



NHPC JE

Civil Engineering

Mega Mock Test

(April 01st - April 02nd 2022)

Questions &
Solutions

5. Which of the following country has the longest coastline in the world?
- A. Australia
B. Norway
C. Canada
D. Indonesia

Ans. C

- Sol. • **Canada has the longest coastline in the world.**
- It is the **second-largest country of the world** by total area.
 - The **capital of Canada** is **Ottwa** and **Currency** is **Canadian Dollar**.
 - **Gujarat** is the **largest mainland coastline** state in India.

6. The Black soil is also known as soil.
- A. Bhangar
B. Humus
C. Crystalline
D. Regur

Ans. D

- Sol. • The Black soil is also known as **Regur soil**.
- The black color of black soil is due to excess of iron.
 - Apart from black soil, it is also called Shregun, Regur, Cotton soil, and Lava soil.
 - It is rich in magnesium, lime and iron and organic matter.
 - It is found abundantly in Maharashtra, Karnataka, Gujarat and Madhya Pradesh.

7. Which Vitamin helps in clotting of blood?
- A. Vitamin A
B. Vitamin C
C. Vitamin B
D. Vitamin K

Ans. D

- Sol. Vitamin K helps to make various proteins that are needed for blood clotting and the building of bones. Prothrombin is a vitamin K-dependent protein directly involved with blood clotting. Osteocalcin is another protein that requires vitamin K to produce healthy bone tissue.

8. The process to separate impurities from water, butter from curd, small stones from wheat etc. is called
- A. Mixture
B. separation
C. Filtration
D. Sublimation

Ans. B

- Sol. Milk or curd is churned to separate the butter. Grain is separated from stalks, while harvesting. The process to separate impurities from water, butter from curd, small stones from wheat etc. is called separation.

9. Elecphanta Island is located at
- A. Goa Coast
B. Mumbai Coast
C. Ganga Delta
D. Kutch Coast

Ans. B

Sol. Elephanta Island is located at Mumbai Coast. Elephanta caves are a UNESCO world heritage site.

10. Which of the following city is known as "The City of Lakes"?
- A. Mysore
B. Jaipur
C. Cherrapunji
D. Udaipur

Ans. D

Sol. The correct answer is option D, i.e., Udaipur. There is very less rainfall in Rajasthan. Most of its cities build lakes to store rainwater. Udaipur is also known as the 'The City of Lakes', for its beautiful and majestic lakes.

11. Name the first city in India to use a robot to control traffic.
- A. Kochi
B. Indore
C. Varanasi
D. Jaipur

Ans. B

Sol. • **The first city in India to use a robot to control traffic is Indore.**
• **The height of the robot is 14 feet and It runs on a 12 watt power supply.**
• **Indore is the cleanest city of India.**
• **Jaipur is also called as the Pink City of India.**

12. Which two countries passport shares top rank in the Henley Passport Index 2022, released in January 2022?
- A. Japan and Singapore
B. Finland and New Zealand
C. Italy and Luxembourg
D. UK and Germany

Ans. A

Sol. * In the latest Henley Passport Index 2022 for quarter 1 the passport of Japan and Singapore ranked at top.
* Germany and South Korea hold onto joint 2nd spot on the latest ranking, with passport holders able to access 190 destinations visa-free, while Finland, Italy, Luxembourg, and Spain share 3rd place, with a score of 189.
* India's passport power has improved this quarter compared to 2021.
* It now ranks at 83rd position in the Henley Passport Index, climbing seven places from 90th rank last year.

13. In January 2022, an 'MSME Technology Centre' was inaugurated by PM Narendra Modi in which place?
- A. Ahmedabad
B. Puducherry
C. Gurugram
D. Bengaluru

Ans. B

Ans. C

Sol. The arrow is moving in 90 degrees and then 45 degrees alternatively in each step in the anticlockwise direction.

Also, the figure inside the square is also moving in 90 degrees and then 45 degrees alternatively in each step in the clockwise direction.



Hence, option C is the correct response.

17. In a certain language, 'roses are yellow' means 'mee muk pic', 'white flowers' means 'nil dic', and flowers are fruits' means 'pic muk dic'. What is the code for 'white' in that language?

- A. nil
- B. pic
- C. dic
- D. muk

Ans. A

Sol. 'roses are yellow' = 'mee muk pic' _____(1)

'white flowers' = 'nil dic' _____(2)

'flowers are fruits' = 'pic muk dic' _____(3)

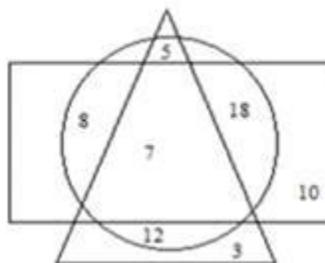
From (2) and (3), flowers=dic

Therefore, from (2), white=nil

Hence, option A is the correct answer.

18. In the following diagram, the rectangle represents doctors, the triangle represents players and the circle represents philosophers.

The number in different segments show the number of persons.

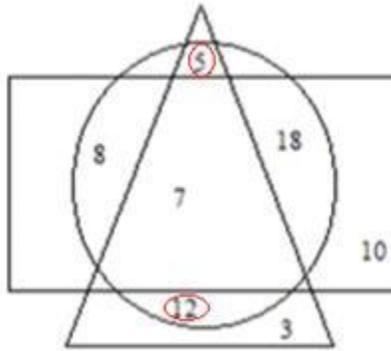


According to the given diagram, How many players are philosophers but not Doctors?

- A. 12
- B. 17
- C. 5
- D. 7

Ans. B

Sol. Here the number circled red in the diagram below shows the number of players are philosophers but not Doctors i.e. 5 and 12.



So, number of players are philosophers but not Doctors = $5+12=17$

Hence, option(B) is the correct response.

19. Which number will come next to the series?

1,14,39,84, ?

A. 104

B. 155

C. 175

D. 110

Ans. B

Sol.

$$1^3 + 1^2 + 1 = 1$$

$$2^3 + 2^2 + 2 = 14$$

$$3^3 + 3^2 + 3 = 39$$

$$4^3 + 4^2 + 4 = 84$$

$$5^3 + 5^2 + 5 = 155$$

Next number of the series is 155.

20. Which number will come next in the following series?

1, 3, 7, 15, 31, 63, _____

A. 126

B. 127

C. 125

D. 139

Ans. B

Sol. Logic is-

$$1+2=3$$

$$3+4=7$$

$$7+8=15$$

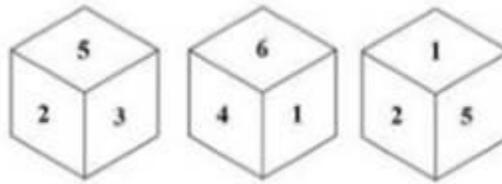
$$15+16=31$$

$$31+32=63$$

$$63+64=127$$

Hence, option(B) is the correct response.

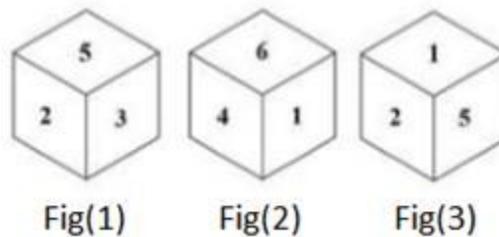
21. Three different position of the same dice are shown below. Which number is on the face opposite the face showing "4"?



- A. 5
- B. 3
- C. 2
- D. 6

Ans. A

Sol.



From fig(1) and fig(3), 2 and 5 are the consecutive side face of 3, also 2 and 5 are the consecutive side face of 1, therefore 3 is the opposite of 1.

From fig(2) and fig(3), 4, 6, 5, 2 are the consecutive side face of 1.

From 4, 6, 5, 2-

4 is opposite of 5 and 6 is opposite of 2.

Hence, the correct option is A.

22. Two statements are given, followed by two conclusion I and II. Assuming these statements to be true, even if they seem to be at variance with commonly known facts, decide which of the given conclusion logically follow (s) from the statements.

Statements:

All plants are flowers.

No flower is blue.

Conclusions:

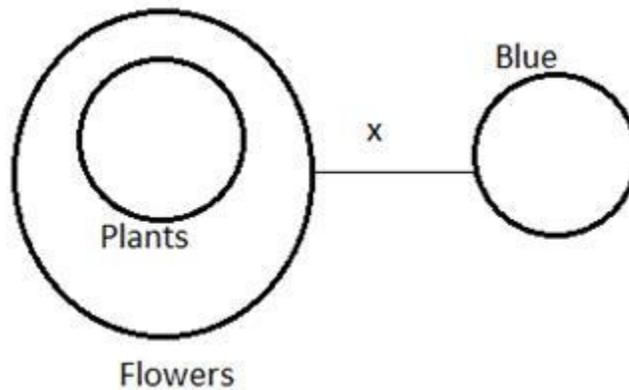
I. Some plants are blue.

II. Those plants that are not flowers are blue.

- A. Only conclusion II follows.
- B. Only conclusion I follows.
- C. Both conclusion I and II follow.
- D. Neither conclusion I nor II follow.

Ans. D

Sol. The minimum possible diagram is-



Conclusions:

I. Some plants are blue - (It does not follow as No flower is blue.)

II. Those plants that are not flowers are blue - (It does not follow as All plants are flowers.)

So, Neither conclusion I nor II follows.

Hence, option D is the correct answer.

23. A Nurse moved 90 m in the East in a hospital to look for her duty Doctor, then she turned left and went 20 m. After this she turned left and after going 30 m she reached I.C.U but the Doctor was not there. From there she went 100 m to her north and met her doctor. What distance did she moved to meet her duty doctor from the starting point.

A. 80m

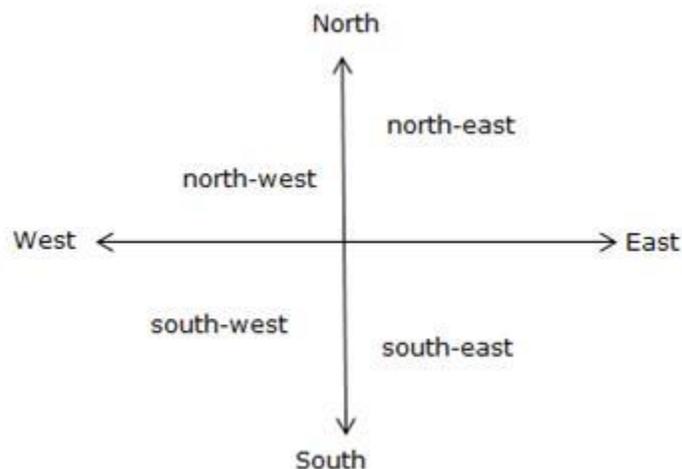
B. 240m

C. 140m

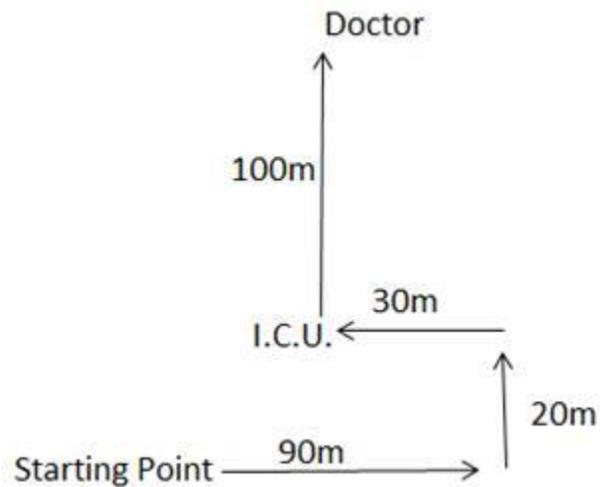
D. 120m

Ans. B

Sol. As we know-



We can draw the following diagram to represent the text given in the question-



Required distance = $90 + 20 + 30 + 100 = 240\text{m}$

Hence, option B is the correct answer.

24. Which of the following interchanges of signs and numbers would make the given equation current?

$$18 - 3 \div 6 + 24 \times 12 = 48$$

A. \times and $-$, 3 and 6

B. \div and $-$, 12 and 6

C. \div and \times , 3 and 12

D. \times and $+$, 3 and 6

Ans. A

Sol. By checking Option A,

$$18 - 3 \div 6 + 24 \times 12 = 48$$

After changing the symbols,

$$18 \times 6 \div 3 + 24 - 12 = 48$$

Applying BODMAS we get,

$$= 36 + 24 - 12$$

$$= 60 - 12$$

$$= 48$$

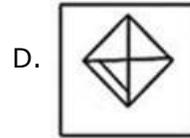
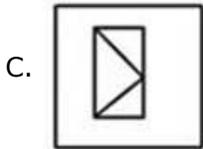
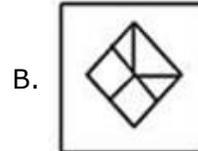
Therefore, $18 - 3 \div 6 + 24 \times 12 = 48$ is the correct equation.

As, we found the correct answer, so no need to check more options.

Hence, option A is the correct answer.

25. Select the option in which the given figure is embedded. (Rotation is not allowed)





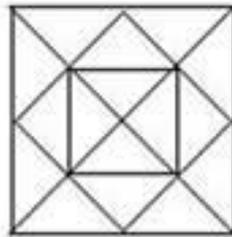
Ans. B

Sol. After carefully observing the figures given in the question, it is very clear that the question figure is embedded in the answer figure (D). It is shown as given below:



Hence, option B is the correct response.

26. Find the number of squares in the following figure.



A. 9

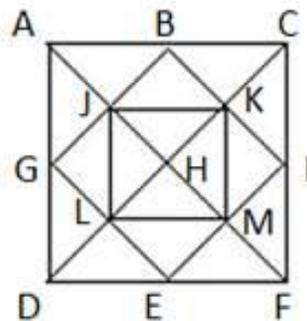
B. 4

C. 6

D. 7

Ans. D

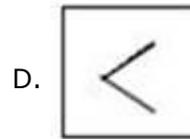
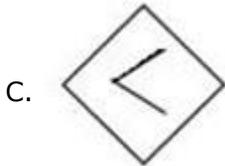
Sol.



There are 7 squares in the given figure; ACFD, BGEI, JKML, GJHL, BKHJ, HMIK, LHME.

Hence, option D is correct.

27. Select the option that will come next in the given series.



Ans. A

Sol. After observation, it is clear that answer figure (a) will be the missing figure.

Logic- 3rd figure is the opposite figure of 1st similarly, 4th figure is the opposite figure of 2nd.



Hence, option (A) is the correct response.

28. Two statements are given, followed by two conclusion I and II. Assuming these statements to be true, even if they seem to be at variance with commonly known facts, decide which of the given conclusion logically follow (s) from the statements.

Statements:

Some boxes are dolls.

All dolls are pen.

Conclusion:

I. Some boxes are pens.

II. Some pens are boxes.

III. Some pens are dolls.

IV. All pen are dolls.

A. Only conclusion II, III and IV follow.

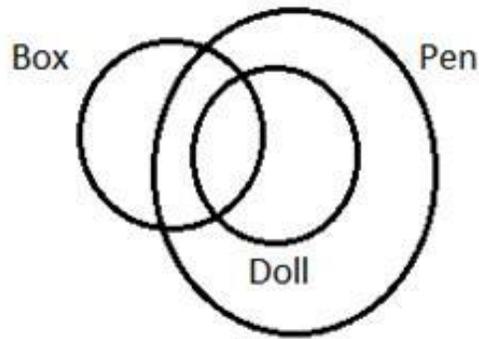
B. Only conclusion I, II and III follow.

C. Only conclusion I, II and IV follow.

D. All the conclusion follow.

Ans. B

Sol. Minimum possible diagram is-



Conclusion:

- I. Some boxes are pens.(It follows as its obvious from the above diagram.)
- II. Some pens are boxes.(It also follows as its obvious from the above diagram.)
- III. Some pens are dolls. .(It also follows as its obvious from the above diagram.)
- IV. All pen are dolls. .(It does not follow as its just a possibility, not surety.)

So, Only conclusion I, II and III follow.

Hence, option B is the correct answer.

29. Select the correct alternative to indicate the arrangement of the following words in a logical and meaningful order.

- 1) Gateway of India
- 2) World
- 3) Mumbai
- 4) India
- 5) Maharashtra

- A. 2, 4, 5, 1, 3
- C. 2, 4, 5, 3, 1

- B. 4, 2, 5, 3, 1
- D. 4, 2, 5, 1, 3

Ans. C

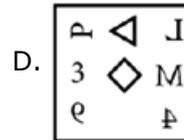
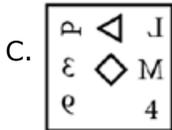
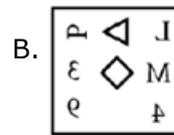
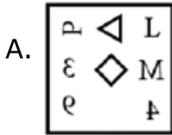
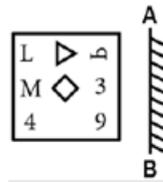
Sol. logical and meaningful order is,

- 2. World
- 4. India
- 5. Maharashtra
- 3. Mumbai
- 1. Gateway of India

Correct sequence = 2, 4, 5, 3, 1

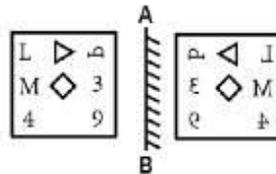
Hence, option D is the correct answer.

30. Select the correct mirror image of the given figure when the mirror is placed at line AB.



Ans. B

Sol. In a plane mirror, a mirror image is a reflected duplication of an object that appears almost identical, but it is reversed in the direction perpendicular to the mirror surface. As an optical effect it results from reflection of substances such as a mirror or water.



Hence, option B is the correct answer.

31. The crop period of a crop is 120 days. It requires 10 cm depth of water at every 10 days. Its delta is :

- A. 120 cm
- C. 12 cm

- B. 60 cm
- D. 6 cm

Ans. A

Sol. Δ = Total depth of water required = (no of watering) \times (depth of water required in watering)

$$= \frac{120}{10} \times 10 \text{cm}$$

$$\Delta = 120 \text{ cm}$$

32. If 20 kg of coarse aggregate is sieved through 80 mm, 40 mm, 20 mm, 10 mm, 4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron, and 150 micron standard sieves and the weights retained are 0 kg, 2 kg, 8kg, 6 kg, 4 kg, respectively, the fineness modulus of the aggregate lies in the range of _____.

- A. 6.85 – 7.10
- C. 7.50 – 7.75

- B. 7.20 – 7.45
- D. None of these

Ans. B

Sol.

Sieve Size	Weight of sand Retained (g)	Cumulative weight of sand retained (g)	Cumulative percentage of sand retained (%)
80	0	0	0
40	2	2	10
20	8	10	50
10	6	16	80
4.75	4	20	100
2.36	0	20	100
1.18	0	20	100
600	0	20	100
300	0	20	100
150	0	20	100

ADD CUM % RETAINED AND DIVIDE BY 100

$$= 740/100 = 7.4.$$

33. Which of the following statement is incorrect?
- A. As per ISI, rolled steel beam sections are classified into 4 series.
 - B. As per ISI, rolled steel channel sections are classified into 4 series.
 - C. As per ISI, rolled steel beam sections are classified into 4 series and rolled steel channel sections are classified into 3 series.
 - D. As per ISI, rolled steel channel sections are classified into 4 series and rolled steel column/heavy weight sections are classified into 2 series.

Ans. C

Sol.

34. A normally consolidated clay layer settles by 25 mm when the effective stress is increased from 15 kPa to 30 kPa. If the effective stress is later increased further from 30 kPa to 60 kPa, then the additional settlement would be:
- A. 25 mm
 - B. 50 mm
 - C. 75 mm
 - D. 100 mm

Ans. A

Sol. The formula for calculating the settlement is given as,

$$\Delta H = \frac{H_0 C_c}{1+e} \log \frac{\sigma_1}{\sigma_0}$$

Where, C_c = Compression index

$$\Delta H_1 = \frac{H_0 C_c}{1+e} \log \frac{30}{15}$$

$$\Delta H_2 = \frac{H_0 C_c}{1+e} \log \frac{60}{15}$$

$$\Delta H_2 = 2 \Delta H_1$$

Therefore, Additional settlement = $\Delta H_2 - \Delta H_1 = 25$ mm

35. Type of cross – drainage work when canal is passed below the drainage is:

- A. Super passage
- B. Aqueduct
- C. Inlet
- D. Level crossing

Ans. A

Sol. Types of cross drainage works

1. CD works carrying the canal over the natural drain

- (i) Aqueduct
- (ii) Syphon aqueduct

2. CD works carrying natural drain over the canal

- (i) Super passage
- (ii) Syphon

3. CD works admitting the drain water into the canal

- (i) Level crossing
- (ii) Inlet and outlet

36. Optimum depth of kor-watering for rice is:

- A. 13.5 cm
- B. 16.5 cm
- C. 19 cm
- D. 20 cm

Ans. C

Sol. Δ = Total depth of water required. Optimum kor watering depth for rice is 19 cm.

37. In order to haul the domestic and storm water, the type of sewer used are

- A. Separate sewerage system
- B. Combined sewerage system
- C. Partially separate system.
- D. None

Ans. B

Sol. **Separate System:** In this system two sets of sewers are provided-one for carrying domestic or sanitary sewage and industrial sewage, and the other for carrying storm water (or rain water). The sewage from the first set of sewers is carried to the treatment plant, and the storm water (or rain water) from the second set of sewers is directly discharged into a natural stream or river without any treatment.

Combined System: In this system only one set of sewers is provided for carrying domestic or sanitary sewage and industrial sewage as well as storm water (or rain water).

Partially Separate System: In this system domestic or sanitary sewage and industrial sewage, and the storm water (or rain water) which is drained from back yards and roofs of houses are

carried in the same set of sewers, while the storm water (or rain water) drained from house fronts as well as from streets and roads is collected and conveyed in a separate set of open drains.

38. A new design of a valve is to be tested. Which of the following parameters is the most important if liquid benzene flows through the valve.

- A. Reynolds number
- B. Euler number
- C. Mach number
- D. Froude number

Ans. A

Sol. The flow will be a laminar flow, if liquid benzene flows through the valve, so for laminar flow Reynold member should be used for new design of a value.

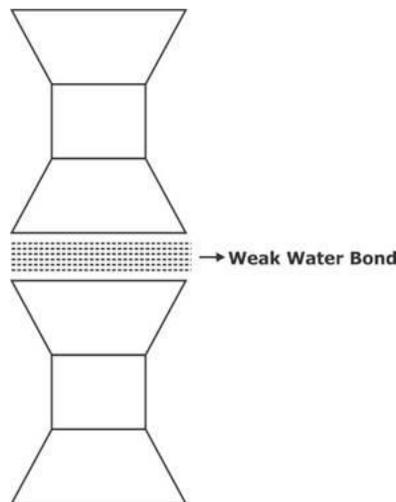
Option (A) Reynold number is correct.

39. Black cotton soil exhibits large swelling and shrinkage due to the presence of the following clay mineral :

- A. Kaolinite
- B. Illite
- C. Montmorillonite
- D. Halloysite

Ans. C

Sol. • Black cotton soil exhibits large swelling and shrinkage due to the presence of the Montmorillonite.



• Several structural units in montmorillonite are joined by weak water bond which can be easily displaced. Hence, the soils having montmorillonite minerals show large swelling and shrinkage characteristics depending upon the nature of exchangeable cation

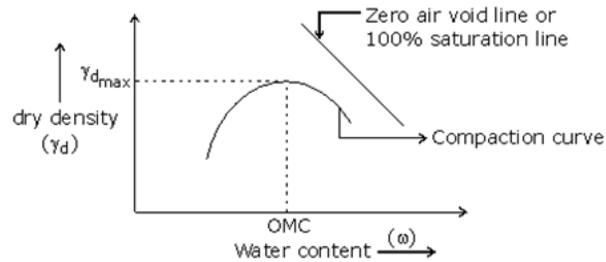
40. Drag force is a function of:
 (i) Projected area of the body
 (ii) Mass density of the fluid
 (iii) Velocity of the body

The correct answer is:

- A. (i) and (ii)
- B. (i) and (iii)
- C. (ii) and (iii)
- D. (i), (ii) and (iii)

Ans. D

Sol. • The degree of saturation of the zero void line is 100%, $S = 100\%$.



Zero air voids line:

A line that shows the water content dry density relation for the compacted soil containing a constant percentage air void is known as an air- voids line. And can be expressed by the following expression.

$$\gamma_d = \frac{(1 - n_a)G\gamma_w}{1 + wG}$$

Where,

n_a = per cent air voids

W = water content of compacted soil

γ_d = dry unit weight

G = specific gravity

γ_w = unit weight of water

So, zero air void line means $n_a = 0$

Alternatively, a line showing the relation between the water content and dry density for the constant degree of saturation 'S' can be expressed as follows

$$\gamma_d = \frac{G\gamma_w}{1 + \frac{wG}{s}}$$

Here, s = degree of saturation

When $s = 1$, zero air void line equals to the 100% saturation line.

44. Pick up the correct sequence of the parts of a canal system
- A. Main canal-d distributary -branch canal-head works-minor
 - B. Head works-main canal-branch canal-distributary-minor
 - C. Head works-main canal-branch canal-minor-distributary
 - D. Head works-branch canal-main canal-distributary-minor

Ans. B

Sol. Main canal runs out from canal head works and branches into branch canal with further bifurcation into distributaries and finally into minors.

45. Settling velocity is proportional to

A. d

B. 1/d

C. d²

D. 1/d²

Ans. C

Sol. As per the Stokes law,

Settling velocity,

$$V_s = \frac{(G-1)\gamma_w d^2}{18\mu}$$

Where G is specific gravity of solid particle

γ_w is unit weight of water

d – Particle size

μ Dynamic viscosity

46. The velocity distribution at any section of a pipe for steady laminar flow is:

A. Linear

B. Exponential

C. Parabolic

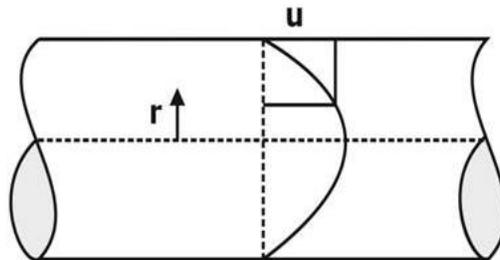
D. Constant

Ans. C

Sol. Velocity distribution at any section of a pipe for steady laminar flow is given as

$$U = \frac{1}{4\mu} \left(-\frac{dp}{dx} \right) R^2 \left(1 - \frac{r^2}{R^2} \right)$$

Hence the distribution is parabolic



47. For the de-chlorination of water, the chemical added to water is

A. Sodium sulphite

B. Alum

C. Hydrogen peroxide

D. Potassium permanganate

Ans. A

Sol. De-chlorination minimizes the effect of potentially toxic disinfection by-products by removing the free or total combined chlorine residual remaining after chlorination. Typically, de-chlorination is accomplished by sulphur dioxide or sulphite salts (i.e. sodium sulphite, sodium bisulphite or sodium meta-bisulphite).

$$\delta_{HB} = \frac{Ml^2}{2EI}; \theta = \frac{Ml}{EI}$$

$$\delta_{HC} = \delta_{HB} = \frac{Ml^2}{2EI}$$

$$\delta_{VC} = \theta \times l + \delta_3$$

$$= \frac{Ml}{EI} \times l + \frac{Ml^2}{2EI} = \frac{3}{2} \cdot \frac{Ml^2}{EI}$$

$$\theta_c = \theta + \alpha$$

$$= \frac{Ml}{EI} + \frac{Ml}{EI} = \frac{2Ml}{EI}$$

50. A fully saturated soil has a water content of 200%
If $G=2.6$, the void ratio is
- A. 1.3
B. 2.6
C. 5.2
D. none of these

Ans. C

Sol. Using

$$eS = wG$$

$$\text{Here } S = 1$$

Therefore,

$$e = 2 \times 2.6 = 5.2$$

51. What is the main principle of Prestressed Concrete Structures?
- A. To introduce shear stress
B. To introduce
C. To introduce compressive stresses in the zone wherever tensile stresses are expected
D. To introduce tensile stresses

Ans. C

Sol. We know that concrete is a brittle material, which are strong enough to resist compressive force but weak in tension.

Pre-stressed concrete is a form of concrete where initial compression is given in the concrete before applying the external load so that stress from external loads are counteracted in the desired way during the service period. This initial compression is introduced by high strength steel wire or alloys (called 'tendon') located in the concrete section.

52. Which of the following statements is not correct?
- A. A gauge always measures pressure above the surrounding atmospheric pressure
B. At a point inside a fluid, pressure is exerted equally in all directions.
C. Typical actual variation of pressure with elevation in the atmosphere is more adiabatic than isothermal
D. Vacuum pressure at a point is always measured above absolute zero pressure.

Ans. D

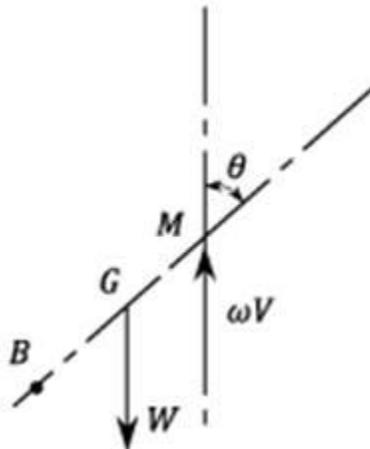
$$Q_u = 152.68 + 1272.34$$

$$Q_u = 1425 \text{ KN}$$

55. A body floats in stable equilibrium _____.
- When its metacentric height is zero
 - When metacentre is above centre of gravity
 - When its centre of gravity is below its centre of buoyancy
 - None of these

Ans. B

Sol. as shown in figure. For stable equilibrium metacentric height should be above the center of gravity & center of gravity should be above the centre of buoyancy.



56. Which of the following bonding is responsible to combine the silica-gibbsite sheet in kaolinite clay mineral?
- | | |
|------------------|------------------------|
| A. Covalent bond | B. Hydrogen bond |
| C. Ionic bond | D. Polar covalent bond |

Ans. B

Sol. The basic units of kaolinite mineral are held together by hydrogen bonds. The strong bonding does not permit water to enter the lattice. Thus kaolinite minerals are stable and shows lesser swelling and shrinkage properties.

57. Consider the following statements in respect of a steady two-dimensional rotational flow:
- Continuity is satisfied and streamlines can be drawn
 - Both stream function and velocity potential exist.
- Which of the statements given above is/are correct?

- | | |
|-----------------|--------------------|
| A. 1 only | B. 2 only |
| C. Both 1 and 2 | D. Neither 1 nor 2 |

Ans. A

Sol. For any type of flow to be possible continuity equation must be satisfied and stream function will exist as it is a direct consequence of continuity equation. Therefore streamline can be drawn.

Velocity potential function is derived from the condition of irrotationality and the flow is rotational, therefore velocity potential function does not exist.

58. A wastewater treatment plant disposes of its effluent in a surface stream. Characteristics of the stream and effluent are shown below:

Parameter	Wastewater	Stream Water	Wastewater mix stream water
Flow (m ³ /s)	0.2	4	
Dissolved oxygen, mg/L	1	7	
BOD ₅ at 20°C, mg/L	100	2	
Oxygen consumption rate (K1 at 20°C) (1/day)	0.2	0.2	0.23
Oxygen reaeration rate (K2 at 20°C) (1/day)	-	0.3	0.3

For 20°C stream water temperature, equilibrium concentration of oxygen = 9.17 mg/L. Assuming no temperature correction is required, answer the following:

Calculate ultimate BOD of wastewater and stream water mix water?

- A. 8.5 mg/L
- B. 9 mg/L
- C. 9.5 mg/L
- D. 9.76 mg/L

Ans. D

Sol. BOD of mix can be calculated as follows

$$(BOD_5)_{mix} = \frac{Q_W \cdot S_W + Q_R \cdot S_R}{Q_R + Q_W}$$

$$= \frac{0.2 \times 100 + 4 \times 2}{0.2 + 4} = 6.67 \text{ mg/L}$$

$$I_0(1 - e^{-K \cdot 5}) = 6.67$$

for wastewater mix stream water $K = 0.23 \text{ d}^{-1}$ (from given table)

$$\therefore I_0 = \text{ultimate BOD}$$

$$I_0 = \frac{6.67}{1 - e^{-0.23 \cdot 5}}$$

$$= 9.76 \text{ mg/L}$$

59. For a water sample the total hardness is 198 mg/l as CaCO₃ and alkalinity is 231 mg/l as CaCO₃. Then the carbonate hardness is

- A. 231
- B. 33
- C. 66
- D. 198

Ans. D

Sol. Total hardness = 198 mg/l
Alkalinity = 231 mg/l

Since, $\text{Alkalinity} \geq \text{total hardness}$

Therefore, Carbonate alkalinity = total hardness = 198 mg/l

60. The following statements (C1, C2, C3, C4) pertain to the characteristics of different type of canals. Which of the following statements is/are correct?

C1 : A contour canal can irrigate command areas on both the banks.

C2 : It is possible to construct a contour canal with banks on one side only.

C3: In the case of a ridge canal, the number of cross drainage works are maximum.

C4: Side slope canal is aligned roughly at right angles to the ground contours.

A. C1 and C3 only

B. C1, C3 and C4 only

C. C1 only

D. C2 and C4 only

Ans. D

Sol. C₁ – Contour canal can irrigate on one side only (False).

C₂ – (True)

C₃ – Number of cross drainage are minimum. (False)

C₄ – Side slope canals aligned with slope which is at right angles to the contour. (True)

61. If 20 mm rivets are used in lacing bars, then the minimum width of lacing bar should be

A. 40 mm

B. 60 mm

C. 80 mm

D. 100 mm

Ans. B

Sol. The minimum width of lacing bar is $3d = 3 \times 20 = 60$ mm

62. Which one of the following pairs is not correctly matched?

A. Air valve: To release the accumulated air

B. Sluice valve: To control the flow of water through pipelines

C. Checked valve: To check water flow in all directions

D. Scour valve: The remove silt in a pipeline

Ans. C

Sol. • Check valves: also called non-returns value, it automatically prevents reversal of flow in a pipeline.

63. For limit state of collapse, the partial safety factors recommended by IS 456:2000 for estimating the design strength of concrete and reinforcing steel are respectively

A. 1.5 and 1.15

B. 1.0 and 1.0

C. 1.15 and 1.5

D. 1.5 and 1.0

Ans. A

Sol. Partial safety factors recommended by IS 456:2000 for

Sol. Duty of a water simply expresses the number of hectare of land that can be irrigated for the full growth of the given crop by supplying 1 cumec water continuously during the entire base period of that crop.

$$D = \frac{A}{Q} \left(\frac{\text{Hectance}}{\text{Cumec}} \right)$$

67. Which of the following causes the major loss in the long pipes?

- A. Friction
 B. Gradual contraction and enlargement both
 C. Sudden contraction
 D. Sudden enlargement

Ans. A

Sol. The **friction loss** in a uniform straight sections of pipe, known as **major loss**. It is caused by the effects of viscosity, the movement of fluid molecules against each other or against the wall of the pipe. The minor losses in the pipes are sudden contraction, sudden enlargement, etc.

68. Quicksand is a

- A. type of sand.
 B. flow condition occurring in cohesive soils.
 C. flow condition occurring in cohesionless soils.
 D. flow condition occurring in both cohesive and cohesionless soils.

Ans. C

Sol. **Quick Sand Condition**

When flow occurs upward, the seepage pressure also acts upward, and the effective pressure is reduced. If the seepage pressure becomes equal to the pressure due to the submerged weight of the soil, the effective stress is reduced to zero. In such a case, cohesionless soil loses all its shear strength, and the soil particles tend to move up in the direction of flow. The phenomenon of the lifting of soil particles is called quick condition, boiling condition or quicksand or piping condition.

69. Uniformity co-efficient of filter sand is given by

- A. $\frac{D_{50}}{D_5}$
 B. $\frac{D_{50}}{D_{10}}$
 C. $\frac{D_{60}}{D_5}$
 D. $\frac{D_{60}}{D_{10}}$

Ans. D

Sol. Classification of filter sand is base on coefficient of uniformity (C_u) and coefficient of curvature (C_c)

Where $C_u = \frac{D_{60}}{D_{10}}$

and $C_c = \frac{(D_{30})^2}{D_{60} \times D_{10}}$

Sol. Minimum velocity of 0.8 m/s at design peak flow and 0.6 m/s at current peak flow is recommended in sanitary sewer.

84. The salt concentration in irrigation water is generally measured by:

- A. SAR value
- B. Electrical conductivity value
- C. pH value
- D. BOD value

Ans. B

Sol. The salt concentration is generally expressed by ppm or by mg/l, both units being equal. The salt concentration is generally measured by determining the electrical conductivity of water. Salt concentration and electrical conductivity are directly proportional to each other.

85. Stream function for a two dimensional flow is given by $\psi = x^2y - xy + 1$. The discharge passing between the stream lines through the points (1, 2) and (2, 1) is :

- A. 1 unit
- B. 1.5 units
- C. 2 units
- D. 3 units

Ans. C

Sol. $\theta = |\psi_2 - \psi_1|$

At (1, 2), $\psi_1 = (1)^2 \times 2 - 1 \times 2 + 1 = 1$

At (2, 1), $\psi_2 = (2)^2 \times 1 - 2 \times 1 + 1 = 3$

$\theta = 3 - 1 = 2$ units

86. The value of the curve lead to be provided for a BG track with crossing number 8.5 is nearly,

- A. 5.1 m
- B. 14.25 m
- C. 21.4 m
- D. 28.5 m

Ans. D

Sol. Curve lead (CL) = 2GN

$CL = 2 \times 1.676 \times 8.5 = 28.5$ m

87. A fluid flow is described by a velocity field

$$\vec{u} = 4x^2\hat{i} - 5x^2y\hat{j} + \hat{k}$$

What is the absolute velocity (in magnitude) at the point (2,2,1)?

- A. $(1802)^{0.5}$
- B. $(1828)^{0.5}$
- C. $(1840)^{0.5}$
- D. $(1857)^{0.5}$

Ans. D

Sol.

$$\vec{u} = 4x^2i - 5x^2yj + 1k.$$

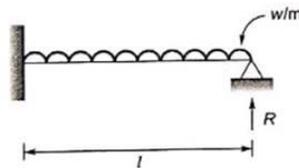
$$\vec{u} = 4 \times 2^2i - 5 \times 2^2 \times 2j + 1k$$

$$\vec{u} = 16i - 40j + 1k$$

Absolute velocity, $|u| = \sqrt{16^2 + 40^2 + 1}$

$$|u| = \sqrt{1857} \text{ m/s}$$

88. Find the reaction R of the propped cantilever shown in figure



A. $\frac{wl}{3}$

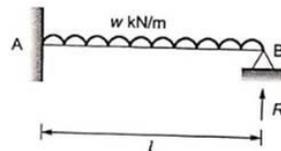
B. $\frac{3}{8}wl$

C. $\frac{wl}{2}$

D. $\frac{5}{8}wl$

Ans. B

Sol.



$$\delta_B = 0 = \delta_{\text{due to udl}} + \delta_{\text{due to R}}$$

$$0 = \left(-\frac{wl^4}{8EI} \right) + \left(\frac{Rl^3}{3EI} \right)$$

$$R = \frac{3}{8}wl$$

89. The motion of outgoing water from the hole made at midpoint of completely filled open cylindrical tank with water is _____.

A. forced vortex

B. irrotational

C. rotational

D. turbulent

Ans. B

Sol. Since there is no external torque, this is a case of free vortex flow.

It can also be reconfirmed by observing the motion, that is, the fluid motion is faster near the centre and slower farther away from it.

For free vortex flow, velocity is inversely proportional to radial distance from the centre.

90. For medium silt whose average grain size is 0.25 mm, Lacey's silt factor is likely to be:

A. 0.88

B. 0.44

C. 0.25

D. None of these

Ans. A

Sol.

$$\text{Lacey silt factor } f = 1.76\sqrt{d(\text{mm})} = 1.76\sqrt{0.25} = 0.88$$

91. Sprinkler irrigation is not suitable to

- | | |
|---------|------------------------------|
| A. Rice | B. Fodder |
| C. Lawn | D. None of the given answers |

Ans. A

Sol. Rice has huge water requirements during its growth, hence sprinkler irrigation is not suitable.

92. How does the depth of ballast cushion affect rail section?

- | | |
|---|---|
| A. Higher the depth bigger the rail section | B. Depth is less, bigger the rail section |
| C. Depth is less, smaller the rail section | D. Depth and Rail section same |

Ans. B

Sol. The selection of the rail section depends on many factors like heaviest axle loads, maximum permissible speed, type of sleepers and depth of ballast cushion. If the depth of the ballast cushion is less, then a bigger rail section has to be provided.

93. The drag on a 10-m-diameter spherical water storage tank in an 80 km/h wind (with air density of 1.23 kg/m³) and coefficient of drag is approximately 0.2.

- | | |
|-----------|-----------|
| A. 4770 N | B. 2385 N |
| C. 6361 N | D. 3181 N |

Ans. A

Sol. Option (A) 4770 is correct

Given, dia d = 10m

$$\text{Wind velocity } v = 80 \frac{\text{km}}{\text{h}} = 22.22 \text{ m / sec}$$

Air density = 1.23 kg/m³

Cd = 0.2

Using Drag, force formula

$$F_D = \frac{1}{2} \rho V^2 \times CD \times A$$

$$= \frac{1}{2} \times 1.23 \times 22.22^2 \times 0.2 \times \frac{\pi}{4} \times 10^2$$

$$F_D = 4770 \text{ N}$$

94. Assertion (A) : Tapered flocculation is more efficient when compared to the conventional process of flocculation.

Reason (R) : In tapered flocculation, velocity gradient at the inlet is less than that at the outlet of the flocculation unit.

- A. Both (A) and (R) are true and (R) is the correct explanation of (A).
- B. Both (A) and (R) are true but (R) is not a correct explanation of (A).
- C. (A) is true but (R) is false.
- D. (A) is false but (R) is true.

Ans. C

Sol. Tapered flocculation: where the velocity gradient slowly decrease through the basin.

95. The initial and final void ratios of a clay sample in a consolidation test are 1.0 and 0.5 respectively. If the initial thickness of the sample is 2.4 cm, then its final thickness will be
- A. 1.3 cm
 - B. 1.8 cm
 - C. 1.9 cm
 - D. 2.2 cm

Ans. B

Sol.

$$\Delta H = H_o \frac{\Delta e}{1 + e_o}$$

$$= 2.4 \times \frac{1 - 0.5}{1 + 1} = 0.6$$

Hence the final thickness = 2.4 - 0.6 = 1.8cm

96. A reservoir which retains excess supplies during periods of peak flows and release them gradually during low flows:
- A. Retarding reservoir
 - B. Flood control reservoir
 - C. Distribution reservoir
 - D. Conservation reservoir

Ans. D

Sol. A reservoir which retains excess supplies during periods of peak flows and release them gradually during low flows is Conservation reservoir.

97. If L is the length of a rail and R is the radius of a curve, the versine h for the curve is _____.
- A. a = L/4R
 - B. a = L²/4R
 - C. h = L²/8R
 - D. h = L²/16R

Ans. C

Sol. If L is the length of a rail and R is the radius of a curve, the versine h for the curve is h = L²/8R

98. Order 4 solutions in increasing order of their BOD values
- A. Industrial water < river water < tap water < bottled water
 - B. Tap water < bottled water < river water < industrial water
 - C. Bottled water < river water < tap water < industrial water
 - D. Bottled water < tap water < river water < industrial

Ans. D

Sol. • Bottled water is chemically treated water and hence least BOD.

- Tap water has been treated by community plant and hence also has negligible BOD.
- Industrial water is untreated water and contains large amount of chemicals and hence has highest BOD.
- River water contains average level of BOD since it is untreated but unpolluted.

99. Which of the following equation of fluid considers the fluid as a viscous flow

- A. Continuity Equation
 B. Euler's Equation
 C. Bernoulli's Equation
 D. Navier's Equation

Ans. D

Sol. Navier's equation considers the fluid as viscous and also considers viscous force, all other equations have assumption that the fluid is inviscid.

100. Consider following expressions as per Lacey's theory for design of stable channels:

1. Velocity, $V = \left(\frac{Qf^2}{140}\right)^{1/6}$

2. Perimeter, $P = 4.75\sqrt{Q}$

3. Silt factor, $f = \frac{5V^2}{2R}$

4. Slope, $S = \frac{f^{2/3}}{3340Q^{1/6}}$

(Symbols have usual meaning)

Correct expressions is/are:

- A. 1, 2, 3 only
 B. 2, 3, 4 only
 C. 1, 2 only
 D. 1, 2, 3 and 4

Ans. A

Sol. As per Lacey's theory

$$P = 4.75\sqrt{Q} \rightarrow \text{correct}$$

$$V = \left(\frac{Qf^2}{140}\right)^{1/6} \rightarrow \text{correct}$$

$$R = \frac{5}{2} \frac{V^2}{f} \Rightarrow f = \frac{5}{2} \frac{V^2}{R} \rightarrow \text{correct}$$

$$S = \frac{f^{5/3}}{3340Q^{1/6}} \rightarrow \text{Incorrect}$$
