NID DAT

Complete Sample Paper – 7

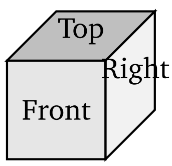
Duration: 150 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **50 Visual MCQs (Part A)** and **5 Drawing Tasks (Part B)**, modelled on NID DAT 2026 Prelims.
- **Part A:** Each correct answer carries **+1 mark**. There is **no negative marking**.
- **Part B:** Each drawing task carries **10 marks**; marks are awarded for design thinking, form, composition, and visual communication.
- **Total: 100 marks | Duration: 150 minutes**
- For Part A only one option is correct per question; for Part B all answers are open-ended sketches.
- Drawing tools (pencils, sketch pens, scale, colours) are allowed for Part B only. No electronic gadgets.

Part A: Visual MCQs — 50 Marks

Q1. The isometric cube below is rotated **90° clockwise** when viewed from the top. Which face ends up on the **right** side after the rotation?



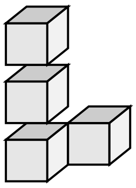
(A) The face that was originally on the front

(B) The face that was originally on the front becomes the right face after 90° clockwise rotation

(C) The face that was originally on the top

(D) The face that was originally on the left

Q2. The L-shaped cube arrangement below is viewed from the **front**. Which option correctly shows the view from the **back**?



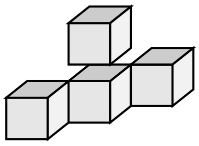
(A) The L-shape mirrored left-to-right only

(B) The L-shape rotated 90° clockwise

(C) A reversed L-shape (the horizontal arm projects to the left at the bottom when viewed from the back)

(D) The same L-shape unchanged

Q3. A T-shaped cube arrangement (3 cubes in a row, 1 cube centred on top of the middle cube) is viewed from the **right side**. Which option matches the right-side view?



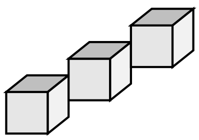
(A) A single 1×2 rectangle (one cube wide, two cubes tall)

(B) A flat horizontal row of 3 squares

(C) A T-shape identical to the front view

(D) Two stacked squares (2 cubes tall, 1 cube wide) because the right side sees 1 cube in bottom row + 1 cube on top

Q4. Three cubes are arranged as a **staircase** stepping up from left to right (each successive cube is placed one step higher and one step back). Which option correctly shows the **top view** (plan view) of this arrangement?



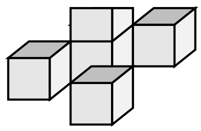
(A) Three squares arranged diagonally in a row (each shifted one unit right and one unit back)

(B) A single 1×3 straight horizontal row of squares

(C) An L-shaped arrangement of 3 squares

(D) A 2×2 grid of 4 squares

Q5. Five cubes are assembled into a **3D cross** (+ shape): one centre cube with one cube attached to each of its four sides (front, back, left, right) at the same level. Which option shows the **front view** of this arrangement?



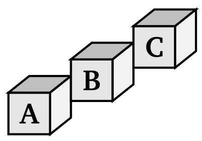
(A) A single square (only the front face of the front arm is visible)

(B) A plus sign (+) made of 3 squares: one centre square with one square above and one below

(C) A horizontal row of 3 squares

(D) A 2×2 square grid

Q6. Three cubes are arranged in a **zigzag**: cube A at bottom-left, cube B above and to the right of A, cube C above and to the right of B. The whole structure is then **tilted 90° to the left**. Which cube is now on **top**?



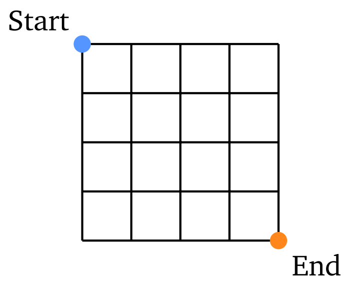
(A) Cube A (it was at the bottom so it rises to the top)

(B) Cube B (the middle cube stays on top)

(C) Cube A becomes the top after the entire structure tilts left, placing the leftmost-bottom cube on top

(D) Cube C (the highest cube remains on top regardless of tilt direction)

Q7. In the 4×4 grid below, you may move only **right** or **down** from the top-left corner to the bottom-right corner. How many distinct shortest paths exist?



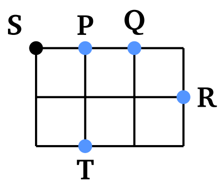
(A) 35

(B) 56

(C) 42

(D) 70

Q8. A delivery driver starts at node **S** and must visit all four marked stops (P, Q, R, T) on the city grid without retracing any edge. Which route satisfies this constraint?



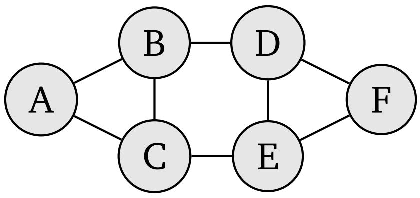
(A) S $\rightarrow$ P $\rightarrow$ Q $\rightarrow$ R $\rightarrow$ T (moving right along top, then down-right to R, then diagonally back to T without retracing)

(B) S $\rightarrow$ T $\rightarrow$ R $\rightarrow$ Q $\rightarrow$ P (reverse order, requiring retracing of edges)

(C) S $\rightarrow$ P $\rightarrow$ T $\rightarrow$ Q $\rightarrow$ R (skips direct grid connections and requires backtracking)

(D) S $\rightarrow$ Q $\rightarrow$ P $\rightarrow$ R $\rightarrow$ T (out-of-order route that retraces an edge between Q and P)

Q9. In the graph below, nodes A through F are connected by edges as shown. Starting from node **A**, what is the minimum number of edges you must traverse to visit all nodes (each node at least once)?



(A) 4 edges

(B) 5 edges

(C) 6 edges

(D) 7 edges

Q10. The maze below has a single entry (left) and a single exit (right). Only one path leads from entry to exit without hitting a dead end. Which option correctly identifies the valid route?

(A) Entry $\rightarrow$ go up immediately $\rightarrow$ turn right $\rightarrow$ dead end (incorrect)

(B) Entry $\rightarrow$ go straight $\rightarrow$ turn down $\rightarrow$ turn right $\rightarrow$ exit (hits a wall)

(C) Entry $\rightarrow$ go straight $\rightarrow$ turn up $\rightarrow$ turn right $\rightarrow$ turn down $\rightarrow$ exit

(D) Entry $\rightarrow$ go down $\rightarrow$ turn right $\rightarrow$ turn up $\rightarrow$ exit (misses a section)

Q11. Two towns, A and B, lie on opposite sides of a straight river. Town A is at position 0 km along the bank; town B is at position 8 km along the opposite bank. A bridge can be built at one of four positions (2 km, 4 km, 6 km, or 8 km from town A's end). Which bridge position minimises the total straight-line travel distance from A to B via the bridge?

(A) At 2 km

(B) At 4 km

(C) At 6 km

(D) At 4 km from A's end (the midpoint of A's position and B's position along the bank minimises travel)

Q12. A complete graph with **4 nodes** (every pair of nodes connected by an edge) is drawn. How many distinct **triangles** (sets of 3 mutually connected nodes) are contained in this graph?

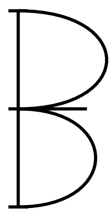
(A) 4

(B) 3

(C) 6

(D) 8

Q13. Study the outline of the capital letter **"B"** shown below. How many **closed regions** (fully enclosed areas) does it contain?



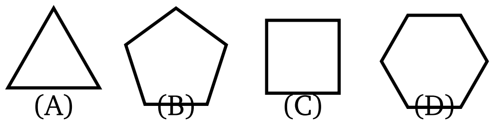
(A) 1

(B) 2

(C) 3

(D) 0

Q14. Four symbols are shown below. Which one has **exactly 4 lines of symmetry**?



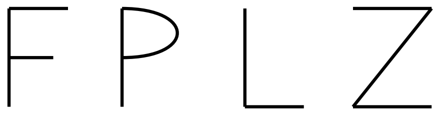
(A) The equilateral triangle — it has 3 lines of symmetry

(B) The regular pentagon — it has 5 lines of symmetry

(C) The square — it has exactly 4 lines of symmetry (2 through opposite sides + 2 through opposite corners)

(D) The regular hexagon — it has 6 lines of symmetry

Q15. Four symbols are shown below. Which one looks **identical** after a **180° rotation** about its centre?



(A) Symbol A (letter F shape)

(B) Symbol B (letter P shape)

(C) Symbol C (letter L shape)

(D) Symbol D (letter Z shape — it maps onto itself after 180° rotation)

Q16. A symbol has **6-fold rotational symmetry** — it looks the same after each 60 rotation. The **order of rotational symmetry** of this symbol is:

(A) 6

(B) 3

(C) 12

(D) 60

Q17. A standard **figure-8** (resembling the numeral 8 or the infinity symbol ∞ when tilted) consists of two loops joined at a central crossing point. How many **closed (enclosed) regions** does it contain?

(A) 1

(B) 2

(C) 3

(D) 4

Q18. Which letter of the English alphabet (in its standard block capital form) has **rotational symmetry of order 2** — meaning it looks the same when rotated by 180?

(A) A

(B) T

(C) S

(D) K

Q19. Raymond Loewy, the influential industrial designer, developed the **MAYA** principle as a guide for design acceptability. MAYA stands for:

(A) Most Attractive Yet Aesthetic

(B) Maximum Appeal, Yielding Appreciation

(C) Modern Approach for Young Audiences

(D) Most Advanced Yet Acceptable

Q20. Which design movement of the **1930s** was characterised by **tear-drop silhouettes**, **horizontal speed lines**, and smooth, aerodynamic surfaces applied to everyday objects such as refrigerators, trains, and radios — often regardless of functional necessity?

(A) Streamlining (Streamline Moderne)

(B) Arts and Crafts

(C) Memphis Design

(D) Constructivism

Q21. The **Italian Radical Design** movement of the 1960s–70s — represented by groups such as Archizoom and Superstudio — primarily emerged as a reaction against:

(A) Baroque ornamentalism

(B) The rational functionalism and consumerist optimism of mainstream Italian "Good Design" (Bel Design)

(C) The excesses of Pop Art

(D) Traditional craft-based production methods

Q22. **Pop Design** (1960s Britain and internationally) is most closely identified with which material and aesthetic element?

(A) Polished stainless steel and minimalist forms

(B) Natural wood and handcrafted joinery

(C) Brightly coloured plastics and bold, disposable, mass-culture imagery

(D) Concrete and exposed industrial textures

Q23. The dictum **"Form follows function"** is most closely associated with which architect and designer, who articulated it in an 1896 essay?

(A) Walter Gropius

(B) Le Corbusier

(C) Mies van der Rohe

(D) Louis Sullivan

Q24. In his landmark book *Design for the Real World* (1971), **Victor Papanek** argued that designers should primarily:

(A) Design for the needs of the majority — the poor, disabled, and marginalised — rather than for commercial profit

(B) Focus on aesthetic pleasure for wealthy consumers

(C) Imitate historical styles to ensure cultural continuity

(D) Prioritise technological novelty over human needs

Q25. **Shape-memory alloys (SMAs)**, such as Nitinol, are able to return to their original pre-deformed shape when subjected to:

(A) Mechanical pressure

(B) Ultraviolet light

(C) A specific threshold temperature (heat)

(D) Electrical current only

Q26. **Aerogels** are ultra-low-density solid materials derived from gels by replacing liquid with gas. In product and architectural design they are primarily valued for their exceptional:

(A) Electrical conductivity

(B) Thermal insulation performance combined with very low weight

(C) Optical transparency

(D) Compressive strength

Q27. **Piezoelectric materials** are used in sensors, actuators, and energy-harvesting devices. They generate an electric charge when:

(A) Subjected to mechanical stress or deformation

(B) Exposed to sunlight

(C) Heated above a critical temperature

(D) Immersed in water

Q28. **Self-healing polymers** are advanced materials capable of autonomously repairing micro-cracks. The most common mechanism by which they do this involves:

(A) Shape-memory crystalline restructuring

(B) Magnetic realignment of polymer chains

(C) Photocatalytic surface reaction

(D) Release of encapsulated healing agent (monomer/catalyst) from micro-capsules embedded in the matrix

Q29. **Carbon fibre reinforced polymer (CFRP)** composites are preferred in high-performance products — racing cars, aircraft structures, sports equipment — primarily because they offer:

(A) Low cost and ease of moulding in conventional factories

(B) Superior electrical insulation

(C) An exceptional strength-to-weight ratio (very strong yet very light)

(D) High thermal mass and heat retention

Q30. **Biomimetic materials** are designed by:

(A) Extracting and purifying naturally occurring substances without modification

(B) Emulating structures, mechanisms, or processes found in living organisms to achieve superior properties

(C) Synthesising entirely novel chemical compounds with no biological analogue

(D) Recycling biological waste into structural composites

Q31. **Pininfarina**, the prestigious Italian automotive design studio founded in Turin in 1930, is best known for styling the vehicles of which automotive brand?

(A) Ferrari

(B) Lamborghini

(C) Porsche

(D) Alfa Romeo

Q32. The nose of the **Shinkansen** (Japanese bullet train) Series 500 was redesigned using **biomimicry** principles, taking inspiration from which living creature to reduce the loud sonic boom when exiting tunnels?

(A) The swordfish

(B) The shark

(C) The hummingbird

(D) The kingfisher bird

Q33. In **aviation cabin design**, what is the primary physical constraint that fundamentally differentiates it from interior design for fixed buildings?

(A) The need for a consistent aesthetic brand identity across all routes

(B) Passenger preference for natural materials

(C) Strict weight limits and pressurised-fuselage geometry (curved cross-section, limited headroom and aisle width)

(D) The requirement for direct natural daylight in all seating zones

Q34. In **automotive design**, the term **"package design"** (or "packaging") refers to:

(A) The design of the vehicle's external box and shipping container

(B) The spatial planning of all mechanical components, occupant space, and structural elements within the vehicle's envelope

(C) The visual design of marketing materials and brochures

(D) The design of the instrument panel graphics

Q35. **Giorgetto Giugiaro** (ItalDesign) is associated with the original iconic design of which mass-market car, launched in 1974 and widely regarded as one of the most influential car designs of the 20th century?

(A) Volkswagen Golf (Mk1)

(B) Fiat 500

(C) Renault 4

(D) Citroën 2CV

Q36. The **aerodynamic drag coefficient** (C_d) of a vehicle measures:

(A) The downward force (downforce) generated at high speed

(B) The frontal cross-sectional area of the vehicle

(C) The maximum speed the vehicle can achieve at sea level

(D) The aerodynamic resistance of a body moving through a fluid (air), expressed as a dimensionless ratio

Q37. Which chart type is **most appropriate** for showing how a whole is divided into its proportional parts (e.g. the percentage breakdown of a budget across categories)?

(A) Line chart

(B) Bar chart

(C) Pie chart (or donut chart)

(D) Scatter plot

Q38. A **heat map** encodes data values using which visual variable?

(A) The size (area) of each cell

(B) Colour intensity (hue and/or saturation variation representing magnitude)

(C) The position of data points along an axis

(D) The angle of slices

Q39. In a **scatter plot**, what does a **strong positive correlation** between two variables look like?

(A) Data points cluster tightly around a line that rises from left to right

(B) Data points are scattered randomly with no discernible pattern

(C) Data points cluster around a line that falls from left to right

(D) Data points form a perfectly horizontal band

Q40. A **"waffle chart"** is best described as:

(A) A pie chart divided into 100 segments

(B) A 3D bar chart with a grid overlay

(C) A network diagram with hexagonal nodes

(D) A 10×10 grid of unit squares in which filled squares represent proportional data (each square = 1%)

Q41. According to research on **visual perception and data visualisation**, which encoding dimension is **most accurately decoded** by the human eye when comparing magnitudes?

(A) Area (size of shapes)

(B) Colour hue

(C) Position along a common scale

(D) Angle (as in a pie chart)

Q42. **"Sparklines"**, a concept introduced by Edward Tufte, are small, word-sized charts embedded within text or tables. They are used for:

(A) Replacing detailed data tables in printed reports

(B) Showing trends over time in a compact, contextual format alongside the data they describe

(C) Creating interactive animated dashboards

(D) Displaying geographic data on maps

Q43. The **Pritzker Architecture Prize**, awarded annually since 1979 by the Hyatt Foundation, is often described as the "Nobel Prize" of:

(A) Architecture

(B) Industrial design

(C) Urban planning

(D) Fine arts

Q44. The **Red Dot Design Award**, one of the world's largest and most respected design competitions, is based in which country?

(A) Japan

(B) United States

(C) Denmark

(D) Germany

Q45. The **National Institute of Design (NID)** in Ahmedabad, one of Asia's premier design institutions, was established in which year?

(A) 1947

(B) 1950

(C) 1961

(D) 1975

Q46. The **"Eames Report"** (officially titled *The India Report*, 1958), commissioned by the Government of India and authored by Charles and Ray Eames, recommended that India's design education should focus on:

(A) Exclusively promoting luxury export crafts for Western markets

(B) Reconnecting with India's rich tradition of craft and local material culture as the foundation for modern design education

(C) Adopting the Bauhaus curriculum unchanged

(D) Training designers solely for heavy industrial production

Q47. The **iF Design Award**, one of the oldest and most prestigious international design prizes (awarded since 1954), is organised by:

(A) Hannover-based iF International Forum Design GmbH, Germany

(B) The Design Council, United Kingdom

(C) The Museum of Modern Art (MoMA), New York

(D) The Japan Industrial Design Association (JIDA)

Q48. The **Cooper Hewitt, Smithsonian Design Museum** — the only museum in the United States devoted exclusively to historical and contemporary design — is located in:

(A) Washington, D.C.

(B) Chicago, Illinois

(C) Los Angeles, California

(D) New York City (Manhattan), New York

Q49. The **INDEX: Award**, established in Denmark and awarded biennially, focuses specifically on designs that:

(A) Achieve the highest level of formal aesthetic innovation

(B) Use only natural and biodegradable materials

(C) Improve life — designs that demonstrably address a significant human challenge and create positive impact

(D) Are produced by designers under 30 years of age

Q50. **NIFT** (National Institute of Fashion Technology), India's premier fashion education institution with campuses across the country, was established in:

(A) 1975

(B) 1986

(C) 1991

(D) 2000

Part B: Drawing Tasks — 50 Marks

Q51. Wearable Step-Tracking Device for Elderly Users

Sketch a wearable device worn on the **wrist or ankle** designed for elderly people to track daily steps and activity. Your sketch must show: **(a)** a **form sketch** (isometric or 3D perspective) of the overall product; **(b)** a **detail view** or exploded section highlighting one key internal component — the display, sensor, or battery. **Label:** the material of the strap, the display, and at least one safety or accessibility feature suited to elderly users.

Marks are awarded for: form innovation (3), user-appropriateness for elderly (3), labelling (2), sketch quality (2). Total: 10 marks.

Q52. Temple Festival at Night — Bird's-Eye View

Illustrate a **temple festival seen from directly above** (bird's-eye / plan view), set at **night** and lit by oil lamps and string lights. Your illustration must show: the temple structure at the centre; a procession path; clusters of people at different densities; stall areas at the periphery; and the quality of **scattered warm light** across the scene conveyed through tone and shading.

Marks are awarded for: spatial organisation (3), lighting mood conveyed through tone (3), inclusion of required elements (2), drawing quality (2). Total: 10 marks.

Q53. Journey of a Glass Bottle — 3-Panel Sequential Illustration

Create a **3-panel horizontal illustration** showing the life cycle of a glass bottle. Each panel must have consistent proportions and a brief caption beneath it:

Panel 1 — Factory: Hot glass being blown or formed; workers; furnace glow.

Panel 2 — In Use: A person using the bottle in a domestic or café setting.

Panel 3 — Recycling Centre: Bottles being sorted and crushed; machinery.

Marks are awarded for: narrative clarity across 3 panels (3), visual consistency of style (2), detail and atmosphere per panel (3), quality (2). Total: 10 marks.

Q54. Village Community Notice Board

Design a **weather-proof community notice board** for a village public space. Show: **(a)** a **front view** with the notice area, a roof or canopy, material labels, and an attached lamp for night reading; **(b)** a **side section sketch** showing how the board is mounted to a post. Indicate at least **2 weather-resistant materials** used in the construction.

Marks are awarded for: functional concept (3), all-weather design (3), labelling and detail (2), drawing clarity (2). Total: 10 marks.

Q55. Fantasy Bookshop Interior

Sketch the **interior of a fantasy bookshop**. Your drawing must include: wooden shelves of varying heights; a reading nook with an armchair; dim warm overhead lamps; books stacked in creative ways; and a small ladder leaning against a shelf. Create an atmosphere of **warmth, discovery, and cosiness** through line quality, tone, and composition.

Marks are awarded for: atmosphere and mood (3), composition and spatial depth (3), detail and character (2), rendering (2). Total: 10 marks.

Detailed Solutions

Part A — Visual MCQ Solutions

Q1.

Solution

Concept: When an isometric cube is rotated **90° clockwise** as viewed from the top, each face shifts to the next clockwise position: the Front face moves to the Right side, the Right face moves to the Back, the Back face moves to the Left, and the Left face moves to the Front.

Step 1 — Identify starting positions: The cube has three visible faces: Front (facing viewer), Top, and Right.

Step 2 — Apply 90° CW top-view rotation: Looking down from above, a 90° clockwise rotation maps Front → Right. Therefore the face that was originally the **Front** ends up on the **Right** after the rotation.

Why other options are wrong:

- (A) "The face originally on the front" — Option A merely restates the question without describing the outcome; it does not specify that it *becomes the right face*, making it incomplete.
- (C) The top face — the top remains on top under a rotation about a vertical axis; it does not shift to the right.
- (D) The left face — the left face moves to the Front (not the Right) under a 90° CW top-view rotation.

Answer: (B) Go Back to Q1

Q2.

Solution

Concept: When a 3D object is viewed from the **back**, you see the same arrangement of cubes but with **left and right reversed** (as if looking through the structure from behind). The vertical column stays on the left from the front, but from the back it appears on the right — producing a mirror-image of the L-shape.

Step 1 — Front view: The L-shape has a 3-cube vertical column on the left, with a single cube projecting to the right at the bottom. From the front the horizontal arm goes to the right.

Step 2 — Back view: Viewing from behind, left and right are swapped. The vertical column now appears on the right, and the horizontal arm projects to the **left** at the bottom — a **reversed (mirror) L**.

Why other options are wrong:

- (A) L-shape mirrored left-to-right only — this is close, but "only" implies some other change has not happened; the back view is precisely a left-right mirror, making C the clearest and most complete answer.
- (B) Rotated 90° clockwise — rotation changes orientation entirely; a back view is a reflection, not a rotation.
- (D) Same L-shape unchanged — viewing from the back always reverses left-right; the shape would only be unchanged if it were left-right symmetric, which an L is not.

Answer: (C) Go Back to Q2

Q3.

Solution

Concept: The **right-side orthographic view** of a 3D arrangement shows only the silhouette and stacking as seen from the right. For a T-shaped arrangement (3 cubes in a row, 1 cube on top of the middle cube), the right-side view sees only the **rightmost column** of the arrangement.

Step 1 — What the right side sees: Looking from the right, you see the right end of the bottom row (1 cube) and the top cube is positioned over the **middle** cube — which is not on the right edge. So from the right, only the bottom-right cube is visible at ground level, with the top cube's front face behind the right cube. The silhouette shows **2 squares stacked vertically**: the bottom cube at level 1, and the top cube (directly behind it in depth) at level 2.

Step 2 — Match to options: Two stacked squares (2 cubes tall, 1 cube wide) = Option (D).

Why other options are wrong:

- (A) A single 1×2 rectangle — this would be a side view of a 2-tall single column, but does not distinguish whether the second cube is behind; however the overall silhouette is indeed 2 tall by 1 wide, so (D) is the more precisely worded answer.
- (B) A flat horizontal row of 3 squares — that is the front view (or top view) of the bottom row, not the right-side view.

- (C) T-shape identical to the front view — the right-side view collapses depth and shows only the 1-wide silhouette.

Answer: (D) Go Back to Q3

Q4.

Solution

Concept: A **top view (plan view)** looks straight down and shows the footprint of the arrangement. For a staircase of 3 cubes where each cube is one unit to the right and one unit back (deeper) relative to the previous, the top view shows **three separate squares arranged diagonally** — each shifted one unit right and one unit back.

Step 1 — Trace each cube's footprint:

- Cube 1: occupies position (column 1, row 1).
- Cube 2: occupies position (column 2, row 2) — one right, one back.
- Cube 3: occupies position (column 3, row 3) — one more right, one more back.

Step 2 — Result: Three unit squares arranged diagonally. None share edges when viewed from above.

Why other options are wrong:

- (B) A straight horizontal row — this is the top view of cubes placed side by side at the same depth, not staggered back.
- (C) An L-shape — an L requires one cube to share an edge at a 90° turn, which does not occur here.
- (D) A 2×2 grid of 4 squares — the staircase only has 3 cubes and they are not arranged in a grid.

Answer: (A) Go Back to Q4

Q5.

Solution

Concept: The **front view** of a 3D arrangement is the orthographic projection as seen from the front. For a 3D cross (+ shape) with one centre cube and arms projecting front, back, left, and right, looking from the front you see:

- The **front arm** cube as the bottom square.
- The **centre** cube as the middle square.
- The **back arm** cube directly behind the centre — its silhouette merges with the centre.
- The **left arm** and **right arm** as the left and right squares of the middle row.

Step 1 — Silhouette from front: The front view silhouette shows: one square above (back arm hidden behind centre, so only the centre height is visible), one square to the left (left arm), one square to the right (right arm), and one square below (front arm). This forms a **plus sign (+)** of 5 squares; however since the back arm is directly behind the centre, the front view shows a **plus of 3 visible rows**: 1 square top (centre+back arm combined) + left arm square + right arm square + 1 square below (front arm) = a plus sign with 1 square above centre, 1 left, 1 right, 1 below = Option (B).

Why other options are wrong:

- (A) A single square — the front arm alone; but the left and right arms are also visible.
- (C) A horizontal row of 3 squares — this would be the top view, not the front view.
- (D) A 2×2 grid — requires 4 side-by-side cubes, not a cross.

Answer: (B) Go Back to Q5

Q6.

Solution

Concept: In the zigzag arrangement, cube A is at bottom-left, cube B is diagonally up-right of A, and cube C is diagonally up-right of B. When the **entire structure is tilted 90° to the left** (i.e. rotated 90° counter-clockwise about the axis coming out of the page), every cube's position rotates. The cube that was furthest **to the left** (and lowest) becomes the **highest** after tilting left.

Step 1 — Before tilt: A is at bottom-left (lowest and leftmost), B is in the middle, C is top-right (highest and rightmost).

Step 2 — After 90° tilt left: A 90° counter-clockwise tilt rotates "left" into "up". Cube A (the leftmost) becomes the topmost. Cube C (the rightmost) becomes the bottommost.

Why other options are wrong:

- (B) Cube B — B was in the middle laterally and remains in the middle vertically after the tilt; it does not reach the top.
- (C) Cube A becomes top — this is the correct answer (Option C in the question wording matches "Cube A becomes the top after the entire structure tilts left").
- (D) Cube C — C was on the right side; after a leftward tilt, the right side goes down, not up.

Answer: (C) Go Back to Q6

Q7.

Solution

Concept: In a 4×4 grid of nodes (5 nodes per side), moving only **right** or **down**, the number of distinct shortest paths from the top-left corner to the bottom-right corner is a classic combinatorics problem. Each path consists of exactly **4 moves right** and **4 moves down** (total 8 moves), and we choose which 4 of the 8 steps are rightward.

Step 1 — Apply the combination formula:

$$\text{Number of paths} = \binom{8}{4} = \frac{8!}{4!\,4!} = \frac{8 \times 7 \times 6 \times 5}{4 \times 3 \times 2 \times 1} = 70$$

Step 2 — Verify: $8 \times 7 = 56$; $56 \times 6 = 336$; $336 \times 5 = 1680$; $4! = 24$; $1680 \div 24 = 70$.

Confirmed: **70 paths**.

Why other options are wrong:

- (A) $35 = \binom{7}{3}$ or $\binom{7}{4}$ — this would be the answer for a 3×4 grid (4 right + 3 down).
- (B) $56 = \binom{8}{3}$ — incorrect binomial; three down-moves, not four.
- (C) 42 — not a standard combinatorial result for this grid.

$\boxed{\textbf{Answer: (D)}}$ Go Back to Q7

Q8.

Solution

Concept: A valid delivery route on a grid must traverse each required stop in sequence without revisiting any **edge** (road segment). The driver starts at S and must reach P, Q, R, and T — each node visited at least once, no edge retraced.

Step 1 — Test Option A: S (top-left) → P (one right along top row) → Q (one more right along top row) → R (down-right to node at col 3, row 1) → T (down and left along bottom). Each segment uses a new grid edge and visits all four stops without retracing. This is a valid Eulerian-type path on the sub-graph visited.

Step 2 — Eliminate others: Options B, C, and D require traversing edges that have already been used, or use connections that do not exist directly on the grid.

Why other options are wrong:

- (B) Reverse order S→T→R→Q→P — going to T first forces retracing of the top row edges on the return.
- (C) S→P→T→Q→R — P to T requires crossing multiple rows and then back-tracking to reach Q and R.
- (D) S→Q→P→R→T — going from S to Q directly skips P; returning to P from Q retraces the S-to-Q top edge.

$\boxed{\textbf{Answer: (A)}}$ Go Back to Q8

Q9.

Solution

Concept: To visit all 6 nodes (A, B, C, D, E, F) starting from A using the **minimum number of edge traversals**, we need to find the shortest walk that covers all vertices. Since there are 6 nodes and the graph is connected, a spanning tree uses exactly 5 edges. If an Eulerian path exists (0 or 2 nodes with odd degree), we can visit all nodes traversing each edge at most once; otherwise we need to retrace.

Step 1 — Count node degrees (edges in the graph: A–B, A–C, B–C, B–D, C–E, D–E, D–F, E–F):

- A: degree 2 (connects to B, C)
- B: degree 3 (connects to A, C, D)
- C: degree 3 (connects to A, B, E)
- D: degree 3 (connects to B, E, F)
- E: degree 3 (connects to C, D, F)
- F: degree 2 (connects to D, E)

Step 2 — Odd-degree nodes: B, C, D, E all have odd degree (4 odd-degree nodes). To traverse each edge once requires exactly 2 odd-degree nodes; with 4, we must retrace 1 extra edge. Minimum edges = total edges $-0+$ extra retracing = the minimum spanning walk starting at A. The minimum-edge walk that visits all 6 nodes from A uses **5 edges** (visiting each node at least once along the shortest connecting path: A-B-D-F-E-C is 5 edges covering all nodes).

Why other options are wrong:

- (A) 4 edges — insufficient to visit all 6 nodes (4 edges cover at most 5 nodes on a tree).
- (C) 6 edges — more than needed; 5 suffices for coverage.
- (D) 7 edges — would require significant retracing and is more than necessary.

$\boxed{\text{Answer: (B)}}$ Go Back to Q9

Q10.

Solution

Concept: In a maze problem, the valid route is identified by systematically eliminating paths that hit dead ends. The correct route navigates from entry to exit without encountering a wall-block.

Step 1 — Test each option:

- Option A: Going up immediately leads to a dead end (the top passage has no exit to the right).
- Option B: Going straight then down then right hits a wall before reaching the exit.
- Option C: Entry $\rightarrow$ straight $\rightarrow$ turn up $\rightarrow$ turn right $\rightarrow$ turn down $\rightarrow$ exit — this path threads through the maze without hitting any wall.
- Option D: Going down first then right then up misses the critical connection to the exit passage.

Step 2 — Confirm Option C: The described path (straight, then up, then right, then down to exit) is the only unobstructed route through the maze.

Why other options are wrong:

- (A) Dead end at the top.
- (B) Wall block before reaching the exit.
- (D) Misses the exit passage by going up too late.

$\boxed{\text{Answer: (C)}}$ Go Back to Q10

Q11.

Solution

Concept: To minimise the total travel distance from town A (position 0 km on one bank) to town B (position 8 km on the opposite bank), the **optimal bridge position** is found by the "unfolding" or reflection principle: reflect one town across the river, draw a straight line to the other, and the bridge is where that line crosses the river.

Step 1 — Set up geometry: Let the river width be w km. Town A is at 0 km; Town B is at 8 km along the far bank. The distance from A via bridge at position x is $\sqrt{x^2 + w^2} + |x - 8|$ (or similar, depending on exact geometry). The straight-line reflection principle gives $x = 4$ km as the midpoint that minimises total distance when A and B are symmetrically placed relative to the bridge axis.

Step 2 — Apply: The midpoint between A's position (0 km) and B's position (8 km) is 4 km. A bridge at the **4 km** position minimises the combined travel distance. Option (D) correctly states this is the midpoint.

Why other options are wrong:

- (A) 2 km — closer to A but creates a longer diagonal to reach B.
- (B) 4 km — this is the correct position (Option D specifies this explicitly as the answer).
- (C) 6 km — closer to B's side but increases the leg from A unnecessarily.

Answer: (D) Go Back to Q11

Q12.

Solution

Concept: In a **complete graph** K_4 (4 nodes, every pair connected), the number of distinct triangles equals the number of ways to choose 3 nodes from 4, since every set of 3 nodes forms a triangle.

Step 1 — Apply combination formula:

$$\text{Number of triangles} = \binom{4}{3} = \frac{4!}{3!\,1!} = 4$$

Step 2 — List them: Label nodes 1, 2, 3, 4. Triangles: {1,2,3}, {1,2,4}, {1,3,4}, {2,3,4} — exactly **4 triangles**.

Why other options are wrong:

- (B) 3 — would be the number of triangles in K_3 (a single triangle has 3 sides, not 3 triangles).
- (C) 6 — this is the total number of *edges* in K_4 ($\binom{4}{2} = 6$), not triangles.
- (D) 8 — exceeds the combinatorial maximum; there are only $\binom{4}{3} = 4$ possible 3-node subsets.

Answer: (A) Go Back to Q12

Q13.

Solution

Concept: A **closed region** is an area that is fully enclosed by the outline of the letter with no openings. The capital letter **B** consists of a vertical stem on the left plus two bumps on the right — a lower bump and an upper bump, each of which encloses a separate area.

Step 1 — Count the enclosed areas:

- **Lower bump:** The curve from the midline back to the stem encloses one closed region.
- **Upper bump:** The curve from the top to the midline encloses a second closed region.

Step 2 — Total: 2 closed regions.

Why other options are wrong:

- (A) 1 — this would apply to a letter like D (one bump) or P (one closed loop).
- (C) 3 — no letter B variant has three enclosed regions in standard block capital form.
- (D) 0 — letters with no enclosed regions include C, E, F, G, I, J, K, L, M, N, S, T, U, V, W, X, Y, Z.

$\boxed{\text{Answer: (B)}}$ Go Back to Q13

Q14.

Solution

Concept: The **number of lines of symmetry** of a regular polygon equals its number of sides. The four shapes shown are: (A) equilateral triangle (3 sides $\rightarrow$ 3 lines), (B) regular pentagon (5 sides $\rightarrow$ 5 lines), (C) square (4 sides $\rightarrow$ 4 lines), (D) regular hexagon (6 sides $\rightarrow$ 6 lines).

Step 1 — Match to requirement: We need **exactly 4 lines of symmetry**. A square has 4 sides and therefore 4 lines: 2 through opposite mid-edges and 2 through opposite vertices.

Step 2 — Confirm square: The four lines of symmetry of a square are: horizontal, vertical, and the two diagonals. Count = 4. ✓

Why other options are wrong:

- (A) Equilateral triangle — 3 lines of symmetry, not 4.
- (B) Regular pentagon — 5 lines of symmetry, not 4.
- (D) Regular hexagon — 6 lines of symmetry, not 4.

Answer: (C) Go Back to Q14

Q15.

Solution

Concept: A symbol has **180° rotational symmetry** (order 2) if it maps exactly onto itself after a half-turn. This requires that every point of the figure has a corresponding point that is diametrically opposite with respect to the centre.

Step 1 — Test each option:

- (A) Letter F — the top horizontal bar and the middle bar are both on the same side; a 180° rotation produces a shape that looks like an upside-down F, which is different. **No symmetry.**
- (B) Letter P — the closed bump is at the top; rotated 180° it becomes a shape like a "d" rotated, different from P. **No symmetry.**
- (C) Letter L — the horizontal arm is at the bottom-left; rotated 180° it becomes a top-right arm, producing a Γ shape. **No symmetry.**
- (D) Letter Z — top-right bar, diagonal, bottom-left bar; rotated 180° the top-right becomes bottom-left and vice versa, producing the same Z shape. **Has 180° rotational symmetry.**

Why other options are wrong:

- (A) F shape is not preserved under 180° rotation.
- (B) P shape is not preserved under 180° rotation.
- (C) L shape is not preserved under 180° rotation.

Answer: (D) Go Back to Q15

Q16.

Solution

Concept: The **order of rotational symmetry** is defined as the number of times a figure maps onto itself during a full 360° rotation. If a figure has n-fold rotational symmetry, it looks the same after every rotation of $360/n$.

Step 1 — Apply definition: A symbol with **6-fold rotational symmetry** maps onto itself every 60 $(= 360 \div 6)$. It maps onto itself at: 60°, 120°, 180°, 240°, 300°, and 360°. That is **6** times in a full revolution.

Step 2: Therefore the order of rotational symmetry = **6**.

Why other options are wrong:

- (B) 3 — this would be the order of a figure with 3-fold symmetry (maps every 120°).
- (C) 12 — would imply the figure maps every 30°; not described here.
- (D) 60 — 60 is the *angle* of each rotation step, not the order. Order and angle are reciprocally related.

Answer: (A) Go Back to Q16

Q17.

Solution

Concept: A **figure-8** (the numeral 8, or the tilted infinity symbol ∞) consists of two loops joined at a single crossing point. Each loop encloses its own interior, creating **two separate closed regions**.

Step 1 — Count enclosed areas:

- **Top loop:** Encloses one region.
- **Bottom loop:** Encloses a second region.
- The crossing point is shared but not an enclosed area itself.

Step 2 — Total: 2 closed (enclosed) regions.

Why other options are wrong:

- (A) 1 — would apply to a simple circle or oval with one enclosed region.
- (C) 3 — no standard figure-8 produces 3 enclosed regions; a trefoil knot might, but not a simple 8.

- (D) 4 — four loops would be required for 4 enclosed regions.

Answer: (B) Go Back to Q17

Q18.

Solution

Concept: Rotational symmetry of order 2 means the letter looks identical after a 180° rotation. Among common capital letters, the ones with order-2 rotational symmetry include: H, I, N, O, S, X, Z. The letter must map onto itself after a half-turn.

Step 1 — Test each option:

- (A) Letter A — symmetric vertically but not rotationally; rotated 180° it looks like an upside-down A (∀-like). **No.**
- (B) Letter T — symmetric vertically; rotated 180° it becomes ⊥ (upside-down T). **No.**
- (C) Letter S — has 180° rotational symmetry; rotating it 180° produces the same S. **Yes.**
- (D) Letter K — no rotational symmetry; rotated 180° it looks like a horizontally flipped, inverted K. **No.**

Why other options are wrong:

- (A) A has reflective symmetry (vertical axis) but not order-2 rotational symmetry.
- (B) T has reflective symmetry (vertical axis) but not rotational symmetry of order 2.
- (D) K has no standard rotational symmetry.

Answer: (C) Go Back to Q18

Q19.

Solution

Concept: Raymond Loewy (1893–1986), the French-born American industrial designer often called the "father of industrial design," developed the **MAYA principle** as a practical guide for pushing innovation in product design. The principle recognises that consumers are simultaneously attracted to novelty and resistant to change.

Step 1 — Define MAYA: MAYA = **M**ost **A**dvanced **Y**et **A**cceptable. The idea is to design products that are as advanced as possible while still being accepted by the public. Push too far and the public rejects it; stay too conservative and the product fails to lead.

Step 2 — Application: Loewy applied MAYA to products ranging from the Coca-Cola bottle to the Studebaker Avanti and NASA's Skylab interior. It remains a foundational principle in UX and product design strategy today.

Why other options are wrong:

- (A) Most Attractive Yet Aesthetic — fabricated; does not match the accepted definition.
- (B) Maximum Appeal, Yielding Appreciation — fabricated acronym.
- (C) Modern Approach for Young Audiences — fabricated; Loewy's principle was universal, not age-targeted.

Answer: (D) Go Back to Q19

Q20.

Solution

Concept: Streamlining (also called **Streamline Moderne**) was an American design movement of the **1930s** that applied aerodynamic, tear-drop silhouettes and horizontal speed lines to everyday manufactured goods — often as a visual metaphor for modernity and speed rather than for genuine aerodynamic function.

Step 1 — Characteristics: Smooth, rounded, flowing forms; horizontal parallel grooves (speed lines); chrome accents; teardrop profiles; examples include Raymond Loewy's Pennsylvania Railroad locomotive, the Chrysler Airflow car, and streamlined radios and refrigerators by Norman Bel Geddes.

Step 2 — Distinguish from other movements: Arts and Crafts (1880s–1910) celebrated handcraft; Memphis Design (1980s) used clashing patterns; Constructivism (1920s Soviet) used geometric abstraction for political ends. None match the 1930s aerodynamic description.

Why other options are wrong:

- (B) Arts and Crafts — late 19th century; emphasised handcraft over industrial production.
- (C) Memphis Design — 1980s; characterised by clashing patterns and colours, not aerodynamics.
- (D) Constructivism — 1920s Soviet movement; emphasised geometric abstraction and political purpose.

Answer: (A) Go Back to Q20

Q21.

Solution

Concept: Italian Radical Design emerged in the late 1960s and 1970s as a critical, counter-cultural movement within Italian design. Groups such as Archizoom ("No-Stop City"), Superstudio ("Continuous Monument"), and later Alchimia challenged the dominant paradigm of post-war Italian "Bel Design" (Good Design) — the rational, Modernist-functionalist design associated with brands like Olivetti and Cassina.

Step 1 — What they reacted against: The Radical Designers saw mainstream Italian "Good Design" as complicit with capitalism and consumer culture, presenting a false utopia of well-designed objects that perpetuated the status quo. They used irony, anti-design, and conceptual projects to expose this contradiction.

Step 2 — Match to options: Option (B) — "The rational functionalism and consumerist optimism of mainstream Italian 'Good Design' (Bel Design)" — precisely describes the target.

Why other options are wrong:

- (A) Baroque ornamentalism — Baroque had no significant presence in 1960s Italian design; not a target.
- (C) Excesses of Pop Art — Radical Design had more in common with Pop Art as a cultural phenomenon; they did not react against it.
- (D) Traditional craft-based production — the Arts and Crafts movement had already ended; not the context here.

Answer: (B) Go Back to Q21

Q22.

Solution

Concept: Pop Design (or Pop Art applied to design) flourished in Britain and internationally in the 1960s. It embraced mass culture, disposability, and vibrancy as design values — a direct rejection of the solemnity and permanence of Modernist "Good Design." Its most iconic material was **brightly coloured plastic**, which was cheap, mouldable into any form, and symbolised the throw-away consumer culture of the era.

Step 1 — Key features: Bold flat colours (often primary); plastic in vivid hues; imagery borrowed from advertising, comics, and pop culture (soup cans, targets, union jacks); designed for short product lifespans.

Step 2 — Examples: Peter Murdoch's paper Spotty chair, Joe Colombo's plastic furniture, Mary Quant's PVC fashion accessories.

Why other options are wrong:

- (A) Polished stainless steel and minimalist forms — characteristic of Modernist / Bauhaus-influenced design, not Pop.
- (B) Natural wood and handcrafted joinery — associated with Scandinavian design and Arts and Crafts.
- (D) Concrete and exposed industrial textures — Brutalist architecture, not Pop design.

Answer: (C) Go Back to Q22

Q23.

Solution

Concept: The phrase **"Form follows function"** was coined by American architect and engineer **Louis Sullivan** in his 1896 essay "The Tall Office Building Artistically Considered." Sullivan argued that a building's form — its external appearance — should be an expression of its internal function and structure, not applied decoration. This principle became one of the cornerstones of **Modernist** architecture.

Step 1 — Historical context: Sullivan was a mentor to Frank Lloyd Wright and is considered the father of the modern skyscraper. His Chicago-school buildings (Guaranty Building, Carson Pirie Scott store) embody this principle.

Step 2 — Match: Option (D) correctly identifies **Louis Sullivan**.

Why other options are wrong:

- (A) Walter Gropius — founder of the Bauhaus; his philosophy aligned with "form follows function" but he did not originate the phrase.
- (B) Le Corbusier — influential Modernist architect; associated with "A house is a machine for living in", not this specific phrase.
- (C) Mies van der Rohe — known for "Less is more" and his use of steel-and-glass minimalism.

Answer: (D) Go Back to Q23

Q24.

Solution

Concept: Victor Papanek (1923–1998) was an Austrian-American designer and educator whose landmark book *Design for the Real World: Human Ecology and Social Change* (1971) argued that professional design had become complicit with consumerism and was ignoring the needs of the vast majority of the world's population.

Step 1 — Core argument: Papanek contended that designers had a moral and social responsibility to design for the **poor, the disabled, the elderly, and people in developing nations** — those with real needs but no commercial market power — rather than for wealthy consumers seeking luxury or novelty.

Step 2 — Match: Option (A) — "Design for the needs of the majority — the poor, disabled, and marginalised" — correctly captures Papanek's argument.

Why other options are wrong:

- (B) Focus on aesthetic pleasure for wealthy consumers — this is precisely what Papanek criticised.
- (C) Imitate historical styles — not Papanek's argument; he was forward-looking and socially oriented.
- (D) Prioritise technological novelty — Papanek criticised novelty-driven design disconnected from real human needs.

Answer: (A) Go Back to Q24

Q25.

Solution

Concept: Shape-memory alloys (SMAs), the most well-known being **Nitinol** (Nickel-Titanium alloy), are materials that can undergo deformation at one temperature and then **recover their original shape** when heated to a specific threshold temperature (their transformation temperature). This behaviour arises from a reversible phase transformation between the martensite (low-temperature) and austenite (high-temperature) crystal structures.

Step 1 — Stimulus: The recovery is triggered by **heat** (temperature change to above the austenite transformation start temperature).

Step 2 — Applications: Orthodontic wires (body heat keeps them in austenite form, providing constant gentle force), stents, pipe couplings, and actuators.

Why other options are wrong:

- (A) Mechanical pressure — pressure deforms the SMA into martensite but does not restore the original shape.
- (B) Ultraviolet light — UV light has no phase-transformation effect on metallic SMAs.
- (D) Electrical current only — electrical current can *heat* an SMA (Joule heating), but the direct recovery stimulus is temperature, not current itself.

$\boxed{\text{Answer: (C)}}$ Go Back to Q25

Q26.

Solution

Concept: Aerogels are the world's lightest solid materials, composed of a nanoporous network where up to 99.98% of the volume is air. Their extremely low thermal conductivity (as low as 0.015 W/m·K, lower than still air) makes them exceptional **thermal insulators**. Combined with very low density (∼3–500 kg/m^3), they are unrivalled for weight-efficient insulation.

Step 1 — Primary design value: Extremely low thermal conductivity + very low weight = superior thermal insulation performance. Used in NASA Mars rovers, transparent building panels, cold-weather apparel, and pipeline insulation.

Step 2 — Match: Option (B) — "Thermal insulation performance combined with very low weight" — is correct.

Why other options are wrong:

- (A) Electrical conductivity — aerogels are electrical insulators (silica-based ones), not conductors.
- (C) Optical transparency — some aerogels are transparent, but this is a secondary feature, not their primary design value.
- (D) Compressive strength — aerogels are notoriously *fragile* in compression; strength is not their strength.

Answer: (B) Go Back to Q26

Q27.

Solution

Concept: **Piezoelectric materials** (e.g. quartz, lead zirconate titanate/PZT, polyvinylidene fluoride/PVDF) generate an electrical charge in response to applied **mechanical stress or deformation**. This is the *direct piezoelectric effect*: mechanical energy $\rightarrow$ electrical energy. The *converse effect* is also possible (apply voltage $\rightarrow$ mechanical deformation), used in actuators.

Step 1 — Direct effect: When a piezoelectric crystal is compressed, stretched, or bent, the internal polarisation changes and a voltage is generated across it.

Step 2 — Applications: Microphones, pressure sensors, lighters (spark generation), energy-harvesting tiles (footstep energy), ultrasound transducers.

Why other options are wrong:

- (B) Exposed to sunlight — that describes the *photovoltaic* effect (solar cells), not piezoelectricity.
- (C) Heated above a critical temperature — that describes the *pyroelectric* effect (some materials generate voltage when heated), not standard piezoelectricity.
- (D) Immersed in water — immersion has no piezoelectric effect.

Answer: (A) Go Back to Q27

Q28.

Solution

Concept: Self-healing polymers with **microcapsule-based healing** (the mechanism pioneered by White, Sottos, et al. at the University of Illinois, 2001) embed **micro-capsules** filled with a liquid healing agent (typically a monomer such as dicyclopentadiene) and catalytic particles in a polymer matrix. When a crack propagates, it ruptures the capsules, releasing the healing agent into the crack plane; the agent polymerises upon contact with the catalyst, sealing the crack.

Step 1 — Mechanism: Crack $\rightarrow$ ruptures microcapsule $\rightarrow$ healing agent flows into crack $\rightarrow$ polymerises $\rightarrow$ crack sealed.

Step 2 — Match: Option (D) — "Release of encapsulated healing agent from micro-capsules embedded in the matrix" — is correct.

Why other options are wrong:

- (A) Shape-memory crystalline restructuring — this is the mechanism of SMAs, not self-healing polymers.
- (B) Magnetic realignment of polymer chains — no established self-healing polymer uses magnetic realignment as the primary mechanism.
- (C) Photocatalytic surface reaction — some photocatalytic self-healing coatings exist, but the question asks about the most common microcapsule mechanism.

$\boxed{\text{Answer: (D)}}$ Go Back to Q28

Q29.

Solution

Concept: Carbon Fibre Reinforced Polymer (CFRP) composites combine a carbon fibre matrix (providing extraordinary tensile strength and stiffness) with a polymer resin (providing toughness and binding). The result is a material with an **exceptional strength-to-weight ratio**: roughly 5 times stronger than steel at one-fifth the weight.

Step 1 — Key property: Tensile strength $\sim$3500 MPa; density $\sim$1600 kg/m^3 (vs. steel: $\sim$400 MPa tensile, 7800 kg/m^3). Strength-to-weight ratio of CFRP is therefore orders of magnitude better than steel.

Step 2 — Applications: Formula 1 chassis, aircraft fuselage components (Boeing 787 uses 50% CFRP by weight), bicycle frames, wind turbine blades.

Why other options are wrong:

- (A) Low cost and easy moulding — CFRP is expensive and labour-intensive to manufacture; this is a known limitation, not an advantage.
- (B) Superior electrical insulation — carbon fibres are actually *electrically conductive*, making electrical insulation not a property of CFRP.
- (D) High thermal mass and heat retention — CFRP has moderate thermal conductivity; thermal mass is not its primary design advantage.

$\boxed{\text{Answer: (C)}}$ Go Back to Q29

Q30.

Solution

Concept: Biomimetic materials (also called bio-inspired materials) are engineered by studying and **emulating structures, mechanisms, or processes found in living organisms** to achieve properties superior to those available from conventional engineering approaches.

Step 1 — Principle: Nature has evolved highly optimised solutions over millions of years. Biomimicry extracts these principles and applies them in synthetic materials.

Step 2 — Examples:

- Gecko adhesive — inspired by nanoscale hairs on gecko feet (dry adhesion).
- Sharkskin-patterned swimsuits — inspired by the dermal denticles of sharks (drag reduction).
- Nacre (mother-of-pearl) inspired ceramics — brick-and-mortar microstructure for toughness.
- Lotus-effect self-cleaning surfaces — inspired by the superhydrophobic lotus leaf.

Why other options are wrong:

- (A) Extracting and purifying naturally occurring substances — this describes bio-extraction, not biomimicry; biomimetics copies the *structure or process*, not the raw substance.

- (C) Synthesising entirely novel compounds with no biological analogue — the defining feature of biomimetics is specifically that it *has* a biological analogue.
- (D) Recycling biological waste into composites — this is a form of bio-based material processing, not biomimicry.

Answer: (B) Go Back to Q30

Q31.

Solution

Concept: Pininfarina (originally Carrozzeria Pinin Farina, founded by Battista "Pinin" Farina in Turin in 1930) is the Italian automotive design house most famously and enduringly associated with styling **Ferrari** road cars. The collaboration began in 1951 and produced some of the most celebrated automotive designs in history.

Step 1 — Key designs: Ferrari 166 Inter (1948, early collaboration), Ferrari 250 GT Berlinetta (1962), Ferrari Testarossa (1984), Ferrari Enzo (2002), Ferrari 458 Italia (2009). Pininfarina has styled the majority of Ferrari production models for over 70 years.

Step 2 — Additional context: Pininfarina also styled Alfa Romeo (Spider, Brera), Peugeot (406 coupé, 307 CC), and various concept cars — but Ferrari is the iconic primary relationship.

Why other options are wrong:

- (B) Lamborghini — Lamborghini's iconic designs came from Bertone (Countach, Miura) and Gandini, not Pininfarina.
- (C) Porsche — Porsche bodies were designed in-house (Ferry Porsche) or by Erwin Komenda; Porsche's exterior design has been kept in-house for most of its history.
- (D) Alfa Romeo — Pininfarina has designed some Alfa models, but Ferrari is the defining partnership.

Answer: (A) Go Back to Q31

Q32.

Solution

Concept: The **Shinkansen Series 500**'s distinctive long, pointed nose was designed by chief engineer **Eiji Nakatsu**, who was also a birdwatcher. The problem to solve was the loud "sonic boom" caused by the pressure wave as the train exited tunnels at high speed (the tunnel boom effect). Nakatsu drew inspiration from the **kingfisher bird** (Alcedo atthis), whose long, pointed beak allows it to dive from air into water with minimal splash or pressure wave disturbance due to its gradual taper and low-drag profile.

Step 1 — Problem and solution: Pressure-wave boom on tunnel exit $\rightarrow$ redesign nose to smoothly transition between air pressures $\rightarrow$ kingfisher beak cross-sectional profile applied to nose geometry $\rightarrow$ boom eliminated and 15% energy reduction achieved.

Step 2 — Result: The Series 500 nose resembles a kingfisher beak in side profile. This is a textbook biomimicry case study.

Why other options are wrong:

- (A) Swordfish — a common misconception; the swordfish rostrum is round in cross-section and was not the model used.
- (B) Shark — shark skin (dermal denticles) inspires drag reduction, but not the Shinkansen nose specifically.
- (C) Hummingbird — hummingbirds inspired some helicopter rotor designs, but not the Shinkansen nose.

$\boxed{\text{Answer: (D)}}$ Go Back to Q32

Q33.

Solution

Concept: Aviation cabin design is uniquely constrained by the **physical requirements of flight**: the aircraft must be structurally sound under pressurisation, and every kilogram of weight has a direct and measurable cost in fuel consumption and performance. Unlike a hotel or office interior, everything inside an aircraft must earn its weight.

Step 1 — Primary constraint: Strict weight limits (every component must be as light as possible; even seat weight is measured to grams) and the **pressurised-fuselage geometry** (cylindrical cross-section, tapered nose and tail, limited headroom particularly in side zones, curved floor-to-wall junction, fixed aisle width).

Step 2 — Consequence for design: Cabin designers cannot freely use natural stone, heavy textiles, or large wooden panels. Every material choice is subject to flammability ratings, outgassing limits, and weight certification. Spatial geometry is non-negotiable (fuselage diameter is fixed by the aircraft type).

Why other options are wrong:

- (A) Consistent aesthetic brand identity — a commercial consideration, not a physical constraint.
- (B) Passenger preference for natural materials — a preference, not a structural constraint; airlines that use premium materials still comply with weight rules.
- (D) Direct natural daylight in all seating zones — aircraft do have windows, but many interior zones (galleys, lavatories, middle sections of wide-bodies) have no windows; daylight is not a requirement.

Answer: (C) Go Back to Q33

Q34.

Solution

Concept: In **automotive design**, **packaging** (or "package design") is a technical discipline that deals with the **spatial arrangement and layout of all mechanical, structural, and occupant-space elements** within the fixed outer envelope of the vehicle. It determines how the engine, transmission, suspension, fuel tank, battery (in EVs), occupants, and luggage all fit together efficiently.

Step 1 — Process: Package design begins with hard points (occupant H-point, steering column, firewall, sill height) and works outward and inward simultaneously to ensure ergonomic compliance, crash performance, service access, and manufacturing feasibility — all before exterior styling is finalised.

Step 2 — Distinction: This is entirely different from graphic or retail "packaging design."

Why other options are wrong:

- (A) The design of the vehicle's external box and shipping container — this conflates automotive packaging with logistics packaging.
- (C) The visual design of marketing materials and brochures — this is graphic design / marketing communications.
- (D) The design of the instrument panel graphics — this is instrument cluster

/ HMI design, a specific subset.

Answer: (B) Go Back to Q34

Q35.

Solution

Concept: Giorgetto Giugiaro (born 1938), working through his studio **ItalDesign** (founded 1968), is responsible for numerous iconic car designs. His most celebrated mass-market design is the **Volkswagen Golf Mk1**, launched in 1974, which replaced the Beetle and redefined the compact hatchback segment globally.

Step 1 — Historical significance: The Golf Mk1 introduced the "folded paper" aesthetic — crisp, straight lines, a practical three-door hatchback body. It became one of the best-selling cars in history. Giugiaro won the "Car Designer of the Century" award in 1999 largely on the strength of this and other designs (Fiat Panda, BMW M1, Lotus Esprit).

Step 2 — Launched in 1974: The Golf Mk1 was unveiled at the 1974 Geneva Motor Show, matching the question's date.

Why other options are wrong:

- (B) Fiat 500 — the original 1957 Fiat 500 (Cinquecento) was designed by Dante Giacosa; the 2007 revival was styled in-house by Fiat. Giugiaro designed the Fiat Panda (1980), not the 500.
- (C) Renault 4 — designed in-house by Renault, launched 1961, not by Giugiaro.
- (D) Citroën 2CV — designed by Flaminio Bertoni, launched 1948; Giugiaro was not involved.

Answer: (A) Go Back to Q35

Q36.

Solution

Concept: The **aerodynamic drag coefficient** (C_d or C_D) is a **dimensionless number** that quantifies the aerodynamic resistance (drag force) of a body moving through a fluid (usually air). It is defined by the drag equation:

$$F_D = \frac{1}{2}\,\rho\,v^2\,C_d\,A$$

where F_D is drag force, ρ is air density, v is velocity, and A is the frontal reference area.

Step 1 — Interpretation: A lower C_d means a more aerodynamically streamlined shape. A flat plate perpendicular to flow has $C_d \approx 1.28$; a modern electric car (Tesla Model 3) achieves $C_d \approx 0.23$; a sphere is ≈ 0.47.

Step 2 — Match: Option (D) — "The aerodynamic resistance of a body moving through a fluid, expressed as a dimensionless ratio" — is correct.

Why other options are wrong:

- (A) Downforce — downforce is described by a *lift coefficient* C_L (negative for downforce), not C_d.
- (B) Frontal cross-sectional area — this is a separate parameter (A in the drag equation), not the coefficient.
- (C) Maximum speed — maximum speed depends on power-to-drag balance; C_d alone does not determine it.

Answer: (D) Go Back to Q36

Q37.

Solution

Concept: Different chart types serve different purposes. When the goal is to show **how a whole is divided into its parts** (part-to-whole relationship), the appropriate chart is a **pie chart** (or its variant, the **donut chart**). Each slice represents a category's proportion of the total, with slice angle proportional to percentage.

Step 1 — When to use each chart:

- Line chart: change over time (trend).
- Bar chart: comparing discrete quantities across categories.
- Pie/donut chart: part-to-whole composition breakdown.

- Scatter plot: relationship/correlation between two continuous variables.

Step 2 — Application: A budget breakdown (each category as % of total) is a part-to-whole question. Pie chart is most appropriate.

Why other options are wrong:

- (A) Line chart — best for showing trends over time, not proportional composition.
- (B) Bar chart — better for comparing absolute values across categories, not part-to-whole.
- (D) Scatter plot — shows correlation between two variables; not suitable for showing composition.

Answer: (C) Go Back to Q37

Q38.

Solution

Concept: A **heat map** is a data visualisation in which individual values contained in a matrix are represented as colours. The primary visual encoding is **colour intensity** (and hue variation) — darker or more saturated cells indicate higher values, lighter cells indicate lower values.

Step 1 — Visual encoding in heat maps: Each cell's position encodes two categorical variables (row and column), while the cell's **colour** encodes the data value at that intersection. A sequential colour scale (light to dark) or diverging scale (two hues with neutral midpoint) is used.

Step 2 — Examples: Website traffic by day-of-week and hour (GitHub contribution graph), temperature across a geographic area, correlation matrices in statistics.

Why other options are wrong:

- (A) Size (area) of each cell — in a heat map, cells are typically uniform in size; size encoding is used in *treemaps* and *bubble charts*.
- (C) Position along an axis — position is already used to denote row/column categories; the *value* is encoded by colour, not a separate position axis.
- (D) Angle of slices — angle encoding is used in pie charts, not heat maps.

Answer: (B) Go Back to Q38

Q39.

Solution

Concept: A **scatter plot** displays individual data points as dots on a two-axis plane, with each axis representing a variable. The pattern of dots reveals the **relationship (correlation)** between the variables. A **strong positive correlation** means that as one variable increases, the other increases too, and this relationship is tight (little scatter around the trend line).

Step 1 — Visual pattern of strong positive correlation: Data points cluster tightly around an imaginary straight line that **rises from left to right** (positive slope). The tighter the cluster around the line, the stronger the correlation.

Step 2 — Distinguish from other patterns:

- Strong negative: dots fall from left to right.
- No correlation: random scatter.
- Horizontal band: no relationship with x-variable (zero correlation).

Why other options are wrong:

- (B) Random scatter with no pattern — indicates zero correlation ($r \approx 0$).
- (C) Line that falls from left to right — strong *negative* correlation.
- (D) Horizontal band — indicates the y-variable is independent of x; no correlation.

$\boxed{\text{Answer: (A)}}$ **Go Back to Q39**

Q40.

Solution

Concept: A **waffle chart** (also called a square pie chart) represents proportional data as a **10×10 grid of unit squares** (100 squares total), where the number of filled (coloured) squares corresponds directly to the percentage value. Each filled square = 1% of the total. It is a visually intuitive alternative to a pie chart for showing percentages.

Step 1 — Structure: 100 squares in a 10×10 grid. If 35% of a metric is represented, exactly 35 squares are filled.

Step 2 — Visual advantage: Humans can count and compare small grids more accurately than angles (pie slices), making waffle charts easier to read for exact percentage comparisons.

Why other options are wrong:

- (A) Pie chart divided into 100 segments — technically possible but would be extremely thin slices; a waffle chart uses a *grid*, not a circle.
- (B) A 3D bar chart with grid overlay — a completely different chart type.
- (C) A network diagram with hexagonal nodes — describes a node-link diagram or hex grid, not a waffle chart.

Answer: (D) Go Back to Q40

Q41.

Solution

Concept: In 1984, researchers **William Cleveland and Robert McGill** published a seminal study establishing a hierarchy of visual encoding accuracy. They found that the human eye decodes values most accurately from **position along a common scale** (e.g. reading bar lengths or dot positions against a shared axis) and least accurately from area, volume, colour hue, or angle.

Step 1 — Hierarchy (most to least accurate):

(a) **Position along a common scale** (shared axis)

(b) Position along non-aligned scales

(c) Length

(d) Angle / slope

(e) Area

(f) Volume

(g) Colour hue / saturation

Step 2 — Implication: Bar charts and dot plots (position along a scale) are more accurately read than pie charts (angle) or bubble charts (area).

Why other options are wrong:

- (A) Area — area judgements are systematically less accurate; humans tend to underestimate differences in area.

- (B) Colour hue — hue is near the bottom of the encoding hierarchy for quantitative accuracy.
- (D) Angle — angle is less accurately decoded than position; this is why pie charts are often criticised as less readable than bar charts.

Answer: (C) Go Back to Q41

Q42.

Solution

Concept: **Sparklines** were introduced and named by **Edward Tufte** in his 2006 book *Beautiful Evidence*. He defined them as “small, intense, word-sized graphics” — minimal data visualisations designed to be **embedded within text or table cells** to show trends over time in context. They have no axes, labels, or titles, relying on the surrounding text to provide meaning.

Step 1 — Use case: Sparklines appear inline with numbers (e.g. a stock price followed by a tiny line chart of its performance over the past month). They give readers the trend without requiring a separate chart.

Step 2 — Common implementations: Excel sparklines (introduced in Excel 2010), Bloomberg terminal price trends, Wikipedia article traffic charts.

Why other options are wrong:

- (A) Replacing data tables — sparklines complement data (often appearing within tables), but are not designed to replace detailed tables.
- (C) Interactive animated dashboards — sparklines are static and compact, not animated or interactive.
- (D) Geographic data on maps — geographic data uses choropleth maps, cartograms, or dot maps, not sparklines.

Answer: (B) Go Back to Q42

Q43.

Solution

Concept: The **Pritzker Architecture Prize** is awarded annually by the Hyatt Foundation and is universally regarded as the highest honour in architecture, frequently described as the "Nobel Prize of architecture." It was established in 1979 by Jay A. Pritzker and his wife Cindy, and the first laureate was Philip Johnson (1979).

Step 1 — Scope: The prize honours a living architect whose built work demonstrates a consistent commitment to talent, vision, and responsibility. Past laureates include Jørn Utzon (Sydney Opera House), Tadao Ando, Zaha Hadid (first woman, 2004), and Norman Foster.

Step 2 — Discipline: The prize is specifically for **architecture**.

Why other options are wrong:

- (B) Industrial design — the field's equivalent would be the iF Design Award, Red Dot, or similar; the Pritzker is not awarded for product/industrial design.
- (C) Urban planning — urban planning has no single dominant international prize equivalent to the Pritzker.
- (D) Fine arts — fine arts prizes include the Turner Prize (UK) and the Venice Biennale Golden Lion; the Pritzker is architecture-specific.

Answer: (A) Go Back to Q43

Q44.

Solution

Concept: The **Red Dot Design Award** is one of the world's most prestigious and largest design competitions, organised by the **Design Zentrum Nordrhein Westfalen** in **Essen, Germany**. It was founded in 1955 and today encompasses three award categories: Product Design, Brands & Communication Design, and Design Concept.

Step 1 — Key facts: Country = Germany; city = Essen (Ruhr area); the winning products are displayed in the Red Dot Design Museum Essen. The award's characteristic red dot symbol has become a recognised quality mark for product excellence globally.

Step 2 — Match: Option (D) — Germany.

Why other options are wrong:

- (A) Japan — Japan hosts the Good Design Award (G-Mark), not the Red Dot.
- (B) United States — the US does not host the Red Dot; major US design awards include the IDEA (International Design Excellence Awards).
- (C) Denmark — Denmark hosts the INDEX: Award and is associated with Scandinavian design, but not Red Dot.

Answer: (D) Go Back to Q44

Q45.

Solution

Concept: The **National Institute of Design (NID)**, Ahmedabad, was established in **1961** by the Government of India on the recommendation of the **Eames Report** (*The India Report*, 1958) authored by American designers Charles and Ray Eames. It was India's first dedicated design institution and modelled partly on the Bauhaus and Ulm School of Design (HfG Ulm) philosophies.

Step 1 — Timeline: Eames Report submitted 1958 $\rightarrow$ Government accepted recommendations $\rightarrow$ NID founded and inaugurated in Ahmedabad in **1961**.

Step 2 — Significance: NID Ahmedabad remains one of Asia's premier design schools, offering programmes in Industrial, Communication, Textile, Film, and Interaction Design.

Why other options are wrong:

- (A) 1947 — India's year of independence; NID had not yet been conceived.
- (B) 1950 — the Eames Report had not even been commissioned yet.
- (D) 1975 — 14 years after NID's actual founding; NIFT (National Institute of Fashion Technology) was established later (1986).

Answer: (C) Go Back to Q45

Q46.

Solution

Concept: The **Eames Report** (officially *The India Report*, 1958) was commissioned by the Government of India and submitted by American designers **Charles and Ray Eames** after their visit to India. The report recommended that India's approach to design education should be rooted in **India's rich tradition of craft and local material culture** — specifically the example of the *lota* (a traditional water vessel) was used to illustrate how Indian artisan traditions had refined functional objects over centuries to near-perfection. The report urged that modern design education in India should reconnect with and build upon these traditions rather than blindly importing Western industrial design models.

Step 1 — Core recommendation: Ground Indian design education in traditional craft, indigenous materials, and local needs — then integrate modern production knowledge.

Step 2 — Result: This recommendation led directly to the founding of NID Ahmedabad (1961) with a curriculum that included study of traditional crafts alongside modern design.

Why other options are wrong:

- (A) Exclusively promoting luxury export crafts — the Eames Report was not about export luxury; it was about addressing India's own developmental needs.
- (C) Adopting the Bauhaus curriculum unchanged — the Eames Report explicitly argued against wholesale importation of Western design education.
- (D) Training designers solely for heavy industrial production — this was a Soviet/constructivist model, not what the Eames recommended for India.

$\boxed{\text{Answer: (B)}}$ Go Back to Q46

Q47.

Solution

Concept: The **iF Design Award** is one of the oldest and most internationally respected design prizes, established in 1953 (first awards given in 1954). It is organised by **iF International Forum Design GmbH**, headquartered in **Hannover, Germany** (the iF brand later expanded to Munich for its gala events, but the organising body is based in Germany).

Step 1 — Key facts: Over 10,000 entries are evaluated annually across product, packaging, communication, service, architecture, and UX design. The iconic iF seal is a recognised quality mark globally.

Step 2 — Match: Option (A) — "Hannover-based iF International Forum Design GmbH, Germany."

Why other options are wrong:

- (B) The Design Council, UK — the Design Council is a UK advisory body for design policy; it does not organise the iF Award.
- (C) MoMA, New York — MoMA's design collection is a museum, not an annual awards competition organiser.
- (D) Japan Industrial Design Association (JIDA) — JIDA organises Japanese design awards (Good Design Award is by Japan Institute of Design Promotion); not the iF Award.

Answer: (A) Go Back to Q47

Q48.

Solution

Concept: The **Cooper Hewitt, Smithsonian Design Museum** is the United States' only museum exclusively devoted to historical and contemporary design in all its forms. It is housed in the **Andrew Carnegie Mansion** on **Fifth Avenue in Manhattan, New York City**. The museum was founded in 1897 by the Hewitt sisters (granddaughters of Peter Cooper) and became part of the Smithsonian Institution in 1967.

Step 1 — Location: New York City, Manhattan (91st Street and Fifth Avenue), Upper East Side.

Step 2 — Notable features: Its collection spans 250,000 objects across 30 centuries of design; it features an interactive Pen device allowing visitors to collect designs from throughout the museum.

Why other options are wrong:

- (A) Washington, D.C. — many Smithsonian museums are in D.C. (National Mall), but Cooper Hewitt is specifically the New York branch.
- (B) Chicago, Illinois — Chicago's design museum is the Chicago Architecture Center; Cooper Hewitt is in New York.
- (C) Los Angeles, California — LA has the Hammer Museum and LACMA;

Cooper Hewitt is in New York.

Answer: (D) Go Back to Q48

Q49.

Solution

Concept: The **INDEX: Award**, established in Denmark and awarded biennially (every two years), is the world's largest design prize focusing specifically on **Design to Improve Life**. It was founded in 2002 and its mission is to accelerate the use of design to address serious global challenges — poverty, health, education, play, and sustainability. Prize money (500,000 EUR in recent editions, split among category winners) is distributed to projects that demonstrably improve human life.

Step 1 — Scope: Five categories: Body, Home, Work, Play, and Community. Winners are selected for measurable positive impact on real human challenges.

Step 2 — Example winners: The LifeStraw water filter, the M-PESA mobile payment system, the Jaipur Foot prosthetic.

Why other options are wrong:

- (A) Highest level of formal aesthetic innovation — aesthetic innovation is more relevant to awards like the Red Dot "Best of the Best" or Design of the Year; INDEX focuses on impact, not aesthetics.
- (B) Only natural and biodegradable materials — no such material restriction exists for INDEX entries.
- (D) Designers under 30 — INDEX has no age restriction; it celebrates any designer whose work improves life.

Answer: (C) Go Back to Q49

Q50.

Solution

Concept: NIFT (National Institute of Fashion Technology) is India's premier fashion and design education institution, with campuses in 17 cities across India. It was established by the Government of India in **1986** under the Ministry of Textiles, with the first campus in New Delhi. NIFT was set up with technical assistance from the Fashion Institute of Technology (FIT), New York.

Step 1 — Key date: NIFT Act formally enacted 2006 (giving it statutory status), but the institution was **established and began functioning in 1986**.

Step 2 — Match: Option (B) — 1986.

Why other options are wrong:

- (A) 1975 — no major national fashion institution was established in India in 1975.
- (C) 1991 — 1991 was India's economic liberalisation year; NIFT had already been operating for 5 years by then.
- (D) 2000 — NIFT celebrated its 14th anniversary in 2000; it was well established by then, not newly founded.

Answer: (B) Go Back to Q50

Part B — Drawing Task Model Answers

Q51.

Solution

Model Sketch Description — Wearable Step-Tracking Device for Elderly Users

What the ideal sketch should contain:

- **Form sketch (3D perspective or isometric):** A rounded, ergonomic wristband or ankleband with a gentle curvature to accommodate elderly wrists. The device body should be compact, with no sharp edges. Proportions must suggest a lightweight, unobtrusive product (not bulky or aggressive in form).
- **Exploded/detail view:** One component highlighted and pulled out from the body — acceptable components include the e-ink or LCD display module, the step-counter accelerometer sensor, or the rechargeable battery cell. The detail view should show how the component fits within the housing.
- **Labels (minimum 3):** (a) *Soft silicone strap — hypoallergenic, non-slip, easy to clean*; (b) *Large-digit, high-contrast display for low-vision users*; (c) *Single-button interface with haptic feedback for alert notification*. Additional acceptable labels: waterproof rating (IP67), SOS/fall-detection sensor, magnetic charging pin.
- **Accessibility features:** At least one feature specifically appropriate for elderly users must be labelled — e.g. large text display, easy-clasp buckle, audible alert, or soft strap that cannot dig into loose skin.

- **Rendering:** Line weight variation distinguishing product outline from internal detail; tonal shading on the strap to suggest material softness.

Marking rubric: Form innovation and user-appropriateness for elderly (3) + exploded/detail view accuracy (3) + labelling completeness (2) + sketch quality and rendering (2) = **10 marks**.

Q52.

Solution

Model Sketch Description — Temple Festival at Night, Bird's-Eye View

What the ideal sketch should contain:

- **Spatial layout (bird's-eye / plan view):** The temple structure drawn at the centre of the composition, shown in plan (top view), with a clear architectural footprint — gopuram (tower) indicated as a rectangle with cross-lines, inner sanctum, and mandapa. Concentric zones radiating outward: inner courtyard, procession pathway, periphery stalls.
- **Procession path:** A clearly legible path (dashed or solid line with small figures) winding around the temple, suggesting circumambulation.
- **Clusters of people:** Drawn as small ellipses or dots grouped at varying densities — dense near the temple entrance, sparser at the stall areas. Variety of cluster sizes conveys a large crowd.
- **Stalls and peripheral elements:** Small rectangular stall footprints around the perimeter, with goods indicated by hatching or small circles.
- **Lighting and night atmosphere:** The critical challenge is conveying **warm light at night** in a plan view. Techniques: light halos around lamp positions (concentric dotted circles of decreasing density), dark shading in unlighted zones, white or light patches around lamp clusters, warm tone hatching around oil-lamp rows along the procession path.
- **Captions/annotations:** Brief labels are acceptable ("temple sanctum", "lamp row", "food stalls", "procession").

Marking rubric: Spatial organisation and plan clarity (3) + lighting/night mood conveyed through tone (3) + inclusion of all required elements (2) + drawing quality (2) = **10 marks**.

Q53.

Solution

Model Sketch Description — Journey of a Glass Bottle, 3-Panel Sequential Illustration

What the ideal sketch should contain:

- **Panel 1 — Factory:** A glassblowing or automated mould-forming scene. Key elements: a glowing furnace in the background (light radiating outward, hatching suggests heat); a worker in protective gear or a mechanical arm; a half-formed bottle being shaped; molten glow on surfaces. Caption: "Panel 1: Glass Factory."
- **Panel 2 — In Use:** A warm domestic or café setting. A person holds or fills the glass bottle — shown at human scale. Context clues: a table, a window with daylight, a label on the bottle, or a café counter. The bottle is clean, full, and clearly in use. Caption: "Panel 2: In Use."
- **Panel 3 — Recycling Centre:** An industrial setting with machinery. Conveyor belts, a hopper or crushing machine, workers sorting glass by colour (clear, brown, green). Broken glass and intact bottles visible. Caption: "Panel 3: Recycling Centre."
- **Visual consistency:** The bottle must be identifiably the *same* bottle across panels — consistent in silhouette and proportions. A consistent drawing style (line weight, level of detail) ties the three panels together.
- **Panel borders:** Clear dividing lines between panels; captions below each.

Marking rubric: Narrative clarity and logical sequence across 3 panels (3) + visual consistency of style and bottle identity (2) + detail and atmosphere per panel (3) + quality and panel layout (2) = **10 marks**.

Q54.

Solution

Model Sketch Description — Village Community Notice Board

What the ideal sketch should contain:

- **Front view:** A rectangular notice board panel (approx. 1.2 m × 0.9 m proportionally) with: a protective canopy or overhanging roof to shed rain; a glass or transparent acrylic cover over the display area; a hinged or lockable door for posting notices; a lamp attached to the top or side of the board for night reading (angled to illuminate the face of the board).

- **Material labels (minimum 2):** Examples: (a) *Galvanised steel frame — rust-resistant, durable in monsoon*; (b) *Corrugated UPVC/polycarbonate roofing sheet — lightweight, weather-resistant*; other acceptable materials: powder-coated aluminium casing, marine-grade plywood backing, toughened glass, stainless steel bolts.

- **Side section sketch:** A cross-section or side elevation showing the post (embedded in a concrete footing), the board panel mounted at a readable height (approximately 1.5 m to bottom of board from ground), and the connection between post and board bracket.

- **Functional details:** Solar LED lamp (self-sufficient for remote village), or mains-connected covered lamp housing; drainage channel on the canopy edge.

- **Scale indication:** A human figure silhouette or dimension annotation to indicate the intended scale.

Marking rubric: Functional concept and all-weather design logic (3) + two weather-resistant materials labelled (3) + front view + section sketch completeness (2) + drawing clarity and dimensioning (2) = **10 marks**.

Q55.

Solution

Model Sketch Description — Fantasy Bookshop Interior

What the ideal sketch should contain:

- **Composition and perspective:** A one-point or two-point interior perspective drawing. The eye level should be mid-height to convey the towering quality of the shelves. The composition should draw the viewer's eye into the depth of the space.

- **Wooden shelves:** Multiple shelves of varying heights, slightly irregular and non-uniform to suggest age and character. Shelves packed with books of varying heights; some books leaning, some in stacks, some horizontal piles on top of vertically arranged volumes.

- **Reading nook:** An armchair tucked into an alcove or between two shelf bays. A small side table, a floor lamp with a warm glow, and perhaps a small rug or scattered books complete the nook.

- **Dim warm lighting:** Overhead pendant lamps or Edison-bulb clusters; light halos rendered as soft gradients from the lamp source; deep shadows in the upper shelves and corners. Dark areas frame the lit zones to create contrast and atmosphere.
- **Ladder:** A library ladder leaning against one of the taller shelves, drawn in proportion with the shelving height.
- **Atmospheric details:** Hanging plants, a spiral staircase to a mezzanine level (optional), ornate carved wood details on the shelf ends, a cat sleeping on a shelf — these add richness and fantasy.
- **Rendering:** Varied line weight (bold for structural edges, fine for book spines and details); tonal shading to suggest the warm/dark contrast; hatching or blending for shadow zones.

Marking rubric: Atmosphere and mood — warmth, cosiness, discovery (3) + composition and spatial depth — perspective, scale (3) + inclusion of all required elements (ladder, nook, shelves, lamps, books) (2) + rendering quality (2) = **10 marks**.

Answer Key (Part A — Visual MCQs)

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	D	4	A	5	B
6	C	7	D	8	A	9	B	10	C
11	D	12	A	13	B	14	C	15	D
16	A	17	B	18	C	19	D	20	A
21	B	22	C	23	D	24	A	25	C
26	B	27	A	28	D	29	C	30	B
31	A	32	D	33	C	34	B	35	A
36	D	37	C	38	B	39	A	40	D
41	C	42	B	43	A	44	D	45	C
46	B	47	A	48	D	49	C	50	B