different kinds and sizes of urban areas, so the unifying subject is urban local self-government.

Step 2: Relate the provision to the listed choices Urban local institutions, option (B), directly expresses that subject. Panchayati Raj in option (C) is rural local government and belongs to the Seventy-third Amendment. The two amendments are often studied together because they strengthen local democracy, but their fields of application remain distinct.

Step 3: Exclude the unrelated amendments A political-party change points towards the anti-defection provisions associated with the Fifty-second Amendment and the Tenth Schedule, rather than municipal government. The right to education is associated with the Eighty-sixth Amendment and Article 21A. Neither subject identifies the Seventy-fourth Amendment. Therefore the urban-local-institutions choice is the only correct answer among the four.

Step 4: Conclusion The Seventy-fourth Constitutional Amendment relates to municipalities and other urban local institutions. Hence, the correct option is (B).

Quick Tip to Solve: Remember the pair in order: 73rd Amendment–rural panchayats; 74th Amendment–urban municipalities.

93. Dandaka form of settlement layout is basically a _____.

A. Radial pattern

B. Grid Iron pattern

C. Star pattern

D. Octagonal pattern

Choose the most appropriate answer from the options given below: [4 marks]

(A) A only

(B) C only

(C) D only

(D) B only

Correct Answer: (D) B only

Solution:

Concept:

- A settlement layout is classified by the arrangement of its streets and blocks. In a gridiron pattern, straight streets intersect to produce a regular network of blocks.
- The Dandaka type in traditional Indian settlement planning has a rectangular arrangement based on straight, intersecting streets; among the given descriptions it is a gridiron pattern.

Step 1: Identify the geometry of Dandaka Dandaka is associated with a rectangular settlement arrangement. Its ordered streets and blocks follow a rectilinear organisation. This is the defining idea of a gridiron layout: two directions of straight streets form a regular framework, instead of all streets converging on a single centre.

Step 2: Distinguish the other named patterns A radial pattern has routes radiating from a central point, which is not the basic Dandaka description. A star pattern uses radiating arms to create a star-like overall arrangement. An octagonal pattern takes an eight-sided form as its organising shape. Neither the star nor the octagonal description expresses the rectangular, rectilinear street network tested here.

Step 3: Translate the statement letter into the option letter In the statement list, Grid Iron pattern is statement B. However, the answer choices do not repeat those letters in the same order: option (A) says A only, option (B) says C only, option (C) says D only, and option (D) says B only. Since only statement B gives the correct pattern, the selected answer must be option (D), not option (B).

Step 4: Conclusion Dandaka is basically a gridiron settlement pattern, so statement B alone is correct. The choice containing B only is option (D). Hence, the correct option is (D).

Quick Tip to Solve: In statement-code questions, select the true statement first, then locate its code in the options; statement B need not mean option (B).

94. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R

Assertion A : Between 1921-1922, the production of tea and coffee grew up.

Reason R : As the non-cooperation moved into economic sphere and foreign goods were boycotted and burnt.

In the light of the above statements, choose the *most appropriate* answer from the options given below: [4 marks]

(A) Both **A** and **R** are correct and **R** is the correct explanation of **A**

(B) Both **A** and **R** are correct but **R** is NOT the correct explanation of **A**

(C) **A** is correct but **R** is not correct

(D) **A** is not correct but **R** is correct

Correct Answer: (D) **A** is not correct but **R** is correct

Solution:

Concept:

- The economic programme of the Non-Cooperation Movement included boycotting foreign goods and promoting Indian alternatives, especially Indian cloth.
- An Assertion–Reason answer requires two separate truth tests. A correct description of the boycott cannot make an incorrect claim about the affected industry true.

Step 1: Evaluate Assertion A against the historical change The familiar 1921–1922 economic development associated with this movement was the decline in foreign-cloth imports and the increased production of Indian textile mills and handlooms. The assertion substitutes tea and coffee for that textile production. It therefore does not correctly state the historical effect being described, and Assertion A is not correct.

Step 2: Evaluate Reason R independently Non-cooperation did extend into the economic sphere. Foreign goods were boycotted, liquor shops were picketed, and foreign cloth was burned in public bonfires. These actions were intended to weaken economic cooperation with colonial rule and encourage Indian-made goods. Thus Reason R is correct even though the assertion identifies the wrong products.

Step 3: Apply the truth combination to the choices Options (A) and (B) both require a correct assertion, so neither can be chosen. Option (C) requires the assertion to be true and the reason false, which reverses the actual findings. Option (D) alone states that the assertion is not correct but the reason is correct. There is no need to invent an increase in tea or coffee output to create an explanatory link.

Step 4: Conclusion Assertion A is not correct: the relevant increase was in Indian textile-mill and handloom production, not the stated tea and coffee production. Reason R correctly describes economic boycott. Hence, the correct option is (D).

Quick Tip to Solve: Link the 1921–1922 boycott with foreign cloth and Indian textiles; a statement replacing textiles with tea and coffee changes the fact being tested.

95. Who was the first Vice-chairman of NITI Aayog? [4 marks]

(A) Rajiv Sharma

(B) Raghu nandan

(C) Arvind Panagariya

(D) Amitabh Kant

Correct Answer: (C) Arvind Panagariya

Solution:

Concept:

- NITI Aayog was established in January 2015 as the National Institution for Transforming India. The question asks for its first Vice-Chairman, a historical appointment.
- The Vice-Chairman is a distinct position from the Chairperson and the Chief Executive Officer. Matching a person to the correct office avoids a common distractor.

Step 1: Recall the founding appointment Arvind Panagariya, an economist, was appointed the first Vice-Chairman of NITI Aayog in January 2015. This was an appointment to the newly constituted institution, so the word first directs us to its founding leadership rather than a later office-holder.

Step 2: Separate the relevant offices The Prime Minister serves as the Chairperson of NITI Aayog. The Vice-Chairman and Chief Executive Officer are separate roles with different responsibilities. Amitabh Kant is strongly associated with NITI Aayog because he served as its Chief Executive Officer, but that association does not make him its first Vice-Chairman.

Step 3: Check each listed name Option (C) gives Arvind Panagariya and therefore matches the historical appointment exactly. Rajiv Sharma in option (A) and Raghu nandan in option (B) do not identify the first Vice-Chairman. Option (D), Amitabh Kant, confuses another prominent NITI Aayog office with the one asked for. Once the office is kept precise, only option (C) remains defensible.

Step 4: Conclusion Arvind Panagariya was the first Vice-Chairman of NITI Aayog, appointed in January 2015. Hence, the correct option is (C).

Quick Tip to Solve: Keep the offices separate: Prime Minister–Chairperson; Arvind Panagariya–first Vice-Chairman; Amitabh Kant–a former CEO.

96. Name the Entrepreneur of India who set factories during colonical period

A. Dwarakanath Tagore

B. Dinshoo Petit

C. Dhirubhai Ambani

D. Jamset Ji Nusserwanji Tata

E. Seth Hukumchand

Choose the correct answer from the options given below: [4 marks]

(A) A, B, C, D only

(B) A, B, D, E only

(C) A, C, D, E only

(D) A, E, B, C only

Correct Answer: (B) A, B, D, E only

Solution:

Concept:

- The colonial period in India ended with independence in 1947. To answer this question, distinguish industrial pioneers active before independence from entrepreneurs whose major enterprises began later.
- The historical list includes Dwarkanath Tagore, Dinshaw Petit, Jamsetjee Nusserwanjee Tata and Seth Hukumchand. Spelling variants in the question refer to these same entrepreneurs.

Step 1: Identify the colonial-era industrialists Dwarkanath Tagore participated in several business ventures in nineteenth-century Bengal. Dinshaw Petit and Jamsetjee Nusserwanjee Tata were prominent Bombay industrial pioneers associated with early Indian industrial enterprise. Seth Hukumchand established industrial ventures during the colonial period, including a major jute enterprise. Thus the listed persons A, B, D and E belong in the required group.

Step 2: Identify the person outside that historical group Dhirubhai Ambani is associated with the growth of Reliance in independent India. His major business career belongs to the post-independence period, so C must be excluded. The question is about when the entrepreneurs established factories, not simply whether they are well-known Indian businessmen.

Step 3: Test the complete combinations Option (B) includes A, B, D and E and omits C, exactly matching the historical distinction. Option (A) includes C and leaves out E. Option (C) includes C and leaves out B. Option (D) also includes C while leaving out D. Each of those alternatives therefore introduces the post-independence entrepreneur and omits a required colonial-era industrialist.

Step 4: Conclusion The required entrepreneurs are A, B, D and E: Dwarkanath Tagore, Dinshaw Petit, Jamsetjee Nusserwanjee Tata and Seth Hukumchand. Dhirubhai Ambani is excluded. Hence, the correct option is (B).

Quick Tip to Solve: Use the 1947 boundary first: exclude Dhirubhai Ambani from this colonial-era list, then select the option containing all four remaining names.

97. What are the three R's those are used to save the environment which includes forest? [4 marks]

(A) Reserve, Reduce & Recycle

(B) Reuse, Reserve & Reduce

(C) Reduce, Reuse & Recycle

(D) Reserve, Reuse & Reduce

Correct Answer: (C) Reduce, Reuse & Recycle

Solution:

Concept:

- The three Rs of responsible consumption are Reduce, Reuse and Recycle. Together they conserve natural resources and limit waste.
- Resource conservation begins by preventing unnecessary consumption; keeping useful products in service and recovering materials follow this first step.

Step 1: Identify the three actions Reduce means using fewer resources and avoiding waste at the point of consumption. For example, printing only when necessary lowers the demand for paper, so fewer raw materials are required. Reuse means using an article again, such as keeping a durable container or using both sides of a sheet. These actions extend useful life and reduce the need for replacement products.

Step 2: Connect recycling with forest conservation Recycle means processing discarded material into material that can be used for new products. Recycling waste paper helps recover fibre and reduces dependence on fresh pulp. Thus the three actions complement one another: lower initial demand, longer use and recovery after use all help protect resources, including forests.

Step 3: Compare the printed alternatives Option (C) gives all three standard terms: Reduce, Reuse and Recycle. Option (A) includes Reserve and omits Reuse. Options (B) and (D) also include Reserve, and both omit Recycle. Reserving a resource may sound protective, but Reserve is not one of the named three Rs in this environmental principle.

Step 4: Conclusion The three Rs are Reduce, Reuse and Recycle. Hence, the correct option is (C).

Quick Tip to Solve: Recall the waste hierarchy in order: first reduce demand, then reuse products, and finally recycle their materials.

98. The 'National Development Council' was constituted on [4 marks]

(A) 16th August 2015

(B) 1st April 1950

(C) 6th August 1952

(D) 16th August 2010

Correct Answer: (C) 6th August 1952

Solution:

Concept:

- The National Development Council was constituted on 6 August 1952 as a forum concerned with national development planning.
- A historical date question requires matching the institution with its own establishment date; related planning institutions have different dates.

Step 1: Recall the establishment date The institution named in the question is the National Development Council, commonly abbreviated to NDC. Its date of constitution is 6 August 1952. The Government of India account of the Council records this date in explaining its establishment for coordinating national effort in support of development plans.

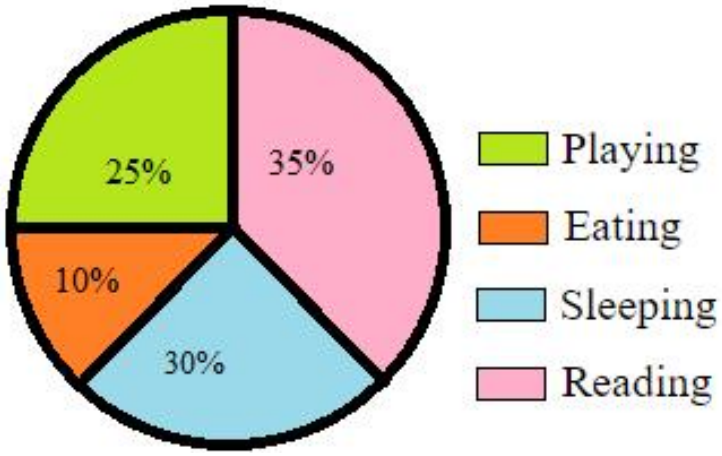
Step 2: Separate the Council from related institutions The Council belonged to the early period of national economic planning. Its role included bringing the Centre and the States into discussion of development priorities and plans. The Planning Commission and, much later, NITI Aayog are distinct institutions, so a date associated loosely with planning cannot be substituted for the Council's own establishment date.

Step 3: Eliminate the other dates Option (C), 6 August 1952, matches the NDC date exactly. Option (B), 1 April 1950, does not: the Council was established in 1952, not 1950. The dates in options (A) and (D) fall in 2015 and 2010, respectively, several decades after the Council had already been constituted. They therefore cannot describe its establishment. The day and month must also agree; matching only a general period is insufficient.

Step 4: Conclusion The National Development Council was constituted on 6 August 1952. Hence, the correct option is (C).

Quick Tip to Solve: Associate NDC with 6 August 1952; keep this date separate from dates of other national planning bodies.

99. Following pie chart gives a percentage distribution of time spent by a student on various activities in a day. How much time she spent in playing every day? [4 marks]



(A) 5 hrs

(B) 6 hrs

(C) 7 hrs

(D) 8 hrs

Correct Answer: (B) 6 hrs

Solution:

Concept:

- A pie chart divides a whole quantity into percentage shares. Here the whole is one complete day, so the total time is $24\,\text{h}$.
- The time for an activity is its percentage divided by 100, multiplied by the total time. Read the activity from the legend before selecting a sector.

Step 1: Identify the playing sector The legend associates Playing with the green sector. Its printed share is 25%. The other sectors are Eating 10%, Sleeping 30%, and Reading 35%; together the four shares add to 100%, as a complete day requires. Therefore the playing share must be taken from 25, rather than from the larger pink reading sector.

Step 2: Convert the share to hours Use the full day as the reference quantity:

$$t_{\text{playing}} = \frac{25}{100} \times 24 = \frac{1}{4} \times 24 = 6\,\text{h}.$$

Thus a quarter of the day is spent playing. No conversion from sector angle is needed because the percentage is already printed.

Step 3: Check the offered times The offered values are 5, 6, 7 and 8 hours. Only 6 hours is exactly one quarter of 24 hours. In particular, 5 hours would be about 20.83%, 7 hours about 29.17%, and 8 hours about 33.33%, none of which agrees with the green sector.

Step 4: Conclusion She spends $6\,\text{h}$ playing every day. Hence, the correct option is (B).

Quick Tip to Solve: First use the legend to identify the activity, then multiply its percentage by 24; a 25% share is immediately one quarter of a day.

100. The given diagram shows the sales of a company with respect to years. Which of the following is correct?

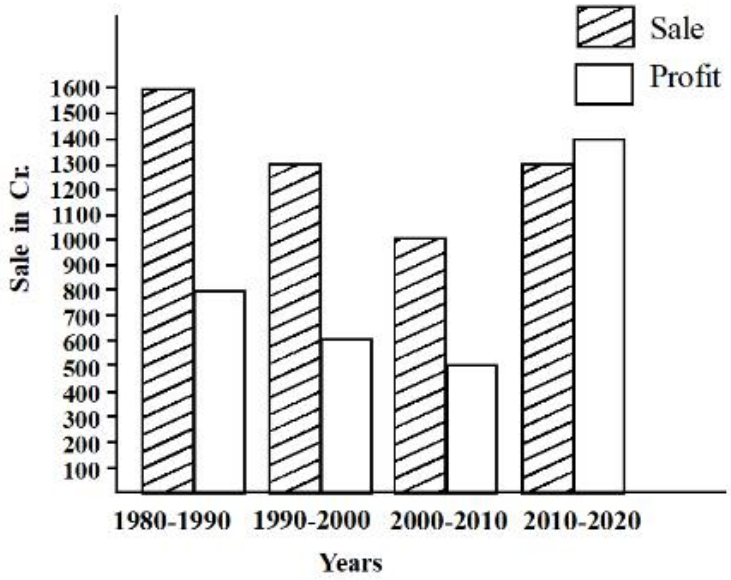
A. Company made minimum profit in 2010-2020.

B. Company made more than 500 crore profit in 2000-2010.

C. In 1990-2000, company has reached highest sale.

D. In, 2010-2020, company made highest profit.

Choose the correct answer from the options given below: [4 marks]



(A) A

(B) B

(C) C

(D) D

Correct Answer: (D) D

Solution:

Concept:

- The hatched bars represent Sale and the unhatched bars represent Profit. Compare like bars using the common vertical scale, expressed in crore.
- A claim about a maximum or minimum must be checked across all four periods. An exact threshold such as "more than 500 excludes equality.

Step 1: Read the sales and profit bars For 1980–1990, the sales and profit values are 1600 and 800 crore. For 1990–2000 they are 1300 and 600 crore. For 2000–2010 they are 1000 and 500 crore. Finally, for 2010–2020 they are 1300 and 1400 crore. These readings use the legend as printed; do not interchange the two series.

Step 2: Test statements A and B Statement A calls the profit in 2010–2020 the minimum. Its unhatched bar is actually the tallest, at 1400 crore, so A is false. Statement B claims more than 500 crore profit in 2000–2010. The relevant profit bar is exactly 500 crore; equality does not satisfy "more than. Thus B is also false.

Step 3: Test statements C and D Statement C assigns the highest sale to 1990–2000, whose hatched bar reaches 1300 crore. The highest sale is instead 1600 crore in 1980–1990, so C is false. Statement D correctly identifies 2010–2020 as the period with the highest profit: $1400 > 800 > 600 > 500$. Only D survives all comparisons.

Step 4: Conclusion Statement D is correct: the company made its highest profit in 2010–2020. Hence, the correct option is (D).

Quick Tip to Solve: Identify the profit series from the legend before comparing heights; distinguish exactly 500 from more than 500.

101. In which year the sales of company is minimum ?

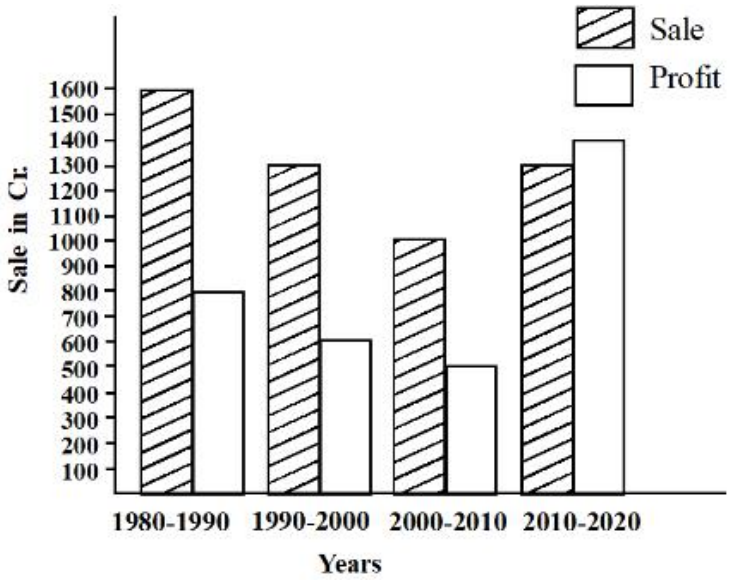
A. 2000-2010

B. 1990-2000

C. 1980-1990

D. 2010-2020

Choose the most appropriate answer from the options given below: [4 marks]



(A) B only

(B) C only

(C) A only

(D) D only

Correct Answer: (C) A only

Solution:

Concept:

- To find the minimum sale, compare only the hatched sales bars. Profit is a different series and must not be substituted for sale.

- This question has two levels of labels: the periods are first named A–D in the question, and the final answer options refer to those statement labels.

Step 1: Compare the four sales values The hatched sales bars give 1600 crore for 1980–1990, 1300 crore for 1990–2000, 1000 crore for 2000–2010, and 1300 crore for 2010–2020. Consequently, the ordering is

$$1000 < 1300 = 1300 < 1600.$$

The shortest sales bar is therefore the one for 2000–2010, not the unhatched profit bar for that period.

Step 2: Match the period to its statement label The question labels 2000–2010 as A, 1990–2000 as B, 1980–1990 as C, and 2010–2020 as D. The minimum-sales period is therefore represented by statement A. None of the other periods ties with its value of 1000 crore; the two 1300-crore periods are both larger.

Step 3: Choose the final option Now read the final answer options rather than using the statement letter directly. Option (A) says B only and refers to 1990–2000. Option (B) says C only and refers to 1980–1990. Option (D) says D only and refers to 2010–2020. All three have sales above 1000 crore. Option (C), which says A only, identifies the required period.

Step 4: Conclusion The minimum sale is in 2000–2010, which is statement A only. Hence, the correct option is (C).

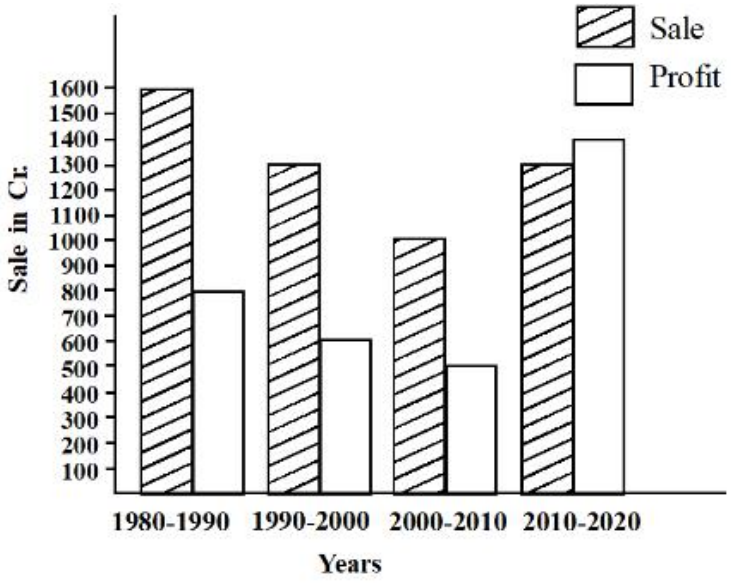
Quick Tip to Solve: For nested labels, find the period first, then its statement letter, then the answer option containing that letter.

102. Given below are two statements:

Statement I : In 2010-2020 company made maximum profit and minimum sale.

Statement II : In 1980-1990 company made 50% profit of its total sale.

In the light of the above statements, choose the *most appropriate* answer from the options given below [4 marks]



(A) Both Statement I and Statement II are correct

(B) Both Statement I and Statement II are incorrect

(C) Statement I is correct but Statement II is incorrect

(D) Statement I is incorrect but Statement II is correct

Correct Answer: (D) Statement I is incorrect but Statement II is correct

Solution:

Concept:

- A statement joined by "and is true only if both of its claims are true. One correct clause does not make the whole statement correct.
- Profit as a percentage of total sale is calculated by $\frac{\text{profit}}{\text{sale}} \times 100$. Use the hatched sales bar and the unhatched profit bar for the same period.

Step 1: Check both clauses of Statement I In 2010–2020 the profit is 1400 crore, larger than 800, 600, and 500 crore in the other periods. Thus the maximum-profit clause is correct. However, sales in 2010–2020 are 1300 crore, while sales in 2000–2010 are only 1000 crore. Hence 2010–2020 does not have minimum sale. Because the statement requires both claims, Statement I is incorrect.

Step 2: Evaluate Statement II For 1980–1990 the chart gives sales of 1600 crore and profit of 800 crore. Taking the sale as the reference quantity specified in the statement gives

$$\frac{800}{1600} \times 100 = \frac{1}{2} \times 100 = 50\%.$$

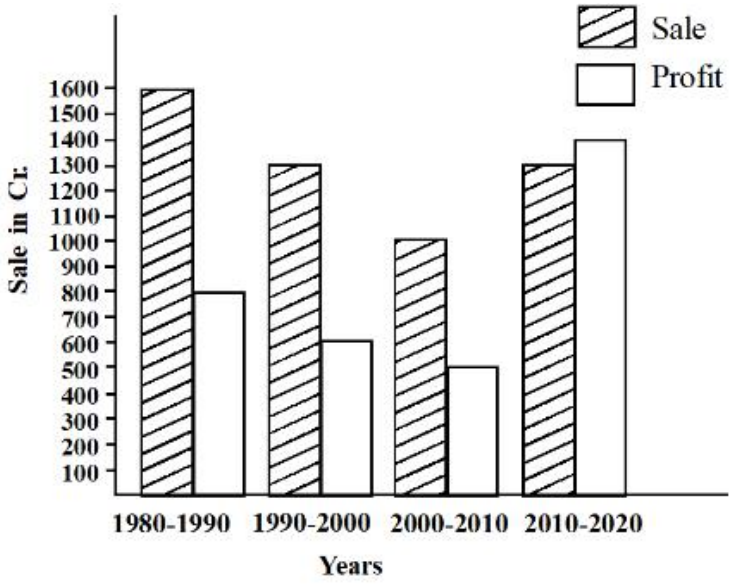
Both figures are in crore, so their units cancel in the ratio. Statement II is therefore correct.

Step 3: Match the truth combination The resulting combination is I incorrect and II correct. Option (A) wrongly treats I as correct, option (B) wrongly treats II as incorrect, and option (C) reverses the actual truth values. Only option (D) matches both independent checks. There is no need to infer expenditure or subtract profit from sale because Statement II explicitly compares profit with total sale.

Step 4: Conclusion Statement I is incorrect but Statement II is correct. Hence, the correct option is (D).

Quick Tip to Solve: Split an "and statement into its two claims, and use the denominator explicitly named when checking a percentage.

103. In 1990-2000 company profit percentage is [4 marks]



(A) 46.15%

(B) 50%

(C) 47%

(D) 45%

Correct Answer: (A) 46.15%

Solution:

Concept:

- In this chart-based question the profit percentage is the profit expressed as a percentage of the corresponding sale: percentage $= \frac{\text{profit}}{\text{sale}} \times 100$.
- Read both bars from the same time period and identify their series from the legend: hatched means Sale, while unhatched means Profit.

Step 1: Read the values for 1990–2000 The hatched sales bar for 1990–2000 reaches 1300 crore, and the adjacent unhatched profit bar reaches 600 crore. These are the two quantities relevant to this period. The values 1600 and 800 belong to 1980–1990 and must not be mixed into the calculation.

Step 2: Calculate the percentage of sale Divide the profit by the sale and multiply by 100:

$$\text{Profit percentage} = \frac{600}{1300} \times 100 = \frac{6}{13} \times 100 = \frac{600}{13}\% = 46.153846\ldots\%.$$

The common crore unit cancels between numerator and denominator. Rounding to two decimal places gives 46.15%, because the third decimal digit is 3.

Step 3: Check the alternatives Option (A) gives 46.15%, exactly the rounded result. Option (B), 50%, would require a profit of 650 crore on sales of 1300 crore; that is not the printed bar. Option (C), 47%, and option (D), 45%, also differ from the computed ratio. The chart and the offered values establish that the required comparison is profit with sale, without introducing an unprinted cost figure.

Step 4: Conclusion The company profit in 1990–2000 is approximately 46.15% of its sale. Hence, the

correct option is (A).

Quick Tip to Solve: Keep the exact fraction 6/13 until the final division, then round once to the precision shown in the options.

104. Given below are two statements:

Statement I : The last five year plan executed is 12^{th} plan. It was launched in 2012.

Statement II : 12^{th} five year plan was for faster, sustainable and more inclusive growth.

In the light of the above statements, choose the *correct* answer from the options given below :

[4 marks]

(A) Both Statement I and Statement II are true

(B) Both Statement I and Statement II are false

(C) Statement I is true but Statement II is false

(D) Statement I is false but Statement II is true

Correct Answer: (A) Both Statement I and Statement II are true

Solution:

Concept:

- The Twelfth Five Year Plan covered the period 2012–2017 and was the last numbered Five Year Plan in India.
- Its development vision combined faster growth with sustainability and greater inclusion. The two statements must be tested separately.

Step 1: Check the number and starting year Statement I identifies the Twelfth Plan as the last Five Year Plan executed and says that it was launched in 2012. The Twelfth Plan period began in 2012 and ran to 2017. The numbered Five Year Plan sequence ended with this plan; a Thirteenth Five Year Plan was not adopted as its successor. Both parts of Statement I therefore agree with the planning chronology.

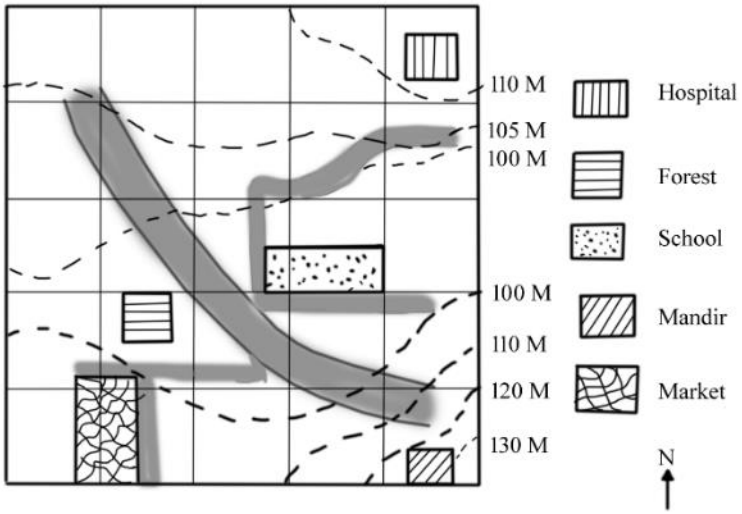
Step 2: Check the stated development objective Statement II describes the Twelfth Plan as being for faster, sustainable and more inclusive growth. These are the three components of its stated development vision. Faster growth concerns the pace of economic expansion; inclusion concerns sharing opportunities and benefits more widely; sustainability concerns maintaining development while respecting resource and environmental constraints. The statement retains all three components and is true.

Step 3: Match the truth values to the options The independent checks give Statement I true and Statement II true. Option (A) is the combination with both statements true. Option (B) incorrectly rejects both. Option (C) incorrectly rejects the development objective in Statement II, while option (D) incorrectly rejects the chronology in Statement I. No relationship of explanation between the statements is required; this is a truth-value question.

Step 4: Conclusion Both Statement I and Statement II are true. Hence, the correct option is (A).

Quick Tip to Solve: Link the Twelfth Plan with 2012–2017 and remember all three objectives: faster growth, inclusion and sustainability.

105. From the given diagram find out that mandir is located at which direction to forest? [4 marks]



(A) North West

(B) East

(C) South West

(D) South East

Correct Answer: (D) South East

Solution:

Concept:

- A relative-direction question asks for the position of the destination measured from the reference place. Here the forest is the reference point and the mandir is the destination.
- The north arrow establishes the map orientation: north is upward, south downward, east to the right and west to the left. A displacement combining south and east is south-east.

Step 1: Identify the two symbols from the legend The legend represents the forest by a rectangle filled with horizontal lines and the mandir by a rectangle filled with diagonal lines. Locate the matching symbols inside the map rather than using their positions in the legend. The forest symbol is in the left-hand part of the map, below its middle. The mandir symbol is near the bottom-right corner. The vertically lined symbol at the upper right denotes the hospital, and the irregular pattern near the lower left denotes the market; neither is the destination asked for.

Step 2: Compare the mandir with the forest Start at the forest symbol and look towards the mandir. The mandir lies to the right of the forest and also lower down. The north arrow points upward, so the rightward component is east and the downward component is south. Combining these components gives south-east. The contour labels, road bends and intermediate school do not alter the relative compass direction between the two symbols.

Step 3: Eliminate the other directions North West would require the mandir to be above and left of the forest, which is the opposite displacement. East would place it directly to the right without a southerly component, but the map clearly places it lower. South West would require it to be below and left, whereas it lies below and right. Thus only the south-east alternative agrees with both components

of the map displacement.

Step 4: Conclusion The mandir is located to the south-east of the forest. Hence, the correct option is (D).

Quick Tip to Solve: Identify both symbols in the map, start at the reference place, and resolve the displacement using the north arrow before choosing a diagonal direction.