

## **General Aptitude**

### **Q.1 – Q.5 Carry ONE mark Each**

1. Fish : Shoal :: Lion : \_\_\_\_\_

Select the correct option to complete the analogy.

- (A) Pride
- (B) School
- (C) Forest
- (D) Series

Answer: A

Explanation: "Pride" is the collective noun for a group of lions, while "shoal" is the collective noun for a group of fish. Collective nouns are names given to groups of people, animals, or things. Other examples of collective nouns include: **Flock**: A group of birds; **Gaggle**: A group of geese; **Litter**: A group of puppies; **Pack**: A group of wolves; **Murder**: A group of crows

2. Identify the grammatically correct sentence:

- (A) It is I who am responsible for this fiasco.
- (B) It is myself who is responsible for this fiasco.
- (C) It is I who is responsible for this fiasco.
- (D) It is I who are responsible for this fiasco.

Answer: A

Explanation: The personal pronoun 'I' always takes the verb 'am'. For example, just turn the sentence into a question. We write - *Am I responsible for this fiasco?* We do not say/write- *Is I responsible for this fiasco?*

So, "It is I who am responsible for this fiasco" is the correct answer.

3. Two cars, P and Q, start from a point X in India at 10 AM. Car P travels North with a speed of 25 km/h and car Q travels East with a speed of 30 km/h. Car P travels continuously but car Q stops for some time after travelling for one hour. If both the cars are at the same distance from X at 11:30 AM, for how long (in minutes) did car Q stop?

- (A) 10
- (B) 12
- (C) 15
- (D) 18

Answer:

Explanation: Car P travels North, continuously from 10 AM to 11:30 AM, at a speed of 25 km/h. So, time of travel = 1.5 hours. Distance travelled = 25 km/h \* 1.5 hour = 37.5 km

Time of travel for Car Q to reach the same distance of 37.5 at 30 km/h =  $37.5/30 = 1.25$  hour

The duration for which car Q stops =  $1.5 - 1.25 = 0.25$  hours = 15 min

4. The ceiling function of a real number  $x$ , denoted by  $ce(x)$ , is defined as the smallest integer that is greater than or equal to  $x$ . Similarly, the floor function, denoted by  $fl(x)$ , is defined as the largest integer that is smaller than or equal to  $x$ . Which one of the following statements is NOT correct for all possible values of  $x$ ?

- (A)  $ce(x) \geq x$
- (B)  $fl(x) \leq x$
- (C)  $ce(x) \geq fl(x)$
- (D)  $fl(x) < ce(x)$

Answer: D

Explanation: Given, “ $ce(x)$ , is defined as the smallest integer that is greater than or equal to  $x$ ”  $\Rightarrow ce(x) \geq x$

Also given, “ $fl(x)$ , is defined as the largest integer that is smaller than or equal to  $x$ ”  $\Rightarrow fl(x) \leq x$

Also, it can be observed that ceiling function is always greater than or equal to floor function (both being equal when the real number is the integer ‘ $x$ ’ itself)  $\Rightarrow ce(x) \geq fl(x)$

5. P and Q play chess frequently against each other. Of these matches, P has won 80% of the matches, drawn 15% of the matches and lost 5% of the matches.

If they play 3 more matches, what is the probability of P winning exactly 2 of these 3 matches?

- (A)  $\frac{48}{125}$
- (B)  $\frac{16}{125}$
- (C)  $\frac{16}{25}$
- (D)  $\frac{25}{48}$

Answer:

Explanation: This is a **binomial probability problem**, where the probability of exactly  $k$  successes (wins) in  $n$  trials (matches) is given by:

$$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

Here,  $n = 3$  and  $k = 2$ ,  $p = 0.8$

$$\Rightarrow P(X = 2) = \binom{3}{2} (0.80)^2 (1 - 0.80)^{3-2} = \frac{48}{125}$$

6. Identify the option that has the most appropriate sequence such that a coherent paragraph is formed:

- P. At once, without thinking much, people rushed towards the city in hordes with the sole aim of grabbing as much gold as they could.
- Q. However, little did they realize about the impending hardships they would have to face on their way to the city: miles of mud, unfriendly forests, hungry beasts and inimical local lords – all of which would reduce their chances of getting gold to almost zero.
- R. All of them thought that easily they could lay their hands on gold and become wealthy overnight.

S. About a hundred years ago, the news that gold had been discovered in Kolar spread like wildfire and the whole State was in raptures.

(A)  $P \rightarrow Q \rightarrow R \rightarrow S$

(B)  $Q \rightarrow S \rightarrow R \rightarrow P$

(C)  $S \rightarrow Q \rightarrow P \rightarrow R$

(D)  $S \rightarrow P \rightarrow R \rightarrow Q$

Answer: D

Explanation: To form a coherent paragraph, we need to establish a logical and chronological flow of events.

- **S** gives the **context and starting point**: the discovery of gold in Kolar about a hundred years ago, and the public excitement.
- **P** follows naturally: people **rushed to the city**, eager to get gold.
- **R** supports the idea in P by giving their **motivation and belief** – they thought they'd get rich quickly.
- **Q** concludes the paragraph by showing the **harsh reality** they failed to anticipate.

So, the proper flow is: **S** – Sets the background. **P** – Describes the reaction. **R** – Explains their belief. **Q** – Reveals the reality.

7. If HIDE and CAGE are coded as 19-23-7-11 and 5-2-17-11 respectively, then what is the code for HIGH?

(A) 5-17-1-2

(B) 17-19-13-17

(C) 13-3-1-2

(D) 19-23-17-19

Answer: D

Explanation: Combining the codes observed from both the given words 'HIDE' and 'CAGE' the following table can be written for the coding method used:

Letter	H	I	D	E	C	A	G
Code	19	23	7	11	5	2	17

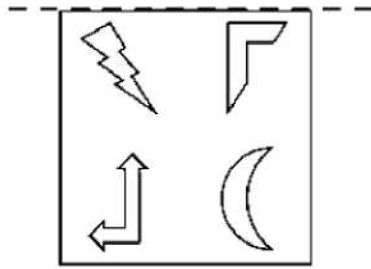
Using the table given above: HIGH can be coded as "19-23-17-19"

8. The given figure is reflected about the horizontal dashed line and then rotated clockwise by  $90^\circ$  about an axis perpendicular to the plane of the figure.

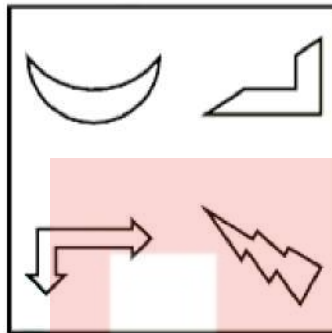
Which one of the following options correctly shows the resultant figure?

Note: The figures shown are representative.

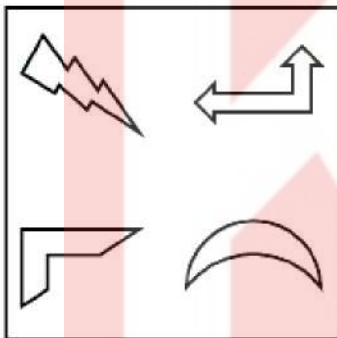




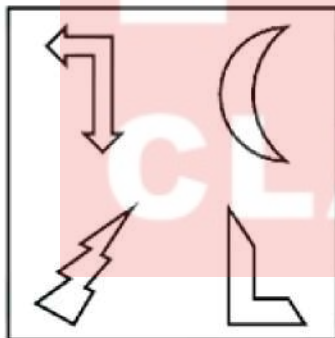
(A)



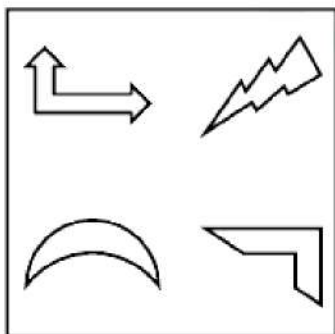
(B)



(C)



(D)



Answer: B

Explanation: Self-explanatory

9. Which one of the following options has the correct sequence of objects arranged in the increasing number of mirror lines (lines of symmetry)?

- (A) Circle; Square; Equilateral triangle; Isosceles triangle
- (B) Isosceles triangle; Equilateral triangle; Square; Circle
- (C) Equilateral triangle; Isosceles triangle; Square; Circle
- (D) Isosceles triangle; Square; Equilateral triangle; Circle

Answer: B

Explanation: An isosceles triangle has 1 line of symmetry, an equilateral triangle has 3 lines of symmetry, a square has 4 lines of symmetry, and a circle has infinite lines of symmetry.

10. A final year student appears for placement interview in two companies, S and T. Based on her interview performance, she estimates the probability of receiving job offers from companies S and T to be 0.8 and 0.6, respectively. Let  $p$  be the probability that she receives job offers from both the companies. Select the most appropriate option.

- (A)  $0 \leq p \leq 0.2$
- (B)  $0.4 \leq p \leq 0.6$
- (C)  $0.2 \leq p \leq 0.4$
- (D)  $0.6 \leq p \leq 1.0$

Answer: B

Explanation: Given, Probability of receiving offer from company S = 0.8 and Probability of receiving offer from company T = 0.6

Probability that she receives job offers from both the companies,  $p = P(S \cap T) = P(S) * P(T) = 0.8 * 0.6 = 0.48$

**PART A: Common**

**FOR ALL CANDIDATES Q.11 – Q.28 Carry ONE mark Each**

11. As per the United Nations Development Report, 1990, which of the following is NOT a key indicator of Human Development Index (HDI)?

- (A) Life Expectancy at Birth
- (B) Expected Years of Schooling
- (C) Per capita Gross National Income (GNI)
- (D) Mortality Rate

Answer: D

Explanation: According to the 1990 UNDP Human Development Report, the indicators used to calculate the Human Development Index (HDI) were: life expectancy at birth (representing health), mean years of schooling for adults and expected years of schooling for children (representing education), and per capita Gross National Product (GNP) (representing standard of living)

12. As per the URDPFI Guidelines, 2015, the suggested population served by a single unit of neighbourhood park for plain areas is \_\_\_\_\_.

- (A) 5000
- (B) 15000
- (C) 35000
- (D) 50000

Answer: B

Explanation: Below are the norms for Organised Green for Plain Areas as per URDPFI Guidelines:

S. No.	Category	Population served per unit	Area Requirement (Ha)
1.	Housing Area Park	5000	0.50
2.	Neighbourhood park	15000	1.00
3.	Community park	1 lakh	5.00
4.	District park	5 lakh	25.00
5.	Sub city park	10 lakh	100.00

13. As per the National Building Code of India, 2016, the minimum clear opening width of a doorway to allow single wheelchair access, is \_\_\_\_\_ mm.

- (A) 600
- (B) 900
- (C) 1200
- (D) 1500

Answer: B

Explanation: As per NBC 2016, the minimum clear floor or ground area required for accommodating a single, stationary wheelchair and occupant is 900 x 1200 mm. Where transfer from wheelchair is involved, the clear space should preferably be 900 mm x 1350 mm. Also, minimum width of entrance/exit door is 900 mm.



14. In landscaping, Miyawaki technique is used for \_\_\_\_\_.

- (A) creating waterbodies to stop rapid urbanization
- (B) pruning shrubs in urban plantation
- (C) creating dense forests with native plants
- (D) identifying sites for urban vertical gardens

Answer: C

Explanation: Japanese botanist Akira Miyawaki endowed the Miyawaki technique to create dense forests with native plants. This unique method is used worldwide for urban afforestation by planting trees very densely together using only native species from the local area, mimicking the natural regeneration process of a forest to rapidly create a diverse, dense forest ecosystem generally on degraded land.

15. In Burgess's Concentric Zone model, 1920, \_\_\_\_\_ is characterized by mixed residential and commercial establishments.

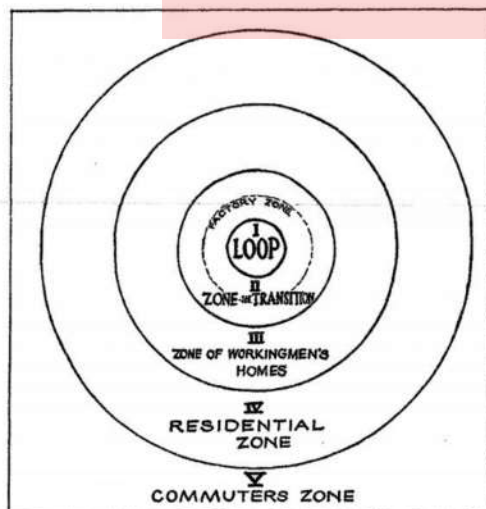
- (A) Zone of better housing
- (B) Zone of independent working class
- (C) Zone of transition
- (D) Zone of high-class homes on outskirts of outer suburbs

Answer: C

Explanation: In 1925, Burgess published a chapter in a volume titled *The City* (which he also edited with Robert Park). The chapter, "The Growth of the City: An Introduction to a Research Project," outlines what would become known as the Concentric Zone Model.

The zones identified are:

1. The center with the central business district,
2. The transition zone of mixed residential and commercial uses or the zone of transition,
3. Working class residential homes (inner suburbs), in later decades called inner city or zone of independent working men's home,
4. Better quality middle-class homes (outer suburbs) or zone of better housing,
5. Commuter zone, high-class homes on outskirts of outer suburbs - homeowner can afford to commute to central business district.



16. Identify the correct relationship with respect to water quality from the following options.

- (A) Total solids = Suspended solids + Dissolved solids + Colloidal solids
- (B) Total gases = Biological Oxygen Demand + Chemical Oxygen Demand + Dissolved Oxygen
- (C) Total solids = Suspended Solids + Dissolved solids
- (D) Total gases = Biological Oxygen Demand + Chemical Oxygen Demand

Answer: C

Explanation: Below are the definitions of related water quality parameters:

**Total Dissolved Solids (TDS):** These are the solids that pass through a filter (usually 2-micron or smaller) and remain dissolved in water.

**Total Suspended Solids (TSS):** These are the solids that are retained on the filter and do not dissolve in water.

**Total Solids (TS):** This is the sum of both dissolved and suspended solids present in water.

So, in water quality analysis, it can be written as  $TS = TSS + TDS$

NOTE: Colloidal solids are considered to be a part of suspended solids, and are not added separately in 'total solids'.

17. As per the Solid Waste Management Rules, 2016, co-processing is the use of \_\_\_\_\_ and \_\_\_\_\_ solid waste having calorific value exceeding 1500 kcal/kg as raw material or as a source of energy, or both.
- (A) Non-biodegradable, Non-recyclable
  - (B) Biodegradable, Recyclable
  - (C) Non-biodegradable, Recyclable
  - (D) Biodegradable, Non-recyclable

Answer: A

Explanation: As per SWM Rules, 2016: “**co-processing**” means use of non-biodegradable and non-recyclable solid waste having calorific value exceeding 1500k/cal as raw material or as a source of energy or both to replace or supplement the natural mineral resources and fossil fuels in industrial processes.

18. For composting, the optimum Carbon to Nitrogen (C:N) ratio is closest to \_\_\_\_\_.

- (A) 5:1
- (B) 30:1
- (C) 70:1
- (D) 1:1

Answer: B

Explanation: Microorganisms that break down organic matter in compost need both carbon (for energy) and nitrogen (for building proteins and other essential compounds). A C:N ratio of 25-30:1 provides the right balance for efficient decomposition and a good quality compost. Higher C:N ratio slows down the



decomposition because the microbes don't have enough nitrogen to support their activity. Low C:N ratio leads to unpleasant odours and a loss of valuable nutrients as Nitrogen can be lost as Ammonia gas. To achieve the ideal C:N ratio, materials that are high in carbon (like dry leaves, wood chips, and straw) are combined with materials that are high in nitrogen (like grass clippings, fruit and vegetable scraps, and manure).

19. Read the following statements and select the correct option.

P: Strong axial layout, symmetry, proportion and infinite perspective of the 17th Century French Gardens reflects the wealth, power and rigid social structure of France.

Q: Italian gardens of early renaissance period were designed as intellectual retreats where scholars and artists could work and debate.

- (A) P is true but Q is false
- (B) P is false but Q is true
- (C) Both P and Q are true
- (D) Both P and Q are false

Answer: C

Explanation: French gardens of the 17th century, particularly those influenced by André Le Nôtre, were characterized by:

- **Strong axial layout** – Gardens were arranged in a rigid, geometric manner, emphasizing symmetry.
- **Symmetry and Proportion** – Everything was planned with strict mathematical precision to reflect order and control.
- **Infinite Perspective** – Features like long, straight avenues and reflecting pools created a visual effect that extended towards the horizon.
- **Wealth and Power Representation** – These gardens, such as **Versailles**, symbolized the authority of the monarchy, particularly **King Louis XIV**, and reinforced the rigid social hierarchy of France.

Italian Renaissance gardens, emerging in the **15th and 16th centuries**, were different from French gardens in intent and style:

- **Intellectual Retreats** – Unlike the grand, formal gardens of France, Italian gardens were designed as spaces for **learning, contemplation, and discussion**.
- **Influence of Humanism** – Renaissance scholars and artists, inspired by classical antiquity, used these gardens as places for **philosophy, poetry, and art**.
- **Examples** – Gardens like **Villa d'Este, Villa Lante, and Boboli Gardens** were built not just for aesthetics but for fostering intellectual activities.
- **Design Features** – These gardens had terraces, fountains, sculptures, and grottos, creating an environment conducive to dialogue and creativity.

20. The concept of \_\_\_\_\_ is primarily used to describe an urban area with plenty of green spaces and waterbodies to retain and/or detain rainwater.

- (A) Sponge City
- (B) Aerocity
- (C) 15-minute City
- (D) Compact City

Answer: A

Explanation: A sponge city is an urban planning model that uses natural systems to manage rainwater and reduce flooding. The term comes from the way sponges absorb, store, and slowly release water. Sponge cities help mitigate the effects of heavy rainfall events, make cities more resilient to climate change and flooding, and make cities more sustainable by using resources more efficiently.

21. Identify the correct sequence of drawings prepared by architects at various stages of building design and construction.

- (A) Working drawing; Statutory approval drawing; Conceptual design drawing; Completion drawing
- (B) Statutory approval drawing; Conceptual design drawing; Completion drawing; Working drawing
- (C) Conceptual design drawing; Statutory approval drawing; Working drawing; Completion drawing
- (D) Conceptual design drawing; Working drawing; Completion drawing; Statutory approval drawing

Answer: C

Explanation: As per the 'Comprehensive Architectural Services' by Council of Architecture (CoA), below are the stages in 'Schedule of Services':

Stage 1: Concept Design – Prepare design brief, site evaluation & survey, soil investigation, prepare conceptual designs & rough estimate of project cost

Stage 2: Preliminary Design & Drawings – Prepare preliminary drawings, sketches, study models, etc., for the client's approval with preliminary estimate of cost

Stage 3: Drawings for Client's/Statutory Approvals – Prepare necessary drawings for client's/statutory approvals and ensure compliance with codes, standards, and legislation, as applicable and assist the client in obtaining statutory approvals thereof, if required

Stage 4: Working drawings & Tender documents – Prepare working drawings, specifications and schedule of quantities sufficient to prepare estimate of cost and tender documents including code of practice covering aspects like mode of measurement, method of payments, quality control procedures on materials & works and other conditions of contract

Stage 5: Appointment of Contractors – Invite, receive, and analyse tenders, advise client on appointment of contractors

Stage 6: Construction – Prepare and issue working drawings & details for proper execution of works during construction. Check and approve shop drawings submitted by the contractor/vendors. Site visit and issue certificate of visual completion of works



Stage 7: Completion – Prepare & submit completion reports& drawings for the project as required and assist the client in obtaining ‘Completion/Occupancy Certificate’ from statutory authorities, whenever required. Issue two sets of as built drawings including services & structures.

The correct sequence of drawings which aligns with the stages explained above is “Conceptual design drawing; Statutory approval drawing; Working drawing; Completion drawing”.

22. As per the National Building Code of India, 2016, choose the correct option where materials are arranged in the increasing order of their embodied energy.

- (A) Medium Density Fibreboard < Aluminium < Float Glass < Fly-ash Bricks
- (B) Fly-ash Bricks < Medium Density Fibreboard < Float Glass < Aluminium
- (C) Medium Density Fibreboard < Fly-ash Bricks < Float Glass < Aluminium
- (D) Fly-ash Bricks < Aluminium < Medium Density Fibreboard < Float Glass

Answer: B

Explanation: Classification of materials based on energy intensity (as per National Building Code, 2016) is given below:

Sl No.	Category of Material	Energy Intensity (Range) GJ/t	Examples
(1)	(2)	(3)	(4)
i)	Very high energy	>50	Aluminium, stainless steel, plastic, copper, zinc
ii)	High energy	5-50	Cement, steel, glass, bitumen, solvents, cardboard, paper and lead
iii)	Medium energy	1-5	Lime, gypsum plaster board, burnt clay brick, burnt clay brick from improved vertical shaft kiln, aerated block, hollow concrete block, gypsum plaster, concrete block, timber, wood products, particle board, medium density fibre board, cellulose insulation, <i>in-situ</i> concrete
iv)	Low energy	<1	Sand, aggregate, fly ash and fly ash based products, cement stabilized soil block, straw bale, bamboo, stone

**NOTES**

**1** While comparing embodied energy of building materials, the total quantity by mass of the material times the embodied energy value per unit mass (energy intensity) of the material to be installed for same surface area of the building may be compared.

**2** The values given in the table are comparative values, and in case of substantial difference in the transportation component of the materials in question, the same should also be taken into account while calculating the embodied energy.



23. Which one of the following Universal Design principles aims to “minimise hazards and the adverse consequences of accidental or unintended actions”?

- (A) Flexibility in use
- (B) Tolerance for error
- (C) Perceptible information
- (D) Simple and intuitive use

Answer: B

Explanation: The 7 Principles of Universal Design were developed in 1997 by a working group of architects, product designers, engineers and environmental design researchers, led by the late Ronald Mace (Design Pioneer, internationally recognized Architect) in North Carolina State University

Principle 1: Equitable Use - The design is useful and marketable to people with diverse abilities.

Principle 2: Flexibility in Use - The design accommodates a wide range of individual preferences and abilities.

Principle 3: Simple and Intuitive Use - Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

Principle 4: Perceptible Information - The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

Principle 5: Tolerance for Error - The design minimizes hazards and the adverse consequences of accidental or unintended actions.

Principle 6: Low Physical Effort - The design can be used efficiently and comfortably and with a minimum of fatigue.

Principle 7: Size and Space for Approach and Use - Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

24. Which one of the following buildings features an Onion dome?

- (A) Matrimandir, Auroville
- (B) Rashtrapati Bhavan, New Delhi
- (C) Taj Mahal, Agra
- (D) Victoria Memorial, Kolkata

Answer: C

Explanation: The marble dome that surmounts Taj Mahal is the most spectacular feature is accentuated as it sits on a cylindrical "drum" which is roughly 23 feet high. Because of its shape, the dome is often called an onion dome. The top is decorated with a lotus design, which also serves to accentuate its height. The central bulbous shaped dome is flanked by four smaller, similarly shaped domes at the corners.

25. As per the UN's Sustainable Development Goals (SDGs), urban health is dealt with in SDG 3 and SDG 6 that are \_\_\_\_\_ and \_\_\_\_\_, respectively.

- (A) Good health and well-being; Clean water and sanitation
- (B) Reduced inequalities; High nutrition
- (C) Reduced inequalities; Sustainable cities and communities
- (D) Good health and well-being; High nutrition

Answer: A

Explanation: SDG 3, "Good Health and Well-being," aims to ensure healthy lives and promote well-being for all at all ages, while SDG 6, "Clean Water and Sanitation," focuses on ensuring the availability and sustainable management of water and sanitation for all.

26. The 4th and 5th dimension of Building Information Modelling (BIM) are \_\_\_\_\_ and \_\_\_\_\_, respectively.

- (A) Facility management; Sustainability
- (B) Construction schedule; Construction costing
- (C) Sustainability; Construction schedule
- (D) Construction costing; Facility management

Answer: B

Explanation: BIM dimensions extend beyond the basic 3D representation, incorporating time (4D), cost (5D), sustainability (6D), facility management (7D), safety (8D), and lean construction (9D) to provide a comprehensive view of a project throughout its lifecycle.

- **3D BIM:** The foundation of BIM, representing the three-dimensional geometry of a building.
- **4D BIM:** Adds the dimension of time, allowing for visualization of the construction sequence and scheduling.
- **5D BIM:** Incorporates cost information, enabling budget planning and cost estimation.
- **6D BIM:** Focuses on sustainability, including energy efficiency and lifecycle performance.
- **7D BIM:** Addresses facility management, including asset and maintenance tracking.
- **8D BIM:** Integrates health and safety considerations, focusing on risk assessment and mitigation.
- **9D BIM:** Focuses on lean construction, optimizing project implementation through digital processes and efficient resource management

27. Which of the following is/are likely to be caused by an earthquake? (MSQ Type)

- (A) Liquefaction
- (B) Heatwave
- (C) Tsunami
- (D) Tornado

Answer: A, C



Explanation: Earthquakes result in various effects, such as ground shaking and soil liquefaction, leading to significant damage and loss of life. When the epicentre of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can trigger landslides.

Primary Effects of Earthquake (Directly from Ground Shaking) include:

- **Ground Shaking:** The primary effect of an earthquake is the shaking of the ground, which can cause damage to buildings, infrastructure, and other structures.
- **Ground Rupture:** Earthquakes can cause the ground to rupture along fault lines, leading to cracks and displacement of the surface.
- **Landslides:** Earthquakes can trigger landslides, especially in areas with steep slopes or unstable soil.
- **Tsunamis:** If the earthquake occurs underwater, it can generate tsunamis, which are large waves that can cause widespread coastal flooding and destruction.
- **Surface Faulting:** Earthquakes can cause the earth's surface to rupture along fault lines.

Secondary Effects (Indirectly Resulting from Earthquake):

- **Liquefaction:** Strong earthquake shaking can cause saturated soil to behave like a liquid, leading to buildings sinking or tilting, and roads and bridges to fail.
- **Fires:** Earthquakes can rupture gas and electrical lines, leading to fires, which can be difficult to control due to potential damage to water infrastructure.
- **Flooding:** Earthquakes can cause dams or levees to fail, leading to flooding.
- **Seiches:** In lakes, earthquakes can cause seiches, which are small tsunamis that can still cause damage to coastal areas.
- **Ground Resonance:** Certain soil types can amplify ground shaking, leading to increased damage.
- **Subsidence:** Earthquakes can cause the ground to sink or subside.
- **Avalanches:** Earthquakes can trigger avalanches in mountainous regions

28. Which of the following cities predominantly has/have a grid iron street pattern? (MSQ Type)

- (A) Cairo
- (B) Chandigarh
- (C) Philadelphia
- (D) Venice

Answer: B, C

Explanation: Both Chandigarh and Philadelphia utilize grid layouts for their urban planning, but with distinct characteristics: Chandigarh's grid emphasizes a modular, sector-based design with a hierarchy of roads, while Philadelphia's grid is a more traditional, rectangular pattern with public squares and varying street widths.



29. Match the following items of work in Group-I with their corresponding units of measurement in Group-II.

Group I	Group II
P. Honeycomb Brickwork	1. Running Meter
Q. Steel Reinforcement	2. Cubic Meter
R. Bridge on Edge	3. Square Meter
S. Earthwork in Excavation	4. Kilogram
	5. Number

- (A) P-1, Q-4, R-3, S-2  
 (B) P-3, Q-1, R-4, S-5  
 (C) P-5, Q-2, R-1, S-4  
 (D) P-3, Q-4, R-1, S-2

Answer: D

Explanation: As per CPWD Specifications, 2019:

**Honeycomb brickwork:** The thickness of the brick honeycomb work shall be half-brick only, unless otherwise specified. The length and height shall be measured correct to a cm. Area shall be calculated in square metres correct to two places of decimal. Honeycomb openings shall not be deducted.

**Brick Edging:** Trenches of required depth and width shall first be made along the edge of the plinth protection to receive the bricks for edging. The bed of trenches shall be compacted to a firm and even surface. The top face of the brick edging shall be in one level to conform to the finished level of the plinth protection adjacent to the edging. After the concreting is done, no portion of the brick edging shall project above the adjacent concrete surface. The brick edging shall be measured in running meter correct a cm.

**Earthwork in Excavation:** The length and breadth of excavation or filling shall be measured with a steel tape correct to the nearest cm. The depth of cutting or height of filling shall be measured, correct to 5 mm, by recording levels before the start of the work and after the completion of the work. The cubical contents shall be worked out to the nearest two places of decimal in cubic metres.

**Steel Reinforcement:** Reinforcement including authorized spacer bars and lappages shall be measured in length of different diameter, as actually (not more than as specified in the drawings.) used in the work nearest to a centimetre and their weight calculated on the basis of standard weight given in IS 1786.

30. Match the types of water carriage system in Group-I with their corresponding functions in Group-II.

Group I	Group II
P. Combined system	1. Rain water from roof is allowed to enter the sewer carrying sewage and the remaining storm water flows separately
Q. Vacuum sewer system	2. Rain water from roof and sewage from buildings are taken along with storm water

R. Partially separate system	3. A pump is used to pump waste from the residences to the low pressure sewer line
S. Pressurized sewer system	4. The sewer is under negative pressure and it pulls sewage and air from different sources
	5. Sewage from buildings is taken in one set of sewers and storm water in another network

(A) P–2, Q–4, R–1, S–3

(B) P–2, Q–3, R–5, S–4

(C) P–1, Q–4, R–5, S–3

(D) P–1, Q–3, R–1, S–4

Answer: A

Explanation: The four types of sewer systems are defined below:

**Combined Sewer System:** A combined sewer system is a type of sewerage network that collects both stormwater runoff and domestic/industrial wastewater in a single pipe system. This system is cost-effective in terms of construction but can lead to issues like combined sewer overflows (CSOs) during heavy rainfall, resulting in untreated sewage being discharged into water bodies.

**Vacuum Sewer System:** A vacuum sewer system uses a network of pipes maintained under negative pressure (vacuum) to transport wastewater. It relies on vacuum stations to create suction, drawing wastewater to a collection point before pumping it to a treatment facility. This system is suitable for flat terrains, areas with high groundwater levels, or locations where excavation is difficult.

**Partially Separate Sewer System:** A partially separate sewer system is a hybrid approach that collects domestic sewage and part of the stormwater separately, reducing the load on treatment plants. Typically, minor rainwater runoff (rainwater from roofs) is carried with sewage, while excess stormwater is directed to natural drainage channels, reducing the risk of overflows.

**Pressurized Sewer System:** A pressurized sewer system (also known as a force main system) uses pumps and pressure pipes to transport wastewater, making it ideal for hilly terrains, areas with high water tables, or when gravity-based systems are impractical. This system ensures controlled flow and prevents blockages by maintaining a consistent pressure.

31. Match the following UNESCO World heritage sites in Group-I with their relevant historic significance in Group-II.

Group I	Group II
P. Walled City of Jaipur	1. A city from the Mughal era, planned as a whole with architectural ensembles constructed at the end of 16th Century
Q. Fatehpur Sikri	2. Timber based architecture of historic city, having exceptional significance from 15th Century Sultanate period



R. Group of Monuments at Hampi	3. Conceived in a single phase in the 18th Century with a grid-iron pattern inspired from prastara plan of vāstushāstra
S. Dholavira, Harappan city	4. Comprises mainly the remnants of the capital city of Vijayanagara Empire
	5. Proto-historic bronze age urban settlement

(A) P–1, Q–2, R–4, S–5

(B) P–5, Q–1, R–3, S–4

(C) P–3, Q–1, R–4, S–5

(D) P–3, Q–5, R–2, S–4

Answer: C

Explanation: The Walled City of Jaipur is an example of planned urban development, following the "Prastara" grid layout of the Vastu Shastra, a traditional Hindu treatise on architecture. The city layout is based on dividing into nine blocks with main streets forming a grid pattern. The layout gives prominence to cardinal directions. The plan of Jaipur is a grid of 3×3 with gridlines being the city's main streets.

Fatehpur Sikri is a small city in northern India, just west of Agra, founded by a 16th-century Mughal emperor. Red sandstone buildings cluster at its center. Buland Darwaza gate is the entrance to Jama Masjid mosque. Nearby is the marble Tomb of Salim Chishti. Diwan-E-Khas hall has a carved central pillar. Jodha Bai's Palace is a mix of Hindu and Mughal styles, next to the 5-story Panch Mahal that overlooks the site.

Hampi, also known as the Group of Monuments at Hampi, is situated in the Tungabhadra basin in Central Karnataka, India. The site comprises the ruins of the capital city of the Vijayanagara Empire, a powerful Hindu kingdom that flourished between the 14th and 16th centuries CE. It is recognized as a UNESCO World Heritage Site. The site showcases the architectural and artistic achievements of the Vijayanagara Empire, including temples and other structures.

Dholavira is an exceptional example of a proto-historic Bronze Age urban settlement pertaining to the Harappan Civilization (early, mature and late Harappan phases) and bears evidence of a multi-cultural and stratified society during the 3rd and 2nd millennia BCE.

32. Match the following principles of design in Group-I to their corresponding descriptions in Group-II.

Group I	Group II
P. Datum	1. The use of recurring patterns to organize a series of like forms or spaces
Q. Symmetry	2. The balanced distribution of equivalent forms and spaces about a common line or point
R. Hierarchy	3. A line established by two points in space, about which forms and spaces can be arranged in a symmetrical or balanced manner



S. Rhythm	4. A line, plane or volume that by its continuity and regularity helps to organize a pattern of forms and spaces
	5. The significance of a form or space based in the size, shape or placement relative to other forms of the organization

- (A) P-3, Q-2, R-5, S-1  
 (B) P-4, Q-1, R-3, S-5  
 (C) P-4, Q-2, R-5, S-1  
 (D) P-3, Q-4, R-2, S-5

Answer: C

Explanation: Below are the 'Ordering Principles' as per 'Architecture: Form, Space, & Order' by Francis D. K. Ching:

**Axis:** A line established by two points in space, about which forms and spaces can be arranged in a symmetrical or balanced manner.

**Symmetry:** The balanced distribution and arrangement of equivalent forms and spaces on opposite sides of a dividing line or plane, or about a center or axis.

**Hierarchy:** The articulation of the importance or significance of a form or space by its size, shape, or placement relative to the other forms and spaces of the organization.

**Rhythm:** A unifying movement characterized by a patterned repetition or alternation of formal elements or motifs in the same or a modified form.

**Datum:** A line, plane, or volume that, by its continuity and regularity, serves to gather, measure, and organize a pattern of forms and spaces.

**Transformation:** The principle that an architectural concept, structure, or organization can be altered through a series of discrete manipulations and permutations in response to a specific context or set of conditions without a loss of identity or concept.

33. Match the following Books in Group-I with their corresponding Authors in Group-II.

Group I	Group II
P. Cities for People	1. Francis D. K. Ching
Q. Architecture: Form, Space, and Order	2. Jan Gehl
R. The Death and Life of Great American Cities	3. Kevin Lynch
S. The Image of the City	4. Jane Jacobs
	5. F. L. Wright

- (A) P-5, Q-2, R-4, S-3  
 (B) P-2, Q-1, R-4, S-3

(C) P-3, Q-4, R-5, S-1

(D) P-2, Q-1, R-3, S-4

Answer: B

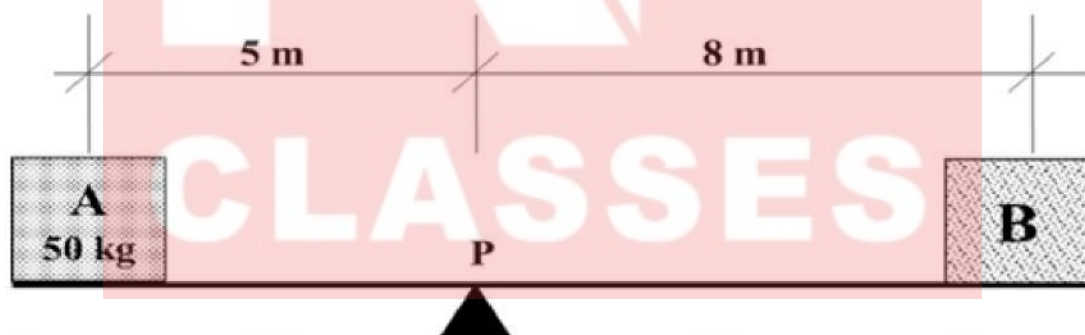
**Explanation: Cities for People:** In this revolutionary book, Jan Gehl presents his latest work creating (or recreating) cityscapes on a human scale. He clearly explains the methods and tools he uses to reconfigure unworkable cityscapes into the landscapes he believes they should be. Considering changing demographics and changing lifestyles, Gehl emphasizes four human issues that he sees as essential to successful city planning. He explains how to develop cities that are Lively, Safe, Sustainable, and Healthy.

**Architecture: Form, Space, and Order:** This book by Francis D. K Ching brings complex concepts of design into a clear focus and brings difficult abstractions to life. The book explains form and space in relation to light, view, openings, and enclosures and explores the organization of space, and the elements and relationships of circulation, as well as proportion and scale. In addition, the text gives detailed illustrations demonstrate the concepts presented and reveal the relationships between fundamental elements of architecture through the ages and across cultures.

**The Death and Life of Great American Cities:** This is a 1961 book by writer and activist Jane Jacobs. The book is a critique of 1950s urban planning policy, which it holds responsible for the decline of many city neighbourhoods in the United States. The book is Jacobs' best-known and most influential work.

**The Image of the City:** This is a 1960 book by American urban theorist Kevin Lynch. The book is the result of a five-year study of Boston, Jersey City and Los Angeles on how observers take in information of the city and use it to make mental maps.

34. In order to achieve the static equilibrium of the see-saw about the fulcrum P, shown in the figure, the weight of the Box B should be \_\_\_\_\_ kg, if weight of Box A is 50 kg.



- (A) 50
- (B) 31.25
- (C) 80
- (D) 61.25

Answer: B

**Explanation:** For static equilibrium of the see-saw about the fulcrum, moments due to each block on both sides about the fulcrum should be equal.

Moment is calculated by “Weight \* Distance from fulcrum”



(Weight of A \* Distance of A from P) = (Weight of B \* Distance of B from P)

$$\Rightarrow (50 * 5) = (\text{Weight of B} * 8)$$

$$\Rightarrow \text{Weight of B} = (50 * 5)/8 = 31.25 \text{ kg}$$

35. Which of the following is/are supply side intervention(s) to improve housing affordability? (MSQ Type)

- (A) Increase in availability of urban land for housing
- (B) Increase in Institutional Housing Finance
- (C) Reduction in Floor Area Ratio
- (D) Increase in Stamp Duty

Answer: A, B

Explanation: Supply-Side Interventions to improve housing affordability (Focus on Increasing Housing Stock & Reducing Costs): These policies aim to **boost the supply of affordable housing** by addressing land availability, construction regulations, and developer incentives.

- **Increasing Land Supply** – Example: Unlocking government-owned land for housing projects.
- **Higher Floor Area Ratio (FAR)/Floor Space Index (FSI)** – Example: Mumbai's FSI reforms allowing higher density development.
- **Streamlining Approvals & Reducing Construction Costs** – Example: Single-window clearance for real estate projects in India.
- **Incentives for Affordable Housing Development** – Example: Pradhan Mantri Awas Yojana (PMAY) providing subsidies to developers.
- **Increase in Institutional Housing Finance**: Increased financing can encourage developers to construct more affordable housing by making funding more accessible, which indirectly increases housing supply.
- **Public-Private Partnerships (PPP) in Housing** – Example: Singapore's Housing and Development Board (HDB) projects.

Demand-Side Interventions to improve housing affordability (Focus on Improving Affordability for Buyers): These policies make homeownership or renting **more affordable for individuals** through financial assistance and subsidies.

- **Subsidized Housing Loans & Interest Rate Reductions** – Example: Credit-Linked Subsidy Scheme (CLSS) under PMAY.
- **Rental Assistance Programs** – Example: Section 8 Housing Choice Voucher Program in the U.S.
- **Reduction in Stamp Duty & Registration Charges** – Example: Maharashtra's stamp duty reduction during the pandemic.
- **First-Time Homebuyer Grants & Tax Benefits** – Example: India's tax deduction under Section 80EE for first-time homebuyers.
- **Government-backed Mortgage Insurance** – Example: FHA Loans in the U.S. ensuring easier loan access.

36. Which of the following method(s) is/are used for desalination of water? (MSQ Type)



- (A) Reverse Osmosis
- (B) Activated Sludge Process
- (C) Incineration
- (D) Distillation

Answer: A, D

Explanation: Reverse Osmosis: Reverse osmosis is a membrane treatment process primarily used to separate dissolved solutes from water. Reverse osmosis is most commonly known for its use in drinking water purification, particularly with regard to removing salt and other effluent materials from water molecules.

Distillation: Distillation of water is a purification method where water is heated to evaporate, leaving behind impurities, and then the vapor is condensed back into liquid form, resulting in purified water. Contaminated water is heated to form steam. Inorganic compounds and large non-volatile organic molecules do not evaporate with the water and are left behind. The steam then cools and condenses to form purified water.

Activated Sludge Process is an aerobic digestion process used in wastewater treatment. Incineration is a thermal treatment process used in Solid Waste Management.

37. Identify the set(s) of complimentary colours based on RGB Model. (MSQ Type)

- (A) Yellow and Purple
- (B) Yellow and Orange
- (C) Blue and Orange
- (D) Blue and Purple

Answer: Marks to All

Explanation: The RGB model is an additive color model, meaning colors are created by mixing varying intensities of red, green, and blue light. In the RGB color model, complementary colors are pairs of colors that, when combined, produce white light (in additive mixing). These colors are directly opposite to each other on the RGB color wheel. Complementary colors in this model are determined by subtracting each primary color from white (255,255,255).

Below are the RGB Complimentary Pairs:

- **Red (255,0,0) and Cyan (0,255,255):** Red (R) + Green (G) + Blue (B) = White, and Cyan is Green + Blue, so Cyan + Red = White.
- **Green (0,255,0) and Magenta (255,0,255):** Green (G) + Red (R) + Blue (B) = White, and Magenta is Red + Blue, so Magenta + Green = White.
- **Blue (0,0,255) and Yellow (255,255,0):** Blue (B) + Red (R) + Green (G) = White, and Yellow is Red + Green, so Yellow + Blue = White.

38. A city has a population of 1,75,000. Using the Kuichling's formula the estimated fire demand for the city is \_\_\_\_\_ litres/min. (rounded off to two decimal places)

Answer: 42000 to 42200

Explanation: Kuichling's formula is used to calculate the fire demand of a city, estimating the amount of water required in liters per minute (Q) based on the population (P) in thousands, using the formula:

$$Q = 3182\sqrt{P}$$

Here,  $P = 175$

Estimated fire demand (in liters/min),  $Q = 3182 * \sqrt{175} = 42,093.90$  liters/min

39. A rectangular plot has the dimensions of 20 m × 15 m. A building on the plot fully utilizes both Floor Area Ratio (FAR) of 3.0 and ground coverage of 50%. Considering all floors having equal area, the maximum number of floors that can be built on the plot is \_\_\_\_\_. (answer in integer)

Answer: 6

Explanation: Maximum permissible Built-up area = Plot Area \* FAR = 20 \* 15 \* 3 = 900 sqm

Area on each floor = 50% of plot area = 0.5 \* 20 \* 15 = 150 sqm

Number of floors = Maximum permissible Built-up area/Area on each floor = 900/150 = 6 Floors

40. A real estate project on a 12 hectare site contains 6 buildings, each with ground coverage of 3 percent of the site area. The landscaped area is 40 percent of the site and rest of the area are roads. Assume coefficient of runoff for landscaped area and road area to be 0.15 and 0.6 respectively. Ignore the rainwater from the roof of the buildings and additional water from outside areas. Considering average rainfall intensity of 70 mm per hour, the estimated peak surface runoff rate from the site is \_\_\_\_\_ m<sup>3</sup>/s. (rounded off to two decimal places)

Answer: 0.70 to 0.74

Explanation: As per the given question, surfaces for runoff calculation are Landscape area, and roads.

The runoff coefficients, 'C' for landscape area and roads are 0.15 and 0.6 respectively (Given)

Intensity of rainfall,  $i = 70$  mm per hour = (0.07/3600) in m<sup>3</sup>/sec

Surface area for landscape area = 40% of site area = 48,000 sqm

Rate of runoff from landscape area =  $0.15 * (0.07/3600) * 48000 = 0.14$  m<sup>3</sup>/sec

Total ground coverage of 6 buildings =  $6 * 3 = 18\%$

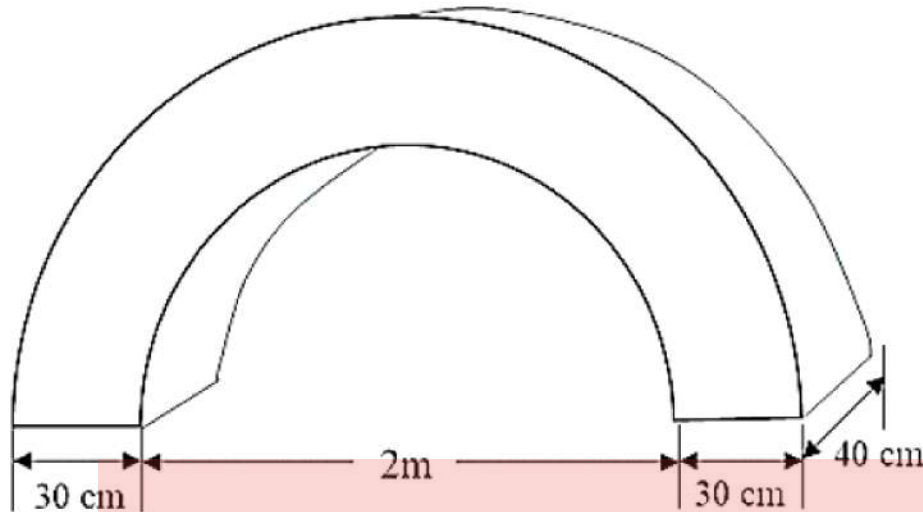
Surface area for roads =  $100 - (40+18) = 42\%$  of site area = 50,400 sqm

Rate of runoff from roads =  $C * i * A = 0.6 * (0.07/3600) * 50400 = 0.588$  m<sup>3</sup>/sec

Estimated peak surface runoff rate =  $0.14 + 0.588 = 0.728$  m<sup>3</sup>/sec

41. In a regular semi-circular arch of 2 m clear span, the thickness of the arch is 30 cm and the breadth of the wall is 40 cm. The total quantity of brickwork in the arch is \_\_\_\_\_ m<sup>3</sup>. (rounded off to two decimal places)





Answer: 0.41 to 0.45

Explanation: Radius till the mean length of the arch = 1 + 0.15 = 1.15 meter

Mean length of the arch =  $\pi * 1.15 = 3.61$  m

Volume of the arch =  $3.61 * 0.3 * 0.4 = 0.4332$  m<sup>3</sup>

42. A roof area of 6000 m<sup>2</sup> of a building is drafted on a drawing sheet as 240 cm<sup>2</sup>. The scale used in the drawing sheet is 1:\_\_\_\_\_ . (rounded off to the nearest integer)

Answer: 500

Explanation:

Scale of the drawing (when data for area is available) is given by:

$$Scale = \sqrt{\frac{Area\ in\ the\ drawing}{Actual\ area\ in\ same\ units}}$$

Area in the drawing = 240 cm<sup>2</sup>

Corresponding actual area = 6000 \* 100 \* 100 cm<sup>2</sup>

$$Scale = \sqrt{\frac{240}{6000 * 100 * 100}} = \frac{1}{500}$$

43. A housing property of INR 50 lakh is on sale either through a Full Down Payment (FDP) scheme with an 8% rebate OR a Deferred Payment Plan (DPP) as shown in the table. A customer after converting all the future payments in DPP using 10% annual discount rate, found the DPP scheme to be financially gainful. The customer would be able to save in INR \_\_\_\_\_ lakh, if DPP is chosen over FDP. (rounded off to two decimal places)

Deferred Payment Plan (DPP)	
At the time of booking	INR 10 lakh

After one year	INR 15 lakh
After two year	INR 15 lakh
After three year	INR 10 lakh

Answer: 2.3 to 2.7

Explanation: Net Present Value for Full Down Payment (FDP) with an 8% rebate = INR 50 Lakh – (8% of INR 50 Lakh) = 50 – 4 = INR 46 Lakh

For a future value 'FV', discount rate 'r', and 'n' number of years; Present value is given by:

$$PV = \frac{FV}{(1 + r)^n}$$

The table below is the Present Value for the cashflows of Deferred Payment Plan:

Year	Payment Amount (Cashflow)	Present Value of Cashflow
0	INR 10 lakh	INR 10 lakh
1	INR 15 lakh	13.64 lakh
2	INR 15 lakh	12.40 lakh
3	INR 10 lakh	$\frac{10}{(1 + 0.1)^3} = 7.51 \text{ lakh}$

Net Present Value for Deferred Payment Plan (DPP) = 10 + 13.64 + 12.40 + 7.51 = INR 43.55 lakh

Amount saved by choosing DPP over FDP = 46 – 43.55 = INR 2.45 lakh

44. The population of a city in the year 2001, 2011, 2021 were recorded as 52,000, 76,000 and 1,20,000 respectively. Calculating the average growth rate using geometric mean, the estimated population of the city for 2031 using geometric increase method is \_\_\_\_\_. (rounded off to the nearest integer)

Answer: 179000 to 184000

Explanation: Percentage increase of population from 2001 to 2011,  $r_1$  is:

$$r_1 = \frac{76000 - 52000}{52000} = 0.4615$$

Percentage increase of population from 2011 to 2021,  $r_2$  is:

$$r_2 = \frac{120000 - 76000}{76000} = 0.5789$$

Average growth rate using geometric mean, 'r' will be:

$$r = \sqrt{0.4615 * 0.5789} = 0.5169$$

Estimated population of the city for 2031 using geometric increase method = 1,20,000 \* (1+0.5169) = 1,82,028



45. A room having dimension of 12 m × 8 m and height 4 m, stores a certain combustible material of volume 80 m<sup>3</sup>. The density and calorific value of the combustible material are 3.0 kg/m<sup>3</sup> and 4000 kcal/kg, respectively. The fire load of the room is \_\_\_\_\_ kcal/m<sup>2</sup>. (rounded off to the nearest integer)

Answer: 10000

Explanation: Total weight of combustible material = Volume \* Density = 80 m<sup>3</sup> \* 3.0 kg/m<sup>3</sup> = 240 kg

Fire load of the room (in kcal) = Weight of combustible material \* Calorific value = 240 kg \* 4000 kcal/kg = 9,60,000 kcal

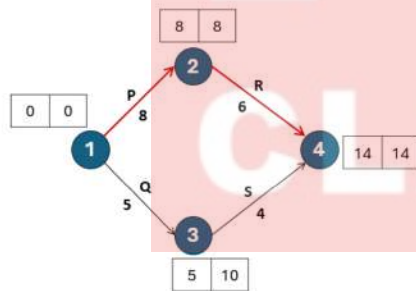
Fire load of the room (in kcal/m<sup>2</sup>) = 9,60,000/(12\*8) = 10,000 kcal/m<sup>2</sup>

46. A construction project consists of four activities. The duration, relationship and cost parameters are given in the table. The indirect cost of the project is INR 5000/- per week. If the project has to be completed by 12 weeks, the total project cost will be, INR \_\_\_\_\_. (Answer in integer)

Activity	Immediate Predecessor Activity	Normal Duration (Weeks)	Crash Duration (Weeks)	Normal Cost (INR)	Crash Cost (INR)
P	Nil	8	5	20,000	26,000
Q	Nil	5	2	30,000	33,000
R	P	6	4	40,000	52,000
S	Q	4	3	10,000	13,000

Answer: 164000

Explanation: Considering the given activities, immediate predecessors, and normal duration, the project network can be developed as follows:



The critical path (P – R) has a path duration of 14 weeks. The only other path from start to end is (Q – S) with a path duration of 9 weeks, which is lower than the required crash duration of 12 weeks for the project. This means, the path P – R has to be crashed to 12 weeks, i.e., it has to be crashed by 2 weeks.

Cost-time slope of an activity is calculated as:

$$\text{Cost – time slope} = \frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$$

The cost-time slope for P = Rs. 2000/week

The cost-time slope for R = Rs. 6000/week

Activity 'P' shall be crashed by 2 weeks: As its cost-time slope is low and it has a scope for 3 weeks of crashing (which is Normal duration – Crash duration). The duration of 'P' after crashing = 6 weeks

Additional cost incurred for crashing = Rs. 2000/week \* 2 weeks = Rs. 4000/-

The direct cost associated with the activities will be: P = 20K, Q = 30K, R = 40K, S = 10K

Total indirect cost for the project = Project Duration after crashing \* Rs. 5000/- per week = 12\*5000 = Rs. 60,000/-

Total Project Cost = Total direct cost of all activities + Total indirect costs + Cost for crashing = (1,00,000 + 60,000 + 4000) = Rs. 1,64,000/-

47. A 24 cm line AB is vertically standing on a horizontal plane. The station point is located 18 cm above ground and 15 cm in front of the line AB. The picture plane is located in between the line AB and station point perpendicular to the sight line. The distance between the picture plane and the station point is 9 cm. The height of the perspective view of the line AB is \_\_\_\_\_ cm. (rounded off to one decimal place)

Answer: 14.2 to 14.6

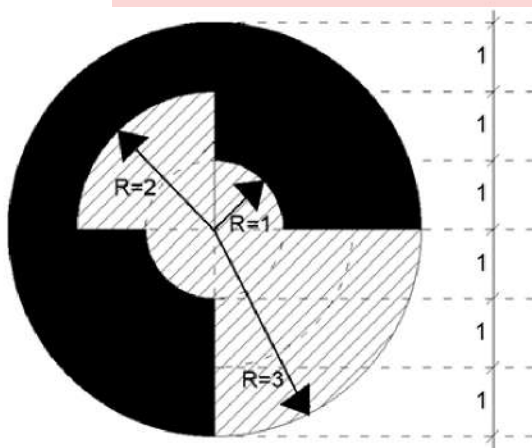
Explanation: Let 'XY' be the height of perspective view on the picture plane, and 'P' be the Station Point. Triangle ABP is similar to triangle XYP (due to angle-angle-angle similarity). If two triangles are similar, the ratio of their corresponding sides and the ratio of their corresponding heights (or altitudes) are equal.

$$\Rightarrow \frac{XY}{AB} = \frac{QP}{RP}$$

$$\Rightarrow \frac{XY}{24} = \frac{9}{15}$$

$$\Rightarrow XY = \frac{9}{15} * 24 = 14.4 \text{ cm}$$

48. The view from ground to sky of a location is projected on a plane as shown in the figure. The hatched and the solid black portion of the diagram represent the sky and the obstructions, respectively. The radius of the whole circle shown in the figure is 3 units and other dimensions are provided in the figure. The Sky View Factor (SVF) of this location is \_\_\_\_\_. (rounded off to two decimal places)



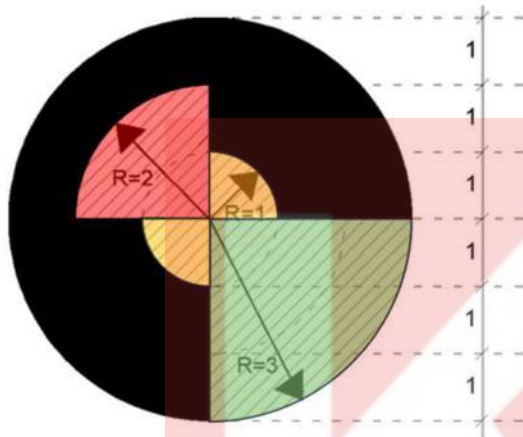


Answer: 0.40 to 0.43

Explanation: The Sky View Factor (SVF) is a dimensionless parameter, ranging from 0 to 1, that quantifies the fraction of the sky visible from a specific location, with 1 representing full visibility and 0 representing no sky visible.

SVF in the given figure is the ratio of (Area of portion hatched with diagonal lines/Area of circle)

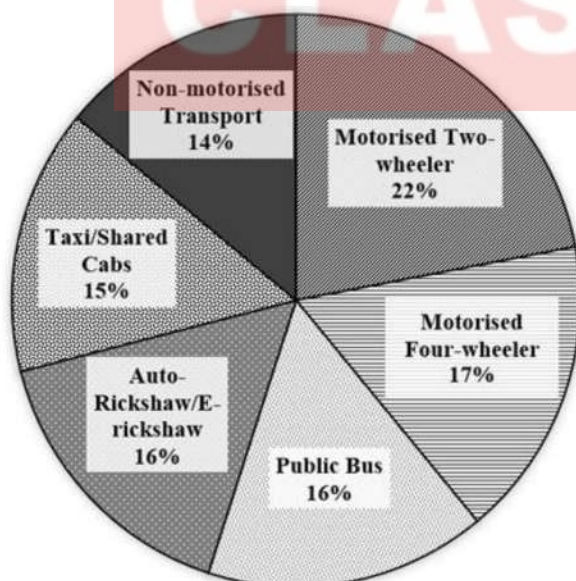
The Area of the portion hatched with diagonal lines can be calculated as: (Area of quarter circle with radius 2 – Shaded red) + (Area of quarter circle with radius 3 – Shaded green) + 2\*(Area of quarter circle with radius 1 – Shaded yellow)



$$\text{Area of hatched portion} = \left( \frac{\pi * 2^2}{4} \right) + \left( \frac{\pi * 3^2}{4} \right) + 2 * \left( \frac{\pi * 1^2}{4} \right) = \frac{4\pi + 9\pi + 2\pi}{4} = \frac{15\pi}{4}$$

$$\Rightarrow \text{Sky View Factor} = \frac{\left( \frac{15\pi}{4} \right)}{(\pi * 3^2)} = \frac{15}{4 * 9} = 0.4167$$

49. A city aims to introduce Metro rail as a sustainable public transport, with a projected daily ridership of 3,67,200 which is expected to shift 18% of the daily trips from other existing modes. The existing modal share (in percentage) is shown in the figure. If half of the above modal shift is expected to replace trips by Motorised Two-wheeler and Motorised Four-wheeler in 2:1 ratio, the trips only by Motorised Two-wheeler, post modal shift to Metro is \_\_\_\_\_. (answer in integer)



Answer: 320000 to 330000

Explanation: Projected Metro ridership = 3,67,200 = 18% of total trips

$$\Rightarrow \text{Projected total trips} = 3,67,200 / 0.18 = 20,40,000 \text{ trips}$$

Given, half of total modal shift (which is  $18/2 = 9\%$ ) is from replaced trips by Motorised Two-wheeler and Motorised Four-wheeler in 2:1 ratio.

$$\Rightarrow \text{Modal shift from motorised two-wheeler} = 6\%$$

$$\Rightarrow \text{Percentage of motorised two-wheeler trips post modal shift} = 16\%$$

$$\Rightarrow \text{Total trips only by motorised two-wheeler (post modal shift)} = 3,26,400$$





**PART B1: FOR Architecture CANDIDATES ONLY**

**Q.50 – Q.56 Carry ONE mark Each**

50. With reference to Squinch adopted in dome construction, choose the correct option related to statements P and Q.

P: Squinch is a structural element used to support the base of a circular or octagonal dome that surmounts a square hall.

Q: Squinch is a double layered dome comprising of an inner and an outer layer of masonry.

(A) Both P and Q are true

(B) P is true but Q is false

(C) P is false but Q is true

(D) Both P and Q are false

Answer: B

Explanation: In architecture, a **squinch** is a structural element used to support the base of a circular or octagonal dome that surmounts a square-plan chamber. Squinches are placed to diagonally span each upper corner where the walls meet. Constructed from masonry, they have several forms, including: a graduated series of stepped arches; a hollow, open half-cone (like a funnel) laid horizontally; or a small half-dome niche. They are designed to spread the load of a dome to the intersecting walls on which they are built. By bridging corners, they also visually transition an angular space to a round or near-circular zone.

51. In Heating Ventilation and Air Conditioning (HVAC) systems, HVAC dampers are essentially \_\_\_\_\_.

(A) valves that regulate the airflow as per the air-conditioned zone requirements

(B) valves that regulate the refrigerant flow as per the air-conditioned zone requirements

(C) desiccants which are used to absorb the moisture and dehumidify the air-conditioned zone

(D) metal-based sheets to absorb heat and to cool the air-conditioned zone

Answer: A

Explanation: Dampers are strategically placed within the duct system to help direct airflow to specific HVAC zones or rooms. This system allows users to better regulate the air-conditioning in different parts of their buildings. Dampers help maintain uniform temperature by adjusting the airflow throughout the building. HVAC dampers act like valves within ductwork, regulating airflow to meet the specific needs of different air-conditioned zones, allowing for personalized comfort and temperature control.

52. \_\_\_\_\_ increases the spreading quality of paints and helps to achieve desired consistency.

(A) Base

(B) Vehicle

(C) Paint Drier

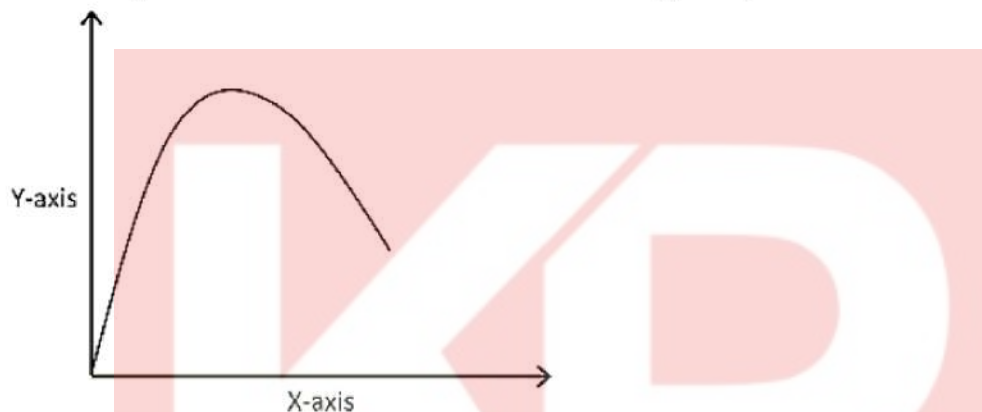
(D) Solvent

Answer: Marks to All

Explanation: Paint is typically composed of four main components: pigments (for color), binders (to hold the pigment and adhere to the surface), solvents (to control viscosity and drying time), and additives (to enhance specific properties).

In paint, the "vehicle" refers to the liquid portion that holds the pigment and binder in suspension, while "solvent" is a volatile liquid that dissolves the film-forming material and adjusts the paint's viscosity, allowing for easier application.

53. The graph shows the typical test result of a property of a building material. Identify the test and the variables represented on the X-axis and Y-axis from the given options.



- (A) Workability test of concrete; X-Axis: water-cement ratio; Y-Axis: amount of slump
- (B) Cube test of concrete; X-Axis: water-cement ratio; Y-Axis: 28-days compressive strength
- (C) Ultrasonic pulse velocity test; X-Axis: pulse velocity; Y-Axis: compressive strength
- (D) Bulking test of sand; X-Axis: moisture percentage; Y-Axis: percentage increase in volume

Answer: D

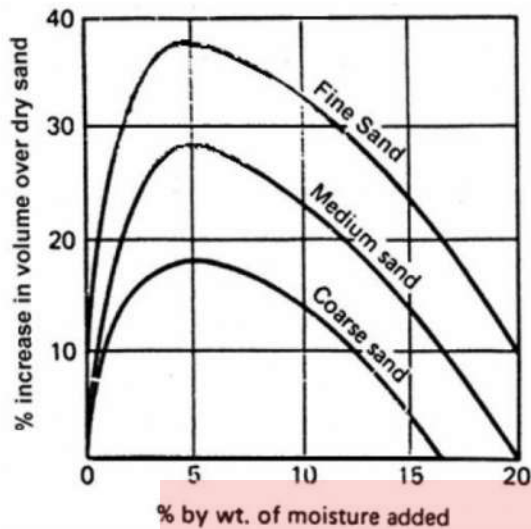
Explanation: In test for workability: Amount of slump increases with increase in water-cement ratio, but rising water-cement ratio beyond a point results in collapse slump – where the concrete mix is not suitable for standard slump test. The graph represents a fall in the value of Y-axis after a peak point which is not applicable in this case of test for workability.

In 28-day compressive strength test: increase along X-axis (water-cement ratio) there should be a fall in the value of Y-axis (compressive strength) – which is not represented in the given graph

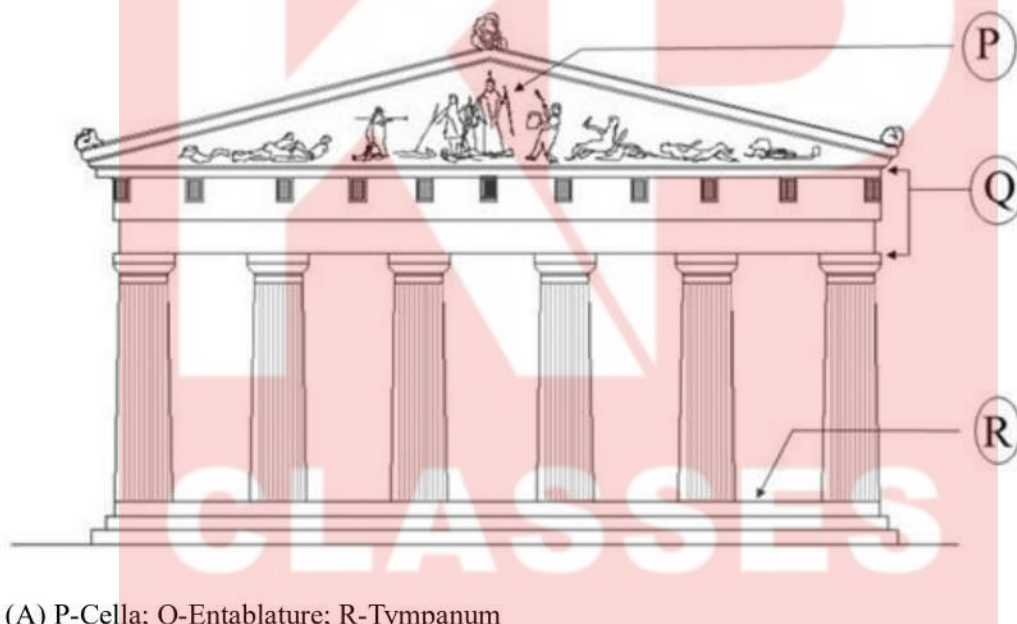
Ultrasonic pulse velocity test: increase in pulse velocity generally implies an increase in compressive strength (as velocity of ultrasonic waves is higher in dense concrete). But the graph also represents a fall in the value on Y-axis after a peak, which is not relevant in this case of ultrasonic pulse velocity test.

In Bulking test of sand: with the increase in moisture percentage along X-axis, there is an increase in volume due to bulking. After the peak, with rise in moisture content, there is a reduction in the % increase of volume. The relevant graph is shown below:





54. A typical Classical Greek temple with Doric order columns is illustrated in the figure. Identify the correct terms corresponding to P, Q and R marked in the figure.



- (A) P-Cella; Q-Entablature; R-Tympanum  
 (B) P-Tympanum; Q-Entablature; R-Stylobate  
 (C) P-Tympanum; Q-Acroterium; R-Stylobate  
 (D) P-Cella; Q-Stylobate; R-Acroterium

Answer: B

Explanation: Pediment & Tympanum: The pediment is the triangular gable found above the horizontal structure of the cornice or entablature in temples of Classical Architecture. The tympanum is the triangular space within the pediment, framed by the entablature on the bottom and the angled sides of the roof. Sculptures or reliefs were often placed within the tympanum.

**Entablature:** The entablature is the horizontal structure that spans across the tops of the columns. It's composed of three main sections: the architrave (the bottom horizontal band), the frieze (the middle section), and the cornice (the top section).

**Stylobate:** The stylobate is the uppermost step of the crepidoma, the stepped platform upon which the temple columns are placed. It essentially forms the floor of the temple.

55. Which of the following is/are example(s) of Concrete Cased Pile? (MSQ Type)

- (A) Raymond Pile
- (B) Swage Pile
- (C) Vibro Pile
- (D) Simplex Pile

Answer: A, B

**Explanation:** Concrete piles fall into 2 basic categories: precast and cast-in-place. Cast-in-place piles can be further subdivided into piles with casing and piles without casing.

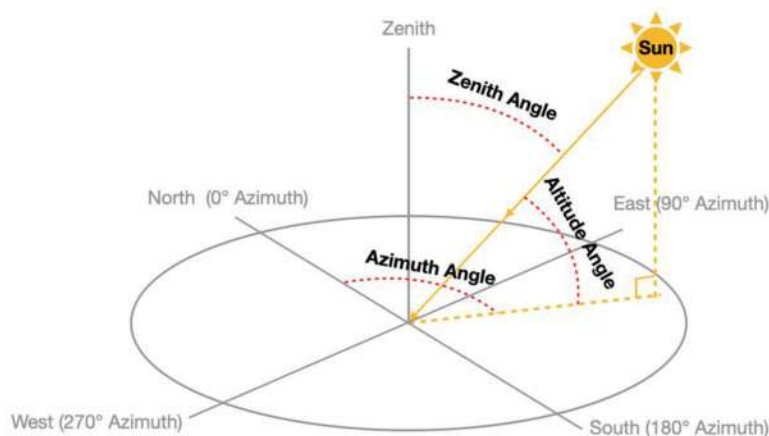
**Cast-in-Place Uncased Concrete Pile:** Cast-in-place uncased concrete piles are load-carrying elements formed in the ground wherein the concrete is in direct contact with the soil. Examples of uncased concrete piles include: MacArthur compressed concrete pile, Simplex concrete pile, Francois express pile, vibro pile, Ridley pile

**Cast-in-Place Cased Concrete Pile:** Cast-in-place cased concrete piles are formed by pouring concrete into a tapered or cylindrical form previously driven into the ground. The form or encasement could be a light-gage metal shell driven with a mandrel, or a steel shell heavy enough to be driven directly without a mandrel. Reinforcement is generally used in the upper section of the pile to take small bending forces that may develop. Examples of cased concrete piles include: Raymond pile (standard type), Raymond step-tapered pile, Monotube pile, Cobi pile, West's Rotinoff shell pile, Button-bottom cased concrete pile, Swage pile, Closed-end steel pipe pile, Open-end steel pipe pile, Pretest pile

56. For a given location, the Sun's position is at  $40^\circ$  Altitude angle and  $130^\circ$  N Azimuth angle. The Zenith Angle of the Sun (in degree) at that given location is \_\_\_\_\_.

Answer: 50

**Explanation:** The zenith angle is the angle between a point in the sky (like the sun) and the point directly overhead (the zenith). It's the complement of the altitude or elevation angle, measured from the horizon.





Always, Altitude angle + Zenith angle =  $90^\circ$

$$\Rightarrow \text{Zenith angle} = 90^\circ - \text{Altitude angle} = 90^\circ - 40^\circ = 50 \text{ degrees}$$

57. Match the items in Group-I with the corresponding items in Group-II.

Group I	Group II
P. Garnet	1. Lock
Q. Aldrop	2. Screw
R. Mortise	3. Bolt
S. Gusset	4. Hinge
	5. Plate

(A) P-4, Q-3, R-1, S-5



(B) P-5, Q-3, R-4, S-2



(C) P-4, Q-1, R-3, S-5

(D) P-3, Q-2, R-1, S-4

Answer: A

Explanation: The hardware components given in the question are described below:

	<p>Garnet Hinge:</p> <p>It is a <b>hinge with an upright bar and a horizontal strap</b>. It is generally used for doors and windows without frame.</p>
	<p>An "aldrop" is a type of door bolt, a mechanical device used to secure a door by sliding a bolt into a bracket or catch, often found on the outside of a door.</p> <p>In Aldrop, the mechanism used to secure doors is by sliding a bolt into a bracket. Latch is a device used to fasten a door, typically operated by a knob or lever from one side and a key or thumb turn from the other.</p>

	A mortise lock is a lock that requires a pocket—the mortise—to be cut into the edge of the door or piece of furniture into which the lock is to be fitted. Mortise lock describes only a method of fitting the lock and says nothing about the quality or key mechanism.
	A gusset plate is a flat, thin sheet of metal used to connect beams, trusses, and columns in structural frameworks, commonly made of steel or aluminium, and fastened using bolts, rivets, or welding.

58. Match the statements in Group-I with the corresponding names of architects in Group-II.

Group I	Group II
P. Form Follows Function	1. Ludwig Mies van der Rohe
Q. Less is More	2. Louis H. Sullivan
R. Architecture should speak of its time and place, but yearn for timelessness	3. Antoni Gaudi
S. There are no straight lines or sharp corners in nature	4. Frank O. Gehry
	5. Adolf Loos

(A) P-1, Q-2, R-4, S-5

(B) P-2, Q-3, R-1, S-4

(C) P-2, Q-1, R-4, S-3

(D) P-5, Q-1, R-2, S-3

Answer: C

Explanation: "Form follows function" is a design principle, popularized by architect Louis Sullivan, stating that the shape and design of an object should primarily reflect its intended purpose or function. This became the guiding principle for 'Modernism' in Architecture.

"Less is more", famously articulated by Mies van der Rohe, emphasizes simplicity and clarity in design, achieving elegance and harmony by removing unnecessary elements and focusing on functionality and form.

The phrase "Architecture should speak of its time and place but yearn for timelessness" encapsulates the idea that buildings should reflect their era and location while also striving for enduring quality and relevance, a concept often attributed to Frank Gehry.



The idea that "there are no straight lines or sharp corners in nature" is a common saying, often attributed to Antoni Gaudí, and it's based on the observation that generally natural forms tend to be organic and rounded, rather than rigid and angular.

59. Match the items in Group-I with the corresponding statements in Group-II.

Group I	Group II
P. Suction lift	1. Difference between point of discharge and the pump
Q. Discharge lift	2. Filling pump casing with air to remove trapped air inside
R. Rotary pump	3. Difference between low water level and pump
S. Priming of pump	4. Water is carried upwards around the side of the casing and pushed through discharge pipe
	5. Work done by a pump in raising the water

(A) P-3, Q-1, R-4, S-2

(B) P-4, Q-5, R-3, S-1

(C) P-3, Q-1, R-5, S-4

(D) P-1, Q-5, R-4, S-2

Answer: A

Explanation: In pumping systems, suction lift refers to the vertical distance a pump can lift liquid from a source below the pump's centreline, while discharge lift (or head) is the vertical distance the pump can move liquid to a higher point.

Rotary pumps are positive displacement pumps that use rotating elements (like vanes, lobes, gears, or screws) to trap and move fluid, providing a steady, non-pulsating flow, unlike reciprocating pumps. In a rotary vane pump, as the rotor spins, the vanes create sealed chambers that trap fluid on the suction side, move it around the pump, and then expel it on the discharge side as the chambers compress.

Priming a pump, especially a centrifugal pump, is the process of filling the pump casing and suction line with the liquid to be pumped, removing any air or vapor, before starting the pump to ensure proper operation and prevent damage.

60. Match the following Indian Temples in Group-I with their relevant descriptions in Group-II.

Group I	Group II
P. Kailasa Temple, Ellora	1. Temple from Chandella culture
Q. Shore Temple, Mamallapuram	2. Temple from late Gupta period entirely built in brick
R. Mahabodhi Temple, Bodh Gaya	3. Pallava temple constructed of dressed stone

S. Brihadisvara Temple, Thanjavur	4. Brahmanical rock-cut architecture, constructed by excavating out of the hill site
	5. One of the largest Chola temples

- (A) P-1, Q-3, R-2, S-4  
 (B) P-4, Q-2, R-5, S-3  
 (C) P-3, Q-4, R-1, S-5  
 (D) P-4, Q-3, R-2, S-5

Answer: D

Explanation: **Cave 16 is the Kailasa temple of Ellora**, which is considered the largest single monolithic excavation in the world. The Kailasa temple is 300 feet long and 175 feet wide.

The Shore Temple (c. 725 AD) is **a complex of temples and shrines that overlooks the shore of the Bay of Bengal**. It is in Mahabalipuram. It was built during the reign of Pallava king Narasimhavarman II, also known as Rajasimha, in the early 8th century.

The Mahabodhi Temple in Bodh Gaya, Bihar is one of the earliest Buddhist temples built entirely in brick, still standing, from the late Gupta period and it is considered to have had significant influence in the development of brick architecture over the centuries.

The Brihadeeswarar Temple (also known as the Rajarajeswaram Temple or Peruvudaiyar Kovil) in Thanjavur, Tamil Nadu, was built by Chola King Rajaraja I and completed around 1010 AD. It is one of the temples forming the UNESCO world heritage site of “Great Living Chola Temples”.

61. Which of the following tall building(s) is/are having bundled-tube structural system?

- (A) Sears Tower, Chicago  
 (B) The 42, Kolkata  
 (C) O-16 Building, Dubai  
 (D) Bank of China, Hong Kong

Answer: A

Explanation: Instead of one tube, bundled-tube structural system consists of several tubes tied together to resist lateral forces. Such buildings have interior columns along the perimeters of the tubes when they fall within the building envelope. Notable examples include Willis Tower, Chicago (formerly and still commonly referred to as the Sears Tower was finished in 1973. This building introduced the bundled tube structural design and was the world's tallest building until 1998) and One Magnificent Mile, Chicago (designed by SOM).

The Bank of China Tower in Hong Kong is a braced tube structure, not a bundled tube structure, featuring four vertical steel shafts and a triangular framework that transfers structural loads, designed to resist high winds and minimize steel usage.



62. A simply supported beam is under a uniformly distributed load (UDL) along the full span. The mid-span deflection is measured as 24 mm. If the length and depth of the beam is doubled while keeping other parameters unchanged, the mid-span deflection is \_\_\_\_\_ mm. (answer in integer)

Answer: 48

Explanation: For a simply supported beam with uniformly distributed load (UDL) along the full span, the maximum deflection ( $\delta$ ) occurs at the mid-span and is given by:

$$\delta = \frac{5 * w * L^4}{384 * E * I}$$

Where, UDL =  $w$  kN/m

Span =  $L$  and Modulus of elasticity =  $E$

Moment of Inertia,  $I = (B * d^3) / 12$

Initially, deflection = 24 mm (given)

$$\Rightarrow \text{Original Deflection, } \delta = \frac{5 * w * L^4}{384 * E * I} = 24 \text{ mm}$$

Given, length ( $L$ ) and depth ( $d$ ) are doubled, while other parameters are unchanged:

$$\Rightarrow \text{Moment of Inertia (after change)} = \frac{8 * B * d^3}{12} = 8 * I$$

$$\Rightarrow \text{Deflection (after change)} = \frac{5 * w * (2L)^4}{384 * E * (8 * I)} = 2 * \delta$$

So, deflection (after length & depth of beam is doubled) =  $2 * 24 = 48$  mm

63. A rectangular RCC beam section of 250 mm width and 400 mm effective depth is under a factored Shear Force of 120 kN. The design shear strength ( $\tau_c$ ) of concrete is 0.35 N/mm<sup>2</sup>. Two-legged, 8 mm diameter stirrups are used for the shear reinforcement. Assuming the Yield Stress of Steel,  $f_y = 415$  N/mm<sup>2</sup>, the design spacing (c/c) of the stirrups is \_\_\_\_\_ mm. (rounded off to the nearest integer)

Answer: 160 to 180

Explanation: Nominal shear stress for the given beam will be:

$$\text{Nominal shear stress } (\tau_v) = \frac{\text{Shear force}}{\text{Area of c/s}} = \frac{120 * 1000 \text{ N}}{250 * 400 \text{ mm}^2} = 1.2 \text{ N/mm}^2$$

As nominal shear stress ( $\tau_v = 1.2$  N/sqmm) exceeds the design shear strength of concrete ( $\tau_c = 0.35$  N/sqmm), the nominal shear reinforcement as per IS 456:2000 shall be provided for a shear stress of  $(\tau_v - \tau_c) = 1.2 - 0.35 = 0.85$  N/sqmm

Shear to be carried by the shear reinforcement = Area of c/s \* Shear stress to be handled by shear reinforcement =  $(250 * 400) * 0.85 = 85,000 \text{ N} = V_s$

As per IS 456:2000, the strength of shear reinforcement ( $V_s$ ) is given by:

$$V_s = \frac{0.87 * f_y * A_{sv} * d}{\text{Spacing}} = 85000 \text{ N (as calculated above)}$$

Here, Yield Stress of Steel,  $f_y = 415$  N/mm<sup>2</sup>

Area of shear reinforcement (considering two-legged stirrup),  $A_{sv} = 2 * (\text{Area of c/s of stirrup})$

$$\Rightarrow A_{sv} = 2 * \left( \frac{\pi * dia^2}{4} \right) = 100.53 \text{ mm}^2$$

Effective depth of beam c/s,  $d = 400 \text{ mm}$

$$\Rightarrow \text{Spacing} = \frac{0.87 * 415 * 100.53 * 400}{85000} = 170.85 \text{ mm}$$

64. A source of light is located at point C. Point A is 1.75 m vertically below point C. Point B is situated horizontally 1.0 m right of point A. If the illumination level at point A due to the light source at point C is 300 Lux, then the illumination level at point B is \_\_\_\_\_ Lux. (rounded off to the nearest integer)

Answer: 185 to 205

Explanation: Consider the angle of incidence is ' $\theta$ ' and distance from point C to point B is ' $R$ '.

Given, illuminance at point A = 300 lux =  $I/r^2$  (as the point A is vertically below point C)

$$\Rightarrow \frac{I}{(1.75)^2} = 300$$

$$\Rightarrow \text{Intensity of source, } I = 918.75 \text{ candela}$$

Distance from point C to point B, ' $R$ ' will be:

$$R = \sqrt{1^2 + 1.75^2} = 2.0156 \text{ meters}$$

For the given angle of incidence  $\theta$ :

$$\cos \theta = 0.8682$$

Illuminance at Point B will be:

$$E = \frac{I}{R^2} * \cos \theta = \frac{918.75}{(2.0156)^2} * 0.8682 = 196.34 \text{ lux}$$

65. There are 16 similar machines located radially and equally distanced from a fixed sound receiver. While operating, each machine records 60 dB sound level at the receiver. Assuming 70 dB to be the highest sound level allowed as per the industrial sound pollution norms, the total number of machines allowed to operate simultaneously without violating the norms is \_\_\_\_\_. (rounded off to the nearest integer)

Answer: 10

Explanation: Sound level at receiver due to each source = 60 dB

$$\Rightarrow 60 \text{ dB} = 10 * \log \left( \frac{I}{10^{-12}} \right)$$

$$\Rightarrow 6 = \log_{10} \left( \frac{I}{10^{-12}} \right)$$

$$\Rightarrow \text{Sound intensity at receiver, due to each source, } I = 10^{6-12} = 10^{-6} \text{ W/m}^2$$

Maximum permissible sound level at receiver = 70 dB (given)

Similar to the above process of converting dB to Sound Intensity, we get:



$\Rightarrow$  Maximum permissible sound intensity at receiver,  $I_{max} = 10^{-5} \text{ W/m}^2$

Let the maximum number of machines allowed to operate simultaneously be 'n'. As all the sound sources are identical, the total sound intensity at receiver due to 'n' sources will be (n \* I)

$$n * I = I_{max}$$

$$\Rightarrow \text{Number of machines, } n = \frac{10^{-5}}{10^{-6}} = 10^{-5+6} = 10$$



**PART B2: FOR Planning CANDIDATES ONLY**

**Q.66 – Q.72 Carry ONE mark Each**

66. Affordable Housing in Partnership (AHP) is one of the verticals of Pradhan Mantri Awas Yojana (PMAY) of Government of India. In AHP, the partnership was envisaged between \_\_\_\_\_.

- (A) States/UTs/ULBs/Parastatals and Academic Institutions
- (B) States/UTs/ULBs/Parastatals and Private Developers
- (C) Non-Government Organisation (NGO) and Private Developers
- (D) Non-Government Organisation (NGO) and Academic Institutions

Answer: B

Explanation: Affordable Housing in Partnership (AHP) of PMAY is a Centrally Sponsored Scheme (CSS) to provide financial assistance to *EWS* houses being built in various partnership models by States/UTs/Cities including private sector and industries. Projects under AHP have a minimum of 250 houses with at least 35% houses of *EWS* category. The central assistance provided under AHP is Rs. 1.50 lakh per *EWS* house.

67. Which are the two wavelength bands of light spectrum used to calculate the Normalised Difference Vegetation Index (NDVI) in remote sensing?

- (A) Green and Blue
- (B) Green and Near Infrared
- (C) Near Infrared and Red
- (D) Red and Green

Answer: C

Explanation: In remote sensing, the Normalized Difference Vegetation Index (NDVI) is a widely used metric that quantifies vegetation health and density by analyzing the reflectance of red and near-infrared light, with higher values indicating denser, healthier vegetation. NDVI values range from -1 to +1.

- **High NDVI (close to +1):** Indicates healthy, dense vegetation.
- **Low NDVI (close to 0):** Suggests sparse or stressed vegetation, or non-vegetated areas like barren rock, sand, or snow.
- **Negative NDVI:** Often indicates water bodies.

68. \_\_\_\_\_ refers to the benefits when industries/firms cluster together resulting in reduced production cost, improved availability of skilled labor, and increased flow of information and knowledge sharing.

- (A) Industrial ecology
- (B) Agglomeration of economies
- (C) Behavioural economics
- (D) Industrial engineering

Answer: B



Explanation: Agglomeration economies are the benefits firms and workers gain from locating near each other in cities or industrial clusters, leading to increased productivity, efficiency, and potentially lower costs. Example: The concentration of technology companies in Silicon Valley is a prime example of agglomeration economies, with firms benefiting from the close proximity of talent, venture capital, and other resources.

69. As per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013, the \_\_\_\_\_ determines the \_\_\_\_\_ for compensation for land acquisition.

- (A) Collector; market value
- (B) Planning Officer; market value
- (C) Collector; circle rate
- (D) Planning Officer; circle rate

Answer: A

Explanation: As per Section 26(1) in The Right to Fair Compensation And Transparency In Land Acquisition, Rehabilitation and Resettlement Act, 2013;

The Collector shall adopt the following criteria in assessing and determining the market value of the land, namely:-

the market value, if any, specified in the Indian Stamp Act, 1899 (2 of 1899) for the registration of sale deeds or agreements to sell, as the case may be, in the area, where the land is situated; or

the average sale price for similar type of land situated in the nearest village or nearest vicinity area; or  
consented amount of compensation as agreed upon under sub-section (2) of section 2 in case of acquisition of lands for private companies or for public private partnership projects, whichever is higher:

Provided that the date for determination of market value shall be the date on which the notification has been issued under section II.

70. Total Station is an equipment used for \_\_\_\_\_.

- (A) measurement of rainfall intensity
- (B) noise level measurement
- (C) air quality measurement
- (D) determination of coordinates of unknown points relative to a known coordinate

Answer: D

Explanation: In land survey, the total station measures the horizontal and vertical angles to the unknown points. It also measures the distances (slope or horizontal) from the total station to the unknown points. The measured angles and distances, along with the known coordinates of the total station, are used in trigonometric calculations to determine the coordinates of the unknown points. Also, the coordinates (X, Y, and Z or easting, northing, and elevation) of the unknown points are calculated relative to the known point where the total station was set up.

The coordinates of an unknown point relative to a known coordinate can be determined using the total station as long as a direct line of sight can be established between the two points.

71. Select the correct statement(s) with regard to Traffic Analysis Zones (TAZs). (MSQ Type)

- (A) TAZs are not determined based on physical barriers like rivers, mountains and forest.
- (B) Demographic characteristics of a TAZ will change with new residents moving into the TAZ.
- (C) 'Cordon line' helps in defining the study area within which TAZs are located.
- (D) TAZs cannot include multiple wards.

Answer: B, C

Explanation: In transportation planning, a Traffic Analysis Zone (TAZ) is a geographically defined area used as a basic unit of analysis to model traffic patterns, trip origins and destinations, and other spatial attributes that influence travel demand. When defining Traffic Analysis Zones (TAZs) for transportation planning, factors like spatial contiguity, compactness, homogeneity of land use, compatibility with administrative boundaries, and avoiding main roads as TAZ boundaries are crucial. Additionally, understanding trip generation patterns and demographic/economic characteristics within each TAZ is important.

In transportation planning, a "cordon line" is an imaginary boundary line that defines the area of study, used to analyze travel patterns and traffic volumes within and around that area.

New residents moving into any geographical unit will result in the change of demographic characteristics of that geographic unit.

72. As per the Census of India, 2011, choose the correct statement(s), regarding the definition of a Census Town.

- (A) The minimum population size is 5000.
- (B) The population density of at least 400 persons per square kilometer.
- (C) 55 percent of the male working population are not engaged in agriculture.
- (D) The population density of at least 250 persons per square kilometer.

Answer: A, B

Explanation: A census town is a settlement that meets certain criteria which suggest urban characteristics:

- **Population:** A minimum population of 5,000.
- **Employment:** At least 75% of the male main working population engaged in non-agricultural pursuits.
- **Density:** A population density of at least 400 persons per sq. km

73. Match the following Planning Strategies in Group-I to their corresponding descriptions in Group-II.

Group I	Group II
P. Urban Sprawl	1. Redeveloping previously utilized land, often resulting in a change in land-use and land cover



Q. Smart Growth	2. Development on previously undeveloped land
R. Greenfield Development	3. Concentrating development in compact, walkable urban centres to improve health and natural environment
S. Brownfield Development	4. Expansion of urban areas into rural areas, typically characterized by low density development
	5. Allocating specific areas for industrial activities to minimize environmental impacts and segregate them from residential areas

(A) P-4, Q-2, R-5, S-1

(B) P-1, Q-2, R-3, S-4

(C) P-4, Q-3, R-2, S-1

(D) P-1, Q-3, R-2, S-5

Answer: C

Explanation: Urban sprawl is the uncontrolled growth of cities and towns, often characterized by low-density residential housing, single-use zoning, and increased reliance on private automobiles for transportation.

Smart growth is an urban planning and development approach that prioritizes compact, walkable, transit-oriented, and mixed-use communities, aiming to reduce sprawl and promote sustainable, liveable environments.

Greenfield development refers to constructing new infrastructure or developments on previously unused land, offering a blank slate for designing sustainable and innovative projects, unlike brownfield development which involves repurposing existing land or structures.

74. Match the following sub categories of urban land use in Group-I with their corresponding broad land use categories in Group-II as per URDPFI Guidelines, 2015.

Group I	Group II
P. Sports complex	1. Protective and undevelopable use zone
Q. Water bodies	2. Recreational
R. Poultry and dairy farming	3. Special area
S. Police station	4. Primary Activity
	5. Public and Semi-Public

(A) P-2, Q-1, R-4, S-5

(B) P-3, Q-2, R-1, S-3

(C) P-4, Q-2, R-3, S-5

(D) P-2, Q-4, R-5, S-3

Answer: A

Explanation: As per URDPFI Guidelines, 2015, Public and Semi-public uses include Government Offices, Schools & Colleges, Religious premises, Socia cultural uses (like multipurpose hall, science center, Anganwari, Old-age home/orphanage/night shelter) and Security & safety facilities (like Police stations/posts, District jail, Firepost/station).

Protective and undevelopable use zone includes water bodies, special recreation zone/protective areas, such as sanctuaries/reserve forests and eco-sensitive zone.

Primary activity includes Agriculture, Forest and horticulture, Poultry & dairy farming, brick kiln & extractive areas, etc.

Recreational zone includes playgrounds/stadium/sports complex, Parks & gardens – public open spaces.

75. Match the following Curves in Group-I with their corresponding uses in Group-II.

Group I	Group II
P. Mass Curve	1. A graphical representation of income or wealth inequality
Q. Lorenz Curve	2. A graphical representation of cumulative inflow (supply) and outflow(demand) over time
R. Density Curve	3. Shows the relationship between the price of a good or service and the quantity demanded within a specified time frame
S. Horizontal Curve	4. Provides a transition between tangent strips of roadway allowing a vehicle to negotiate a turn
	5. An idealised representation of distribution in which the area under the curve is defined to be 1

(A) P–2, Q–3, R–4, S–5

(B) P–3, Q–1, R–5, S–2

(C) P–1, Q–2, R–3, S–4

(D) P–2, Q–1, R–5, S–4

Answer: D

Explanation: The mass curve method is a graphical technique which plots accumulated inflow and outflow (demand) against time to determine the storage capacity of a water reservoir.

A Lorenz curve is a graphical representation of the distribution of income or wealth within a population. Lorenz curves graph percentiles of the population against cumulative income or wealth of people at or below that percentile.

A density curve is a graphical representation of a continuous probability distribution, where the total area under the curve always equals 1, and the curve never dips below the horizontal axis.



In highway design, a horizontal curve provides a gradual change in the direction of the road's centerline, allowing vehicles to negotiate turns smoothly, and is a crucial element for safety and driver comfort, especially at higher speeds.

76. Match the following types of migration in Group-I to their corresponding descriptions in Group- II.

Group I	Group II
P. Involuntary migration	1. When a migrant follows a path or series of stages towards a final destination
Q. Step migration	2. Repetitive movement of a migrant worker between home and destination areas
R. Circular migration	3. Forced displacement from their origin to destination areas
S. Chain migration	4. Immigrants from a particular area follow others from that area to a particular destination
	5. Relocation or process of people leaving one country to reside in another

- (A) P–2, Q–3, R–4, S–1  
(B) P–3, Q–1, R–2, S–4  
(C) P–3, Q–1, R–5, S–4  
(D) P–1, Q–4, R–2, S–3

Answer: B

Explanation: Involuntary migration, also known as forced displacement, refers to the movement of people compelled to leave their homes or places of habitual residence due to factors like conflict, violence, persecution, human rights violations, natural or human-made disasters, or climate change.

Step migration, a concept introduced by Ernst Georg Ravenstein, describes a migration pattern where individuals move to their final destination in stages, rather than directly, often moving from rural areas to smaller towns and then to larger urban centers.

Circular migration is the repetitive movement of people between their country/place of origin and a destination country/place, often for employment, with the intention of returning to their home country/place.

Chain migration is a social process where immigrants from a particular area follow others from that area to a specific destination, often a new country or location, with the initial migrants facilitating the migration of family and friends.

77. Which of the following characteristics of a house or land is/are considered in hedonic price function? (MSQ Type)

- (A) Quality of the view from the house  
(B) Low crime rate in the surrounding area

(C) Number of bedrooms in the house

(D) Household size

Answer: A, B, C

Explanation: The hedonic pricing method is most used in real estate. The price of a building or piece of land is determined by characteristics of both the property or land itself and its surrounding environment. Hedonic pricing is used to estimate the extent to which each factor affects the market price of the property. This model gives the price of a house/land as a function of its characteristics (like size, location, amenities), environmental factors, surrounding development, safety & crime rate, etc.

78. Which of the following is/are the characteristics of urban agglomeration as per the Census of India, 2011? (MSQ Type)

(A) A continuous urban spread constituting a town and its adjoining outgrowths

(B) Urban settlements combined with one rural settlement

(C) Two or more contiguous towns together with or without outgrowths

(D) Urban villages engulfed within a metropolitan area

Answer: A, C

Explanation: According to the 2011 Census of India, an urban agglomeration is a continuous urban spread constituting a town and its adjoining outgrowths (OGs), or two or more physically contiguous towns together with or without outgrowths of such towns. An Urban Agglomeration must consist of at least a statutory town and its total population (i.e. all the constituents put together) should not be less than 20,000 as per the 2001 Census. Examples: Greater Mumbai UA, Delhi UA, etc

79. The spot speeds (in km/h) of eight vehicles in a traffic stream are 42, 52, 56, X, 53, 62, 65, and 48. X is the spot speed of the fourth vehicle. The Time Mean Speed of the traffic stream is 56.25 km/h. After determining the value of X, the calculated Space Mean Speed of the traffic stream is \_\_\_\_\_ km/h. (rounded off to two decimal places)

Answer: 52.00 to 57.00

Explanation: Time mean speed is the arithmetic average of the speeds of all vehicles passing a specific point on a road over a certain time period.

Given time mean speed = 56.75 km/h

$$\Rightarrow (\text{Sum of eight spot speeds})/8 = 56.75$$

$$\Rightarrow (378 + X)/8 = 56.75$$

$$\Rightarrow X = 76 \text{ km/h}$$

In the context of traffic flow, space mean speed (SMS) is the average speed of all vehicles occupying a given section of roadway over a specific time period, calculated as the harmonic mean of spot speeds.

$$\text{So, Space Mean Speed} = \frac{8}{0.1453} = 55.06 \text{ km/h}$$

80. An individual chooses a transport mode for a particular trip based on three attributes i.e., cost of journey (X), In-vehicle travel time to reach destination (Y), and Out-of vehicle time taken to access mode at respective stops (Z). The values for these attributes for three modes Rail, Bus and Para-



transit are given in the table. If the general utility (U) equation is  $U = -0.5 \times X - 0.3 \times Y - 0.4 \times Z$ , using Logit model, the estimated probability of choosing Bus is \_\_\_\_\_. (rounded off to two decimal places)

Mode	X = Cost of Journey (in INR)	Y = In-Vehicle travel time (in min)	Z = Out-of-Vehicle travel time (in min)
Rail	20	20	10
Bus	10	40	7.5
Para-transit	15	35	5

Answer: 0.30 to 0.34

Explanation: In logit model, the probability of choosing any mode is given by  $e$  raised to the power of the utility divided by sum of  $e$  raised to the power of utility for all modes.

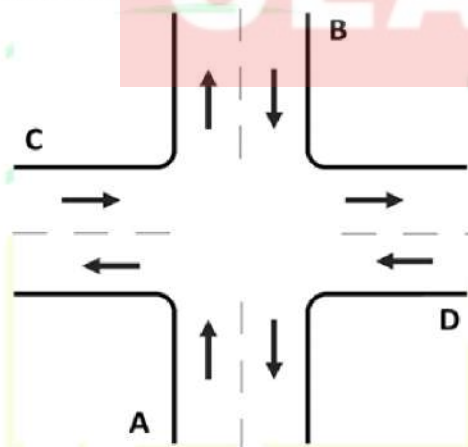
Utility values for all the given modes based on the given general utility equation are calculated below:

Mode	Utility value, $U = -0.5 \times X - 0.3 \times Y - 0.4 \times Z$
Rail	$U = (-0.5 \times 20 - 0.3 \times 20 - 0.4 \times 10) = (-20)$
Bus	$U = (-0.5 \times 10 - 0.3 \times 40 - 0.4 \times 7.5) = (-20)$
Para-transit	$U = (-0.5 \times 15 - 0.3 \times 35 - 0.4 \times 5) = (-20)$

Estimated probability of choosing bus, 'P' will be:

$$P = \frac{e^{-20}}{(e^{-20} + e^{-20} + e^{-20})} = \frac{1}{3} = 0.33$$

81. A four-arm uncontrolled un-signalized urban intersection of both way traffic is illustrated in the figure. Vehicles approaching the intersection from the directions A, B, C, and D can move to either left, right, or continue in straight direction. No U-turn is allowed. In the given situation, the maximum number of vehicular crossing conflict points for this intersection is \_\_\_\_\_. (answer in integer)



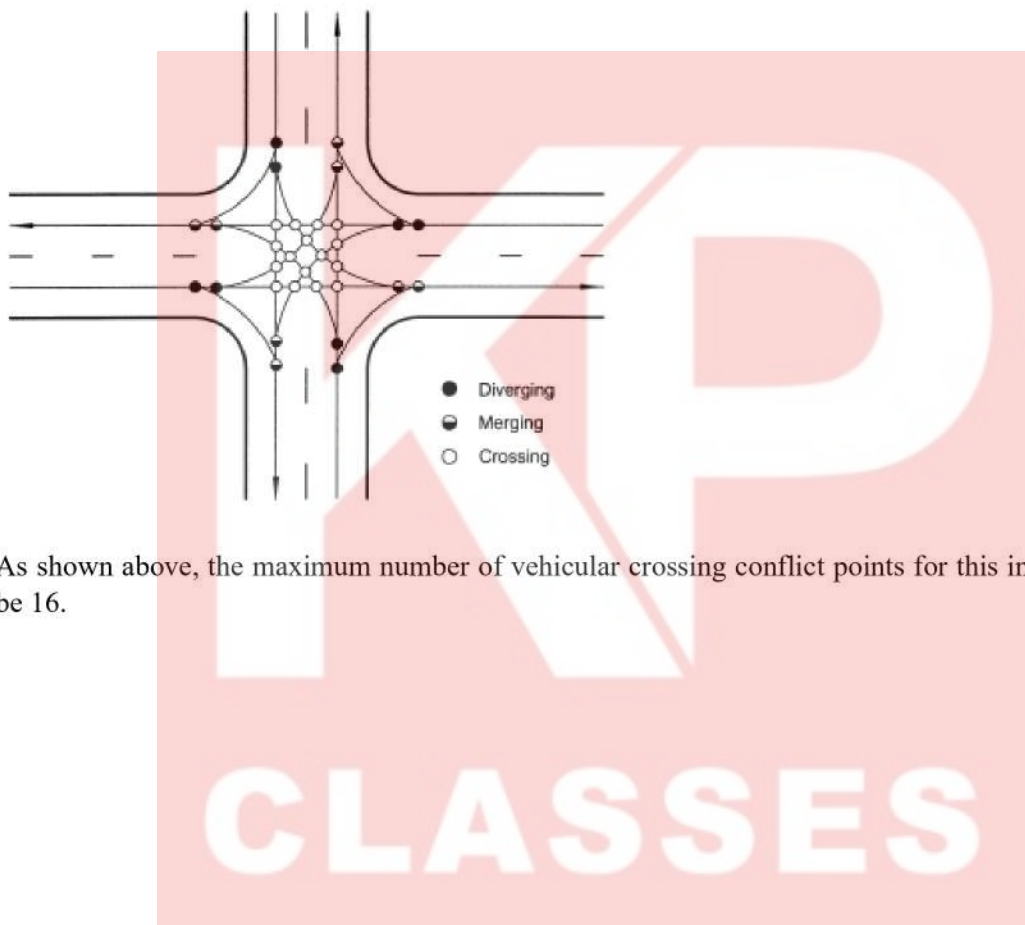
Answer: 16



Explanation: The given four-legged intersection has 32 potential conflict points, encompassing 16 major and 8 minor vehicular conflicts, plus 8 pedestrian conflicts as listed below:

- Vehicle-to-Vehicle Conflicts:
  - Major Conflicts (Crossing): 16
  - Minor Conflicts (Merging/Diverging): 8
- Vehicle-to-Pedestrian Conflicts: 8
- Total Conflicts: 32

The conflicts are denoted in the figure below:



As shown above, the maximum number of vehicular crossing conflict points for this intersection will be 16.