JEE Main 2023 Paper 2B (B.Planning) Jan 28 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) 2023, Session 1 (January), conducted by the National Testing Agency (NTA) in Computer Based Test (CBT) mode on 28 January 2023, Shift 2. 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. Let R_1 and R_2 be two relations on $\mathbb{R}^2$ defined as

$(a, b)\ \mathrm{R}_1\ (c, d)$ **if** $ad - bc \geq 0$

$(a, b)\ \mathrm{R}_2\ (c, d)$ **if** $a + d \geq b + c$**. Then :** [4 marks]

(A) R_1 is transitive but R_2 is not transitive

(B) R_2 is transitive but R_1 is not transitive

(C) Both R_1 and R_2 are transitive

(D) Neither R_1 nor R_2 is transitive

Correct Answer: (B) R_2 is transitive but R_1 is not transitive

Solution:

Concept:

- A relation is transitive if uRv and vRw imply uRw for every three elements of its domain.
- To disprove transitivity, one counterexample suffices. To prove it, combine the two defining inequalities for arbitrary elements.

Step 1: Test the determinant relation For R_1, take $u = (1, 0)$, $v = (0, 0)$ and $w = (0, -1)$. The determinants for the first two ordered pairs are zero, so uR_1v and vR_1w both hold. However, the determinant for u, w is $1(-1) - 0(0) = -1 < 0$. Thus uR_1w fails, proving that R_1 is not transitive. The zero vector is allowed because the domain is all of $\mathbb{R}^2$.

Step 2: Rewrite and combine the second relation The condition $(a, b)R_2(c, d)$ is equivalent to $a - b \geq c - d$. If also $(c, d)R_2(e, f)$, then $c - d \geq e - f$. Combining gives $a - b \geq e - f$, which is precisely $(a, b)R_2(e, f)$. Thus R_2 is transitive. Options asserting transitivity of R_1, or failure of transitivity of R_2, contradict these checks.

Step 3: Conclusion Only R_2 is transitive. Hence, the correct option is (B).

Quick Tip to Solve: For a relation on pairs, try rewriting it as a comparison of one scalar quantity; use the zero vector to test determinant conditions.

2. Let α and β be the roots of $x^2 - 3x + 9 = 0$. Then $\left(\frac{\beta^{30}}{(9\alpha)^{10}} + \frac{\alpha^{30}}{(9\beta)^{10}}\right)^2$ is equal to [4 marks]

(A) 1

(B) $\frac{1}{9}$

(C) 3

(D) 9

Correct Answer: (A) 1

Solution:

Concept:

- The quadratic formula gives complex conjugate roots. Their polar forms convert high powers into multiplication of arguments.
- For $r > 0$, De Moivre's formula is $(re^{i\theta})^n = r^n e^{in\theta}$; conjugate exponentials add to $2\cos\theta$.

Step 1: Express the roots in polar form The discriminant is $9 - 36 = -27$, hence

$$\alpha = \frac{3 + 3\sqrt{3}i}{2} = 3e^{i\pi/3}, \qquad \beta = 3e^{-i\pi/3}.$$

Interchanging their names does not affect the symmetric expression. Each root has modulus 3, so the moduli in each quotient cancel: $3^{30}/(9 \cdot 3)^{10} = 1$.

Step 2: Simplify the two quotients and square Using the arguments of numerator and denominator,

$$\frac{\beta^{30}}{(9\alpha)^{10}} = e^{-40\pi i/3}, \qquad \frac{\alpha^{30}}{(9\beta)^{10}} = e^{40\pi i/3}.$$

Their sum is $2\cos(40\pi/3) = 2\cos(4\pi/3) = -1$, because arguments differing by 2π are equivalent. Squaring this sum gives $(-1)^2 = 1$. In particular, no residual factor of 3 survives, ruling out $1/9$, 3 and 9.

Step 3: Conclusion The required value is 1. Hence, the correct option is (A).

Quick Tip to Solve: Before expanding high complex powers, compare numerator and denominator moduli; then reduce their arguments modulo 2π.

3. For $z = 2 + 5i$, the modulus of $2z^3 + 21z^2 - 58z + 4$ is : [4 marks]

(A) 1153

(B) 947

(C) 537

(D) 837

Correct Answer: (D) 837

Solution:

Concept:

- If $z = 2 + 5i$, then $(z - 2)^2 = -25$, which yields a quadratic relation that reduces every higher power of z.
- The modulus of a real complex number $a + 0i$ is $|a|$, even when a itself is negative.

Step 1: Derive the quadratic relation Squaring $z - 2 = 5i$ gives

$$z^2 - 4z + 4 = -25 \quad \Rightarrow \quad z^2 = 4z - 29.$$

Multiply by z and reduce again:

$$z^3 = 4z^2 - 29z = 4(4z - 29) - 29z = -13z - 116.$$

This avoids the unnecessary expansion of the full cubic in real and imaginary parts.

Step 2: Reduce the polynomial and take its modulus Substitute both identities into the required expression:

$$\begin{aligned} 2z^3 + 21z^2 - 58z + 4 &= 2(-13z - 116) + 21(4z - 29) - 58z + 4 \\ &= (-26 + 84 - 58)z - 232 - 609 + 4 \\ &= -837. \end{aligned}$$

The coefficient of z cancels exactly; consequently the imaginary part is zero. Its modulus is $\sqrt{(-837)^2 + 0^2} = 837$. The other listed integers cannot equal this modulus; the negative sign is removed only when taking the absolute value.

Step 3: Conclusion The modulus is 837. Hence, the correct option is (D).

Quick Tip to Solve: Find the quadratic equation satisfied by a given complex number and reduce the polynomial before calculating its modulus.

4. If the system of equations

$$Kx - \sqrt{2}y + \sqrt{5}z = \sqrt{7}$$

$$\sqrt{5}x + \sqrt{3}y - \sqrt{2}z = \sqrt{11}$$

$$30x + (3\sqrt{15} - 5\sqrt{6})y + (5\sqrt{15} - 3\sqrt{10})z = 5\sqrt{21} + 3\sqrt{55}$$

has infinitely many solutions, then K^2 is [4 marks]

(A) 27

(B) $\frac{1}{3}$

(C) 9

(D) 3

Correct Answer: (D) 3

Solution:

Concept:

- A system of three linear equations in three unknowns has infinitely many solutions when the coefficient and augmented matrices have the same rank less than three.
- A third equation that is a linear combination of two independent equations, including its right side, creates exactly this situation.

Step 1: Identify the required row combination Let the first two equations be E_1, E_2. Their y and z coefficients in $5\sqrt{3}E_1 + 3\sqrt{5}E_2$ are

$$-5\sqrt{6} + 3\sqrt{15}, \qquad 5\sqrt{15} - 3\sqrt{10}.$$

These match the third equation. Its right side also matches, since $5\sqrt{3}\sqrt{7} + 3\sqrt{5}\sqrt{11} = 5\sqrt{21} + 3\sqrt{55}$. The two coefficient pairs are independent: their determinant is $2 - \sqrt{15} \neq 0$, so this combination is uniquely determined.

Step 2: Match the remaining coefficient and check rank The x coefficient of the same combination must equal 30:

$$5\sqrt{3}K + 3\sqrt{5}\sqrt{5} = 30.$$

Therefore $5\sqrt{3}K + 15 = 30$, giving $K = \sqrt{3}$. At this value the third equation adds no constraint to the two independent equations, leaving one free variable and infinitely many solutions. Squaring gives $K^2 = 3$, rather than 27, $1/3$ or 9.

Step 3: Conclusion The required value is $K^2 = 3$. Hence, the correct option is (D).

Quick Tip to Solve: Match a visibly dependent equation using its two simplest coefficients, then compare the remaining coefficient and constant term.

5. For $\alpha, \beta \in \mathbb{R}$, if the matrices $\mathrm{A} = \begin{pmatrix} \alpha & 0 \\ 0 & \beta \end{pmatrix}$, $\mathrm{B} = \begin{pmatrix} \alpha & 0 \\ 0 & \alpha \end{pmatrix}$ and $\mathrm{I} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ satisfy the equation $(\mathrm{A} * \mathrm{B}) * 2\mathrm{I} = 20\mathrm{I}$, where $*$ is defined as $\mathrm{A} * \mathrm{B} = \mathrm{A}^2 + \mathrm{B}^2$, then $|\alpha\beta|$ is equal to : [4 marks]

(A) $2\sqrt{3}$

(B) $2\sqrt{2}$

(C) 4

(D) 2

Correct Answer: (D) 2

Solution:

Concept:

- The symbol $*$ denotes the stated operation $X * Y = X^2 + Y^2$; it must not be replaced by ordinary matrix multiplication.
- For a diagonal matrix, squaring squares each diagonal entry. Since α, β are real, α^2 and β^2 are nonnegative.

Step 1: Evaluate the inner operation first Write $C = A * B$. The diagonal forms give

$$C = \begin{pmatrix} 2\alpha^2 & 0 \\ 0 & \alpha^2 + \beta^2 \end{pmatrix}.$$

Applying the outer operation as defined, $C * 2I = C^2 + (2I)^2 = C^2 + 4I$. Thus the given equality becomes $C^2 = 16I$, not $2C = 20I$. The parentheses specify the order of operations.

Step 2: Compare the diagonal entries The first entry yields $(2\alpha^2)^2 = 16$, so $\alpha^4 = 4$, and reality implies $\alpha^2 = 2$. The second entry yields $(\alpha^2 + \beta^2)^2 = 16$. The sum is nonnegative, hence $\alpha^2 + \beta^2 = 4$, giving $\beta^2 = 2$. Therefore

$$|\alpha\beta| = \sqrt{\alpha^2\beta^2} = \sqrt{4} = 2.$$

Both signs of each parameter produce the same absolute product. Neither $2\sqrt{3}$, $2\sqrt{2}$, nor 4 agrees with the diagonal constraints.

Step 3: Conclusion The absolute product is $|\alpha\beta| = 2$. Hence, the correct option is (D).

Quick Tip to Solve: For a specially defined operation, introduce a name for the inner result and apply the definition again to the outer operation.

6. The sum of the first eleven terms of the series is $\frac{1}{1+1^2+1^4}+\frac{2}{1+2^2+2^4}+\frac{3}{1+3^2+3^4}+\ldots$ [4 marks]

(A) $\frac{61}{133}$

(B) $\frac{66}{133}$

(C) $\frac{16}{33}$

(D) $\frac{33}{67}$

Correct Answer: (B) $\frac{66}{133}$

Solution:

Concept:

- A telescoping sum cancels successive terms after expressing each summand as the difference of two shifted expressions.
- The factorisation $n^4+n^2+1=(n^2-n+1)(n^2+n+1)$ is obtained by writing it as $(n^2+1)^2-n^2$.

Step 1: Split the general summand The difference between the two quadratic factors is $2n$. Consequently

$$\frac{n}{n^4+n^2+1}=\frac{1}{2}\left(\frac{1}{n^2-n+1}-\frac{1}{n^2+n+1}\right).$$

The negative denominator at index n equals the positive denominator at index $n+1$, because $(n+1)^2-(n+1)+1=n^2+n+1$. Thus the cancellation applies to precisely the given sequence.

Step 2: Keep the two uncancelled endpoint terms Summing from $n=1$ through 11, all interior fractions disappear:

$$\begin{aligned}S_{11}&=\frac{1}{2}\left(\frac{1}{1}-\frac{1}{11^2+11+1}\right)\\&=\frac{1}{2}\left(1-\frac{1}{133}\right)=\frac{66}{133}.\end{aligned}$$

The endpoint is 133, not the denominator of the tenth or twelfth term. As a check, the sum must be slightly less than $1/2$, its limiting infinite sum. Direct cross-multiplication shows each of the other listed fractions differs from $66/133$.

Step 3: Conclusion The first eleven terms sum to $66/133$. Hence, the correct option is (B).

Quick Tip to Solve: For $n/(n^4+n^2+1)$, factor the denominator as a difference of squares; the resulting quadratic factors differ by $2n$.

7. $\lim_{x\to 0}(1+3x)^{\frac{x+2}{x}}$ **is equal to** [4 marks]

(A) e

(B) e^3

(C) e^6

(D) e^9

Correct Answer: (C) e^6

Solution:

Concept:

- For real u approaching zero, $\ln(1+u)/u \to 1$. Taking logarithms converts a variable power into a product.
- The base $1+3x$ is positive for all x sufficiently close to zero, so real logarithms and continuity of the exponential function apply.

Step 1: Take the logarithm of the variable power Let $y(x) = (1+3x)^{(x+2)/x}$ for $x \neq 0$ near zero. Then

$$\ln y(x) = \frac{x+2}{x}\ln(1+3x) = 3(x+2)\frac{\ln(1+3x)}{3x}.$$

This form separates the factor with a finite limit from the standard logarithmic quotient. Simply substituting into the original exponent is invalid because it is unbounded.

Step 2: Use the logarithmic limit and exponentiate As $x \to 0$, the factor $3(x+2)$ tends to 6, and the quotient $\ln(1+3x)/(3x)$ tends to 1. Thus $\ln y(x) \to 6$. Continuity of e^t now gives $y(x) \to e^6$. The coefficient 3 from the base and the constant 2 in the numerator both contribute, so retaining only one of them would incorrectly give e^3 or another listed value. Since the exponential function is one-to-one, e, e^3, and e^9 cannot equal e^6.

Step 3: Conclusion The limit equals e^6. Hence, the correct option is (C).

Quick Tip to Solve: In a limit of the form $(1+ax)^{(b+x)/x}$, take logarithms: the limiting exponent is the product ab.

8. Let $P(\alpha, \beta, \lambda)$ be the image of the point $\mathrm{Q}(1, 2, 0)$ in the line $\frac{x-5}{3} = \frac{y-12}{1} = \frac{z-10}{2}$, then $(\mathrm{PQ})^2$ is equal to [4 marks]

(A) 90

(B) 180

(C) 360

(D) 270

Correct Answer: (C) 360

Solution:

Concept:

- If P is the reflection of Q in a line, the perpendicular foot H of Q on that line is the midpoint of PQ. Thus $PQ = 2QH$.
- For a line through A with direction d, the foot is $H = A + td$, where $t = (Q - A) \cdot d/(d \cdot d)$.

Step 1: Find the perpendicular foot on the line From the symmetric equation take $A = (5, 12, 10)$ and $d = (3, 1, 2)$. For $Q = (1, 2, 0)$, $Q - A = (-4, -10, -10)$, so

$$(Q - A) \cdot d = -12 - 10 - 20 = -42, \qquad d \cdot d = 9 + 1 + 4 = 14.$$

Hence $t = -42/14 = -3$, giving $H = (5, 12, 10) - 3(3, 1, 2) = (-4, 9, 4)$. Indeed, $(Q - H) \cdot d = (5, -7, -4) \cdot (3, 1, 2) = 0$.

Step 2: Reflect the point and calculate the separation Since H is the midpoint,

$$P = 2H - Q = (-9, 16, 8).$$

Therefore $P - Q = (-10, 14, 8)$ and

$$(PQ)^2 = (-10)^2 + 14^2 + 8^2 = 100 + 196 + 64 = 360.$$

Equivalently, $QH^2 = 25 + 49 + 16 = 90$, and reflection gives $PQ^2 = 4QH^2$. Thus 90 is only the perpendicular distance squared, while 180 and 270 use incorrect scale factors.

Step 3: Conclusion The squared distance is $(PQ)^2 = 360$. Hence, the correct option is (C).

Quick Tip to Solve: For reflection in a line, find the perpendicular foot first; the point-to-image distance is twice the point-to-line distance.

9. A box contains 7 red and 9 white balls. The number of ways of drawing 8 balls such that there are at least three balls of each colour, is : [4 marks]

(A) 8820

(B) 10584

(C) 1764

(D) 3515

Correct Answer: (B) 10584

Solution:

Concept:

- Drawing balls without regard to order uses combinations: $\binom{n}{r}$ counts selections of r distinct balls from n.
- For a fixed colour split, multiply the red and white selection counts. Add the counts of mutually exclusive colour splits.

Step 1: List the permitted colour splits Let r be the number of red balls. Since eight balls are drawn, the number of white balls is $8-r$. At least three of each colour means $r \geq 3$ and $8-r \geq 3$, so $r = 3, 4, 5$. Thus the only possibilities are three red and five white, four of each, or five red and three white.

Step 2: Count and add the selections Choose the red balls from seven and the white balls from nine independently:

$$\begin{aligned} N &= \binom{7}{3}\binom{9}{5} + \binom{7}{4}\binom{9}{4} + \binom{7}{5}\binom{9}{3} \\ &= 35(126) + 35(126) + 21(84) \\ &= 4410 + 4410 + 1764 = 10584. \end{aligned}$$

The number 8820 omits the five-red case, whereas 1764 counts only that case. The remaining proposed value 3515 does not equal the sum of the three disjoint cases.

Step 3: Conclusion The required number of selections is $\boxed{10584}$. Hence, the correct option is (B).

Quick Tip to Solve: Convert the minimum-colour condition into bounds on the red count, then sum one product of combinations for each allowed count.

10. Let $[t]$ denote the greatest integer function. If $\int_0^1 [1+x^2+x^4]\,dx = a$, then $36a - 25a^2 + 8a^3 - a^4$ is equal to [4 marks]

(A) 19

(B) -19

(C) 18

(D) -21

Correct Answer: (A) 19

Solution:

Concept:

- The greatest integer function is constant between successive integer crossings of its argument. Values at isolated endpoints do not change a definite integral.
- Use the equation defining the crossing point to simplify the final polynomial instead of substituting nested radicals.

Step 1: Locate the integer crossing On $[0,1]$, $1+x^2+x^4$ increases from 1 to 3. Its crossing of 2 occurs at $x = c$, where

$$c^2 + c^4 = 1, \qquad c = \sqrt{\frac{\sqrt{5}-1}{2}}.$$

The floor is 1 for $0 \le x < c$ and 2 for $c \le x < 1$. At $x = 1$ its value is 3, which contributes no area. Therefore

$$a = c + 2(1-c) = 2 - c.$$

Step 2: Simplify using the crossing equation Substitute $a = 2 - c$ and expand, collecting like powers of c:

$$\begin{aligned} 36a - 25a^2 + 8a^3 - a^4 &= 36(2-c) - 25(2-c)^2 \\ &\quad + 8(2-c)^3 - (2-c)^4 \\ &= 20 - c^2 - c^4 = 20 - 1 = 19. \end{aligned}$$

In particular the integral is positive and the exact expression is 19, ruling out both negative choices as well as 18.

Step 3: Conclusion The expression equals $\boxed{19}$. Hence, the correct option is (A).

Quick Tip to Solve: Keep the threshold as a symbol: its relation $c^2 + c^4 = 1$ removes the radicals after the polynomial is expanded.

11. Let $\mathrm{PL}=8$ units and $\mathrm{QM}=2$ units be two parallel line segments such that the line segments PM and QL intersect at the point R. If PL and QM are tangents to a circle passing through points $\mathrm{P}, \mathrm{Q}, \mathrm{R}$ then radius of this circle is [4 marks]

(A) $\sqrt{2}$

(B) 2

(C) $2\sqrt{2}$

(D) 4

Correct Answer: (B) 2

Solution:

Concept:

- Radii to points of tangency are perpendicular to the tangents. Two distinct parallel tangents touch at opposite ends of a diameter.
- From an external point, the square of the tangent length equals the product of the two secant lengths. Parallel lines also give similar triangles.

Step 1: Find the secant division ratio The circle is tangent to PL at P and to QM at Q; thus PQ is a diameter. Since the segments PM and QL intersect at R and $PL \parallel QM$, triangles RPL and RMQ are similar. Consequently

$$\frac{RL}{RQ} = \frac{PL}{QM} = \frac{8}{2} = 4.$$

The point R is between L and Q, so $LR = \frac{4}{5}LQ$.

Step 2: Apply the tangent-secant identity From L, the tangent is LP and the secant meets the circle at R and Q. Therefore

$$LP^2 = LR \cdot LQ = \frac{4}{5}LQ^2, \qquad LQ^2 = \frac{5}{4}(8^2) = 80.$$

Since $LP \perp PQ$, the right triangle LPQ gives

$$PQ^2 = LQ^2 - LP^2 = 80 - 64 = 16.$$

Thus the diameter is 4 and the radius is 2. The other proposed radii have squares 2, 8 and 16, whereas the required squared radius is 4.

Step 3: Conclusion The radius is $\boxed{2 \text{ units}}$. Hence, the correct option is (B).

Quick Tip to Solve: For parallel tangents, first identify the diameter joining the contact points; similarity gives the secant ratio before Pythagoras finds the radius.

12. For some $\alpha \in \mathbb{N}$, let PQR be a triangle with two fixed vertices $\mathrm{P}(2,5)$ and $\mathrm{Q}(\alpha,-11)$. If the point R moves on the line $l_1 : 9x+7y+\alpha=0$, then the centroid of $\Delta\mathrm{PQR}$ moves on the line l_2, which is parallel to l_1 at a distance $\frac{20}{3\sqrt{130}}$ units from it. If the distance of Q from l_2 is $\frac{k}{3\sqrt{130}}$, then k is equal to : [4 marks]

(A) 117

(B) 129

(C) 131

(D) 133

Correct Answer: (C) 131

Solution:

Concept:

- The centroid of a triangle is the coordinate-wise average of its vertices. Express the moving vertex in terms of the centroid to find its locus.
- For parallel lines $Ax+By+C_1=0$ and $Ax+By+C_2=0$, the distance is $|C_1-C_2|/\sqrt{A^2+B^2}$.

Step 1: Find the centroid locus Write $R=(u,v)$ and the centroid as (x,y). Then

$$u = 3x-2-\alpha, \qquad v = 3y+6.$$

Substitute these into $9u+7v+\alpha=0$:

$$27x+21y+24-8\alpha=0.$$

Thus l_2 is $9x+7y+(24-8\alpha)/3=0$, with the same normal as l_1.

Step 2: Use the line separation to determine alpha The given distance yields

$$\frac{|24-11\alpha|}{3\sqrt{130}} = \frac{20}{3\sqrt{130}}, \qquad |24-11\alpha| = 20.$$

Hence $\alpha = 4/11$ or 4. Only $\alpha=4$ is a natural number, so $l_2 : 9x+7y-8/3=0$.

Step 3: Compute the distance from Q Now $Q=(4,-11)$. Its perpendicular distance from l_2 is

$$\frac{|9(4)+7(-11)-8/3|}{\sqrt{130}} = \frac{131}{3\sqrt{130}}.$$

Comparison with the stated form gives $k=131$, so the other proposed numerators 117, 129 and 133 do not satisfy the distance formula.

Step 4: Conclusion The value is $\boxed{k=131}$. Hence, the correct option is (C).

Quick Tip to Solve: Normalize both parallel-line equations to the same coefficients of x and y before comparing their constants.

13. Let $A_i(x_i, y_i)$, $i = 1, 2, 3$ be points on the circle $x^2 + y^2 = 10$ such that A_1 lies in the 1^{st} quadrant and it is the image of point A_2 with respect to y-axis. If the distance of point A_1 from each of the points A_2 and A_3 is 2, then twenty times the area of the $\Delta A_1A_2A_3$ is [4 marks]

(A) 12

(B) 30

(C) 24

(D) 48

Correct Answer: (C) 24

Solution:

Concept:

- Reflection in the y-axis changes the sign of the horizontal coordinate while preserving the vertical coordinate.
- Subtracting two circle equations removes their quadratic terms. Triangle area is one half of base times perpendicular height.

Step 1: Find the reflected pair Put $A_1 = (x, y)$, with $x, y > 0$. Its reflection is $A_2 = (-x, y)$, so $A_1A_2 = 2x = 2$ gives $x = 1$. The circle equation then gives $y^2 = 9$. Since A_1 is in the first quadrant,

$$A_1 = (1, 3), \qquad A_2 = (-1, 3).$$

Step 2: Find the third vertex For $A_3 = (u, v)$, we have $u^2 + v^2 = 10$ and $(u - 1)^2 + (v - 3)^2 = 4$. Subtracting gives $u + 3v = 8$. Eliminate v:

$$5u^2 - 8u - 13 = 0, \qquad (u + 1)(5u - 13) = 0.$$

The root $u = -1$ is the already used point A_2. The distinct third vertex is therefore $A_3 = (13/5, 9/5)$.

Step 3: Evaluate the area The horizontal base A_1A_2 has length 2 and lies on $y = 3$. Its height from A_3 is $3 - 9/5 = 6/5$. Hence

$$20[\triangle A_1A_2A_3] = 20\left(\frac{1}{2} \cdot 2 \cdot \frac{6}{5}\right) = 24.$$

The result rules out 12, 30 and 48; using the height itself as the area happens to work here only because the base equals 2.

Step 4: Conclusion Twenty times the area equals $\boxed{24}$. Hence, the correct option is (C).

Quick Tip to Solve: Use reflection to find the first chord immediately, then subtract the distance-circle equation from the original circle equation.

14. The remainder when 7^{89} is divided by 15 is [4 marks]

(A) 5

(B) 7

(C) 9

(D) 11

Correct Answer: (B) 7

Solution:

Concept:

- Congruence modulo 15 lets us replace any integer by its remainder without changing the final remainder of a product.
- When a power is congruent to 1 modulo the divisor, powers repeat with a period dividing that exponent.

Step 1: Find a short power cycle Calculate successive powers of 7 modulo 15:

$$7^2 = 49 \equiv 4 \pmod{15}, \qquad 7^4 \equiv 4^2 = 16 \equiv 1 \pmod{15}.$$

Thus every block of four factors of 7 contributes a factor congruent to 1. This avoids computing the very large integer 7^{89}. The division remainder must lie between 0 and 14.

Step 2: Reduce the exponent Divide the exponent by the cycle length:

$$89 = 4(22) + 1.$$

Consequently,

$$7^{89} = (7^4)^{22} \cdot 7 \equiv 1^{22} \cdot 7 \equiv 7 \pmod{15}.$$

The positive residue 7 is already in the valid remainder interval. The proposed residues 5, 9 and 11 therefore do not agree with the power cycle. One can also check that successive odd-exponent residues alternate between 7 and 13, and 89 leaves residue 1 modulo 4.

Step 3: Conclusion The remainder is $\boxed{7}$. Hence, the correct option is (B).

Quick Tip to Solve: For a large exponent, compute small powers modulo the divisor until 1 appears, then reduce the exponent by that cycle length.

15. If the plane $y = \alpha x - \beta z + \gamma$ passing through the point $(1, -1, 3)$ is perpendicular to each of the planes $2x + y + z = 1$ and $3x - 2y + 2z = 0$, then $\alpha + \beta + \gamma$ is equal to : [4 marks]

(A) 5

(B) 13

(C) 19

(D) 27

Correct Answer: (D) 27

Solution:

Concept:

- Two planes are perpendicular exactly when their normal vectors have zero dot product.
- For a plane written as $Ax + By + Cz = D$, a normal vector is (A, B, C); a point on the plane determines its constant term.

Step 1: Translate perpendicularity into equations Write the unknown plane as $\alpha x - y - \beta z + \gamma = 0$, with normal $(\alpha, -1, -\beta)$. Dot this with the normals $(2, 1, 1)$ and $(3, -2, 2)$ of the given planes:

$$2\alpha - 1 - \beta = 0, \qquad 3\alpha + 2 - 2\beta = 0.$$

The first equation gives $\beta = 2\alpha - 1$. Substitute into the second to get $3\alpha + 2 - 4\alpha + 2 = 0$, hence $\alpha = 4$ and $\beta = 7$.

Step 2: Use the specified point and add Substitute $(1, -1, 3)$ in $y = 4x - 7z + \gamma$:

$$-1 = 4 - 21 + \gamma, \qquad \gamma = 16.$$

Therefore

$$\alpha + \beta + \gamma = 4 + 7 + 16 = 27.$$

As a check, the resulting normal $(4, -1, -7)$ has dot products $8 - 1 - 7 = 0$ and $12 + 2 - 14 = 0$. Thus both perpendicularity conditions hold, and the sum excludes 5, 13 and 19.

Step 3: Conclusion The required sum equals $\boxed{27}$. Hence, the correct option is (D).

Quick Tip to Solve: Fix the sign of the normal from the displayed plane equation before taking dot products; determine the constant only after finding its direction.

16. Let $\vec{a} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = \hat{i} - \hat{j} + 2\hat{k}$, $\vec{c} = 2\hat{i} + \hat{j} - 4\hat{k}$ be three vectors. If $\vec{r}$ is the vector such that $\vec{r} \times \vec{a} = (\vec{b} + \vec{c}) \times \vec{a}$ and $\vec{r} \cdot (\vec{b} - \vec{c}) = 0$, then $\vec{r} \cdot (\hat{i} + \hat{j} - \hat{k})$ is equal to : [4 marks]

(A) 3

(B) 4

(C) 5

(D) 6

Correct Answer: (C) 5

Solution:

Concept:

- If $\mathbf{u} \times \mathbf{a} = \mathbf{0}$ for nonzero $\mathbf{a}$, then $\mathbf{u}$ is parallel to $\mathbf{a}$.
- A component parallel to $\mathbf{a}$ has zero projection along any vector perpendicular to $\mathbf{a}$.

Step 1: Describe all vectors satisfying the cross product Rearranging the first condition gives

$$(\vec{r} - \vec{b} - \vec{c}) \times \vec{a} = \vec{0}, \qquad \vec{r} = \vec{b} + \vec{c} + \lambda\vec{a}.$$

Here $\vec{b} + \vec{c} = (3, 0, -2)$ and $\vec{a} = (1, 2, 3)$, so $\vec{r} = (3 + \lambda, 2\lambda, -2 + 3\lambda)$. The second condition uses $\vec{b} - \vec{c} = (-1, -2, 6)$, giving

$$\vec{r} \cdot (\vec{b} - \vec{c}) = -15 + 13\lambda = 0.$$

Thus $\lambda = 15/13$, which confirms the two constraints are consistent and determine one vector.

Step 2: Take the requested dot product Let $\vec{d} = (1, 1, -1)$. Since $\vec{a} \cdot \vec{d} = 1 + 2 - 3 = 0$, the term containing λ makes no contribution:

$$\begin{aligned} \vec{r} \cdot \vec{d} &= (\vec{b} + \vec{c}) \cdot \vec{d} + \lambda\vec{a} \cdot \vec{d} \\ &= 3 + 0 + 2 = 5. \end{aligned}$$

Therefore 3, 4 and 6 are excluded. The dot product is unchanged across the entire family supplied by the cross-product equation.

Step 3: Conclusion The requested dot product is $\boxed{5}$. Hence, the correct option is (C).

Quick Tip to Solve: Before solving for the free scalar in a cross-product equation, check whether the requested dot-product direction is perpendicular to its free direction.

17. The probability that a randomly selected root of the equation $1 + x + x^2 + \ldots + x^{118} = 0$ satisfies the equation $x^7 = 1$, is [4 marks]

(A) 0

(B) $\frac{1}{59}$

(C) $\frac{3}{59}$

(D) $\frac{7}{118}$

Correct Answer: (C) $\frac{3}{59}$

Solution:

Concept:

- For equally likely distinct roots, probability is the number satisfying the additional equation divided by the total number of roots.
- The finite geometric identity $(x-1)(1+x+\cdots+x^{118}) = x^{119}-1$ identifies the roots as the 119th roots of unity other than 1.

Step 1: Count the possible roots The polynomial has degree 118. Its roots satisfy $x^{119} = 1$, but $x = 1$ is excluded because the original sum is then 119. The roots of $x^{119} - 1$ are all distinct, since its derivative $119x^{118}$ is nonzero at every such root. Therefore there are exactly 118 equally likely roots in the sample space.

Step 2: Count the roots satisfying both equations Because $119 = 7 \times 17$, every solution of $x^7 = 1$ also satisfies $x^{119} = (x^7)^{17} = 1$. There are seven distinct seventh roots of unity, of which 1 must again be excluded. Hence precisely six roots belong to the original sample space and satisfy the additional condition. Thus

$$P = \frac{6}{118} = \frac{3}{59}.$$

The value 0 overlooks the common roots; $1/59$ counts only two favourable roots, while $7/118$ incorrectly includes the excluded root 1.

Step 3: Conclusion The required probability is $\boxed{3/59}$. Hence, the correct option is (C).

Quick Tip to Solve: When using the geometric-sum identity, remove the root 1 before counting common roots of unity.

18. Let X have the binomial distribution $\mathrm{B}(n, p)$. If its mean is 3 and variance is 2, then $\mathrm{P}\left(X < \frac{n}{4}\right)$ is equal to : [4 marks]

(A) $\frac{29\times 2^8}{3^9}$

(B) $\frac{25\times 2^9}{3^9}$

(C) $\frac{163}{3^9}$

(D) $\frac{835}{3^9}$

Correct Answer: (A) $\frac{29\times 2^8}{3^9}$

Solution:

Concept:

- For $X \sim \mathrm{B}(n, p)$, the mean is np and the variance is $np(1-p)$.
- The probability mass function is $P(X = r) = \binom{n}{r}p^r(1-p)^{n-r}$, with integer r between 0 and n.

Step 1: Determine the distribution parameters The given mean and variance yield

$$np = 3, \qquad np(1-p) = 2.$$

Dividing the second equation by the first gives $1 - p = 2/3$, hence $p = 1/3$. Substituting into $np = 3$ gives $n = 9$. Therefore $n/4 = 9/4 = 2.25$; since X is integer valued, the strict event $X < n/4$ consists exactly of $X = 0, 1, 2$.

Step 2: Add the three binomial probabilities Using the common denominator 3^9,

$$\begin{aligned} P(X < 9/4) &= \sum_{r=0}^{2} \binom{9}{r} \left(\frac{1}{3}\right)^r \left(\frac{2}{3}\right)^{9-r} \\ &= \frac{2^9 + 9\cdot 2^8 + 36\cdot 2^7}{3^9} \\ &= \frac{2^8(2+9+18)}{3^9} = \frac{29\cdot 2^8}{3^9}. \end{aligned}$$

This includes the term $X = 2$, which must not be dropped merely because the inequality is strict. The other numerators do not equal the sum $512 + 2304 + 4608 = 7424$, so none represents this event.

Step 3: Conclusion $P(X < n/4) = \boxed{\frac{29 \times 2^8}{3^9}}$. Hence, the correct option is (A).

Quick Tip to Solve: Convert the probability bound to the allowed integer values before summing binomial terms.

19. The domain of the function $f(x) = \cos^{-1}\left(\frac{x^2-3x+2}{x^2+2x-1}\right)$ is : [4 marks]

(A) $\left(\sqrt{2}-1, \frac{3}{5}\right]$

(B) $\left[\frac{3}{5}, \infty\right)$

(C) $\mathbb{R} - \{-\sqrt{2}-1, \sqrt{2}-1\}$

(D) $(-\infty, -1-\sqrt{2}) \cup (\sqrt{2}-1, \infty)$

Correct Answer: (B) $\left[\frac{3}{5}, \infty\right)$

Solution:

Concept:

- The real function $\cos^{-1} t$ is defined exactly for $-1 \le t \le 1$. The denominator of a rational argument must also be nonzero.
- For real N, D, with $D \neq 0$, the condition $|N/D| \le 1$ is equivalent to $D^2 - N^2 \ge 0$.

Step 1: Factor the domain inequality Put $N = x^2 - 3x + 2$ and $D = x^2 + 2x - 1$. Rather than multiply separate inequalities by a denominator of unknown sign, square the absolute-value condition. This gives

$$\begin{aligned} D^2 - N^2 &= (D-N)(D+N) \\ &= (5x-3)(2x^2 - x + 1) \ge 0. \end{aligned}$$

The factor $2x^2 - x + 1$ is always positive: it equals $2(x - 1/4)^2 + 7/8$. Thus the complete inequality reduces to $5x - 3 \ge 0$, or $x \ge 3/5$.

Step 2: Check excluded points and endpoints The denominator vanishes at $x = -1 \pm \sqrt{2}$. Both these numbers are below $3/5$, so neither removes any point from the obtained interval. At $x = 3/5$, $N = D \neq 0$, giving an inverse-cosine argument of 1; the endpoint is therefore included. Option (A) includes values below $3/5$, which violate the squared inequality. Options (C) and (D) likewise include many points where the rational argument lies outside $[-1, 1]$; excluding poles alone is insufficient.

Step 3: Conclusion The real domain is $\boxed{[3/5, \infty)}$. Hence, the correct option is (B).

Quick Tip to Solve: For an inverse cosine of a rational expression, factor denominator squared minus numerator squared, then check the poles separately.

20. Which of the following statements is a tautology ? [4 marks]

(A) $((p \Rightarrow q) \vee p) \Rightarrow q$

(B) $((p \wedge q) \Rightarrow p) \Rightarrow q$

(C) $((p \wedge q) \wedge (\sim q)) \Rightarrow p$

(D) $((p \Rightarrow q) \vee p) \Rightarrow p$

Correct Answer: (C) $((p \wedge q) \wedge (\sim q)) \Rightarrow p$

Solution:

Concept:

- An implication $u \Rightarrow v$ is false only when u is true and v is false. Equivalently, it is $(\sim u) \vee v$.

- A tautology is true for every truth assignment to its component statements. A single counterexample is enough to reject a proposed tautology.

Step 1: Test the contradictory antecedent In option (C), the antecedent is

$$(p \wedge q) \wedge (\sim q) = p \wedge (q \wedge \sim q).$$

The expression $q \wedge \sim q$ is always false, so this whole antecedent is always false, irrespective of p. Consequently its implication to p is always true. This proves directly that (C) is a tautology without needing to enumerate four rows of a truth table.

Step 2: Reject each remaining option For option (A), use $p = \mathrm{T}, q = \mathrm{F}$. Then $p \Rightarrow q$ is false, but its disjunction with p is true; the implication to false q is false. In (B), $(p \wedge q) \Rightarrow p$ is always true, so the whole option has the same truth value as q; it is false whenever q is false. In (D), choose $p = \mathrm{F}, q = \mathrm{F}$. The inner implication is true, so the antecedent is true while its consequent p is false. Thus (D) also fails a truth assignment.

Step 3: Conclusion $\boxed{((p \wedge q) \wedge (\sim q)) \Rightarrow p}$ is always true. Hence, the correct option is (C).

Quick Tip to Solve: Look first for a contradiction in the antecedent: an implication with an always-false antecedent is automatically true.

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

Attempt any 5 of the 10 questions in this section.

21. The curve $y = x^2 + 1$ divides the area enclosed by the curves $y + |x| = 3$ and $y = |x - 1|$ in the ratio m : n, where m and n are coprime, then m + n is equal to _____. [4 marks]

Solution:

Concept:

- The area between an upper curve $U(x)$ and a lower curve $L(x)$ is $\int (U - L)\,dx$, split at changes of formula or intersections.
- Here the enclosing curves are $U(x) = 3 - |x|$ and $L(x) = |x - 1|$; the dividing curve is $P(x) = x^2 + 1$.

Step 1: Find the enclosing interval and total area The two enclosing curves meet at $x = -1$ and $x = 2$. On $[-1, 0]$, their difference is $(3 + x) - (1 - x) = 2 + 2x$. On $[0, 1]$, it is $(3 - x) - (1 - x) = 2$. On $[1, 2]$, it is $(3 - x) - (x - 1) = 4 - 2x$. Therefore

$$A = \int_{-1}^{0} (2 + 2x)\,dx + \int_{0}^{1} 2\,dx + \int_{1}^{2} (4 - 2x)\,dx = 1 + 2 + 1 = 4.$$

Step 2: Locate the parabola inside the enclosed region For $-1 < x < 0$, $P - L = x^2 + x < 0$, so the entire vertical strip lies above the parabola. On $0 < x < 1$, $P - L = x^2 + x > 0$ and $U - P = 2 - x - x^2 > 0$, so the parabola passes through the region. For $1 < x < 2$, $P > U$, so the

entire strip lies below the parabola. Thus the area below the parabola is

$$A_1 = \int_0^1 (x^2 + x)\,dx + \int_1^2 (4 - 2x)\,dx = \frac{5}{6} + 1 = \frac{11}{6}.$$

Step 3: Form the coprime ratio The area above the parabola is $A_2 = 4 - 11/6 = 13/6$. Hence the two areas are in the ratio $11 : 13$, or its reciprocal depending on which part is named first. Both integers are coprime, so either convention gives the same requested sum $m + n = 11 + 13$.

Step 4: Conclusion The required value is $\boxed{24}$.

Quick Tip to Solve: Split absolute-value area problems at both absolute-value corners and at every intersection with the dividing curve.

22. The number of ways in which 30 identical pens can be distributed among 12 students so that each student gets at least one pen and exactly two students get at least two pens each, is _____.

[4 marks]

Solution:

Concept:

- The pens are identical but the 12 students are distinct; only the number received by each student determines a distribution.
- Exactly two students receive at least two pens. Every other student must receive exactly one pen, because everyone receives at least one.

Step 1: Choose the two exceptional students Select the two students who will receive more than one pen. This can be done in

$$\binom{12}{2} = \frac{12 \cdot 11}{2} = 66$$

ways. The remaining ten students each get one pen, using ten pens, so twenty pens remain for the selected pair. For a fixed selected pair, identify its members by their student labels; interchanging their pen counts generally produces a different distribution.

Step 2: Count the allowed allocations to the pair If the selected students receive a and b pens, then

$$a + b = 20, \qquad a \geq 2, \quad b \geq 2.$$

Write $u = a - 2$ and $v = b - 2$. Then $u + v = 16$ with $u, v \geq 0$, which has 17 solutions: $u = 0, 1, \ldots, 16$. Equivalently, a ranges from 2 through 18 inclusive and uniquely determines b. Each allocation gives exactly the chosen two students at least two pens, while the other ten remain at one pen each.

Step 3: Multiply the independent choices The exceptional pair is uniquely recoverable from any admissible distribution, so choices for different pairs never overlap. Multiplying the 66 choices of pair by the 17 allocations for each pair gives

$$N = 66 \cdot 17 = 1122.$$

No factorial for permuting the pens is needed, since the objects are identical; no division by two is needed after counting allocations for two already identified students.

Step 4: Conclusion The number of distributions is $\boxed{1122}$.

Quick Tip to Solve: With exactly two recipients above the minimum, fix all other recipients at the minimum before applying stars and bars.

23. Let $(1+x^2-x^4)^{12}=\sum_{n=0}^{48} a_n x^n$. Then $a_0+a_2+a_4+\ldots+a_{44}$ is equal to _____. [4 marks]

Solution:

Concept:

- Evaluating a polynomial at $x=1$ gives the sum of all its coefficients. Here only even powers occur because every term in the base has even degree.
- The required sum omits only the coefficients of x^{46} and x^{48}. These highest-degree coefficients can be counted directly from the 12 factors.

Step 1: Find the sum of all coefficients Let $F(x)=(1+x^2-x^4)^{12}$. Since each selected term has even degree, all odd-indexed coefficients vanish. Substituting $x=1$ gives

$$a_0+a_2+\cdots+a_{48}=F(1)=(1+1-1)^{12}=1.$$

The requested sum stops at degree 44, so it is this total minus $a_{46}+a_{48}$. There is no need to expand the entire polynomial or compute the intervening coefficients.

Step 2: Compute the last two coefficients The degree-48 term comes only from choosing $-x^4$ in all 12 factors, so $a_{48}=(-1)^{12}=1$. To get degree 46, decrease the maximum degree by exactly two: choose x^2 from one factor and $-x^4$ from the other eleven. Replacing a highest-degree term by 1 decreases degree by four and cannot contribute here. There are 12 choices for the factor supplying x^2, and each contribution has sign $(-1)^{11}=-1$. Hence

$$a_{46}=12(-1)^{11}=-12.$$

Step 3: Subtract the omitted terms Therefore

$$a_0+a_2+\cdots+a_{44}=1-a_{46}-a_{48}=1-(-12)-1=12.$$

Keeping the minus sign of the degree-46 coefficient is essential: the missing tail has sum -11, so removing it increases the sum from 1 to 12.

Step 4: Conclusion The requested coefficient sum is $\boxed{12}$.

Quick Tip to Solve: For a coefficient sum that stops near the highest power, evaluate at 1 and subtract the few omitted highest-degree terms.

24. If S_n denotes the sum of first n terms of the series $7+10+16+25+37+\ldots$, then $S_{30}-S_{20}$ is equal to _____. [4 marks]

Solution:

Concept:

- The consecutive differences of the sequence $7, 10, 16, 25, 37, \ldots$ are $3, 6, 9, 12, \ldots$, an arithmetic sequence.
- The identities $\sum_{k=1}^{n} k = n(n+1)/2$ and $\sum_{k=1}^{n} k^2 = n(n+1)(2n+1)/6$ sum the resulting quadratic general term.

Step 1: Obtain the general term Let the kth term be t_k, so $t_1 = 7$ and $t_{k+1} - t_k = 3k$. Adding the first $k-1$ differences gives

$$t_k = 7 + 3(1 + 2 + \cdots + (k-1)) = 7 + \frac{3}{2}k(k-1).$$

This reproduces $t_2 = 10$, $t_3 = 16$, and $t_4 = 25$, confirming the indexing. In particular the given terms themselves do not form an arithmetic progression; their differences do.

Step 2: Find the partial sum formula Adding the general term over $k = 1, \ldots, n$,

$$\begin{aligned} S_n &= 7n + \frac{3}{2}\left(\sum_{k=1}^{n} k^2 - \sum_{k=1}^{n} k\right) \\ &= 7n + \frac{3}{2}\left(\frac{n(n+1)(2n+1)}{6} - \frac{n(n+1)}{2}\right) \\ &= 7n + \frac{n(n+1)(n-1)}{2} = \frac{n^3 + 13n}{2}. \end{aligned}$$

The factor $n-1$ is consistent with there being no first difference included when $n = 1$.

Step 3: Evaluate the difference of partial sums The quantity $S_{30} - S_{20}$ contains terms 21 through 30, with the first twenty terms cancelling. Using the formula directly,

$$\begin{aligned} S_{30} - S_{20} &= \frac{30^3 - 20^3 + 13(30-20)}{2} \\ &= \frac{27000 - 8000 + 130}{2} = \frac{19130}{2} = 9565. \end{aligned}$$

This subtraction avoids separately listing ten large terms and reduces the chance of an endpoint error.

Step 4: Conclusion The required value is $\boxed{9565}$.

Quick Tip to Solve: When successive differences are linear, express the original term as a quadratic and sum it before substituting large indices.

25. If $[t]$ denotes the greatest integer $\leq t$, then the number of points, at which the function $f(x) = [x + x^3] + |x - x^3| + |x + \frac{1}{2}|$ is not differentiable in the open interval $(-10, 10)$, is _____. [4 marks]

Solution:

Concept:

- The greatest-integer function jumps when its argument crosses an integer. A discontinuous function cannot be differentiable at that point.
- For an absolute value of a differentiable function, possible corners occur at zeros of the expression inside it. Count the union of all exceptional points, rather than adding counts with repetitions.

Step 1: Count the jumps of the greatest-integer term Put $g(x) = x + x^3$. Since $g'(x) = 1 + 3x^2 > 0$, it is strictly increasing, and every integer in its range has exactly one preimage. On the open interval $(-10, 10)$, its range is $(-1010, 1010)$. The integers in this open interval run from -1009 to 1009, so their number is

$$1009 - (-1009) + 1 = 2019.$$

At each preimage, $[g(x)]$ has a jump of size one. Both absolute-value terms are continuous, so neither can cancel such a jump.

Step 2: Check the absolute-value corners and remove duplicates The equation $x - x^3 = x(1 - x^2) = 0$ gives $x = -1, 0, 1$. All three are already included, because $g(-1) = -2$, $g(0) = 0$, and $g(1) = 2$ are integers. The term $|x + \frac{1}{2}|$ has a corner at $x = -\frac{1}{2}$. Here $g(-\frac{1}{2}) = -\frac{5}{8}$, so the floor term is locally constant. Also $x - x^3 \neq 0$ there, making its absolute value differentiable. Thus the last term contributes exactly one new nondifferentiable point. Away from these sets, the floor is locally constant and both absolute values are differentiable.

Step 3: Conclusion The required number is $2019 + 1 = \boxed{2020}$. The count is dimensionless.

Quick Tip to Solve: List the integer crossings first, then add only absolute-value corners that are absent from that list.

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26. If $\int \frac{dx}{(3x^2+5)\sqrt{10x^2+7}} = -\frac{1}{\sqrt{580}} \log_e |f(x)| + C$ where C is an arbitrary constant, then $f(0)$ is equal to _____. [4 marks]

Solution:

Concept:

- A substitution involving $x/\sqrt{ax^2 + b}$ removes the square root and converts this integral into a rational function.
- For positive a, b, $\int dt/(a^2 - b^2t^2) = \frac{1}{2ab} \ln \left|\frac{a+bt}{a-bt}\right| + C$. A multiplicative integration constant in a logarithm is conventionally absorbed into the additive constant.

Step 1: Remove the square root Let $t = x/\sqrt{10x^2 + 7}$. Differentiation and rearrangement give

$$dt = \frac{7\,dx}{(10x^2 + 7)^{3/2}}, \qquad x^2 = \frac{7t^2}{1 - 10t^2}.$$

Hence

$$\frac{dx}{\sqrt{10x^2+7}} = \frac{dt}{1-10t^2}, \qquad 3x^2+5 = \frac{5-29t^2}{1-10t^2}.$$

The two factors $1-10t^2$ cancel, and the integral becomes $\int dt/(5-29t^2)$. The substitution is well defined for every real x, since $10x^2+7>0$.

Step 2: Integrate and identify the standard logarithmic expression Using partial fractions,

$$\int \frac{dt}{5-29t^2} = \frac{1}{2\sqrt{145}} \ln\left|\frac{\sqrt{5}+\sqrt{29}\,t}{\sqrt{5}-\sqrt{29}\,t}\right| + C$$
$$= -\frac{1}{\sqrt{580}} \ln\left|\frac{\sqrt{5(10x^2+7)}-\sqrt{29}\,x}{\sqrt{5(10x^2+7)}+\sqrt{29}\,x}\right| + C.$$

Thus the usual choice, after absorbing the multiplicative constant into C, is the ratio in the last logarithm. Its numerator and denominator are nonzero because $5(10x^2+7)-29x^2 = 21x^2+35>0$. At $x=0$, both equal $\sqrt{35}$.

Step 3: Conclusion For the standard logarithmic representative, $f(0) = \sqrt{35}/\sqrt{35} = \boxed{1}$, agreeing with the given key. Strictly, an arbitrary nonzero constant multiplier of f can be absorbed into C; the value 1 uses the conventional representative displayed above.

Quick Tip to Solve: Try $t = x/\sqrt{ax^2+b}$ when a quadratic factor accompanies a square-root quadratic in the denominator.

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27. Let the equation of the hyperbola with foci $(1,5),(1,-1)$ and eccentricity $\sqrt{3}$ be $x^2-2y^2+ax+by+c=0$. Then $|a+b+c|$ is equal to _____. [4 marks]

Solution:

Concept:

- The centre of a hyperbola is the midpoint of its foci. The focal axis is its transverse axis.
- For a vertical hyperbola, $(y-k)^2/A^2-(x-h)^2/B^2=1$, with $c^2=A^2+B^2$ and eccentricity $e=c/A$. Capital letters for semiaxes avoid confusion with the requested coefficients a,b,c.

Step 1: Find the centre and the semiaxes The foci $(1,5)$ and $(1,-1)$ have midpoint $(1,2)$, so the centre is $(h,k)=(1,2)$. They have the same first coordinate, which makes the transverse axis vertical. Their distance from the centre is $c_f=3$. With $e=\sqrt{3}$, the transverse semiaxis satisfies

$$A = \frac{c_f}{e} = \frac{3}{\sqrt{3}} = \sqrt{3}, \qquad A^2 = 3.$$

The focal relation then gives

$$B^2 = c_f^2 - A^2 = 9-3 = 6.$$

These are positive, as required for a genuine hyperbola. Interchanging the two denominators would produce a different focal distance or eccentricity.

Step 2: Expand the equation and compare coefficients The equation is

$$\frac{(y-2)^2}{3} - \frac{(x-1)^2}{6} = 1.$$

Multiply by 6, expand both squares, and collect terms:

$$\begin{aligned} 2(y-2)^2 - (x-1)^2 &= 6, \\ 2y^2 - 8y + 8 - x^2 + 2x - 1 &= 6, \\ x^2 - 2y^2 - 2x + 8y - 1 &= 0. \end{aligned}$$

The coefficient of x^2 is now exactly 1, as in the question. Comparing with $x^2 - 2y^2 + ax + by + c = 0$ gives $a = -2$, $b = 8$, and $c = -1$.

Step 3: Conclusion Therefore $|a + b + c| = |-2 + 8 - 1| = \boxed{5}$.

Quick Tip to Solve: Locate the centre and focal direction before choosing the standard hyperbola form; expand only after both semiaxes are fixed.

28. Let α_1, α_2 be the values of α such that the distance between the point $(2, 4, 3)$ and the plane $3x + y + \alpha z + 10 = 0$ is $\sqrt{35}$ units. Then the area of the triangle with vertices $(\alpha_1, \alpha_2, 0)$, $(\alpha_2, \alpha_1, 0)$ and $\left(\frac{164}{13}, 5, 0\right)$ is _____ unit^2. [4 marks]

Solution:

Concept:

- The distance of (x_0, y_0, z_0) from $Ax + By + Cz + D = 0$ is $|Ax_0 + By_0 + Cz_0 + D|/\sqrt{A^2 + B^2 + C^2}$.
- All three vertices have $z = 0$, so their triangle lies in the coordinate plane. A horizontal base makes its area one half of base times vertical height.

Step 1: Determine the two plane parameters Substitute the point $(2, 4, 3)$ into the distance formula:

$$\frac{|3(2) + 4 + 3\alpha + 10|}{\sqrt{9 + 1 + \alpha^2}} = \sqrt{35}.$$

The numerator is $|20 + 3\alpha|$. Squaring is valid because both sides are nonnegative, and the denominator is strictly positive. Thus

$$\begin{aligned} (20 + 3\alpha)^2 &= 35(10 + \alpha^2), \\ 26\alpha^2 - 120\alpha - 50 &= 0, \\ 13\alpha^2 - 60\alpha - 25 &= 0, \\ (\alpha - 5)(13\alpha + 5) &= 0. \end{aligned}$$

So the unordered pair is $\{\alpha_1, \alpha_2\} = \{5, -5/13\}$. Both roots satisfy the original distance condition.

Step 2: Choose a horizontal side as the base Take $P = (5, -5/13, 0)$, $Q = (-5/13, 5, 0)$, and $R = (164/13, 5, 0)$. Exchanging α_1 and α_2 only exchanges the first two vertices and cannot change

the area. The segment QR is horizontal, with length

$$QR = \frac{164}{13} - \left(-\frac{5}{13}\right) = \frac{169}{13} = 13.$$

The perpendicular distance of P from the line $y = 5$ is

$$h = 5 - \left(-\frac{5}{13}\right) = \frac{70}{13}.$$

Use these lengths in the planar triangle-area formula.

Step 3: Conclusion The required area is $\frac{1}{2}(13)(70/13) = \boxed{35 \text{ unit}^2}$.

Quick Tip to Solve: After finding both parameter values, look for two vertices sharing a coordinate; this often avoids a determinant.

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29. Let O be the origin and let the vectors $\overrightarrow{OA} = -3\hat{i} + 7\hat{j} + 5\hat{k}$, $\overrightarrow{OB} = -5\hat{i} + 7\hat{j} - 3\hat{k}$ and $\overrightarrow{OC} = \hat{u}$ represent three sides of a parallelopiped, where $\hat{u}$ is a unit vector in the xy- plane. If the maximum volume of the parallelopiped is $2\sqrt{\alpha}$, then α is equal to _____. [4 marks]

Solution:

Concept:

- The volume of a parallelepiped with three adjacent vectors $\mathbf{a}, \mathbf{b}, \mathbf{u}$ is $|(\mathbf{a} \times \mathbf{b}) \cdot \mathbf{u}|$.
- If $\mathbf{u}$ is restricted to a plane, only the projection of $\mathbf{a} \times \mathbf{b}$ into that plane contributes. For unit $\mathbf{u}$, Cauchy–Schwarz bounds the dot product by the length of that projection, with equality in its direction.

Step 1: Calculate the cross product of the fixed sides Let $\mathbf{a} = (-3, 7, 5)$ and $\mathbf{b} = (-5, 7, -3)$. Expanding the determinant carefully,

$$\begin{aligned}\mathbf{a} \times \mathbf{b} &= \big(7(-3) - 5(7),\ 5(-5) - (-3)(-3),\ (-3)(7) - 7(-5)\big) \\ &= (-56, -34, 14).\end{aligned}$$

The middle component is $-25 - 9 = -34$; keeping its sign correct matters for the maximizing direction, even though it is squared in the maximum value. Since $\hat{u}$ lies in the xy-plane, write $\hat{u} = (p, q, 0)$ with $p^2 + q^2 = 1$.

Step 2: Maximize over the allowed unit vectors The volume becomes

$$V = |-56p - 34q|.$$

By Cauchy–Schwarz,

$$V^2 \le (56^2 + 34^2)(p^2 + q^2) = 3136 + 1156 = 4292.$$

This bound is attained: choose $(p, q) = (56, 34)/\sqrt{4292}$, or its negative. These choices are permitted unit vectors in the stated plane. Hence the bound is the actual maximum, not merely an upper

estimate:

$$V_{\max} = \sqrt{4292} = 2\sqrt{1073}.$$

The component 14 cannot increase the volume because the third component of every permitted $\hat{u}$ is zero.

Step 3: Conclusion Comparison with $V_{\max} = 2\sqrt{\alpha}$ gives $\boxed{\alpha = 1073}$.

Quick Tip to Solve: For a unit vector constrained to a plane, project the fixed cross product into that plane before taking its norm.

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30. If the solution curve of the differential equation $\frac{x+y-2}{x+y-1}\frac{dy}{dx} = \frac{x+y+2}{x+y+1}$, $x + y > 2$ passes through the points $(\sqrt{2}, \sqrt{2})$ and $(2, \alpha)$, then $2\alpha - \log_e\left(\frac{\alpha^2+4\alpha+2}{6}\right)$ is equal to _____. [4 marks]

Solution:

Concept:

- When a first-order differential equation depends on $x + y$, substitute $u = x + y$, so that $du/dx = 1 + dy/dx$.
- Separation then gives an implicit solution. Use the initial point to fix its constant, and substitute the second point into the same identity.

Step 1: Reduce the differential equation to a separable form Put $u = x + y > 2$. The given equation yields

$$\frac{dy}{dx} = \frac{(u+2)(u-1)}{(u+1)(u-2)}.$$

Therefore

$$\frac{du}{dx} = 1 + \frac{u^2+u-2}{u^2-u-2} = \frac{2(u^2-2)}{u^2-u-2},$$
$$\frac{dx}{du} = \frac{u^2-u-2}{2(u^2-2)} = \frac{1}{2} - \frac{u}{2(u^2-2)}.$$

The condition $u > 2$ ensures that the denominators are nonzero. Integrating with respect to u gives

$$x = \frac{u}{2} - \frac{1}{4}\ln(u^2-2) + C.$$

An absolute value in the logarithm is unnecessary on this domain because $u^2 - 2 > 0$.

Step 2: Apply the two points and isolate the requested expression Multiply the integrated equation by 4 and replace u by $x + y$. Absorbing the constant gives

$$2x - 2y + \ln\big((x+y)^2 - 2\big) = K.$$

At $(\sqrt{2}, \sqrt{2})$, $x + y = 2\sqrt{2}$ and $2x - 2y = 0$, so $K = \ln(8-2) = \ln 6$. At $(2, \alpha)$, the same solution curve consequently satisfies

$$4 - 2\alpha + \ln(\alpha^2 + 4\alpha + 2) = \ln 6.$$

Move the logarithms to one side and combine their difference as a quotient. This obtains the desired

value directly; solving a transcendental equation for α is unnecessary.

Step 3: Conclusion Thus $2\alpha - \ln\left(\frac{\alpha^2+4\alpha+2}{6}\right) = \boxed{4}$.

Quick Tip to Solve: If the requested expression resembles the implicit solution, substitute the given point directly instead of solving for its unknown coordinate.

Aptitude Test (200 marks)

31. Adobe is a [4 marks]

(A) Type of cement

(B) Type of floor finish

(C) Type of paint

(D) Type of Brick

Correct Answer: (D) Type of Brick

Solution:

Concept:

- Adobe is an earth-based building material formed into blocks or bricks and hardened by drying, commonly in the sun, rather than by firing in a kiln.
- Classify a construction material by its basic form and use. Bricks are masonry units; cement is a binder, and paint and floor finishes are surface treatments.

Step 1: Identify the material and its production Adobe bricks are traditionally made by mixing suitable earth containing clay and sand with water. Fibrous material such as straw may be added to limit cracking and improve cohesion during drying. The workable mixture is placed in moulds to form individual building units and allowed to dry. These dried blocks can be assembled with compatible mortar to make walls. Their defining feature in this question is the brick or block form of the earth material, rather than a manufactured cement binder or a liquid surface coating. The word may also describe buildings constructed from these blocks, but that broader use does not change the material category being tested.

Step 2: Compare every listed category Option (A), type of cement, is incorrect: adobe is not a hydraulic binder that sets like Portland cement when mixed with water. Option (B), type of floor finish, is incorrect: although earth can be used in earthen floors, the term adobe conventionally identifies sun-dried earth bricks in this classification. Option (C), type of paint, is incorrect because adobe is not a film-forming coating applied for colour or protection. Option (D), type of brick, matches its moulded masonry-unit form and its common architectural meaning. Drying instead of firing distinguishes it from a conventional fired clay brick without taking it out of the brick category.

Step 3: Conclusion Adobe is a **type of brick**, specifically a sun-dried earth brick. Hence, the correct option is (D).

Quick Tip to Solve: Associate adobe with moulded, sun-dried earth masonry; the manufacturing method separates it from cement and surface coatings.

32. Given below are two statements:

Statement I : Chandigarh is the first planned city of Independent India

Statement II : Chandigarh city was designed by Swiss French architect Le Corbusier

In the light of above statements, choose the most appropriate answer form 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:

- Chandigarh was developed after Indian independence as a new planned capital city, making it a standard example in modern Indian urban planning.
- Le Corbusier was a Swiss-born French architect closely associated with Chandigarh's master plan and major civic buildings. Evaluate the truth of both statements separately before selecting the combination.

Step 1: Check the statement about the planned city Statement I calls Chandigarh the first planned city of independent India. Chandigarh was conceived and developed after independence as a new capital for Punjab following Partition. Its urban plan organized the city into sectors with a road hierarchy, civic facilities, residential areas and open spaces. In the conventional modern Indian planning description used here, it is recognized as the first planned city of independent India, so Statement I is correct. This description refers to the post-independence city-building programme. It does not assert that no planned settlements existed on the subcontinent before independence; older planned cities therefore do not invalidate this statement.

Step 2: Check the architect and choose the matching combination Statement II associates the design of Chandigarh with the Swiss French architect Le Corbusier. He developed the city's revised master plan and designed its celebrated Capitol Complex buildings, establishing the association tested in the statement. The wider project also involved other planners and architects; the statement does not claim that he personally designed every individual building. Thus Statement II is also correct. Option (A) states that both are correct and fits these two assessments. Option (B) rejects both true statements. Option (C) incorrectly rejects the Le Corbusier association, while option (D) incorrectly rejects Chandigarh's post-independence planned-city status.

Step 3: Conclusion Both Statement I and Statement II are correct. Hence, the correct option is (A).

Quick Tip to Solve: For statement-pair questions, determine each truth value independently; remember Chandigarh together with Le Corbusier.

33. Given below are two statements:

Statement I : Glass has low thermal conductivity

Statement II : Glass can absorb, refract and transmit light.

In the light of above statements, choose the most appropriate answer form 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:

- Thermal conductivity measures how readily a material transfers heat by conduction. Ordinary building glass is a relatively poor conductor compared with metals.
- Light incident on glass can be reflected, absorbed or transmitted. A transmitted ray can also change direction by refraction at a glass surface.

Step 1: Assess the thermal statement Statement I is correct. Glass has low thermal conductivity, so it does not conduct heat as readily as a metal such as aluminium or steel. This property concerns conduction through the material; it does not mean that a glass window prevents every kind of heat transfer.

Step 2: Assess the optical statement and compare the choices Statement II is also correct. Glass transmits light, refracts rays at its interfaces, and absorbs some radiation according to its composition and wavelength. Absorption and transmission can occur for different portions of the incident energy. Thus the choice saying both statements are false fails, and each choice declaring just one statement false also fails.

Step 3: Conclusion Both Statement I and Statement II are correct. Hence, the correct option is (A).

Quick Tip to Solve: Evaluate thermal and optical behaviour separately: poor heat conduction does not prevent a material from transmitting and refracting light.

34. Match List I with List II

LIST I	LIST II		
A.	PMUY	I.	KAUSHAL VISKAS YOJNA
B.	PMAY	II.	JAN DHAN YOJANA
C.	PMKVY	III.	UJJWALA YOJANA
D.	PMJDY	IV.	AWAS YOJANA

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

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

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

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

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

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

Solution:

Concept:

- An abbreviation is matched by expanding the full scheme name, rather than by the order of entries in the second list.
- PM denotes Pradhan Mantri. The remaining letters identify Ujjwala, Awas, Kaushal Vikas and Jan Dhan respectively.

Step 1: Expand the four abbreviations PMUY is Pradhan Mantri Ujjwala Yojana, so A matches III. PMAY is Pradhan Mantri Awas Yojana, so B matches IV. PMKVY is Pradhan Mantri Kaushal Vikas Yojana, so C matches I. PMJDY is Pradhan Mantri Jan Dhan Yojana, so D matches II.

Step 2: Check the complete matching against all options The resulting ordered matching is A-III, B-IV, C-I, D-II. The first option incorrectly assigns PMUY to skill development and PMAY to Ujjwala. The third option confuses the housing, banking and fuel-scheme names. The fourth option gets the last two matches right but incorrectly gives A-IV and B-III. Only the second option preserves all four expansions simultaneously.

Step 3: Conclusion The correct matching is A-III, B-IV, C-I, D-II. Hence, the correct option is (B).

Quick Tip to Solve: Use the distinctive letters: U for Ujjwala, A for Awas, KV for Kaushal Vikas and JD for Jan Dhan.

35. Match List I with List II

LIST I	LIST II		
A.	CP Kukreja	I.	IIM Ahmedabad
B.	Louis I Kahn	II.	Jawahar Lal Nehru University
C.	B.V Doshi	III.	IIT Kanpur
D.	Achyut Kanvinde	IV.	IIM Bengaluru

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

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

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

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

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

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

Solution:

Concept:

- Architectural-awareness matching links an architect to the institution whose campus or principal complex they designed.
- The four associations here are CP Kukreja with JNU, Louis I Kahn with IIM Ahmedabad, B.V. Doshi with IIM Bengaluru, and Achyut Kanvinde with IIT Kanpur.

Step 1: Identify each architect-campus association CP Kukreja is associated with the Jawaharlal Nehru University campus in New Delhi, giving A-II. Louis I Kahn designed the celebrated IIM Ahmedabad campus, giving B-I. B.V. Doshi designed IIM Bengaluru, giving C-IV. Achyut Kanvinde is associated with the IIT Kanpur campus, giving D-III.

Step 2: Eliminate mismatched combinations The complete sequence is therefore II, I, IV, III. The first option wrongly links Kukreja to IIM Bengaluru and Kahn to JNU. The second option preserves Kahn-IIM Ahmedabad but interchanges the other institutional associations. The fourth option does not preserve any of the required pairs. The third option alone agrees with every architect-campus association.

Step 3: Conclusion The matching is A-II, B-I, C-IV, D-III. Hence, the correct option is (C).

Quick Tip to Solve: Anchor the matching with Kahn-IIM Ahmedabad and Doshi-IIM Bengaluru, then verify the JNU and IIT Kanpur pairs.

36. Which one of these is not a complimentary colour? [4 marks]

(A) Blue-Orange

(B) Red-Green

(C) Blue-Green

(D) Violet-Yellow

Correct Answer: (C) Blue-Green

Solution:

Concept:

- In the traditional artist's red-yellow-blue colour wheel, complementary colours lie opposite one another.
- The principal complementary pairs are red-green, yellow-violet and blue-orange. Neighbouring colours are analogous rather than complementary.

Step 1: Identify the opposite pairs Blue is opposite orange, red is opposite green, and violet is opposite yellow on the traditional colour wheel used in basic design. Consequently Blue-Orange, Red-Green and Violet-Yellow each form a complementary pair. These three choices do not satisfy the question's demand to identify the pair that is not complementary.

Step 2: Test the remaining pair Blue and green lie beside one another in the cool-colour region of the wheel. They share a close visual relationship and are described as analogous colours. They are not an opposite pair. The negative word "not" therefore selects Blue-Green, rather than any of the three standard complementary pairs already checked.

Step 3: Conclusion Blue-Green is not a complementary colour pair. Hence, the correct option is (C).

Quick Tip to Solve: For a negative colour-wheel question, first mark the three familiar opposite pairs; the adjacent pair is the exception.

37. In which State of India, Robbers cave is situated: [4 marks]

(A) Himachal Pradesh

(B) Uttarakhand

(C) Uttar Pradesh

(D) Madhya Pradesh

Correct Answer: (B) Uttarakhand

Solution:

Concept:

- A landmark-location question is answered by identifying the known place first, then matching its administrative state.
- Robbers Cave, also called Guchhupani, is a natural cave attraction near Dehradun. Dehradun is in Uttarakhand.

Step 1: Locate the named landmark The Robbers Cave referred to in this Indian landmark question

is Guchhupani near Dehradun. Its association with Dehradun is the decisive geographical clue. The question asks for its state, so the final selection must be the state containing this locality rather than merely another Himalayan state.

Step 2: Connect the city with the listed state Dehradun belongs to Uttarakhand, giving the second option. Himachal Pradesh is another Himalayan state but does not contain Dehradun. Uttar Pradesh is a different present-day state; the location is in Uttarakhand. Madhya Pradesh lies in central India and does not contain this landmark. Thus the three alternatives fail the same location check.

Step 3: Conclusion Robbers Cave is situated in Uttarakhand. Hence, the correct option is (B).

Quick Tip to Solve: Remember the chain Robbers Cave-Guchhupani-Dehradun-Uttarakhand, which fixes both the local name and the state.

38. Choose the correct option among the following:

Petronas Tower is situated in: [4 marks]

(A) Paris

(B) Dubai

(C) Kuala Lumpur

(D) New York

Correct Answer: (C) Kuala Lumpur

Solution:

Concept:

- A landmark-city association identifies the city containing the named building; a familiar skyline alone is not sufficient.
- The Petronas Twin Towers are the paired landmark towers in Kuala Lumpur, Malaysia.

Step 1: Identify the building and its city The name Petronas refers here to the famous twin-tower complex in Kuala Lumpur. The building is associated with Malaysia and is a prominent feature of the Kuala Lumpur skyline. Therefore its city must be selected from the choices, rather than selecting another city merely because it also has tall buildings.

Step 2: Compare the alternatives Kuala Lumpur is the third listed city and matches the towers. Paris is associated with landmarks such as the Eiffel Tower, but it is not the site of the Petronas Towers. Dubai has its own skyscraper landmarks and does not contain this complex. New York likewise has a well-known high-rise skyline but is not the location. Only Kuala Lumpur satisfies the named-building identification.

Step 3: Conclusion The Petronas Towers are situated in Kuala Lumpur. Hence, the correct option is (C).

Quick Tip to Solve: Keep the city-country pair together: Petronas Towers-Kuala Lumpur-Malaysia, rather than associating all tall towers with Dubai.

39. The Konark Temple is located in which state? [4 marks]

(A) Madhya Pradesh

(B) Odisha

(C) Karnataka

(D) Rajasthan

Correct Answer: (B) Odisha

Solution:

Concept:

- Temple-location questions link the specific monument to its town and state; architectural fame alone does not determine its location.
- The Konark Sun Temple stands at Konark in Odisha on India's eastern side. Its chariot form is a useful identifying feature.

Step 1: Identify the monument The question refers to the famous Sun Temple at Konark. Its monumental chariot conception, with carved stone wheels, distinguishes this particular temple in Indian architectural awareness. Konark is a town in Odisha, so the state follows directly from identifying the named monument correctly.

Step 2: Test the listed states Odisha is the second option and contains Konark. Madhya Pradesh has other important temple sites but does not contain Konark. Karnataka has major examples of temple architecture of its own, yet the named Sun Temple is not there. Rajasthan is also not the state containing Konark. These alternatives cannot replace the exact town-state association requested.

Step 3: Conclusion The Konark Temple is located in Odisha. Hence, the correct option is (B).

Quick Tip to Solve: Associate the Sun Temple's stone chariot and wheels with Konark-Odisha to keep it distinct from other celebrated temple sites.

40. Who is the architect of the Lotus Temple? [4 marks]

(A) Louis I Kahn

(B) Mohse Safdi

(C) Fariborz Sahba

(D) Richard Meyer

Correct Answer: (C) Fariborz Sahba

Solution:

Concept:

- An architect-identification question requires the designer of the particular named building, rather than another architect working in the same broad modern period.
- The Lotus Temple in New Delhi was designed by Fariborz Sahba. Its lotus-inspired form identifies the building in this question.

Step 1: Identify the temple and its designer The Lotus Temple is the lotus-shaped Baha'i House of

Worship in New Delhi. The architect associated with its design is Fariborz Sahba. The name of the designer is the decisive fact, while the lotus form helps ensure that the correct landmark has been identified.

Step 2: Check all four architect choices Fariborz Sahba appears as the third option. Louis I Kahn is associated with other landmark works, including IIM Ahmedabad, rather than the Lotus Temple. The second name refers to Moshe Safdie, who is not its architect. The fourth refers to Richard Meier, who is also not the designer of this temple. Therefore the alternatives do not match the required architect-building pair.

Step 3: Conclusion The architect of the Lotus Temple is Fariborz Sahba. Hence, the correct option is (C).

Quick Tip to Solve: Remember the direct association Lotus Temple-New Delhi-Fariborz Sahba; do not confuse it with other modern architects' institutional projects.

41. A small lift for carrying only a small load is known as: [4 marks]

(A) A dead Bearer

(B) A Dumb Waiter

(C) A Jockey Boy

(D) A push upper

Correct Answer: (B) A Dumb Waiter

Solution:

Concept:

- A lift is a vertical transportation device. Its name depends on the load it is designed to carry and whether people are permitted inside it.
- A dumbwaiter is a small goods lift used for light articles such as meals, dishes, documents or other supplies between different floors. It is not a passenger lift.

Step 1: Identify the function described The question specifies a small lift and a small load. This describes a service installation for moving articles rather than a lift intended to carry occupants. A familiar example is a kitchen sending food to a dining floor through a small enclosed lift shaft. The important clue is the limited size and service-load function, rather than the power source or the direction of movement.

Step 2: Match the technical term A dumbwaiter is the established building-services term for this device, so option (B) matches both its size and its purpose. A dead bearer is not the technical name of a light-duty service lift. Neither a jockey boy nor a push upper denotes this standard lift installation, so options (A), (C) and (D) do not describe the equipment asked about. The term dumbwaiter identifies the equipment, not a person operating it.

Step 3: Conclusion A small lift carrying only small goods or service loads is a dumbwaiter. Hence, the correct option is (B).

Quick Tip to Solve: Link dumbwaiter with meals or small supplies travelling between floors; reserve passenger lift for a lift designed to carry people.

42. Which are often referred as 'twin cities' of Odisha? [4 marks]

(A) Bhubaneshwar-Puri

(B) Puri-Cuttack

(C) Bhubaneshwar-Cuttack

(D) Bhubaneshwar-Rourkela

Correct Answer: (C) Bhubaneshwar-Cuttack

Solution:

Concept:

- The expression twin cities commonly identifies a closely associated pair of neighbouring urban centres whose functions and urban growth are strongly connected.
- Bhubaneshwar and Cuttack form Odisha's recognised twin-city pair. Bhubaneshwar is the state capital, while Cuttack is its historic administrative and commercial centre.

Step 1: Identify the recognised urban pair Bhubaneshwar and Cuttack are nearby cities in coastal Odisha and have complementary administrative, institutional and commercial roles. Their close association gives rise to the usual description of them as the twin cities of the state. This is a conventional geographical name, so the answer must be the recognised pair rather than simply any two important cities situated in Odisha.

Step 2: Eliminate the other combinations Option (C) lists Bhubaneshwar-Cuttack and therefore gives the required pair. Puri is a major pilgrimage and coastal city, but neither Bhubaneshwar-Puri in option (A) nor Puri-Cuttack in option (B) is the pair meant by this particular twin-city designation. Rourkela is an important industrial city in another part of the state; Bhubaneshwar-Rourkela in option (D) is also not the recognised pair.

Step 3: Conclusion Bhubaneshwar and Cuttack are commonly called the twin cities of Odisha. Hence, the correct option is (C).

Quick Tip to Solve: Remember the pair as Odisha's present capital, Bhubaneshwar, together with its historic administrative centre, Cuttack.

43. Which is the correct chronology of Human Civilizations in terms of their existence? [4 marks]

(A) Mesopotamia-Harappa-Egyptian-Chinese

(B) Mesopotamia-Egyptian-Harappa-Chinese

(C) Mesopotamia-Chinese-Harappa-Egyptian

(D) Egyptian-Mesopotamia-Harappa-Sumerian

Correct Answer: (B) Mesopotamia-Egyptian-Harappa-Chinese

Solution:

Concept:

- Chronological order places civilisations according to the conventional dates of their early urban development, from earlier to later. The dates are approximate and depend on the historical phase being compared.
- The usual broad sequence for these ancient river-valley civilisations is Mesopotamian, Egyptian, Harappan and Chinese. Early urban Mesopotamia precedes the other three in this convention.

Step 1: Arrange the early river-valley civilisations Mesopotamian urban civilisation developed in the Tigris-Euphrates region during the fourth millennium BCE. Egyptian civilisation around the Nile is conventionally associated with political unification around 3100 BCE. The Mature Harappan urban phase is placed around 2600 BCE onward. Early Chinese dynastic civilisation in the Yellow River region is conventionally placed later in this comparison. These reference points establish the broad sequence required by the question.

Step 2: Compare the sequences in the options The resulting order is Mesopotamia-Egyptian-Harappa-Chinese, exactly as in option (B). Option (A) interchanges the Egyptian and Harappan positions. Option (C) places Chinese civilisation too early, before both Harappan and Egyptian civilisation. Option (D) begins with Egyptian civilisation and separates Sumerian civilisation from its Mesopotamian context, so it cannot give the standard chronological sequence of the four traditions listed.

Step 3: Conclusion The conventional chronological order is Mesopotamian, Egyptian, Harappan and Chinese civilisation. Hence, the correct option is (B).

Quick Tip to Solve: Use the four river regions as memory anchors: Tigris-Euphrates, Nile, Indus and Yellow River, in that conventional chronological order.

44. Qutub-Minar in Delhi was built by: [4 marks]

(A) Shah Jahan

(B) Jahangir

(C) Akbar

(D) Qutub ud-din Aibak

Correct Answer: (D) Qutub ud-din Aibak

Solution:

Concept:

- Monument attribution may refer to the ruler who initiated a building, even when later rulers completed or repaired it. The historical phase of the monument helps distinguish the options.
- Qutb-ud-din Aibak began the Qutub Minar in Delhi in the late twelfth century. Iltutmish subsequently added storeys, and later rulers carried out further work.

Step 1: Identify the ruler who initiated the minaret The Qutub Minar belongs to the early Delhi Sultanate architectural tradition. Its construction was initiated by Qutb-ud-din Aibak, associated with the establishment of Turkish rule at Delhi. Thus the question's conventional attribution to a builder points to Aibak. This does not imply that every storey was completed during his lifetime; later additions are a separate part of the monument's building history.

Step 2: Check the other names against the period Shah Jahan, Jahangir and Akbar were Mughal emperors who ruled several centuries after the minaret was begun. They therefore cannot be the ruler responsible for initiating its original construction. Options (A), (B) and (C) are rejected on this historical basis. Option (D), Qutub ud-din Aibak, is the only listed ruler belonging to the relevant early Sultanate context and is the accepted attribution.

Step 3: Conclusion The Qutub Minar was begun by Qutb-ud-din Aibak. Hence, the correct option is (D).

Quick Tip to Solve: For Qutub Minar, distinguish Aibak, who began it, from Iltutmish, who extended it; the Mughal rulers listed belong to a later period.

45. Which direction in the southern hemisphere would you get glare free (diffused) light throughout the year? [4 marks]

(A) North

(B) South

(C) East

(D) West

Correct Answer: (B) South

Solution:

Concept:

- Diffuse daylight is skylight scattered by the atmosphere. Direct solar rays can produce glare and heat gain, so a studio seeking even light is generally oriented away from the predominant solar exposure.
- The usual north-light rule of the northern hemisphere is reversed in the southern hemisphere: a south-facing opening is the conventional choice for relatively even, diffuse daylight.

Step 1: Reverse the hemisphere-based orientation For a typical southern-hemisphere site outside the tropics, the midday sun lies to the north. Consequently, a north-facing opening receives appreciable direct solar exposure. A south-facing opening faces away from this principal solar path and is preferred when the aim is steadier, indirect light rather than strong sunlight entering a room. This is the standard architectural daylighting convention tested here.

Step 2: Eliminate the sun-facing alternatives Option (B), South, gives the direction for the conventional diffuse-light orientation. North in option (A) faces the predominant solar exposure in this hemisphere. East in option (C) admits low-angle morning sun, while West in option (D) admits low-angle afternoon sun; both can produce glare. Actual year-round glare control also depends on latitude, window geometry and shading, particularly within tropical latitudes, so orientation is a design principle rather than an absolute guarantee for every possible site.

Step 3: Conclusion Under the conventional southern-hemisphere daylighting rule, south-facing light is preferred for diffuse, relatively glare-free illumination. Hence, the correct option is (B).

Quick Tip to Solve: Reverse the studio-light rule when crossing hemispheres: north light in the northern hemisphere corresponds to south light in the southern hemisphere.

46. Who is the architect of the famous "Jawaharlal Kala Complex" in Jaipur? [4 marks]

(A) Raj Rewal

(B) Charles Correa

(C) Achyut Kanvinde

(D) Hafeez Contractor

Correct Answer: (B) Charles Correa

Solution:

Concept:

- Architectural-awareness questions pair a named building with its designer. The correct attribution depends on the specific project, rather than on the fame of an architect alone.
- The Jaipur arts complex referred to here is the Jawahar Kala Kendra, designed by Charles Correa. Its planning is associated with the nine-square organisation and a response to Jaipur's historic urban design.

Step 1: Identify the Jaipur cultural complex The name in the question refers to the well-known arts and cultural complex in Jaipur associated with Charles Correa. It is commonly known as Jawahar Kala Kendra. Its arrangement of courts and built spaces interprets a nine-square planning idea, making it one of Correa's recognised Indian cultural projects. This project identity determines the architectural attribution.

Step 2: Match the designer with the available names Charles Correa appears in option (B), so that is the direct match. Raj Rewal is associated with projects such as the Hall of Nations in Delhi, rather than this Jaipur complex. Achyut Kanvinde is known for institutional and modern Indian architectural work, but is not its designer. Hafeez Contractor is also not the architect of this complex. Therefore options (A), (C) and (D) do not satisfy the project-designer pairing asked for.

Step 3: Conclusion The Jaipur arts complex referred to in the question was designed by Charles Correa. Hence, the correct option is (B).

Quick Tip to Solve: Associate Jaipur's Jawahar Kala Kendra and its nine-square planning concept with Charles Correa to distinguish it from other architects' projects.

47. Dhajji-Dewari is a construction style popular predominantly in _____. [4 marks]

(A) Coastal Areas

(B) Plains

(C) Mountainous Region

(D) Desert Areas

Correct Answer: (C) Mountainous Region

Solution:

Concept:

- Dhajji-Dewari is a traditional construction system using a timber framework divided into small panels with masonry infill. The timber members tie the wall assembly together.
- The system is strongly associated with Himalayan mountain regions, including Kashmir. Its timber framing and subdivision of infill are characteristic of construction traditions in seismic mountain areas.

Step 1: Recognise the construction technique In Dhajji-Dewari construction, the wall is not simply a solid unreinforced mass of stone or brick. Timber horizontal, vertical and diagonal members form an interconnected framework, and the smaller spaces are filled with masonry. The technique has a well-established vernacular association with Himalayan settlements. This geographic link, rather than the broad availability of timber alone, answers the question.

Step 2: Select the region and reject the alternatives Mountainous Region in option (C) matches the Himalayan association of Dhajji-Dewari. Coastal areas, plains and desert areas can each have their own vernacular building systems, but they are not the predominant regional setting identified by this particular name. Therefore options (A), (B) and (D) are rejected. The timber-laced construction is especially significant in discussions of traditional responses to earthquake risk in mountain settlements.

Step 3: Conclusion Dhajji-Dewari is predominantly associated with mountainous regions, particularly the Himalayan belt. Hence, the correct option is (C).

Quick Tip to Solve: Connect Dhajji-Dewari with a timber grid and masonry infill in Himalayan settlements; this links both the technique and its characteristic region.

48. Which stone is used for roofing in mountainous regions? [4 marks]

(A) Marble

(B) Granite

(C) Shale

(D) Sand Stone

Correct Answer: (C) Shale

Solution:

Concept:

- A stone used for sloping roofs should be available as relatively thin overlapping pieces, so its ability to split along closely spaced planes is relevant to the material comparison.
- Shale is a fine-grained sedimentary rock with a layered, fissile structure. Slate, the better-known durable natural roofing stone, is a distinct metamorphic rock commonly derived from shale; the two names should not be treated as synonyms.

Step 1: Compare the material properties of the listed stones The question's intended association is with a thinly layered stone rather than with a massive decorative or structural stone. Shale is the listed fine-grained material characterised by splitting into thin layers. This makes option (C) the expected selection in this material-awareness question. For practical construction, the suitability of a particular stone still depends on weather resistance, water absorption and local material quality, not only on its ability to split.

Step 2: Distinguish the answer from the other stones Marble and granite are generally associated with massive blocks, slabs, finishes and other building uses rather than with the thin layered roofing association tested here. Sandstone is commonly used in walling, paving and architectural stonework and is not the intended choice in this list. Thus options (A), (B) and (D) are eliminated. In precise material terminology, traditional durable mountain stone roofs are especially associated with slate; slate is not offered among these options, and it must not be confused with ordinary untreated shale.

Step 3: Conclusion Among the listed options, the expected answer is shale, the thinly layered material in option (C). Slate is the distinct stone commonly specified for durable natural roofing. Hence, the correct option is (C).

Quick Tip to Solve: For this option list, identify shale by its thin layers; in practical building terminology, keep shale distinct from metamorphic roofing slate.

49. Chandigarh is an example of which type of city planning. [4 marks]

(A) Radio Centric

(B) Grid-iron

(C) Linear

(D) Organic

Correct Answer: (B) Grid-iron

Solution:

Concept:

- A grid-iron plan organises the principal circulation routes into a network of intersecting roads, producing a repeated arrangement of blocks or sectors.
- Planning patterns describe the overall organisation of a settlement. They are distinguished by the relationship between roads, development areas and major centres, rather than by the shape of an individual building.

Step 1: Identify the organisation of Chandigarh Chandigarh is a planned city organised into sectors, with a hierarchy of roads separating and serving those sectors. Its repeated sector arrangement and intersecting major routes provide the characteristic framework of a grid-iron plan. The term does not require every minor lane to be straight or every intersection to have identical dimensions; it describes the dominant city-scale pattern.

Step 2: Compare the other planning patterns A radio-centric city has routes radiating from a centre, usually connected by circumferential routes. That radial framework is not the defining sector pattern of Chandigarh. A linear city develops principally along one elongated transport corridor or geographic axis, rather than as a repeated network of sectors. An organic city develops incrementally with an irregular street pattern adapted to local growth and terrain. Chandigarh's deliberately laid-out sector grid is therefore not classified as organic. These distinctions eliminate (A), (C) and (D).

Step 3: Conclusion Chandigarh is an example of grid-iron city planning. Hence, the correct option is (B).

Quick Tip to Solve: Associate Chandigarh's repeated sectors and intersecting road network with the grid-iron pattern; reserve radio-centric for spokes and rings around a centre.

50. If you have to build on the seashore in Goa, which rooms would have the best view of the sea? [4 marks]

(A) Those facing North

(B) Those facing South

(C) Those facing East

(D) Those facing West

Correct Answer: (D) Those facing West

Solution:

Concept:

- A room receives its principal outward view through the direction its windows or open frontage face. To choose a sea-facing room, first locate the sea relative to the land at the named place.
- Goa lies on India's western coast, with the Arabian Sea to its west. The question asks for the direction of the sea view, rather than an orientation chosen for solar control or ventilation.

Step 1: Locate the sea relative to Goa On the western coastline of India, the Arabian Sea lies on the seaward, western side of Goa. A building on that seashore therefore has its general sea-facing side towards the west. A person looking outward from that side looks from the coast towards the sea, whereas a person looking east generally looks towards the land.

Step 2: Match the room frontage to the sea direction Rooms facing west have the direct orientation towards the Arabian Sea in the geographic setting described. East-facing rooms face the inland direction and therefore do not supply the requested general orientation. North-facing and south-facing rooms look approximately along the coastline rather than directly towards its seaward side. The question gives no particular curved bay, promontory, obstructions or site plan that would reverse the general west-coast relationship, so the choice follows Goa's stated coastal location. This is a view-orientation decision: afternoon sun on a west-facing room is a separate design consideration and does not change which side faces the sea.

Step 3: Conclusion The west-facing rooms would have the best direct view of the sea. Hence, the correct option is (D).

Quick Tip to Solve: Locate the named place on India's coastline first: Goa is on the west coast, so its general seaward view is towards the west.

51. "NIFT" National Institute of Fashion Technology, Delhi is designed by [4 marks]

(A) B.V Doshi

(B) C.P Kukreja

(C) Raj Rewal

(D) Bimal Patel

Correct Answer: (A) B.V Doshi

Solution:

Concept:

- Architectural-awareness questions are answered by identifying the documented architect of the particular building or campus named, rather than merely choosing a prominent architect associated with the same city.
- The National Institute of Fashion Technology campus in New Delhi is a work of Balkrishna Vithaldas Doshi, commonly written B. V. Doshi.

Step 1: Identify the named institutional campus The question specifies NIFT in Delhi. This campus is associated with B. V. Doshi, whose institutional architecture gives importance to connected spaces, courts, circulation and opportunities for interaction. The identification concerns this particular Delhi campus; the existence of other NIFT campuses in other cities does not change the architect asked for here. Expanding the initials also makes the match unambiguous: B. V. refers to Balkrishna Vithaldas Doshi.

Step 2: Eliminate the other architect names C. P. Kukreja, Raj Rewal and Bimal Patel are distinct architects and do not provide the architect-building attribution requested for NIFT Delhi. Their inclusion as alternatives tests recognition of the specific commission rather than a general association with Indian institutional design. In particular, the fact that Raj Rewal is strongly associated with major public and institutional buildings in Delhi is insufficient to select his name for every Delhi institution. The direct NIFT Delhi–Doshi attribution selects (A) and excludes (B), (C) and (D).

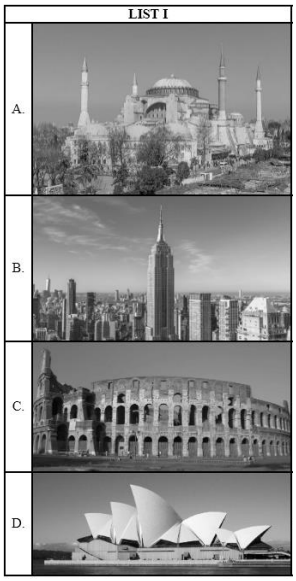
Step 3: Conclusion NIFT, Delhi was designed by B. V. Doshi. Hence, the correct option is (A).

Quick Tip to Solve: Learn architect-building pairs with the city attached: NIFT Delhi pairs with B. V. Doshi, which prevents confusion with other institutional projects.

52. Match List I with List II

LIST II	
I.	Empire state Building
II.	Hagia Sophia
III.	Sydney Opera House
IV.	Colosseum

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



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

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

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

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

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

Solution:

Concept:

- Landmark buildings can be identified from their characteristic massing, roof form and facade. Match the pictured building first, then read its Roman numeral from List II.
- A matching answer must satisfy all four pairs simultaneously. A familiar building name in an option does not make the entire matching correct.

Step 1: Identify pictures A and B Picture A shows a massive central dome with smaller surrounding domes and four slender minarets. These features identify Hagia Sophia, so A matches II. Picture B shows a tall stepped skyscraper with a narrow upper tower and spire, the familiar silhouette of the Empire State Building in New York. Therefore B matches I. The two pictures are quite different in scale and architectural composition: a broad domed monument versus a vertically emphasised skyscraper.

Step 2: Identify pictures C and D Picture C shows a large elliptical amphitheatre with repeated tiers

of arches around its exterior. This is the Colosseum, so C matches IV. Picture D has a group of large white shell-shaped roofs beside the water, identifying the Sydney Opera House. Thus D matches III. The continuous arcaded facade in C cannot be confused with the separated sculptural roof shells in D.

Step 3: Compare the complete mapping The four identifications give A-II, B-I, C-IV and D-III. Option (A) reproduces every pair. Option (B) begins by treating A as the Empire State Building; option (C) also assigns A to that skyscraper; option (D) assigns A to the Colosseum. Each of those alternatives already conflicts with the domes and minarets visible in picture A, so none can be the complete matching.

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

Quick Tip to Solve: Use the most distinctive silhouettes first: the Opera House has white roof shells, while the Colosseum has repeated tiers of arches.

53. Match List I with List II

LIST II	
I.	Tesla
II.	Ferrari
III.	Porsche
IV.	Toyota

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

LIST I

A. 

B. 

C. 

D. 

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

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

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

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

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

Solution:

Concept:

- An emblem is identified by its graphic construction, not merely by whether it contains an animal or a letter. Compare its outline and internal symbol with the named manufacturer.
- List I uses letters A-D for the pictures, whereas List II uses Roman numerals I-IV for the brands. Keep these two label systems separate when forming the matching.

Step 1: Identify the first two emblems Emblem A consists of overlapping ovals enclosed by a larger horizontal oval. It is the Toyota emblem, which is entry IV in List II. Thus A-IV. Emblem B is the stylised letter T with a curved upper bar, identifying Tesla. Tesla is entry I, giving B-I. Neither of these first two symbols is a horse-bearing shield.

Step 2: Distinguish the two horse-bearing shields Emblem C shows a prancing horse on a shield, together with the letters S F below it; this is Ferrari. Ferrari is entry II, so C-II. Emblem D is a subdivided crest that contains a central horse and the visible word Stuttgart, together with the outer Porsche name. It identifies Porsche, entry III, giving D-III. The presence of a horse alone would not distinguish these last two, but the complete crest does.

Step 3: Select the option matching all four Combining the observations gives A-IV, B-I, C-II, D-III. This is exactly option (A). Option (B) identifies the oval emblem as Ferrari and is inconsistent with the first picture. Option (C) identifies that same oval as Porsche, also incorrect. Option (D) gets Toyota and Ferrari in their correct positions but interchanges Tesla and Porsche; its assignments to B and D contradict the visible T and the Stuttgart crest.

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

Quick Tip to Solve: Distinguish Ferrari from Porsche by the whole shield: the Ferrari horse has S F below it; Porsche uses a subdivided Stuttgart crest.

54. Given below are two statements:

Statement I : Red, Blue and Yellow are the primary colours of a colour wheel.

Statement II : The colours which are positioned opposite to each other in a colour wheel are known as complementary colours.

In the light of above statements, choose the correct answer form 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:

- In the traditional artist's colour wheel used for basic colour theory, the primary colours are red, yellow and blue. Mixing pairs of these produces the secondary colours orange, green and violet.
- Complementary colours occupy opposite positions on a colour wheel. In the traditional wheel the complementary pairs include red–green, blue–orange and yellow–violet.

Step 1: Evaluate Statement I in its colour-wheel context Statement I lists red, blue and yellow as the primary colours. These are the three primary colours of the traditional painting and design colour wheel. For example, yellow mixed with blue produces green, red mixed with yellow produces orange, and blue mixed with red produces violet. Thus the statement is correct in the artist's colour-wheel context of this aptitude question. The red, green and blue primaries used for additive light in screens concern a different mixing model and should not be substituted for the traditional wheel here.

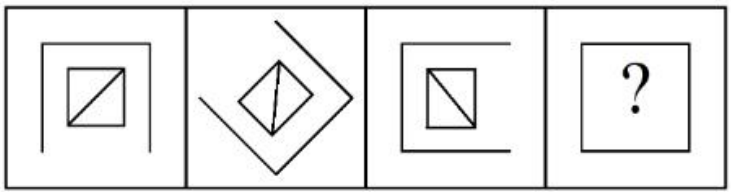
Step 2: Evaluate Statement II and select the joint verdict Statement II defines complementary colours as colours positioned opposite one another on the wheel. That is precisely the complementary relationship: each traditional primary faces the secondary made from the other two primaries. Red therefore faces green, blue faces orange, and yellow faces violet. Statement II is also correct. Option (B) incorrectly rejects both statements. Option (C) wrongly rejects the definition of complementary colours, while option (D) wrongly rejects the traditional red–yellow–blue set. Only option (A) accepts both correct statements.

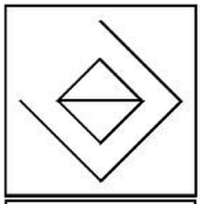
Step 3: Conclusion Both Statement I and Statement II are correct for the traditional colour wheel. Hence, the correct option is (A).

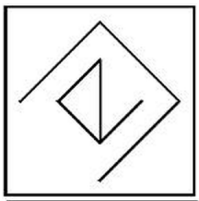
Quick Tip to Solve: For a traditional art colour wheel, use red–yellow–blue primaries and identify complementary colours by opposite positions, such as blue and orange.

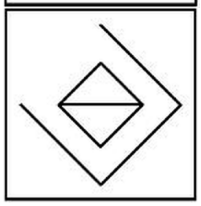
55. Following question consists of problem figures followed by answer figures. Select a figure from amongst the answer figures which will continue the same series or pattern as established by the problem figures.

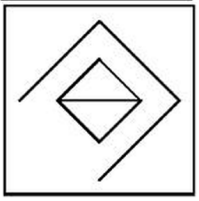
PROBLEM FIGURES [4 marks]



(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- A visual-series rule must account for every changing part. Here the large open frame and the smaller divided figure provide two independent checks.
- Rotation preserves the number of sides and the connections between segments. A candidate that loses a side of the inner figure cannot be a rotated continuation.

Step 1: Track the opening in the outer frame In the first problem figure the large three-sided frame has its open side at the bottom. In the second it is a diamond-oriented frame with its opening at the upper left. In the third the frame is square-oriented again and has its opening at the right. These successive positions correspond to turning the frame through the same angle each time. Continuing this change places the next opening at the lower left of a diamond-oriented frame.

Step 2: Track the line dividing the inner figure The smaller closed figure alternates between a square and a diamond. Its internal dividing line is first an upward-sloping diagonal, then a nearly vertical diagonal of the diamond, then a downward-sloping diagonal of the square. Continuing the turn gives a horizontal line across the next diamond. The diamond must remain closed, because the preceding inner figures are closed and retain their complete outlines.

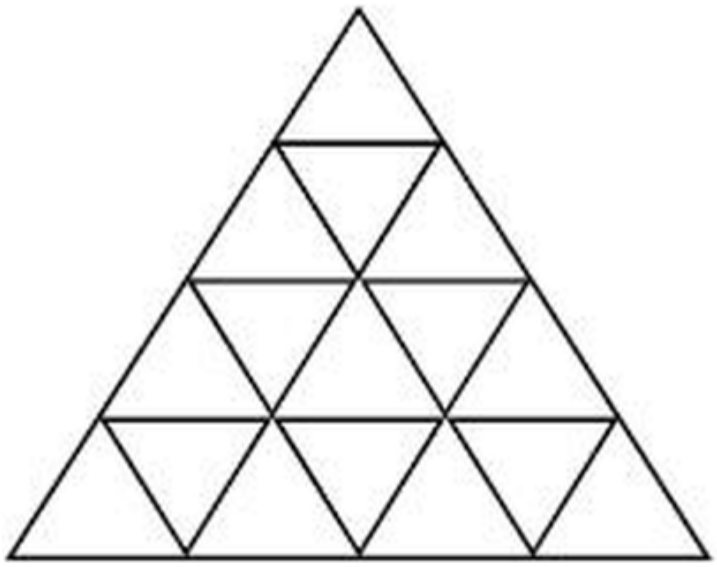
Step 3: Test the answer figures against both rules Option (D) has the required lower-left opening in the large frame and a closed inner diamond divided horizontally. Options (A) and (C) have the outer opening at the upper left, which repeats the wrong orientation instead of continuing the established

changes. Option (B) has an incomplete inner figure and a vertical segment, so it fails the inner-figure rule even though its outer frame has the relevant general orientation. Only (D) satisfies both checks together.

Step 4: Conclusion The next figure is the closed, horizontally divided inner diamond inside the outer frame open at the lower left. Hence, the correct option is (D).

Quick Tip to Solve: Track the outer opening and the inner dividing line separately, then choose a figure that satisfies both changes.

56. How many triangles are there in given figure:- [4 marks]



(A) 26

(B) 25

(C) 27

(D) 24

Correct Answer: (C) 27

Solution:

Concept:

- Count triangles by orientation and side length to avoid counting a large triangle several times. The smallest visible triangle supplies the unit of side length.
- The outer triangle has four unit segments along each side. Every triangle must have sides along the three directions of the drawn grid, so upward and downward triangles exhaust the possibilities.

Step 1: Count all upward-pointing triangles For side length one unit, the rows contain 1, 2, 3 and 4 upward triangles, giving 10. For side length two units, their possible top positions lie in rows containing 1, 2 and 3 positions, giving 6. For side length three units there are $1+2=3$ positions. The complete outer triangle is the only upward triangle with side length four. Therefore the upward total

is $10 + 6 + 3 + 1 = 20$. This grouping includes triangles formed from several small cells as well as the smallest ones.

Step 2: Count all downward-pointing triangles The one-unit downward triangles occur between the upward ones. Their rows contain 1, 2 and 3 positions, so there are $1 + 2 + 3 = 6$. There is also one downward triangle with side length two units: its horizontal top is the full segment across the middle row and its lower vertex is at the midpoint of the bottom edge. A larger downward triangle would need more room below its top edge than the outer boundary permits. Thus the downward total is $6 + 1 = 7$.

Step 3: Combine the two orientations and compare The two sets do not overlap because their vertices point in opposite directions. Adding their totals gives

$$20 + 7 = 27.$$

Options 24, 25 and 26 omit one or more of the larger or inverted triangles. Counting only the smallest cells would also miss composite triangles, which is why grouping by side length is necessary.

Step 4: Conclusion There are 27 triangles in the figure. Hence, the correct option is (C).

Quick Tip to Solve: For a four-division triangular grid, list upward counts 10, 6, 3, 1 and downward counts 6, 1 before adding.

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57. Find the odd one out:-

7, 9, 25, 32, 43, 59 [4 marks]

(A) 59

(B) 32

(C) 25

(D) 9

Correct Answer: (B) 32

Solution:

Concept:

- An integer is even when division by 2 leaves no remainder; an odd integer leaves remainder 1. A parity test is often the simplest way to find an exceptional member of a numerical list.
- The units digit alone determines parity: 0, 2, 4, 6 and 8 indicate an even number, while 1, 3, 5, 7 and 9 indicate an odd number.

Step 1: Classify the numbers by parity The numbers 7, 9, 25, 43 and 59 end in 7, 9, 5, 3 and 9, respectively. Each is therefore odd. The number 32 ends in 2 and is even. In particular, $32 = 2 \times 16$, so it alone is divisible by 2 without a remainder.

Step 2: Compare the offered choices Among the choices, 59, 25 and 9 all belong to the group of odd integers. Their being prime or composite does not give a common classification of the full list: 7, 43 and 59 are prime, whereas 9 and 25 are composite. Parity instead separates exactly one entry from all five others.

Step 3: Conclusion The only even number in the list is 32, so it is the odd one out. Hence, the correct option is (B).

Quick Tip to Solve: For an odd-one-out list of integers, test the units digits for parity before trying complicated differences or factor patterns.

58. A residential building has 15 floors. The height of ground floor is 4.2 meter (including length and slab thickness). Rest all other floors are of 3.3 meter high (including slab thickness). What is the total height of the building (from ground to terrace) in meters? [4 marks]

(A) 45.6 meter

(B) 50 meter

(C) 50.4 meter

(D) 51.6 meter

Correct Answer: (C) 50.4 meter

Solution:

Concept:

- The total building height is the sum of the individual floor-to-floor heights. When those heights already include slab thickness, the slab must not be added a second time.
- The stated 15 floors include the ground floor. Thus there is one ground floor of height 4.2 m and $15 - 1 = 14$ remaining floors of height 3.3 m each.

Step 1: Find the height above the ground floor There are 14 identical remaining floors. Their combined height is

$$14 \times 3.3 = 46.2 \text{ m}.$$

Counting 15 such floors in addition to the ground floor would count 16 floors, contradicting the given total.

Step 2: Add the ground floor and check the choices Adding the ground-floor height gives

$$H = 4.2 + 46.2 = 50.4 \text{ m}.$$

An equivalent check is to take all 15 floors as 3.3 m, then add the ground floor's extra 0.9 m: $15(3.3) + 0.9 = 50.4$. The alternatives 45.6 m, 50 m and 51.6 m do not equal this sum; no rounding or additional slab allowance is requested.

Step 3: Conclusion The total height from ground to terrace is 50.4 m. Hence, the correct option is (C).

Quick Tip to Solve: For mixed floor heights, subtract the exceptional floor from the total count before multiplying the height of the remaining floors.

59. Identify the mirror image of the given word shown below. [4 marks]



(A) SSECCUS
(B) SUCCESS
(C) SUCCESS
(D) SSECCUS

Correct Answer: (A) SSECCUS

Solution:

Concept:

- Reflection in a vertical mirror reverses horizontal positions: the rightmost part of the original becomes the leftmost part of the image. Heights and vertical orientation are preserved.
- A word must be reflected as a complete picture. Both the order of its letters and the horizontal orientation of each individual letter must be checked; reversing the spelling alone is insufficient.

Step 1: Locate the mirror and reverse the positions The dashed mirror is vertical and lies to the right of SUCCESS. Reading the reflected image from left to right therefore encounters the original letters in the order S, S, E, C, C, U, S. The last S of the original is closest to the mirror and becomes the first reflected character. The image remains upright; it is not turned upside down.

Step 2: Check the orientation of the reflected letters Every asymmetric character must also face the opposite way. In particular, each C must open to the left in the reflected picture, and the E must have its vertical stroke on the right. The U retains its upright appearance because it is symmetric about a vertical line. Option (A) has the required reversed arrangement together with these reflected character shapes.

Step 3: Eliminate the other arrangements Option (B) reflects individual letter shapes while retaining an incorrect arrangement of the letters, so its central sequence does not reproduce reflection of the entire word. Option (C) is the original upright word without reflection. Option (D) changes the letter arrangement but leaves ordinary, unreflected letter shapes. A vertical mirror requires both tests to succeed simultaneously, which only option (A) does.

Step 4: Conclusion The complete horizontal reflection of SUCCESS is the image shown in option (A). Hence, the correct option is (A).

Quick Tip to Solve: First check that the final two S letters move to the beginning; then check that the C letters open left and the E has its spine on the right.

60. The scale of a map is 1:1000. If a car travels 7 cm from point 'A' to point 'B' on the Map. Then how much the car has travelled in original:- [4 marks]

(A) 0.7 km

(B) 7000 mm

(C) 7 km

(D) 70 meter

Correct Answer: (D) 70 meter

Solution:

Concept:

- A linear scale of $1 : 1000$ means that one unit on the map represents 1000 of the same units on the ground. Keep the units identical while applying the ratio.
- After finding the actual distance in centimetres, use $100\ \text{cm} = 1\ \text{m}$ and $1000\ \text{m} = 1\ \text{km}$ to compare the answer choices.

Step 1: Apply the scale factor The map separation of A and B is 7 cm. Therefore the actual distance represented is

$$d = 7 \times 1000 = 7000\ \text{cm}.$$

The scale multiplies a length, so there is no square or cube of 1000 in this calculation.

Step 2: Convert and eliminate the other units Convert to metres by dividing by 100:

$$d = \frac{7000}{100} = 70\ \text{m}.$$

This is $0.07\ \text{km}$, rather than 0.7 km or 7 km. In millimetres the same distance is $7000 \times 10 = 70000\ \text{mm}$, rather than 7000 mm. Thus the first three offered distances each use an incorrect unit conversion.

Step 3: Conclusion The actual distance travelled is $70\ \text{m}$. Hence, the correct option is (D).

Quick Tip to Solve: Multiply by the map denominator in the original map units first; convert centimetres to metres only after that multiplication.

61. A land size of 80 meter $\times$ 40 meter for a house design is drawn on paper at a scale of 1:100, then what size is drawn on paper to represent the land? [4 marks]

(A) 8 meter $\times$ 4 meter

(B) 80 meter $\times$ 40 meter

(C) 8 centimeter $\times$ 4 centimeter

(D) 4 meter $\times$ 2 meter

Correct Answer: No option equals the correct scaled size, 80 cm by 40 cm; the official key dropped the question.

Solution:

Concept:

- For a drawing scale $1 : 100$, each length on the drawing equals the corresponding actual length divided by 100, with both lengths measured in the same unit.
- A scale applies separately to both linear dimensions. It does not change the rectangular proportions, and an area scale must not be used to reduce a length.

Step 1: Reduce both dimensions The actual plot measures $80\ \text{m} \times 40\ \text{m}$. Its drawing dimensions must therefore be

$$\frac{80}{100} = 0.8\ \text{m}, \qquad \frac{40}{100} = 0.4\ \text{m}.$$

Since one metre is 100 centimetres, these are $80\ \text{cm}$ and $40\ \text{cm}$.

Step 2: Check every printed option The first option, 8 m by 4 m, represents a 1:10 scale. The second option leaves the original dimensions unchanged and represents 1:1. The third option, 8 cm by 4 cm, represents 1:1000 after converting the plot dimensions to centimetres. The fourth option, 4 m by 2 m, represents 1:20. None of these matches the specified 1:100 scale.

Step 3: Conclusion The required drawing measures $80\ \text{cm} \times 40\ \text{cm}$, or $0.8\ \text{m} \times 0.4\ \text{m}$. No printed option is correct. The official answer key dropped this question and awarded bonus marks to all candidates.

Quick Tip to Solve: At 1:100, the numerical value of an actual length in metres equals its drawing length in centimetres: 80 m becomes 80 cm.

62. Find the missing number in given series.

16, 33, 65, 131, 261, (.....) [4 marks]

(A) 523

(B) 521

(C) 524

(D) 520

Correct Answer: (A) 523

Solution:

Concept:

- A numerical sequence may use alternating operations. Test a proposed rule against every adjacent pair, rather than choosing an operation that fits only the last pair.
- Here the recurring operation is multiplication by 2, followed alternately by adding 1 and subtracting 1. The sign must continue in its established order.

Step 1: Identify and verify the alternating rule The successive transitions are

$$16 \times 2 + 1 = 33,$$
$$33 \times 2 - 1 = 65,$$
$$65 \times 2 + 1 = 131,$$
$$131 \times 2 - 1 = 261.$$

Thus the signs are $+1, -1, +1, -1$, and the next transition uses $+1$.

Step 2: Continue the same rule The missing entry is

$$261 \times 2 + 1 = 522 + 1 = 523.$$

The alternative 521 would repeat subtraction instead of alternating to addition; 524 would require adding 2, and 520 would require subtracting 2. Neither adjustment appears in the verified rule. All four known transitions therefore support 523 as the intended continuation.

Step 3: Conclusion The missing number is 523. Hence, the correct option is (A).

Quick Tip to Solve: When a sequence is close to successive doubling, calculate each next term minus twice the current term and look for an alternating pattern.

63. In a code language if ROMAN is written as TQOCP: then ITALY is..... [4 marks]

(A) KVCMA

(B) KWCNB

(C) KUCLA

(D) KVCNA

Correct Answer: (D) KVCNA

Solution:

Concept:

- In a fixed-shift alphabet code, every letter is moved through the same number of positions. The supplied example determines both the direction and the size of the shift.
- Treat the alphabet cyclically: after Z comes A. Preserve the original order of the letters while substituting their shifted forms.

Step 1: Find the shift in the example Compare ROMAN with TQOCP one letter at a time:

$$R \to T, \quad O \to Q, \quad M \to O, \quad A \to C, \quad N \to P.$$

Every substitution moves two positions forward in the alphabet, so the same rule must be applied to ITALY.

Step 2: Encode each letter and check the choices The required substitutions are

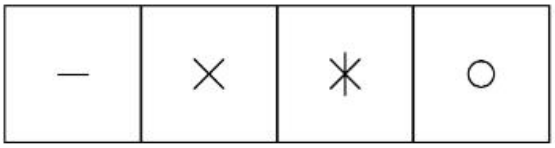
$$I \to K, \quad T \to V, \quad A \to C, \quad L \to N, \quad Y \to A.$$

The last step wraps around: Y moves first to Z and then to A. Reading these results in order gives KVCNA. KVCMA shifts L incorrectly; KWCNB shifts T and Y incorrectly; KUCLA shifts T and L incorrectly. Only KVCNA follows the two-position shift at every position.

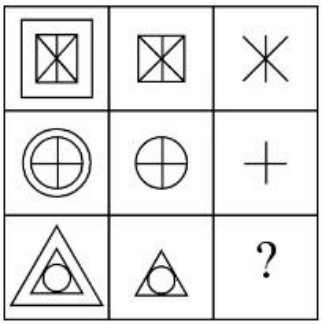
Step 3: Conclusion ITALY is encoded as KVCNA. Hence, the correct option is (D).

Quick Tip to Solve: Derive the shift from several letters of the example, then pay special attention to letters near Z where the alphabet wraps around.

64. Select a suitable figure from the four alternatives which will come in the empty box. [4 marks]



(A) (B) (C) (D)



(A) D

(B) C

(C) B

(D) A

Correct Answer: (A) D

Solution:

Concept:

- A figure matrix is completed by finding a transformation that holds throughout the completed rows, then applying that same transformation to the incomplete row.
- Here the figures contain nested boundaries surrounding an inner motif. Moving from left to right removes one enclosing boundary at a time while preserving the central motif.

Step 1: Establish the rule from the rectangular row In the first row, the left figure has an outer rectangle surrounding another rectangle and a central arrangement of intersecting strokes. The middle figure retains the inner rectangle and its strokes after the outer rectangle is removed. The right figure removes the remaining rectangular enclosure, leaving only the central intersecting strokes. Thus the operation is deletion of one successive enclosing outline, rather than rotation of the figure.

Step 2: Verify the rule with the circular row The second row begins with two concentric circular outlines and a central plus sign. Removing the outer circular outline gives the middle figure, which contains one circle around the same plus sign. Removing that remaining circular outline gives the plus sign alone in the rightmost box. This confirms that the central content is kept while the successive outer boundaries disappear.

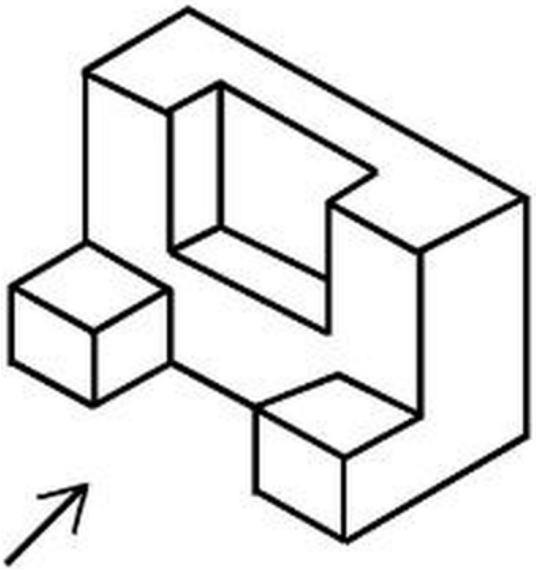
Step 3: Apply the removal rule to the triangular row The bottom-left figure contains nested triangular boundaries surrounding a small circle. The middle figure is obtained by removing the outer triangle, so it contains one triangle with the small circle inside. Removing the remaining triangular boundary must therefore leave the small circle alone. The horizontal stroke, diagonal cross and multiple intersecting

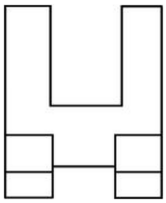
strokes do not preserve the central circular motif, so the diagrams labelled A, B and C are excluded.

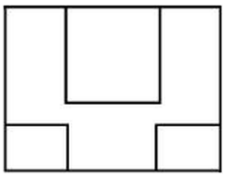
Step 4: Conclusion The missing diagram is the circle labelled D in the figure. Since D is listed as option (A), the correct option is (A).

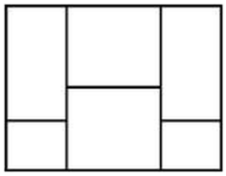
Quick Tip to Solve: Use both completed rows to identify what is removed and what survives; then keep the small circle and remove the last triangle in the bottom row.

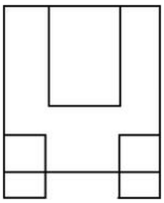
65. The 3D figure shows the view of an object. Looking in the direction of arrow, identify the most appropriate elevation from the given answer figures. [4 marks]

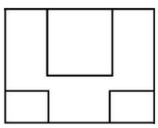


(A) 

(B) 

(C) 

(D) 

Correct Answer: (B) 

Solution:

Concept:

- An elevation is an orthographic projection along the viewing arrow: height and transverse width remain, while depth collapses.

- The outline is determined by the furthest projected boundary; recesses and projecting blocks contribute visible internal edges.

Step 1: Fix the direction of projection The arrow points from the open side towards the tall rear wall. Look horizontally along this arrow; depth along the arrow collapses, while horizontal positions across the opening and vertical heights are retained. The outline must therefore be the full rectangular width and height of the rear wall. The central recess is not a hole through that wall, so the outer top boundary remains continuous.

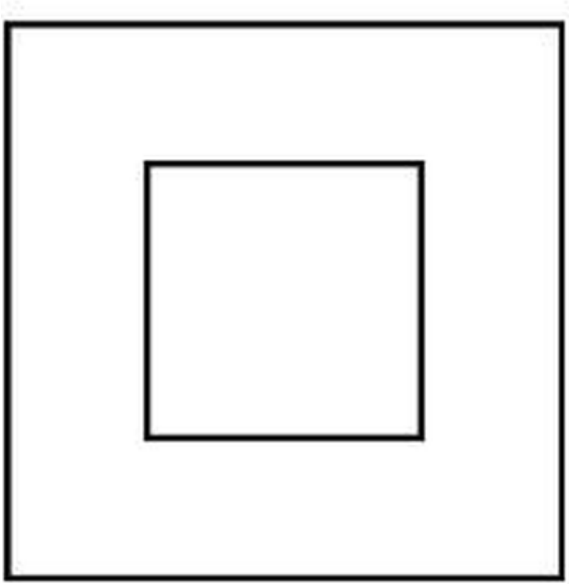
Step 2: Project the visible changes in depth The recessed central portion contributes two vertical boundaries joined by a horizontal lower boundary, giving the inverted rectangular recess visible inside the outline. The two low projections at the front produce small rectangular divisions at the lower left and lower right. Their bottom edges coincide with the bottom edge of the complete object; they do not extend below it.

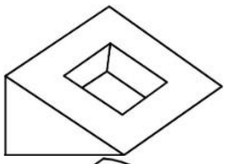
Step 3: Compare all four answer figures Figure B combines the continuous rectangular outer boundary, the internal central recess and the two corner blocks at the base. Figure A incorrectly opens the top outline into a U shape. Figure C gives the wrong central horizontal divisions and omits the recessed profile. Figure D incorrectly extends the low corner blocks beneath the main lower boundary, creating a second, lower level that this projection does not have.

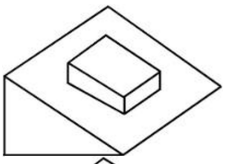
Step 4: Conclusion The elevation from the marked direction is figure B. Hence, the correct option is (B).

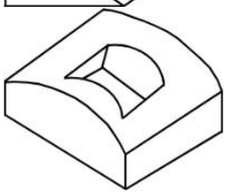
Quick Tip to Solve: First project the outer silhouette, then add visible edges inside it. Do not copy depth offsets as changes in height.

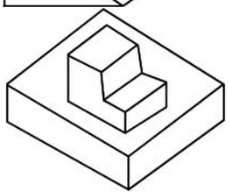
66. Question figure shows top view/ plan of an object. Identify the INCORRECT 3D view from the given answers figure. [4 marks]

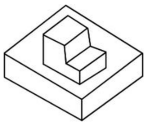


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- A plan is a vertical projection onto a horizontal plane. Equal footprints can belong to solids of different heights or surface profiles.
- A visible step introduces a projected boundary; an answer with extra top-view edges cannot match the given plan.

Step 1: Read the information contained in the plan The given top view consists of an outer square and a smaller closed square inside it. A plan records the horizontal positions of boundaries and visible changes of surface, rather than showing the heights themselves. Thus a raised square block, a square recess or a suitable sloping surface can share this plan if their projected boundary lines remain the same.

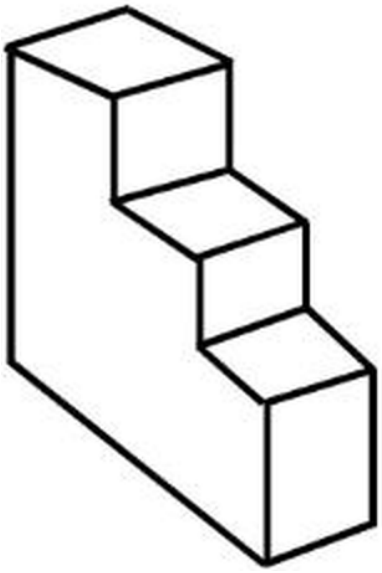
Step 2: Test the first three solids In A, the square opening in the sloping solid projects to the inner square, and the overall footprint supplies the outer square. In B, a simple square block on a square base has precisely those two boundaries when viewed vertically from above. In C, the curved height profile does not by itself change the square footprint or the square boundary of the opening in the plan. Curvature seen in elevation must not be mistaken for a curved footprint.

Step 3: Locate the extra boundary in the remaining solid In D, the central raised feature has two different horizontal levels arranged as a step. Looking down, the edge separating the upper and lower treads remains visible inside the central footprint. The plan would therefore contain an additional line dividing the smaller square. No such division is present in the question figure. That extra visible edge makes D incompatible, whereas the other three can retain the two-square plan.

Step 4: Conclusion Figure D has an additional step edge in its top view and is the incorrect 3D view. Hence, the correct option is (D).

Quick Tip to Solve: For an incorrect-plan question, look for an extra visible edge: height can change without changing the footprint, but a step can add a line.

67. How many surfaces does the object have? [4 marks]



(A) 9

(B) 10

(C) 8

(D) 11

Correct Answer: (B) 10

Solution:

Concept:

- Count distinct exterior planar surfaces, including hidden faces; ignore imagined internal contacts.
- A prism formed by extruding a polygon with n edges has $n + 2$ surfaces: one per profile edge and two end profiles.

Step 1: Recognise the extruded stair profile The object is a three-step solid of uniform width. Its side profile is a staircase, and extending that profile through the width produces the object shown. Count complete planar surfaces, including those hidden from the chosen viewpoint. Internal boundaries between imagined cubes are not external surfaces, and a single continuous flat side is one surface even though its outline has several steps.

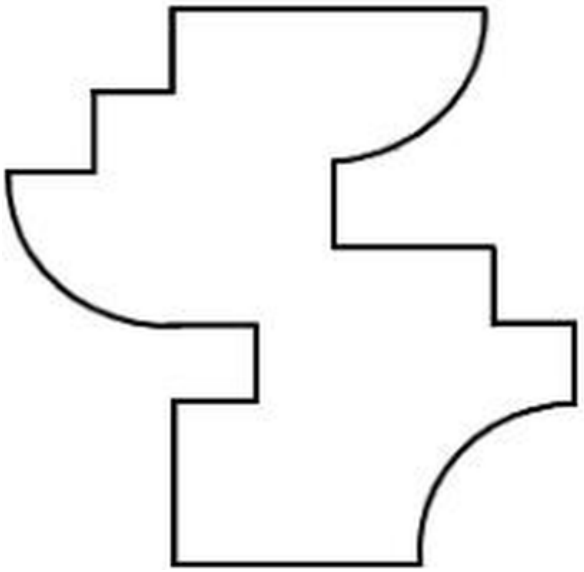
Step 2: Count the horizontal and vertical faces There are three horizontal tread surfaces, one at each visible level. The underside contributes one more horizontal surface, so the horizontal subtotal is four. Vertically, there are two risers between consecutive tread levels, the front end face at the lowest level, and the tall rear end face. These are four separate vertical surfaces. The rear face and the underside must be counted although the perspective drawing hides them.

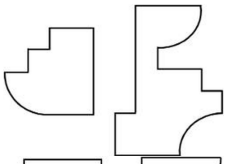
Step 3: Include both side faces and compare the totals The left and right sides each form one continuous staircase-shaped plane. They add two surfaces, rather than a separate side face for each step. Therefore the complete count is $4 + 4 + 2 = 10$. Counting only visible faces gives too few; subdividing a continuous coplanar side or counting internal cube contacts gives too many. Among 9, 10, 8 and 11, only 10 includes every exterior plane once.

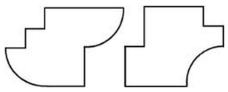
Step 4: Conclusion The object has 10 surfaces. Hence, the correct option is (B).

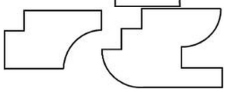
Quick Tip to Solve: For a uniform prism, count the edges around its side profile, then add the two end profiles; include hidden exterior faces.

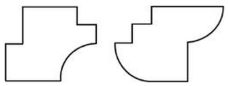
68. If the question figure is cut into two parts, which of the answer figures complete the question figure without any overlappings? [4 marks]

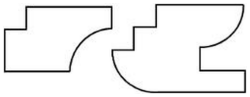


(A) 

(B) 

(C) 

(D) 

Correct Answer: (C) 

Solution:

Concept:

- Two pieces complete a figure only when their interiors are disjoint and their union has exactly the required outer boundary.
- Matching joins must have equal length and complementary steps; convex and concave arcs must occur in the same boundary order as the target.

Step 1: Record the boundary features of the target The target has two outward curved portions in its upper part and one inward curved portion at the lower right. It also has short rectangular steps on both sides. Reassembly must preserve all these boundary features in their cyclic order. A plausible total outline is insufficient if the joining edges leave a gap or place one piece over the other.

Step 2: Fit the pair in figure C Keep the larger piece of C in the orientation shown. It provides the

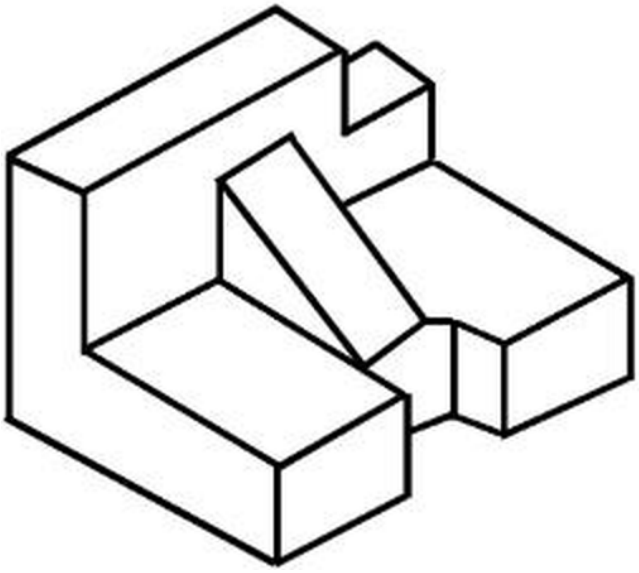
stepped upper-left boundary, the upper-right convex curve, the left convex curve and the small step on the right. The smaller piece has a matching straight upper joining edge and supplies the lower portion. Move it below the larger piece so that the straight joining edges coincide: its left step completes the notch and its inward curved right edge completes the lower-right concavity. The interiors remain on opposite sides of the join.

Step 3: Check the alternatives against the complete outline This fit uses each part once and reproduces the lower straight base as well as all three curves. In A, the stepped edge on the left-hand piece has too many levels for the required complementary join. B does not supply the required matching lower-left step at the join. In D, the smaller piece has an additional step on its upper-right side that prevents the required uninterrupted fit. C alone preserves both the external boundary and a compatible internal joining edge.

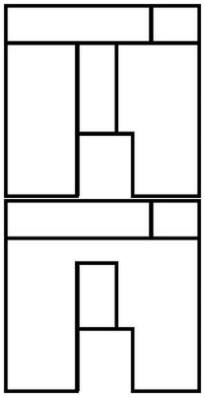
Step 4: Conclusion The two pieces in figure C complete the question figure without overlap. Hence, the correct option is (C).

Quick Tip to Solve: Check the joining edge and the order of convex and concave curves together; matching only the overall size can conceal an overlap.

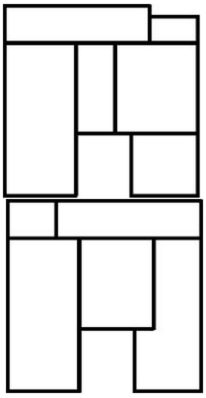
69. The 3D problem figure shows the view of an object. Identify its appropriate top view from the answer figures. [4 marks]



(A)



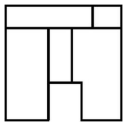
(B)



(C)

(D)

Correct Answer: (A)



Solution:

Concept:

- A top view preserves horizontal positions and footprints while collapsing height.
- Inclined faces project to their horizontal extent; edges at their attachment points must retain their connectivity.

Step 1: Project the footprint vertically A top view is obtained by looking straight down, so vertical heights disappear but the horizontal footprint remains. The front of the object has a rectangular notch between the two projecting portions. The rear wall forms a continuous strip across the width. Its small change in height on the right creates a division inside that strip, without moving its outside boundary in plan.

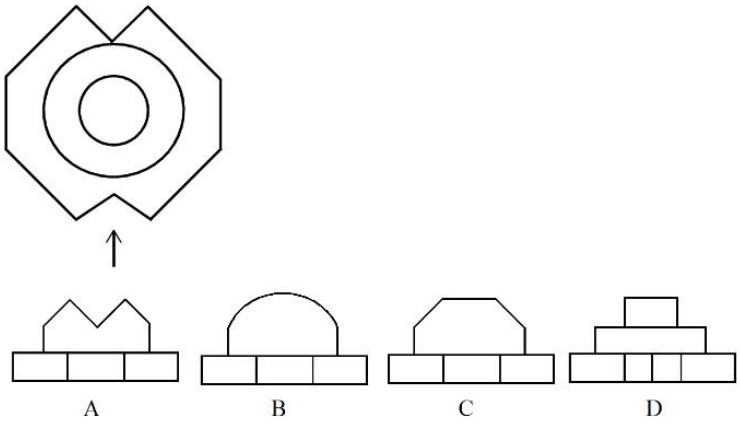
Step 2: Trace the inclined central surface The sloping central surface reaches the rear wall and runs towards the front notch. In a top projection its two long edges become parallel boundaries connecting the rear strip to the region just behind the notch. The slope changes height, not the horizontal attachment to the wall. The right-hand division of the rear strip must stay on the same side as the small raised end in the perspective drawing.

Step 3: Eliminate the incorrect projections A shows the front notch, the central strip joining the rear wall and the division near the right end of the rear strip. B wrongly steps the outer rear boundary and adds a horizontal division across the right projection. C stops the central strip before it reaches the rear wall, despite the visible attachment there. D reverses the rear division to the left and changes the central-strip arrangement. These are changes of footprint or edge connectivity, rather than effects of height.

Step 4: Conclusion The appropriate top view is figure A. Hence, the correct option is (A).

Quick Tip to Solve: Trace where each sloping face touches the rear wall and front notch; a slope still has a definite footprint in a top view.

70. Identify the correct elevation when you look into the object from the marked arrow side of the plan of the object. [4 marks]



(A) D

(B) A

(C) B

(D) C

Correct Answer: (A) D

Solution:

Concept:

- An elevation preserves transverse positions and heights; each visible vertical arris of a prismatic base projects to a vertical division.
- The circular upper boundaries must be checked together with the angular base. Matching the upper silhouette alone is insufficient to identify the complete elevation.

Step 1: Project the angular base from the marked side The arrow points towards the lower, notched boundary of the plan. Trace that boundary from left to right: its sloping segments form two forward corners with a central inward corner between them. These changes in direction are vertical arrises of the base. In the elevation they remain visible at distinct horizontal positions. Consequently, the base requires three interior vertical dividing lines, giving four panels across its width. The central notch edge must not be omitted simply because it is recessed.

Step 2: Check the upper circular features The two concentric circles can be represented by two coaxial cylindrical tiers: a wider lower tier and a narrower centred upper tier. Their horizontal elevation is the pair of centred rectangles shown in figure D. Circular boundaries alone do not uniquely determine a vertical surface: for example, the upper trapezoid of figure C could describe a conical frustum with the same two circular rims. Therefore the circles alone are not a sufficient reason to reject C; the base must also match.

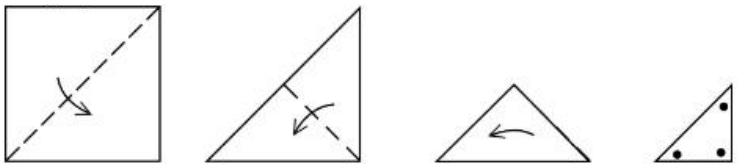
Step 3: Compare every complete candidate and map the answer Figure D combines compatible concentric upper tiers with the required four-panel base, including the central vertical line produced by the inward corner. The bases in figures A, B and C each have only two interior dividing lines and three panels. They omit the central edge visible from the marked direction, so none is the correct complete elevation even if an upper surface alone could share the circular plan. Figure A additionally

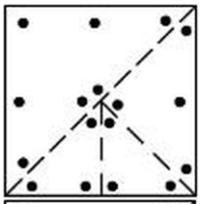
copies an angular profile into the upper shape. The matching elevation is thus the figure labelled D. The answer options list the figure letters in the order D, A, B, C, so the printed figure D corresponds to option (A).

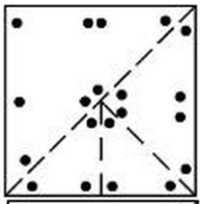
Step 4: Conclusion The correct complete elevation is figure D, including its four-panel base. Figure D is listed as option (A). Hence, the correct option is (A).

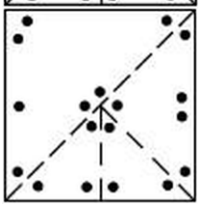
Quick Tip to Solve: Trace the notched base as well as the circular upper features; its central vertical edge distinguishes D from the other elevations.

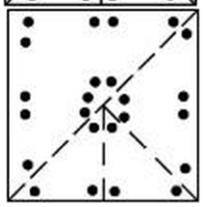
71. A paper is folded in a given pattern and it is cut at the end. Identify which pattern is formed when the paper is unfold. [4 marks]

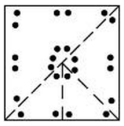


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- Unfolding reverses each fold by mirror reflection in the fold line.
- An interior hole through a packet formed by three halving folds generates $2^3 = 8$ reflected positions, unless it lies on a fold.

Step 1: Count the layers and identify the reversal operations There are three successive folds: first along a diagonal of the square, then along the indicated line in the triangle, and finally along the symmetry line of the resulting smaller triangle. Each fold doubles the superposed layers. The final triangular packet therefore contains eight layers. The three marked cuts lie inside the triangular region rather than exactly on a fold, so each cut must generate eight separate holes on unfolding.

Step 2: Unfold by reflection in reverse order First reflect the three holes across the last fold line. Reflect the resulting six positions across the preceding triangular fold, and finally reflect all twelve

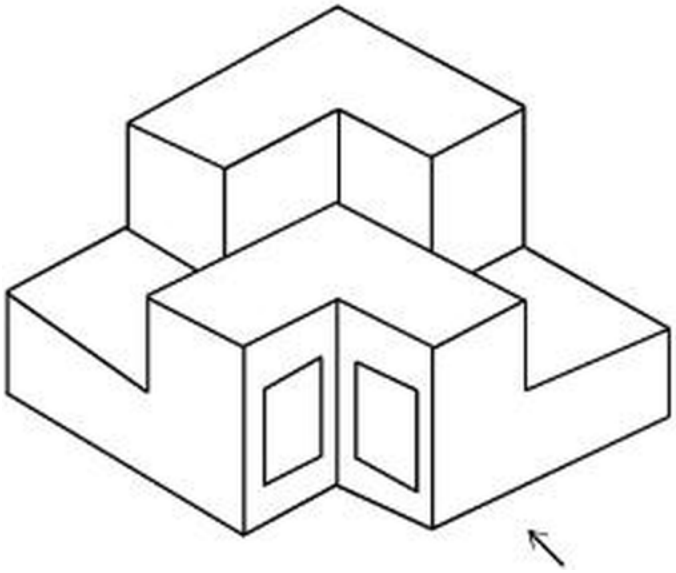
positions across the original diagonal of the square. Reflections preserve each hole's distance from its fold. The hole near the pointed corner generates the group around the centre; the other two generate paired positions near the outer boundary. The final pattern must be symmetric under every restored fold.

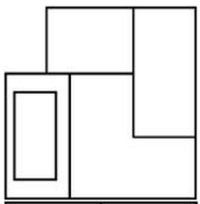
Step 3: Compare the multiplicities and placements The unfolded square must contain $3 \times 2^3 = 24$ holes. In figure D the corner regions contain paired holes, the side-middle regions contain pairs, and the central group contains eight reflected positions. Together these reproduce the three complete eight-position reflection sets. A, B and C omit members of one or more sets: they have isolated rather than paired holes at some side or corner positions and an incomplete central reflection pattern. Such omissions cannot result from three interior cuts through all eight layers.

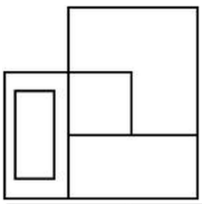
Step 4: Conclusion The complete unfolded pattern is figure D. Hence, the correct option is (D).

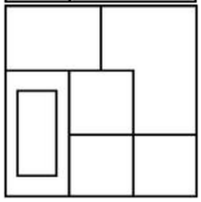
Quick Tip to Solve: Count the expected holes before comparing patterns, then unfold in reverse order; an interior cut through eight layers gives eight images.

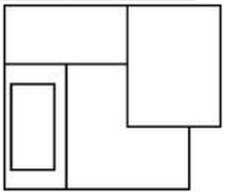
72. The question figure shows the 3-D view of an object. Identify the correct view, looking in the direction of arrow. [4 marks]

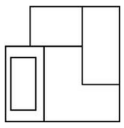


(A) 

(B) 

(C) 

(D) 

Correct Answer: (A) 

Solution:

Concept:

- A directional elevation collapses depth along the arrow while retaining vertical heights.
- Visible inset rectangles identify the face orientation; stepped height levels determine the outer silhouette and termination of internal edges.

Step 1: Fix which faces are seen from the arrow The arrow approaches from the lower-right side of the perspective drawing. Project parallel to that direction, keeping heights vertical and collapsing depth. The nearer face with a rectangular inset remains visible on the left part of the elevation. The other inset lies on the face turned across the viewing direction, so it is not drawn as a second front-facing rectangle in this view.

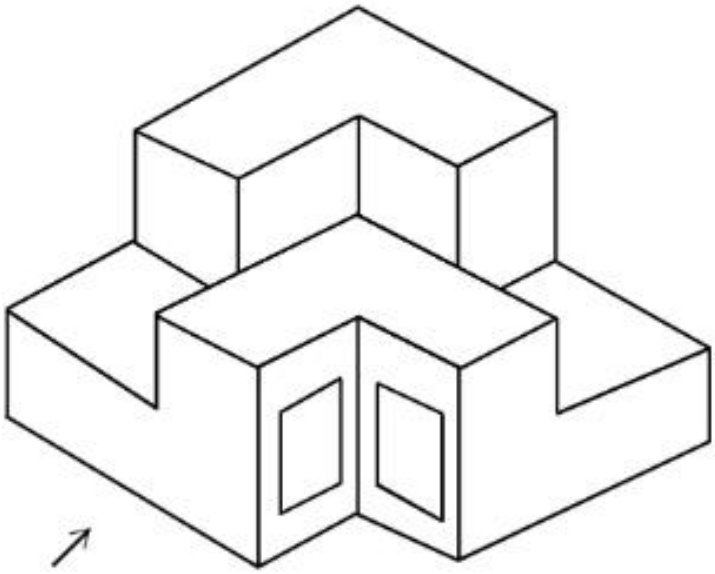
Step 2: Build the outline from the height levels The nearest raised portion forms a lower-height block containing the inset. Behind it, the higher rear portion reaches the top level. Its left boundary begins to the right of the lower block's left boundary, producing a step in the upper outline rather than a full-width high rectangle. On the right, the projecting rear upright extends down to the low platform level and its edge remains visible inside the overall outline. Vertical alignment must follow these projected edges, not the diagonal distances in the perspective sketch.

Step 3: Match the internal lines as well as the silhouette Figure A has the lower inset-bearing region on the left, the stepped top boundary and the long right-hand vertical division ending above the base. B shortens and relocates the central horizontal division, so the rear upright no longer has the correct projected extent. C makes the highest boundary extend across the whole width and adds a lower horizontal division inconsistent with the step arrangement. D gives a projecting right edge and bottom offset that the marked view does not produce. Only A preserves all three level changes and the visible inset.

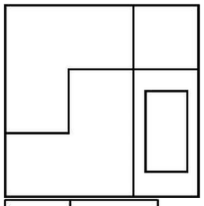
Step 4: Conclusion The correct view from the marked arrow is figure A. Hence, the correct option is (A).

Quick Tip to Solve: Use the inset as an orientation marker, then compare the heights and where each vertical boundary ends; the outer silhouette alone is insufficient.

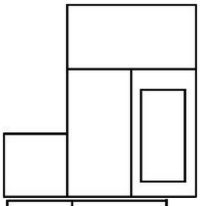
73. The question figure shows the 3-D view of an object. Identify the correct view, looking in the direction of arrow. [4 marks]



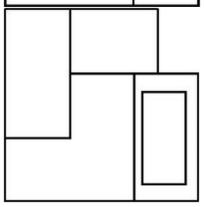
(A)



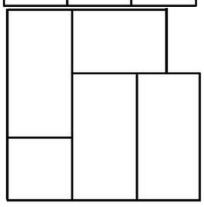
(B)



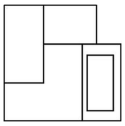
(C)



(D)



Correct Answer: (C)



Solution:

Concept:

- An orthographic elevation projects the object along the viewing arrow; depth is suppressed but heights and visible changes of level remain.
- A window or recess is shown only when its face is visible from the specified direction. Features on the perpendicular side must not be copied into the elevation.

Step 1: Fix the viewing direction The arrow points towards the object from the lower-left side of the isometric drawing. We therefore look normally at the left-facing family of surfaces, rather than from above. The rectangular inset on the near visible face remains visible in this elevation; the inset on the perpendicular face does not become a second rectangle. Keep left and right consistent while projecting, since reversing them would give a different elevation.

Step 2: Project the changes of height The rear raised portion reaches the greatest height. Its projection

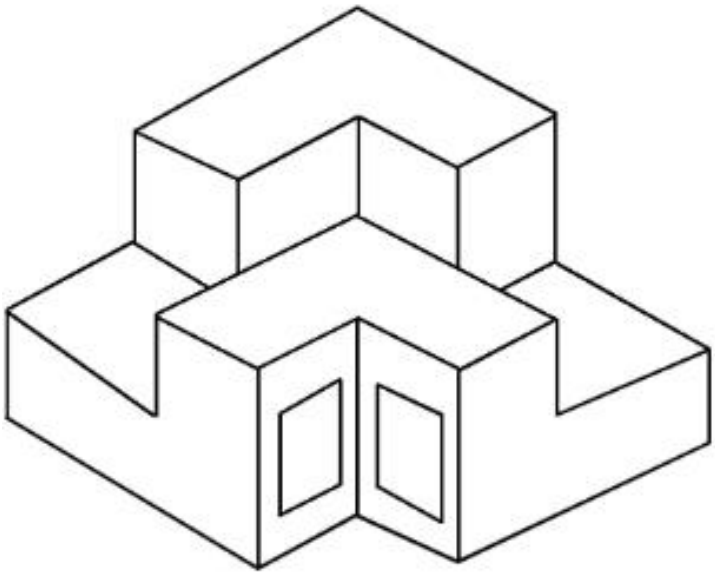
occupies the left and middle portions of the view. The nearer upright with the rectangular inset occupies the right portion and terminates below the highest rear level. The lower platform supplies the base. The visible internal edge on the left stops at the lower step, while the horizontal edge from that upright runs across the middle towards the inset-bearing face.

Step 3: Compare the four drawings Option (C) preserves this silhouette, the lower step on the left, the horizontal division in the middle and the single rectangular inset on the right. Option (A) incorrectly makes the right-hand outer edge reach the full upper level. Option (B) reduces the left-hand silhouette to the low platform. Option (D) omits the visible rectangular inset, so it cannot be the required view.

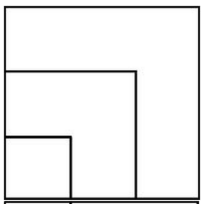
Step 4: Conclusion The elevation along the arrow is the drawing in option (C). Hence, the correct option is (C).

Quick Tip to Solve: Compare the outside silhouette first, then check the visible rectangular inset and the ends of the internal step lines.

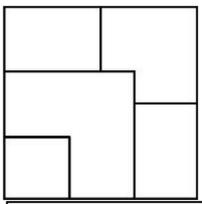
74. From the given options below, choose the correct plan of the 3-D object, when viewed from the top. [4 marks]



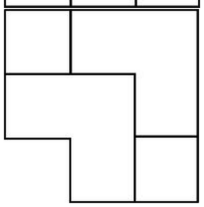
(A)



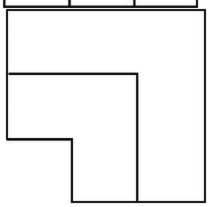
(B)



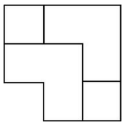
(C)



(D)



Correct Answer: (C)



Solution:

Concept:

- A plan is the orthographic view from directly above: horizontal positions remain, whereas vertical heights collapse onto the same plane.
- The footprint gives the outer boundary; edges separating exposed horizontal surfaces at different levels remain as internal lines.

Step 1: Trace the footprint from above Look vertically down on the object instead of using the oblique isometric outlines as its plan. The base has a re-entrant corner on its near side, so the plan must show a notch rather than an uninterrupted rectangular outline. The rear and side platforms project into a stepped footprint. Vertical faces and their rectangular inset details do not appear as rectangles in the top view.

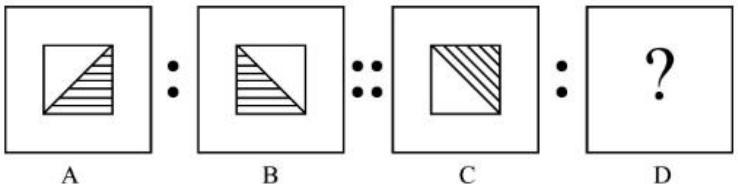
Step 2: Retain the boundaries between levels The raised rear part forms an L-shaped region in plan. Its inner boundary turns through a right angle above the near central portion. The ends of that raised part and the lower exposed platforms introduce the short dividing lines shown on the left upper region and the right lower region. These are changes in height, rather than additional holes in the object. The near re-entrant corner must remain open in the outline.

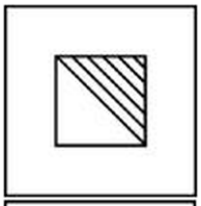
Step 3: Eliminate the mismatching options Option (C) includes both the notched footprint and the internal boundaries of the raised and lower surfaces. Options (A) and (B) give a complete rectangular footprint, filling the recess which is clearly open in the object. Option (D) has the recess but suppresses the short level-boundary lines, so it loses visible information needed for the correct plan.

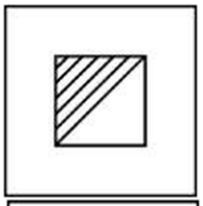
Step 4: Conclusion The correct plan, including the footprint notch and the changes of level, is option (C). Hence, the correct option is (C).

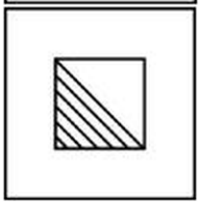
Quick Tip to Solve: For a plan, ignore the windows on vertical faces; trace the footprint and then add the edges of the exposed horizontal levels.

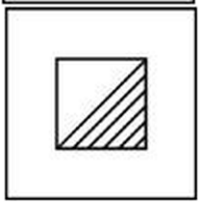
75. The second figure in the first part of the problem figures bears certain relationship to the first figure. Similarly, one of the figures of answer figures bears the same relationship to the first figure of the second part. Identify the correct option from the given answer figures. [4 marks]



(A) 

(B) 

(C) 

(D) 

Correct Answer: (B) 

Solution:

Concept:

- A visual analogy applies the same geometric transformation to the second pair as to the first pair.
- A reflection about a vertical axis interchanges left and right while keeping top and bottom fixed; it also reverses the slope of diagonal lines.

Step 1: Identify the transformation in the first pair In the first problem figure, the diagonal rises from the lower-left corner to the upper-right corner and the hatched triangle is on the lower-right side. In the second, the diagonal falls from upper left to lower right and the hatched triangle is on the lower-left side. This is a left-right mirror reflection. The horizontal hatch strokes remain horizontal, which is consistent with a reflection about a vertical axis.

Step 2: Reflect the second starting figure The third problem figure has its shaded triangle at the upper-right of the inner square. Its diagonal hatch lines run downwards towards the right. Applying the same left-right reflection moves that triangle to the upper-left and reverses the sloping strokes so that they rise towards the right. The size and orientation of the outer and inner square frames remain unchanged.

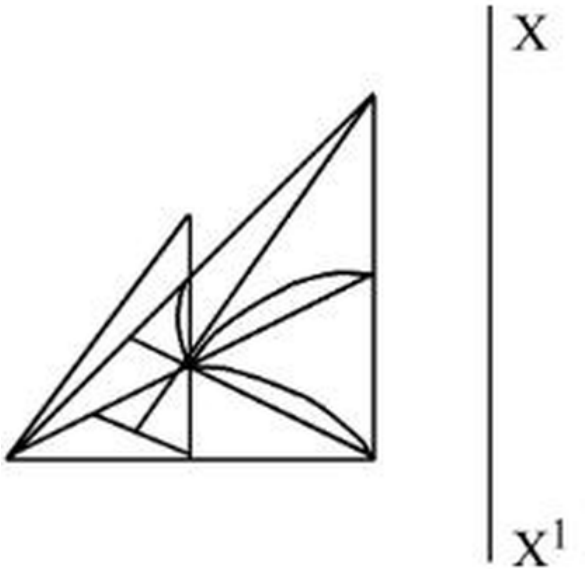
Step 3: Check position and hatching together Option (B) alone places the shaded triangular region in the upper-left and gives the reflected diagonal hatching. Option (A) leaves the triangle on the original upper-right side. Options (C) and (D) place the shaded region in lower corners, introducing a top-bottom change that is absent from the demonstrated transformation. Thus a rotation or a change in shading alone does not reproduce the given relation.

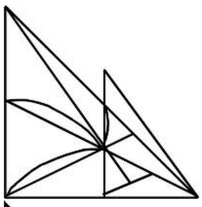
Step 4: Conclusion The required reflected figure is option (B). Hence, the correct option is (B).

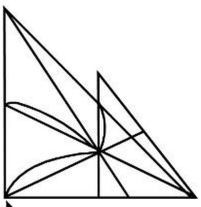
Quick Tip to Solve: Track both the shaded corner and the slope of the hatch lines; matching just one of these can select the wrong reflection.

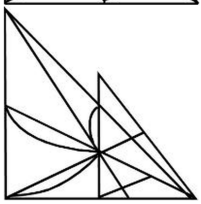
76. Identify the true mirror image of the figure amongst the answer figures with respect to X-X

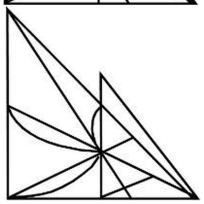
[4 marks]

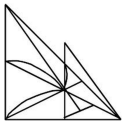


(A) 

(B) 

(C) 

(D) 

Correct Answer: (A) 

Solution:

Concept:

- A mirror image in a vertical line reverses horizontal positions and preserves vertical positions and lengths.
- Every straight segment, curved arc and junction must be reflected consistently; a correct outer triangle alone is insufficient.

Step 1: Reflect the outer framework The mirror X-X is vertical and lies to the right of the question figure. The tall vertical side that is on the right of the original must therefore be on the left of the image. The long base remains horizontal, and the smaller upright moves from the left side of the central junction to its right. The highest vertex stays at the same height; this is not a rotation or an upside-down view.

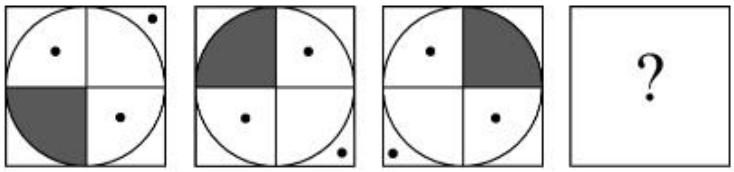
Step 2: Check the curved and straight internal lines In the reflected figure, the two curved lobes from the central junction open towards the tall left edge. The upper arc lies above its straight chord, while the lower arc lies above the segment rising from the bottom-left corner towards the junction. A small curved connection beside the shorter upright lies immediately to the right of that upright. The lower short straight segment meets the sloping inner boundary, rather than simply running to an arbitrary point on the base.

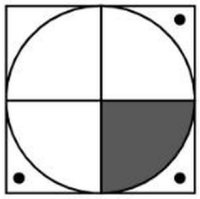
Step 3: Compare all distinguishing details Option (A) has the correct outer framework and the correct placement of both large arcs and the small curved connection. Option (B) changes the lower straight-line arrangement. Options (C) and (D) reverse the bulges of the left-hand arcs or put the small curved connection on the wrong side of the short upright. Those differences cannot be produced by reflecting the original in a vertical mirror.

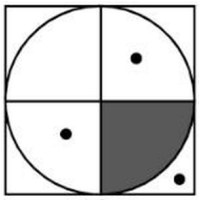
Step 4: Conclusion The faithful mirror image with respect to X-X is option (A). Hence, the correct option is (A).

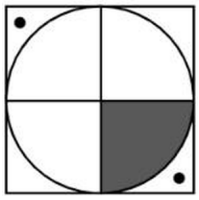
Quick Tip to Solve: After reversing the outline, compare the side on which each arc bulges and the exact endpoints of the shortest internal lines.

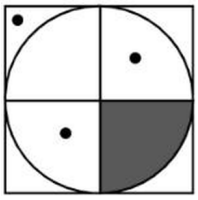
77. Choose the correct option amongst the answer figures which complete the series. [4 marks]

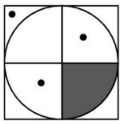


(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- A visual series can be tested by following one distinctive feature through successive positions.
- A clockwise quarter-turn moves top-left to top-right, top-right to bottom-right, bottom-right to bottom-left and bottom-left to top-left.

Step 1: Follow the shaded quadrant The shaded quarter of the circle is at the bottom-left in the first figure, top-left in the second and top-right in the third. Each change is a clockwise rotation through a right angle. Consequently, the fourth figure must have its shaded quadrant at the bottom-right. All four options have this shaded position, so this feature alone is not enough to decide the answer.

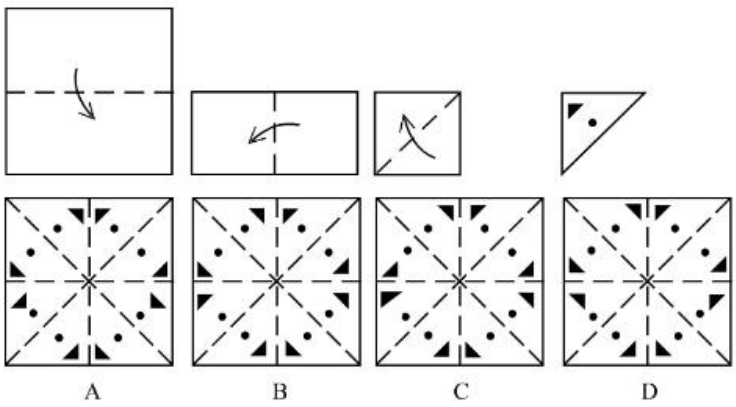
Step 2: Rotate the three dots by the same amount In the third figure, the dots inside the circle are in the top-left and bottom-right quadrants, and the dot outside the circle is in the bottom-left corner of the square. Rotating everything clockwise puts the inside dots in the top-right and bottom-left quadrants. The outside dot moves to the top-left corner. Distances from the centre and membership inside or outside the circle are unchanged by a rotation.

Step 3: Choose the option preserving the whole pattern Option (D) has a bottom-right shaded quadrant, inside dots in the top-right and bottom-left, and an outside dot in the top-left. Option (A) puts all its dots outside the circle. Option (B) has the two correct inside dots but leaves the outside dot at the bottom-right. Option (C) has outside dots in place of the two required inside dots. Only (D) continues the same rigid rotation.

Step 4: Conclusion The next figure is obtained by a clockwise quarter-turn of the third figure and is option (D). Hence, the correct option is (D).

Quick Tip to Solve: When every option has the same shaded quadrant, use the dot outside the circle as a second independent rotation marker.

78. Sheet is folded in marked format and cut led at last as shown. Identify from the options below, how the pattern will be made when it's fully unfold? [4 marks]



(A) B

(B) A

(C) D

(D) C

Correct Answer: (A) B

Solution:

Concept:

- Unfolding a cut sheet reflects every cut across each crease in reverse order of the folds.
- The position and orientation of a triangular cut both reverse in a reflection, while a round punched hole remains round.

Step 1: Reverse the final diagonal fold The square is first folded across its horizontal centre and then across its vertical centre. The resulting smaller square is folded diagonally into a triangle. Start with the final triangular packet: it has one small triangular cut near its right-angled corner and one circular cut inside. Undoing the diagonal fold gives a reflected pair of each cut in the smaller square. The triangular pair must face in opposite reflected directions, not simply be copied by translation.

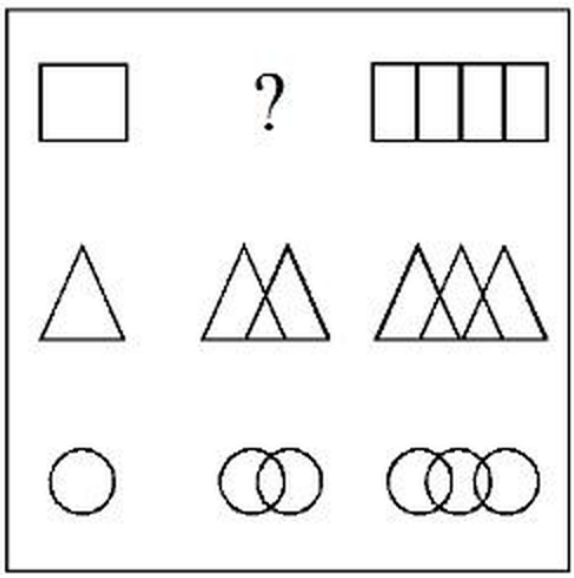
Step 2: Undo the two centre folds Reflect this pair across the vertical crease to restore the half-sheet, and then across the horizontal crease to restore the full square. Each original cut consequently appears in eight positions. The circular holes occur in symmetric pairs in all four quadrants. The triangular cuts lie near the middle portions of the four sides, with the orientation in each position determined by the corresponding reflected crease. Every pair across a horizontal or vertical centre line must be a mirror pair.

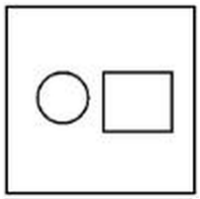
Step 3: Match the printed patterns to the listed choices The pattern labelled B beneath the folding sequence satisfies these reflected positions and orientations. The other printed patterns have an incorrectly directed triangular cut or an incorrect placement of a hole, so they cannot result from reversing all the folds. In the answer list, printed pattern B is listed as option (A); option (B) instead refers to pattern A, option (C) to pattern D and option (D) to pattern C.

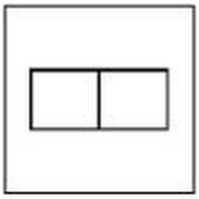
Step 4: Conclusion The unfolded sheet has the pattern labelled B in the diagram, which is listed as option (A). Hence, the correct option is (A).

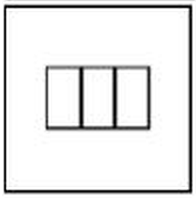
Quick Tip to Solve: Undo folds in reverse order and check triangular-cut orientation; then translate the diagram label into the letter used in the answer list.

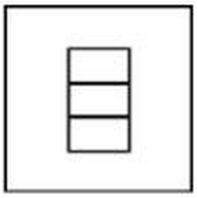
79. In the figure mentioned below find the missing series:- [4 marks]

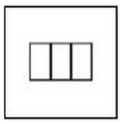


(A) 

(B) 

(C) 

(D) 

Correct Answer: (C) 

Solution:

Concept:

- A figure matrix can use the same progression across each row while changing the basic shape from row to row.
- Overlapping identical outlines produces intermediate enclosed regions; count the original shapes and the resulting visible divisions separately.

Step 1: Read the complete rows The second row begins with one triangle, continues with two overlapping triangles and ends with three overlapping triangles. The third row uses the same progression with circles: one circle, two overlapping circles and three overlapping circles. Thus the columns encode one, two and three copies of a row-specific shape, arranged horizontally with overlaps.

Step 2: Apply the progression to the square row The first row must follow the same rule using squares. The first entry is a single square. The last entry is formed by three horizontally overlapping squares; their vertical edges divide the outline into several narrow rectangular regions. The missing middle entry must therefore show two overlapping squares. Their two outer edges and their two inner overlapping edges produce three adjacent rectangular regions inside one horizontal outline.

Step 3: Select the matching construction Option (C) shows that horizontal outline divided into three vertical regions, corresponding to the two overlapping squares. Option (B) has only two regions and represents two merely adjoining squares, without the required overlap. Option (D) stacks its divisions vertically instead of extending the figure horizontally. Option (A) mixes a circle and a square, whereas each row keeps a single basic shape throughout the progression.

Step 4: Conclusion The missing figure is the pair of overlapping squares represented by option (C). Hence, the correct option is (C).

Quick Tip to Solve: Use the complete triangle and circle rows to find the rule, then distinguish two overlapping squares from two squares that only share an edge.

80. The diagram shows the supply and demand of different users for different items. Which of the following is/are correct?

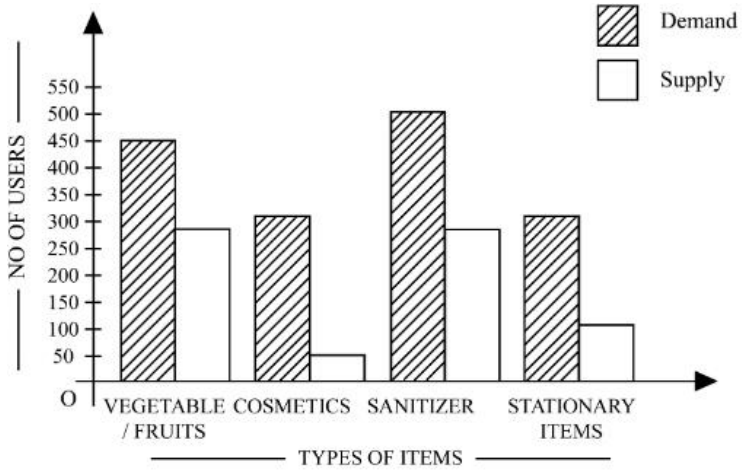
A. Sanitizer only meet 50% of the demand

B. Cosmetics has the least supply among all.

C. Among all, two items have equal demand but difference in supply

D. Among all, two items have equal supply and two items have equal demand.

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



(A) B and D only

(B) A and B only

(C) A and C only

(D) B, C and D only

Correct Answer: (D) B, C and D only

Solution:

Concept:

- Use the legend to distinguish demand, shown by the hatched bars, from supply, shown by the unshaded bars.
- Test every statement independently; equality of demand and equality of supply are separate comparisons.

Step 1: Compare the sanitizer bars and minimum supply The sanitizer demand bar reaches 500, while its supply is a little below 300 and equal to the vegetables/fruits supply bar. Half of 500 would be 250. The supply bar is above that level, so statement A, which says only 50 percent of the demand is met, is false. Cosmetics has the shortest unshaded bar, at about 50; the stationery supply is about 100 and the other supplies are much higher. Thus statement B is true.

Step 2: Find equal demand and equal supply The hatched bars for cosmetics and stationery items have equal heights, slightly above 300. Their unshaded bars are different: cosmetics has about 50 supplied whereas stationery has about 100. This establishes statement C. Separately, the unshaded bars for vegetables/fruits and sanitizer are equal in height. Hence there is both a pair with equal supply and a pair with equal demand, establishing statement D as well.

Step 3: Combine only the true statements The truth pattern is therefore A false, B true, C true and D true. Option (A) omits the true statement C. Options (B) and (C) both include the false statement A and omit at least one true statement. Option (D), B, C and D only, is the only list that includes all and only the statements supported by the plotted bars. The decision uses the graph heights, not the everyday demand expected for these products.

Step 4: Conclusion Statements B, C and D are correct, while A is false. Hence, the correct option is (D).

Quick Tip to Solve: Read the bar legend first; check the 250 halfway level for sanitizer and compare equal-height bars within the same demand or supply category.

Planning (100 marks)

81. When a person cannot meet a minimum level of living standards compared to others in the same time and place, it is called : [4 marks]

(A) Poverty

(B) Abundance

(C) Adequacy

(D) Luxury

Correct Answer: (A) Poverty

Solution:

Concept:

- Poverty is a condition in which a person lacks the resources needed to achieve a minimum acceptable standard of living. It concerns the inability to meet basic needs, rather than simply having fewer luxury goods.
- A relative assessment compares living conditions with those prevailing among other people in the same society, at the same time and place. The comparison in the question points to this social dimension of poverty.

Step 1: Identify the decisive condition The person described cannot meet the minimum level of living standards. Minimum living standards include essentials such as adequate food, clothing, shelter and access to basic services. The failure to attain this minimum is a deprivation of necessities. It therefore fits the meaning of poverty; it is not merely a preference for a simple lifestyle or a temporary decision not to buy a luxury item.

Step 2: Compare the four options Option (A), Poverty, names the deprivation described. Abundance means having plentiful resources and therefore suggests the opposite condition. Adequacy means having enough to meet the relevant standard, whereas the person here cannot meet it. Luxury refers to comforts or goods beyond basic necessities, so it does not name the inability to secure the minimum standard. These distinctions eliminate (B), (C) and (D).

Step 3: Conclusion The condition is poverty, with the wording comparing the person with others in the same time and place. Hence, the correct option is (A).

Quick Tip to Solve: Look for the phrase minimum living standard: inability to attain it indicates poverty, while adequacy means that the minimum is met.

82. Acropolis in Greece is a/an: [4 marks]

(A) Court

(B) Citadel on a High Land

(C) Open Air Theatre

(D) Great Bath

Correct Answer: (B) Citadel on a High Land

Solution:

Concept:

- An acropolis is the elevated, fortified part of an ancient Greek settlement. Its position on high ground made it suitable for defence and for prominent civic or sacred buildings.
- The term combines the ideas of a high place and a city. The famous Acropolis of Athens is a rocky height carrying important ancient monuments, rather than the name of a single court, theatre or bathing structure.

Step 1: Interpret the architectural term Read Acropolis as a type of urban place. A citadel is a fortified stronghold, often occupying an elevated site overlooking the surrounding settlement. This description agrees with an acropolis: the high position provided visibility and a defensible location. Although major temples can stand on an acropolis, the term describes the elevated citadel or precinct and does not mean a temple alone.

Step 2: Eliminate narrower building types Option (B), Citadel on a High Land, gives both the elevated setting and the character of the place. A court is an enclosed or open space associated with buildings and does not define an acropolis. An open-air theatre is a performance structure with seating around a stage; it can be associated with a Greek city but is a different urban element. A Great Bath is a bathing structure and likewise does not denote the fortified high part of a Greek settlement. Thus (A), (C) and (D) do not fit the term.

Step 3: Conclusion Acropolis denotes a citadel on high land. Hence, the correct option is (B).

Quick Tip to Solve: Associate acro with height: an acropolis is the high citadel of a Greek settlement, not a particular performance or bathing building.

83. In Land-use map, identify the colour code used for recreational uses. [4 marks]

(A) Yellow

(B) Green

(C) Purple

(D) Blue

Correct Answer: (B) Green

Solution:

Concept:

- Land-use maps use a colour legend to distinguish broad functions such as residential, industrial, public and recreational land. For this question, the relevant convention is the standard planning association between green and recreational open space.
- Recreational uses include parks, playgrounds, gardens and other open spaces intended for leisure. Their colour code helps distinguish them from built-up residential areas and other urban functions.

Step 1: Identify the function being mapped The category in the question is recreational use. Think of the land occupied by public parks, play fields and similar open spaces, rather than housing or industry. These functions are conventionally shown in green on a land-use map. The colour communicates their association with open and landscaped space, even though an individual recreation facility may also contain paths, courts or small buildings.

Step 2: Compare the supplied colour codes Green is option (B), so it directly matches the recreational category. Yellow is commonly associated with residential use, making it a tempting but incorrect choice here. Purple is associated with industrial use in standard land-use conventions and therefore does not identify parks and recreational open space. Blue is used for other categories in planning legends, commonly public and semi-public facilities, and is not the recreational code asked for. Therefore none of (A), (C) or (D) gives the required conventional match.

Step 3: Conclusion The conventional colour for recreational land use is green. Hence, the correct option is (B).

Quick Tip to Solve: Pair recreational parks and playgrounds with green; keep that association separate from the yellow convention for residential areas.

84. Statement I : The plan of Delhi city is in the radial form.

Statement II : The plan of Delhi city is in the Grid Iron form.

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: (C) Statement **I** is true but Statement **II** is false

Solution:

Concept:

- A radial urban plan has principal roads radiating from important centres, often linked by circular or connecting roads. A grid-iron plan is organised predominantly as intersecting straight streets forming rectangular blocks.
- The question tests the conventional planning description of Delhi, particularly the planned New Delhi layout. Its major avenues, roundabouts and focal spaces make radial planning the relevant identifying feature.

Step 1: Evaluate Statement I Statement I describes the plan of Delhi as radial. In the planned New Delhi area, broad avenues radiate from focal points and meet at major circles and civic spaces. This organisation is characteristic of a radial pattern. The statement therefore agrees with the usual planning classification used for Delhi in this comparison. The classification describes its characteristic planned layout; it need not mean that every lane throughout the entire metropolitan area is radial.

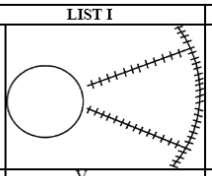
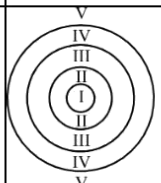
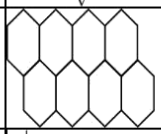
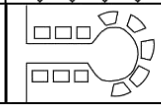
Step 2: Evaluate Statement II and choose the combination Statement II instead calls the plan grid iron. A grid-iron arrangement would have a predominantly regular network of streets intersecting to form repeated rectangular blocks. That is not the identifying pattern being tested for Delhi here, so Statement II is false. The required truth combination is true for I and false for II. Option (A) incorrectly makes II true; option (B) incorrectly makes I false; option (D) reverses both evaluations. Only option (C) expresses the correct combination.

Step 3: Conclusion Statement I is true but Statement II is false. Hence, the correct option is (C).

Quick Tip to Solve: Use the road pattern to distinguish plans: radiating avenues and circles suggest Delhi, while a repeated rectangular street network suggests a grid iron.

85. Match List I with List II.

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

LIST I		LIST II	
A.		I.	Christaller's concept
B.		II.	Garden City concept
C.		III.	Ernest Burgess
D.		IV.	Radburn concept

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

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

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

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

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

Solution:

Concept:

- Planning diagrams can be identified by their characteristic geometry. Ebenezer Howard's Garden City combines a compact settlement with an agricultural belt and radial links; Burgess represents urban land-use zones by concentric rings.
- Christaller's central-place concept uses hexagonal market areas, while the Radburn concept separates pedestrian movement from vehicular access and groups houses around short access roads such as cul-de-sacs.

Step 1: Identify the circular and concentric diagrams Diagram A shows a circular settlement associated with a sector of its wider surroundings and radial connections. Among the four named concepts, this is the Garden City concept, so A matches II. Diagram B consists of successive concentric rings labelled I to V. These rings represent the zones of Ernest Burgess's concentric-zone model, extending outward from the central area. Thus B matches III. A central-place diagram would instead show adjoining polygonal service areas, and a Radburn diagram would emphasise local street and housing arrangement.

Step 2: Identify the hexagons and local access layout Diagram C is a network of adjoining hexagons. Hexagonal areas cover a region without gaps while approximating the service areas around central places; this is the distinctive geometry of Christaller's concept. Therefore C matches I. Diagram D shows houses arranged along a short access road with a turning end, illustrating the residential access

arrangement associated with the Radburn concept. Therefore D matches IV. These two matches also rule out any option that associates C with Garden City or Radburn.

Step 3: Check the complete matching against the choices Combining the four identifications gives A-II, B-III, C-I and D-IV. Option (A) reproduces all four pairs. Option (B) wrongly assigns the concentric-ring diagram to Christaller and the hexagons to Garden City. Option (C) swaps the Garden City and Radburn associations for A and D. Option (D) interchanges the hexagonal central-place pattern and the local Radburn layout. Only the first option preserves every graphical match.

Step 4: Conclusion A matches II (Garden City), B matches III (Ernest Burgess), C matches I (Christaller) and D matches IV (Radburn). Hence, the correct option is (A).

Quick Tip to Solve: Identify the clearest signatures first: concentric rings indicate Burgess, hexagons indicate Christaller, and a residential cul-de-sac points to Radburn.

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86. Match List I with List II

LIST I	LIST II		
A.	Tower in the Park	I.	Sir Ebenezer Howards
B.	Neighbourhood Unit	II.	Le-Corbusier
C.	Garden City	III.	Clerence Perry
D.	Sector Model	IV.	Homer Hoyt

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

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

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

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

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

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

Solution:

Concept:

- Urban planning models are identified by both their spatial idea and their associated thinker. Matching the model first is more reliable than choosing a code merely because one familiar name appears in it.
- Le Corbusier is associated with towers set in open space; Clarence Perry with the neighbourhood unit; Ebenezer Howard with the garden city; and Homer Hoyt with the sector model of urban land use.

Step 1: Match each planning idea with its proponent A, Tower in the Park, matches Le Corbusier, listed as II: the idea places tall buildings within extensive open space. B, Neighbourhood Unit, matches Clarence Perry, listed as III: the concept organises a residential neighbourhood around local facilities and an appropriate street arrangement. C, Garden City, matches Ebenezer Howard, listed as I: the garden-city idea integrates urban settlement with surrounding green and agricultural land. D, Sector Model, matches Homer Hoyt, listed as IV: urban land uses develop in sectors extending outward along

important routes.

Step 2: Check the complete answer code Putting the four independently identified pairs together gives A-II, B-III, C-I, D-IV. Option (B) contains exactly this sequence. Option (A) incorrectly assigns the tower idea to Howard and the garden city to Hoyt. Option (C) gets A and B right but exchanges the garden-city and sector-model associations. Option (D) gives Perry the tower idea and Le Corbusier the neighbourhood unit, reversing their correct contributions. Checking all four pairs therefore singles out (B).

Step 3: Conclusion The correct matching is A-II, B-III, C-I, D-IV. Hence, the correct option is (B).

Quick Tip to Solve: Anchor the matching with Howard–Garden City and Hoyt–Sector Model, then verify Perry–Neighbourhood Unit and Le Corbusier–Tower in the Park.

87. Match List I with List II

LIST I	LIST II		
A.	1st Five Year Plan	I.	1969-1974
B.	4th Five Year Plan	II.	1951-1956
C.	8th Five Year Plan	III.	1992-1997
D.	11th Five Year Plan	IV.	2007-2012

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

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

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

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

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

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

Solution:

Concept:

- A Five Year Plan is identified by its actual implementation period. Successive plan numbers cannot always be dated by simply adding five years because India also had annual-plan intervals between some five-year plans.
- The periods needed here are: First Plan, 1951–1956; Fourth Plan, 1969–1974; Eighth Plan, 1992–1997; and Eleventh Plan, 2007–2012. Match each date interval to its Roman numeral in List II.

Step 1: Assign the four printed periods A is the 1st Five Year Plan, implemented during 1951–1956; this period appears at II. B is the 4th Five Year Plan, implemented during 1969–1974; this period appears at I. C is the 8th Five Year Plan, implemented during 1992–1997; this period appears at III. D is the 11th Five Year Plan, implemented during 2007–2012; this period appears at IV. Thus the required sequence is A-II, B-I, C-III, D-IV.

Step 2: Eliminate the alternative codes Option (B) reproduces all four pairs exactly. Option (A) interchanges the first and fourth plan periods, assigning 1969–1974 to the First Plan and 1951–1956

to the Fourth Plan. Option (C) assigns the wrong periods to the Fourth, Eighth and Eleventh Plans. Option (D) gets the First and Fourth Plans right but exchanges the Eighth and Eleventh Plan periods. Since the question requires a complete matching, even one incorrect pair eliminates an option; only (B) survives.

Step 3: Conclusion The correct matching is A-II, B-I, C-III, D-IV. Hence, the correct option is (B).

Quick Tip to Solve: Memorise actual plan dates instead of extending an unbroken five-year sequence: the Eighth Plan began in 1992 after an annual-plan interval.

88. Match List I with List II

LIST I	LIST II		
A.	Madurai	I.	Planned Hill city
B.	Aurovile	II.	Kadamba Vanam
C.	Lavasa	III.	Grid Iron
D.	Chandigarh	IV.	Matri Mandir

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

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

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

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

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

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

Solution:

Concept:

- A city-feature matching question requires recognising the distinctive historical, architectural or planning association of each place. Each city must receive its own matching feature before the final answer code is selected.
- Madurai is associated with Kadamba Vanam; Auroville with the Matrimandir; Lavasa with a planned hill city; and Chandigarh with a grid-iron layout. The printed list gives these features Roman-numeral codes II, IV, I and III respectively.

Step 1: Establish each city-feature pair A, Madurai, matches II, Kadamba Vanam, referring to the traditional association of the city with the kadamba forest. B, Auroville, matches IV, Matri Mandir: the Matrimandir is a defining landmark of Auroville. C, Lavasa, matches I, Planned Hill city, describing its development as a planned settlement in a hilly setting. D, Chandigarh, matches III, Grid Iron, identifying its planned sector and street organisation. Combining them yields A-II, B-IV, C-I, D-III.

Step 2: Compare the complete code with the choices Option (D) is exactly A-II, B-IV, C-I, D-III. Option (A) wrongly associates Madurai with the Matrimandir, Auroville with the planned hill city and Lavasa with Kadamba Vanam. Option (B) also misassigns Madurai and Auroville, although it retains the correct Lavasa and Chandigarh matches. Option (C) assigns the planned hill city to Madurai, Kadamba Vanam to Auroville and the Matrimandir to Lavasa. All four choices include D-III, so Chandigarh

alone cannot distinguish them; the other three pairs establish (D).

Step 3: Conclusion The correct matching is A-II, B-IV, C-I, D-III. Hence, the correct option is (D).

Quick Tip to Solve: Start with the distinctive Auroville–Matrimandir pair: it separates the choices here, then verify Madurai, Lavasa and Chandigarh independently.

89. Which of the following article is related to Panchayati Raj ? [4 marks]

(A) Article 243

(B) Article 324

(C) Article 124

(D) Article 73

Correct Answer: (A) Article 243

Solution:

Concept:

- Panchayati Raj is the system of rural local self-government. Part IX of the Constitution deals with Panchayats and begins with Article 243.
- The 73rd Constitutional Amendment gave constitutional recognition to Panchayati Raj institutions. Article numbers must be matched to their subject rather than to a general governmental function.

Step 1: Locate the provisions on Panchayats Article 243 supplies the definitions used in Part IX. The related provisions in Articles 243A to 243O cover matters such as the Gram Sabha, constitution of Panchayats, elections and their duration. Thus Article 243 is directly associated with Panchayati Raj, even though several more detailed provisions follow it.

Step 2: Eliminate the unrelated articles Article 324 concerns the superintendence, direction and control of elections by the Election Commission. Article 124 concerns the establishment and constitution of the Supreme Court. Article 73 concerns the extent of the executive power of the Union. These are different constitutional subjects and do not identify the Part IX Panchayat framework.

Step 3: Conclusion Article 243 is related to Panchayati Raj. Hence, the correct option is (A).

Quick Tip to Solve: Remember Part IX with Article 243 for Panchayats; Part IXA with Article 243P onward concerns Municipalities.

90. How many acres is 1 hectare? [4 marks]

(A) 2.47

(B) 3.47

(C) 4.47

(D) 5.47

Correct Answer: (A) 2.47

Solution:

Concept:

- A hectare is a metric unit of area equal to 10,000 square metres. An acre is a different area unit equal to approximately 4,046.856 square metres.
- To convert a given area into acres, divide its area in square metres by the square metres in one acre. This is an area conversion, so a linear-distance conversion is inappropriate.

Step 1: Express both units in square metres Use $1\,\text{ha} = 10{,}000\,\text{m}^2$ and $1\,\text{acre} \approx 4{,}046.856\,\text{m}^2$. The common square-metre unit cancels in the ratio, leaving a numerical count of acres. A hectare is larger than an acre, so the result should exceed one.

Step 2: Calculate and compare the choices

$$1\,\text{ha} = \frac{10{,}000}{4{,}046.856}\,\text{acres} \approx 2.47105\,\text{acres}.$$

Rounded to two decimal places this is 2.47 acres. The alternatives 3.47, 4.47 and 5.47 exceed the conversion value and cannot represent the same area. No additional scaling is needed because the initial value is exactly one hectare.

Step 3: Conclusion One hectare is approximately 2.47 acres. Hence, the correct option is (A).

Quick Tip to Solve: Use 1 hectare = 2.471 acres for a quick conversion; multiply hectares by this factor to obtain acres.

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91. What is the full form of the NITI ? [4 marks]

(A) National Institute for Transforming India

(B) National Industry for Technology India

(C) National Industry for Transforming India

(D) National Industrial Technical Institute

Correct Answer: No option is exact: NITI means National Institution for Transforming India; (A) is the intended keyed answer but prints Institute.

Solution:

Concept:

- NITI Aayog is the Government of India's policy think tank. Its official expansion is National Institution for Transforming India.

- For an acronym-expansion question, the complete official name matters: a similar-sounding word should not silently replace a word in the name.

Step 1: Expand the acronym accurately N stands for National, I for Institution, T for Transforming and I for India. NITI Aayog was constituted in 2015, and its policy role helps identify why the name refers to transforming India rather than an industrial or technical institute. The official name uses Institution, not Institute.

Step 2: Compare the printed alternatives Option (A) is evidently the intended and keyed choice because it contains National and Transforming India, but it prints Institute instead of Institution. Options (B) and (C) substitute Industry, and option (B) also substitutes Technology for Transforming. Option (D) gives Industrial Technical Institute, which describes a different expansion. Consequently none reproduces the official full form exactly.

Step 3: Conclusion The exact full form is National Institution for Transforming India. The key selects (A) as the intended answer, but its printed word Institute is inaccurate; no listed option gives the exact official expansion.

Quick Tip to Solve: Learn the exact phrase National Institution for Transforming India; do not confuse Institution with Institute.

92. The term "Conurbation" was coined by ? [4 marks]

(A) Kevin Lynch

(B) Patrick Geddes

(C) Ebenezer Howard

(D) Lewis Mumford

Correct Answer: (B) Patrick Geddes

Solution:

Concept:

- A conurbation is a large urban region formed when neighbouring towns or cities grow and their built-up areas join together.
- Patrick Geddes introduced the term conurbation. The term concerns the joining of urban settlements rather than the planned creation of a single garden city.

Step 1: Identify the urban process As separate settlements expand, the spaces between them may become continuously developed. They can retain their individual identities while forming one extensive urban region. Geddes used conurbation to describe this pattern of urban growth, linking the term with his study of cities and their surrounding regions.

Step 2: Distinguish the named planners Patrick Geddes is the name associated with coining conurbation, so option (B) fits. Kevin Lynch is associated with urban imageability and elements such as paths and landmarks. Ebenezer Howard developed the garden-city idea. Lewis Mumford was an influential writer on cities and their history, but he did not coin this term. The familiar urban associations of the other names should not be substituted for the specific attribution asked here.

Step 3: Conclusion Patrick Geddes coined the term conurbation. Hence, the correct option is (B).

Quick Tip to Solve: Connect conurbation with Geddes and the joining of neighbouring urban areas; connect garden city with Howard.

93. Who is the planner of Durgapur city? [4 marks]

(A) Le Corbusier

(B) Ebenezer Howard

(C) Joseph Allen Stein

(D) Charles Correa

Correct Answer: (C) Joseph Allen Stein

Solution:

Concept:

- Durgapur in West Bengal is a planned industrial city. Joseph Allen Stein is associated with the planning of its township, working with Benjamin Polk.
- Questions about planned cities require the specific city-planner association; the best-known modernist architect is not automatically the answer for every planned Indian city.

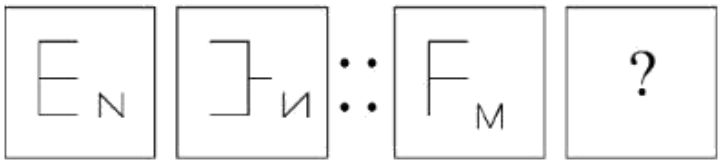
Step 1: Identify Durgapur's planning association Durgapur developed as an industrial centre with an organised township serving its industrial population. Stein worked on its planning in collaboration with Benjamin Polk. Among the four supplied names, Joseph Allen Stein is therefore the relevant planner. The question asks for the city-planner association rather than a general theory of city design.

Step 2: Check the alternative names Le Corbusier is closely associated with Chandigarh, so option (A) refers to a different planned city. Ebenezer Howard is associated with the garden-city movement rather than the Durgapur township. Charles Correa is associated with major Indian architectural and urban-planning work, including Navi Mumbai, but he is not the supplied name linked with Durgapur. These distinctions leave Stein as the correct choice.

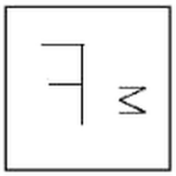
Step 3: Conclusion Joseph Allen Stein is the planner associated with Durgapur among these options. Hence, the correct option is (C).

Quick Tip to Solve: Keep city-planner pairs together: Durgapur–Stein, Chandigarh–Le Corbusier and Navi Mumbai–Correa.

94. In problem figures, A and B have certain relation. Identify which one of the answer figures will have similar relation between C and D? [4 marks]



(A) 

(B) 

(C) 

(D) 

Correct Answer: (D) 

Solution:

Concept:

- A visual analogy transfers the changes actually shown in the first pair to the corresponding features of the second pair. Each stroke must be checked separately rather than treating a familiar-looking character as a whole.
- In the first pair, the outer horizontal arms of the large character change from the right side of the vertical stroke to the left, but its short middle arm still projects right. The small N reverses its diagonal orientation; a corresponding left-right reversal leaves the vertically symmetric M unchanged.

Step 1: Read the individual changes from A to B In A, the large E-like figure has top, middle and bottom horizontal arms extending right. In B, the top and bottom arms extend left from its vertical stroke, whereas the middle arm still extends right. Thus the large character does not undergo a uniform mirror reflection of every stroke. Separately, the small N changes its diagonal orientation to its left-right reverse. These visible details define the analogy.

Step 2: Transfer the changes to C The large F-like figure in C has a top arm and a short middle arm, with no bottom arm. Move its outer top arm to the left of the vertical stroke, just as the outer arms change sides in the first pair. Retain its short middle arm projecting right, as B does. The small M remains an upright M under left-right reversal because its shape is symmetric about a vertical line. No bottom arm should be added to the F-like figure.

Step 3: Compare the four answer figures Option (D) combines the required left-projecting top arm, right-projecting middle arm and upright M. Option (A) does not have the required top-arm orientation and turns the small letter sideways. Option (B) turns the small letter sideways and places the middle

arm on the wrong side. Option (C) has the appropriate large-stroke arrangement but changes the upright M to W. Only (D) preserves all the feature changes shown by the first pair.

Step 4: Conclusion The required figure has its top arm extending left, middle arm extending right, and small M remaining upright, as in option (D). Hence, the correct option is (D).

Quick Tip to Solve: Track the top, middle and bottom arms separately before naming a transformation; a familiar letter shape can conceal a stroke that stays on its original side.

95. The Housing Development Finance Corporation Limited (HDFC) was founded in: [4 marks]

(A) 1947

(B) 1961

(C) 1977

(D) 1981

Correct Answer: (C) 1977

Solution:

Concept:

- Housing Development Finance Corporation Limited was established in 1977 as a specialised housing-finance institution in India.
- HDFC Limited and HDFC Bank were distinct organisations at the time of this examination. A founding-year question must be answered for the entity named in full.

Step 1: Identify the institution in the question The words Housing Development Finance Corporation Limited specify HDFC Limited, the housing-finance company. Its original purpose was to provide finance supporting home purchase and construction. The question does not ask for the incorporation year of HDFC Bank, so the bank's later history should not be substituted for the corporation's founding date.

Step 2: Compare the dates HDFC Limited was founded in 1977. Therefore option (C) agrees with the required historical fact. The other dates, 1947, 1961 and 1981, do not give its founding year. In particular, 1947 is a prominent national historical year, but that prominence is unrelated to the establishment of the named housing-finance corporation.

Step 3: Conclusion Housing Development Finance Corporation Limited was founded in 1977. Hence, the correct option is (C).

Quick Tip to Solve: Link HDFC Limited with 1977; distinguish the original housing-finance corporation from the later HDFC Bank.

96. An essential feature of federal government is: [4 marks]

(A) Centralisation of Powers

(B) Division of Powers between various levels

(C) Opposition

(D) Unwritten Constitution

Correct Answer: (B) Division of Powers between various levels

Solution:

Concept:

- Federalism divides governmental powers between different levels of government, usually a national government and regional or state governments.
- Each level has a constitutionally assigned area of authority. The central point is the division of powers, rather than whether a country has opposition parties or a particular constitutional writing style.

Step 1: Identify the defining feature In a federal arrangement, more than one level of government exercises authority over the same territory and population. Their respective powers are allocated so that each level can act within its own jurisdiction. This division distinguishes federal government from a system in which the central government holds all authority and other levels simply exercise powers at its discretion.

Step 2: Eliminate the alternatives Centralisation of powers in option (A) runs against the defining division of authority. An opposition in option (C) is relevant to democratic political competition but can exist in both federal and unitary systems. An unwritten constitution in option (D) is not an essential feature of federalism; the nature of the power-sharing arrangement is decisive. Option (B) directly states the required division between levels.

Step 3: Conclusion Division of powers between various levels is an essential feature of federal government. Hence, the correct option is (B).

Quick Tip to Solve: When identifying federalism, look for constitutionally divided authority between levels, rather than merely several administrative offices.

97. Which of the following is not a public sector bank? [4 marks]

(A) ICICI

(B) State Bank of India

(C) Indian Bank

(D) Canara Bank

Correct Answer: (A) ICICI

Solution:

Concept:

- A public sector bank is classified by government ownership and control. Offering banking services to the public does not, by itself, make a bank a public sector bank.
- A private sector bank is a banking company whose controlling ownership is in the private sector. ICICI Bank belongs to this category, whereas State Bank of India, Indian Bank and Canara Bank belong to the public sector.

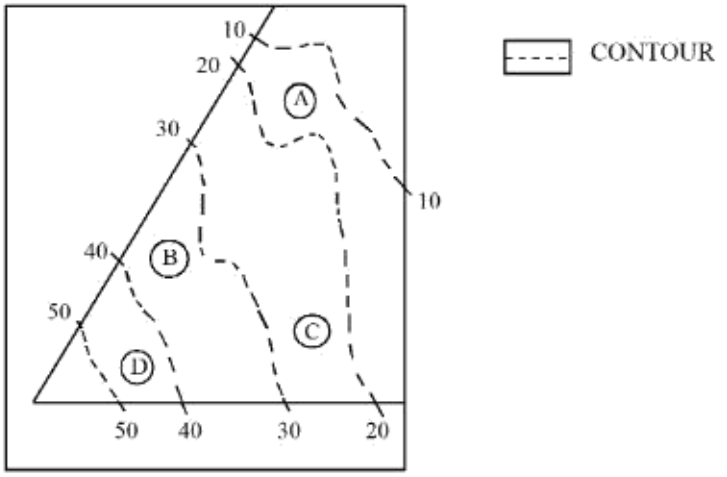
Step 1: Apply the ownership criterion The question asks for the bank that is *not* a public sector bank. Therefore, identify the exception among the four names rather than selecting a familiar government-owned bank. ICICI Bank is classified as a private sector bank. Its nationwide branch network and its acceptance of deposits from the general public do not change its ownership category. It consequently satisfies the negative condition in the question.

Step 2: Eliminate the public sector alternatives State Bank of India is a public sector bank, so option (B) cannot be the required exception. Indian Bank is also a public sector bank; option (C) therefore fails the word *not*. Canara Bank likewise belongs to the public sector, eliminating option (D). These three alternatives share the ownership classification that the question excludes. Only ICICI Bank differs from that group, so there is a single matching option rather than more than one defensible answer.

Step 3: Conclusion ICICI Bank is a private sector bank and hence is not a public sector bank. State Bank of India, Indian Bank and Canara Bank are public sector banks. Hence, the correct option is (A).

Quick Tip to Solve: In a bank-classification question, use ownership rather than size or services. Circle the word *not* first so that you select the private sector exception.

98. In the given diagram, the location of D on the site is: [4 marks]



(A) 30-40

(B) 40-50

(C) 10-20

(D) 20-30

Correct Answer: (B) 40-50

Solution:

Concept:

- A contour joins points at the same elevation. The numbers printed beside the dashed curves give their levels; height must be read from these labels, rather than from how high a point appears on the page.
- A point lying between two consecutive contours is located in the elevation band bounded by those contours. Trace each curve continuously to a printed value before comparing different parts of the site.

Step 1: Locate D within its contour band Find the circled D near the lower-left corner of the triangular site. The dashed contour immediately to its left meets the site boundary at the label 50, while the dashed contour to its right meets the lower boundary at the label 40. D lies between these two curves, rather than between the curves labelled 30 and 40.

Step 2: Read the two bounding levels The relevant lower and upper levels are therefore 40 and 50. Thus the position belongs to the 40–50 band. The range 30–40 is the next band to the right; 20–30 contains C, and 10–20 contains A. These alternatives cannot describe D.

Step 3: Conclusion D is located between contours 40 and 50. Hence, the correct option is (B).

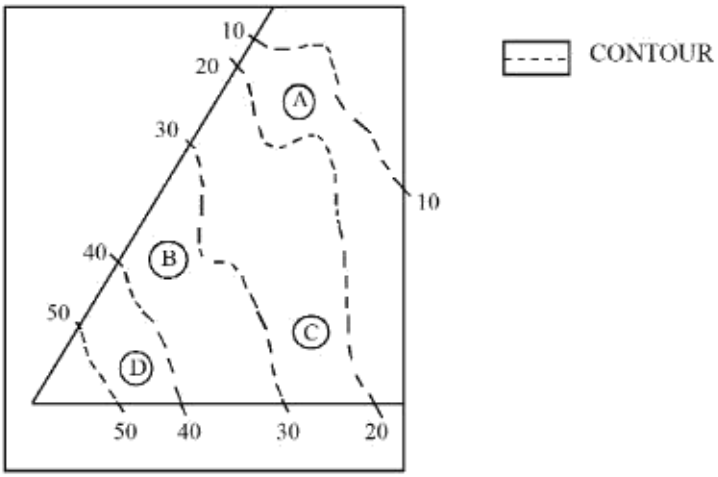
Quick Tip to Solve: Follow both dashed curves beside D to their boundary labels; the point nearest a corner need not lie on the lowest contour.

99. Statement I: In the given diagram, the location of B is higher than C

Statement II: In the given diagram, the location of A is lower than C

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:

- A contour joins points at the same elevation. The numbers printed beside the dashed curves give their levels; height must be read from these labels, rather than from how high a point appears on the page.
- A point lying between two consecutive contours is located in the elevation band bounded by those contours. Trace each curve continuously to a printed value before comparing different parts of the site.

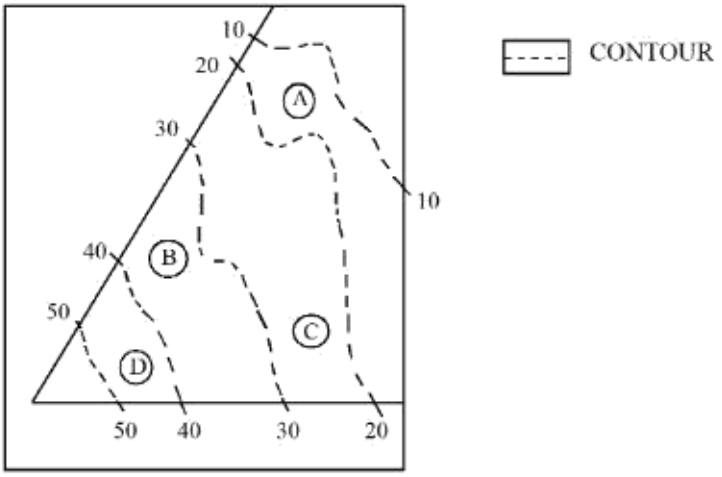
Step 1: Test Statement I using B and C B is enclosed in the strip between the contours labelled 30 and 40. C lies in the adjacent lower strip between 20 and 30. Every interior elevation in B's band exceeds every interior elevation in C's band, so B is higher than C. Statement I is true.

Step 2: Test Statement II using A and C A lies in the band between the contours 10 and 20, whereas C lies between contours 20 and 30. Thus A is lower than C, even though A appears nearer the top of the drawing. Statement II is also true. Option (B) rejects both correct comparisons, and options (C) and (D) reject one of them.

Step 3: Conclusion Both Statement I and Statement II are true. Hence, the correct option is (A).

Quick Tip to Solve: Write the bands beside the letters first: A is 10–20, C is 20–30 and B is 30–40; compare the numbers rather than page positions.

100. In the given diagram, the location of the A lies on which contour ? [4 marks]



(A) 20-30

(B) 30-40

(C) 10-20

(D) 40-50

Correct Answer: (C) 10-20

Solution:

Concept:

- A contour joins points at the same elevation. The numbers printed beside the dashed curves give their levels; height must be read from these labels, rather than from how high a point appears on the page.
- A point lying between two consecutive contours is located in the elevation band bounded by those contours. Trace each curve continuously to a printed value before comparing different parts of the site.

Step 1: Trace the contours bordering A The circled A is in the upper part of the triangular site. The dashed curve on its outer/right side is the one labelled 10 where it reaches the right boundary. The other boundary of A's strip is the dashed contour labelled 20 on the lower edge and near the sloping edge. These are the two consecutive levels enclosing A.

Step 2: Select the matching elevation range A therefore belongs to the 10–20 contour band. The question uses the word contour while giving ranges as its answers, so we select the band that contains the point. The ranges 20–30, 30–40, and 40–50 lie progressively farther toward the lower-left part of the diagram and do not contain A.

Step 3: Conclusion A lies in the 10–20 contour band. Hence, the correct option is (C).

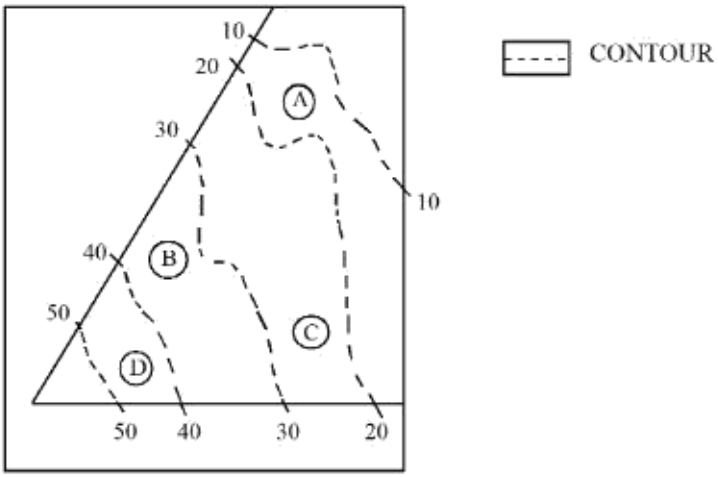
Quick Tip to Solve: When the choices are ranges, identify the two curves enclosing A; do not select a single contour value or infer height from the top of the page.

101. Statement I: 'A' is located at the lowest point of the site.

Statement II: 'A' is located at a lower point than 'B' on the site.

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: (D) Statement **I** is false but Statement **II** is true

Solution:

Concept:

- A contour joins points at the same elevation. The numbers printed beside the dashed curves give their levels; height must be read from these labels, rather than from how high a point appears on the page.
- A point lying between two consecutive contours is located in the elevation band bounded by those contours. Trace each curve continuously to a printed value before comparing different parts of the site.

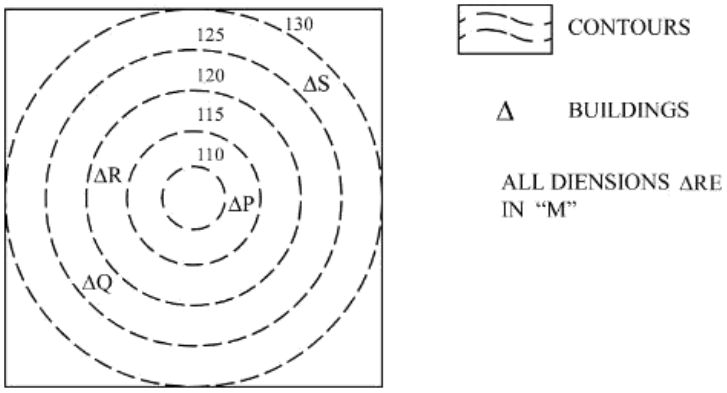
Step 1: Test the literal lowest-point claim A lies between the contours 10 and 20, so its elevation exceeds 10. The site also contains the contour labelled 10, whose points are lower than A. Therefore A cannot be the lowest point of the whole site. A is merely the lowest of the four labelled locations A, B, C and D. Statement I refers to the site itself, not just to these four locations, and is false as written.

Step 2: Compare A with B independently B lies in the 30–40 band, while A lies in the 10–20 band. Hence A is certainly lower than B, making Statement II true. The supplied key chooses both statements true, which would require replacing "lowest point of the site" with "lowest of the labelled locations". That restriction is absent from the printed statement. We preserve the wording and therefore reject options (A), (B) and (C).

Step 3: Conclusion As written, Statement I is false and Statement II is true. The supplied key accepts both statements, but the visible 10 contour disproves Statement I. Hence, the correct option is (D).

Quick Tip to Solve: Distinguish the lowest labelled point from the lowest point anywhere on the site; a lower contour is enough to disprove an absolute minimum claim.

102. In the given diagram, how many contour levels are present in between "P" and "S" [4 marks]



(A) 2

(B) 3

(C) 1

(D) 4

Correct Answer: (B) 3

Solution:

Concept:

- The nested dashed lines are contours: each represents one elevation. Their labels increase outward as 110, 115, 120, 125 and 130 metres, so the contour interval is $5\,\mathrm{m}$.
- The triangular symbols mark buildings. Read their positions relative to the labelled contour belts; do not confuse the physical distance between rings with the vertical difference between their levels.

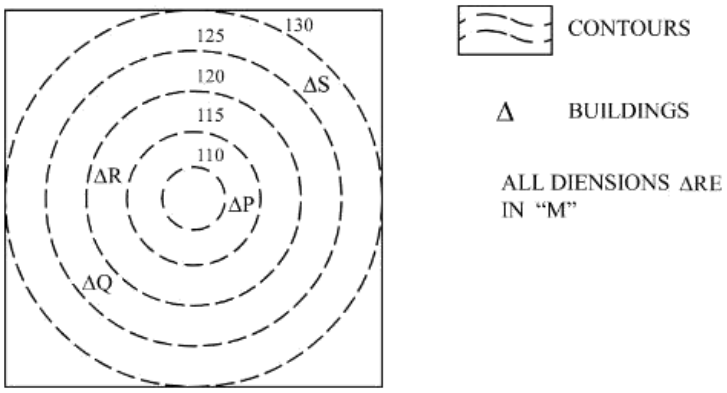
Step 1: Locate the two buildings between contours P lies between the 110-metre and 115-metre contours, while S lies between the 125-metre and 130-metre contours. Neither triangular building symbol is drawn on a contour. A route from P outward toward S must therefore cross the dashed rings labelled 115, 120 and 125. The contour at 110 lies inward of P, and the contour at 130 lies outward of S.

Step 2: Count the curves actually separating P and S There are three intervening contour levels: $115, 120, 125$. Excluding 125 would wrongly treat S as lying exactly on that contour, even though its building symbol is beyond the curve. One or two misses separating curves; four includes an external contour. The supplied answer key selects two, but the visible positions in the diagram give three; the literal figure therefore supports option (B).

Step 3: Conclusion Three contour levels lie between P and S in the drawn figure, contrary to the supplied key. Hence, the correct option is (B).

Quick Tip to Solve: Count the contours between the actual point symbols; do not round a building to the nearest labelled contour before counting.

103. In the given diagram, "S" is higher than _____ meter from "R" [4 marks]



(A) 5

(B) 10

(C) 25

(D) 15

Correct Answer: The figure gives elevation bands, so an exact height difference cannot be determined; 10 m is the keyed value but is not established uniquely.

Solution:

Concept:

- The nested dashed lines are contours: each represents one elevation. Their labels increase outward as 110, 115, 120, 125 and 130 metres, so the contour interval is $5\,\mathrm{m}$.
- The triangular symbols mark buildings. Read their positions relative to the labelled contour belts; do not confuse the physical distance between rings with the vertical difference between their levels.

Step 1: Read the elevation bands rather than assign exact heights R is drawn between the contours at 115 and 120 metres. S is drawn between those at 125 and 130 metres. Consequently $115 < h_R < 120$ and $125 < h_S < 130$. The building symbols are not spot-height labels and do not sit exactly on a contour. No rule of linear interpolation, slope profile or exact point elevation is supplied.

Step 2: Bound the difference and assess the options Subtracting the bounds gives

$$5 < h_S - h_R < 15 \quad \text{metres.}$$

The keyed value 10 metres is possible, for instance if the two buildings have the same offset above their respective lower contours. It is not forced: heights 116 and 128 metres also fit the map but differ by 12 metres. Values 5 and 15 are boundary limits, and 25 is outside the range. An exact difference therefore cannot be inferred merely because 10 is the only listed value inside the bounds.

Step 3: Conclusion S is higher than R, but the figure does not determine an exact difference. The supplied key gives (B), 10 metres; this is a possible value rather than a uniquely established answer.

Quick Tip to Solve: Use inequalities for points between contour lines; subtract exact heights only when spot elevations or a stated interpolation rule provide them.

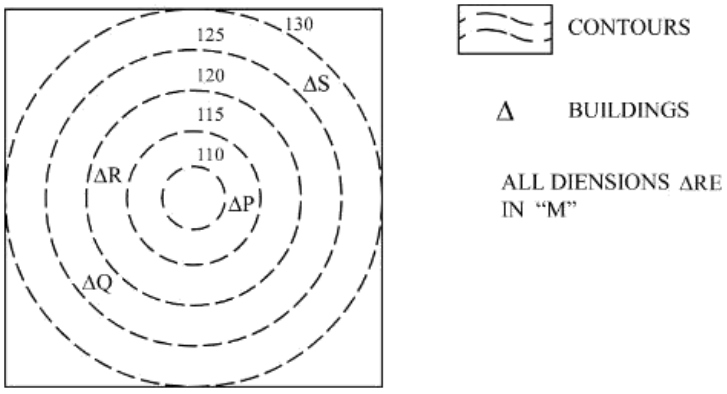
104. Based on the given diagram:

Statement I : "R" is higher than "P" and "Q"

Statement II : "S" is higher than "P", "Q" and "R"

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: (D) Statement **I** is false but Statement **II** is true

Solution:

Concept:

- The nested dashed lines are contours: each represents one elevation. Their labels increase outward as 110, 115, 120, 125 and 130 metres, so the contour interval is $5\,\mathrm{m}$.
- The triangular symbols mark buildings. Read their positions relative to the labelled contour belts; do not confuse the physical distance between rings with the vertical difference between their levels.

Step 1: Test Statement I by comparing R with P and Q The contour labels increase from the centre toward the outside. P occupies the innermost building belt, R the next belt outward, and Q a belt farther outward than R. Thus R is higher than P but lower than Q. Statement I requires R to be higher than both P and Q; its comparison with Q fails, so the complete statement is false.

Step 2: Test Statement II by locating S S lies farther outward than P, R and Q, next to the 125-metre contour belt. Since the labels increase outward through 110, 115, 120 and 125, S is higher than all three of those marked buildings. Statement II is true. Options (A) and (C) incorrectly accept Statement I, while (B) incorrectly rejects Statement II.

Step 3: Conclusion Statement I is false, but Statement II is true. Hence, the correct option is (D).

Quick Tip to Solve: For a statement containing "and", test both comparisons: R is above P but below Q, which is enough to make Statement I false.

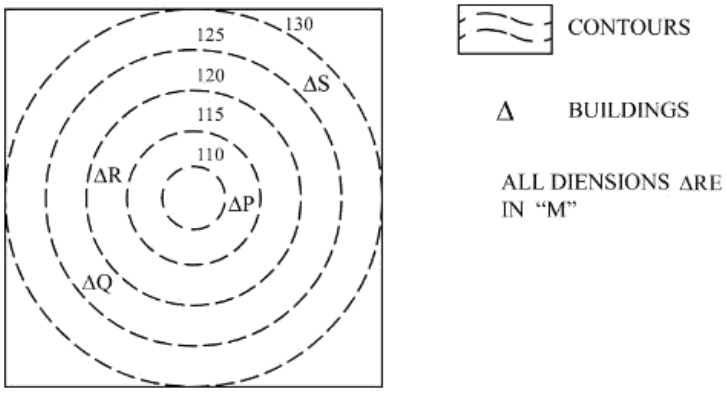
105. Based on the given diagram:

Statement I : "P" is located at a height of 110 M

Statement II : "Q" is located 5 M lower than "S"

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: The contour map does not fix the exact heights of P, Q and S, so the statements cannot be assigned a unique listed truth combination.

Solution:

Concept:

- A contour joins locations of equal elevation. A point between two contours is constrained by their elevations, but its exact height cannot be read without an additional spot height or an interpolation rule.
- The successive contour elevations are $110, 115, 120, 125, 130\,\mathrm{m}$, giving a contour interval of $5\,\mathrm{m}$. Equal contour intervals do not imply that arbitrary points in neighbouring contour bands have exactly that elevation difference.

Step 1: Inspect P's position relative to the contours Trace the innermost closed contour to its $110\,\mathrm{m}$ label and the next contour to $115\,\mathrm{m}$. The triangular building symbol P is drawn between these two contours, not on the $110\,\mathrm{m}$ contour. Thus the map supplies an elevation band, rather than the claimed exact height:

$$110 < h_P < 115 \quad \text{(in metres)}.$$

Statement I cannot be justified by assigning P the label of the nearest contour. The drawing contains no spot-height annotation giving P an exact elevation of $110\,\mathrm{m}$.

Step 2: Distinguish a contour interval from a point-height difference Q lies in the band between $120\,\mathrm{m}$ and $125\,\mathrm{m}$; S lies between $125\,\mathrm{m}$ and $130\,\mathrm{m}$. S is therefore higher than Q, but the precise difference is not specified. These bounds allow

$$0 < h_S - h_Q < 10\,\mathrm{m}.$$

For example, heights of $122\,\mathrm{m}$ and $127\,\mathrm{m}$ give a difference of $5\,\mathrm{m}$, whereas $121\,\mathrm{m}$ and $129\,\mathrm{m}$ give $8\,\mathrm{m}$. Both pairs respect the displayed bands. Thus Statement II might hold, but it is not established by the map. Neither (B) nor (D) is uniquely forced, while (A) and (C) incorrectly assert the exact height claimed in Statement I.

Step 3: Conclusion The supplied contour map is insufficient to determine the listed truth combination uniquely. In particular, P is not shown on the $110\,\mathrm{m}$ contour, and the exact Q-to-S height difference is unspecified. The answer key selects (A), but that selection requires exact elevations that the printed diagram does not establish.

Quick Tip to Solve: Assign an exact elevation only to a point on a labelled contour or carrying a spot height; adjacent contour bands alone do not give an exact height difference.