JEE Mains 2025 9 April B Arch and B Planning Question Paper with Solutions

Time Allowed :3 Hours	Maximum Marks :300	Total questions :75

Important Instructions

1. **The test is of 3 hours duration.**
2. **This test paper consists of 75 questions. Each subject (PCM) has 25 questions. The maximum marks are 300.**
3. **This question paper contains Three Parts. Part-A is Physics, Part-B is Chemistry, and Part-C is Mathematics. Each part has only two sections: Section-A and Section-B.**
4. **Section-A: Attempt all questions.**
5. **Section-B: Attempt all questions.**
6. **Section-A (01 – 20):** Contains 20 multiple choice questions which have only one correct answer. Each question carries +4 marks for the correct answer and –1 mark for the wrong answer.
7. **Section-B (21 – 25):** Contains 5 Numerical value-based questions. The answer to each question should be rounded off to the nearest integer. Each question carries +4 marks for the correct answer and –1 mark for the wrong answer.

1. If the range of the function $f(x) = \sqrt{3-x} + \sqrt{5+x}$ is $[\alpha, \beta]$, then $\alpha^2 + \beta^2$ is equal to:

(A) 18
(B) 20
(C) 24
(D) 25

Correct Answer: (4) 25

Solution:
Concept: For functions involving square roots:

- The expression inside each square root must be non-negative.
- To find the range, determine the minimum and maximum values of the function over its domain.
- For sums of square roots, symmetry and critical point analysis are useful.

Step 1: Finding the domain For $f(x) = \sqrt{3-x} + \sqrt{5+x}$,

$$3 - x \geq 0 \quad \text{and} \quad 5 + x \geq 0$$

$$\Rightarrow -5 \leq x \leq 3$$

Step 2: Finding the maximum value Differentiate:

$$f'(x) = -\frac{1}{2\sqrt{3-x}} + \frac{1}{2\sqrt{5+x}}$$

Set $f'(x) = 0$:

$$\frac{1}{\sqrt{5+x}} = \frac{1}{\sqrt{3-x}} \Rightarrow 5 + x = 3 - x \Rightarrow x = -1$$

$$f(-1) = \sqrt{4} + \sqrt{4} = 4$$

Thus, $\beta = 4$.

Step 3: Finding the minimum value Check endpoints:

$$f(-5) = \sqrt{8} + 0 = 2\sqrt{2}$$

$$f(3) = 0 + \sqrt{8} = 2\sqrt{2}$$

Thus, $\alpha = 2\sqrt{2}$.

Step 4: Required value

$$\alpha^2 + \beta^2 = (2\sqrt{2})^2 + 4^2 = 8 + 16 = 25$$

Quick Tip

For expressions like $\sqrt{a-x} + \sqrt{b+x}$, the maximum often occurs when the two square roots are equal.

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2. If the line $\arg(z) = \frac{\pi}{3}$ intersects the curve $|z - 2\sqrt{3}i| = 2$, $z \in \mathbb{C}$, at two distinct points A and B, then AB equals:

(A) 1
(B) 2
(C) 4
(D) 6

Correct Answer: (2) 2

Solution:
Concept:

- The equation $\arg(z) = \theta$ represents a straight line through the origin making an angle θ with the positive real axis.
- The equation $|z - z_0| = r$ represents a circle with center z_0 and radius r.
- The distance between two intersection points on a straight line can be found using the difference of their parameters.

Step 1: Parametric form of the line Given $\arg(z) = \frac{\pi}{3}$, any point on the line can be written as:

$$z = re^{i\pi/3} = r\left(\frac{1}{2} + i\frac{\sqrt{3}}{2}\right), \quad r \in \mathbb{R}$$

Thus,

$$z = \frac{r}{2} + i\frac{r\sqrt{3}}{2}$$

Step 2: Substitute into the circle equation The circle is:

$$|z - 2\sqrt{3}i| = 2$$

Substitute z:

$$\left|\frac{r}{2} + i\left(\frac{r\sqrt{3}}{2} - 2\sqrt{3}\right)\right| = 2$$

Step 3: Simplify

$$\left(\frac{r}{2}\right)^2 + \left(\frac{r\sqrt{3}}{2} - 2\sqrt{3}\right)^2 = 4$$

$$\frac{r^2}{4} + 3\left(\frac{r}{2} - 2\right)^2 = 4$$

$$\frac{r^2}{4} + \frac{3r^2}{4} - 6r + 12 = 4$$

$$r^2 - 6r + 8 = 0$$

Step 4: Solve for r

$$(r-2)(r-4) = 0 \Rightarrow r = 2,\ 4$$

Step 5: Distance between points The points A and B correspond to $r = 2$ and $r = 4$.

$$AB = |4 - 2| = 2$$

Quick Tip

For intersections of a line $\arg(z) = \theta$ with a circle, parametrize the line using $z = re^{i\theta}$ to reduce the problem to a quadratic in r.

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3. If the system of linear equations :

$$x + y + z = 4, \quad x + 2y + 3z = 6, \quad 4x + 5y + \lambda z = \mu$$

has more than one solution, then the value of $\lambda + \mu$ is equal to:

(A) 18
(B) 9
(C) 12
(D) 24

Correct Answer: (4) 24

Solution:
Concept: A system of linear equations has more than one solution if:

- The equations are consistent, and
- The rank of the coefficient matrix is less than the number of variables.

This happens when one equation is a linear combination of the others, including the constant terms.

Step 1: Express the third equation as a combination of the first two

Assume:

$$a(x+y+z)+b(x+2y+3z)=4x+5y+\lambda z$$

Comparing coefficients:

$$a+b=4 \quad (1)$$
$$a+2b=5 \quad (2)$$
$$a+3b=\lambda \quad (3)$$

Step 2: Solve for a and b Subtract (1) from (2):

$$b=1$$

Substitute in (1):

$$a+1=4 \Rightarrow a=3$$

Step 3: Find λ From (3):

$$\lambda=a+3b=3+3=6$$

Step 4: Find μ The constants must satisfy the same linear combination:

$$\mu=4a+6b=4(3)+6(1)=12+6=18$$

Step 5: Required value

$$\lambda+\mu=6+18=24$$

Quick Tip

For infinitely many solutions, one equation must be a linear combination of the others, including the constant terms.

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4. Let $b_1=3, b_2, b_3, \ldots$ be a geometric progression of increasing positive numbers. Let

$$\sum_{n=1}^{20} b_{3n}=4\sum_{n=1}^{20} b_{3n-2}.$$

Then, the sum of the first ten terms of the G.P. is:

(A) 1023
(B) 2046
(C) 3069
(D) 3149

Correct Answer: (3) 3069

Solution:

Concept: For a geometric progression:

- The n^{th} term is $b_n = ar^{n-1}$
- The sum of the first n terms is

$$S_n = a\frac{r^n - 1}{r - 1}, \quad r \neq 1$$

- Given summation conditions can be used to determine the common ratio r.

Step 1: Write the general term Given $b_1 = 3$, let the common ratio be r. Then:

$$b_n = 3r^{n-1}$$

Step 2: Express the given sums

$$\sum_{n=1}^{20} b_{3n} = \sum_{n=1}^{20} 3r^{3n-1}$$

$$\sum_{n=1}^{20} b_{3n-2} = \sum_{n=1}^{20} 3r^{3n-3}$$

Step 3: Use the given condition

$$\sum_{n=1}^{20} 3r^{3n-1} = 4\sum_{n=1}^{20} 3r^{3n-3}$$

Cancel 3 from both sides:

$$\sum_{n=1}^{20} r^{3n-1} = 4\sum_{n=1}^{20} r^{3n-3}$$

Factor out r^2 from the left:

$$r^2\sum_{n=1}^{20} r^{3n-3} = 4\sum_{n=1}^{20} r^{3n-3}$$

Since the sum is nonzero:

$$r^2 = 4 \Rightarrow r = 2 \quad \text{(as the G.P. is increasing)}$$

Step 4: Find the sum of the first ten terms

$$S_{10} = 3\frac{2^{10} - 1}{2 - 1} = 3(1024 - 1) = 3069$$

Quick Tip

When sums of selected terms of a G.P. are related, factor out common powers of the ratio to simplify the equation.

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5. If all the words, with or without meaning, made using all the letters of the word "RANCHI" are arranged as in a dictionary, then the word at 560^{th} position is:

(A) NICHRA
(B) NICAHR
(C) NICARH
(D) NICHAR

Correct Answer: (3) NICARH

Solution:
Concept:

- The number of arrangements of n distinct letters is $n!$.
- Dictionary (lexicographical) order depends on alphabetical arrangement.
- To find the word at a given position, we use the factorial number system.

Step 1: Arrange letters alphabetically The letters of the word **RANCHI** arranged alphabetically are:

$$A,\ C,\ H,\ I,\ N,\ R$$

Total number of words:

$$6! = 720$$

Step 2: Convert position to zero-based index

$$560 - 1 = 559$$

Step 3: Determine letters position-wise

- Each block of words starting with a fixed first letter has $5! = 120$ words.

  $$559 \div 120 = 4 \quad \text{(remainder 79)}$$

  The 5^{th} letter is **N**.

  Remaining letters: A, C, H, I, R

- Each block now has $4! = 24$ words.

  $$79 \div 24 = 3 \quad \text{(remainder 7)}$$

  The 4^{th} letter is **I**.

  Remaining letters: A, C, H, R

- Each block now has $3! = 6$ words.

  $$7 \div 6 = 1 \quad \text{(remainder 1)}$$

  The 2^{nd} letter is **C**.

  Remaining letters: A, H, R

- Each block now has $2! = 2$ words.

  $$1 \div 2 = 0 \quad \text{(remainder 1)}$$

  The 1^{st} letter is **A**.

  Remaining letters: H, R

- Each block now has $1! = 1$ word.

$$1 \div 1 = 1$$

The 2^{nd} letter is **R**.

The last remaining letter is **H**.

Step 4: Required word

$$\boxed{\text{NICARH}}$$

Quick Tip

For dictionary order problems, always subtract 1 from the given position and use factorial grouping to identify each letter step-by-step.

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6. The number of integral terms in the binomial expansion of

$$\left(11^{\frac{1}{2}} + 17^{\frac{1}{8}}\right)^{1024}$$

is:

(A) 129
(B) 131
(C) 133
(D) 137

Correct Answer: (1) 129

Solution:
Concept:

- The general term of $(a+b)^n$ is

$$T_{k+1} = \binom{n}{k} a^{n-k} b^k$$

- A term is integral if the combined exponent of all radicals is an integer.
- Congruence conditions help count valid values of k.

Step 1: Write the general term

$$T_{k+1} = \binom{1024}{k} \left(11^{\frac{1}{2}}\right)^{1024-k} \left(17^{\frac{1}{8}}\right)^{k}$$

Step 2: Simplify the powers

$$= \binom{1024}{k} 11^{\frac{1024-k}{2}} 17^{\frac{k}{8}}$$

Write everything with denominator 8:

$$11^{\frac{4(1024-k)}{8}} \cdot 17^{\frac{k}{8}}$$

The total power of radicals is:

$$\frac{4096 - 3k}{8}$$

Step 3: Condition for integrality For the term to be integral:

$$4096 - 3k \equiv 0 \pmod 8$$

$$3k \equiv 0 \pmod 8$$

Since 3 is coprime with 8,

$$k \equiv 0 \pmod 8$$

Step 4: Count valid values of k

$$k = 0, 8, 16, \ldots, 1024$$

Number of such values:

$$\frac{1024}{8} + 1 = 128 + 1 = 129$$

Quick Tip

In binomial expansions with radicals, convert all exponents to a common denominator and use modular arithmetic to count integral terms efficiently.

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7. Two persons A and B alternately throw a pair of dice. A wins if he throws a sum of 4 before B throws a sum of 9, and B wins if he throws a sum of 9 before A throws a sum of 4. The probability that A wins if B makes the first throw is:

(A) $\frac{1}{5}$

(B) $\frac{2}{5}$

(C) $\frac{3}{5}$

(D) $\frac{4}{5}$

Correct Answer: (2) $\frac{2}{5}$

Solution:
Concept:

- Probability of getting a sum of 4 with two dice is $\frac{3}{36} = \frac{1}{12}$.
- Probability of getting a sum of 9 with two dice is $\frac{4}{36} = \frac{1}{9}$.
- When players alternate turns, recursive probability (infinite geometric process) is used.

Step 1: Define the probability
Let p be the probability that A wins when it is B's turn to throw.
Step 2: Consider B's throw

- With probability $\frac{1}{9}$, B throws a sum of 9 and wins $\Rightarrow$ A loses.
- With probability $\frac{8}{9}$, the game continues to A's turn.

Step 3: Consider A's throw

- With probability $\frac{1}{12}$, A throws a sum of 4 and wins.
- With probability $\frac{11}{12}$, the game returns to B's turn.

Step 4: Form the equation

$$p = \frac{8}{9}\left(\frac{1}{12} + \frac{11}{12}p\right)$$

Step 5: Solve

$$p = \frac{2}{27}(1 + 11p)$$

$$27p = 2 + 22p \Rightarrow 5p = 2 \Rightarrow p = \frac{2}{5}$$

Quick Tip

For turn-based probability problems, define the probability at a fixed turn and form a recursive equation.

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8. Let the distance between the foci of an ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad (a > b)$$

be 4 and the distance between its directrices be 10. Then the length of its latus rectum is:

(A) $\frac{12}{\sqrt{10}}$
(B) $\frac{6}{\sqrt{10}}$
(C) $\frac{8}{\sqrt{5}}$
(D) $\sqrt{10}$

Correct Answer: (1) $\frac{12}{\sqrt{10}}$

Solution:
Concept: For an ellipse:

- Distance between the foci $= 2c$, where $c^2 = a^2 - b^2$
- Eccentricity $e = \frac{c}{a}$

- Distance between the directrices $= \dfrac{2a}{e}$
- Length of latus rectum $= \dfrac{2b^2}{a}$

Step 1: Use the distance between the foci

$$2c = 4 \Rightarrow c = 2$$

Step 2: Use the distance between the directrices

$$\frac{2a}{e} = 10$$

Since $e = \dfrac{c}{a}$,

$$\frac{2a}{c/a} = 10 \Rightarrow \frac{2a^2}{c} = 10$$

Substitute $c = 2$:

$$a^2 = 10 \Rightarrow a = \sqrt{10}$$

Step 3: Find b^2

$$b^2 = a^2 - c^2 = 10 - 4 = 6$$

Step 4: Find the length of the latus rectum

$$\text{Latus rectum} = \frac{2b^2}{a} = \frac{2 \times 6}{\sqrt{10}} = \frac{12}{\sqrt{10}}$$

Quick Tip

For ellipse problems, memorize standard results for foci, directrices, eccentricity, and latus rectum to quickly link given data.

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9. Let e_1 and e_2 be the eccentricities of the ellipse $2x^2 + 9y^2 = 36$ and the hyperbola $4x^2 - 9y^2 = 36$, respectively. Then the distance between the point of intersection of the lines $5x - 7y = 3$ and $3x + y = 7$, and the point $(9e_1^2,\ 9e_2^2)$ is:

(A) 11
(B) 12
(C) 13
(D) 15

Correct Answer: (3) 13

Solution:
Concept:

- Standard form of ellipse: $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$, eccentricity $e = \sqrt{1 - \dfrac{b^2}{a^2}}$.

- Standard form of hyperbola: $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$, eccentricity $e = \sqrt{1 + \dfrac{b^2}{a^2}}$.
- Distance between two points (x_1, y_1) and (x_2, y_2) is $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

Step 1: Find e_1 for the ellipse

$$2x^2 + 9y^2 = 36 \Rightarrow \frac{x^2}{18} + \frac{y^2}{4} = 1$$

Thus, $a^2 = 18,\ b^2 = 4$.

$$e_1 = \sqrt{1 - \frac{4}{18}} = \sqrt{\frac{14}{18}} = \frac{\sqrt{7}}{3}$$

Step 2: Find e_2 for the hyperbola

$$4x^2 - 9y^2 = 36 \Rightarrow \frac{x^2}{9} - \frac{y^2}{4} = 1$$

Thus, $a^2 = 9,\ b^2 = 4$.

$$e_2 = \sqrt{1 + \frac{4}{9}} = \sqrt{\frac{13}{9}} = \frac{\sqrt{13}}{3}$$

Step 3: Coordinates of the given point

$$(9e_1^2, 9e_2^2) = \left(9 \cdot \frac{7}{9},\ 9 \cdot \frac{13}{9}\right) = (7, 13)$$

Step 4: Point of intersection of the lines From $3x + y = 7$, $y = 7 - 3x$. Substitute in $5x - 7y = 3$:

$$5x - 7(7 - 3x) = 3 \Rightarrow 26x = 52 \Rightarrow x = 2,\ y = 1$$

So the point is $(2, 1)$.

Step 5: Required distance

$$\sqrt{(7 - 2)^2 + (13 - 1)^2} = \sqrt{25 + 144} = \sqrt{169} = 13$$

Quick Tip

Always convert conic equations to standard form first; eccentricities and related points follow directly.

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10. Let $A(3, 4)$, $B(5, -2)$ and $P(\alpha, \beta)$, $\alpha\beta \neq 0$, be three points such that $PA = PB$ and the area of $\triangle PAB$ is 10. Then the distance of the point $Q(2\alpha - 5\beta,\ \alpha - \beta^2)$ from the line having intercepts 3 and 1 on the x- and y-axis respectively, is:

(A) 10
(B) $\sqrt{10}$
(C) 15
(D) 2

Correct Answer: (2) $\sqrt{10}$

Solution:
Concept:

- A point equidistant from A and B lies on the perpendicular bisector of $\overline{AB}$.
- Area of a triangle $= \frac{1}{2} \times$ base $\times$ height.
- Distance of a point (x_1, y_1) from a line $ax + by + c = 0$ is

$$\frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}.$$

Step 1: Equation of the perpendicular bisector of AB
Midpoint of AB:

$$M\left(\frac{3+5}{2}, \frac{4-2}{2}\right) = (4, 1)$$

Slope of AB:

$$m_{AB} = \frac{-2-4}{5-3} = -3$$

Slope of perpendicular bisector $= \frac{1}{3}$.
Hence its equation is:

$$y - 1 = \frac{1}{3}(x - 4)$$

Step 2: Use the area condition
Length of AB:

$$AB = \sqrt{(5-3)^2 + (-2-4)^2} = \sqrt{40} = 2\sqrt{10}$$

Given area $= 10$,

$$10 = \frac{1}{2} \cdot 2\sqrt{10} \cdot h \Rightarrow h = \sqrt{10}$$

Equation of line AB is:

$$y - 4 = -3(x - 3) \Rightarrow 3x + y - 13 = 0$$

Thus,

$$\frac{|3\alpha + \beta - 13|}{\sqrt{10}} = \sqrt{10} \Rightarrow |3\alpha + \beta - 13| = 10$$

Step 3: Find point P
From perpendicular bisector, let

$$\alpha = 4 + 3t, \quad \beta = 1 + t$$

Substitute:

$$|3(4 + 3t) + (1 + t) - 13| = |10t| = 10 \Rightarrow |t| = 1$$

So $t = 1$ or -1. Since $\alpha\beta \neq 0$, choose $t = 1$:

$$P = (7, 2)$$

Step 4: Find point Q

$$Q(2\alpha - 5\beta, \alpha - \beta^2) = (14 - 10, 7 - 4) = (4, 3)$$

Step 5: Distance of Q from the given line

Line with intercepts 3 and 1:

$$\frac{x}{3} + \frac{y}{1} = 1 \Rightarrow x + 3y - 3 = 0$$

Distance:

$$\frac{|4 + 9 - 3|}{\sqrt{1 + 9}} = \frac{10}{\sqrt{10}} = \sqrt{10}$$

Quick Tip

For problems involving equal distances from two points, always use the perpendicular bisector to simplify calculations.

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11. The number of integral values of n, for which the equation

$$3\cos x + 5\sin x = 2n + 1$$

has a solution, is:

(A) 4
(B) 6
(C) 8
(D) 10

Correct Answer: (2) 6

Solution:
Concept:

- An expression of the form $a\cos x + b\sin x$ can be written as

$$\sqrt{a^2 + b^2}\sin(x + \phi)$$

- Hence, its range is

$$-\sqrt{a^2 + b^2} \leq a\cos x + b\sin x \leq \sqrt{a^2 + b^2}.$$

Step 1: Find the range of the left-hand side

$$3\cos x + 5\sin x$$

Its maximum value is:

$$\sqrt{3^2 + 5^2} = \sqrt{34}$$

Hence,

$$-\sqrt{34} \leq 3\cos x + 5\sin x \leq \sqrt{34}$$

Step 2: Apply the condition for solution For the equation to have a solution,

$$-\sqrt{34} \leq 2n + 1 \leq \sqrt{34}$$

Step 3: Solve the inequality

$$-\sqrt{34} - 1 \leq 2n \leq \sqrt{34} - 1$$

$$-3.415 < n < 2.415$$

Step 4: Count integral values of n The integers satisfying the inequality are:

$$n = -3, -2, -1, 0, 1, 2$$

Total number of integral values:

$$6$$

Quick Tip

For equations of the form $a\cos x + b\sin x = k$, always compare k with $\pm\sqrt{a^2 + b^2}$ to determine solvability.

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12. Let the points $A(a, -1, 2)$, $B(1, b, -4)$, $C(-1, 1, c)$ and $D(1, -2, 8)$ be the vertices of a parallelogram $ABCD$. Then its area is equal to:

(A) $2\sqrt{73}$
(B) $2\sqrt{51}$
(C) 28
(D) 14

Correct Answer: (3) 28

Solution:
Concept:

- In a parallelogram, diagonals bisect each other.
- If position vectors of vertices satisfy $\vec{A} + \vec{C} = \vec{B} + \vec{D}$, then the points form a parallelogram.
- Area of a parallelogram formed by vectors $\vec{u}$ and $\vec{v}$ is $|\vec{u} \times \vec{v}|$.

Step 1: Use the diagonal property
For parallelogram $ABCD$,

$$\vec{A} + \vec{C} = \vec{B} + \vec{D}$$

$$(a, -1, 2) + (-1, 1, c) = (1, b, -4) + (1, -2, 8)$$

Equating components:

$$a - 1 = 2 \Rightarrow a = 3$$

$$0 = b - 2 \Rightarrow b = 2$$

$$2 + c = 4 \Rightarrow c = 2$$

Step 2: Find direction vectors

$$\vec{AB} = B - A = (1-3,\ 2+1,\ -4-2) = (-2, 3, -6)$$

$$\vec{AD} = D - A = (1-3,\ -2+1,\ 8-2) = (-2, -1, 6)$$

Step 3: Find the cross product

$$\vec{AB} \times \vec{AD} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ -2 & 3 & -6 \\ -2 & -1 & 6 \end{vmatrix}$$

$$= \mathbf{i}(18-6) - \mathbf{j}(-12-12) + \mathbf{k}(2+6)$$

$$= (12,\ 24,\ 8)$$

Step 4: Find the area

$$\text{Area} = \sqrt{12^2 + 24^2 + 8^2} = \sqrt{144 + 576 + 64} = \sqrt{784} = 28$$

Quick Tip

For 3D parallelogram problems, always use the diagonal condition first to determine unknowns, then apply the cross product for area.

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13. Let (α, β, γ) be the foot of the perpendicular from the point $(25, 2, 41)$ on the line

$$\frac{x-4}{3} = \frac{y+1}{7} = \frac{z-2}{3}.$$

Then $\alpha + \beta + \gamma$ is equal to:

(A) 41
(B) 42
(C) 44
(D) 45

Correct Answer: (3) 44

Solution:
Concept:

- A point on a line in symmetric form can be written using a parameter.
- The foot of the perpendicular from a point to a line satisfies the condition that the vector joining them is perpendicular to the direction vector of the line.
- Two vectors are perpendicular if their dot product is zero.

Step 1: Parametric form of the given line
Let

$$\frac{x-4}{3} = \frac{y+1}{7} = \frac{z-2}{3} = t$$

Then a general point on the line is:

$$A(4+3t,\ -1+7t,\ 2+3t)$$

The direction vector of the line is:

$$\vec{d} = (3, 7, 3)$$

Step 2: Use perpendicularity condition
Given point $P(25, 2, 41)$. For A to be the foot of the perpendicular,

$$\overrightarrow{AP} \cdot \vec{d} = 0$$

$$(25-(4+3t),\ 2-(-1+7t),\ 41-(2+3t)) \cdot (3,7,3) = 0$$

$$(21-3t,\ 3-7t,\ 39-3t) \cdot (3,7,3) = 0$$

Step 3: Solve for t

$$3(21-3t) + 7(3-7t) + 3(39-3t) = 0$$
$$63 - 9t + 21 - 49t + 117 - 9t = 0$$
$$201 - 67t = 0 \Rightarrow t = 3$$

Step 4: Find the foot of the perpendicular
Substitute $t = 3$:

$$\alpha = 4+9 = 13, \quad \beta = -1+21 = 20, \quad \gamma = 2+9 = 11$$

Step 5: Required sum

$$\alpha + \beta + \gamma = 13 + 20 + 11 = 44$$

Quick Tip

For foot of perpendicular problems in 3D, always use the dot product condition with the direction vector of the line.

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14. Let

$$f(x) = \begin{vmatrix} -\cos x & \tan x & 3\sin x \\ 1 & -3x & 2x^2 \\ x^3 & x & x^2 \end{vmatrix}.$$

Then the value of

$$\lim_{x\to 0} \frac{(1+x)f(x) - 3x\sin x}{x^3}$$

is:

(A) 3
(B) 5
(C) 7
(D) 8

Correct Answer: (3) 7

Solution:
Concept:

- Expand the determinant and retain terms up to the required order of x.
- Use standard Taylor expansions of trigonometric functions near $x = 0$.
- Since the limit involves division by x^3, terms beyond x^3 can be ignored.

Step 1: Expand the determinant

$$f(x) = -\cos x \begin{vmatrix} -3x & 2x^2 \\ x & x^2 \end{vmatrix} - \tan x \begin{vmatrix} 1 & 2x^2 \\ x^3 & x^2 \end{vmatrix} + 3\sin x \begin{vmatrix} 1 & -3x \\ x^3 & x \end{vmatrix}$$

$$= 5x^3 \cos x - x^2 \tan x + 3x \sin x + O(x^4)$$

Step 2: Use Taylor expansions

$$\cos x = 1 - \frac{x^2}{2}, \quad \tan x = x + \frac{x^3}{3}, \quad \sin x = x - \frac{x^3}{6}$$

Substituting,

$$f(x) = 3x^2 + 4x^3 + O(x^4)$$

Step 3: Evaluate the numerator

$$(1 + x)f(x) = 3x^2 + 7x^3 + O(x^4)$$
$$3x \sin x = 3x^2 + O(x^4)$$

$$(1 + x)f(x) - 3x \sin x = 7x^3 + O(x^4)$$

Step 4: Take the limit

$$\lim_{x \to 0} \frac{(1 + x)f(x) - 3x \sin x}{x^3} = \lim_{x \to 0} \frac{7x^3}{x^3} = 7$$

Quick Tip

When limits involve determinants and small x, expand both the determinant and trigonometric functions only up to the necessary order.

---

15. The area of the region

$$\{(x, y) : \sin x \leq y \leq \sqrt{\pi^2 - x^2}\}$$

is:

(A) π^3
(B) $\dfrac{\pi^3}{2}$
(C) $\dfrac{\pi^3}{4}$
(D) $\dfrac{\pi^3}{8}$

Correct Answer: (2) $\dfrac{\pi^3}{2}$

Solution:
Concept:

- The area between two curves $y = f(x)$ and $y = g(x)$ is $\displaystyle\int (g(x) - f(x))\, dx$.
- The curve $y = \sqrt{\pi^2 - x^2}$ represents the upper semicircle of radius π.
- The function $\sin x$ is odd, hence its integral over a symmetric interval about the origin is zero.

Step 1: Determine the limits of integration
For $y = \sqrt{\pi^2 - x^2}$, we must have:

$$\pi^2 - x^2 \geq 0 \Rightarrow -\pi \leq x \leq \pi$$

Step 2: Set up the area integral

$$\text{Area} = \int_{-\pi}^{\pi} \left(\sqrt{\pi^2 - x^2} - \sin x \right) dx$$

Step 3: Split the integral

$$\text{Area} = \int_{-\pi}^{\pi} \sqrt{\pi^2 - x^2}\, dx - \int_{-\pi}^{\pi} \sin x\, dx$$

Step 4: Evaluate the integrals
Since $\sin x$ is an odd function,

$$\int_{-\pi}^{\pi} \sin x\, dx = 0$$

The remaining integral represents the area of a semicircle of radius π:

$$\int_{-\pi}^{\pi} \sqrt{\pi^2 - x^2}\, dx = \frac{1}{2}\pi(\pi)^2 = \frac{\pi^3}{2}$$

Step 5: Final answer

$$\text{Area} = \frac{\pi^3}{2}$$

Quick Tip

Whenever limits are symmetric and the integrand contains odd functions, check if the integral evaluates to zero to simplify calculations.

---

16. Let

$$f(x) = \begin{cases} 3x, & x < 0, \\ 1 + x + [x], & 0 \le x \le 2, \\ 5, & x > 2, \end{cases}$$

where $[x]$ denotes the greatest integer function. If α and β are the number of points in $\mathbb{R}$ where f is not continuous and is not differentiable respectively, then $\alpha + \beta$ equals:

(A) 3
(B) 4
(C) 5
(D) 6

Correct Answer: (3) 5

Solution:
Concept:

- A function involving the greatest integer function may be discontinuous at integer points.
- A function is not differentiable at points of discontinuity or where the left and right derivatives are unequal.
- Piecewise-defined functions must be checked at the junction points.

Step 1: Points of possible discontinuity
Potential points are:

$$x = 0,\ 1,\ 2$$

Step 2: Check continuity

- At $x = 0$:

  $$\lim_{x \to 0^-} f(x) = 0, \quad f(0) = 1$$

  Hence, discontinuous at $x = 0$.
- At $x = 1$: Left value $= 1 + 1 + [0] = 2$, right value $= 1 + 1 + [1] = 3$. Hence, discontinuous at $x = 1$.
- At $x = 2$: Left value $= 1 + 2 + [2] = 5$, right value $= 5$. Hence, continuous at $x = 2$.

Thus,

$$\alpha = 2$$

Step 3: Check differentiability

- At $x = 0$: discontinuous $\Rightarrow$ not differentiable.
- At $x = 1$: discontinuous $\Rightarrow$ not differentiable.
- At $x = 2$: Left derivative $= 1$, right derivative $= 0$. Hence, not differentiable.

Thus,

$$\beta = 3$$

Step 4: Required value

$$\alpha + \beta = 2 + 3 = 5$$

Quick Tip

For functions involving $[x]$, always check continuity and differentiability separately at integer points and at junctions of piecewise definitions.

---

17. Let

$$f(x) = \int \left(\frac{1}{\log_e x} - \frac{2}{(\log_e x)^3} \right) dx.$$

If $f(e) = 2e$, then $f(e^2)$ is equal to:

(A) $\frac{e^2}{4}$

(B) $\frac{e^2}{2}$

(C) $\frac{3e^2}{4}$

(D) $\frac{4e^2}{3}$

Correct Answer: (3) $\frac{3e^2}{4}$

Solution:

Concept:

- Try to identify the integrand as the derivative of a suitable expression.
- Logarithmic differentiation is helpful when integrands involve powers of $\log x$.
- Use the given value of the function to determine the constant of integration.

Step 1: Observe the integrand

Consider the function

$$F(x) = x \left(\frac{1}{\log x} + \frac{1}{(\log x)^2} \right)$$

Differentiate:

$$F'(x) = \left(\frac{1}{\log x} + \frac{1}{(\log x)^2} \right) + x \left(-\frac{1}{x(\log x)^2} - \frac{2}{x(\log x)^3} \right)$$

$$F'(x) = \frac{1}{\log x} - \frac{2}{(\log x)^3}$$

Hence,

$$f(x) = x\left(\frac{1}{\log x} + \frac{1}{(\log x)^2}\right) + C$$

Step 2: Use the given condition $f(e) = 2e$

$$f(e) = e\,(1+1) + C = 2e + C$$

Given $f(e) = 2e$,

$$C = 0$$

Step 3: Find $f(e^2)$

$$f(e^2) = e^2\left(\frac{1}{2} + \frac{1}{4}\right) = e^2 \cdot \frac{3}{4} = \frac{3e^2}{4}$$

Quick Tip

When an integrand looks complicated, try differentiating expressions of the form $x(\log x)^n$ or $x/(\log x)^n$ to match terms efficiently.

---

18. Let the value of p, such that the sum of the squares of the roots of the quadratic equation

$$x^2 + (7-p)x + 4 = p$$

has the least value, be α, and the corresponding roots be β and γ. Then $\alpha^3+\beta^3+\gamma^3$ equals _____.

Solution:
Concept:

- If the roots of a quadratic equation are β and γ, then

$$\beta + \gamma = -\frac{b}{a}, \quad \beta\gamma = \frac{c}{a}.$$

- The sum of squares of roots is

$$\beta^2 + \gamma^2 = (\beta+\gamma)^2 - 2\beta\gamma.$$

- To find the least value of an expression involving a parameter, convert it into a quadratic in that parameter and minimize it.

Step 1: Write the quadratic equation in standard form

$$x^2 + (7-p)x + (4-p) = 0$$

Step 2: Find sum and product of roots

$$\beta + \gamma = p - 7, \qquad \beta\gamma = 4 - p$$

Step 3: Find the sum of squares of the roots

$$\beta^2 + \gamma^2 = (p-7)^2 - 2(4-p)$$
$$= p^2 - 14p + 49 - 8 + 2p$$
$$= p^2 - 12p + 41$$

Step 4: Minimize the sum of squares

The expression

$$p^2 - 12p + 41$$

is minimum when

$$p = \frac{12}{2} = 6$$

Hence,

$$\alpha = 6$$

Step 5: Find $\beta + \gamma$ and $\beta\gamma$ for $p = 6$

$$\beta + \gamma = 6 - 7 = -1, \qquad \beta\gamma = 4 - 6 = -2$$

Step 6: Find $\beta^3 + \gamma^3$

$$\beta^3 + \gamma^3 = (\beta + \gamma)^3 - 3\beta\gamma(\beta + \gamma)$$
$$= (-1)^3 - 3(-2)(-1) = -1 - 6 = -7$$

Step 7: Find the required value

$$\alpha^3 + \beta^3 + \gamma^3 = 6^3 - 7 = 216 - 7 = 209$$

Final Answer: $\boxed{209}$

Quick Tip

Whenever a question asks for the minimum or maximum value involving roots, express everything in terms of coefficients and reduce it to a quadratic form.

---

19. Let $25^x + 25^{-x}$, $\frac{\alpha}{3}$, $20^{1+x} + 20^{1-x}$, where $x, \alpha \in \mathbb{R}$, be the first three terms of an A.P. of increasing terms. For the least value of α, the sum of its first 10 terms is _____.

Solution:

Concept:

- For three consecutive terms of an A.P., the middle term is the arithmetic mean of the other two.

- For increasing A.P., the common difference must be positive.
- The sum of the first n terms of an A.P. is

$$S_n = \frac{n}{2}\,[2a + (n-1)d].$$

Step 1: Use the A.P. condition
Let

$$T_1 = 25^x + 25^{-x}, \quad T_2 = \frac{\alpha}{3}, \quad T_3 = 20^{1+x} + 20^{1-x}.$$

For an A.P.,

$$2T_2 = T_1 + T_3$$

$$\Rightarrow \alpha = \frac{3}{2}\Big(25^x + 25^{-x} + 20^{1+x} + 20^{1-x}\Big).$$

Step 2: Find the least value of α
The expression

$$25^x + 25^{-x} + 20^{1+x} + 20^{1-x}$$

is minimum at $x = 0$.
Thus,

$$\alpha = \frac{3}{2}\Big(2 + 40\Big) = \frac{3}{2} \cdot 42 = 63.$$

Step 3: Determine the A.P.

$$T_1 = 2, \quad T_2 = \frac{63}{3} = 21$$

$$d = 21 - 2 = 19.$$

Step 4: Find the sum of the first 10 terms

$$S_{10} = \frac{10}{2}\,[2(2) + 9(19)] = 5(4 + 171) = 5 \times 175 = 875.$$

Final Answer: $\boxed{875}$

Quick Tip

For least or greatest values involving exponentials like $a^x + a^{-x}$, the minimum occurs at $x = 0$.

---

20. If the circles

$$x^2 + y^2 - 2x - 8y + 17 = r \quad \textbf{and} \quad x^2 + y^2 - 26x - 18y + 234 = 0$$

intersect at exactly one point, then the sum of all possible values of r is _____.

Solution:
Concept:

- A circle $x^2 + y^2 + 2gx + 2fy + c = 0$ has center $(-g, -f)$ and radius $\sqrt{g^2 + f^2 - c}$.

- Two circles intersect at exactly one point if they touch each other (are tangent).
- For tangency:
$$d = r_1 + r_2 \quad \text{or} \quad d = |r_1 - r_2|,$$
where d is the distance between the centers.

Step 1: Find the center and radius of the first circle

$$x^2 + y^2 - 2x - 8y + (17 - r) = 0$$

Center:
$$C_1(1, 4)$$

Radius:
$$r_1 = \sqrt{1^2 + 4^2 - (17 - r)} = \sqrt{r}$$

Step 2: Find the center and radius of the second circle

$$x^2 + y^2 - 26x - 18y + 234 = 0$$

Center:
$$C_2(13, 9)$$

Radius:
$$r_2 = \sqrt{13^2 + 9^2 - 234} = \sqrt{16} = 4$$

Step 3: Find the distance between the centers

$$d = \sqrt{(13 - 1)^2 + (9 - 4)^2} = \sqrt{144 + 25} = 13$$

Step 4: Apply the tangency conditions
(i) External tangency:
$$13 = \sqrt{r} + 4 \Rightarrow \sqrt{r} = 9 \Rightarrow r = 81$$

(ii) Internal tangency:

$$13 = |\sqrt{r} - 4| \Rightarrow \sqrt{r} = 17 \Rightarrow r = 289$$

Step 5: Sum of all possible values of r

$$81 + 289 = 370$$

Final Answer: $\boxed{370}$

Quick Tip

When two circles intersect at exactly one point, always check both internal and external tangency cases.

---

21. Let $\vec{a} = 2\hat{i} + 3\hat{j} + 5\hat{k}$, $\vec{b} = \hat{i} - \hat{j} + 3\hat{k}$ and $\vec{c}$ be a vector such that

$$\vec{a} \cdot \vec{c} = 104 \quad \textbf{and} \quad \vec{a} \times \vec{c} = \vec{c} \times \vec{b}.$$

Then $\vec{b} \cdot \vec{c}$ is equal to _____.

Solution:
Concept:

- For vectors, $\vec{u} \times \vec{v} = -(\vec{v} \times \vec{u})$.
- If $\vec{p} \times \vec{q} = \vec{0}$, then $\vec{p}$ and $\vec{q}$ are parallel.
- A vector parallel to $\vec{v}$ can be written as $t\vec{v}$, where t is a scalar.

Step 1: Use the given cross product condition

$$\vec{a} \times \vec{c} = \vec{c} \times \vec{b} = -(\vec{b} \times \vec{c})$$

Hence,

$$\vec{a} \times \vec{c} + \vec{b} \times \vec{c} = \vec{0}$$
$$(\vec{a} + \vec{b}) \times \vec{c} = \vec{0}$$

Thus, $\vec{c}$ is parallel to $\vec{a} + \vec{b}$.
Step 2: Find $\vec{a} + \vec{b}$

$$\vec{a} + \vec{b} = (2+1)\hat{i} + (3-1)\hat{j} + (5+3)\hat{k} = 3\hat{i} + 2\hat{j} + 8\hat{k}$$

Let

$$\vec{c} = t(3\hat{i} + 2\hat{j} + 8\hat{k})$$

Step 3: Use the dot product condition

$$\vec{a} \cdot \vec{c} = t\,[2(3) + 3(2) + 5(8)]$$
$$= t(6 + 6 + 40) = 52t$$

Given $\vec{a} \cdot \vec{c} = 104$,

$$52t = 104 \Rightarrow t = 2$$

So,

$$\vec{c} = 6\hat{i} + 4\hat{j} + 16\hat{k}$$

Step 4: Find $\vec{b} \cdot \vec{c}$

$$\vec{b} \cdot \vec{c} = (1)(6) + (-1)(4) + (3)(16)$$
$$= 6 - 4 + 48 = 50$$

Final Answer: $\boxed{50}$

Quick Tip

If a cross product of a sum with a vector is zero, it usually indicates parallel vectors—this greatly simplifies such problems.

22. The concept of scale is clearly associated with which of the following in reality?

(A) Texture of a material
(B) Relative size of objects in comparison to human dimensions
(C) Height capacity of buildings
(D) Color scheme of fragrance

Correct Answer: (B)

Solution:
Concept: In design, architecture, and visual arts, **scale** refers to the size of an object in relation to a known reference, most commonly the human body. It helps in understanding proportion, usability, and visual harmony.
Explanation:

- **Texture** relates to surface quality, not size.
- **Scale** is primarily concerned with how large or small an object appears when compared to human dimensions.
- **Height capacity of buildings** is an absolute measurement, not a relative comparison.
- **Color scheme** is related to aesthetics, not scale.

Thus, the concept of scale is most clearly associated with the relative size of objects when compared to human dimensions.

Quick Tip

Scale is always relative—it gains meaning only when compared with a familiar reference, most often the human body.

---

23. BRICK : MASONRY :: TILES : _____

(A) Carpentry
(B) Wiring
(C) Plumbing
(D) Flooring

Correct Answer: (D) Flooring

Solution:
Concept: This is an analogy based on the relationship between a **material** and the **type of work or construction** in which it is primarily used.
Explanation:

- **Brick** is the basic material used in **masonry** work.
- Similarly, **tiles** are the primary material used in **flooring**.
- **Carpentry** involves wood.

- **Wiring** involves electrical cables.
- **Plumbing** involves pipes and fittings.

Thus, the correct analogy is:

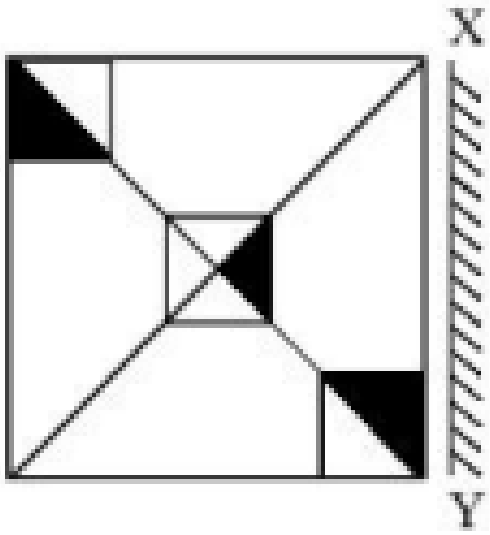
$$\text{BRICK} : \text{MASONRY} :: \text{TILES} : \text{FLOORING}$$

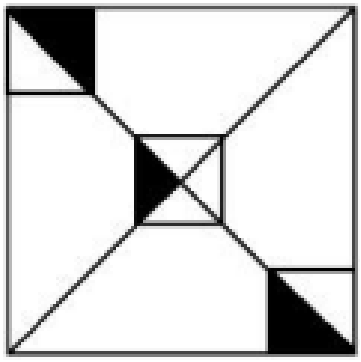
Quick Tip

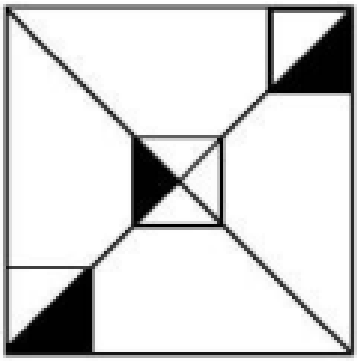
In analogy questions, first identify whether the relation is material–work, tool–function, or cause–effect before choosing the answer.

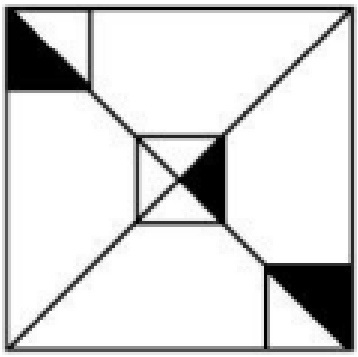
---

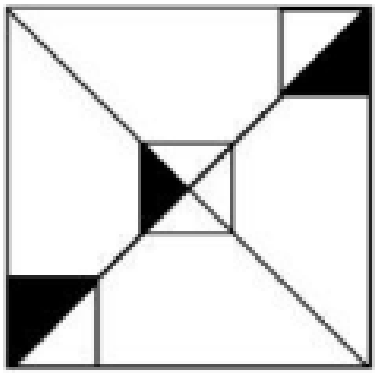
24. Identify the correct mirror image of the given figure along the XY-axis.



3475777049. 

3475777050. 

3475777051. 

3475777052. 

(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (C) Option 3

Solution:
Concept:

- A mirror image along a given axis is obtained by reflecting the figure across that axis.
- When a figure is reflected, the relative positions of all parts reverse with respect to the mirror line, while their shapes and sizes remain unchanged.
- For a mirror placed along the XY-axis, the left–right orientation of the figure is reversed.

Explanation:

- Observe the positions of the shaded (black) triangular parts in the original figure.
- After reflection across the XY-axis, each shaded region must appear at the symmetric position on the opposite side of the axis.
- The internal diagonal lines and the central small square must also appear as mirror images, not rotated or rearranged.

Among the given options, only **Option (C)** correctly shows:

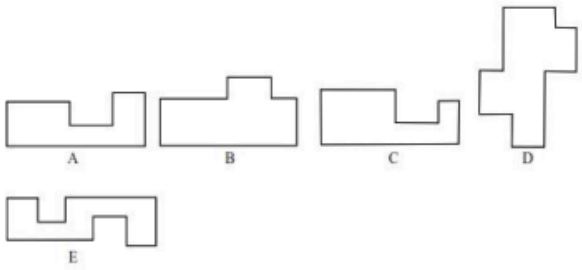
- Proper left–right reversal of the shaded regions,
- Correct symmetry of the diagonals,
- Exact mirror placement of the central shape.

Quick Tip

In mirror-image questions, first fix the mirror line in your mind, then mentally "flip" the figure across it—do not rotate it.

---

25. Five diagrams $A, B, C, D,$ and E are given. Three out of these, when put together, form a square. Identify the correct set of diagrams.



(A) A, C, D
(B) B, C, D
(C) A, B, C
(D) C, D, E

Correct Answer: (B) B, C, D

Solution:
Concept:

- In figure-assembly problems, the combined shapes must form a perfect square with:
  - No gaps,
  - No overlaps,
  - Straight outer boundaries.
- Each selected piece must complement the others so that all protrusions and indentations cancel out.

Explanation:

- Diagram D provides the vertical extension needed for the square.
- Diagrams B and C together balance the horizontal protrusions and fill the remaining gaps.
- When combined, B, C, and D fit together to form a complete square with straight edges on all sides.
- The other combinations either leave gaps or produce an irregular boundary.

Hence, the three diagrams that form a square are:

$$\boxed{B,\ C,\ D}$$

Quick Tip

In such puzzles, always focus on the outer boundary first—if it cannot become a perfect square, the combination is incorrect.

---

26. A man is looking at a photograph of a woman and his friend asks him, "Who is she?" The man replies, "I have no brother or sister, but the father of the woman in the photograph is my father's son." Who is the woman in the photograph?

(A) His daughter
(B) His wife
(C) His sister
(D) His mother

Correct Answer: (A) His daughter

Solution:
Concept: This is a blood-relation puzzle that requires careful interpretation of family relationships, especially when indirect references are used.
Step-by-step explanation:

- The man says, *"I have no brother or sister."* Hence, **his father's son is himself**.
- He also says, *"The father of the woman in the photograph is my father's son."*
- Substituting from the first statement: The father of the woman is **the man himself**.

Conclusion: If the man himself is the father of the woman in the photograph, then the woman must be **his daughter**.

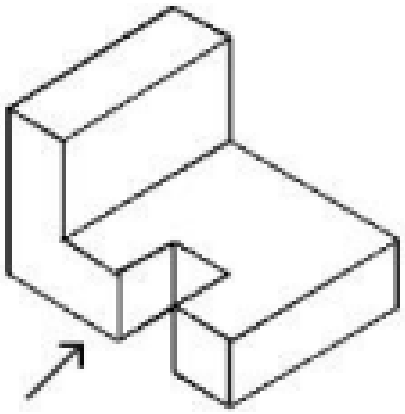
Final Answer: His daughter

Quick Tip

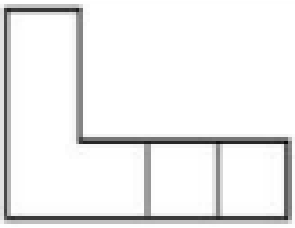
In blood-relation problems, always replace indirect phrases like "my father's son" using the given family constraints.

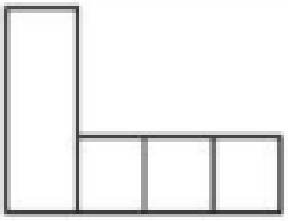
---

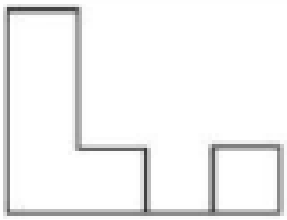
27. The question figure shows the 3D view of an object. Identify the correct view when looking in the direction of the arrow.

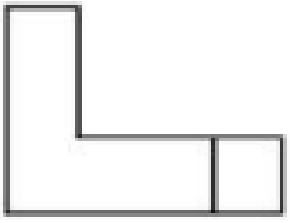


Options :

3475777061. 

3475777062. 

3475777063. 

3475777064. 

(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (B) Option 2

Solution:
Concept:

- In 3D-to-2D visualization problems, the required view is obtained by projecting the object onto a plane perpendicular to the given direction.
- Only the faces visible from the arrow direction are considered; depth details collapse into a single outline.
- Relative heights and horizontal extensions must remain consistent with the original object.

Step-by-step analysis:

- The arrow indicates a viewing direction from the lower-left side of the object.
- From this direction, the vertical block on the left remains fully visible.
- The horizontal base extends to the right with three equal segments visible.
- The inner cut or recess does not appear separately in the projection and merges into the outline.

Comparison with options:

- **Option (A):** Length and segmentation do not match the base.
- **Option (B):** Correctly shows the tall left vertical face and the three-unit horizontal extension.
- **Option (C):** Shows a disconnected or misplaced segment.
- **Option (D):** Misses one horizontal division.

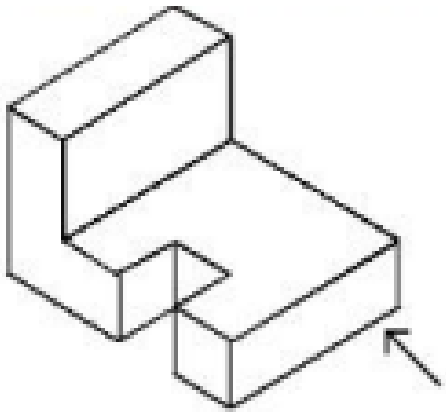
Thus, the correct view corresponding to the given direction is **Option (B)**.

Quick Tip

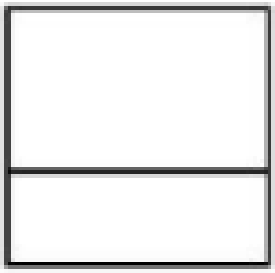
For direction-based views, mentally "flatten" the object along the arrow direction and focus only on the outermost visible edges.

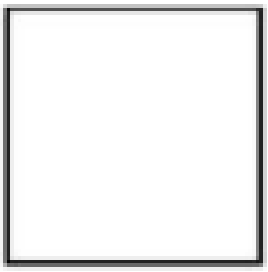
---

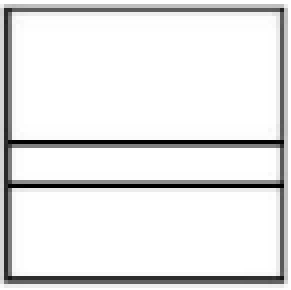
28. The question figure shows the 3D view of an object. Identify the correct view when looking in the direction of the arrow.

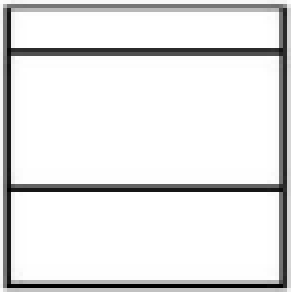


Options :

3475777065. 

3475777066. 

3475777067. 

3475777068. 

(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (D) Option 4

Solution:
Concept:

- When viewing a 3D object from a given direction, depth collapses and only height and width remain visible.
- Internal steps or levels appear as horizontal divisions in the front/side view.
- The number and position of horizontal lines indicate changes in height.

Step-by-step analysis:

- The arrow indicates viewing the object from the right-hand side.
- From this direction, the object shows:
  - One full vertical rectangular outline,
  - Two distinct height changes due to the stepped structure.
- Hence, the correct projection must show **two horizontal dividing lines** inside a rectangle.

Comparison with options:

- **Option (A):** Shows only one horizontal division — incomplete.
- **Option (B):** Shows no internal division — incorrect.
- **Option (C):** Horizontal divisions are incorrectly placed.
- **Option (D):** Correctly shows two horizontal divisions corresponding to the stepped heights.

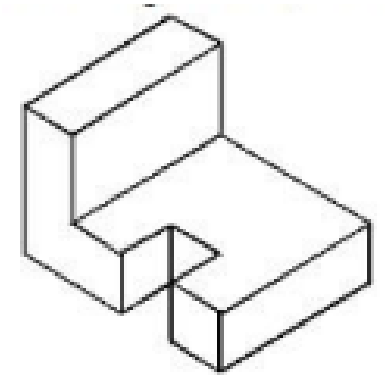
Therefore, the correct view when looking in the direction of the arrow is **Option (D)**.

Quick Tip

In 3D-view questions, count the number of vertical level changes—each change usually appears as a horizontal line in the projected view.

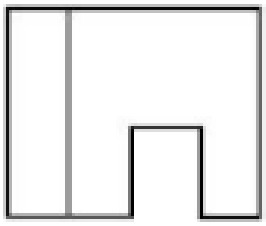
---

29. The question figure shows the 3D view of an object. Identify the correct top view.

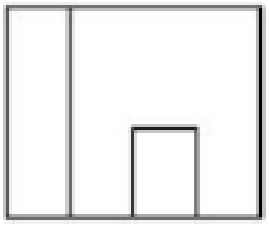


Options :

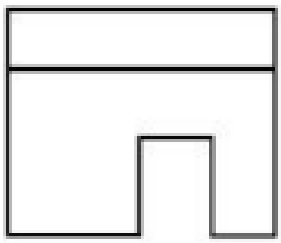
3475777069.



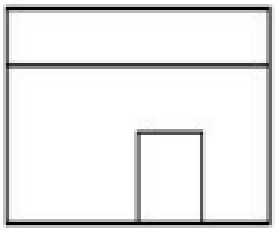
3475777070.



3475777071.



3475777072.



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (C) Option 3

Solution:
Concept:

- A **top view** shows the outline and cut-outs visible when the object is viewed from directly above.
- Heights are ignored; only the horizontal footprint matters.
- Recesses or steps that are open at the top must appear as cut-outs in the top view.

Step-by-step analysis:

- The object has an overall rectangular base.
- There is a central rectangular cut-out open from the top, which must appear clearly in the top view.
- A raised block is present at the back portion of the object; from the top, this appears as a horizontal strip.

Comparison with options:

- **Option (A):** Shows incorrect placement of the raised portion.
- **Option (B):** The cut-out size and position do not match the object.
- **Option (C):** Correctly shows:
  - The full rectangular outline,
  - The horizontal strip due to the raised block,
  - The central rectangular cut-out.
- **Option (D):** The cut-out does not align with the object's structure.

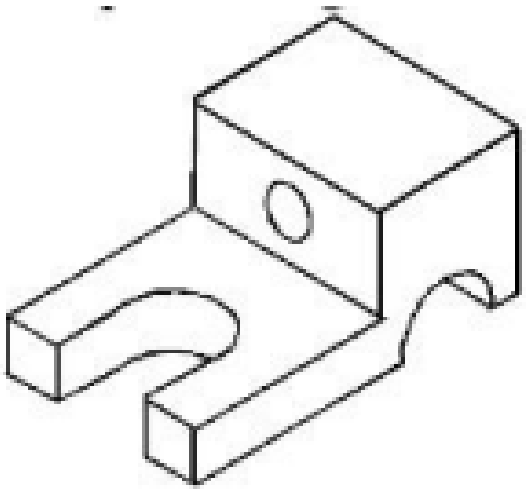
Hence, the correct top view of the given 3D object is **Option (C)**.

Quick Tip

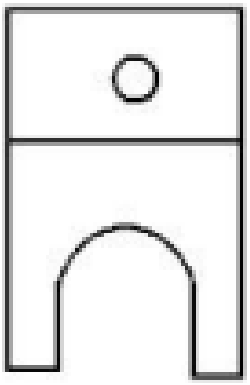
For top-view questions, imagine removing the height of the object and looking only at its shadow on the ground.

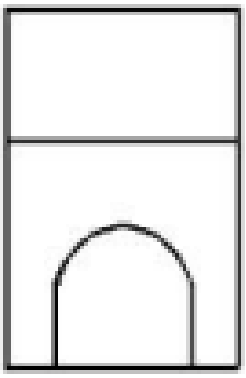
---

30. The question figure shows the 3D view of an object. Identify the correct top view of the object.

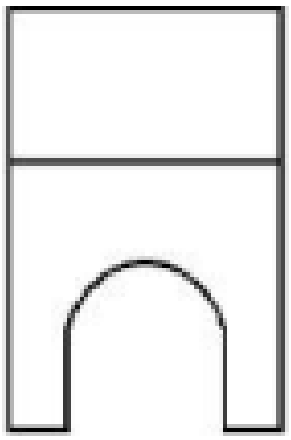


Options :

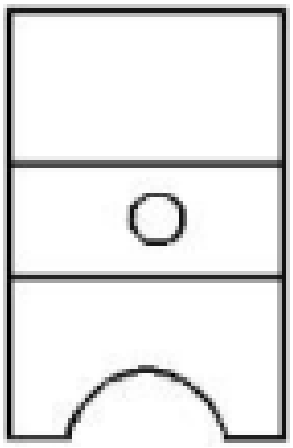
3475777073. 

3475777074. 

3475777075.



3475777076.



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (D) Option 4

Solution:
Concept:

- A **top view** shows only those features visible from directly above.
- Vertical features like holes appear as circles in the top view.
- Curved cut-outs that are open on the front but not on the top do *not* appear as curved shapes in the top view.

Step-by-step analysis:

- The object has a rectangular top surface.
- There is a **cylindrical hole** drilled vertically through the upper block, which must appear as a circle in the top view.
- The front portion has a curved opening, but since it is not open from the top, it does not affect the top view outline.

- The stepped nature of the object creates a horizontal division in the top view.

Comparison with options:

- **Option (A):** Shows the circle but places the curved cut-out incorrectly.
- **Option (B):** Missing the circular hole.
- **Option (C):** Also missing the circular hole.
- **Option (D):** Correctly shows:
  - Rectangular outline,
  - Horizontal division due to the step,
  - Circular hole at the correct position.

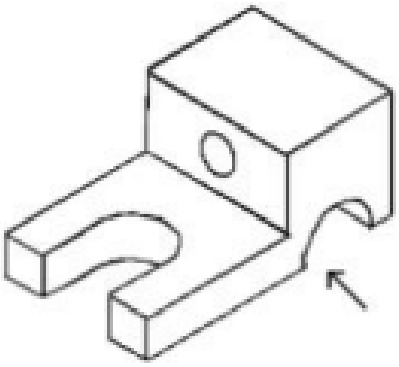
Hence, the correct top view of the given 3D object is **Option (D)**.

Quick Tip

In top-view problems, ignore all height variations and focus only on what is directly visible from above.

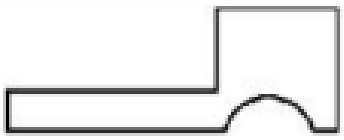
---

31. The question figure shows the 3D view of an object. Identify the correct view when looking in the direction of the arrow.

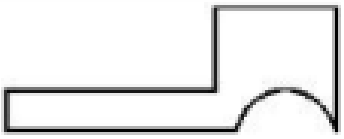


Options :

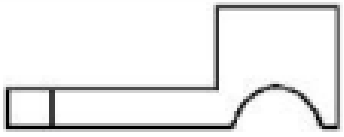
3475777077.



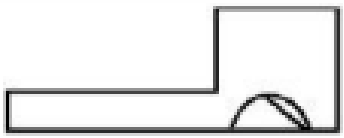
3475777078.



3475777079.



3475777080.



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (B) Option 2

Solution:
Concept:

- When viewing an object from a given direction, only the faces directly visible from that direction appear in the projection.
- Internal holes or features appear only if they are exposed in the viewing direction.
- Curved cut-outs appear as curved boundaries only if the cut is open towards the observer.

Step-by-step analysis:

- The arrow indicates viewing the object from the right-hand side.
- From this direction, the rectangular vertical face on the right is clearly visible.
- The semi-circular cut-out on the right side is open toward the observer and must appear as a curved notch.
- The cylindrical hole on the upper block is not visible from this direction, so it should not appear in the view.
- The long horizontal arm extends to the left and appears as a straight rectangular projection.

Comparison with options:

- **Option (A):** Missing correct curvature alignment.
- **Option (B):** Correctly shows the stepped profile and the semi-circular cut-out without showing the top hole.
- **Option (C):** Incorrect extra internal division.
- **Option (D):** Shows an incorrect triangular/arched feature.

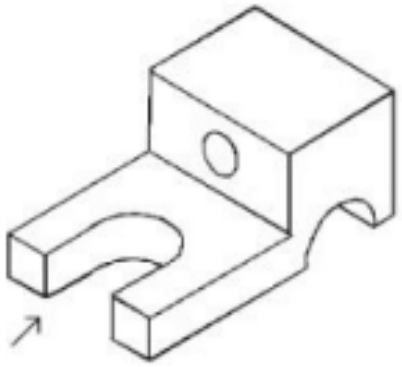
Hence, the correct view when looking in the direction of the arrow is **Option (B)**.

Quick Tip

Always ignore features that are hidden from the viewing direction; only exposed edges and curves appear in the final view.

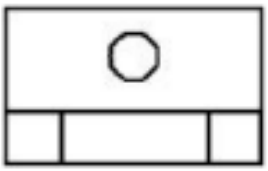
---

32. The question figure shows the 3D view of an object. Identify the correct view when looking in the direction of the arrow.

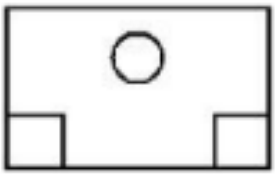


Options :

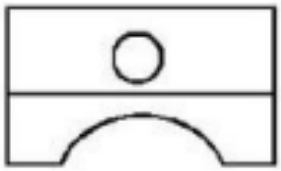
3475777081.



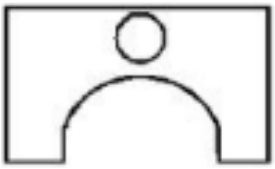
3475777082.



3475777083.



3475777084.



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (D) Option 4

Solution:
Concept:

- The required view is the orthographic projection in the direction of the arrow.
- Only features directly visible from the arrow direction should appear.
- Hidden edges and features not facing the observer are not shown.

Step-by-step analysis:

- The arrow indicates viewing the object from the **front side of the fork-shaped opening**.
- From this direction, the following features are visible:
  - The **semi-circular cut-out** at the bottom (open towards the observer),
  - The **circular hole** in the upper block, visible as a circle,
  - A simple rectangular outer boundary.
- The horizontal step seen in the 3D view is along the depth and hence does not appear as a dividing line in this projection.

Comparison with options:

- **Option (A):** Shows extra internal divisions not visible from this direction.
- **Option (B):** Does not show the curved cut-out correctly.
- **Option (C):** Shows an incorrect horizontal separation.
- **Option (D):** Correctly shows:
  - The circular hole,
  - The semi-circular bottom cut-out,
  - No unnecessary internal lines.

Hence, the correct view when looking in the direction of the arrow is **Option (D)**.

Quick Tip

For direction-based views, imagine standing at the arrow and sketch only what your eyes can see—ignore all hidden depth features.

---

33. A person walks 10 km towards the north, then turns to his left and walks 5 km, and then again turns to his left and walks 10 km. How far is he from his starting point now?

(A) 10 kilometers
(B) 20 kilometers
(C) 15 kilometers
(D) 5 kilometers

Correct Answer: (D) 5 kilometers

Solution:
Concept: Such problems are based on direction sense and displacement. The shortest distance from the starting point to the final position is found using simple geometry or coordinate representation.
Step 1: Trace the path

- The person starts from point O.
- He walks 10 km north to point A.
- Turning left, he walks 5 km west to point B.
- Turning left again, he walks 10 km south to point C.

Step 2: Determine the final position The northward and southward movements cancel each other:

$$10 \text{ km north} - 10 \text{ km south} = 0$$

So the person is directly west of the starting point by 5 km.
Step 3: Find the distance from the starting point

$$\text{Distance} = 5 \text{ km}$$

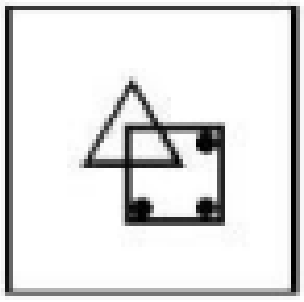
Final Answer: $\boxed{5 \text{ kilometers}}$

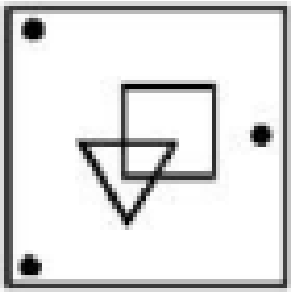
Quick Tip

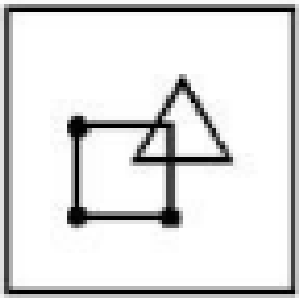
In direction problems, always check if movements in opposite directions cancel each other before applying distance formulas.

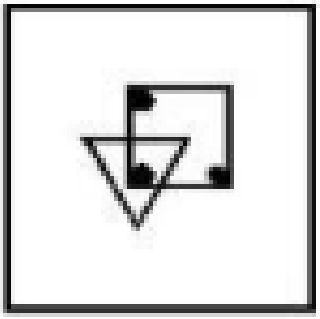
---

34. Identify the figure which is odd from the rest of the figures.

3475777089. 

3475777090. 

3475777091. 

3475777092. 

(A) Figure 1
(B) Figure 2
(C) Figure 3
(D) Figure 4

Correct Answer: (B) Figure 2

Solution:

Concept: Odd-one-out questions are based on identifying a common pattern shared by most figures and spotting the one that violates it. The pattern may involve:

- Orientation of shapes,
- Relative position of dots,
- Direction of arrows or triangles,
- Consistency in arrangement.

Observation:

- In Figures 1, 3, and 4:
  - The triangle and square follow a consistent relative orientation.
  - The dots are placed at corresponding corners with respect to the square.
- In Figure 2:
  - The triangle is inverted in a manner inconsistent with the others.
  - The placement of dots does not follow the same positional pattern seen in the remaining figures.

Conclusion: Since Figure 2 does not follow the common structural and positional pattern shared by the other figures, it is the odd one out.

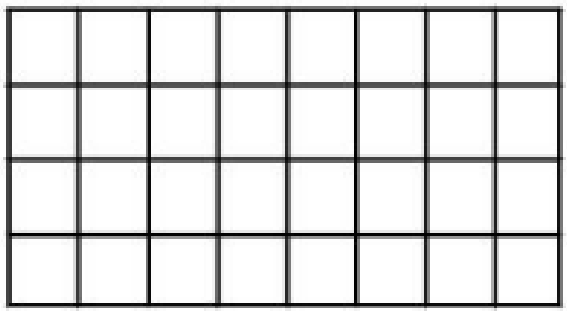
Final Answer: Figure 2

Quick Tip

In non-verbal reasoning, first identify what stays the same across most figures—shape orientation and dot placement are often key clues.

---

35. How many squares are there in the given figure?



(A) 32
(B) 48
(C) 78
(D) 70

Correct Answer: (D) 70

Solution:
Concept: To count the total number of squares in a rectangular grid, we must count:

- All the smallest unit squares,
- All larger squares formed by combining smaller ones.

If a grid has m rows and n columns, the total number of squares is:

$$\sum_{k=1}^{\min(m,n)} (m-k+1)(n-k+1)$$

Step 1: Identify the grid size
From the figure:

$$\text{Number of rows } = 4, \quad \text{Number of columns } = 8$$

Step 2: Count squares of different sizes

- 1×1 squares:

$$4 \times 8 = 32$$

- 2×2 squares:

$$3 \times 7 = 21$$

- 3×3 squares:

$$2 \times 6 = 12$$

- 4×4 squares:

$$1 \times 5 = 5$$

Step 3: Add all squares

$$32 + 21 + 12 + 5 = 70$$

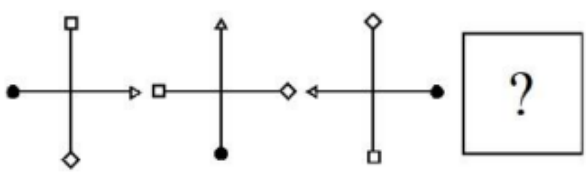
Final Answer: $\boxed{70}$

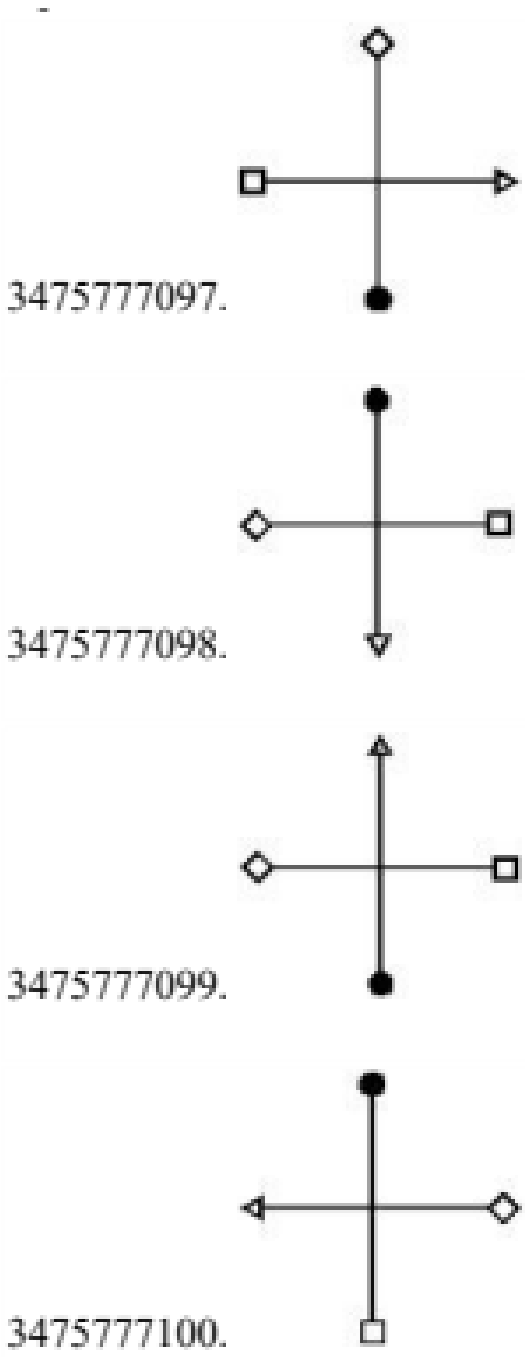
Quick Tip

In grid problems, never stop at counting unit squares—always look for larger squares formed by combining them.

---

36. Choose the figure that will correctly replace the question mark (?) in the given series.





(A) Figure 1
(B) Figure 2
(C) Figure 3
(D) Figure 4

Correct Answer: (C) Figure 3

Solution:
Concept: This is a figure-series completion problem based on:

- Rotation of the entire figure,
- Cyclic movement of symbols (filled circle, hollow square, diamond, arrow),

- Consistent clockwise shifting of elements.

Step 1: Observe the pattern of rotation Each successive figure is obtained by rotating the previous figure by 90° clockwise.
Step 2: Track the symbols Across the series:

- The **arrow** rotates 90° clockwise each step.
- The **filled circle**, **hollow square**, and **diamond** also shift positions accordingly while maintaining their relative order.

Step 3: Predict the next figure Applying another 90° clockwise rotation to the last given figure:

- The arrow points upward,
- The filled circle appears at the bottom,
- The diamond shifts to the left,
- The hollow square moves to the right.

Step 4: Match with options Only **Option (C)** satisfies all these conditions simultaneously.

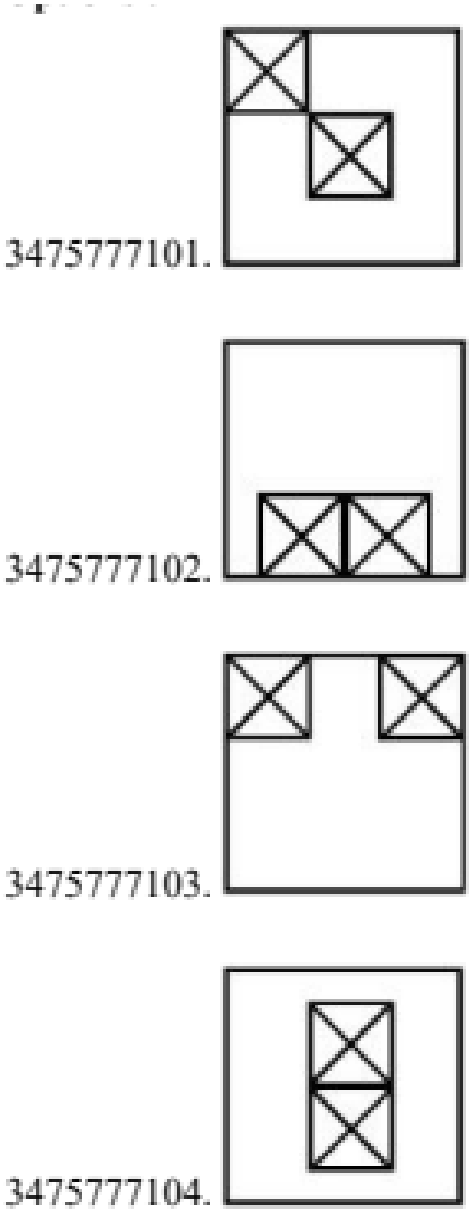
Final Answer: Figure 3

Quick Tip

In figure-series problems, always check for uniform rotation first—most symbol-based series follow rotational symmetry.

---

37. Find the odd one out when the object is divided vertically through the centre.



(A) Figure 1
(B) Figure 2
(C) Figure 3
(D) Figure 4

Correct Answer: (A) Figure 1

Solution:
Concept: When an object is divided vertically through its centre, a **vertically symmetrical** figure will have identical left and right halves. The odd figure is the one that does *not* satisfy this condition.
Step-by-step analysis:

- **Figure 1:** The two small squares with diagonal crosses are placed diagonally. After vertical division, the left and right halves do **not** match. Hence, it is **not vertically symmetrical**.

- **Figure 2:** The crossed squares at the bottom are arranged symmetrically about the vertical centre line.
- **Figure 3:** The two crossed squares at the top are mirror images across the vertical centre.
- **Figure 4:** The stacked crossed squares are centrally placed and remain identical on both sides after division.

Conclusion: Only **Figure 1** fails the vertical symmetry test. Hence, it is the odd one out.

Final Answer: Figure 1

Quick Tip

For symmetry-based questions, always imagine a mirror placed along the given axis and check whether both halves coincide perfectly.

---

38. A man is facing East, turns 90° clockwise, then 180° anticlockwise, and then another 90° clockwise. In which direction is he facing?

(A) West
(B) East
(C) North
(D) South

Correct Answer: (B) East

Solution:
Concept: Direction-sense problems are solved by tracking each turn step by step, remembering:

- Clockwise turn = right turn
- Anticlockwise turn = left turn

Step 1: Initial direction The man starts facing **East**.
Step 2: First turn He turns 90° clockwise (right):

$$\text{East} \rightarrow \text{South}$$

Step 3: Second turn He turns 180° anticlockwise (left):

$$\text{South} \rightarrow \text{North}$$

Step 4: Third turn He turns another 90° clockwise:

$$\text{North} \rightarrow \text{East}$$

Conclusion: After all the turns, the man is facing **East**.

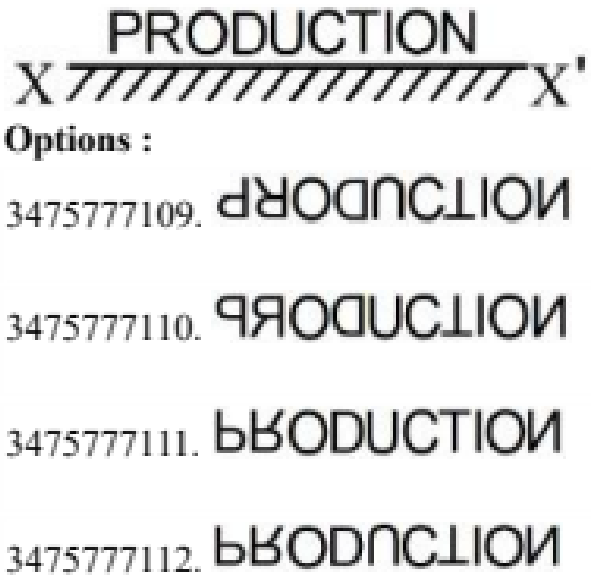
Final Answer: East

Quick Tip

Always move step by step in direction problems—never try to shortcut multiple turns at once.

---

39. What is the mirror image of the word PRODUCTION along the $X-X'$ axis?



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (B) Option 2

Solution:
Concept:

- A mirror placed along the $X-X'$ axis represents a **horizontal mirror**.
- In a horizontal mirror image:
  - The word is **not reversed left to right**,
  - Each letter is flipped **vertically (upside down)**.

Step-by-step analysis:

- The word **PRODUCTION** remains in the same left-to-right order.
- Each letter appears inverted vertically.
- Options that reverse the order of letters correspond to a *vertical* mirror and are incorrect.

Conclusion: Among the given options, only **Option (B)** shows the word with:

- Correct left-to-right sequence, and

- Vertically inverted letters.

Hence, the correct mirror image along the $X-X'$ axis is **Option (B)**.

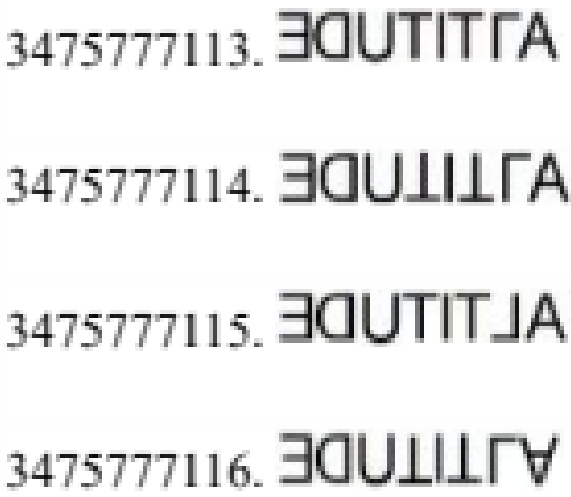
Final Answer: Option 2

Quick Tip

For word mirror problems: Horizontal mirror → letters flip upside down, order stays same. Vertical mirror → letters reverse order.

---

40. Identify the mirror image of the given word ALTITUDE along the $Y-Y'$ axis.



(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (A) Option 1

Solution:
Concept:

- A mirror along the $Y-Y'$ axis represents a **vertical mirror**.
- In a vertical mirror image:
  - The order of letters is reversed (right-to-left),
  - Each letter is laterally inverted.

Step-by-step analysis:

- The original word is **ALTITUDE**.

- Reversing the order of letters gives: **EDUTITLA**.
- Each letter must also appear as its left–right mirror image.
- Among the given options, only **Option (A)** shows:
  - Correct reversed order of letters, and
  - Proper lateral (left–right) mirroring of each letter.

Conclusion: Therefore, the correct mirror image of the word **ALTITUDE** along the $Y-Y'$ axis is **Option (A)**.

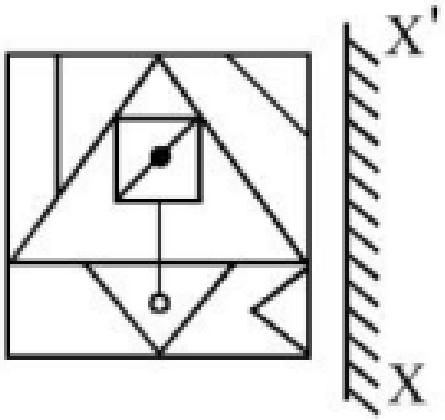
Final Answer: Option 1

Quick Tip

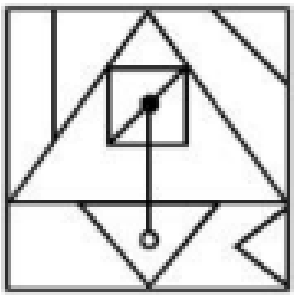
Vertical mirror $\rightarrow$ reverse the order of letters and imagine each letter flipped left to right.

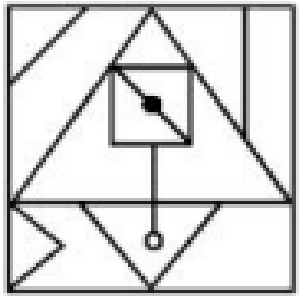
---

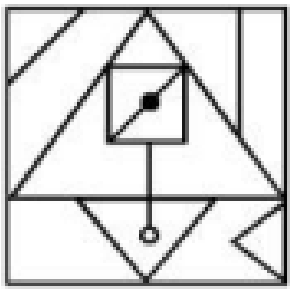
41. Identify the correct mirror image of the given figure along the $X-X'$ axis.

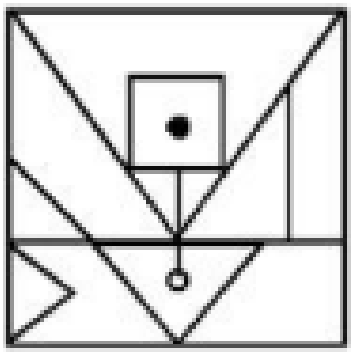


Options :

3475777117. 

3475777118. 

3475777119. 

3475777120. 

(A) Option 1
(B) Option 2
(C) Option 3
(D) Option 4

Correct Answer: (B) Option 2

Solution:
Concept:

- The mirror is placed along the $X-X'$ axis, which represents a **vertical mirror**.
- In a vertical mirror image:
  - The figure is reversed left to right,
  - Top and bottom positions remain unchanged.
- All internal elements (arrows, dots, diagonals, and shaded parts) must also reverse their horizontal orientation.

Step-by-step analysis:

- The slanting lines on the right side of the original figure appear on the left in the mirror image.
- The small triangle in the bottom-right corner shifts to the bottom-left.
- The arrow inside the central square reverses its horizontal direction.
- The positions of the dots remain vertically aligned but shift horizontally.

Comparison with options:

- **Option (A):** Does not correctly reverse all diagonal elements.
- **Option (B):** Shows an exact left–right reversal of every component.
- **Option (C):** Central arrow orientation is incorrect.
- **Option (D):** Overall structure does not match the mirrored layout.

Hence, the correct mirror image along the $X-X'$ axis is **Option (B)**.

Final Answer: Option 2

Quick Tip

For vertical mirror images, imagine sliding the entire figure sideways into a mirror—left and right swap, but top and bottom stay the same.

---

42. Identify the most used building material seen in the façade of the building shown in the picture.

(A) Sand Stone
(B) Granite
(C) Marble
(D) Slate

Correct Answer: (C) Marble

Solution:
Concept: The façade of a building refers to its exterior front surface. Identifying the building material depends on visual characteristics such as color, texture, and historical construction practices.
Explanation:

- The building shown has a smooth, white, polished appearance.
- Such a finish is characteristic of **marble**, which has been extensively used in Mughal architecture.
- **Sandstone** is usually reddish or brown.
- **Granite** is darker and coarser in texture.
- **Slate** is commonly used for roofing rather than façades.

Thus, the most used building material visible on the façade is **marble**.

Final Answer: Marble

Quick Tip

White, smooth, and polished stone façades in historic Indian monuments are most often made of marble.

---

43. Identify the name of the monument shown in the picture.

(A) Tower of Victory
(B) Connaught Place
(C) The Pantheon
(D) The Parthenon

Correct Answer: (D) The Parthenon

Solution:
Concept: Monuments can be identified by their architectural style, structural features, and historical origin.
Explanation:

- The structure shown has a rectangular form with tall Doric columns surrounding it.
- It is an ancient Greek temple situated on the Acropolis of Athens.
- **The Pantheon** has a large dome, which is absent here.
- **Connaught Place** is a commercial area in New Delhi, not a classical monument.
- **Tower of Victory** is a tall tower, not a colonnaded temple.

Hence, the monument shown in the image is **The Parthenon**.

Final Answer: The Parthenon

Quick Tip

Greek temples are commonly identified by straight columns and triangular pediments, unlike Roman monuments which often feature domes and arches.

44. Which book by Robert Venturi is considered a pivotal text in the development of postmodern architecture?

(A) *The Timeless Way of Building*
(B) *The Poetics of Space*
(C) *Complexity and Contradiction in Architecture*
(D) *Architecture: Form, Space and Order*

Correct Answer: (C) *Complexity and Contradiction in Architecture*

Solution:
Concept: Postmodern architecture emerged as a reaction against the simplicity and rigidity of modernism. Texts that questioned functional purity and embraced historical reference, ambiguity, and symbolism became foundational to this movement.
Explanation:

- **Robert Venturi**'s book *Complexity and Contradiction in Architecture* (1966) challenged the modernist principle of "less is more" by proposing "less is a bore."
- The book argued for richness, ambiguity, and historical reference in architectural design.
- *The Timeless Way of Building* is by Christopher Alexander.
- *The Poetics of Space* is written by Gaston Bachelard.
- *Architecture: Form, Space and Order* is authored by Francis D.K. Ching.

Thus, the book that played a pivotal role in shaping postmodern architectural thought is ***Complexity and Contradiction in Architecture***.

Quick Tip

If a question asks about the theoretical foundation of postmodern architecture, Robert Venturi's critique of modernism is almost always the key reference.

---

45. Which material is used traditionally to make sandpaper?

(A) Brick
(B) Silica
(C) Iron
(D) Rubber

Correct Answer: (B) Silica

Solution:
Concept: Sandpaper is an abrasive material used for smoothing and finishing surfaces. The effectiveness of sandpaper depends on the hardness and sharpness of the abrasive grains bonded to the paper backing.
Explanation:

- **Silica** (silicon dioxide) is a naturally occurring hard mineral commonly found in sand.
- Traditionally, sandpaper was made by fixing fine grains of silica sand onto paper using adhesive.
- **Brick** is too coarse and irregular for controlled abrasion.
- **Iron** is a metal and not used as an abrasive grain in sandpaper.
- **Rubber** is soft and flexible, unsuitable for abrasion.

Hence, the material traditionally used to make sandpaper is **silica**.

Final Answer: Silica

Quick Tip

Modern sandpapers may use abrasives like aluminum oxide or silicon carbide, but traditional sandpaper used natural silica sand.

---

46. Pointed arches and flying buttresses were the prominent architectural features introduced in which architectural style?

(A) Romanesque
(B) Renaissance
(C) Gothic
(D) Baroque

Correct Answer: (C) Gothic

Solution:
Concept: Architectural styles are identified by their structural innovations and visual characteristics. Certain construction elements are uniquely associated with specific historical periods.
Explanation:

- **Gothic architecture** introduced:
  - **Pointed arches** to distribute weight more efficiently,
  - **Flying buttresses** to support tall walls and allow large stained-glass windows.
- **Romanesque** architecture used round arches and thick walls.
- **Renaissance** architecture emphasized symmetry, proportion, and classical elements.
- **Baroque** architecture is known for dramatic ornamentation and grandeur, not structural innovations like flying buttresses.

Thus, pointed arches and flying buttresses are hallmark features of **Gothic architecture**.

Final Answer: Gothic

Quick Tip

If you see pointed arches, ribbed vaults, and flying buttresses together, the architectural style is almost certainly Gothic.

---

47. "Acoustical Design" deals with:

(A) Structure of building
(B) Sound in the building
(C) Ventilation of the building
(D) Facade design

Correct Answer: (B) Sound in the building

Solution:
Concept: Acoustical design focuses on the control and quality of sound within a built environment to ensure comfort, clarity, and functionality.
Explanation:

- **Acoustical design** involves:
  - Sound propagation,
  - Noise control,
  - Echo and reverberation management,
  - Speech intelligibility and sound clarity.
- It is especially important in auditoriums, classrooms, theatres, and concert halls.
- **Structure of building** relates to strength and stability.
- **Ventilation** deals with air circulation.
- **Facade design** concerns the external appearance of a building.

Hence, acoustical design deals with **sound in the building**.

Final Answer: Sound in the building

Quick Tip

Whenever the question mentions acoustics, think about sound behavior, not structure or airflow.

---

48. What is the primary purpose of using a 'mullion' in window design?

(A) For decoration
(B) To enhance ventilation

(C) To support the glass within the window frame
(D) To block sunlight

Correct Answer: (C) To support the glass within the window frame

Solution:
Concept: A **mullion** is a vertical structural element that divides adjacent window units and provides support to the glazing system.
Explanation:

- The primary function of a mullion is **structural support**, especially in large window openings.
- It helps transfer the load of the glass and frame safely to the building structure.
- Mullions also allow windows to be divided into smaller panes, improving strength and stability.
- Decoration may be a secondary visual effect, but it is not the main purpose.
- Ventilation and sunlight control are handled by operable sashes, louvers, or shading devices—not mullions.

Therefore, the main purpose of a mullion is to support the glass within the window frame.

Final Answer: To support the glass within the window frame

Quick Tip

Mullion = vertical support between window panes; Transom = horizontal support between window panes.

---

49. The usable area of a floor is called:

(A) Carpet area
(B) Plinth area
(C) Surface area
(D) Built-up area

Correct Answer: (A) Carpet area

Solution:
Concept: Different types of floor areas are defined in building planning to distinguish between usable space and structural or circulation spaces.
Explanation:

- **Carpet area** is the net usable area within a building, measured from wall to wall.
- It excludes wall thickness, balconies, corridors, staircases, and other common areas.
- **Plinth area** includes carpet area plus wall thickness and other covered spaces.

- **Built-up area** further includes balconies and external walls.
- **Surface area** is a general term and not specifically used to denote usable floor space.

Hence, the usable area of a floor is called **carpet area**.

Final Answer: Carpet area

Quick Tip

When asked about usable living space in buildings, the answer is almost always carpet area.

---

50. Name the place where the Statue of Unity is situated.

(A) Gandhinagar, Gujarat
(B) Kadi, Gujarat
(C) Anand, Gujarat
(D) Kevadia, Gujarat

Correct Answer: (D) Kevadia, Gujarat

Solution:
Concept: The Statue of Unity is a famous national monument, and questions related to its location are based on general knowledge of Indian landmarks.
Explanation:

- The **Statue of Unity** is located near the Sardar Sarovar Dam on the Narmada River.
- It is situated at **Kevadia** (also known as Ekta Nagar) in the state of Gujarat.
- **Gandhinagar** is the capital of Gujarat but not the site of the statue.
- **Kadi** and **Anand** are towns in Gujarat, unrelated to the monument.

Hence, the Statue of Unity is situated in **Kevadia, Gujarat**.

Final Answer: Kevadia, Gujarat

Quick Tip

Remember: Statue of Unity → Sardar Vallabhbhai Patel → Kevadia → Gujarat.

---

51. What is the proportional relationship in classical architecture, represented as 1.618?

(A) Fibonacci sequence
(B) Symmetry ratio

(C) Golden ratio
(D) Modular scale

Correct Answer: (C) Golden ratio

Solution:
Concept: Classical architecture often relied on mathematical proportions to achieve visual harmony and balance. One such proportion has been historically regarded as aesthetically ideal.
Explanation:

- The number 1.618 (approximately) represents the **Golden Ratio**, denoted by the Greek letter ϕ.
- It is defined as the ratio where:

$$\frac{a+b}{a} = \frac{a}{b} \approx 1.618$$

- The Golden Ratio was widely used in classical Greek architecture, sculpture, and later in Renaissance design to create pleasing proportions.
- The **Fibonacci sequence** approaches the golden ratio but is not itself the ratio.
- **Symmetry ratio** and **modular scale** are general design concepts, not specifically equal to 1.618.

Thus, the proportional relationship represented by 1.618 is known as the **Golden Ratio**.

Final Answer: Golden ratio

Quick Tip

If you see the number 1.618 in architecture, art, or design questions, it almost always refers to the Golden Ratio.

---

52. Rings of the wooden log represent:

(A) Strength of wood
(B) Age of the wood
(C) Colour of wood
(D) Defects of wood

Correct Answer: (B) Age of the wood

Solution:
Concept: Trees grow by forming one growth ring each year. These rings are clearly visible in a cross-section of a wooden log.
Explanation:

- Each ring represents one year of growth of the tree.

- By counting the number of rings in a wooden log, the **age of the tree (and hence the wood)** can be determined.
- The rings do not directly indicate strength, colour, or defects of the wood.

Hence, the rings of a wooden log represent the **age of the wood**.

Final Answer: Age of the wood

Quick Tip

One growth ring = one year of tree growth. Counting rings gives the age of the wood.

---

53. Which ancient civilization is credited with inventing the arch, a fundamental structural element in architecture?

(A) Greek
(B) Roman
(C) Egyptian
(D) Mesopotamian

Correct Answer: (B) Roman

Solution:
Concept: The arch is a crucial structural innovation that allows loads to be distributed efficiently, enabling the construction of larger and more durable structures.
Explanation:

- Although earlier civilizations experimented with primitive arches, the **Romans** are credited with developing and widely using the true arch as a major architectural element.
- Roman mastery of the arch led to monumental structures such as aqueducts, bridges, amphitheatres, and basilicas.
- **Greek** architecture relied mainly on post-and-lintel construction.
- **Egyptian** architecture also used trabeated systems with massive stone blocks.
- **Mesopotamian** civilizations used basic arches, but did not develop them to the structural and architectural sophistication achieved by the Romans.

Hence, the ancient civilization credited with inventing and perfecting the arch in architecture is the **Roman civilization**.

Final Answer: Roman

Quick Tip

If a question links arches with large-scale engineering like aqueducts and bridges, the answer is almost always Roman.

54. In which type of garden style is the concept of the four-part garden given importance?

(A) Chinese Garden
(B) Mughal Garden
(C) Japanese Garden
(D) French Garden

Correct Answer: (B) Mughal Garden

Solution:
Concept: The four-part garden concept is known as the **Charbagh** layout. It is a traditional garden design based on geometric division and symbolism.
Explanation:

- The **Mughal Garden** is based on the **Charbagh** concept, where the garden is divided into four equal quadrants.
- These divisions are usually separated by water channels or pathways.
- The design symbolizes the four rivers of paradise described in Islamic tradition.
- **Chinese** and **Japanese** gardens emphasize natural, asymmetrical layouts.
- **French** gardens focus on axial symmetry and grand vistas, not four-part division.

Hence, the garden style that gives importance to the four-part garden concept is the **Mughal Garden**.

Final Answer: Mughal Garden

Quick Tip

Charbagh = Four-part garden = Mughal architecture and landscape design.

---

55. If a room is painted with a dark colour, what will be the appearance of the room?

(A) Room will appear smaller than the original room size
(B) Room will appear larger than the original room size
(C) Room will look brighter and appear larger than the original size
(D) Room will look brighter

Correct Answer: (A) Room will appear smaller than the original room size

Solution:
Concept: Colour psychology and light reflection play an important role in interior perception. Dark colours absorb more light, affecting how spacious a room feels.
Explanation:

- Dark colours absorb light instead of reflecting it.
- This reduces brightness and creates a sense of enclosure.
- As a result, rooms painted in dark colours tend to feel **smaller and more confined**.
- Light colours, on the other hand, reflect more light and make spaces appear larger and brighter.

Hence, a room painted with a dark colour will appear **smaller than its original size**.

Final Answer: Room will appear smaller than the original room size

Quick Tip

Use light colours for small rooms to create an illusion of space; dark colours make rooms feel compact.

---

56. The ground floor plan of a building has 3 entrances. If each entrance can be connected by stairs or an elevator externally, in how many ways can a person enter the building through the entrance?

(A) 03
(B) 06
(C) 09
(D) 12

Correct Answer: (B) 06

Solution:
Concept: This problem is based on the **multiplication principle** of counting. If an event can occur in m ways and another independent event can occur in n ways, then the total number of ways both events can occur together is $m \times n$.
Step 1: Identify choices at each entrance

- Number of entrances $= 3$
- For each entrance, a person can use:
  - Stairs, or
  - Elevator

  So, number of choices per entrance $= 2$.

Step 2: Apply multiplication principle

$$\text{Total ways} = 3 \times 2 = 6$$

Conclusion: A person can enter the building in $\boxed{6}$ different ways.

Final Answer: $\boxed{6}$

Quick Tip

When multiple independent choices exist, multiply the number of options at each stage to find total possible ways.

---

57. Given below are two statements:
Statement I: The concept of "form follows function" suggests that a building's design should primarily consider its use.
Statement II: The concept of "form follows function" means that aesthetics should take precedence over functionality.
In the light of the above statements, choose the correct answer from the options given below.

(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: The principle **"form follows function"** was introduced by architect Louis Sullivan and became a foundational idea in modern architecture.
Explanation:

- **Statement I** is **true** because the concept emphasizes that the shape and form of a building should be determined by its intended function or use.
- **Statement II** is **false** because the principle does *not* suggest that aesthetics should dominate functionality. Instead, aesthetics are expected to emerge naturally from functional design.

Thus, only Statement I is correct.

Final Answer: Statement I is true but Statement II is false

Quick Tip

"Form follows function" means function comes first—appearance is shaped by use, not the other way around.

---

58. Given below are two statements:
Statement I: The sun has a maximum altitude of 90° on the Tropic of Capricorn on 22nd June at 12 noon and gradually decreases thereafter till 22nd December.
Statement II: The tilt of the Earth on its axis of 23.5° has no role to play in the change of altitude of the sun on the Tropic of Capricorn.

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

(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: (B) Both Statement I and Statement II are false

Solution:
Concept: The apparent position of the Sun and its altitude at different latitudes depend on the **tilt of the Earth's axis** and the **revolution of the Earth around the Sun**.
Explanation:

- **Statement I** is **false** because the Sun is overhead (90°) at the **Tropic of Capricorn on 22nd December**, not on 22nd June.
- On 22nd June, the Sun is overhead at the **Tropic of Cancer**.
- **Statement II** is also **false** because the Earth's axial tilt of 23.5° is the **main reason** for the change in the Sun's altitude at different places and times of the year.

Since both statements are incorrect, the correct option is **(B)**.

Final Answer: Both Statement I and Statement II are false

Quick Tip

Sun overhead at Tropic of Cancer → 22nd June Sun overhead at Tropic of Capricorn → 22nd December

---

59. Given below are two statements:
Statement I: *Granite* is the hardest stone.
Statement II: *Marble* is a soft stone.
In the light of the above statements, choose the correct answer from the options given below.

(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: (B) Both Statement I and Statement II are false

Solution:
Concept: Building stones are classified based on their **geological origin**, **hardness**, and **engineering properties**. In construction materials, stones are broadly categorized into **hard stones** and **soft stones**.
Detailed Explanation:

- **Statement I: "Granite is the hardest stone."**
  - Granite is an **igneous rock** and is known for its high compressive strength, durability, and resistance to weathering.
  - However, granite is **not the hardest stone**. Stones such as **quartzite** and minerals like **diamond** are harder than granite.
  - Therefore, while granite is a *very hard stone*, calling it the *hardest stone* is incorrect.
  - Hence, **Statement I is false**.
- **Statement II: "Marble is a soft stone."**
  - Marble is a **metamorphic rock** formed from limestone.
  - In building material classification, marble is considered a **hard stone**, widely used for flooring, cladding, and decorative works.
  - **Soft stones** include limestone, sandstone, and laterite—not marble.
  - Therefore, **Statement II is also false**.

Conclusion: Since both Statement I and Statement II are incorrect, the correct choice is **Option (B)**.

Final Answer: Both Statement I and Statement II are false

Quick Tip

Granite = very hard but not the hardest stone. Marble = hard stone (not a soft stone) used extensively in construction and architecture.

---

60. Given below are two statements:
Statement I: "Wind speed" should be considered while designing tall buildings.
Statement II: "Buildings" should be rigid in an earthquake high risk zone.
In the light of the above statements, choose the correct answer from the options given below.

(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: Structural design of buildings must account for different types of loads such as **wind loads** and **seismic loads**. Each type of load requires a specific design approach to ensure safety and performance.
Detailed Explanation:

- **Statement I:**

- Tall buildings are significantly affected by **wind forces**.
- Wind speed influences lateral loads, sway, vibration, and overall stability.
- Ignoring wind effects can lead to discomfort for occupants and even structural failure.
- Therefore, considering wind speed in the design of tall buildings is **essential**.
- Hence, **Statement I is true**.

- **Statement II:**
  - In earthquake-prone (high seismic risk) zones, buildings should be **ductile and flexible**, not rigid.
  - Excessive rigidity makes structures brittle, increasing the risk of sudden collapse during earthquakes.
  - Modern seismic design promotes energy dissipation through controlled deformation.
  - Hence, the statement that buildings should be rigid in high-risk earthquake zones is **incorrect**.
  - Therefore, **Statement II is false**.

Conclusion: Statement I is correct, while Statement II is incorrect. Thus, the correct option is **(C)**.

Final Answer: Statement I is true but Statement II is false

Quick Tip

Wind loads affect tall buildings, while earthquake-resistant buildings must be ductile—not rigid.

---

61. Match the LIST-I with LIST-II and choose the correct answer.

LIST-I (Building)

- A. Sanchi Stupa
- B. Circular Column
- C. Pyramid
- D. Palaces

LIST-II (Shape)

- I. Cylinder
- II. Triangular Surfaces
- III. Dome
- IV. Cuboids

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

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

Solution:
Concept: Buildings and architectural elements are often associated with basic geometric forms. Identifying the dominant geometric shape helps in correctly matching structures with their forms.
Detailed Matching Explanation:

- **A. Sanchi Stupa → III. Dome**
  - The Sanchi Stupa is a hemispherical structure.
  - A hemisphere is a type of dome.
- **B. Circular Column → I. Cylinder**
  - A circular column has a constant circular cross-section.
  - This corresponds to the geometric shape of a cylinder.
- **C. Pyramid → II. Triangular Surfaces**
  - A pyramid is composed of triangular faces meeting at a point.
  - Hence, its defining surfaces are triangular.
- **D. Palaces → IV. Cuboids**
  - Palaces generally consist of rectangular blocks and volumes.
  - These volumes resemble cuboids in geometric form.

Conclusion: The correct matching is:

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

Final Answer: A-III, B-I, C-II, D-IV

Quick Tip

When matching buildings with shapes, identify the most dominant and simplest geometric form of the structure.

---

62. Match the LIST-I with LIST-II and choose the correct answer.

LIST-I (Temple)

- A. Sun Temple

- B. Shiva Temple
- C. Balaji Temple
- D. Brahma Temple

LIST-II (Location)

- I. Tirupati
- II. Pushkar
- III. Modhera
- IV. Ujjain

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

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

Solution:
Concept: Many famous temples in India are strongly associated with specific locations. Correctly matching temples with their locations requires knowledge of Indian cultural and architectural heritage.
Detailed Matching Explanation:

- **A. Sun Temple → III. Modhera**
  - The famous Sun Temple of Modhera is located in Gujarat.
  - It is dedicated to the Sun God, Surya.
- **B. Shiva Temple → IV. Ujjain**
  - Ujjain is home to the Mahakaleshwar Jyotirlinga, one of the most important Shiva temples in India.
- **C. Balaji Temple → I. Tirupati**
  - The Balaji Temple (Lord Venkateswara) is located at Tirupati in Andhra Pradesh.
  - It is one of the richest and most visited temples in the world.
- **D. Brahma Temple → II. Pushkar**
  - Pushkar, Rajasthan, is famous for one of the very few temples dedicated to Lord Brahma.

Conclusion: The correct matching is:

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

Final Answer: A-III, B-IV, C-I, D-II

Quick Tip

Remember key temple–location pairs: Sun Temple → Modhera, Balaji → Tirupati, Brahma Temple → Pushkar, Mahakaleshwar → Ujjain.

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63. Match the LIST-I with LIST-II and choose the correct answer.

LIST-I (Construction Equipments)

- A. Bulldozer
- B. Crane
- C. Concrete Mixer
- D. Wheel Barrow

LIST-II (Functions)

- I. Used for transporting smaller loads over short distances at site
- II. Mixes cement, sand and aggregate with water to produce concrete
- III. Used to transport concrete to different locations at site
- IV. Used to level and move debris from the site

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

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

Solution:
Concept: Construction activities require different equipment, each designed to perform a specific function efficiently on site. Correct identification depends on understanding the primary use of each equipment.
Detailed Matching Explanation:

- **A. Bulldozer → IV. Used to level and move debris from the site**
  - Bulldozers are heavy earth-moving machines.
  - They are commonly used for clearing, leveling ground, and pushing debris.
- **B. Crane → III. Used to transport concrete to different locations at site**
  - Cranes lift and move heavy materials vertically and horizontally.
  - Buckets or containers attached to cranes are often used to carry concrete.
- **C. Concrete Mixer → II. Mixes cement, sand and aggregate with water to produce concrete**

  - Concrete mixers ensure uniform mixing of all concrete ingredients.
  - They are essential for producing workable concrete on site.
- **D. Wheel Barrow → I. Used for transporting smaller loads over short distances at site**
  - Wheel barrows are manually operated tools.
  - They are ideal for carrying small quantities of materials like sand, bricks, or concrete.

Conclusion: The correct matching is:

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

Final Answer: A-IV, B-III, C-II, D-I

Quick Tip

Remember: Bulldozer → earthwork, Crane → lifting/transporting, Concrete mixer → mixing, Wheel barrow → short-distance manual transport.

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64. "SDG" stands for:

(A) Sustainable Development Goals
(B) Strategic Design Guidelines
(C) Social Development Growth
(D) Systematic Development Governance

Correct Answer: (A) Sustainable Development Goals

Solution:
Concept: SDGs are a set of global goals adopted by the United Nations to address major social, economic, and environmental challenges faced by the world.
Explanation:

- **SDG** stands for **Sustainable Development Goals**.
- These goals were adopted by the **United Nations in 2015**.
- There are **17 SDGs**, aiming to be achieved by the year 2030.
- They focus on key areas such as:
  - Poverty eradication,
  - Quality education,
  - Clean water and sanitation,
  - Climate action,
  - Sustainable cities and communities.

- The term emphasizes development that meets present needs without compromising the ability of future generations to meet their own needs.

Thus, SDG correctly expands to **Sustainable Development Goals**.

Final Answer: Sustainable Development Goals

Quick Tip

SDGs = 17 global goals by the UN for a better, fairer, and more sustainable world by 2030.

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65. Write the full form of GRIHA:

(A) Green Rating for Integrated Habitat Assessment
(B) Labour Rating for Integrated Heat Assessment
(C) Green Rating for Insulation Heat Assessment
(D) Labour Rating for Insulation Heat Assessment

Correct Answer: (A) Green Rating for Integrated Habitat Assessment

Solution:
Concept: GRIHA is India's national rating system for green buildings. It evaluates the environmental performance of buildings over their entire life cycle.
Explanation:

- **GRIHA** stands for **Green Rating for Integrated Habitat Assessment**.
- It was developed jointly by **The Energy and Resources Institute (TERI)** and the **Ministry of New and Renewable Energy (MNRE), Government of India**.
- GRIHA promotes:
  - Energy efficiency,
  - Water conservation,
  - Use of sustainable materials,
  - Reduction of environmental impact.
- Options (B), (C), and (D) are incorrect as they do not reflect the purpose or scope of the GRIHA rating system.

Conclusion: The correct full form of GRIHA is **Green Rating for Integrated Habitat Assessment**.

Final Answer: Green Rating for Integrated Habitat Assessment

Quick Tip

GRIHA is India's equivalent of global green building rating systems like LEED, focusing on sustainability and environmental performance.

66. ECBC stands for:

(A) Electricity Conservation Building Code
(B) Electricity Consumption Building Code
(C) Energy Conversion Building Code
(D) Energy Conservation Building Code

Correct Answer: (D) Energy Conservation Building Code

Solution:
Concept: ECBC is an important regulatory framework in India aimed at improving the energy efficiency of buildings and reducing overall energy consumption.
Explanation:

- **ECBC** stands for **Energy Conservation Building Code**.
- It was developed by the **Bureau of Energy Efficiency (BEE)** under the Ministry of Power, Government of India.
- ECBC sets minimum energy performance standards for:
  - Building envelope (walls, roofs, windows),
  - Lighting systems,
  - HVAC (heating, ventilation, and air conditioning),
  - Electrical systems.
- The objective of ECBC is to reduce energy demand without compromising occupant comfort.
- The other options are incorrect because:
  - ECBC focuses on **energy conservation**, not electricity consumption alone,
  - It is not related to energy conversion.

Conclusion: Hence, ECBC correctly expands to **Energy Conservation Building Code**.

Final Answer: Energy Conservation Building Code

Quick Tip

ECBC is mandatory for certain categories of buildings and plays a key role in sustainable and energy-efficient architecture in India.

67. 'HRIDAY' stands for:

(A) Heritage City in Developed Association Yojana
(B) High Residential in Densified Augmented Yojana

(C) Heritage City Development and Augmentation Yojana
(D) Hermitage Centre of Development and Association Yojana

Correct Answer: (C) Heritage City Development and Augmentation Yojana

Solution:
Concept: HRIDAY is a Government of India scheme focused on the preservation, revitalization, and sustainable development of heritage cities.
Explanation:

- **HRIDAY** stands for **Heritage City Development and Augmentation Yojana**.
- It was launched by the **Ministry of Housing and Urban Affairs (MoHUA)**.
- The scheme aims to:
  - Preserve cultural heritage of historic cities,
  - Improve urban infrastructure in heritage areas,
  - Enhance tourism potential,
  - Promote inclusive and sustainable urban development.
- Option (A) is incorrect due to wrong expansion.
- Option (B) has no relation to heritage or urban development schemes.
- Option (D) is not associated with any official government program.

Conclusion: The correct full form of HRIDAY is **Heritage City Development and Augmentation Yojana**.

Final Answer: Heritage City Development and Augmentation Yojana

Quick Tip

HRIDAY focuses on heritage cities, while AMRUT focuses on basic urban infrastructure and SMART Cities on technology-driven urban solutions.

---

68. What is the architectural term for a semi-circular or polygonal recess, often found at the end of a church nave?

(A) Atrium
(B) Apse
(C) Cloister
(D) Ambulatory

Correct Answer: (B) Apse

Solution:
Concept: In church architecture, specific spatial terms are used to describe distinct functional and symbolic areas. These elements evolved from early Christian and Roman architectural traditions.
Explanation:

- An **apse** is a semi-circular or polygonal recess located typically at the eastern end of a church.
- It usually houses the altar and is a focal point of liturgical importance.
- **Atrium** refers to an open courtyard, often found in Roman houses or early Christian churches.
- **Cloister** is a covered walk, usually surrounding a courtyard in monasteries.
- **Ambulatory** is a passageway that runs behind the altar and around the apse, allowing circulation.

Thus, the correct architectural term for the described feature is **apse**.

Final Answer: Apse

Quick Tip

In church plans: Nave → main hall, Apse → altar end, Ambulatory → circulation around the apse.

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69. Which of the following city is facing a 'water crisis' and approaching towards 'Zero Day'?

(A) Hyderabad
(B) Bengaluru
(C) Indore
(D) Pune

Correct Answer: (A) Hyderabad

Solution:
Concept: Zero Day refers to the situation when a city runs out of usable water supply and taps run dry. It usually occurs due to prolonged drought, over-extraction of groundwater, rapid urbanization, and inadequate water management.
Explanation:

- **Hyderabad** has faced severe water shortages in recent years due to:
  - Rapid population growth and urban expansion,
  - Declining groundwater levels,
  - Poor rainfall and drying reservoirs.
- Several reports and studies have warned that Hyderabad is moving towards a **Zero Day–like situation** if sustainable water management practices are not adopted.
- While cities like **Bengaluru**, **Pune**, and **Indore** also face water stress, Hyderabad has been most prominently highlighted in the context of an approaching Zero Day.

Conclusion: Therefore, the city identified as facing a serious water crisis and approaching Zero Day is **Hyderabad**.

Final Answer: Hyderabad

Quick Tip

Zero Day = No usable water left. Urban water crises are often caused by groundwater overuse and lack of sustainable planning.

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70. Identify the aspect that deals with the 'Demography' of a town.

(A) Per capita income
(B) Crime rate
(C) Sex ratio
(D) Social security

Correct Answer: (C) Sex ratio

Solution:
Concept: Demography is the statistical study of human populations. It focuses on population structure, composition, and changes over time.
Explanation:

- Demographic characteristics typically include:
  - Population size,
  - Age distribution,
  - Birth and death rates,
  - **Sex ratio**.
- **Sex ratio** represents the number of females per 1000 males and is a key demographic indicator.
- **Per capita income** relates to economic conditions, not demography.
- **Crime rate** is a social indicator.
- **Social security** refers to welfare and policy measures.

Conclusion: Among the given options, **sex ratio** directly deals with the demography of a town.

Final Answer: Sex ratio

Quick Tip

Demography = population statistics such as age, gender, growth rate, and density.

71. Bharatiya Sakshya Adhiniyam, 2023 has replaced:

(A) Indian Eviction Act, 1870
(B) Indian Education Act, 1872
(C) Indian Emergency Act, 1870
(D) Indian Evidence Act, 1872

Correct Answer: (D) Indian Evidence Act, 1872

Solution:
Concept: India has undertaken major legal reforms to replace colonial-era laws with modern, context-appropriate legislation. One such reform relates to laws governing evidence in courts.
Explanation:

- The **Indian Evidence Act, 1872** was a colonial-era law governing admissibility and evaluation of evidence in courts.
- In 2023, it was replaced by the **Bharatiya Sakshya Adhiniyam, 2023**.
- The new Act aims to:
  - Modernize evidentiary rules,
  - Incorporate digital and electronic evidence,
  - Simplify legal language,
  - Align the law with contemporary judicial needs.
- The other options are unrelated laws and have not been replaced by this Act.

Conclusion: Bharatiya Sakshya Adhiniyam, 2023 has replaced the **Indian Evidence Act, 1872**.

Final Answer: Indian Evidence Act, 1872

Quick Tip

Remember the legal reform trio: IPC → Bharatiya Nyaya Sanhita CrPC → Bharatiya Nagarik Suraksha Sanhita Evidence Act → Bharatiya Sakshya Adhiniyam

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72. Given below are two statements:

Statement I: Urban green spaces can help to reduce air pollution and improve public health.
Statement II: Urban green spaces are solely for aesthetic purposes and have no functional benefits.

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

(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:

Step 1: Understanding Statement I.
Statement I says that urban green spaces help in reducing air pollution and improving public health. This is correct because trees and plants absorb pollutants, improve air quality, regulate temperature, and promote physical and mental well-being among urban populations.

Step 2: Understanding Statement II.
Statement II claims that urban green spaces are only for aesthetic purposes and have no functional benefits. This is incorrect because urban green spaces provide multiple functional benefits such as pollution control, biodiversity conservation, climate regulation, and public health improvement.

Step 3: Analyzing the options.
(A) Incorrect, because Statement II is false.
(B) Incorrect, because Statement I is true.
(C) Correct, because Statement I is true and Statement II is false.
(D) Incorrect, because Statement I is not false.

Step 4: Conclusion.
The correct answer is **(C) Statement I is true but Statement II is false**.

Quick Tip

In assertion–reason or statement-based questions, evaluate each statement independently before matching them with the given options.

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73. Given below are two statements:

Statement I: In general, city of Delhi is considered to be planned in radial concentric design.
Statement II: City of Mumbai is planned in linear design.

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

(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:

Step 1: Understanding Statement I.
Statement I states that the city of Delhi is planned in a radial concentric design. This is correct because Delhi has developed around a central core with major roads radiating outward in different directions, especially evident in areas like Lutyens' Delhi and the broader National Capital Region.

Step 2: Understanding Statement II.
Statement II mentions that the city of Mumbai is planned in a linear design. This is also correct. Mumbai has developed in a north–south linear pattern along the western coast, constrained by the Arabian Sea on one side and limited land availability on the other.

Step 3: Analyzing the options.
(A) Correct, because both Statement I and Statement II are true.
(B) Incorrect, because neither statement is false.
(C) Incorrect, because Statement II is also true.
(D) Incorrect, because Statement I is not false.

Step 4: Conclusion.
The correct answer is **(A) Both Statement I and Statement II are true**.

Quick Tip

Radial city patterns usually develop around a central core, while linear cities grow along transport corridors or natural features like coastlines.

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74. Given below are two statements:

Statement I: Constitutional amendments empower village panchayat.
Statement II: Village panchayats were formed under 73rd Amendment Act.

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

(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:

Step 1: Understanding Statement I.
Statement I says that constitutional amendments empower village panchayats. This is correct because constitutional provisions provide legal status, powers, and responsibilities to Panchayati Raj Institutions, strengthening grassroots democracy.

Step 2: Understanding Statement II.
Statement II states that village panchayats were formed under the 73rd Constitutional Amendment Act. This is correct, as the 73rd Amendment Act of 1992 institutionalized Panchayati Raj and established village-level panchayats across India.

Step 3: Analyzing the options.
(A) Correct, because both statements are true.
(B) Incorrect, because neither statement is false.
(C) Incorrect, because Statement II is also true.
(D) Incorrect, because Statement I is not false.

Step 4: Conclusion.
The correct answer is **(A) Both Statement I and Statement II are true**.

Quick Tip

The 73rd Constitutional Amendment Act, 1992 is the foundation of Panchayati Raj Institutions in rural India.

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75. Name the person responsible for 'White Revolution' in India.

(A) Verghese Kurien
(B) Jawahar Lal Nehru
(C) Indira Gandhi
(D) Mother Teresa

Correct Answer: (A) Verghese Kurien

Solution:

Step 1: Understanding the White Revolution.
The White Revolution refers to the rapid increase in milk production in India, which transformed the country into one of the largest producers of milk in the world. This movement is also known as *Operation Flood*.

Step 2: Role of Verghese Kurien.
Dr. Verghese Kurien played a crucial role in organizing dairy cooperatives, strengthening rural livelihoods, and establishing institutions like AMUL. His leadership and vision laid the foundation of India's dairy development.

Step 3: Analyzing the options.
(A) Verghese Kurien: Correct — He is known as the "Father of the White Revolution" in India.
(B) Jawahar Lal Nehru: He was India's first Prime Minister, but not directly responsible for the White Revolution.
(C) Indira Gandhi: She was a former Prime Minister, but she did not lead the White Revolution.
(D) Mother Teresa: She was a social reformer and humanitarian, not associated with agricultural or dairy reforms.

Step 4: Conclusion.
The correct answer is **(A) Verghese Kurien**, who is regarded as the architect of India's White Revolution.

Quick Tip

Remember the associations: **White Revolution – Milk – Verghese Kurien – Operation Flood**.

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76. What is the full form of HUDCO?

(A) Housing and Urban Development Center
(B) Heritage and Urban Development Corporation Limited
(C) Housing and Urban Development Corporation Limited
(D) Health and Urban Development Center

Correct Answer: (C) Housing and Urban Development Corporation Limited

Solution:

Step 1: Understanding HUDCO.
HUDCO is a public sector enterprise of the Government of India that provides finance for housing and urban infrastructure projects. It plays an important role in planned urban development and affordable housing.

Step 2: Analyzing the options.
(A) Housing and Urban Development Center: Incorrect, as HUDCO is a corporation, not merely a center.
(B) Heritage and Urban Development Corporation Limited: Incorrect, because HUDCO is not related to heritage development.
(C) Housing and Urban Development Corporation Limited: Correct — this is the official and complete expansion of HUDCO.
(D) Health and Urban Development Center: Incorrect, as HUDCO is not related to health services.

Step 3: Conclusion.
The correct answer is **(C) Housing and Urban Development Corporation Limited**, which is the official full form of HUDCO.

Quick Tip

HUDCO is commonly associated with housing finance, urban infrastructure, and smart city development projects in India.

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77. Select which of the followings does not represent the 'Vedic Town Plan'.

(A) Vartaka
(B) Padmaka
(C) Prastara
(D) Dandaka

Correct Answer: (D) Dandaka

Solution:

Step 1: Understanding Vedic Town Plans.
Vedic town planning refers to settlement patterns described in ancient Indian texts such as the Vastu Shastra. These plans were based on geometric layouts and functional zoning for

habitation, administration, and religious activities.

Step 2: Analyzing the given options.
(A) Vartaka: This is a recognized type of Vedic town plan characterized by organized residential and commercial areas.
(B) Padmaka: This represents a lotus-shaped town plan, commonly mentioned in ancient planning texts.
(C) Prastara: This refers to a grid-based settlement pattern and is a known Vedic town layout.
(D) Dandaka: This does not represent a town plan. Dandaka refers to a forest region (Dandakaranya) mentioned in ancient Indian literature, not an urban settlement pattern.

Step 3: Conclusion.
The correct answer is **(D) Dandaka**, as it does not represent a Vedic town plan.

Quick Tip

Names of Vedic town plans usually describe settlement layouts, whereas geographical regions like forests are not town planning concepts.

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78. A person starts moving from a point 'A' towards south direction for 200 mts, then he returns back to point 'A' by taking 180° turn. Identify the primary design element he made after completing his journey.

(A) A point
(B) A vertical line
(C) A horizontal line
(D) A diagonal line

Correct Answer: (B) A vertical line

Solution:

Step 1: Understanding the movement.
The person starts from point A and moves straight towards the south direction for 200 meters. This movement creates a straight line in the north–south direction.

Step 2: Effect of the 180° turn.
After reaching the end point, the person takes a 180° turn and returns to point A along the same path. A 180° turn means moving in the exact opposite direction, i.e., north, along the

same straight line.

Step 3: Identifying the design element.
The complete journey traces a straight line along the north–south axis. In design terminology, a line running from north to south is identified as a vertical line.

Step 4: Eliminating other options.
(A) A point: Incorrect, because movement creates a line, not just a single point.
(C) A horizontal line: Incorrect, as horizontal lines run east–west, not north–south.
(D) A diagonal line: Incorrect, because there is no angular movement involved.

Step 5: Conclusion.
The primary design element formed after completing the journey is a **vertical line**.

Quick Tip

In design and geometry, movement along the north–south direction always represents a vertical line.

---

79. When was the Planning Commission of India launched?

(A) 1948
(B) 2015
(C) 1994
(D) 1952

Correct Answer: (D) 1952

Solution:

Step 1: Understanding the Planning Commission.
The Planning Commission of India was responsible for formulating Five-Year Plans and guiding India's economic and social development in the post-independence period.

Step 2: Historical background.
Although the Planning Commission was constituted in 1950, it became fully functional with the launch and implementation phase of planned economic development through the First Five-Year Plan, which came into operation in the early 1950s.

Step 3: Analyzing the options.
(A) 1948: Incorrect, as the Planning Commission did not exist at that time.

(B) 2015: Incorrect, as this year marks the replacement of the Planning Commission by NITI Aayog.
(C) 1994: Incorrect, as the Planning Commission was active much earlier.
(D) 1952: Correct — this period is associated with the operational launch of planned development through Five-Year Plans.

Step 4: Conclusion.
The correct answer is **(D) 1952**.

Quick Tip

The Planning Commission was replaced by **NITI Aayog in 2015**, marking a shift from centralized planning to cooperative federalism.

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80. Match List–I with List–II.

List–I		**List–II**	
A.	Population	I.	Productivity
B.	Communication	II.	Demand
C.	Agriculture	III.	Immobility
D.	Industrial	IV.	Density

Choose the correct answer from the options given below:

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

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

Solution:

Step 1: Population → Density.
Population is commonly measured and studied in terms of density, which shows the number of people living per unit area. Hence, A is correctly matched with IV.

Step 2: Communication → Immobility.
Better communication reduces the need for physical movement, leading to relative immobility

of people and activities. Therefore, B matches with III.

Step 3: Agriculture → Productivity.
Agriculture is directly related to productivity, as it depends on crop yield and output per unit of land. Thus, C is matched with I.

Step 4: Industrial → Demand.
Industrial development is closely linked with demand for goods and services in the economy. Hence, D corresponds to II.

Step 5: Conclusion.
The correct matching is **A–IV, B–III, C–I, D–II**, which corresponds to option **(B)**.

Quick Tip

In matching questions, first identify the most obvious pairs to eliminate incorrect options quickly.

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81. Match the LIST–I with LIST–II.

LIST–I		**LIST–II**	
A.	Mawlynnong	I.	Port city
B.	Vishakhapatnam	II.	Steel city
C.	Ladakh	III.	Cleanest village in Asia
D.	Jamshedpur	IV.	Frozen desert

Choose the correct answer from the options given below:

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

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

Solution:

Step 1: Mawlynnong → Cleanest village in Asia.
Mawlynnong, located in Meghalaya, is famously known as the cleanest village in Asia due to

its community-driven cleanliness practices. Hence, A is correctly matched with III.

Step 2: Vishakhapatnam → Port city.
Vishakhapatnam is a major port city on the eastern coast of India and serves as an important maritime and industrial center. Therefore, B matches with I.

Step 3: Ladakh → Frozen desert.
Ladakh is characterized by extremely cold climatic conditions and low precipitation, which is why it is known as a cold or frozen desert. Thus, C corresponds to IV.

Step 4: Jamshedpur → Steel city.
Jamshedpur is widely known as the Steel City of India because it is home to Tata Steel and a major center of iron and steel production. Hence, D is matched with II.

Step 5: Conclusion.
The correct matching is **A–III, B–I, C–IV, D–II**, which corresponds to option **(A)**.

Quick Tip

Link places with their most famous identity first—such as industries, climate, or unique features—to solve matching questions quickly.

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82. Match the LIST–I with LIST–II.

LIST–I (Schemes)		**LIST–II (Objectives)**	
A.	Smart City	I.	Affordable housing
B.	P.M. Jan Dhan Yojana	II.	Primary education
C.	PMAY	III.	IoT
D.	Sarva Shiksha Abhiyan	IV.	Bank account opening

Choose the correct answer from the options given below:

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

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

Solution:

Step 1: Smart City → IoT.
The Smart City Mission focuses on using technology such as Internet of Things (IoT) to improve urban infrastructure, governance, and quality of life. Hence, A is correctly matched with III.

Step 2: P.M. Jan Dhan Yojana → Bank account opening.
Pradhan Mantri Jan Dhan Yojana aims to promote financial inclusion by ensuring access to banking services, especially bank account opening for all citizens. Therefore, B matches with IV.

Step 3: PMAY → Affordable housing.
Pradhan Mantri Awas Yojana (PMAY) is a flagship housing scheme aimed at providing affordable housing to all by the year 2022. Thus, C is correctly matched with I.

Step 4: Sarva Shiksha Abhiyan → Primary education.
Sarva Shiksha Abhiyan is a major initiative to universalize elementary education and improve access to primary schooling across India. Hence, D corresponds to II.

Step 5: Conclusion.
The correct matching is **A–III, B–IV, C–I, D–II**, which corresponds to option **(A)**.

Quick Tip

Government schemes are best matched by remembering their core objectives—finance, housing, education, or technology.

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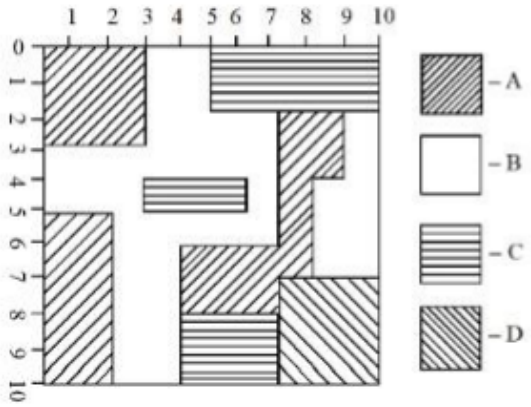
83. The figure shows an area of 10 km × 10 km with different land uses. Which land use covers the second largest area?



(A) C
(B) A

(C) B
(D) D

Correct Answer: (D) D

Solution:

Step 1: Understanding the figure.
The given diagram represents a total area of 10 km $\times$ 10 km divided into different land-use categories represented by symbols A, B, C, and D. Each symbol corresponds to a specific pattern shown in the legend.

Step 2: Estimating areas visually.
By carefully observing the figure, the unshaded region (B) occupies the maximum number of grid squares and hence represents the largest land-use area.

Step 3: Identifying the second largest land-use.
Among the remaining patterns, land-use D (dense diagonal shading) covers more grid blocks than A and C. Its spatial spread across multiple blocks makes it the second largest area after B.

Step 4: Eliminating other options.
(A) C: Covers fewer grid squares than D.
(B) A: Occupies smaller scattered regions.
(C) B: This is the largest area, not the second largest.

Step 5: Conclusion.
Therefore, the land use that covers the **second largest area** is **D**.

Quick Tip

In map-based questions, first identify the largest area, then compare remaining regions block by block to find the second largest.

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84. What is the full form of UNICEF?

(A) United Nations Iconic Childcare Economic Federation
(B) United Nations International Children's Fellowship
(C) United Nations International Children's Education Fund
(D) United Nations Children's Fund

Correct Answer: (D) United Nations Children's Fund

Solution:

Step 1: Understanding UNICEF.
UNICEF is a United Nations agency working globally for the welfare, protection, and development of children, especially in developing countries. It focuses on health, nutrition, education, sanitation, and child rights.

Step 2: Analyzing the options.
(A) Incorrect, as this is not an official United Nations organization.
(B) Incorrect, because UNICEF is not a fellowship program.
(C) Incorrect, as the word "Education" alone does not represent UNICEF's official name.
(D) Correct — UNICEF is officially known as the **United Nations Children's Fund**.

Step 3: Conclusion.
The correct expansion of UNICEF is **United Nations Children's Fund**.

Quick Tip

Although UNICEF was originally called the United Nations International Children's Emergency Fund, its current official name is **United Nations Children's Fund**.

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85. Identify the city ruled by 'Begums-the Queens.'

(A) Hyderabad
(B) Murshidabad
(C) Bhopal
(D) Aligarh

Correct Answer: (C) Bhopal

Solution:

Step 1: Understanding the phrase "Begums-the Queens."
The term "Begums-the Queens" refers to the unique period in Indian history when a princely state was ruled by a succession of female Muslim rulers known as Begums.

Step 2: Historical background.
The princely state of Bhopal was ruled by four Begums between 1819 and 1926. These rulers

were Shah Jahan Begum, Sikandar Begum, Qudsia Begum, and Sultan Jahan Begum, who were known for their administrative efficiency and progressive reforms.

Step 3: Analyzing the options.
(A) Hyderabad: Ruled by Nizams, not Begums.
(B) Murshidabad: Associated with Nawabs of Bengal.
(C) Bhopal: Correct — it was uniquely ruled by Begums for over a century.
(D) Aligarh: Known for educational reforms, not female rulers.

Step 4: Conclusion.
The city ruled by "Begums-the Queens" was **Bhopal**.

Quick Tip

Bhopal is the only princely state in India that was ruled by female rulers (Begums) for such a long continuous period.

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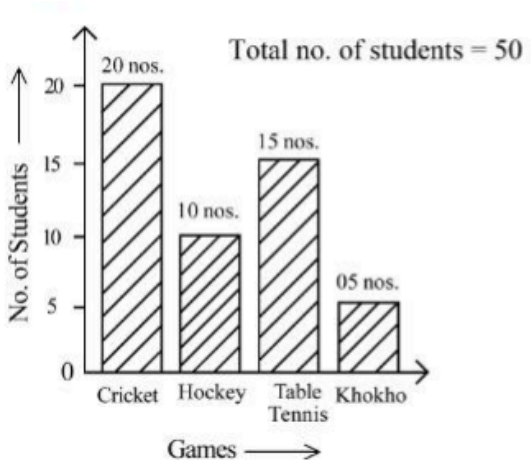
86. As per the given bar chart, what is the total percentage of students who prefer to play cricket?



(A) 15%
(B) 20%
(C) 30%
(D) 40%

Correct Answer: (D) 40%

Solution:

Step 1: Reading the data from the bar chart.
From the bar chart, the number of students who prefer different games is given as follows:
Cricket = 20 students
Hockey = 10 students
Table Tennis = 15 students
Khokho = 5 students

The total number of students is clearly mentioned as 50.

Step 2: Identifying the number of students preferring cricket.
According to the chart, 20 students prefer to play cricket.

Step 3: Calculating the percentage.

$$\text{Percentage} = \left(\frac{\text{Number of students preferring cricket}}{\text{Total number of students}}\right) \times 100$$
$$= \left(\frac{20}{50}\right) \times 100 = 40\%$$

Step 4: Conclusion.
The total percentage of students who prefer to play cricket is **40%**.

Quick Tip

To find percentage from a bar graph, always divide the required category value by the total and multiply by 100.

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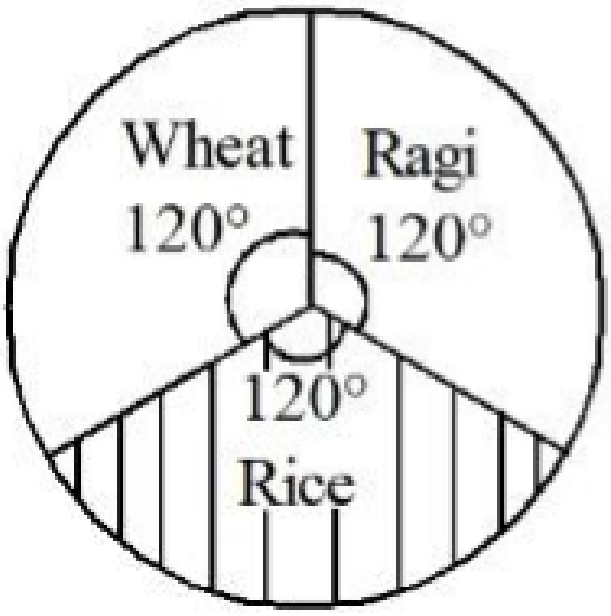
87. As per the given pie chart, identify the percentage (%) of the shaded portion.



(A) 22.22%
(B) 45.55%
(C) 33.33%
(D) 11.11%

Correct Answer: (C) 33.33%

Solution:

Step 1: Understanding the pie chart.
The pie chart is divided into three equal sectors representing Wheat, Ragi, and Rice. Each sector has an angle of 120°, as clearly shown in the diagram.

Step 2: Identifying the shaded portion.
The shaded portion corresponds to the Rice sector, which measures 120°.

Step 3: Calculating the percentage.
The total angle of a pie chart is 360°.

$$\text{Percentage of shaded portion} = \left(\frac{120^\circ}{360^\circ}\right) \times 100$$

$$= \frac{1}{3} \times 100 = 33.33\%$$

Step 4: Conclusion.
The percentage of the shaded portion shown in the pie chart is **33.33%**.

Quick Tip

To find percentages in a pie chart, divide the angle of the required sector by 360° and multiply by 100.

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88. Using black and white medium only, draw a proportionate sketch of the image given below in detail with proper light and shade.

Solution:

Step 1: Observing overall proportion and composition.
The given image represents a monumental architectural structure (India Gate) shown in perspective view. Before starting the sketch, observe the overall height–width ratio, the central arch as the focal point, and the symmetrical balance of the structure. Lightly block the main outline using faint pencil lines to maintain correct proportions.

Step 2: Constructing basic geometric forms.
Begin by drawing the basic rectangular mass of the monument. Add the central arch using a semi-circular form, ensuring symmetry on both sides. Mark horizontal divisions for cornices, pillars, and base steps. Keep all construction lines light.

Step 3: Adding architectural details.
Refine the sketch by adding columns, engraved panels, moldings, and the top crown structure. Carefully draw the depth of the archway to show perspective. Include secondary elements such as the flag pole, trees, ground plane, and background elements lightly.

Step 4: Light and shade application.
Identify the direction of light (appearing from the left side in the reference image). Shade the opposite surfaces using gradual tonal values. Use darker tones inside the arch to create depth. Apply mid-tones on side walls and lighter tones on illuminated surfaces. Avoid harsh outlines; rely on tonal contrast.

Step 5: Textures and finishing.
Use controlled pencil strokes to indicate stone texture. Soften background trees and sky using light shading to create atmospheric depth. Darken foreground shadows on the ground to anchor the monument. Clean unnecessary guidelines and sharpen important edges.

Step 6: Final presentation.
Ensure neatness, clear contrast between light and shadow, and accurate proportions. The final sketch should appear balanced, realistic, and well-composed using only black and white medium.

Quick Tip

Always establish proportions first and apply shading gradually from light to dark to achieve realistic architectural depth.

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89. Sketch a unique treehouse that reconnects with nature. Include features such as wooden decks, ladder using natural materials. The structure should blend harmoniously with the surrounding. Depict natural light, shadow and textures effectively. Colour it as per your choice.

Solution

Step 1: Concept and composition.
The treehouse is conceptualized as an eco-friendly structure built around a large, mature tree. The overall form follows the natural growth of the tree, ensuring harmony with the environment. The composition balances the treehouse centrally with surrounding foliage to emphasize integration with nature.

Step 2: Structural elements.
The sketch includes a wooden deck supported by thick branches, a rope-and-wood ladder made from natural materials, and railings crafted from bamboo or logs. The house structure is kept compact with sloping roofs to blend with the forest setting.

Step 3: Light, shadow, and texture.
Natural light is shown filtering through the leaves, creating soft highlights on wooden surfaces. Shadows are added beneath the deck, ladder, and branches to provide depth. Textures of wood grain, bark, and leaves are carefully rendered for realism.

Step 4: Colour application.
Earthy tones such as browns, greens, and muted yellows are used. The tree trunk is shaded

with dark browns, foliage with multiple green tones, and the deck with warm wooden hues to maintain a natural appearance.

Step 5: Final presentation.
The final sketch appears peaceful, organic, and environmentally sensitive, successfully reconnecting architecture with nature through form, material, and colour.

Quick Tip

When drawing nature-based structures, follow organic shapes and use soft tonal transitions to maintain harmony with the surroundings.

OR
90. Visualize a vibrant street food festival set in an urban environment. Consider street food stalls, chefs preparing dishes, people standing in line and a variety of cuisines. Include street decorations and seating arrangements capturing the lively and diverse scene. Use suitable colours of your choice.

Solution

Step 1: Scene planning and layout.
The street food festival is visualized in a busy urban street with multiple food stalls arranged on both sides. The central pathway is occupied by people standing in queues, walking, and interacting, creating a dynamic composition.

Step 2: Detailing elements.
The sketch includes food stalls with signboards, chefs cooking on stoves, smoke rising from pans, and counters displaying different cuisines. Seating arrangements such as benches and small tables are added to enhance realism.

Step 3: Human activity and movement.
People are drawn in varied postures—waiting in line, ordering food, sitting, and eating—to capture the lively atmosphere. Facial expressions and gestures add vibrancy and diversity to

the scene.

Step 4: Light, colour, and texture.
Bright and festive colours like reds, yellows, blues, and greens are used for stalls and decorations. Warm lighting from bulbs and lamps highlights food counters, while shadows under stalls and people add depth. Textures of cloth canopies, food items, and pavement are carefully illustrated.

Step 5: Final presentation.
The completed artwork reflects energy, cultural diversity, and urban vibrancy, effectively portraying the spirit of a street food festival through colour, composition, and detail.

Quick Tip

Crowded scenes look lively when figures overlap slightly and colours vary in intensity to create visual rhythm.