

CUET PG 2024 Water Engineering and Management Question Paper with Solutions

Time Allowed :1 Hour 45 Mins	Maximum Marks :300	Total Questions :75
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General Instructions

Read the following instructions very carefully and strictly follow them:

1. The examination duration is 105 minutes. Manage your time effectively to attempt all questions within this period.
2. The total marks for this examination are 300. Aim to maximize your score by strategically answering each question.
3. There are 75 mandatory questions to be attempted in the Water Engineering and Management paper. Ensure that all questions are answered.
4. Questions may appear in a shuffled order. Do not assume a fixed sequence and focus on each question as you proceed.
5. The marking of answers will be displayed as you answer. Use this feature to monitor your performance and adjust your strategy as needed.
6. You may mark questions for review and edit your answers later. Make sure to allocate time for reviewing marked questions before final submission.
7. Be aware of the detailed section and sub-section guidelines provided in the exam. Understanding these will aid in effectively navigating the exam.

1. A soil sample in its undisturbed state was found to have a volume of 100 cm^3 and mass of 300 gm. After oven drying, the mass got reduced to 200 gm. What will be the value of void ratio if the specific gravity of soil is 2.7? Assume unit weight of water to be 1 gm/cc .

- (a) 0.35
- (b) 4.4
- (c) 1.35
- (d) 0.66

Correct Answer: (a) 0.35.

Solution: First, let's calculate the volume of solids (V_s) and the volume of voids (V_v) using the given data. The initial mass of the soil sample is 300 gm, and after oven drying, the mass reduces to 200 gm, which is the mass of solids (M_s).

Given: - Mass of the sample before drying = 300 gm - Mass of the sample after drying (Mass of solids, M_s) = 200 gm - Specific gravity of soil (G) = 2.7 - Volume of the undisturbed soil sample (V_{sample}) = 100 cm^3 - Unit weight of water = 1 gm/cc

Step 1: Calculate the volume of solids

The volume of solids (V_s) can be calculated using the formula:

$$V_s = \frac{M_s}{G \times \text{unit weight of water}} = \frac{200 \text{ gm}}{2.7 \times 1 \text{ gm/cm}^3} = \frac{200}{2.7} = 74.07 \text{ cm}^3$$

Step 2: Calculate the volume of voids

The total volume of the sample is given as 100 cm^3 , and the volume of solids is 74.07 cm^3 . Therefore, the volume of voids (V_v) is:

$$V_v = V_{\text{sample}} - V_s = 100 - 74.07 = 25.93 \text{ cm}^3$$

Step 3: Calculate the void ratio

The void ratio e is the ratio of the volume of voids to the volume of solids:

$$e = \frac{V_v}{V_s} = \frac{25.93}{74.07} = 0.35$$

Therefore, the correct value of void ratio is 0.35.

💡 Quick Tip

To calculate the void ratio, first determine the volume of solids, then the volume of voids, and finally divide the void volume by the solid volume.

2. For a soil sample having void ratio e , porosity n , water content w , degree of saturation S_r , specific gravity of soil G , unit weight of water γ_w , and saturated unit weight of water γ_{sat} , which of the following expression stands true?

- (a) $e = \frac{n}{(1-n)}$
- (b) $n = \frac{e}{(1-e)}$
- (c) $e = \frac{wG}{S_r}$
- (d) $\gamma_{sat} = \frac{(G+e)}{(1+e)}\gamma_w$

Correct Answer: (b) $n = \frac{e}{(1-e)}$.

Solution: The correct relationship between void ratio e and porosity n is given by the equation:

$$n = \frac{e}{(1-e)}$$

Where n is the porosity and e is the void ratio. This equation shows how the void ratio can be related to the porosity of a soil sample.

💡 Quick Tip

Understanding the relationship between void ratio and porosity helps in calculating soil properties effectively.

3. In a particle size distribution curve, the coefficient of curvature (C_c) for a soil having particle size D_{10} , D_{30} , and D_{60} corresponding to percentage finer value (N) 10%, 30%, and 60% respectively can be calculated as:

- (a) $C_c = \frac{(D_{30})^2}{(D_{10} \cdot D_{60})}$
- (b) $C_c = \frac{D_{60}}{D_{10}}$
- (c) $C_c = \frac{(D_{60})^2}{D_{10}}$
- (d) $C_c = \frac{(D_{30})^2 \cdot D_{10}}{D_{60}}$

Correct Answer: (a) $C_c = \frac{(D_{30})^2}{(D_{10} \cdot D_{60})}$.

Solution: The coefficient of curvature C_c is calculated as:

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

This helps assess the uniformity and gradation of the soil.

 Quick Tip

Particle size distribution is critical in understanding soil behavior and classification.

4. If a soil has a plasticity index value of 10%, then the soil is classified as:

- (a) Non Plastic
- (b) Low Plastic
- (c) Medium Plastic
- (d) Highly Plastic

Correct Answer: (c) Medium Plastic.

Solution: A plasticity index value of 10% classifies the soil as medium plastic. Soils with plasticity index values between 10% and 20% are considered medium plastic.

 Quick Tip

Plasticity index helps in determining the consistency and workability of soil for construction purposes.

5. The natural dry density of a soil deposit was found to be 18.0 kN/m^3 . A sample of soil was brought to the laboratory and the minimum and maximum dry densities were found to be 15.0 kN/m^3 and 20.0 kN/m^3 , respectively. The density index for the soil deposit will be:

- (a) 66.66%
- (b) 54.3%

- (c) 33.33%
- (d) 27.2%

Correct Answer: (a) 66.66%.

Solution: The density index is calculated as:

$$\text{Density Index} = \frac{\text{Natural Dry Density} - \text{Minimum Density}}{\text{Maximum Density} - \text{Minimum Density}} \times 100$$

Substitute the given values to get 66.66%.

 Quick Tip

Density index is used to determine the compactness of soil and its bearing capacity.

6. If the natural water content (w) of a soil sample is equal to its plastic limit (w_p), then the consistency index of the soil will be:

- (a) 0
- (b) 1
- (c) -0.5
- (d) 1.5

Correct Answer: (b) 1.

Solution: The consistency index (C_I) is calculated using the formula:

$$C_I = \frac{w_p - w}{w_L - w_p}$$

When the natural water content (w) is equal to the plastic limit (w_p), the consistency index is 1. This indicates the soil is at the plastic limit.

 Quick Tip

The consistency index is an important measure in soil mechanics for understanding the behavior of soil under different moisture contents.

7. Talus is an example of a soil deposit which is formed:

- (a) By the action of flowing water
- (b) By the consistent action of wind flow from the same direction
- (c) Due to action of glacier drift
- (d) By the action of gravitational forces

Correct Answer: (d) By the action of gravitational forces.

Solution: Talus is a type of soil deposit formed at the base of slopes due to the action of gravitational forces, causing rocks and debris to accumulate.

 Quick Tip

Talus formation is a typical example of gravity-driven soil deposition.

8. The swelling and shrinking nature of black cotton soil is primarily due to the presence of:

- (a) Kaolinite
- (b) Illite
- (c) Montmorillonite
- (d) Vermiculite

Correct Answer: (c) Montmorillonite.

Solution: The swelling and shrinking behavior of black cotton soil is mainly attributed to the presence of montmorillonite, a type of clay mineral with high shrink-swell properties.

 Quick Tip

Montmorillonite is a smectite clay mineral responsible for expansive soils.

9. What will be the maximum capillary rise for a tube having internal diameter 0.1 mm, when it is held vertical with bottom end dipped in pure water taken in trough? Consider the temperature of water to be 20°C. The value of surface tension (γ_s) is $72.8 \times 10^{-3} \text{ N/m}$, and $\gamma_w = 9.79 \text{ kN/m}^3$.

- (a) 0.2974 m
- (b) 0.3867 m
- (c) 0.5671 m
- (d) 0.6782 m

Correct Answer: (a) 0.2974 m.

Solution: The maximum capillary rise (h) is given by the formula:

$$h = \frac{2\gamma_s \cos \theta}{r\rho g}$$

Where r is the radius of the tube, γ_s is the surface tension, and ρ is the density of water. Substituting the given values, the maximum capillary rise is calculated as 0.2974 m.

💡 Quick Tip

Capillary rise is influenced by the surface tension of the liquid and the radius of the tube.

10. Water held by fine grained soil particles due to electrochemical force of adhesion is known as:

- (a) Free water
- (b) Capillary water
- (c) Structural water
- (d) Adsorbed water

Correct Answer: (d) Adsorbed water.

Solution: Adsorbed water is the water that is held by fine grained soil particles due to electrochemical forces. This water is not free to move and is bound to the surface of soil particles.

💡 Quick Tip

Adsorbed water plays a significant role in the physical properties of fine grained soils.

11. Find the relation between h_1 , h_2 , and h_3 , if during a variable head permeability test on a soil sample, equal time intervals are noted for head to drop from h_1 to h_2 and h_2 to h_3 .

- (a) $h_1 = \sqrt{h_2 h_3}$
- (b) $h_2 = \sqrt{\frac{h_3}{h_1}}$
- (c) $h_2 = \sqrt{h_1 h_3}$
- (d) $h_3 = \sqrt{h_1 h_2}$

Correct Answer: (c) $h_2 = \sqrt{h_1 h_3}$.

Solution: In a variable head permeability test, the head at h_2 can be expressed as the geometric mean of h_1 and h_3 , as the time intervals for the drops in head are equal. Hence, $h_2 = \sqrt{h_1 h_3}$.

💡 Quick Tip

In permeability tests, the relation between head changes helps in determining the soil's hydraulic conductivity.

12. Calculate the critical hydraulic gradient for a soil deposit with a void ratio of

0.7 and having a specific gravity of 2.7.

- (a) 0.25
- (b) 0.50
- (c) 1
- (d) 1.5

Correct Answer: (c) 1.

Solution: The critical hydraulic gradient i_c is calculated using the formula:

$$i_c = \frac{e \cdot G}{1 + e}$$

Where: - e is the void ratio of the soil, - G is the specific gravity of the soil.

Substituting the given values $e = 0.7$ and $G = 2.7$, we get:

$$i_c = \frac{0.7 \cdot 2.7}{1 + 0.7} = \frac{1.89}{1.7} = 1.11 \approx 1$$

Thus, the correct answer is 1.

 Quick Tip

The critical hydraulic gradient is an important parameter in geotechnical engineering to assess soil stability under seepage conditions.

13. The ratio of compactive energies used in modified proctor test to standard proctor test is about

- (a) 4.5
- (b) 6.5
- (c) 2.5
- (d) 1.5

Correct Answer: (a) 4.5.

Solution: In the modified proctor test, the compactive energy is about 4.5 times higher than that in the standard proctor test due to higher compaction energy used in the modified test.

 Quick Tip

Higher compactive energies result in denser soil compaction, important for determining maximum dry density.

14. What will be the value of coefficient of volume change if in a consolidation test void ratio decreased from 0.70 to 0.65 when the load was changed from 50 kN/m²

to 100 kN/m^2 ?

- (a) $5.88 \times 10^{-4} \text{ m}^2/\text{kN}$
- (b) $2.88 \times 10^{-4} \text{ m}^2/\text{kN}$
- (c) $3.12 \times 10^{-4} \text{ m}^2/\text{kN}$
- (d) $1.05 \times 10^{-4} \text{ m}^2/\text{kN}$

Correct Answer: (a) $5.88 \times 10^{-4} \text{ m}^2/\text{kN}$.

Solution: The coefficient of volume change α_v is given by the formula:

$$\alpha_v = \frac{\Delta e}{\Delta \sigma}$$

Where Δe is the change in void ratio, and $\Delta \sigma$ is the change in stress.

$$\Delta e = 0.70 - 0.65 = 0.05, \quad \Delta \sigma = 100 - 50 = 50 \text{ kN/m}^2$$

$$\alpha_v = \frac{0.05}{50} = 5.88 \times 10^{-4} \text{ m}^2/\text{kN}$$

 Quick Tip

The coefficient of volume change indicates the compressibility of soil under varying loading conditions.

15. The science which deals with the surface streams is known as

- (a) Limnology
- (b) Cryology
- (c) Geomorphology
- (d) Potamology

Correct Answer: (d) Potamology.

Solution: Potamology is the branch of hydrology that deals with the study of surface streams, particularly rivers and streams.

 Quick Tip

Potamology helps in understanding river dynamics and water flow patterns.

16. The instrument which detects shortwave radiation both direct and diffused reaching the earth's surface is known as

- (a) Psychrometer
- (b) Stevenson screen

- (c) Pyranometer
- (d) Atmometer

Correct Answer: (c) Pyranometer.

Solution: A pyranometer is used to measure the shortwave radiation, both direct and diffuse, reaching the earth's surface. It is typically used in meteorological studies.

 Quick Tip

Pyranometers are crucial for studying solar radiation and its impact on the environment.

17. The instrument which measures the variation of atmospheric humidity with time is known as:

- (a) Barograph
- (b) Thermograph
- (c) Hygrograph
- (d) Radiometer

Correct Answer: (c) Hygrograph.

Solution: A hygrograph measures the variation in atmospheric humidity over time. It is commonly used in meteorology to study humidity changes.

 Quick Tip

Hygrographs are used for monitoring humidity levels and their changes over time, which is important in climate studies.

18. The rainfall that takes place due to western disturbances in Rajasthan which is much needed for wheat-growing regions of the country takes place due to

- (a) Cold weather
- (b) Hot weather
- (c) Southwest monsoon
- (d) Retreating Southwest monsoon

Correct Answer: (c) Southwest monsoon.

Solution: Western disturbances primarily affect the region during the retreating Southwest monsoon, bringing rainfall that is vital for wheat cultivation in Rajasthan and other parts of northern India. These disturbances cause significant rainfall needed for the winter crop season.

💡 Quick Tip

Western disturbances during the retreating Southwest monsoon play a crucial role in providing rainfall to wheat-growing regions of India.

19. What will be the form factor for a drainage basin having the following data: Area of the basin = 3000 km², Length of the main stream = 100 km, and perimeter of the basin = 300 km.

- (a) 0.1
- (b) 0.3
- (c) 10
- (d) 0.05

Correct Answer: (b) 0.3.

Solution: The form factor F is given by the formula:

$$F = \frac{A}{L^2}$$

Where A is the area of the basin (3000 km²) and L is the length of the main stream (100 km). Substituting the values, we get:

$$F = \frac{3000}{100^2} = 0.3$$

💡 Quick Tip

Form factor helps in assessing the shape and flow characteristics of a drainage basin.

20. The Thiessen weights of 4 raingauges A, B, C and D covering a river basin are 0.15, 0.25, 0.30, and 0.30, respectively. If the average depth of rainfall for the basin is 5 cm, and the rainfalls recorded at B, C, and D are 5 cm, 4 cm, and 5 cm respectively. What will be the rainfall at A?

- (a) 5 cm
- (b) 3 cm
- (c) 7 cm
- (d) 9 cm

Correct Answer: (c) 7 cm.

Solution: The average depth of rainfall in the basin can be calculated using Thiessen's method:

$$\text{Average rainfall} = \sum (\text{weight of each gauge} \times \text{rainfall at the gauge})$$

Substituting the values:

$$5 = (0.25 \times 5) + (0.30 \times 4) + (0.30 \times 5) + (0.15 \times R_A)$$

Solving for R_A , the rainfall at A:

$$5 = 1.25 + 1.2 + 1.5 + (0.15 \times R_A)$$

$$1.05 = 0.15 \times R_A$$

$$R_A = \frac{1.05}{0.15} = 7 \text{ cm}$$

 Quick Tip

Thiessen's method helps in calculating the weighted average rainfall across different rain gauge locations.

21. For a given storm, the relation between highest rainfall P_0 and average rainfall depth P in cm over an area $A \text{ km}^2$, where K and n are storm constants is given by:

- (a) $P = P_0 \exp(-KA^n)$
- (b) $P = P_0 K \exp(A^n)$
- (c) $P = P_0 K - A^n$
- (d) $P = P_0 K^n$

Correct Answer: (a) $P = P_0 \exp(-KA^n)$.

Solution: This formula relates the average rainfall depth to the highest rainfall for a given storm using the storm constants K and n . It is used for estimating rainfall distribution across an area.

 Quick Tip

The equation is useful for understanding the spatial distribution of rainfall in a given area during a storm.

22. The average pan coefficient for United States weather Bureau Class A pan is equal to:

- (a) 0.95
- (b) 1.10
- (c) 0.70
- (d) 0.20

Correct Answer: (c) 0.70.

Solution: The average pan coefficient for a standard Class A pan in the United States is 0.70, which is used to adjust pan evaporation data to better estimate actual evaporation from natural water bodies.

 Quick Tip

The pan coefficient helps in the accurate estimation of evaporation rates based on pan measurements.

23. The total observed runoff volume during a 6 hr storm with a uniform intensity of 1.5 cm/hr is 21.6×10^6 m³. What will be the average infiltration rate of the basin if area of the basin is 300 km²?

- (a) 2.4 mm/hr
- (b) 3 mm/hr
- (c) 1.2 mm/hr
- (d) 4 mm/hr

Correct Answer: (b) 3 mm/hr.

Solution: The total runoff volume is the product of the intensity and the area. The infiltration rate can be calculated by subtracting the runoff from the total precipitation and dividing by the area.

$$\begin{aligned}\text{Total Precipitation} &= \text{Intensity} \times \text{Time} = 1.5 \times 6 = 9 \text{ cm} \\ \text{Infiltration Rate} &= \frac{\text{Total Precipitation} - \text{Runoff}}{\text{Area}} = \frac{9 - 6}{300} = 3 \text{ mm/hr}\end{aligned}$$

 Quick Tip

The infiltration rate is a key measure for understanding water movement into the soil during rainfall events.

24. Which of the following formation does not contain any groundwater?

- (a) Aquifer
- (b) Aquifuge
- (c) Aquitard
- (d) Aquiclude

Correct Answer: (b) Aquifuge.

Solution: An aquifuge is a rock or sediment layer that does not contain groundwater because it is impermeable. Unlike aquifers, aquitards, and aquicludes, it does not allow water to pass through it.

💡 Quick Tip

Understanding groundwater formations is essential for managing water resources.

25. Coulomb's Theory is also known as:

- (a) Maximum Principal Stress Theory
- (b) Maximum Shear Stress Theory
- (c) Maximum Principal Strain Theory
- (d) Total Strain Energy Theory

Correct Answer: (b) Maximum Shear Stress Theory.

Solution: Coulomb's Theory, also known as the Maximum Shear Stress Theory, is a criterion for predicting the failure of materials under shear stress. It states that failure occurs when the shear stress exceeds a certain threshold.

💡 Quick Tip

Coulomb's theory is used to analyze the strength of materials under shear stress.

26. How much force is required to punch a 20 mm diameter hole in a plate that is 25 mm thick?

- (a) 550 kN
- (b) 1350 kN
- (c) 1750 kN
- (d) 175 kN

Correct Answer: (a) 550 kN

Solution: The force required to punch a hole can be calculated using the formula:

$$F = \sigma \cdot A$$

Where σ is the shear strength and A is the area. For punching, the force is proportional to the thickness of the plate and the perimeter of the hole.

💡 Quick Tip

The punching force depends on the material strength and the hole's dimensions.

27. The relationship between Young's Modulus of Elasticity (E), Bulk's Modulus (K), and Poisson's ratio (v) is given by:

- (a) $E = 3K(1 - 2v)$
- (b) $E = 3K(1 + 2v)$
- (c) $E = \frac{9K}{(1+v)}$
- (d) $E = 2K(1 + v)$

Correct Answer: (a) $E = 3K(1 - 2v)$.

Solution: This is the relationship between Young's Modulus, Bulk's Modulus, and Poisson's ratio for an isotropic material. It is used in material science and structural engineering to analyze the elastic properties of materials.

 Quick Tip

Understanding the relationship between these moduli helps in the analysis of material behavior under stress.

28. The bending moment at supports in case of simply supported beams of length L and carrying a point load W in the mid-span of the beam is always:

- (a) $\frac{WL}{4}$
- (b) $\frac{WL^2}{8}$
- (c) Zero
- (d) W^2

Correct Answer: (a) $\frac{WL}{4}$.

Solution: In a simply supported beam with a point load at the mid-span, the bending moment at the supports is always equal to $\frac{WL}{4}$. This is derived from the standard formulas for bending moments in structural analysis.

 Quick Tip

The bending moment at supports is crucial for analyzing structural stability and designing beams.

29. In case of a circular section of diameter d , the section modulus is given by:

- (a) $\frac{\pi d^2}{16}$
- (b) $\frac{\pi d^3}{16}$
- (c) $\frac{\pi d^3}{32}$

(d) $\frac{\pi d^3}{64}$

Correct Answer: (c) $\frac{\pi d^3}{32}$.

Solution: The section modulus for a circular section is given by the formula (c) $\frac{\pi d^3}{32}$, which is derived from the geometry of the circular section. This value is used in calculating the strength of the material.

 Quick Tip

Section modulus is an important parameter for designing structural elements under bending stress.

30. Two shafts of solid circular cross-section identical except their diameters are subjected to the same Torque T . What will be the ratio of strain energies $\frac{U_1}{U_2}$ stored in both the shafts if the diameter of the first shaft is d_1 and the diameter of the second shaft is d_2 respectively?

- (a) $\left(\frac{d_1}{d_2}\right)^4$
- (b) $\left(\frac{d_1}{d_2}\right)^2$
- (c) $\left(\frac{d_2}{d_1}\right)^2$
- (d) $\left(\frac{d_2}{d_1}\right)^4$

Correct Answer: (d) $\left(\frac{d_2}{d_1}\right)^4$

Solution: The strain energy stored in a shaft under torque is proportional to the fourth power of its diameter. Therefore, the ratio of strain energies is $\left(\frac{d_2}{d_1}\right)^4$. This relationship arises from the torsional rigidity of the shafts.

 Quick Tip

The strain energy ratio reflects the difference in the diameters of shafts under the same torque.

31. The circumferential strain in the case of a thin cylindrical shell, when subjected to internal pressure (p), is equal to:

- (a) $\frac{pd}{2tE} \left(1 - \frac{v}{2}\right)$
- (b) $\frac{pd}{2tE} \left(1 - \frac{1}{2}v\right)$
- (c) $\frac{pd}{4tE} (1 - v)$
- (d) $\frac{3pd}{4tE} (1 - v)$

Correct Answer: (c) $\frac{pd}{4tE} (1 - \nu)$.

Solution: The circumferential strain in a thin cylindrical shell subjected to internal pressure is given by $\frac{pd}{4tE} (1 - \nu)$, where p is the internal pressure, d is the diameter of the shell, t is the thickness of the shell, E is the modulus of elasticity, and ν is Poisson's ratio.

 Quick Tip

For thin cylindrical shells, the circumferential strain is affected by pressure, material properties, and dimensions of the shell.

32. Which construction stage is required to carry out technical investigations such as soil investigation, topographic investigation, material supply, and market survey, etc.?

- (a) Report Stage
- (b) Planning Stage
- (c) Tendering Stage
- (d) Construction Stage

Correct Answer: (b) Planning Stage.

Solution: The planning stage is when technical investigations like soil investigations, topographic surveys, material supply, and market surveys are carried out to ensure the feasibility and requirements of the project.

 Quick Tip

Planning is a crucial phase where initial surveys and assessments are performed to ensure the success of the construction project.

33. Out of the following, which drawing together with other documents like the bill of quantities describes the project scheme to the contractor so that he can price the construction work accordingly?

- (a) Contract Drawing
- (b) Tender Drawing
- (c) Working Drawing
- (d) Completion Drawing

Correct Answer: (b) Tender Drawing.

Solution: Tender drawings along with the bill of quantities provide the necessary details of

the project for the contractor to price the work accurately. These drawings form the basis for tendering.

 Quick Tip

Tender drawings provide essential details for the contractor to estimate costs and plan the project.

34. Which type of contract is not suitable for difficult foundations, excavation of uncertain character, and projects susceptible to unpredictable hazards and variations?

- (a) Lump Sum contract
- (b) Item rate contract
- (c) Cost Plus Fixed Fee contract
- (d) Running contract

Correct Answer: (a) Lump Sum contract.

Solution: A lump sum contract is not suitable for projects with uncertain conditions like difficult foundations or unpredictable hazards because it fixes the price at the start, which may lead to financial strain if the conditions change.

 Quick Tip

For projects with uncertain conditions, contracts that allow for flexibility in pricing, like cost-plus contracts, are more appropriate.

35. What will be the expected time for driving the precast piles for a bridge abutment activity having optimistic time 22, most likely time 30, and pessimistic time 50?

- (a) 34 days
- (b) 32 days
- (c) 42 days
- (d) 40 days

Correct Answer: (b) 32 days.

Solution: The expected time for an activity in project management using the PERT method is calculated as:

$$\text{Expected Time} = \frac{O + 4M + P}{6}$$

Where O is the optimistic time, M is the most likely time, and P is the pessimistic time.

Substituting the values:

$$\text{Expected Time} = \frac{22 + 4(30) + 50}{6} = \frac{22 + 120 + 50}{6} = 32 \text{ days}$$

💡 Quick Tip

Using the PERT formula helps estimate project timelines by considering optimistic, most likely, and pessimistic scenarios.

36. Which Act makes the provision for the statutory fixation of a minimum rate of wages in the industries?

- (a) Payment of wages Act, 1936
- (b) Minimum wages Act, 1948
- (c) Workmen's compensation Act, 1923
- (d) Contract Labour Act, 1970

Correct Answer: (b) Minimum wages Act, 1948.

Solution: The Minimum Wages Act, 1948, provides for the statutory fixation of minimum wages in industries to ensure fair wages for workers.

💡 Quick Tip

The Minimum Wages Act ensures that workers receive fair compensation for their labor, protecting their basic rights.

37. The distance AB on the ground as measured on a plan drawn to a scale of 1 cm = 50 m was found to be 500 m. Later it was detected that the surveyor wrongly used a scale of 1 cm = 40 m in the calculations. What will be the true length of the line AB?

- (a) 400 m
- (b) 5125 m
- (c) 625 m
- (d) 4125 m

Correct Answer: (c) 625 m.

Solution: The measured length on the plan is 500 m, but the scale used was 1 cm = 40 m instead of 50 m. The true length of the line can be calculated using the ratio of the scales:

$$\text{True Length} = \frac{500}{\frac{40}{50}} = 625 \text{ m}$$

💡 Quick Tip

When the wrong scale is used, the true length can be calculated by adjusting for the scale discrepancy.

38. Surveys which are carried out to indicate the inequalities of land surface and to depict the mountain, water bodies, woods, etc. are known as:

- (a) Cadastral survey
- (b) City survey
- (c) Topographical survey
- (d) Hydrographic survey

Correct Answer: (c) Topographical survey.

Solution: Topographical surveys are conducted to show the features of the land surface, such as mountains, valleys, water bodies, forests, and other natural features.

💡 Quick Tip

Topographical surveys are essential for understanding the natural features and terrain of an area.

39. What will be the sag correction for a 100 m tape which is suspended between the ends under a pull of 10 N? The total weight of the tape is 12 N.

- (a) 10 m
- (b) 6 m
- (c) 3 m
- (d) 12 m

Correct Answer: (b) 6 m.

Solution: The sag correction can be calculated using the formula:

$$\text{Sag correction} = \frac{wL^2}{8T}$$

Where w is the weight of the tape, L is the length of the tape, and T is the pull. Substituting the values:

$$\text{Sag correction} = \frac{12 \times 100^2}{8 \times 10} = 6 \text{ m}$$

 Quick Tip

Sag correction compensates for the elongation of the tape due to its weight and the pull applied.

40. Geodimeter is based on:

- (a) Propagation of modulated light waves
- (b) High-frequency radio waves
- (c) Intermittent signal of high frequency near 500 MHz
- (d) Propagation of infrared radiation

Correct Answer: (a) Propagation of modulated light waves.

Solution: A Geodimeter uses the principle of modulated light waves for distance measurement, which helps achieve high accuracy in surveying and geodesy.

 Quick Tip

Geodimeter technology is based on the use of light waves to measure distances precisely in surveying applications.

41. Oblique offsets are used to:

- (a) locate broken boundary
- (b) locate corner of the building
- (c) Plot the chainage
- (d) check the accuracy of the plotted work in chain survey.

Correct Answer: (a) locate broken boundary.

Solution: Oblique offsets are used in chain surveying to measure the distances to points that are not on the baseline but are at an angle to it, helping to locate broken boundaries.

 Quick Tip

Oblique offsets help in accurately plotting points that are off the baseline but at an angle to it.

42. Find the magnetic declination if the magnetic bearing of the sun at noon is 356° :

- (a) 4°N
- (b) 4°S

- (c) 4°E
- (d) 4°W

Correct Answer: (c) 4°E.

Solution: The magnetic declination can be calculated by subtracting the magnetic bearing of the sun at noon (356°) from the true bearing (360°).

$$360 - 356 = 4 \quad (\text{East})$$

 Quick Tip

The magnetic declination is the angle between magnetic north and true north, measured in degrees east or west.

43. For which of the following permanent adjustment of a theodolite is the spire test used?

- (a) Adjustment of plate levels
- (b) Adjustment of line of sight
- (c) Adjustment of horizontal axis
- (d) Adjustment of altitude bubble and vertical index frame

Correct Answer: (b) Adjustment of line of sight.

Solution: The spire test is used to ensure that the line of sight of the theodolite is true and not affected by errors in the instrument's leveling or alignment.

 Quick Tip

The spire test checks the alignment of the theodolite's line of sight for accuracy during adjustments.

44. In case of angular measurements being more precise than the linear measurements, the traverse can be balanced by:

- (a) Graphical method
- (b) Bowditch rule
- (c) Fast needle method
- (d) Transit rule

Correct Answer: (b) Bowditch rule.

Solution: The Bowditch rule is used to balance a traverse when angular measurements are more precise than the linear measurements, typically correcting for the errors in distance.

 Quick Tip

The Bowditch rule adjusts for error when angular precision is higher than linear distance accuracy.

45. The reduced level of a factory floor is 30.00 m and the staff reading on the floor is 1.40 m. The staff reading when held inverted with the bottom touching the Tee-beam of the roof is 3.67 m. What will be the height of the beam above the floor?

- (a) 5.07
- (b) 2.27
- (c) 35.07
- (d) 27.73

Correct Answer: (a) 5.07.

Solution: The height of the beam above the floor is calculated by subtracting the inverted staff reading from the sum of the reduced level and the staff reading:

$$\text{Height of beam} = 30.00 + 1.40 - 3.67 = 5.07 \text{ m}$$

 Quick Tip

When the staff is held inverted, subtract the reading from the sum of the reduced level and the original staff reading to find the height.

46. The rock fragments contributed by the frost action mainly along valley-sides and the adjoining cliffs, and carried away by glaciers are known as:

- (a) Moraines
- (b) Mesa
- (c) Monadnocks
- (d) Peneplains

Correct Answer: (a) Moraines.

Solution: Moraines are accumulations of glacial debris (such as rock fragments) carried and deposited by glaciers. These are typically found along valley sides and at the base of cliffs.

 Quick Tip

Moraines provide evidence of past glacial activity, marked by the accumulation of rock fragments.

47. The shine of mineral is known as:

- (a) Lustre
- (b) Streak
- (c) Tenacity
- (d) Cleavage

Correct Answer: (a) Lustre.

Solution: Lustre refers to the way a mineral reflects light from its surface, giving it a shiny appearance. It is an important property in mineral identification.

 Quick Tip

Lustre is one of the primary visual properties used to identify minerals based on their reflective qualities.

48. Muscovite is a family member of which category of mineral group?

- (a) Feldspar Group
- (b) Mica Group
- (c) Amphibole group
- (d) Garnet group

Correct Answer: (b) Mica Group.

Solution: Muscovite is a member of the mica group of minerals, known for their sheet-like structure and excellent cleavage.

 Quick Tip

Mica minerals, like muscovite, have unique properties such as perfect cleavage and sheet-like structure.

49. Basalt is a

- (a) Volcanic igneous rock
- (b) Argillaceous elastic sedimentary rock
- (c) Calcareous sedimentary rock

(d) Crystalline metamorphic rock

Correct Answer: (a) Volcanic igneous rock.

Solution: Basalt is a type of igneous rock formed from the rapid cooling of lava exposed at or near the Earth's surface.

 Quick Tip

Igneous rocks, like basalt, are formed from the solidification of magma or lava.

50. 1 Stoke is equal to

- (a) 10^{-4} m²/sec
- (b) 10^{-4} m square/sec
- (c) 10^{-5} m/s
- (d) 10^{-3} m/s

Correct Answer: (a) 10^{-4} m²/sec.

Solution: 1 Stoke is equal to $1 \text{ cm}^2/\text{s}$, which is equivalent to $10^{-4} \text{ m}^2/\text{s}$.

 Quick Tip

The Stoke is a unit of kinematic viscosity.

51. In a static fluid with y as the vertical direction, the pressure variation is given by:

- (a) $\frac{dp}{dy} = \rho$
- (b) $\frac{dp}{dy} = -\rho$
- (c) $\frac{dp}{dy} = \gamma$
- (d) $\frac{dp}{dy} = -\gamma$

Correct Answer: (d) $\frac{dp}{dy} = -\gamma$.

Solution:

In fluid statics, γ denotes the specific weight of the fluid ($\gamma = \rho g$). Taking upward as the positive y-direction, the pressure decreases with an increase in y, hence

$$\frac{dp}{dy} = -\rho g \quad \text{or} \quad \frac{dp}{dy} = -\gamma.$$

 Quick Tip

When analyzing fluid statics, always keep track of the sign convention and the direction in which y is measured.

52. The gauge pressure at the surface of a liquid of density 900 kg/m^3 is 0.4 bar . If the atmospheric pressure is $1 \times 10^5 \text{ Pa}$, calculate the absolute pressure at a depth of 50 m .

- (a) 5.8145 bar
- (b) 6.2345 bar
- (c) 7.324 bar
- (d) 3.467 bar

Correct Answer: (a) 5.8145 bar .

Solution:

$$\text{Gauge pressure at surface} = 0.4 \text{ bar} = 0.4 \times 10^5 \text{ Pa} = 4 \times 10^4 \text{ Pa}.$$

$$\text{Absolute pressure at surface} = p_{\text{atm}} + p_{\text{gauge}} = 1 \times 10^5 + 4 \times 10^4 = 1.4 \times 10^5 \text{ Pa} = 1.4 \text{ bar}.$$

$$\text{Hydrostatic pressure at depth } 50 \text{ m} = \rho gh = 900 \times 9.81 \times 50 \approx 4.4145 \times 10^5 \text{ Pa} = 4.4145 \text{ bar}.$$

$$\text{Total absolute pressure at } 50 \text{ m depth} = 1.4 \text{ bar} + 4.4145 \text{ bar} \approx 5.8145 \text{ bar}.$$

 Quick Tip

Remember: Absolute pressure = Atmospheric pressure + Gauge pressure.

53. Condition for irrotational flow is given by:

- (a) $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}$
- (b) $\frac{\partial u}{\partial x} = -\frac{\partial v}{\partial y}$
- (c) $\frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}$
- (d) $\frac{\partial v}{\partial x} = -\frac{\partial u}{\partial y}$

Correct Answer: (c) $\frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}$.

Solution:

For two-dimensional flow with velocity components (u, v) , the z -component of the vorticity

$$\omega_z = \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}.$$

$$\text{Irrotational flow} \implies \omega_z = 0 \implies \frac{\partial v}{\partial x} = \frac{\partial u}{\partial y}.$$

 Quick Tip

For ideal (irrotational) fluid flow, the curl (vorticity) must be zero.

54. As per Rankine Theory, the coefficient of active earth pressure (K_a) is given by:

- (a) $K_a = \frac{1 - \sin \phi}{1 + \sin \phi}$
- (b) $K_a = \frac{1 + \sin \phi}{1 - \sin \phi}$
- (c) $K_a = \frac{1 + \tan \phi}{1 - \tan \phi}$
- (d) $K_a = \frac{1 - \tan \phi}{1 + \tan \phi}$

Correct Answer: (a) $K_a = \frac{1 - \sin \phi}{1 + \sin \phi}$.

Solution:

Rankine's theory for active earth pressure assumes that the wall yields sufficiently such that the lateral stress on the backfill is minimized. The coefficient for active state is:

$$K_a = \frac{1 - \sin \phi}{1 + \sin \phi}.$$

 Quick Tip

Remember: $K_a < 1$ and it decreases with increasing ϕ .

55. In stone masonry, the projection which is usually provided to serve as support for joist, truss, weather shed etc. is known as:

- (a) Through Stone
- (b) Corbel
- (c) Jambs
- (d) Coping

Correct Answer: (b) Corbel.

Solution:

A corbel is a masonry projection from the face of a wall, used to support structural or ornamental elements such as beams, trusses, or eaves.

 Quick Tip

Corbels must be built and anchored carefully to carry intended loads safely.

56. The treatment step adopted for removing bushes, debris, and wood from water is known as:

- (a) Sedimentation
- (b) Coagulation
- (c) Screening

(d) Filtration

Correct Answer: (c) Screening.

Solution:

Screening is the initial unit operation in water treatment plants used to remove large floating and suspended matter such as leaves, pieces of wood, and other large debris.

💡 Quick Tip

Always provide adequate screening before other treatment steps to protect downstream units.

57. Addition of Alum in water treatment increases:

- (a) Acidity and hardness of water
- (b) Alkalinity and hardness of water
- (c) Sulphate and sulphides in water
- (d) Carbonate and bicarbonates in water

Correct Answer: (a) Acidity and hardness of water.

Solution:

Alum ($\text{Al}_2(\text{SO}_4)_3$) is commonly used as a coagulant. When added, it hydrolyzes and consumes alkalinity (thus increasing acidity), and can increase permanent hardness (e.g., formation of calcium sulfate).

💡 Quick Tip

Alum reacts with bicarbonates in water to form insoluble flocs and also releases SO_4^{2-} , leading to increased acidity and potential rise in hardness.

58. The disease Methaemoglobinaemia is caused when drinking water supply contains high concentration of:

- (a) Fluoride
- (b) Iron
- (c) Chloride
- (d) Nitrate

Correct Answer: (d) Nitrate.

Solution:

High nitrate concentration in drinking water may lead to Methemoglobinemia (blue baby syndrome) in infants. It reduces the oxygen-carrying capacity of blood due to the formation of methemoglobin.

 Quick Tip

Always monitor nitrate levels in drinking water, especially in agricultural areas with excessive use of nitrogenous fertilizers.

59. Addition of gypsum to the irrigation water is recommended to overcome difficulties posed by:

- (a) Highly saline irrigation supplies
- (b) Irrigation supplies containing high quantities of sodium
- (c) Irrigation supplies containing heavy sediment
- (d) Irrigation supplies containing heavy metals

Correct Answer: (b) Irrigation supplies containing high quantities of sodium.

Solution:

Gypsum (calcium sulfate) improves soil structure by replacing sodium with calcium on soil exchange sites, thus mitigating sodic soil conditions.

 Quick Tip

Excess sodium in irrigation water degrades soil structure; adding gypsum is a common remedy.

60. The crop sequence, which cannot serve any useful purpose in crop rotation is:

- (a) Wheat — Juar — Gram
- (b) Rice — Gram — Rice
- (c) Cotton — Wheat — Gram
- (d) Rice — Wheat — Cotton

Correct Answer: (d) Rice — Wheat — Cotton.

Solution:

A good crop rotation aims to optimize soil fertility, reduce pest/disease incidence, and avoid repetitive cropping of the same or similar crop in a short cycle. The sequence Rice — Wheat — Cotton consists of two cereals (Rice and Wheat) and one cash crop (Cotton), but it lacks a pulse or legume. Leguminous breaks are important to replenish soil nitrogen and break pest cycles effectively. Hence, this particular rotation does not provide the desired benefit in terms of soil fertility and pest management.

 Quick Tip

Including a leguminous crop (e.g., Gram, Lentils, or other pulses) in the rotation helps fix nitrogen, thereby improving soil health and overall sustainability of the cropping system.

61. The moisture held by a well-drained soil against gravity drainage, by the force of surface tension between soil grains and water drops is called:

- (a) Field capacity water
- (b) Hygroscopic water
- (c) Capillary water
- (d) Water of adhesion

Correct Answer: (c) Capillary water.

Solution:

Capillary water is held in the small pores of the soil by the force of surface tension. After gravitational water drains away, the remaining water that adheres to soil particles and is available to plants is largely in the form of capillary water.

💡 Quick Tip

Field capacity is the upper limit of capillary water held in soil after free drainage. But the water held specifically by surface tension in micropores is called capillary water.

62. The ratio of water stored in the root zone during irrigation, to the water needed in the root zone prior to irrigation is called:

- (a) Efficiency of water use
- (b) Efficiency of water storage
- (c) Efficiency of water application
- (d) Efficiency of water conveyance

Correct Answer: (b) Efficiency of water storage.

Solution:

$$\text{Efficiency of water storage} = \frac{\text{Water actually stored in the root zone}}{\text{Water needed in the root zone before irrigation}} \times 100\%.$$

It measures how effectively the applied water replenishes the soil moisture deficit in the root zone.

💡 Quick Tip

Other efficiencies in irrigation engineering include application efficiency, conveyance efficiency, and water use efficiency, each addressing different parts of the water delivery/use cycle.

63. Bio Diesel is commonly known as:

- (a) Wood Alcohol

- (b) Mono alkyl esters
- (c) Gasohol
- (d) Propane

Correct Answer: (b) Mono alkyl esters.

Solution:

Biodiesel is produced through the transesterification of vegetable oils or animal fats, resulting in chemicals commonly referred to as mono alkyl esters.

💡 Quick Tip

"Wood alcohol" (methanol) and "gasohol" (gasoline + ethanol blend) are different bio-fuels, while propane is a hydrocarbon gas. Biodiesel = mono alkyl esters.

64. Breathing ability of an engine can be represented by:

- (a) Thermal efficiency
- (b) Mechanical efficiency
- (c) Volumetric efficiency
- (d) Relative efficiency

Correct Answer: (c) Volumetric efficiency.

Solution:

Volumetric efficiency measures how effectively an engine can intake air compared to its theoretical cylinder volume. A higher volumetric efficiency means better "breathing" of the engine.

💡 Quick Tip

Improving volumetric efficiency (e.g., by turbocharging) increases engine power output and performance.

65. Travel reduction ratio (TRR) is commonly known as:

- (a) Wheel slip
- (b) Velocity or pull losses
- (c) Motion resistance
- (d) Coefficient of traction

Correct Answer: (a) Wheel slip.

Solution:

Travel reduction ratio (TRR) is the percentage difference between the theoretical travel speed of a wheel (based on its geometry and rotation) and the actual travel speed on the ground. This difference is also called slip.

💡 Quick Tip

Wheel slip significantly affects tractor efficiency and fuel consumption in field operations.

66. Puddler is used:

- (a) To reduce the leaching of water and destruction of weeds
- (b) For digging circular pits for planting saplings in orchards and forests
- (c) For zero tillage
- (d) For making furrows

Correct Answer: (a) To reduce the leaching of water and destruction of weeds.

Solution:

Puddling involves mixing soil and water thoroughly to create a dense layer in wetland (paddy) cultivation, reducing percolation losses and helping in weed control.

💡 Quick Tip

Puddling is mainly practiced in rice fields to maintain a shallow water depth and minimize water loss.

67. The process of breaking of larger fat globules into smaller size to prevent fat separation is known as:

- (a) Homogenization
- (b) Sterilization
- (c) Pasteurization
- (d) Sanitization

Correct Answer: (a) Homogenization.

Solution:

Homogenization is a mechanical process used in milk processing to reduce fat globule size, prevent cream separation, and improve texture and taste.

💡 Quick Tip

Pasteurization involves heating to destroy pathogens. Sterilization extends shelf life under high temperature. Sanitization is cleaning to reduce microorganisms, but doesn't break fat globules.

68. Pulsed light is a method of food preservation that involves:

- (a) Pressure processing

- (b) The use of intense and short duration pulses of broad-spectrum light
- (c) Electron beam
- (d) Dense phase carbon dioxide

Correct Answer: (b) The use of intense and short duration pulses of broad-spectrum light.

Solution:

Pulsed light technology uses high-intensity, short-duration flashes of broad-spectrum light (UV to near IR) to inactivate microorganisms on food surfaces without significant heat generation.

 Quick Tip

Compared to thermal methods, pulsed light is considered a non-thermal or minimally thermal technology, helping to preserve fresh-like characteristics.

69. The hoop tension force (F_{ht}) per metre (in kg) exerted on a cylindrical silo wall is given by:

- (a) $F_{ht} = r \cdot P_z$
- (b) $F_{ht} = t P_z$
- (c) $F_{ht} = \frac{P_z}{r}$
- (d) $F_{ht} = \frac{t P_z}{r}$

Correct Answer: (a) $F_{ht} = r \cdot P_z$.

Solution:

For a thin-walled cylinder of radius r subjected to an internal lateral pressure P_z , the hoop tension (force per metre of height) is:

$$F_{ht} = (\text{Pressure}) \times (\text{Radius}) = r \cdot P_z.$$

 Quick Tip

Hoop tension is a key factor in silo wall design to prevent structural failure due to horizontal grain pressure.

70. Certified seed has a tag of which colour?

- (a) Yellow colour
- (b) Red colour
- (c) Blue colour
- (d) Black colour

Correct Answer: (c) Blue colour.

Solution:

In standard seed certification schemes (e.g., in India), the certified seed label is blue. Foundation

seed usually has a white tag, while breeder seed is tagged with a golden yellow label.

💡 Quick Tip

Colour coding helps ensure seed quality traceability and authenticity from breeder to farmer.

71. Which of the following irrigation method has been developed in Israel?

- (a) Drip Irrigation
- (b) Sprinkler Irrigation
- (c) Furrow Irrigation
- (d) Border Strip Irrigation

Correct Answer: (a) Drip Irrigation.

Solution:

Drip irrigation (also called trickle irrigation) was pioneered and extensively developed in Israel. It delivers water directly to the root zone of the crop, minimizing evaporation losses and improving water-use efficiency.

💡 Quick Tip

Drip irrigation reduces water use substantially while ensuring consistent moisture for plant roots, making it ideal for arid and semi-arid regions.

72. Adulteration of which of the following weed in mustard oil causes dropsy disease?

- (a) Cuscuta
- (b) Motha
- (c) Piazi
- (d) Satyanashi

Correct Answer: (d) Satyanashi.

Solution:

The seeds of *Argemone mexicana* (commonly known as Satyanashi) contain toxic alkaloids. When these seeds contaminate mustard seeds and are used for oil extraction, they can cause epidemic dropsy, a serious health condition.

💡 Quick Tip

Always ensure proper seed cleaning to avoid contamination with *Argemone* (Satyanashi) seeds.

73. Indian Dairy Corporation was established in which year?

- (a) 13 January 1970
- (b) 27 August 1955
- (c) 26 June 1975
- (d) 11 July 2016

Correct Answer: (a) 13 January 1970.

Solution:

The Indian Dairy Corporation was established on 13 January 1970 to further the objectives of the “Operation Flood” program and to modernize the dairy sector in India.

 Quick Tip

Operation Flood, launched in 1970, was a major rural development program that helped transform India into one of the largest milk producers in the world.

74. Slip erosion is associated with:

- (a) Saturation of steep hills and slopes
- (b) Rain drops falling on land surface
- (c) Erosion against natural cover
- (d) High velocity of winds moving over barren land surface

Correct Answer: (a) Saturation of steep hills and slopes.

Solution:

Slip erosion (also referred to as slip failure or slump) occurs when soil or rock on steep slopes becomes saturated with water, reducing shear strength and causing a mass movement downslope.

 Quick Tip

Preventing water infiltration and improving drainage on steep slopes helps reduce slip erosion.

75. The sediment yield (Dr) of a watershed, which is a function of sediment yield (Sy) and gross erosion (Eg), is represented by:

- (a) $Dr = \frac{Sy}{Eg}$
- (b) $Dr = Sy \times Eg$
- (c) $Dr = \frac{Eg}{Sy}$
- (d) $Dr = Eg + Sy$

Correct Answer: (a) $Dr = \frac{Sy}{Eg}$.

Solution:

“Delivery ratio” (often denoted as Dr) is the ratio of the sediment yield (Sy) at a watershed’s outlet to the gross erosion (Eg) within the watershed:

$$Dr = \frac{Sy}{Eg}.$$

 Quick Tip

A higher delivery ratio indicates that a greater proportion of eroded material reaches the outlet, while a lower ratio suggests much of the eroded material is deposited within the watershed itself.