General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

1. If '→' denotes increasing order of intensity, then the meaning of the words

   [sick → infirm → moribund] is analogous to [silly → _____ → daft].

   Which one of the given options is appropriate to fill the blank?

   (A) frown

   (B) fawn

   (C) vein

   (D) vain

Answer: D

Explanation: Meanings of the words in given set are:

Sick = bad health; infirm = weak especially because of age; moribund = dying (which is a set of words depicting increasing intensity)

Silly = lacking judgement; daft = ridiculous/foolish. So, the correct word for the set should be a synonym for foolish – ideally between silly and daft in intensity

Meaning of the options:

Frown = furrow one's brows in an expression indicating disapproval, displeasure, or concentration.

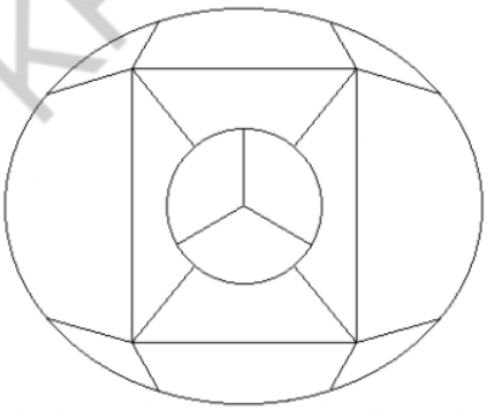
Fawn = to praise someone too much and give them a lot of attention that is not sincere, in order to get a positive reaction (Fawn as noun also means a young deer)

Vein = A blood vessel transporting blood from the capillaries to heart

Vain = Having no real importance or purpose, Worthless

The most appropriate word for the given set will be 'VAIN'.

2. The 15 parts of the given figure are to be painted such that no two adjacent parts with shared boundaries (excluding corners) have the same color. The minimum number of colors required is:

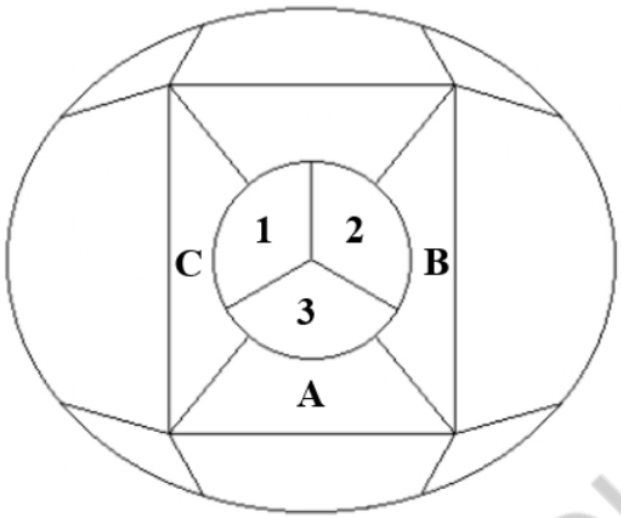


   (A) 4

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

Answer: A

Explanation: The inner circle has three sectors and hence we should be starting with three colours (marked 1, 2, 3 in the figure below).



Part A can have colour 1 or 2 as its adjacent to colour 3. If part A is given colour 1, then part B cannot have any of these three colours and will need a fourth colour. Similarly, if Part A is given colour 2, then Part C cannot have any of these three colours and will need a fourth colour. So, a minimum of FOUR colours will be required.

In mathematics, the four-color theorem, or the four-color map theorem, states that no more than four colors are required to color the regions of any map so that no two adjacent regions have the same color. Adjacent means that two regions share a common boundary of non-zero length (i.e., not merely a corner where three or more regions meet).

3. How many 4-digit positive integers divisible by 3 can be formed using only the digits {1, 3, 4, 6, 7}, such that no digit appears more than once in a number?
(A) 24
(B) 48
(C) 72
(D) 12

Answer: B

Explanation: Given 5 digits are 1,3,4,6,7 whose sum is 21 we have to make 4-digit number (no repetition)

So, we must reject one digit such that their sum divisible by 3.

We have 2 cases to do:

Case 1. reject 3

{1,4,6,7} => 4! = 24 ways (permutations)

Case 2. reject 6

{1,3,4,7} => 4! = 24 ways (permutations)

So total number of positive integers with the given condition = 24+24 = 48 ways

4. The sum of the following infinite series is:

$$2+\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{8}+\frac{1}{9}+\frac{1}{16}+\frac{1}{27}+\cdots$$

(A) 11/3
(B) 7/2
(C) 13/4
(D) 9/2

Answer: B

Explanation: The given series can be divided into two parts as shown below:

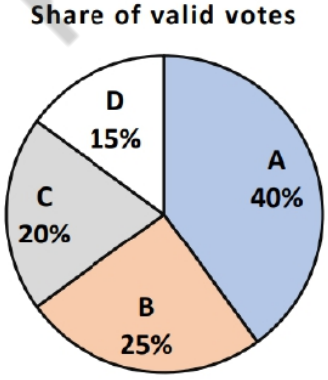
$$\left[1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{16}+\cdots\right]+\left[1+\frac{1}{3}+\frac{1}{9}+\frac{1}{27}+\cdots\right]$$

Both the series' above are infinite series of geometric progression. In infinite series of GP, sum will be [a/(1-r)] where 'a' is first term and 'r' is common ratio.

The sum will be:

$$\left[\frac{1}{1-\frac{1}{2}}\right]+\left[\frac{1}{1-\frac{1}{3}}\right]=2+\frac{3}{2}=\frac{7}{2}$$

5. In an election, the share of valid votes received by the four candidates A, B, C, and D is represented by the pie chart shown. The total number of votes cast in the election were 1,15,000, out of which 5,000 were invalid.



Based on the data provided, the total number of valid votes received by the candidates B and C is:
(A) 45,000
(B) 49,500
(C) 51,750
(D) 54,000

Answer: B

Explanation: Given: total valid votes = 115,000 - 5,000 (invalid votes) = 110,000

Valid votes of Candidate B = 25% of 110,000 = 0.25 * 110,000 = 27,500 votes

Valid votes of Candidate C = 20% of 110,000 = 0.2 * 110,000 = 22,000 votes

Now, the total number of valid votes received by candidates B and C:will be;

B + C = 27,500 (votes for B) + 22,000 (votes for C) = 49,500 votes.

Q.6 – Q.10 Carry TWO marks Each

6. Thousands of years ago, some people began dairy farming. This coincided with a number of mutations in a particular gene that resulted in these people developing the ability to digest dairy milk.
Based on the given passage, which of the following can be inferred?
(A) All human beings can digest dairy milk.
(B) No human being can digest dairy milk.
(C) Digestion of dairy milk is essential for human beings.
(D) In human beings, digestion of dairy milk resulted from a mutated gene.

Answer: D

Explanation: As in the first statement of the given passage it is mentioned that SOME people began dairy farming, and these people developed the ability to digest dairy milk – options A and B cannot be logically inferred.

Option C also cannot be inferred as the given passage does not mention anything about milk being essential. Option D can be inferred from the passage as it mentions the reason for human beings being able to digest dairy milk as a mutated gene.

7. The probability of a boy or a girl being born is 1/2. For a family having only three children, what is the probability of having two girls and one boy?
(A) 3/8
(B) 1/8
(C) 1/4
(D) 1/2

Answer: A

Explanation: Given probability of boy or girl being born = ½

The given case is – for a family having only 3 children – having 2 girls (G) and 1 boy (B). The possible combinations are: (B, G, G); (G, B, G); (G, G, B).

The probability will be:

$$\left[\frac{1}{2}*\frac{1}{2}*\frac{1}{2}\right]+\left[\frac{1}{2}*\frac{1}{2}*\frac{1}{2}\right]+\left[\frac{1}{2}*\frac{1}{2}*\frac{1}{2}\right]=\frac{3}{8}$$

8. Person 1 and Person 2 invest in three mutual funds A, B, and C. The amounts they invest in each of these mutual funds are given in the table.

	Mutual fund A	Mutual fund B	Mutual fund C
Person 1	₹10,000	₹20,000	₹20,000
Person 2	₹20,000	₹15,000	₹15,000

At the end of one year, the total amount that Person 1 gets is ₹500 more than Person 2. The annual rate of return for the mutual funds B and C is 15% each. What is the annual rate of return for the mutual fund A?

(A) 7.5%
(B) 10%
(C) 15%
(D) 20%

Answer: B

Explanation: For Mutual funds B and C, P1 invests 40,000 at 15%. Amount after 1 year for P1 = 40000 * 1.15 = 46,000/-

For Mutual funds B and C, P2 invests 30,000 at 15%. Amount after 1 year for P2 = 30000 * 1.15 = 34,500/-

Difference in amount from mutual funds B and C = (46000 – 34500) = 11500/-

Person 1 earns 11500 Rs more than Person 2 from mutual funds B and C. And it is given that Person 1 gets Rs. 500 more than Person 2 from all mutual funds A, B, C together.

So, it can be concluded that Person 2 earns (11500 – 500 = Rs.11000) more than Person 1 from mutual fund A. Person 2 invests Rs 10,000 more than Person 1 in mutual fund A.

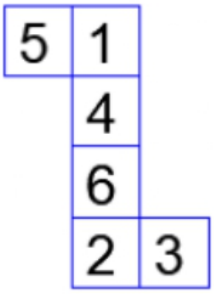
$11000 = 10000 * (1 + x)$

$=> 1 + x = 1.1$

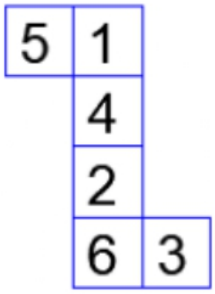
$=> x = 1.1 - 1 = 0.1 = 10\%$

9. Three different views of a dice are shown in the figure below.

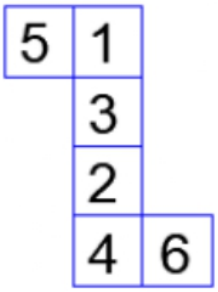
The piece of paper that can be folded to make this dice is



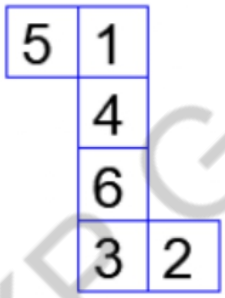
(A)



(B)



(C)



(D)

Answer: A

Explanation: From the given three figures, it can be concluded that 5 and 3 on the opposite faces; 1 and 6 are on the opposite faces; 2 and 4 are on the opposite faces.

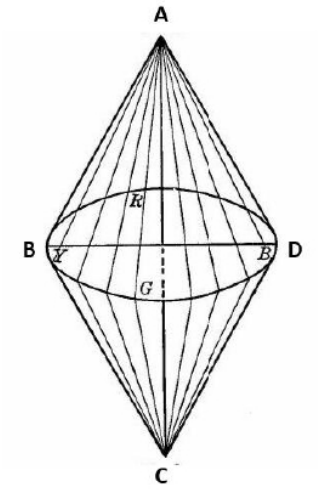
From given options, only option A follows the above three conditions.

10. Visualize two identical right circular cones such that one is inverted over the other and they share a common circular base. If a cutting plane passes through the vertices of the assembled cones, what shape does the outer boundary of the resulting cross-section make?
    (A) A rhombus
    (B) A triangle

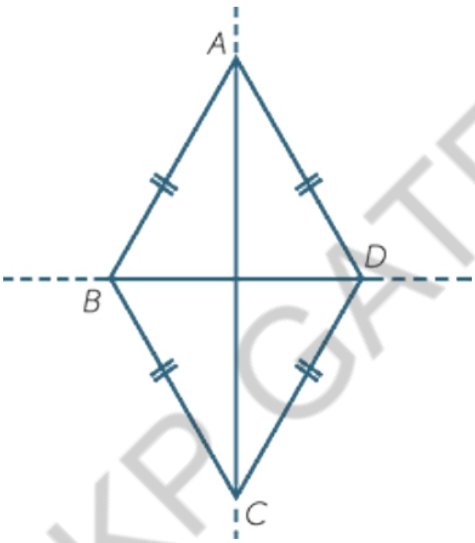
(C) An ellipse
(D) A hexagon

Answer: A

Explanation: The mentioned arrangement of two cones is shown below:



The cross-section obtained by plane cutting through the vertices of both cones is as follows:

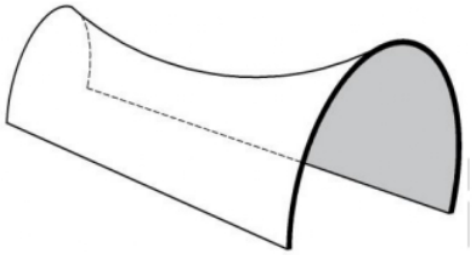


The above figure is a Rhombus.

PART A: Common FOR ALL CANDIDATES

Q.11 – Q.28 Carry ONE mark Each

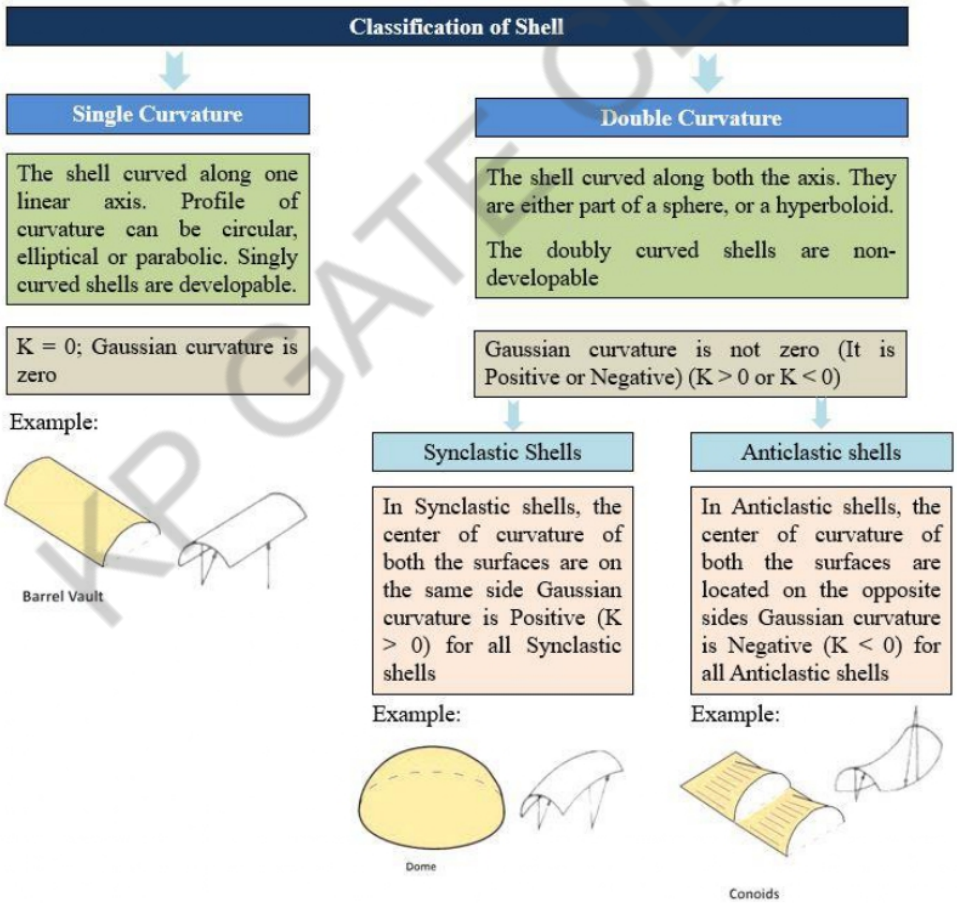
11. The nature of curvature of the following *structural form* is:



(A) monoclastic
(B) synclastic
(C) anticlastic
(D) möbius

Answer: C

Explanation: Classification of shell structures based on curvature type is shown below, along with examples:



12. As per the *Ekistics Logarithmic Scale*, the '*world city*' is referred as:
    (A) Megalopolis
    (B) Conurbation
    (C) Acropolis
    (D) Ecumenopolis

Answer: D

Explanation: Ekistics Logarithmic Scale (ELS) is a classification of settlements according to their size, presented on the basis of a logarithmic scale, running from Anthropos (ekistic unit 1), as the smallest unit of measurement, to the whole earth (ekistic unit 15).

Unit Number	Ekistic Unit	Population
1	Man	1
2	Room	2
3	Dwelling	4
4	Dwelling group	40
5	Small neighbourhood	250
6	Neighbourhood	1,500T
7	Small town	9,000
8	Town	50,000
9	Large city	300,000
10	Metropolis	3,000,000
11	Conurbation	14,000,000
12	Megalopolis	100,000,000
13	Urban region	700,000,000
14	Urbanised continent	5,000,000,00
15	Ecumenopolis	30,000,000,000

Ecumenopolis: Term coined by C.A. Doxiadis from the Greek words ecumene, that is, the total inhabited area of the world, and polis, or city, in the broadest sense of the word. It means the coming city that will - together with the corresponding open land, which is indispensable for Anthropos - cover the entire earth as a continuous system forming a universal settlement.

13. In *Mānasāra Silpasāstra*, a bow-shaped town plan is known as:
    (A) Dandaka
    (B) Prastara
    (C) Kārmuka
    (D) Nandyāvarta

Answer: C

Explanation: Karmukha is one of the 8 types of layouts described in Manasara. This kind of layout is usually in semi-circle, parabolic or in a bow shape usually applied near the banks of the river or near the seashore. The main streets of the town are laid from north to south or east to west and the cross streets run at right-angles to them, dividing the whole area into blocks. The deity, commonly a female deity, is installed in the temple built in any convenient place.

14. The value of a property when sold at a *lower price* than its open market price is called:
    (A) Distress Value
    (B) Accommodation Value
    (C) Speculative Value
    (D) Replacement Value

Answer: A

Explanation: Some important terms related to real-estate valuation are described below:

Market value: The market value of a property is defined as the amount which can be obtained at the time when property is put for sell in the open market. It constantly changes with time and market conditions.

Book value: Value of the property is calculated from account book in such a way that for the particular year, book value is original cost minus total depreciation till that year.

Distress value: A distressed sale is a sale of a property below its actual value. The owner sells the property for less than the market value or price to manage his debt immediately. It is the minimum value at which the property gets sold by the owner.

Accommodation value: When a land parcel is very small in size and has constraints to be developed, due to restriction in length, depth; the only feasible option for the owner is to sell the land parcel to the adjacent owner. But the adjacent owner generally offers a low cost for it due to its condition. This is referred to as accommodation value.

Salvage value: It is the estimated value of the property at the end of its useful life.

Monopoly value: The property which has special advantages due to its adjacent property, location, size, shape, etc., can fetch a higher value than market value. This is referred to as Monopoly value.

15. In a traffic survey, *Enoscope* is used to measure:
    (A) Volume to Capacity ratio
    (B) Sight distance
    (C) Spot speed
    (D) Intersection delay

Answer: C

Explanation: The enoscope is used to determine the spot speed of vehicles passing through a particular point on the road. The spot speed is the instantaneous speed of a vehicle at a particular point in time.

16. The author of the book '*Human Aspects of Urban Form*' is:
    (A) Cliff Moughtin
    (B) Amos Rapoport
    (C) Peter Katz
    (D) Lewis Mumford

Answer: B

Explanation: Human Aspects of Urban Form: Towards a Man-Environment Approach to Urban Form and Design examines the way people perceive the city, the effects of urban forms on people, and the role of images. This book was authored by Amos Rapoport. By adopting a man-environment approach, this book seeks to understand the importance of cities for human behaviour or satisfaction.

17. Which of the following statements is correct for Urban Cool Island (UCI)?
    (A) The UCI and Urban Heat Island (UHI) cannot happen in a city at the same time.
    (B) Air temperature of surrounding rural areas is warmer than that of the urban areas.
    (C) Air temperature of surrounding rural areas is cooler than that of the urban areas.
    (D) UCI happens only in a snow-clad mountain.

Answer: B

Explanation: Urban Cool Island (UCI) Effect is a phenomenon where the surrounding rural areas which are sparsely populated have higher temperatures compared to the high-rise compact urban areas. When anthropogenic heat is small or absent, a high-rise, and high-density city experiences a significant daytime UCI effect. This is explained by an intensified heat storage capacity and the reduced solar radiation gain of urban surfaces. In a low-rise, low-density city, the UCI phenomenon also occurs when there is no anthropogenic heat, but easily disappears when there is little anthropogenic heat, and the UHI phenomenon dominates.

18. Which of the following statements is correct for an *oxidation pond* to treat wastewater?
    (A) It is an aerobic pond.
    (B) It is an anaerobic pond.
    (C) It does not require sunlight.
    (D) It does not remove Biological Oxygen Demand (BOD).

Answer: A

Explanation: The oxidation pond is one of the biological systems which are used for the treatment of wastewater. It is a totally aerobic pond, where stabilization is bought about by aerobic bacteria. The oxygen demand is met by the combined action of algae and other microorganisms.

Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water.

19. The conservation architect of the *Maitreya Buddha Temple* at *Basgo, Ladakh* which won the 2007 UNESCO Asia-Pacific Heritage Award is:
    (A) Abha Narain Lambah
    (B) Vinod Kumar M. M.
    (C) Rahul Mehrotra
    (D) Saima Iqbal

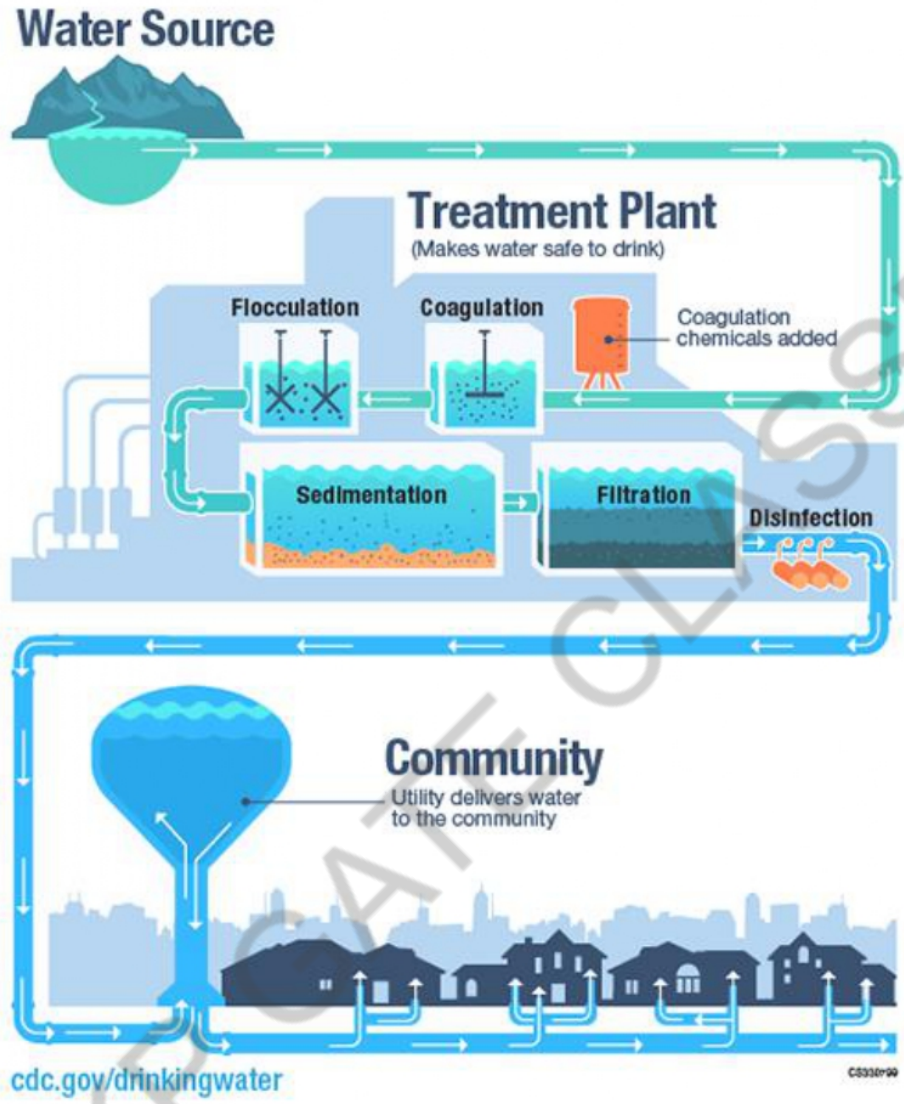
Answer: A

Explanation: Abha Narain Lambah's firm, Abha Narain Lambah Associates, has won 13 UNESCO awards and undertaken projects as varied as the Maitreya Buddha Temple in Ladakh, the Ajanta Caves of Maharashtra, the Raj Bhavan in Kolkata, the Hampi temples of Karnataka and the Opera House in Mumbai.

20. Which of the following options is/are the right sequence(s) in *water treatment process*? (MSQ Type)
    (A) Coagulation → Flocculation → Sedimentation
    (B) Sedimentation → Filtration → Disinfection
    (C) Sedimentation → Flocculation → Coagulation
    (D) Disinfection → Filtration → Flocculation

Answer: A, B

Explanation: Public drinking water systems use different water treatment methods to provide safe drinking water for their communities. Public water systems often use a series of water treatment steps that include coagulation, flocculation, sedimentation, filtration, and disinfection. Below is a typical sequence of steps in water treatment:



21. Which of the following is/are associated with *Gentrification* in a neighbourhood? (MSQ Type)
    (A) Wealthier households displace poor households
    (B) Poor households displace wealthier households
    (C) Real estate value increases
    (D) Real estate value decreases

Answer: A, C

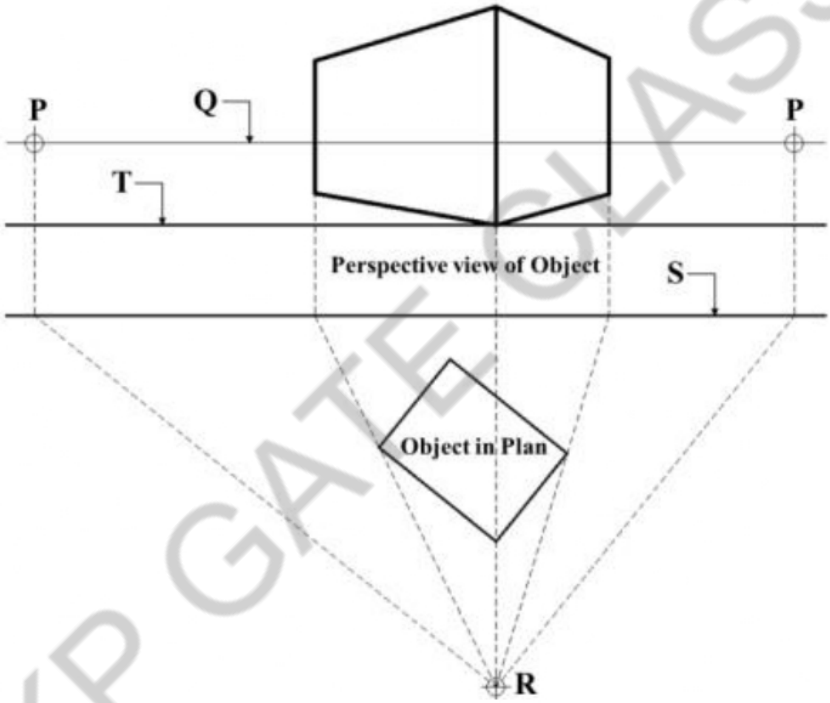
Explanation: Gentrification is the process whereby the character of a poor urban area is changed by wealthier people moving in, improving housing, and attracting new businesses, often displacing current inhabitants in the process. Gentrification is the transformation of a city neighbourhood from low value to high value.

22. Which of the following sites is/are included in the *UNESCO World Heritage List* as on December 2022? (MSQ Type)
(A) Capitol Complex, Chandigarh
(B) Moth ki Masjid, Delhi
(C) Keoladeo National Park, Bharatpur
(D) Paradesi Synagogue, Kochi

Answer: A, C

Explanation: There are 42 UNESCO World Heritage Sites in India (as of September 2023 when last addition to the list was done). Santiniketan, established by Nobel laureate Rabindranath Tagore, becomes the 41st site to be declared a world heritage site in India in September 2023. The UNESCO also included the Sacred Ensembles of the Hoysalas in Karnataka in the list in September 2023. This takes the total number of UNESCO World Heritage sites in India to 42.

23. The reference points, lines, and planes for drawing a two-point perspective of an object are marked in the Figure below. Select the correct option(s) that match(es) with the corresponding nomenclature. (MSQ Type)



(A) R – Station point, S – Picture plane
(B) R – Vanishing point, T – Picture plane
(C) P – Vanishing point, T – Ground line
(D) Q – Ground line, S – Horizon line

Answer: A, C

Explanation: Below are some important terms used in perspective drawings:

Station Point: It is the position of the observer. (R in given figure)

Eye-level: This is the position of eye of the viewer if the object is viewed from below. (Q in the given figure)

Picture plane: This is the vertical transparent plane, placed between the object and station point on which the perspective view will be projected. (S in the given figure)

Gound line: This is the horizontal plane on which the observer stands to intersect the picture plane on the ground line. (T in the given figure)

Horizontal line: This is the horizontal line on the picture plane which is at the eye level of the observer. (Q in the given figure)

Vanishing point (VP): This is an imaginary point where the perspective lines meet. (P in the given figure)

24. India's intended *Nationally Determined Contribution* to the United Nations Framework Convention on Climate Change in 2022 include(s): (MSQ Type)
    (A) reduction of emissions intensity of India's GDP by 45% by 2030 from 2005 level
    (B) achieving about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030
    (C) achieving the target of net-zero emission by 2030
    (D) reduction of total projected carbon emission by one billion tonnes from 2022 to 2025

Answer: A, B

Explanation: In accordance with the provisions of the Paris Agreement read with relevant decisions, India (in August 2022) had communicated an update to its first NDC submitted earlier on October 2, 2015, for the period up to 2030, as under:

1. To put forward and further propagate a healthy and sustainable way of living based on traditions and values of conservation and moderation, including through a mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change [UPDATED].

2. To adopt a climate friendly and a cleaner path than the one followed hitherto by others at corresponding level of economic development.

3. To reduce Emissions Intensity of its GDP by 45 percent by 2030, from 2005 level [UPDATED].

4. To achieve about 50 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030, with the help of transfer of technology and low-cost international finance including from Green Climate Fund (GCF) [UPDATED].

5. To create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030.

6. To better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, Himalayan region, coastal regions, health, and disaster management.

7. To mobilize domestic and new & additional funds from developed countries to implement the above mitigation and adaptation actions in view of the resource required and the resource gap.

8. To build capacities, create domestic framework and international architecture for quick diffusion of cutting-edge climate technology in India and for joint collaborative R&D for such future technologies.

This update to India's existing NDC was a step forward towards our long term goal of reaching net-zero by 2070.

25. As per the Census of India 2011, *non-notified slums* is/are categorised as: (MSQ Type)
    (A) Recognised
    (B) Identified
    (C) Unrecognised
    (D) Authorised

Answer: A, B

Explanation: Three types of slums have been defined in Census of India, namely, Notified, Recognized and Identified;

(i) All notified areas in a town or city notified as 'Slum' by State, Union territories Administration or Local Government under any Act including a 'Slum Act' may be considered as Notified slums
(ii) All areas recognized as 'Slum' by State, Union territories Administration or Local Government, Housing and Slum Boards, which may have not been formally notified as slum under any act may be considered as Recognized slums
(iii) A compact area of at least 300 population or about 60-70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities may be considered as Identified slums.

So, non-notified slums can be Recognised or Identified slums.

26. Which of the following is/are under the purview of the *Energy Conservation Building Code of India 2017*? (MSQ Type)
    (A) Indoor Lighting
    (B) Outdoor Lighting
    (C) Plug Loads
    (D) Embodied Energy

Answer: A, B

Explanation: The provisions of ECBC apply to: (a) Building envelope, (b) Mechanical systems and equipment, including heating, ventilating, and air conditioning, service hot water heating, (c) Interior and exterior lighting, and (d) Electrical power and motors, and renewable energy systems.

The provisions of this code do not apply to plug loads, and equipment and parts of buildings that use energy for manufacturing processes, unless otherwise specified in the Code.

27. Which of the following is/are used for *municipal fiscal resource mobilisation*? (MSQ Type)
    (A) Property tax
    (B) Development charges
    (C) Income tax
    (D) Salary of municipal staff

Answer: A, B

Explanation: Municipal fiscal resource mobilization can be from various traditional and innovative approaches (as per URDPFI Guidelines). Some of these revenue sources at ULB level are detailed below:

a. Taxes: State government authorises local governments by law, to collect taxes. Taxes are major source of revenue of ULBs. Property tax, professional tax, and advertisement tax are major sources of revenue in local governments.
b. Charges and fees: Local bodies levy charges and fees for services provided to citizens. These charges, for water supply, solid waste management, parking, and other such services to cover the cost of undertaking the provision of services.
c. Grants and Subsidies: Grants and subsidies are generally given by central government to state/local government or state to local government for development and provision of services to citizens.
d. Public Private Partnership: PPP is an agreement between public and private entity for providing services or infrastructure to citizens. It helps municipal authorities to shed some of its functions and evolve alternative institutional arrangement for the performance of such functions.
e. Loans for financial institutions: Public and private organizations come together to pool funds from public and investing it in financial assets. Such loans are for long term.
f. Funding by Bilateral and Multilateral Agencies: These are developmental agencies which provide soft loans for infrastructural projects. Almost all such loans are backed by sovereign guarantee and take long process to access.
g. Foreign Direct Investment: FDI is direct investment from company or entity into a foreign country.
h. Pooled Finance Development Fund (PFDF) Scheme of Government of India: PFDF is meant to provide credit enhancement grants to enable ULBs to access market borrowings to facilitate development of municipal infrastructure.
i. Municipal Bonds and Debentures: Municipal bonds and debentures are issued by ULBs and Infrastructure Funds, to public or specific institutional investors to raise finance for developing physical infrastructure.

28. A ramp with a slope of 1:12 is required for wheelchair access. Intermediate landings of length 1.5 m each have to be provided after every 9 m running length. The *running length* of a straight ramp including landing, to negotiate a level difference of 900 mm vertical height, in m, is _____ (*rounded off to two decimal places*). (NAT Type)

Answer: 12.29 to 12.31

Explanation: Given, Slope = Rise/Run = 1/12 and rise = 900 mm

Run = Rise * 12 = 0.9*12 = 10.8 m (as its more than 9m, one intermediate landing should be provided)

Total running length = 10.8 + 1.5 = 12.3 meters

Q.29 – Q.49 Carry TWO marks Each

29. Match the *features* in Group–I with the corresponding *software tools* in Group–II.

Group I	Group II
P. Raster Graphics Editing	1. OpenStudio
Q. Energy Modelling	2. GIMP
R. Visual Programming Interface	3. STAAD
S. Structural Analysis	4. Grasshopper
	5. Radiance

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

Answer: B

Explanation: GIMP is an acronym for GNU Image Manipulation Program. It is a freely distributed raster graphics editing program for such tasks as photo retouching, image composition and image authoring.

OpenStudio ® is a cross-platform (Windows, Mac, and Linux) collection of software tools to support whole building energy modelling using EnergyPlus and advanced daylight analysis using Radiance. OpenStudio is an open-source project to facilitate community development, extension, and private sector adoption.

Grasshopper is a visual programming interface primarily used to build generative algorithms, such as for generative art. Many of Grasshopper's components create 3D geometry. Programs may also contain other types of algorithms including numeric, textual, audio-visual and haptic applications.

STAAD's full form is Structural Analysis and Design. STAAD Pro is one of the popular software that is used for analysing & designing structures like – buildings, towers, bridges, industrial, transportation, and utility structures.

30. Match the *elements* in Group–I with the corresponding *buildings* in Group–II.

Group I	Group II
P. Lightweight Structure	1. Taipei 101, Taipei by Lee and Wang
Q. Base Isolator	2. The Gherkin, London by Foster & Partners
R. Tuned-mass Damper	3. Museum of New Zealand Te Papa Tongarewa, Wellington by Ivan Mercep
S. Diagrid	4. Paper Log Houses, Kobe by Shigeru Ban
	5. Metropolitan Cathedral of Christ the King, Liverpool by Lutyens and Gibberd

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

Answer: B

Explanation: Below is a brief description of the features and buildings listed in the given question:

In 1995, a disastrous earthquake hit Kobe, Japan. It devastated the city and caused more than three hundred thousand people to leave in despair and homeless. Six months after the crises, recognizing the critical demands, Architect Shigeru Ban took upon this challenge to create an innovative approach for developing these emergency shelters in response to the severe needs of the people. This novel prototype of construction became noted as the Paper Log House.

	Museum of New Zealand Te Papa Tongarewa, Wellington by Ivan Mercep is protected from earthquakes by base isolators. The base isolators are made of a rubber-and-steel sandwich with a core of lead. The rubber gives flexibility, and the sheets of steel add strength. The lead core absorbs shock and turns some of an earthquake's energy into heat. In the 7.8-magnitude Kaikoura earthquake, the building 'slid' about 15 to 20 millimetres.
	A Tuned Mass Damper (TMD), also called a "harmonic absorber", is a device mounted to a specific location in a structure, so as to reduce the amplitude of vibration to an acceptable level whenever a strong lateral force such as an earthquake or high winds hit. Some famous buildings with tuned mass damper include Shanghai Tower (Tallest building in China and world's tallest LEED Platinum certified building); Taipei 101, Taiwan
	The Gherkin, formally 30 St Mary Axe and previously known as the Swiss Re Building, is a commercial skyscraper in London's primary financial district, the City of London. The perimeter diagrid is formed from intersecting steel tubes that frame the light wells. It follows the curve of the building to maximise column-free office space, while keeping the structure stable. The Gherkin offers minimal resistance to wind, reducing the load on the building.

31. Match the following *concepts* in Group–I with their corresponding *description* in Group–II.

Group I	Group II
P. NIMBY	1. Affording a clear view of the waterfront to a plot through the abutting street
Q. Form based code	2. Planning and zoning tool to regulate development primarily through urban form
R. Tactical urbanism	3. Establishment of residential areas on the outskirts of a city
S. Suburbanisation	4. Short-term, low cost, scalable interventions, and policies to change a neighbourhood
	5. Resisting any physical intervention by public or private enterprises within their neighbourhood

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

Answer: A

Explanation: NIMBY is an acronym for. not in my back yard. It is a term related to a person who objects to the occurrence of something if it will affect him or her or take place in his or her locality.

Form-based codes are a method of development regulation, adopted into municipal or county law, that emphasizes the physical character of development (its form) and includes—but often de-emphasizes—the regulation of land uses.

Tactical urbanism is a fast, cheap, action-oriented approach to making meaningful civic changes to neighbourhoods, towns, and cities. For example, adding some tires and spray paint or a mural on an underused street to reclaim the space for pedestrians, can be seen as tactical urbanism.

Suburbanisation can be defined as the outward growth of urban development which may engulf surrounding villages and towns into a larger urban agglomeration. Suburbanization is mainly caused by overcrowding in urban areas, deterioration of public services, high crime rates and lack of job opportunities in cities.

32. Match the urban renewal projects in Group–I with the corresponding cities in Group–II.

Group I	Group II
P. Cheonggyecheon	1. New York
Q. The High Line	2. London
R. False Creek South	3. Seoul
S. Canary Wharf	4. Vancouver
	5. Tokyo

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

Answer: A

Explanation: Cheonggyecheon is famous for being a beautiful urban park and a historic landmark in Seoul, South Korea. It is a 10.9-kilometer-long stream that flows through the heart of the city, offering a serene and picturesque escape from the bustling urban environment.

The High Line is a 1.45-mile-long (2.33 km) elevated linear park, greenway, and rail trail created on a former New York Central Railroad spur on the west side of Manhattan in New York City. The abandoned spur has been redesigned as a "living system" drawing from multiple disciplines which include landscape architecture, urban design, and ecology.

False Creek is a short narrow inlet in the heart of Vancouver, separating the Downtown and West End neighbourhoods from the rest of the city. It is one of the four main bodies of water bordering Vancouver. False creek south is a unique waterfront community that was regarded as a model of progressive urban planning in the 1970s, when the city transformed industrial land into a neighbourhood known for its abundance of open space and intentional design.

In addition to being a leading global financial district in the United Kingdom, Canary Wharf is famous for a cluster of the tallest modern commercial complexes and residential high-rise buildings.

33. Match the Biosphere Reserves in Group–I with their corresponding features in Group–II.

Group I	Group II
P. Gulf of Mannar	1. Ridge, Glacier
Q. Sunderbans	2. Sub-tropical/Tropical Forest, Stepped Hill
R. Nanda Devi	3. Swamp Forest, Mangrove
S. Nilgiri	4. Coral Reefs, Seagrass bed
	5. Salt Marsh, Flat Terrain

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

Answer: C

Explanation: The Gulf of Mannar endowed with three distinct Coastal ecosystems namely coral reef, seagrass bed and mangroves is considered one of the world's richest region from a marine biodiversity perspective, is known for its unique biological wealth and is a store house of marine diversity of global significance. It is located on the southeastern tip of the Indian subcontinent.

The Sundarbans mangrove forest, one of the largest such forests in the world (140,000 ha), lies on the delta of the Ganges, Brahmaputra, and Meghna rivers on the Bay of Bengal. The site is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests and presents an excellent example of ongoing ecological processes.

One of the most spectacular wilderness areas in the Himalayas, Nanda Devi National Park is dominated by the 7,817 m peak of Nanda Devi, India's second highest mountain which is approached through the Rishi Ganga gorge, one of the deepest in the world.

The Nilgiri Mountains form part of the Western Ghats in northwestern Tamil Nadu, Southern Karnataka, and eastern Kerala in India. They are located at the trijunction of three states and connect the Western Ghats with the Eastern Ghats. At least 24 of the Nilgiri Mountains' peaks are above 2,000 metres (6,600 ft).

34. Match the terminologies in Group–I with their descriptions in Group–II

Group I	Group II
P. Edge City	1. Rapid expansion of geographical areas of towns or cities
Q. Synekism	2. Violence against the city
R. Urbicide	3. A secondary CBD on the edge of the city
S. Urban Sprawl	4. Rebuilding core city area
	5. Union of several small urban settlements under one rule

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

Answer: A

Explanation: Edge city is a term that originated in the United States for a concentration of business, shopping, and entertainment outside a traditional downtown or central business district, in what had previously been a suburban residential or rural area.

Synekism, is a concept in urban studies coined by Edward Soja. It refers to the dynamic formation of the polis state — the union of several small urban settlements under the rule of a "capital" city (or so-called city-state or urban system). Soja's definition of synekism, mentioned in Writing the city spatially, is "the stimulus of urban agglomeration."

Urbicide means the killing of cities. The concept refers to the premeditated and deliberate destruction of cities, their iconic architecture, and their identity. It can also be referred to as 'violence against the city'.

Urban sprawl is described as the rapid expansion of the geographic extent of cities and towns, often characterized by low-density residential housing, single-use zoning, and increased reliance on the private automobile for transportation.

35. Match the items in Group–I with their corresponding items in Group–II.

Group I	Group II
P. Floating floor	1. Overflow control
Q. Float valve	2. Delay not affecting a project
R. Metal float	3. Acoustical buffer
S. Free float	4. Plastering equipment
	5. Traffic flow control

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

Answer: C

Explanation: A floating floor is a floor that does not need to be nailed or glued to the subfloor. The term floating floor refers to the installation method but is often used synonymously with laminate flooring. Acoustic floating floors control the transmission of sounds and vibration from floor impacts to the surrounding building structure.

Float valves can be used to prevent overfilling or overflow of tanks when the liquid needs to be diverted rather than dumped in a drain.

A Metal Float is a tool with a smooth metallic plain that is applied on flattened layers of mortar and concrete during surface finishing.

Free Float refers to the amount of time that a task can be delayed without affecting the start date of its subsequent tasks. It is calculated as the difference between the earliest possible start date of the next task and the latest possible finish date of the current task.

36. As per the URDPFI Guidelines 2015, match the type of educational facilities in Group–I with the corresponding minimum population to be served per facility in Group–II.

Group I	Group II
P. Integrated school	1. 4,000
Q. Senior secondary school	2. 2,500
R. College	3. 90,000
S. Primary school	4. 1,25,000
	5. 7,500

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

Answer: B

Explanation: Below table gives the population served and student strength details of various education facilities as per URDPFI Guidelines:

Category	Student strength	Population served per unit
Pre-primary Nursing School	---	2500
Primary school (class I to V)	500	5000
Senior secondary school (VI to XII)	1000	7500
Integrated school without hostel facility (class I-XII)	1500	90,000 – 1 lakh
Integrated school with hostel facility (Class I-XII)	1500	90,000 – 1 lakh
School for Physically Challenged	400	45,000
School for Mentally Challenged		10 lakh

37. Which of the following statements is/are true? (MSQ Type)
    (A) Physiological Equivalent Temperature is used in outdoor thermal comfort evaluation.
    (B) Thermal Performance Index is computed using outside surface temperature of building envelope.
    (C) Reynolds number less than 2000 refers to laminar wind flow.
    (D) Reynolds number greater than 4000 refers to turbulent wind flow.

Answer: A, C, D

Explanation: PET is defined as the air temperature at which, in a typical indoor setting (without wind and solar radiation), the heat budget of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions to be assessed. PET is used in outdoor thermal comfort evaluation.

Rating of 100 TPI (Thermal Performance Index) of building assembly corresponds to 38-degree Celsius peak inside surface temperature in an unconditioned environment taking base temperature as 30 degrees Celsius.

In fluid dynamics, the Reynolds number (Re) is a dimensionless quantity that helps predict fluid flow patterns in different situations by measuring the ratio between inertial and viscous forces. At low Reynolds numbers, flows tend to be dominated by laminar (sheet-like) flow, while at high Reynolds numbers, flows tend to be turbulent. If the Reynolds number is less than 2000, the flow is laminar. This is also known as viscous flow. In terms of Reynolds number, the flow is considered to be turbulent when Re > 3500. It is considered fully turbulent when Re > 4000.

38. Which of the following statements is/are correct? (MSQ Type)
    (A) Yellow, blue-violet and red-violet are split complementary hues.
    (B) Orange, green and violet are analogous combinations.
    (C) CMYK is a subtractive colour system.
    (D) Blue, green, orange, and red are tetrad combinations.

Answer: A, C, D

Explanation: A split-complementary color scheme uses two colors across the color wheel, with those two colors lying on either side of the complementary color. For example, Yellow's complimentary color is violet, but its split-complementary colors are blue-violet and red-violet.

Analogous hues are three color families that are adjacent to each other on the color wheel.

The subtractive colors are cyan, yellow, magenta, and black, also known as CMYK. Subtractive color begins with white (paper) and ends with black; as color is added, the result is darker.

A tetrad is four colors, that is, two pairs of complementary combinations. Tetradic color scheme examples are green with red and blue with orange. The four selected shades connected should form a rectangle within the color spectrum (not necessarily a square).

39. Which of the following statements is/are correct? (MSQ Type)
    (A) The Royal Botanical Garden is in Kew, England.
    (B) The Villa d'Este is in Tivoli, Italy.
    (C) Indira Gandhi Memorial Tulip Garden is in Srinagar, J&K, India.
    (D) Shinjuku Gyoen National Garden is in Beijing, China.

Answer: A, B, C

Explanation: Kew Gardens is a Royal botanic garden in southwest London that houses the "largest and most diverse botanical and mycological collections in the world". It is one of London's top tourist attractions and is a UNESCO World Heritage Site.

The Villa d'Este in Tivoli, with its palace and garden, is one of the most remarkable and comprehensive illustrations of Renaissance culture at its most refined. Its innovative design along with the architectural components in the garden (fountains, ornamental basins, etc.) make this a unique example of an Italian 16th-century garden.

Indira Gandhi Memorial Tulip Garden, previously Model Floriculture Center, is a tulip garden in Srinagar, in the Indian union territory of Jammu and Kashmir. It is the largest tulip garden in Asia spread over an area of about 30 ha (74 acres). It is situated at the base of the Zabarwan range, built on a sloping ground in a terraced fashion consisting of seven terraces with an overview of the Dal Lake.

Shinjuku Gyoen National Garden is a must-visit tourist spot in Tokyo, Japan. This beautiful garden offers a serene escape from the bustling city life. It is known for its stunning landscapes, vibrant flowers, and peaceful atmosphere.

40. Which of the following statements is/are correct? (MSQ Type)
    (A) Hibiscus or china rose (Hibiscus rosa-sinensis) is a shrub which has red, pink, white, and yellow blossoms.
    (B) Frangipani, champa, and plumeria alba are names of the same flowering tree.
    (C) Jacaranda (Jacarenda mimisifolia), gulmohar (delonix regia), and amaltas (laburnum) are flowering trees.
    (D) The fruit of the Kadam/cadamba tree (Neolamarckia cadamba) is conical in shape and poisonous for humans.

Answer: A, B, C

Explanation: Hibiscus is a genus of flowering plants in the mallow family, Malvaceae. Several species are widely cultivated as ornamental plants, notably Hibiscus syriacus and Hibiscus rosa-sinensis. The flowers are large, conspicuous, trumpet-shaped, with five or more petals, colour from white to pink, red, blue, orange, peach, yellow or purple, and from 4–18 cm broad.

Frangipani, (genus Plumeria), genus of about 12 species of deciduous shrubs or small trees in the dogbane family (Apocynaceae), native to the New World tropics. Plumeria plants are also known as Champa, Lei flowers and Frangipani. They are small trees. The plant is used for ornamental purpose.

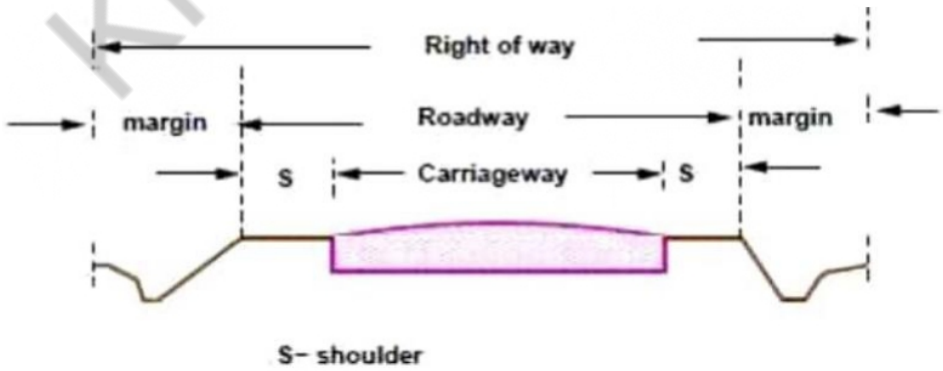
Jacaranda, any plant of the genus Jacaranda (family Bignoniaceae), especially the two ornamental trees J. mimosifolia and J. cuspidifolia, are widely grown in warm parts of the world and in greenhouses for their showy blue or violet flowers and attractive, oppositely paired, compound leaves. Amaltas also known as Rajvraksha in Ayurveda has bright yellow flowers. It is considered as one of the most beautiful trees of India.

Neolamarckia cadamba, with English common names burflower-tree, laran, and Leichhardt pine, and called kadam or cadamba locally, is an evergreen, tropical tree native to South and Southeast Asia. Its flowers are sweetly fragrant, red to orange in colour, occurring in dense, globular heads of approximately 5.5 cm (2.2 in) diameter. The fruit of N. cadamba occur in small, fleshy capsules packed closely together to form a fleshy yellow orange infructescence containing approximately 8000 seeds.

41. Which of the following is/are component(s) of Right of Way (RoW) of a road? (MSQ Type)
    (A) Building line
    (B) Kerb
    (C) Carriageway
    (D) Sidewalk

Answer: B, C, D

Explanation: Right of way (RoW) or land width is the width of land acquired for the road, along its alignment. It should be adequate to accommodate all the cross-sectional elements of the highway and may reasonably provide for future development. To prevent ribbon development along highways, control lines and building lines may be provided. Control line is a line which represents the nearest limits of future uncontrolled building activity in relation to a road. Building line represents a line on either side of the road, between which and the road no building activity is permitted. RoW width is mainly governed by width of formation, height of embankment or depth of cutting, side slopes of embankment or cutting, sight distance considerations, and reserve land for future widening. A typical RoW is shown below:



S– shoulder

42. As per the National Building Code of India 2016, terminologies associated with firefighting in a building is/are: (MSQ Type)
(A) Refuge area
(B) Water sprinkler system
(C) Panic bar
(D) Atrium

Answer: A, B, C (or) A, B, C, D

Explanation: Below are some important terms related to Fire and Life Safety as per National Building Code 2016:

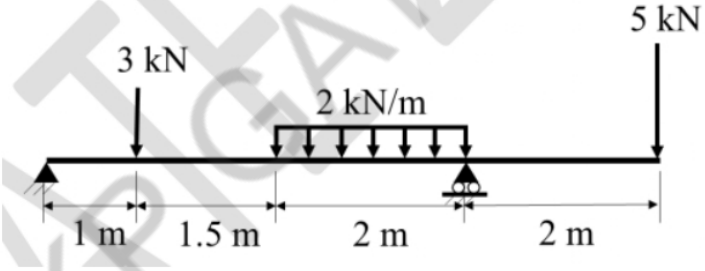
Refuge area: An area within the building for a temporary use during egress. It generally serves as a staging area which is protected from the effect if fire and smoke.

Water sprinkler system: Automatic water sprinkler system is a system of water pipes fitted with sprinkler heads at suitable intervals and heights and designed to actuate automatically, control and extinguish fire by the discharge of water.

Panic bar: A push bar (also known as a panic exit device, panic bar, crash bar, or bump bar) is a type of door opening mechanism which allows users to open a door by pushing a bar.

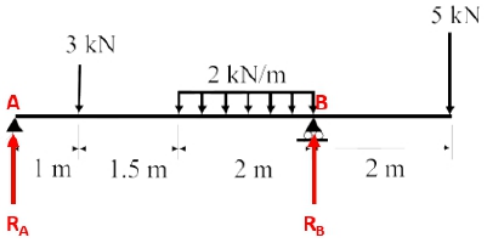
Atrium: A large-volume space created by a floor opening or series of floor openings connecting two or more stories that is covered at the top of the series of openings and is used for purposes other than an enclosed stairway; lifts hoist-way; an escalator opening; or utility shaft used for plumbing, electrical, air-conditioning, or communications facilities.

43. For the beam shown below, ignoring the self-weight, the maximum hogging moment (in kN·m) generated for the loads indicated is _____ (rounded off to one decimal place). (NAT)

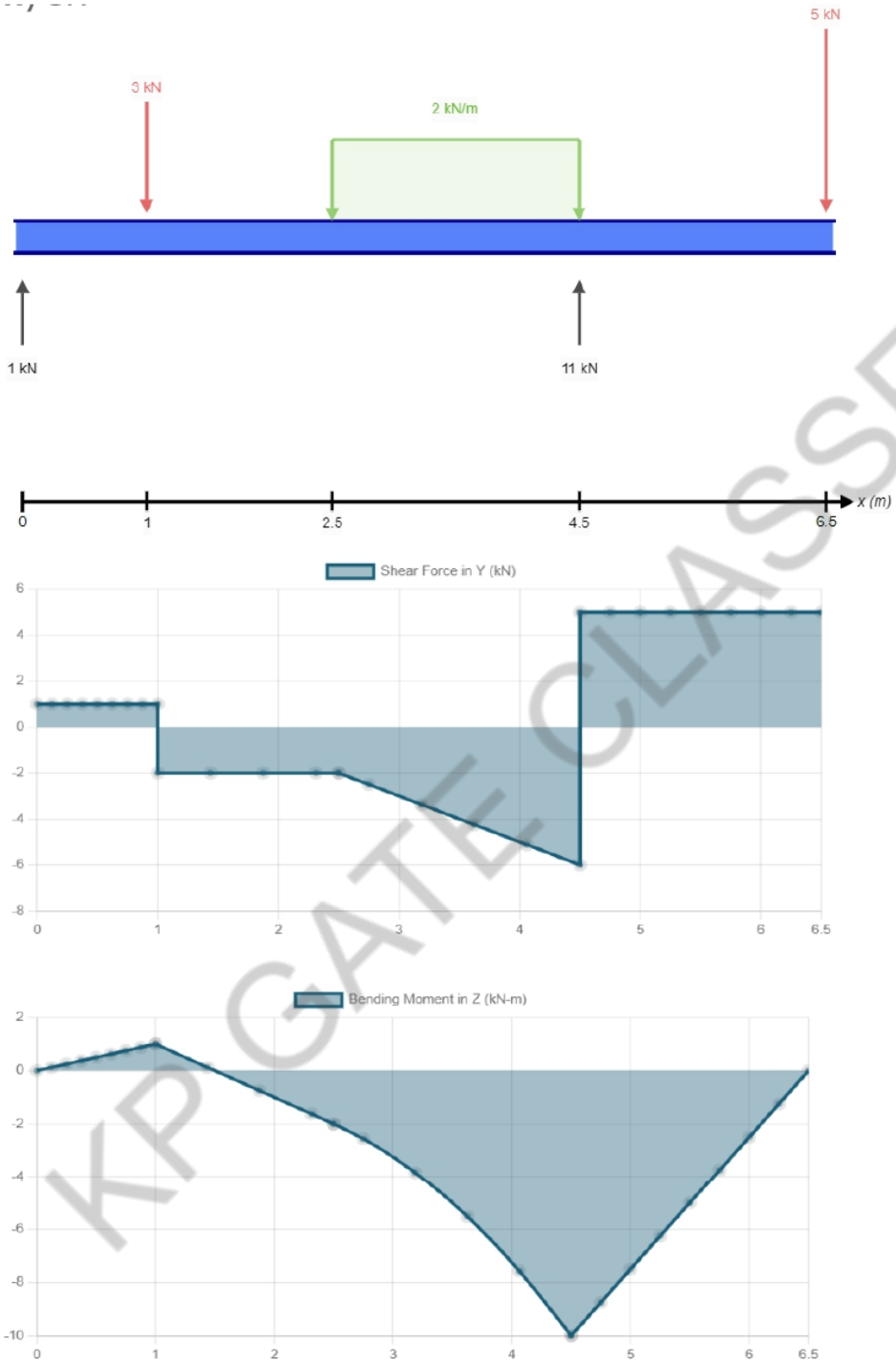


Answer: 9.9 to 10.1

Explanation: The calculation of unknown support reactions for the given beam is the first step:



Calculating the Shear force and Bending moment at various points on the beam and drawing the SFD (Shear Force Diagram) and BMD (Bending Moment Diagram), we get the following:



As seen in the BMD above, the maximum bending moment occurs at 4.5 meters distance from the first support (A) – and its magnitude is 10 kNm (negative sign denotes hogging moment)

44. At present, the cost of a new office equipment is 50,000 (in Indian Rupees). It has 15% salvage value after a useful life of 5 years. Using straight line method of depreciation, the book value of the equipment 3 years from now, in Indian Rupees, will be _____ (in integer). (NAT)

Answer: 24500

Explanation: Initial value, I = 50,000/-

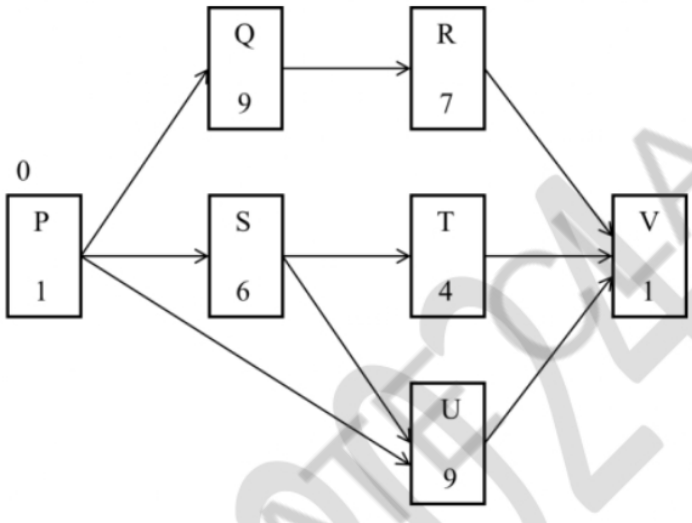
Salvage value, S = 15% of 50,000 = (0.15*50,000) = 7,500/-

Total depreciation, D = I – S = 50,000 – 7,500 = 42,500/-

Annual depreciation, A = Total depreciation/years of useful life = 42500/5 = Rs. 8,500/-

Book value after 3 years = Initial value – (depreciation in 3 years) = (I) – (A*n) = (50,000) – (8500*3) = Rs. 24,500/-

45. The network diagram of a construction project is shown in the following Figure. The duration of each activity, in days, and the early start time of the project are denoted in the diagram. The total project duration along the critical path, in days, is _____ (in integer). (NAT)



Answer: 18

Explanation: All the paths from start to end and their respective durations are listed below:

P – Q – R – V = 18 days

P – S – T – V = 12 days

P – S – U – V = 17 days

P – U – V = 11 days

It can be observed that P – Q – R – V with 18 days is the longest path and hence the critical path.

Alternatively, from forward and backward pass calculations, the EST, EFT, LST and LFT values for each activity can be calculated to find the answer.

46. The design of a 1200 capacity concert hall considers 1/3rd female audience and 2/3rd male audience. The Table below shows the guideline for calculating Water Closet requirements.

Fixture	Male	Female
Water closet	1 number per 100 up to 400 and over 400, 1 number for every 250 or part thereof	3 numbers per 100 up to 200 population and over 200, 2 numbers for every 100 or part thereof

Using the above guideline, the number of Water Closets required for the total audience is _____ (in integer). (NAT)

Answer: 16

Explanation: Total number of female audience = 1/3 of 1200 = 400

WCs for female audience required = (3 + 3 + 2 + 2) = 10 WCs (considering 3 numbers per 100 up to 200 population and over 200, 2 numbers for every 100 or part thereof)

Number of male audience = 2/3 of 1200 = 800

WCs for male audience required = (1 + 1 + 1 + 1 + 1 + 1) = 6 WCs (considering 1 number per 100 up to 400 and over 400, 1 number for every 250 or part thereof)

Total number of WCs required for the total audience = 10 + 6 = 16 WCs

47. A declining Industrial Town has proposed to improve water sustainability by reducing stormwater runoff through change of land use land cover (LULC), as shown in the Table below, to attract new residents.

LULC	Runoff Coefficient	Existing Area in hectare	Proposed Area in hectare
Industrial	0.7	1500	800
Residential	0.5	1000	1200
Park and Playgrounds	0.25	1200	1000
Forest	0.15	300	1000

Considering a flat topography and zero additional runoff from the adjoining areas, the reduction in run-off generation for a 400 mm rainfall event in the industrial town for the proposed intervention, in cubic meters, is _____$\times 10^6$ (rounded off to two decimal places). (NAT)

Answer: 1.30 to 1.38

Explanation: Intensity of rainfall, I = 400 mm = 0.4 m

Volume of run-off generated = C * I * A (where C is runoff coefficient, I is intensity of rainfall, A is surface area)

Run-off generated as per the existing LULC (A) will be:

$$A = [(0.7 * 1500) + (0.5 * 1000) + (0.25 * 1200) + (0.15 * 300)] * 0.4m = 758\ hectare * m$$
$$= 7.58 * 10^6 cubic\ meters$$

Run-off generated as per the proposed LULC (B) will be:

$$B = [(0.7 * 800) + (0.5 * 1200) + (0.25 * 1000) + (0.15 * 1000)] * 0.4m = 624\ hectare * m$$
$$= 6.24 * 10^6 cubic\ meters$$

Reduction in run-off generation = A – B = $(7.58\times10^6) - (6.24\times10^6) = 1.34\times10^6$ cubic meters

48. A real estate developer is developing a township on a PPP mode. The total area of the site is 2.672 hectares with an allowable FAR of 2.25, of which 20% is earmarked for MIG category. The gross area of each MIG unit including common areas and services is 72 m². Assuming super built up area to be same as FAR, the maximum number of MIG apartments that can be constructed is _____ (in integer). (NAT)

Answer: 167

Explanation: 1 hectare = 10,000 sqm

Maximum permissible built-up area = Plot area * FAR = 2.672 * 2.25 *10000 = 60,120 sqm

Built-up area earmarked for MIG units = 20% of 60,120 = (0.2*60120) = 12024 sqm

Maximum number of MIG apartments = 12024/72 = 167 apartments

49. A municipal town requires a volume of 70,000 m³ compacted solid waste to fill a low-lying land. The city has a total of 10,000 households.

Type of House	Percentage of Households	Equivalent volume of compacted solid waste generated/ household/ day
LIG	30%	0.10 m³
MIG	60%	0.15 m³
HIG	10%	0.20 m³

Using the information as shown in the Table above, the estimated minimum number of days required to fill the low-lying land is _____ (in integer). (NAT)

Answer: 50

Explanation: Total number of LIG households = (0.3*10000) = 3000 units

Total number of MIG households = (0.6*10000) = 6000 units

Total number of HIG households = (0.1*10000) = 1000 units

Total volume of compacted solid waste generated by the city = (3000 * 0.1) + (6000 * 0.15) + (1000 * 0.2) = 300 + 900 + 200 = 1400 m³

Number of days to fill the low-lying land = 70,000/1400 = 50 days

PART B1: FOR Architecture CANDIDATES ONLY

Q.50 – Q.56 Carry ONE mark Each

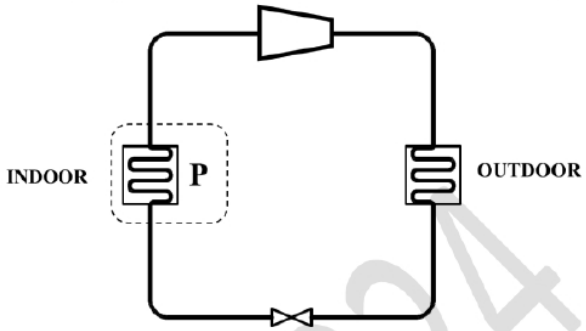
50. Rose window is a characteristic feature of:
(A) Great Temple of Ammon, Karnak, Egypt
(B) Temple of Jupiter, Baalbek, Lebanon
(C) Notre-Dame, Paris, France
(D) Humayun Tomb, Nizamuddin, Delhi

Answer: C

Explanation: Rose window is often used as a generic term applied to a circular window but is especially used for those found in Gothic cathedrals and churches. The windows are divided into segments by

stone mullions and tracery. France has a great number of medieval rose windows, many containing ancient glass. In northern France, a rose window is usually the central feature of the facade. The transept facades commonly contain rose windows as well. Examples can be seen at Notre Dame, Paris, the Basilica of Saint Denis, Reims Cathedral, Amiens Cathedral, etc.

51. The schematic diagram of a unitary air-conditioner operating in cooling mode, is shown in the following Figure. The component P marked in the figure represents:



(A) Condenser
(B) Evaporator
(C) Compressor
(D) Expansion valve

Answer: B

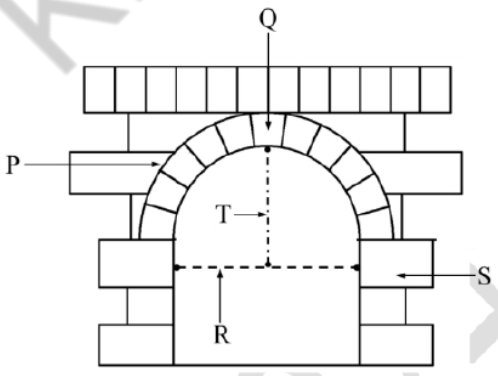
Explanation: The evaporator coil is the component in an AC system that absorbs the heat from the air in a space. It is often located inside an air handler or in the indoor unit of an AC system. It works with a condenser coil to complete the heat exchange process that produces cool air.

52. Titan Integrity Campus, Bengaluru is designed by:
(A) Christopher C. Benninger
(B) Sanjay Mohe
(C) Raj Rewal
(D) Anant Raje

Answer: B

Explanation: Titan Integrity Campus (Bangalore) is a corporate office building located on a 6.5acre site which has a lake on the eastern side and road towards north. The building was designed by Mindscape Architects with Lead Architect as Sanjay Mohe.

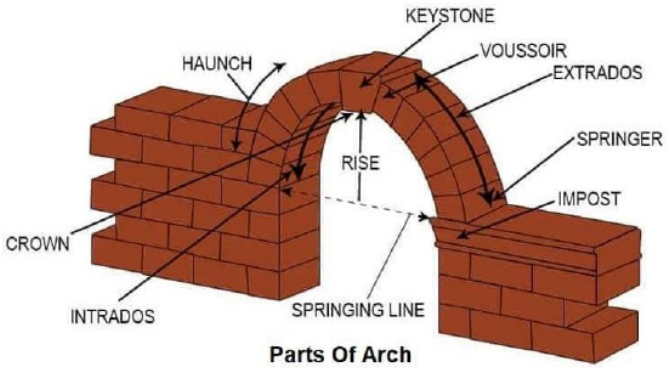
53. With reference to the Figure below, which of the following labelling is/are correct? (MSQ Type)



(A) P – Extrados, Q – Key, R – Span
(B) Q – Key, S – Abutment, T – Rise
(C) P – Abutment, R – Rise, T – Extrados
(D) Q – Key, S – Span, T – Extrados

Answer: A, B

Explanation: The image below marks the important parts of an arch:



Parts Of Arch

54. Which of the following buildings has/have pendentives as a structural element? (MSQ Type)
(A) St. Mark's Basilica, Venice, Italy
(B) Westminster Cathedral, London, UK
(C) Dilwara Temple, Mount Abu, India
(D) Hagia Irene Museum and Concert Hall, Istanbul

Answer: A, D

Explanation: St. Mark's Basilica is a cathedral church of Venice. The present structure is the third church at the same site, the construction for which is assumed to have begun in 1063 CE. It is modelled on the sixth century Church of the Holy Apostles in Constantinople. It's architecture has middle-byzantine (like the pendentives), Romanesque, and Islamic influences, and Gothic elements were later incorporated.

Hagia Irene Museum and Concert Hall is an Eastern Orthodox church located in the outer courtyard of Topkapı Palace in Istanbul. It is the oldest known church in the city and the only Byzantine church in Istanbul that was never converted into a mosque, as it was used as an arsenal for storing weapons until the 19th century. The Hagia Irene today operates as a museum and concert hall.

55. Polytetrafluroethylene (PTFE) coated fiberglass has been used as a roofing membrane in: (MSQ Type)
(A) Jawaharlal Nehru Stadium, New Delhi
(B) Eden Gardens Stadium, Kolkata
(C) Melbourne Cricket Ground Stadium, Melbourne
(D) Beijing National Stadium, Beijing

Answer: Marks to All

Explanation: The image of Beijing National Stadium is purely structural: facade and structure are identical. The load-bearing elements support one another and converge into a spatial grid-like formation

in which facades, stairs, bowl structure and roof are integrated. To make the roof weatherproof, the spaces in the structure of the stadium are filled with translucent membranes of ETFE (ethylene tetrafluoroethylene), recalling the soft fillers birds use to stuff the spaces between the woven twigs of their nests. The ceiling is clad with PTFE (polytetrafluoroethylene), an acoustic membrane that reflects sound to maintain the enthusiastic atmosphere of the stadium while veiling the structure to focus attention on the spectators and events on the field.

Jawaharlal Nehru Stadium, New Delhi has 53,800 m² (579,000 sq ft) Teflon-coated roof, designed by the German structural engineering and consulting firm Schlaich Bergermann Partner, and was built at a cost of ₹308 crore (US$67.36 million). Taiyo Membrane Corporation supplied and installed the PTFE glass fibre fabric roof. It is one of the largest membrane roof systems in the world. 8,500 tonnes of steel were used in the construction of the stadium's roof and its support structure.

56. A non-stop express elevator directly connects the observatory level at 80th floor of a tower with the podium at 2nd floor level. The tower has a uniform floor-floor height of 4 m. The elevator attains a maximum speed of 8 m/s. Assume 2 m/s² as net vertical acceleration and net vertical deceleration (incorporating gravity). If the elevator starts from a state of rest from the podium, the time taken to reach the observatory, in seconds, is _____ (rounded off to one decimal place). (NAT)

Answer: 42 to 44

Explanation: Total distance for elevator = (80-2)*4 = 312 meters

The elevator has three types of upward travel; accelerating part, constant velocity part, decelerating part.

Distance travelled with acceleration (S1) will be:

$v^2 - u^2 = 2 * a * S_1$

$=> S_1 = \frac{64}{4} = 16\ meters$

Time taken for accelerating distance (T1) will be:

$v = u + at$

$=> T_1 = 4\ seconds$

Similarly, distance travelled with deceleration (S3) will be:

$=> S_3 = \frac{64}{4} = 16\ meters$

Time taken for accelerating distance (T3) will be:

$=> T_3 = 4\ seconds$

Distance for constant velocity part (S2) will be Total distance – S1 – S3 = 312 – 16 – 16 = 280 meters

Time for constant velocity part (T2) will be:

$T2 = \frac{S2}{Velocity} = \frac{280}{8} = 35\ seconds$

Total time for travel = T1 + T2 + T3 = 4 + 35 + 4 = 43 seconds

Q.57 – Q.65 Carry TWO marks Each

57. Match the elements in Group–I with the corresponding religious buildings in Group–II.

Group I	Group II
P. Bell Capital	1. Mosque
Q. Mehrab	2. Hindu Temple
R. Gopuram	3. Greek Temple
S. Pediment	4. Romanesque Church
	5. Egyptian Temple

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

Answer: A

Explanation: Mihrab is a niche in the wall of a mosque that indicates the qibla, the direction of the Kaaba in Mecca towards which Muslims should face when praying. The wall in which a mihrab appears is thus the "qibla wall".

A gopuram or gopura is a monumental entrance tower, usually ornate, at the entrance of a Hindu temple, in the South Indian architecture of the southern Indian states of Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, and Telangana, and Sri Lanka. In other areas of India they are much more modest, while in Southern Indian temples they are very often by far the highest part of the temple.

In Classical architecture, the pediment is the traditionally triangular section at the top of a temple's entrance. This form was introduced by the ancient Greeks. For them, the pediment was a gable, a vertical structural element that supported a low-pitched, gabled roof.

58. Match the museums in Group–I with their architects in Group–II.

Group I	Group II
P. Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal	1. Charles Correa
Q. Bihar Museum, Patna	2. Ram Sharma
R. Gandhi Memorial Museum, Ahmedabad	3. Romi Khosla
S. Museum of Art and Photography, Bengaluru	4. Soumitro Ghosh & Nisha Mathew
	5. Fumihiko Maki

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

Answer: D

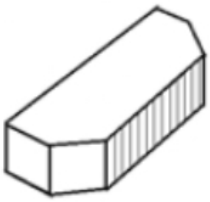
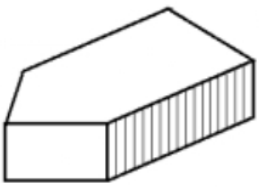
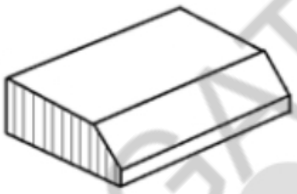
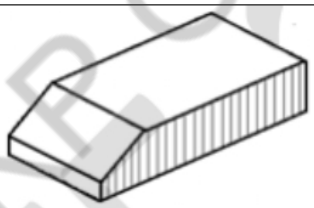
Explanation: The initial conceptual plan of the National Museum of Man was formed by the Expert group followed by the constitution of the Advisory Committee under the Chairpersonship of Mrs. Pupul Jayakar in September 1979. The Services of Shri Ram Sharma as Architect for the Sangrahalaya was recommended by the Advisory Committee. The Revised Design of the Indoor Museum Building incorporating the recommended amendments was submitted by the Architect and the Design was approved by the Executive Council of the RMSS.

Maki and Associates' design for the Bihar Museum creates an engaging and appropriately scaled response to a prominent site and an ambitious, multi-faceted museum program. The Museum houses a rich variety of treasures from the region and includes event and education spaces that nurture a newfound sense of pride and connection to Bihar's storied history.

Gandhi Memorial Museum was inaugurated on May 10, 1963, by India's first Prime Minister Pandit Jawaharlal Nehru. It is housed in an iconic building designed by Charles Correa. It has 3 galleries (Gandhi in Ahmedabad Gallery, Painting Gallery and My Life is My Message Gallery) and houses the Ashram's library.

The Museum of Art & Photography, housed in a state-of-the-art building in Banalore was designed by Bangalore-based architects Mathew & Ghosh Architects.

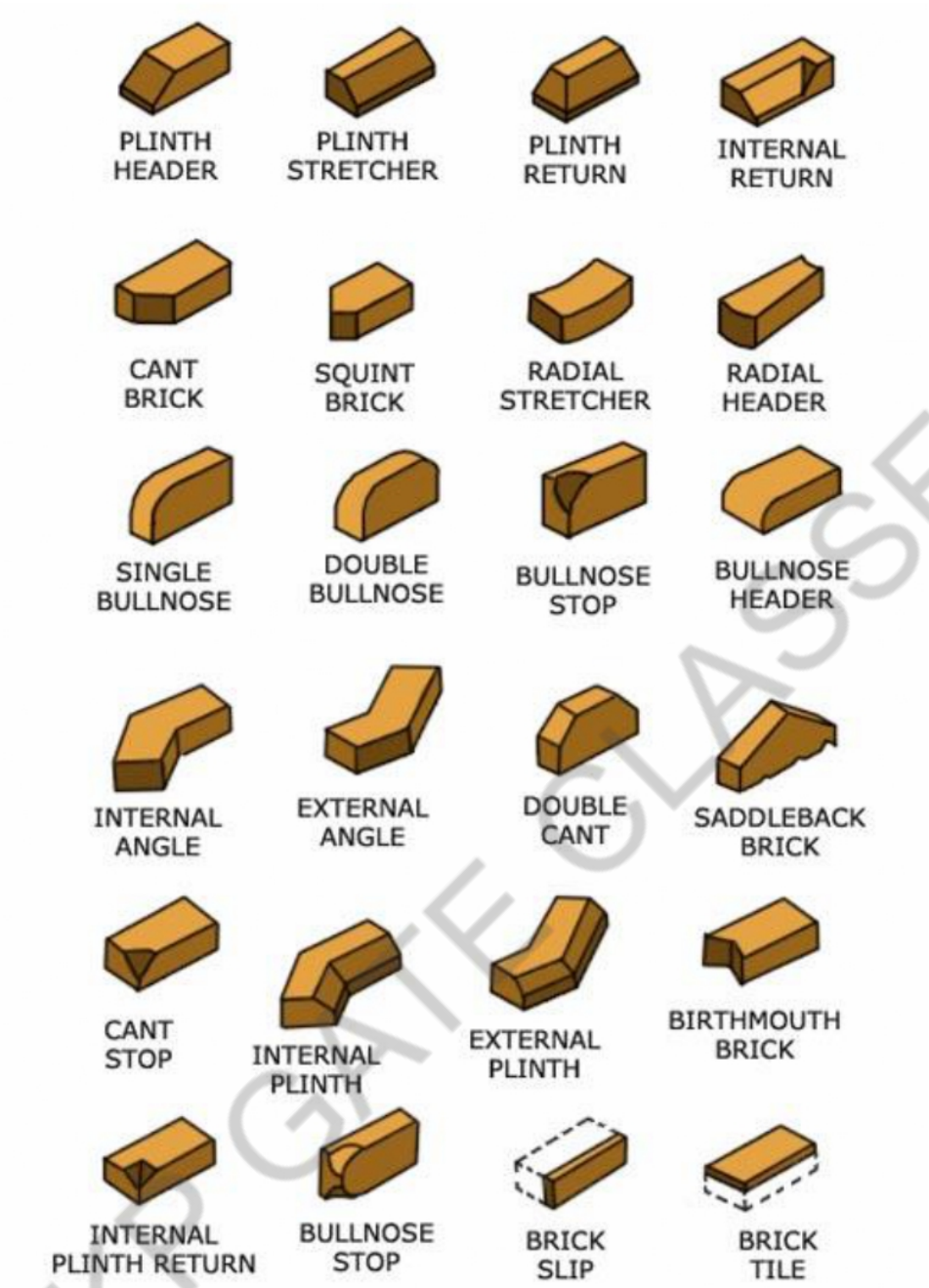
59. Match the specially shaped bricks in Group–I with their corresponding nomenclature in Group–II.

Group I	Group II
P. 	1. Plinth Header
Q. 	2. Bird's mouth
R. 	3. Squint
S. 	4. Double cant
	5. Plinth stretcher

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

Answer: A

Explanation: Various types of specially shaped bricks and their respective nomenclature are shown in the figure below:



60. Which of the following statements is/are correct? (MSQ Type)
    (A) The unit of Lighting Power Density is W/m².
    (B) The unit of Lighting Power Density is cd/m².
    (C) The unit of Sound Power is W.
    (D) The unit of Energy Performance Index is kWh/m²/year.

Answer: A, C, D

Explanation: Lighting power density is a simple screening measure that indicates whether a space offers opportunities for energy savings. Lighting Power Density (LPD) is defined as watts of lighting per unit room floor area, generally measured in W/sqm.

Sound power or acoustic power is the rate at which sound energy is emitted, reflected, transmitted, or received, per unit time. It is defined as "through a surface, the product of the sound pressure, and the component of the particle velocity, at a point on the surface in the direction normal to the surface, integrated over that surface." The SI unit of sound power is the watt (W). It relates to the power of the sound force on a surface enclosing a sound source, in air.

The Energy Performance Index (EPI) is an important metric used in building design and construction to measure the energy efficiency of a building. It is essentially a ratio that measures a building's **annual energy consumption** in kilowatt-hours **per square meter** of the building.

61. Which of the following statements is/are correct? (MSQ Type)
    (A) Kath-kuni construction comprises layers of stone and timber.
    (B) Nālukettu houses have a courtyard.
    (C) Ikra is a two-storeyed house with stone masonry and a flat-roof.
    (D) Bhunga has a circular plan.

Answer: A, B, D

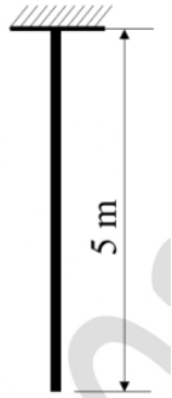
Explanation: Kath-Kuni is an indigenous construction technique prevalent in the isolated hills of northern India, especially in the region of Himachal Pradesh Kath is derived from the Sanskrit word kashth meaning wood and kuni from the word kona meaning corner. It is a traditional technique that uses alternating layers of wood and stone masonry, held in place without using mortar.

Nālukettu is the traditional homestead of old Tharavadu where many generations of a matrilineal family lived. These types of buildings are typically found in the Indian state of Kerala. The traditional architecture is typically a rectangular structure where four halls are joined with a central courtyard, or Nadumuttam, open to the sky. The four halls on the sides are named Vadakkini (northern block), Padinjattini (western block), Kizhakkini (eastern block) and Thekkini (southern block).

Ikra houses (mainly found in Assam) are single-storey structures consisting of brick or stone masonry walls up to about 1 m above the plinth. This masonry supports the walls consisting of bamboo woven together with a wooden frame and plastered with cement or mud plaster.

Bhungas are traditional houses unique to the Kutch region in Gujarat. The houses are circular walled with thatched roof. They are known for their structural stability in earthquakes and for being climate responsive. It also protects against sandstorms and cyclonic winds.

62. A 5 m long Aluminium tie rod of cross-section 0.20 m × 0.04 m is subjected to a tensile force induced by its self-weight of 21.20 kg/m considering gravitational acceleration of 10 m/s^2. If tensile Young's modulus of Aluminium is 70,000 MPa, the maximum tensile strain in the rod is _____$\times 10^{-6}$ (rounded off to two decimal places). (NAT Type)



Answer: 1.80 to 1.90

Explanation: Force applied, F for the given rod will be:

$F = m * g = 21.20 * 5 * 10 = 1060\ N$

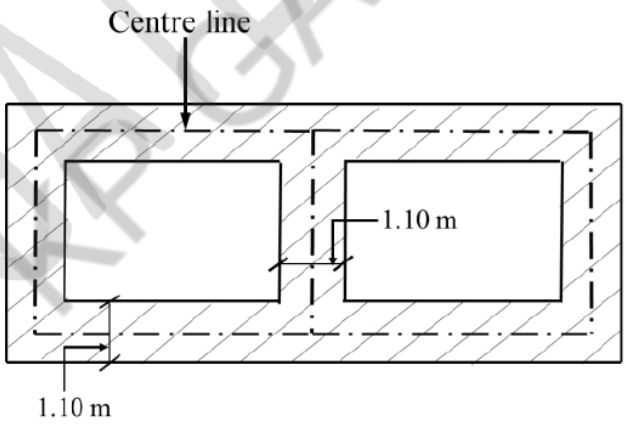
Stress for the given rod will be Force/Area; calculated as follows:

$$Stress, \sigma = \frac{1060}{A} = \frac{1060}{(200 * 40)} = 0.1325 \frac{N}{mm^2}$$

From Hooke's Law; Youngs Modulus, E = Stress/Strain

$$=> Strain = \frac{Stress}{E} = \frac{0.1325}{70000} = 1.8929 * 10^{-6}$$

63. The following Figure shows the excavation plan of a two-room structure, where the trench has a uniform width of 1.10 meters. If the cumulative centre line length of the trench is 41.10 meters and the required depth of concrete to be poured is 0.30 meters, the volume of concrete in foundation, in cubic meters, will be _____ (rounded off to two decimal places). (MSQ Type)



Answer: 13.20

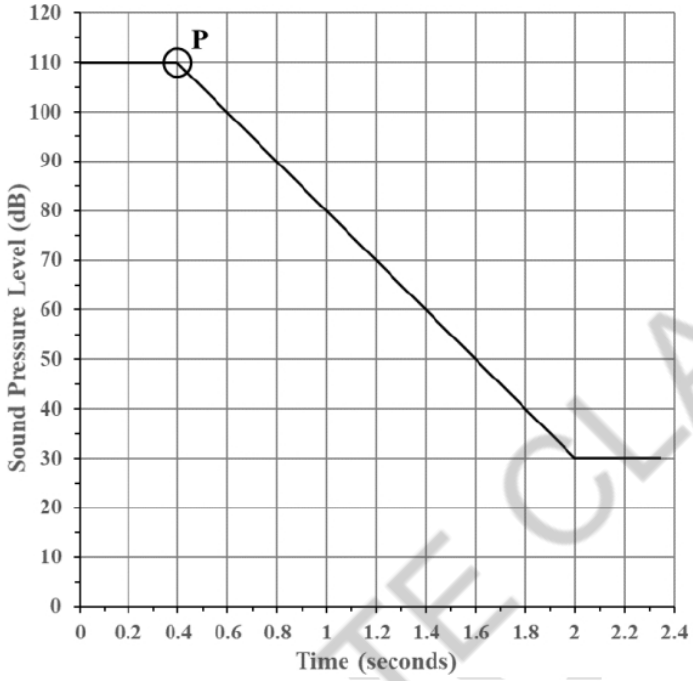
Explanation: In center-line method, for each interior T-junctions, we consider a deduction of half-wall thickness from center-line length.

So, effective length of center-line for the given plan, after deductions, will be = 41.10 – (1.10) = 40 meters

Area of foundation foot print = Effective length of center-line after deductions * Thickness = 40*1.1 = 44 sqm

Volume of concrete in foundation = Area * Depth = 44 * 0.3 = 13.2 cubic meters

64. The decay of sound in an enclosed lecture hall of volume 3500 m³ is shown in the Figure below. The sound source is switched off at point P. Using the Reverberation Time (RT_{60}) obtained from the figure, the calculated total sound absorption of the hall, in Sabins, is _____ (rounded off to the nearest integer).



Answer: 430 to 510

Explanation: RT is defined as the time taken for sound to fall by 60 dB from its original level, after the source has stopped. From the given graph, original sound level is 110 dB. RT will be the time taken for the sound to fall to 50 dB (which is 60dB below the original level). So, RT = 1.6 – 0.4 = 1.2 seconds

From Sabins equation,

$$RT = 0.16 * \frac{V}{A}$$

$$=> Absorption, A = \frac{0.16 * V}{RT} = 0.16 * \frac{3500}{1.2} = 466.67\ sabins$$

65. A 2 TR window air-conditioner of Energy Efficiency Ratio (EER) 3.1 is catering to a room of volume 40 m³. The air-conditioner is operational for 600 hours during summer on cooling mode. The compressor is also operational for the complete duration. The total energy consumption of the air-conditioner during the above-mentioned period, in kWh, is _____ (rounded off to nearest integer).

Answer: 1350 to 1394

Explanation: EER is defined as Cooling load/Power consumption

Given EER = 3.1 and Cooling load = 2 TR = 2*3517 = 7034 Watts (as approx 1 TR = 3517 Watts)

Power Consumption = Cooling load/EER = 7034/3.1 = 2269 Watts = 2.269 kW

Total energy consumption for AC for 600 hours = Power consumption * Time = 2.269 * 600 = 1361.4 kWh

PART B2: FOR Planning CANDIDATES ONLY

Q.66 – Q.72 Carry ONE mark Each

66. Which of the following aims is set under the SVAMITVA scheme of the Ministry of Panchayati Raj, Government of India?
    (A) Provide tap water connection to all households in rural areas.
    (B) Provide 'right to work' to the rural people falling Below Poverty Line.
    (C) Establish clear ownership of property in rural inhabited (Abadi) areas, by mapping of land parcels using improvised technology.
    (D) Provide effective and efficient institutional platforms to enable the rural poor to increase their household income by means of sustainable livelihood enhancement.

Answer: C

Explanation: SVAMITVA is an abbreviation for Survey of Villages Abadi and Mapping with Improvised Technology in Village Areas. The objective of the SVAMITVA scheme is to prepare housing rights records of the rural population using drone survey technology in collaboration with the Ministry of Panchayati Raj, Government of India, State Revenue Departments, and the Survey of India.

67. Mass Rapid Transit System is a:
    (A) Fixed Route and Fixed Schedule service.
    (B) Fixed Route and Flexible Schedule service.
    (C) Flexible Route and Fixed Schedule service.
    (D) Flexible Route and Flexible Schedule service.

Answer: A

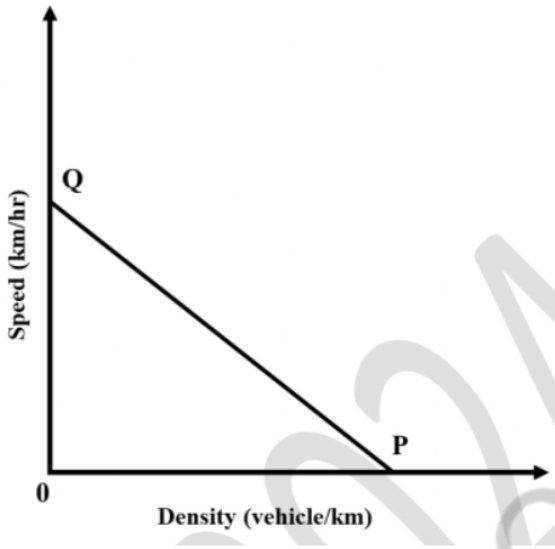
Explanation: The term "fixed route system" means a system of providing transportation of individuals (other than by aircraft) on which a vehicle is operated along a prescribed route and generally according to a fixed schedule. Mass Rapid Transit System (MRTS) is a fixed-route fixed-schedule system.

68. Which of the following initiatives of the Government of India is also known as the National Master Plan for Multi-modal Connectivity?
    (A) PM Gati Shakti
    (B) Bharatmala
    (C) Parvatmala
    (D) Sagarmala

Answer: A

Explanation: PM GatiShakti is a National Master Plan to provide multimodal connectivity infrastructure to various economic zones. Hon'ble Prime Minister launched the PM Gati Shakti National Master Plan (NMP) on 13 th October2021 for providing multimodal connectivity infrastructure to various economic zones.

69. With reference to the Speed-Density diagram given below, which of the following statements is/are correct? (MSQ Type)



(A) Point P represents Maximum Flow
(B) Point P represents Jam Density
(C) Point Q represents Space Mean Speed for Free Flow condition
(D) Point Q represents Time Mean Speed

Answer: B, C

Explanation: Point P has maximum vehicle density with zero speed and hence denotes 'Jam Density'. Point Q has zero vehicle density with maximum speed and hence denotes 'Space Mean Speed' for free flow condition.

The space-mean speed is the distance travelled divided by an average travel time, whereas the time-mean speed is an average of individual vehicle speeds. Free-flow speed is the term used to describe the average speed that a motorist would travel if there were no congestion or other adverse conditions (such as bad weather).

70. Which of the following statements correctly represent(s) the Demographic dividend of a country? (MSQ Type)
(A) Share of working age population is larger than dependent population.
(B) Share of working age population is lesser than dependent population.
(C) Demographic dividend demands more job creation.
(D) Demographic dividend can never lead to demographic disaster.

Answer: A, C

Explanation: Demographic dividend is economic growth brought on by a change in the structure of a country's population, usually a result of a fall in fertility and mortality rates. The demographic dividend

comes as there's an increase in the working population's productivity, which boosts per capita income. These benefits of demographic dividend are lost and the "dividend" becomes a "disaster" if the persons of working age are unemployed during the period of low dependency ratio.

71. As per the URDPFI Guidelines 2015, choose the option(s) which indicate(s) the appropriate hierarchy of plans from higher to lower order. (MSQ Type)
(A) Perspective Plan > Development Plan > Local Area Plan
(B) Development Plan > Special Purpose Plan > Annual Plan
(C) Local Area Plan > Development Plan > Annual Plan
(D) Special Purpose Plan > Perspective Plan > Local Area Plan

Answer: A, B

Explanation: Below is the hierarchy of plans from higher to lower order (as per URDPFI Guidelines)

72. In 2021, a city survey report revealed a sex ratio of 930 with an estimated increase of 2.16% over the next 20 years. In 2041, the total population of the city is projected to be 15,00,000. The estimated female population in the year 2041 will be _____ (in integer). (NAT)

Answer: 730500 to 731200

Explanation: From given information, sex-ratio for 2041 = 930 + (2.16% growth) = 930 + (930*0.0216) = 950.088 = 950 approx (Sex ratio is number of females per 1000 males)

Percentage of total population formed by females = 950/(1000+950) = 48.7179%

Estimated female population in 2041 = 48.7179% of 15,00,000 = 0.4872 * 15,00,000 = 7,30,800

Q.73– Q.81 Carry TWO marks Each

73. Match the terms in Group–I with their descriptions in Group–II.

Group I	Group II
P. Landfill site	1. Development on previously developed site
Q. Greenfield development	2. Land to dispose solid waste
R. Green Belt	3. Development on previously undeveloped land
S. Brownfield development	4. Policy to protect livestock
	5. A buffer to control urban development

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

Answer: C

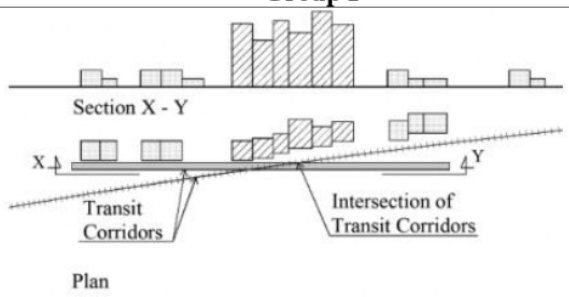
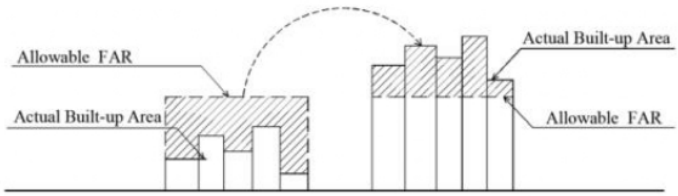
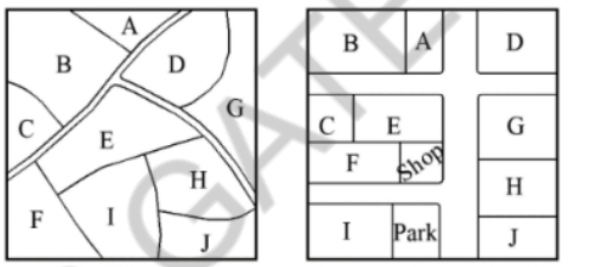
Explanation: A landfill site is an area of land that is used to dump rubbish, either directly on the ground or filling an unwanted hole in the ground.

Greenfield development is any kind of real estate development in previously undeveloped areas. The new development can be of any variety of land use—residential, commercial, industrial, or infrastructural.

"Greenbelt" is a general term that refers to natural, undeveloped, and/or agricultural lands that surround urban areas. These lands may include open spaces, parks, farms and ranches, wildlands, or a combination thereof—as designated by cities, counties, special districts, and other jurisdictions.

Brownfield land would either have been used for industrial or commercial purposes but is no longer in use. The land may still have existing structures, but it is likely to have been contaminated by varying concentrations of hazardous industrial waste, pollutants, or other contaminants.

74. Match the following illustrations in Group–I with their corresponding concepts in Group–II.

Group I	Group II
P. 	1. Figure Ground Relationship
Q. 	2. Town Planning Scheme (TPS)
R. 	3. Transit Oriented Development (TOD)
S. 	4. Transferable Development Rights (TDR)
	5. Cul-de-Sac

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

Answer: A

Explanation: TOD, or transit-oriented development, means integrated urban places designed to bring people, activities, buildings, and public space together, with easy walking and cycling connection between them and near-excellent transit service to the rest of the city.

Transferable development rights (TDR) is a method by which developers can purchase the development rights of certain parcels within a designated "sending district" and transfer the rights to another "receiving district" to increase the density of their new development.

A figure-ground illustrates a mass-to-void relationship, and analysis of it identifies a "fabric" of urban structures.

The Town Planning Scheme (TPS) is a land pooling and readjustment mechanism that allows the city to appropriate land from private landowners for public purposes, such as roads, open spaces, low-income housing, underlying utility infrastructure, and other health, education and community services.

75. Match the following planning theories/concepts in Group–I with their corresponding proponents in Group–II.

Group I	Group II
P. Valley Section	1. McGee and Gemburg
Q. Third Place Theory	2. Oscar Newman
R. Defensible Space	3. Ray Oldenberg
S. Desakota Model	4. Patrick Geddes
	5. C. A. Doxiadis

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

Answer: A

Explanation: The valley section is a complex model, which combines physical condition- geology and geomorphology and their biological associations - with so-called natural or basic occupations such as miner, hunter, shepherd, or fisher, and with the human settlements that arise from them. It was given by Patrick Geddes.

Third places is a term coined by sociologist Ray Oldenburg and refers to places where people spend time between home ('first' place) and work ('second' place). They are locations where we exchange ideas, have a good time, and build relationships.

The defensible space theory of architect and city planner Oscar Newman encompasses ideas about crime prevention and neighbourhood safety. The theory developed in the early 1970s, and he wrote his first book on the topic, Defensible Space, in 1972. The book contains a study from New York that pointed out that higher crime rate existed in high-rise housing projects than in low-rise complexes.

Desakota is a term used in urban geography used to describe areas in the extended surroundings of large cities, in which urban and agricultural forms of land use and settlement coexist and are intensively intermingled. The term was coined by the urban researcher Terry McGee of the University of British Columbia around 1990. It comes from Indonesian desa "village" and kota "city".

76. Which of the following methods is/are used in traffic survey to measure the Running Speed and Journey Speed?
(A) Moving Observer Method
(B) Registration Number Method
(C) Elevated Observer Method
(D) Hardy Cross Method

Answer: A, B, C

Explanation: Moving car or moving observer method of traffic stream measurement has been developed to provide simultaneous measurement of traffic stream variables. In this, the observer records the number of oncoming vehicles met, the number of vehicles overtaken by the observer, and the number of times the observer is overtaken by other vehicles.

Registration number plate survey consists of nothing but the registration numbers of vehicles entering or leaving the survey point located on the cordon line. By matching the registration numbers of vehicles at the points of entry and exit from the area, one is enabled to identify 2 points on the paths of the vehicle.

In urban areas, it is sometime possible to station observers in high buildings or other elevated points from which a considerable length of route may be observed. These investigators select vehicle at random and record; time, location, and causes-of-delay.

The Hardy Cross method is an iterative method for determining the flow in pipe network systems where the inputs and outputs are known, but the flow inside the network is unknown. So, it is not a method in traffic survey to measure running speed and journey speed.

77. In the context of regional planning, which of the following terms represent(s) a region?
    (A) Formal
    (B) Functional
    (C) Isometric
    (D) Planning

Answer: A, B, D

Explanation: Formal regions usually have clearly demarcated boundaries, such as political borders. Functional regions' boundaries are determined by the extent of interaction or influence of a central node and can change over time. Vernacular regions, being based on perceptions, have fluid, and often debated boundaries. A planning region can be defined as a geographical region where designing and implementation of development plan is possible for tackling of regional problems. Example – Delhi Metropolitan Region.

78. In a one-way single lane traffic stream, the observed average time headway is 2.5 seconds. The traffic flow of the above mentioned lane, in vehicle/hr, is _____ (in integer). (NAT)

Answer: 1440

Explanation: Time headway is defined as the time difference between any two successive vehicles when they cross a given point. Practically, it involves the measurement of time between the passage of one rear bumper and the next past a given point.

So, the flow of vehicles can be considered 1 for every 2.5 seconds.

Traffic flow in vehicle/hr will be = 3600/2.5 = 1440 vehicle/hr

79. The demand of a EcoCity theme park is estimated as P = 1500 − 7.5Q, where P (in Indian Rupees) is the price of a ticket for single entry, and Q (in integer) is the number of tickets sold per hour. The maximum revenue per hour along the demand curve, in Indian Rupees, is _____ (in integer)

Answer: 75000

Explanation: Revenue = Price * Number of tickets = P * Q

From given equation, Revenue R = (1500 – 7.5Q) * Q = 1500Q – 7.5Q²

Number of tickets sold for maximum revenue can be calculated by equating First derivative of Revenue equation to zero and solving for Q.

First derivative of Revenue equation will be:

$R' = 1500 - 15Q$

Equating R' = 0 and calculating for 'Q', we get:

$1500 - 15Q = 0$

$=> Q = \frac{1500}{15} = 100$

The price when Q = 100 will be:

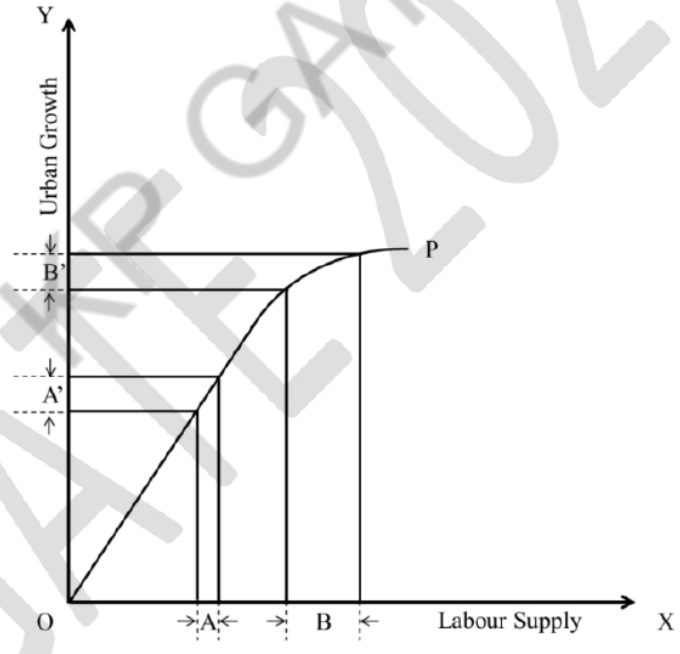
$P = 1500 - 7.5Q = 1500 - (7.5 * 100) = 750$

SO, maximum revenue per hour = 750 * 100 = Rs. 75,000

80. Labour supply and urban growth are represented in X and Y axis of the Figure below. Curve OP represents the relationship between labour supply and urban growth.

The ratios A:A' and B:B' are 1:1.2 and 3:1.2, respectively.

If 6 units of labour is supplied in B, then the number of units of urban growth in B' will be _____ (rounded off to one decimal place).



Answer: 2.4

Explanation: Given ratio B:B' = 3:1.2 and for B = 6 units the value of B' can be calculated as:

$Given, \frac{B}{B'} = \frac{3}{1.2}$

$=> \frac{6}{B'} = \frac{3}{1.2}$

$=> B' = \frac{6}{3} * 1.2 = 2.4\ units$

81. A city with a present population of 1,75,000 is expecting an annual population growth rate of 0.85%. In a traffic assessment study, the trip generation model has been developed as Y = 142 + 0.675X, where Y is the number of daily trips generated within the city and X is the population of the city. The number of daily trips to be generated within the city after 10 years is _____ (in integer).

Answer: 128500 to 128800

Explanation: Population of the city after 10 years = Present population * (1+r)^n and given r = 0.85% = 0.0085

$Population\ after\ 10\ years = 175000 * (1 + 0.0085)^{10} = 175000 * 1.0085^{10} = 1{,}90{,}457$

Number of daily trips within the city after 10 years = 142 + 0.675X = 142 + (0.675*190457) = 128700