MADE EASY

ESE 2022

Preliminary Examination

Detailed Solution of

CIVIL ENGINEERING

Set-C

Scroll down

Civil Engineering Paper Analysis of ESE 2022 Preliminary Examination

Sl.	Subjects	No. of Questions
1	Building Materials	12
2	Strength of Materials	19
3	Structural Analysis	09
4	Design of Steel Structures	10
5	RCC & Prestress Concrete	15
6	Construction Practice, Planning & Management	12
7	Fluid & Hydraulic Machines + OCF	13
8	Engineering Hydrology	02
9	Irrigation Engineering	08
10	Environmental Engineering	14
11	Geo-technical Engineering	13
12	Surveying and Geology	12
13	Transportation Engineering (Highway, Tunnel, Railway Engg.)	11

UPSC ESE Prelims Exam 2022
Civil Engineering Analysis
by MADE EASY faculties

https://www.youtube.com/watch?v=1_4run5qoE0&t=8630s

Q.1 Which one of the following is NOT a factor affecting losses and wastes in water supply scheme?
- (a) Metering
- (b) Unauthorised connections
- (c) Water demand
- (d) Pressure in the distribution system

Ans. **(c)**

Water demand doesn't affect losses and wastes in water supply scheme.

End of Solution

Q.2 Which one of the following forecasting methods for population is also known as uniform increase method?
- (a) Arithmetic increase method
- (b) Decreasing rate method
- (c) Geometric increase method
- (d) Simple geographical method

Ans. **(a)**

Arithmetic increase method is based on the assumption that population increase at constant rate i.e., $\dfrac{dP}{dt} = \text{Constant}$ whereas geometric increase method or uniform percentage growth method is based on assumption that percentage rate growth is constant.

End of Solution

Q.3 Storage capacity of a reservoir can be estimated by using
- (a) Cuboidal formula
- (b) Cylindrical formula
- (c) Prismoidal formula
- (d) Conical formula

Ans. **(c)**

Storage capacity of a reservoir can be estimated by mass curve, prismoidal and trapezoidal method.

End of Solution

Q.4 Modern commercial turbidimeter which works on the principle of scattering of light at right angles to the incident light, is called
- (a) Spectrometer
- (b) Nephelometer
- (c) Optimeter
- (d) Lightmeter

Ans. **(b)**

Baylis turbidmeter works on the principle of scattering of light in the direction of light whereas nephelometer at right angles to the incident light.

End of Solution

Q.5 Which one of the following is a disease caused by protozoal infections under water-borne disease?
- (a) Infectious hepatitis
- (b) Amoebic dysentery
- (c) Infectious jaundice
- (d) Poliomyelitis

Ans. **(b)**

End of Solution

Q.6 Which of the following methods adopted for purifying the public water supplies?
1. Screening
2. Sedimentation aided with coagulation
3. Disinfection
Select the correct answer using the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. **(d)**

End of Solution

Q.7 According to Stoke's law, if the diameter (d) is less than 0.1 mm, then the settling velocity of spherical particles is directly proportional to
(a) d^2
(b) d^3
(c) d
(d) $d^{1/2}$

Ans. **(a)**
For $d \le 0.1$ mm (i.e., Laminar flow)

Settling velocity, $v_s = \dfrac{g}{18}(G-1)\dfrac{d^2}{\nu}$

$v_s \propto d^2$

End of Solution

Q.8 What is the settling velocity of a discrete particles in water under conditions when Reynold's number is less than 0.5? (Take the diameter and specific gravity of the particles are 5×10^{-3} cm and 2.65 respectively and Kinematic viscosity of water at 20°C is 1.01 $\times 10^{-2}$ cm^2/s and g = 9.81 m/s^2)
(a) 0.22 cm/s
(b) 0.35 cm/s
(c) 0.14 cm/s
(d) 0.46 cm/s

Ans. **(a)**

$$v_s = \frac{g}{18}(G-1)\frac{d^2}{\nu}$$

$$= \frac{981\,\text{cm/s}^2}{18} \times \frac{(2.65-1)\times\left(5\times10^{-3}\right)^2\,\text{cm}^2}{1.01\times10^{-2}\,\text{cm}^2/\text{s}}$$

$$= 0.22\ \text{cm/s}$$

End of Solution

Q.9 The rate of filtration of pressure filter as compared to rapid gravity filter is about
(a) 10 times
(b) 15 times
(c) 2 to 5 times
(d) 6 to 8 times

Ans. **(c)**

Filtration rate of RGF = 3000 to 6000 l/h/m^2

Filtration rate of pressure filter = 6000 to 18000 l/h/m^2

i.e., rate of pressure filter as compared to rapid gravity filter is about 2 to 5 times.

End of Solution

Directions: Each of the next **Six (6)** items consist of two statements, one labelled as 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the code given below:

Code:

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **NOT** the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false

(d) Statement (I) is false but Statement (II) is true

Q.10 **Statement (I):** The stone should be well seasoned.

Statement (II): The resistances of stone against the wear and tear due to natural agencies should be high.

Ans. **(a)**

- A freshly cut stone carries natural moisture i.e. quarry sap which is a mineral solution reacts with mineral constituent when stone exposed to atmosphere after quarrying.

- When quarry sap evaporates, it leaves crystalline film on face of stone and make them weather resistant.

End of Solution

Q.11 **Statement (I):** The tensile strength (or ultimate strength) is defined as the highest value of the engineering stress.

Statement (II): For ductile materials, the tensile strength corresponds to the point at which necking starts.

Ans. **(b)**
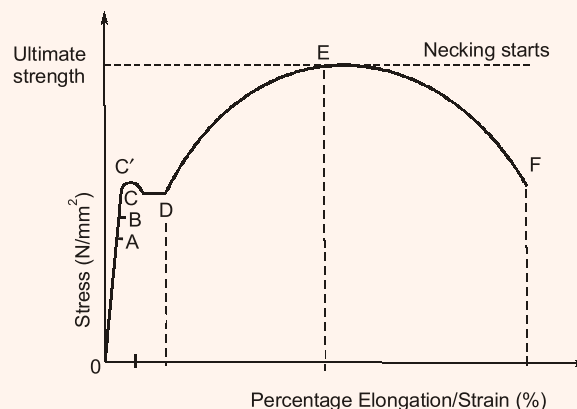
End of Solution

Q.12 **Statement (I):** The use of slope deflection method is limited to structures which are not highly indeterminate.

Statement (II): The slope deflection equations can be obtained by using the principle of superposition by considering separately the moments developed at each support due to each of the displacement, and then the loads.

Ans. **(b)**

Q.13 **Statement (I):** In the partial safety factor based design format, the design capacity is defined by considering the corresponding partial safety factor.

Statement (II): The partial safety factors are associated with the inherent and modeling uncertainties.

Ans. **(a)**

Q.14 **Statement (I):** The theory of reinforced concrete is developed with the assumption that there is perfect bond between steel and concrete, in other words, there is no slip.

Statement (II): In case of ribbed bars, there is no need to check the bond failures.

Ans. **(c)**

Q.15 **Statement (I):** The boundary layer thickness decreases as distance from the leading edge increases.

Statement (II): Greater is the kinematic viscosity of the fluid greater is the boundary layer thickness.

Ans. **(d)**

The boundary layer thickness increases with the increase in distance from the leading edge.

Q.16 A catchment has six rain gauge stations, In a year, the annual rainfall recorded by the gauges are as follows:

Station	A	B	C	D	E	F
Rainfall (cm)	82.6	102.9	180.3	110.3	98.8	136.7

For a 10% error in the estimation of the mean rainfall, what is the optimum number of stations in the catchment? (Take $\bar{P}$ = 118.6, σ_{m-1} = 35.04 and ε = 10)

(a) 10   (b) 9

(c) 8   (d) 7

Ans. (b)

$$N = \left(\frac{C_v}{E}\right)^2$$

$$C_v = \frac{\sigma}{P} \times 100 = \frac{35.04}{118.6} \times 100 = 29.545\%$$

$$N = \left(\frac{29.545}{10}\right)^2 = 8.73 \simeq 9$$

End of Solution

Q.17 Which one of the following is defined as the process by which the water leaves a living plant during photosynthesis, through its leaves, to enter the atmosphere as water vapour?
(a) Transpiration   (b) Evapotranspiration
(c) Stomata   (d) Evaporation

Ans. (a)
Transpiration is the process by which water leaves the body of a living plant and reaches the atmosphere as water vapour.

End of Solution

Q.18 Which one of the following is a gap developed in the canal bank due to erosion of some portion of the bank?
(a) Canal breach
(b) Sub canal
(c) Temporary outlet used for irrigation
(d) Fault

Ans. (a)
Canal Breach or Canal Bank Breach can happen due to erosion of soil from the sides. IT is mostly observed in unlined canals.

End of Solution

Q.19 Which one of the following stages does the river bed consist of a mixture of boulders, gravels, shingles and alluvial sand deposit created by itself?
(a) Rocky stage   (b) Incised river stage
(c) Boulder river stage   (d) Rivers in alluvial flood plains stage

Ans. (c)
In rocky stage, river mostly contains rocks or very large boulders.
In incised river stage, river flows sufficiently below the natural ground surface as opposed to the one flowing in flood plains, both of which carry mostly sand and shingle.
Boulder river stage is characterised by steep slopes and their beds consists of a mixture of boulders, gravel, shingle and sand.

End of Solution

Q.20 Which of the following are the only two factors which govern the storage capacity of the reservoir?
(a) Inflow to reservoir and the outflow from the reservoir
(b) Inflow and catchment area
(c) Catchment area and outflow
(d) Height of reservoir and catchment area

Ans. **(c)**
- Storage capacity of a reservoir is function of outflow discharge only. Where this discharge depends on catchment area.
- Storage capacity of channel is function of outflow and inflow discharge.

End of Solution

Q.21 Formation of successive bends of reverse order may lead to the formation of a complete S curve called
(a) Concave or outer edge   (b) Scouring
(c) Meander   (d) Convex or inner edge

Ans. **(c)**

End of Solution

Q.22 The monthly consumptive use values for paddy are tabulated below. What is average monthly consumptive use?

Month	Dates	Rice (Loam Soil) C_u in cm
June	1-30 ⎫ Nursery	29.69
July	1-12 ⎭	8.76
July	13-31	14.38
August	1-31	22.73
September	1-30	21.29
October	1-31	25.50
November	1-24	15.06

(a) 7.7 cm   (b) 23.1 cm
(c) 26.69 cm   (d) 137.41 cm

Ans. **(b)**
Total consumptive use of rise:

$29.69 + 8.76 + 14.38 + 22.73 + 21.29 + 25.50 + 15.06$

Average daily consumptive use

$$\frac{137.41}{31+31+31+30+30+24} = 0.776$$

Monthly consumptive use $= 0.776 \times 30$
$= 23.28 \simeq 23.1$

End of Solution

Q.23 Water bearing stratum, having no confined impermeable over burden lying over it, is known as
(a) An unconfined aquifer
(b) An artesian aquifer
(c) Confined aquifer
(d) Controlled aquifer

Ans. **(a)**
An unconfined aquifer is an aquifer whose upper water surface (water table) is at atmospheric pressure and thus is able to rise and fall.

End of Solution

Q.24 The permeable groynes made from timber stakes or wooden piles, are called
(a) Balli spurs
(b) Tree spurs
(c) Balli crates
(d) Wire crates

Ans. **(a)**
Permeable groynes do permit restricted flow through them. The groynes are more or less temporary structures & are susceptible to damage by floating debris, etc. "The common materials used as permeable groynes, are "1. Trees used as groynes, called Tree spur. "2. Timber stakes or wooden piles called Balli spurs. "3. Stone filled in balli crates."4. Stone filled in wire crates.

End of Solution

Q.25 A reservoir with uncontrolled and ungated outlets is known as
(a) Retarding basin
(b) Storage reservoir
(c) Controlled reservoir
(d) Detention basin

Ans. **(a)**
A reservoir having gates and valves installed at the spillway and at its sluice outlets is known as a storage reservoir or detention reservoir on the other hand, a reservoir with uncontrolled and ungates outlets is known as retarding reservoir.
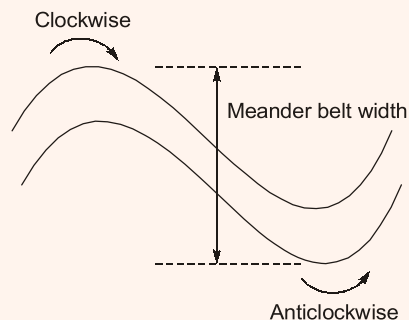
End of Solution

Q.26 The distance between the outer edges of clockwise and anti-clockwise loops of the meander
(a) Meander length
(b) Meander belt
(c) Meander ratio
(d) Cross-overs

Ans. **(b)**
Meander belt width clockwise.

The distance between outer banks of two adjacent clockwise an anticlockwise meanders is known as meander belt width.

End of Solution

Q.27 Which one of the following is the one which rests in a pervious stratum and draws its supply from the surrounding material?
(a) Sidetrack well
(b) Horizontal well
(c) Deep well
(d) Shallow well

Ans. **(d)**

End of Solution

Q.28 The various types of water demand, which a city may have, may be broken down into which of the following classes?
1. Domestic water demand
2. Industrial water demand
3. Demand for public uses
Select the correct answer using the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. **(d)**

End of Solution

Q.29 In a big city having population of 50 lakhs, if 6 moderate fires each of 3 hours break out in a day, what is the approximate amount of water required per person per day? (Assume 3 jet streams simultaneously throwing water from a hydrant with discharge of 1100 litres/minute/stream)
(a) less than 1 litre
(b) between 1-3 litre
(c) between 3-5 litres
(d) 20 litres

Ans. **(a)**

Population = 50 lacs

Total duration of fire fighting = 6 × 3 × 60 min

Total volume of water for fire fighting = 3 × 1100 lit/min × 6 × 3 × 60 min

Per capita fire demand $= \dfrac{3 \times 1100 \times 6 \times 3 \times 60}{5000000} = 0.7$ lit/day
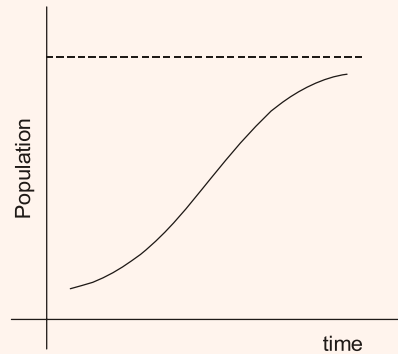
End of Solution

Q.30 For water supply scheme design of a town or a city, the suitable method of estimating future population by the end of the design period is
(a) increasing rate method
(b) decreasing rate method
(c) exponential curve method
(d) incremental decrease method

Ans.   (b)

As we reach the end of design period, the city passes through its initial exponential growth phase and reaches a phase where the growth happens, but at a decreasing rate.

End of Solution

Q.31   The thickness design of pavement mainly depends on
(a) the pavement materials   (b) the climatic factors
(c) the design wheel road   (d) the subgrade soil

Ans.   (c)

End of Solution

Q.32   For traffic surveys using origin and destination studies, the most suitable method in case of heavy traffic and absence of skilled or trained personnel is
(a) Road side interview method
(b) License plate method
(c) Work spot or home interview method
(d) Return post card method

Ans.   (d)

End of Solution

Q.33   In traffic control, the speed at which vehicles are presumed to travel through the coordinated signal system is known as
(a) Signal coordination   (b) Speed of progression
(c) Cycle   (d) Through band

Ans.   (b)

End of Solution

Q.34   The pressure outside the droplet of water of diameter 0.04 mm is 10.32 N/cm^2 (atmospheric pressure). What is the pressure within the droplet if surface tension is 0.0725 N/m of water?
(a) 11.045 N/cm^2 (b) 10.32 N/cm^2
(c) 9.45 N/cm^2 (d) 8.595 N/cm^2

Ans. (a)

$$\Delta P = \frac{2\sigma}{R} = \frac{2(.0725)0}{0.02 \times 10^{-3}} = 7250 \text{ N/m}^2 = 0.7250 \text{ N/cm}^2$$

$$P_i - P_o = 0.725$$
$$P_i = 10.32 + 0.725 = 11.045 \text{ N/cm}^2$$

End of Solution

Q.35 What is the viscosity of a liquid whose kinematic viscosity is 6 stokes and specific gravity is 1.90?

   (a) 1.14 poise   (b) 11.40 poise

   (c) 0.114 Ns/m^2 (d) 11.40 Ns/m^2

Ans. (b)

$$\gamma = 6 \text{ stokes}$$
$$\gamma = 6 \times 10^{-4} \text{ m}^2/\text{s}$$
$$S_l = 1.9$$
$$r_l = 1.90 \times 10^3 \text{ kg/m}^3$$

$$\gamma = \frac{\mu}{\rho}$$

$$\mu = 6 \times 10^{-4} \times 1.9 \times 10^3$$
$$= 1.14 \text{ Ns/m}^2 = 11.4 \text{ poise}$$

End of Solution

Q.36 A 2 m wide tank contains water upto a height of 0.50 m above its base. An immiscible liquid of specific gravity 0.80 is filled on the top of the water upto 1 m height. What is the total pressure force on one side of the tank? (Take density of water as 1000 kg/m^3 and g = 9.81 m/s^2)
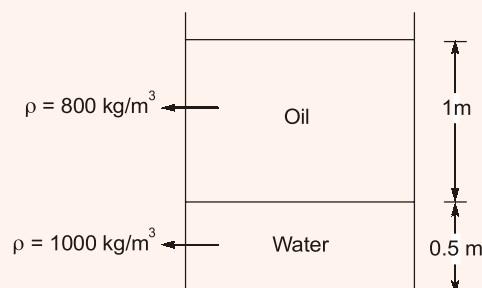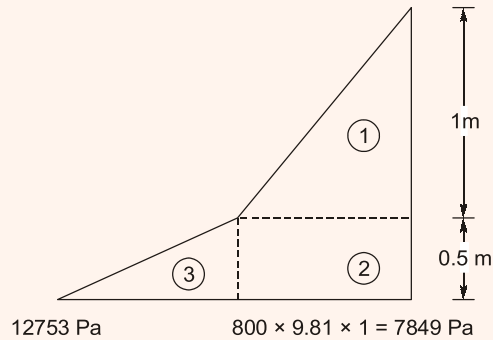
   (a) 7.85 kN   (b) 24.52 kN

   (c) 10.3 kN   (d) 18.15 kN

Ans. (d)

Pressure diagram

1m

0.5 m

12753 Pa   800 × 9.81 × 1 = 7849 Pa

$$F = \left[\frac{1}{2} \times 1 \times 7849 + 0.5 \times 7849 + \frac{1}{2} \times 0.5 \times (12753 - 78749)\right] \times 2$$

F = 18150.5 N
F = 18.15 kN

End of Solution

Q.37 A pipeline of uniformly varying cross-section carries an oil of specific gravity 0.87. The diameter of pipe is 200 mm at end A and 500 mm at end B. The end B is located at 4 m higher than A. What is the loss of head in the pipeline if the pressure reading at A is 9.81 N/cm^2 and at B is 5.886 N/cm^2? (Take discharge is 200 litres/s and g = 9.81 m/s^2)

(a) 2.609 m   (b) 26.09 cm
(c) 2.109 m   (d) 21.09 cm

Ans. **(a)**

$$\frac{P_A}{\rho g} = \frac{9.81 \times 10^4}{870 \times 9.81} = 11.494 \text{ m}$$

$$\frac{V_A^2}{2g} = \frac{1}{2 \times 9.81} \left\{ \frac{0.2}{\frac{\pi}{4}(0.02)^2} \right\}^2 = 2.0657 \text{ m}$$

Given, $Z_B - Z_A$ = 4 m

$$\frac{P_B}{\rho g} = \frac{5.886 \times 10^4}{870 \times 9.81} = 6.89655 \text{ m}$$

$$\frac{V_B^2}{2g} = \frac{1}{2 \times 9.81} \left\{ \frac{6.2}{\frac{\pi}{4} \times (0.5)^2} \right\}^2 = 0.0529 \text{ m}$$

$$\text{Head loss} = \left(\frac{P_A}{\rho g} + \frac{V_A^2}{2g} \times Z_A\right) - \left(\frac{P_B}{\rho g} + \frac{V_B^2}{2g} + Z_B\right)$$

$$= 2.61025 \text{ m}$$

Q.38 Air at standard conditions flows over a flat plate. The free stream speed is 3 m/s. What is the thickness of boundary layer at a distance of 1 m from the leading edge of the flat plate? (Take the kinematic viscosity of air is 1.5×10^{-5} m^2/s and density is 1.23 kg/m^2)

(a) 1.80 mm
(b) 1.80 cm
(c) 10.3 cm
(d) 10.3 mm

Ans. **(d)**

$$\text{Re}_x = \frac{\rho U_\infty x}{\mu} = \frac{U_\infty x}{\nu}$$

$$= \frac{3 \times 1}{2 \times 10^{-5}} = 2 \times 10^5$$

Since, $\text{Re}_x < 5 \times 10^5$
Laminar boundary layer over flat plate

$$\frac{\delta}{x} = \frac{5}{\sqrt{\text{Re}_x}}$$

$$\frac{\delta}{1} = \frac{5}{\sqrt{2 \times 10^5}}$$

$$\delta = 11.18 \text{ m}$$

So nearest option is (d)

Q.39 The water is flowing with a velocity of 1.5 m/s in a pipe of length 2500 m and diameter 500 mm. A valve is provided at the end of the pipe. What is the rise in pressure if the valve is closed in 25 seconds? (Take velocity of pressure wave is 1460 m/s)

(a) 15 N/cm^2
(b) 1500 N/cm^2
(c) 150 N/m^2
(d) 15 kN/m^2

Ans. **(a)**

$$T_a = 25 \text{ seconds}$$

$$\frac{2L}{C} = \frac{2 \times 2500}{1460} = 3.4246 \text{ seconds}$$

$$\frac{2L}{C} < T_a \Rightarrow \text{Gradual closure of valve}$$

$$\frac{P}{\rho g} = \frac{L}{g} \times \frac{V}{T}$$

$$P = \left(10^3\right) \times \frac{2500(1.5)}{25}$$

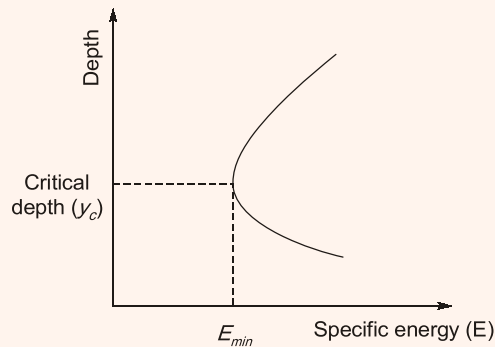$$P = 15 \times 10^4 \text{ N/m}^2$$

$$P = 15 \text{ N/cm}^2$$

End of Solution

Q.40 The depth of flow of a channel section at which the specific energy is minimum, is called
  (a) Critical velocity
  (b) Critical depth
  (c) Critical energy
  (d) Subcritical flow

Ans. **(b)**

The depth at which specific energy is minimum is called critical depth.

End of Solution

Q.41 Which one of the following statements is correct with respect to Kaplan Turbine?
  (a) The peripheral velocity at inlet is more than peripheral velocity at outlet.
  (b) Velocity of flow at inlet is more than velocity of flow at outlet.
  (c) The peripheral velocity at inlet and outlet are equal.
  (d) Velocity of flow at outlet is more than velocity of flow at inlet.

Ans. **(c)**

End of Solution

Q.42 The speed of the generator can be maintained constant only if the speed of the turbine runner is constant equal to the one given by equation $N = \dfrac{60f}{p}$ and it is known as
  (a) Synchronous speed
  (b) Asynchronous sped
  (c) Derived speed
  (d) Measured variable speed

Ans. **(a)**

End of Solution

Q.43 Consider the following statements related to negative slip of the reciprocating pump:
1. The actual discharge of a reciprocating pump is more than the theoretical discharge.
2. The co-efficient of discharge will be more than unity.
3. When the suction pipe is short and delivery pipe is long and pump is running at slow speed, then negative slip of the pump occurs.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (a)

$$\text{Percentage slip} = \left(\frac{Q_{theo} - Q_{act}}{Q_{theo}}\right) \times 100$$

$$\text{Slip} < 0$$

$$\Rightarrow \qquad Q_{theo} < Q_{act}$$

If $\qquad Q_{act} > Q_{theo} \qquad \left\{C_d = \dfrac{Q_{act}}{Q_{theo}}\right\}$

$$C_d > 1$$

End of Solution

Q.44 A single acting reciprocating pump has a plunger of diameter 250 mm and stoke of 350 mm. If the speed of the pump is 60 rpm and it delivers 16.5 lit/sec of water against a suction head of 5 m and a delivery head of 20 m, what is the co-efficient of discharge?
(a) 0.72
(b) 0.79
(c) 0.86
(d) 0.96

Ans. (d)

$$Q_{theo} = \frac{ALN}{60} = \frac{\frac{\pi}{4}(0.25)^2 \times (0.35) \times (60)}{60}$$

$$= 0.017180 \text{ m}^3/\text{s}$$

$$Q_{theo} = 17.18 \text{ litre/s}$$

Coefficient of discharge,

$$C_d = \frac{Q_{act}}{Q_{theo}} = \frac{16.2}{17.18} = 0.96$$

End of Solution

Q.45 The stream function is given by the expression $\psi = 2x^2 - y^2$. What is the resultant velocity at a point denoted by $x = 2$ and $y = 3$?
(a) 10
(b) 12
(c) 15
(d) 18

Ans. **(a)**

Given: $\psi = 2x^2 - y^2$

$$u = -\frac{\partial \psi}{\partial y} = -\frac{\partial}{\partial y}\left(2x^2 - y^2\right)$$

$$u = 2y$$

$$v = \frac{\partial \psi}{\partial x} = 4x$$

At $(x, y) = (2, 3)$

$$u = 2 \times 3 = 6 \text{ units}$$

$$v = 4 \times 2 = 8 \text{ units}$$

$$v_{net} = \sqrt{u^2 + v^2} = \sqrt{6^2 + 8^2}$$

$$= \sqrt{100} = 10 \text{ units}$$

End of Solution

Q.46 Which one of the following is the source of error in curve computations and layout?
(a) ability to set on the plates of the theodolite, the required sub-division of a minute for the deflection angles.
(b) use of less than full tape lengths on arc-definition curves.
(c) Carrying out computed elevations to more than 10 mm.
(d) Good intersections between tape line and site line on flat curves.

Ans. **(b)**

Source of errors:
1. Inability to set on plates of theodolite.
2. Use of less than full tape length on arc definition curve.
3. Carrying out computed elevation to less than 3 mm.
4. Poor intersections between tape line and sight line on flat curve.

End of Solution

Q.47 Photographic surveying is suitable for
(a) small-scale mapping of open hilly or mountainous countries
(b) flat or wooded country
(c) roads
(d) transmission lines

Ans. **(a)**

Suitable for small scale mapping of open hilly or mountainous contours.

End of Solution

Q.48 What is the difference of longitude between two places C and D from the following longitudes?
1. Longitude of C = 46° W
2. Longitude of D = 64° W

(a) 18°　　　　　　　　　　(b) 36°
(c) 110°　　　　　　　　　(d) 220°

Ans. **(a)**

Difference in longitude = 64° − 46° = 18°

End of Solution

Q.49 If the focal length of lens (f), flying height (H) and height of ground above mean sea level (h) are known, then the scale at height 'h' (S_h) is equal to

(a) $\dfrac{f}{(H\text{-}h)}$　　　　　　(b) $\dfrac{(H\text{-}h)}{f}$

(c) $\dfrac{(h\text{-}H)}{2f}$　　　　　　(d) $\dfrac{2f}{(h\text{-}H)}$

Ans. **(a)**

Scale of vertical photograph

$$S = \dfrac{f}{(H\text{-}h)}$$

End of Solution

Q.50 The terrestrial photogrammetry can be divided into how many branches?

(a) Four　　　　　　　　(b) Three
(c) Two　　　　　　　　(d) Five

Ans. **(c)**

The terrestrial photogrammetry can be divided into two branches:
(i) Plane table photogrammetry
(ii) Terrestrial stereo photogrammetry

End of Solution

Q.51 Which one of the following is an aerial photograph taken with the camera axis directed intentionally between the horizontal and the vertical?

(a) Tilted photograph　　　　(b) Oblique photograph
(c) Slanting photograph　　　(d) Vertical photograph

Ans. **(b)**

An oblique photograph is an aerial photograph taken with camera axis directed intentionally between the horizontal and vertical.
• A vertical photograph is an aerial photograph mode with the camera axis coinciding with directed of gravity.

• A tilted photograph is an aerial photograph made with the camera axis unintentionally tilted from vertical by small amount less than 3°.

End of Solution

Q.52 A plate load test is carried out on submerged soil using a 300 mm radius rigid plate. A load of 5 Tons resulted in a deflection of 1.20 mm. What is the elastic modulus of the soil by considering the Poisson's ratio as 0.50?
(a) 5216 kPa
(b) 521.6 GPa
(c) 52.16 MPa
(d) 52160 Pa

Ans. **(c)**

$$a = 300 \text{ mm}$$
$$\Delta = 1.2 \text{ mm}$$
$$P = 5 \text{ tons}$$
$$\mu = 0.5$$
$$p = \frac{P}{\pi a^2} = \frac{5000}{\pi \times 30^2} = 1.768 \text{ kg/cm}^2$$

For rigid plate method [F_2 = 1 for soil subgrade]

$$\Delta = 1.18 \frac{p.a}{E_s} \times F_2$$

$\Rightarrow$ $$1.2 \text{ mm} = 1.18 \times \frac{1.768 \times 300}{E_s} \times 1$$

$\Rightarrow$ $$E_s = 521.56 \text{ kg/cm}^2$$
$$= 52156 \text{ kPa} = 52.156 \text{ MPa}$$

End of Solution

Q.53 In case of horizontal curves in pavement, the purpose of super-elevation or banking of curve is to
(a) counteract the centripetal acceleration produced as a vehicle rounds a curve
(b) provide proper cross-drainage
(c) prevent vehicle from sliding inwards
(d) make road look good

Ans. **(a)**

Counteract the centripetal acceleration produced as a vertical rounds a curve.

End of Solution

Q.54 Which of the following are the design elements in highway embankments?
1. height
2. fill material
3. settlement
Select the correct answer using the codes given below:
(a) 1, 2 and 3
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1 and 2 only

Ans. (a)

The design elements in highway embankments are:
(i) Height
(ii) Fill material
(iii) Settlement
(iv) Stability of foundation
(v) Stability of slope

End of Solution

Q.55 Consider the following statements related to construction of bituminous pavements:
1. It is not possible to construct relatively thin bituminous pavement layers over a an existing pavement.
2. In India, the bituminous construction is by and large adopted on the surface course.
3. The black top construction is in extensive use in developing nations.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (b)

It is possible to construct relatively thin bituminous pavement layers over an existing pavement.

End of Solution

Q.56 The held water in subgrade soil forms ice crystals at some spots if the freezing temperatures continue for a certain period. These ice crystals grow further in size if there is a continuous supply of water due to capillary action and the depressed temperature continues. This results in raising of portion of the pavement structure known as
(a) Frost heave
(b) Frost melting
(c) Alternate freeze-thaw cycle
(d) Frost action

Ans. (a)

End of Solution

Q.57 Consider the following statements related to IRC recommendations for the CBR method of design (IRC: 37-1970):
1. The CBR tests should be performed on remoulded soils on the field.
2. For the design of new roads, the subgrade soil sample should be compacted at OMC to proctor density
3. In new construction, the CBR test samples may be soaked in water for four days period before testing.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (d)

End of Solution

Q.58 Which one of the following measures should be taken for maintaining rolling stock?
(a) The different parts of rolling stock need not be cleaned every day.
(b) All axles completed service life need not be replaced.
(c) The parts of rolling stock which get worn out need not be replaced.
(d) Lubrication of all the reciprocating parts and bearings with a suitable lubricant should be done.

Ans. **(d)**
- Lubrication of all reciprocating part and bearing with suitable lubricant should be done.
- The different part of rolling stock should be cleaned every day.
- All axle which have completed.

End of Solution

Q.59 Space-mean speed represents
(a) the instantaneous speed of a vehicle at a specified section or location.
(b) the effective speed with which a vehicle traverses a particular route between two terminals.
(c) the average speed of vehicle in a certain road length at any time.
(d) the average of instantaneous speed of observed vehicles at the spot.

Ans. **(c)**
The average speed of vehicle in a certain road length at any time.

End of Solution

Q.60 A vehicle has wheel base of 6.5 m. What is the off tracking while negotiating a curved path with a mean radius 32 m?
(a) 1.32 m   (b) 1.15 m
(c) 0.86 m   (d) 0.66 m

Ans. **(d)**

$$l = 6.5 \text{ m}, \quad R = 32 \text{ m}$$

$$O_T = \frac{l^2}{2R} = \frac{6.5^2}{2 \times 32} = 0.66 \text{ m}$$

End of Solution

Q.61 Which one of the following does NOT affect the permeability of soils?
(a) Void ratio   (b) Soil strength
(c) Grain size   (d) Temperature

Ans. **(b)**

$$k = CD_{10}^2 \frac{e^3}{1+e} \frac{\gamma_w}{\mu}$$

k depends on D_{10}, e, μ, γ_w (μ, γ_w depends temperature)

End of Solution

Q.62 Consistency is a term used to indicate
(a) the quantitative analysis of soils
(b) the degree of firmness of cohesive soils
(c) the fineness of non-cohesive soils
(d) the fineness of clay soils

Ans. (b)

End of Solution

Q.63 The primary function of geogrids is
(a) connecting two layers
(b) separators
(c) reinforcement
(d) protection from corrosion

Ans. (c)
Geogrid is geosynthetic material used to reinforce soil and similar material.

End of Solution

Q.64 Which of the following is/are the laboratory methods of determination of coefficients of permeability of soils?
1. Constant head permeability method
2. Falling head permeability method
Select the correct answer using the codes given below:
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans. (c)

End of Solution

Q.65 Which one of the following characteristics is NOT measured by geophysical method of soil exploration?
(a) Magnetism
(b) Density
(c) Electrical resistivity
(d) Plasticity

Ans. (d)

End of Solution

Q.66 Which one of the following is a method of wet mechanical analysis of a fine-grained material?
(a) Partial sedimentation
(b) Sedimentation into dirty water
(c) Observation of partial sedimented soil
(d) Elutriation

Ans. (a)

End of Solution

Q.67 According to Highway Research Board (HRB) classification system, which one of the following is NOT relevant for dependency of group index of soil?
(a) The amount of material passing the 75-micron IS sieve
(b) The liquid limit
(c) The plastic limit
(d) The shrinkage limit

Ans. **(d)**

$GI = 0.2\,a + 0.005\,ac + 0.01\,bd$

Where, a = % finer passing 75μ sieve = $p - 35 \ngtr 40$
    b = % finer passing 75μ sieve = $p - 15 \ngtr 40$
    $c = W_L - 40 \ngtr 20$
    $d = I_P - 10 \ngtr 20$
    W_L = Liquid limit
    I_P = Plasticity Index

<div align="right">End of Solution</div>

Q.68 An oven-dried soil having a mass of 200 g is placed in a pycnometer which is then completely filled with water. The total mass of the pycnometer with water and soil inside is 1605g. The pycnometer filled with water alone has a mass of 1480 g. What is the specific gravity of the soil?
(a) 2.21   (b) 2.41
(c) 2.67   (d) 3.32

Ans. **(c)**

$$G = \frac{W_2 - W_1}{(W_4 - W_3) + (W_2 - W_1)}$$

$$= \frac{W_d}{(W_4 - W_3) + W_d}$$

$$= \frac{200}{1480 - 1605 + 200}$$

$$= \frac{200}{75} = \frac{8}{3} = 2.667$$

<div align="right">End of Solution</div>

Q.69 A soil sample has a porosity of 40 percent. The specific gravity of solids is 2.70. What is voids ratio?
(a) 0.467   (b) 0.567
(c) 0.667   (d) 0.743

Ans. **(c)**

$$e = \frac{n}{1-n} = \frac{0.4}{1-0.4} = \frac{2}{3} = 0.667$$

<div align="right">End of Solution</div>

Q.70 Which one of the following is used for determining different strata in the earth's crust?
(a) Mine survey   (b) Topographic survey
(c) Archaeological survey   (d) Geological survey

Ans. **(d)**
Geological survey used to determine different strata in earth crust.
• Mine survey used to explore mineral wealth.
• Archaeological survey used to unearthing relies of antiquity.
• Topographic survey is used to determine natural features of country such as river, lake, steam lake, wood, hill etc.

End of Solution

Q.71 Consider the following statements related to set out the curve using two theodolite method:
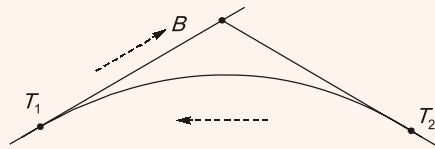To set out the curve,
1. set up a theodolite over T_1 and another over T_2.
2. set the vernier of each of the instruments to zero.
3. direct the instrument at T_1 to the ranging rod at the point of intersection B and bisect it.
Which of the above statements are correct?
(a) 1 and 2 only   (b) 1 and 3 only
(c) 2 and 3 only   (d) 1, 2 and 3
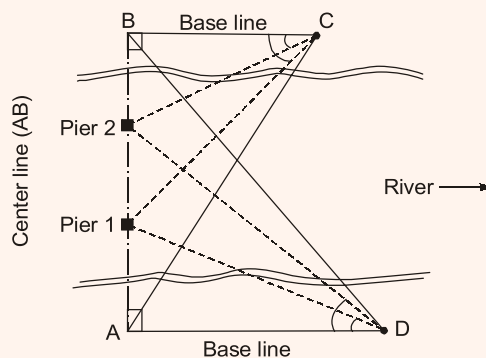
Ans. **(d)**

End of Solution

Q.72 In setting out location of piers, the central points of the piers are located by intersection of sights, simultaneous sights being taken from
(a) the ends of a base   (b) the top of the pier
(c) the back of the pier   (d) the front of the pier

Ans. **(a)**

End of Solution

Q.73 Which one of the following tapes is generally used for work of the highest precision?
  (a) Linen tape
  (b) Metric woven metallic tape
  (c) Metric steel tape
  (d) Invar tape

Ans. **(d)**
  Invar tape has highest precision.

Q.74 A vertical circle which is at right angles to the meridian is also known as
  (a) an altitude
  (b) a co-altitude
  (c) a prime vertical
  (d) an azimuth

Ans. **(c)**

Q.75 Which one of the following is a staff reading taken on a point whose elevation is to be determined?
  (a) Fore sight
  (b) Back sight
  (c) Intermediate sight
  (d) Line of sight

Ans. **(a)**

Q.76 The value of Poisson's ratio for Brass material is
  (a) 0.14
  (b) 0.24
  (c) 0.34
  (d) 0.44

Ans. **(c)**
  Ductility $\propto$ Poisson's ratio
  Brass $\rightarrow \mu = 0.34$

Q.77 A hole is to be punched through a steel plate of 8 mm thickness. What is the least diameter of hole which can be punched, if the steel punch can be worked to a compressive stress of 800 N/mm^2 and the ultimate shear strength is 300 N/mm^2?
  (a) 1.2 mm
  (b) 12 mm
  (c) 21 mm
  (d) 2.1 mm

Ans. **(b)**

$$\sigma_u = 300 \text{ N/mm}^2$$
$$\sigma_c = 800 \text{ N/mm}^2$$
$$\sigma_c = \frac{P}{A}$$

$$\Rightarrow \qquad P = \sigma_c \frac{\pi}{4} d^2$$

$$\sigma_u = \frac{P}{\pi dt} = \frac{\sigma_c \frac{\pi}{4} d^2}{\pi dt} = \frac{\sigma_c d}{4t}$$

$$d = \frac{\sigma_u 4t}{\sigma_c} = \frac{300 \times 4 \times 8}{800} = 12 \text{ mm}$$

End of Solution

Q.78 Consider the following statements regarding the strain displacement?
1. The strain depends on the displacement of points within the body.
2. The strain at points within the body does not depend on the relative displacements of various points within the body.

Which of the above statements is/are correct?
(a) Both 1 and 2
(b) 1 only
(c) 2 only
(d) Neither 1 nor 2

Ans. (b)

End of Solution

Q.79 A flat bar 10 mm thick and 100 mm wide is subjected to a pull of 100 kN. One side of the bar is polished and lines are ruled on it to form a square of 50 mm side, one diagonal of the square being along the middle line of the polished side. What is the change in the sides? (Take E = 200 kN/m^2 and Poisson's ratio is 0.30)
(a) 0.0875 mm (increases)
(b) 0.00875 mm (decreases)
(c) 0.00875 mm (increases)
(d) 0.0875 mm (decreases)

Ans. (c)

$$\sigma = \frac{100 \times 10^3}{100 \times 10} = 100 \text{ MPa}$$
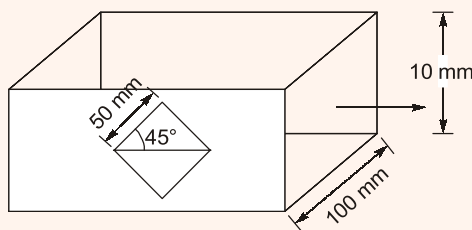
$$\epsilon_x = \frac{\sigma}{E} = \frac{100}{200 \times 10^3} = 5 \times 10^{-4}$$

$$\mu = -\frac{\epsilon_y}{\epsilon_x}$$

$$\epsilon_y = -(0.3)(5 \times 10^{-4}) = -1.5 \times 10^{-4}$$

$$\in_x' = \in_x \cos^2\theta + \in_y \sin^2\theta + \gamma_{xy}\cos\theta\sin\theta^{0}$$

$$\in_x' = (5 \times 10^{-4})\cos^2 45 + (-1.5 \times 10^{-4})\sin^2 45$$

Change in length = $50 \times (\in_x')$

$\qquad = 0.00875$ mm (increases)

End of Solution

Q.80 In a tensile test carried out in the laboratory on a steel specimen for 5 minutes. The strain value noted at that time was 0.30. What is the average strain rate of that steel specimen?

(a) 0.01/second   (b) 0.001/minute

(c) 0.001/second   (d) 0.01/minute

Ans. **(c)**

$$\text{Average strain rate} = \frac{d\in}{dt} = \frac{0.30}{5\times 60} = 0.001/\text{second}$$

End of Solution

Q.81 Maximum principal strain theory of elastic failure is also known as

(a) Guest's Theory   (b) Rankine's Theory

(c) Haigh's Theory   (d) Saint Venant's Theory

Ans. **(d)**

Saint Venant's theory $\Rightarrow$ Maximum principal strain theory

End of Solution

Q.82 Which one of the following is the limitation of the maximum strain energy theory?

(a) The theory does not apply to the ductile materials

(b) It can only be applicable for the materials under the hydrostatic pressure

(c) It cannot be applied for materials under the hydrostatic pressure

(d) The theory does not give accurate results in case of torsion test

Ans. **(d)**

Maximum strain energy theory

$\qquad \Downarrow$

In pure shear condition

$\qquad \Downarrow$

$\tau = 0.62\sigma_y$

which is greater than $0.577\sigma_y$

(So it does not provide accurate result in torsion test)

End of Solution

Q.83 What are the values of maximum shear stress (τ_{max}) and the angle of twist (θ) respectively for an equilateral triangle with side a and twisting moment M_t? (Take the modulus of rigidity is G)

(a) $\dfrac{20M_t}{a^3}$ and $\dfrac{46M_t}{a^4G}$

(b) $\dfrac{20M_t}{a^2}$ and $\dfrac{26M_t}{a^4G}$

(c) $\dfrac{46M_t}{a^3}$ and $\dfrac{20M_t}{a^4G}$

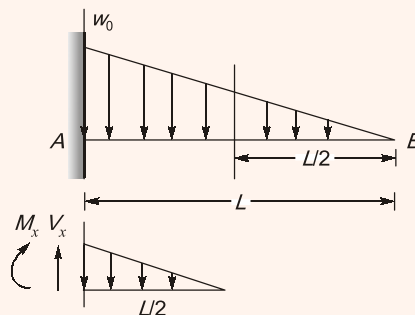(d) $\dfrac{20M_t}{a^4}$ and $\dfrac{46M_t}{a^3G}$

Ans. **(a)**

End of Solution

Q.84 A cantilever beam of length L is loaded by a transverse load varying linearly from w_0 at fixed end and zero at free end. What is the shear at $\dfrac{L}{2}$ of the beam?

(a) $\dfrac{w_0L}{4}$

(b) $\dfrac{w_0L^2}{8}$

(c) $\dfrac{w_0L^2}{4}$

(d) $\dfrac{w_0L}{8}$

Ans. **(d)**

$$V_x = \frac{1}{2} \cdot \left(\frac{w_0}{2}\right)\left(\frac{L}{2}\right) = \frac{w_0L}{4}$$

End of Solution

Q.85 Two of the principal stresses at a point are 130 MPa and 90 MPa. What is the safe range of the third principal stress at the point by using maximum shear stress theory? (Take the failure stress in tension as $f_y = 210$ N/mm^2)

(a) -80 MPa $\le \sigma \le 300$ MPa

(b) -155 MPa $\le \sigma \le 210$ MPa

(c) -112 MPa $\le \sigma \le 222$ MPa

(d) -210 MPa $\le \sigma \le 210$ MPa

Ans. **(a)**

$$\sigma_1 = 130, \ \sigma_2 = 90, \ \sigma_3 = ?$$

$$\tau_{max} = \left|\frac{130-90}{2}\right|, \ \left|\frac{130-\sigma_3}{2}\right|, \ \left|\frac{90-\sigma_3}{2}\right|$$

$$\left|\frac{130-\sigma_3}{2}\right| \le \frac{210}{2}$$

$$\Rightarrow \qquad \sigma_3 \ge -80, \ \sigma_3 \le 340$$

$$\left|\frac{90-\sigma_3}{2}\right| \le \frac{210}{2}$$

$$\Rightarrow \qquad \sigma_3 \ge -120, \ \sigma_3 \le 300$$

End of Solution

Q.86 A close-coiled helical spring is subjected to an axial pull of W. The spring is made out of d mm diameter rod, and has n complete coils, each of radius R and modulus of rigidity as N then the deflection under the pull is

(a) $\delta = \dfrac{16WR^3n}{Nd^4}$

(b) $\delta = \dfrac{32WR^3n}{Nd^4}$

(c) $\delta = \dfrac{64WR^3n}{Nd^4}$

(d) $\delta = \dfrac{64WR^2n}{Nd^3}$

Ans. **(c)**

$$\delta = \frac{64WR^3n}{Nd^4}$$

End of Solution

Q.87 A steel wire of cross-sectional area 100 mm^2 and length 100 m is used to lift a weight of 2.5 kN at its lowest end. What is the total elongation of the wire if the mass density of the wire is 8 kg/m^3? (Take E = 200 GPa and acceleration due to gravity is 10 m/s^2)

(a) 14.5 mm

(b) 29 mm

(c) 7.5 mm

(d) 36.5 mm

Ans. **(a)**

$$\Delta_{load} = \frac{WL}{AE} = \frac{2.5\times10^3\times100\times10^3}{100\times200\times10^3} = 12.5 \text{ mm}$$

$$W_{wire} = \rho gv = 8\times10\times100\times10^{-6}\times100 = 0.8 \text{ N}$$

$$\Delta_{wt} = \frac{W_{wire}L}{2AE} = \frac{0.8\times100\times10^3}{2\times100\times200\times10^3} = 0.2\times10^{-2} \text{ mm}$$

For $\qquad \rho = 8000 \text{ kg/m}^3, \ \Delta_{wt} = 2 \text{ mm}$

$$\Delta = 14.5 \text{ mm}$$

End of Solution

Q.88 For non-homogeneous clays, the coefficient of permeability in (mm/s) should be ranges between
(a) 10^{-1} to 10^{-2}
(b) 10^{-2} to 10^{-3}
(c) 10^{-3} to 10^{-4}
(d) 10^{-4} to 10^{-6}

Ans. **(d)**
Clay has least coefficient of permeability.

End of Solution

Q.89 Large parts of northern India lying north of Vindhya-Satpura range in the Indo-Gangetic and Brahmaputra flood plains are covered by
(a) the colluvial soils
(b) the aeolian soils
(c) the alluvial soils
(d) the talus soils

Ans. **(c)**

End of Solution

Q.90 The maximum test load on a working pile should not exceed
(a) 250 kN
(b) 180 kN
(c) two and a half times the design load
(d) one and a half times the design load

Ans. **(d)**
The maximum test load on a working pile should not exceed one and a half times the design load.

End of Solution

Q.91 Which one of the following is the amount of time by which the start of an activity may be delayed without delaying the start of a following activity?
(a) Total float
(b) Interference float
(c) Independent float
(d) Free float

Ans. **(d)**
Free float: It is that portion of positive total float which can be used by an activity without delaying any succeeding activity (or without affecting total float of succeeding activity).

End of Solution

Q.92 Which of the following is/are consumed time and resources?
(a) Event only
(b) Activity (other than dummy) only
(c) Dummy activity only
(d) Both event and activity (other than dummy)

Ans. **(b)**
An activity requires both time and resources for its completion.

End of Solution

Q.93 Construction quality can NOT be directly affected by
(a) whether a clear set of designs and drawings is available
(b) whether a clear, well-laid-out and unambiguous set of specifications is available
(c) whether a clearly defined time duration of project
(d) whether there has been usage of proper materials, workers and equipments during the construction processes

Ans. **(c)**

End of Solution

Q.94 Marble is an example of
(a) Metamorphic Rock
(b) Sedimentary Rock
(c) Igneous Rock
(d) Argillaceous Rock

Ans. **(a)**
Marble is metamorphic rock formed by igneous or sedimentary rock as a result of reaction of earth movement, temperature change, liquid pressure etc.
Original rock for marble: Limestone, marl, dolamites

End of Solution

Q.95 Which one of the following is caused by the crushing of fibres running transversely during the growth of the tree?
(a) Shake
(b) Knot
(c) Upset
(d) Rind gall

Ans. **(c)**
Shake: are longitudinal separations inward between the annual rings.
Knot: are branches buried by cambial activity of mother branch.
Upset: caused by crushing of fiber running transversely during growth of a tree due to strong wind and unskilled felling.
Rind gall: it's a swelling caused by growth of layer of sapwood over wounds after the branch has been cut off in irregular manner.

End of Solution

Q.96 Which one of the following statements is NOT correct for Aluminium?
(a) It is less ductile than copper
(b) It is harder than tin
(c) It can be soldered
(d) It can be welded

Ans. **(c)**
- Aluminium is malleable, less ductile than copper but excels zinc, tin and lead.
- Aluminium can be riveted and welded but can not be soldered.
- Aluminium in harder then tin. It is light, soft strong, durable and has low thermal conductivity but is a good conductor of electricity.

End of Solution

Q.97 Which one of the following limes is the quick-lime coming out of kilns?
(a) Lump lime   (b) Fat lime
(c) Hydraulic lime   (d) Hydrated lime

Ans. **(a)**
- Lump lime is the quick lime coming out of the kilin.
- Fat time manufactured by burning marble, chalks pure lime stone, sea shell, coral etc. and has high CaO component.
- Hydraulic lime produced from carboniferous lime stone and magnesian lime stone.
- Hydrated lime, when quick lime finely crushed and scaled with minimum amount of water and then ground to form a fine homogeneous powder.

End of Solution

Q.98 Which one of the following is generally recommended for small jobs only?
(a) Volume batching   (b) Weigh batching
(c) Machine mixing   (d) Non-tilting mixer

Ans. **(a)**
- Volume batching is recommended for small job only but for important works weigh batching used.
- Hand mixing is recommended for small jobs.

End of Solution

Q.99 Consider the following statements regarding the transit mixer:
1. Their function is mainly to keep the mix in an agitated condition.
2. These mixers in addition to the outer spirals have four inner spirals.
3. A number of special nozzles provided on the lower side of inner mixing spirals, precisely and uniformly spray water on the mix under pressure along the entire length of the drum.
Which of the above statements are correct?
(a) 1 and 2 only   (b) 2 and 3 only
(c) 1 and 3 only   (d) 1, 2 and 3

Ans. **(c)**
- These are truck mounted mixer keep mix in agitated condition.
- These mixer in addition to outer spiral have two opposed inner spiral. The outer spiral convey the mix material toward bottom of drum while opposed mixing spiral push the mix towards feed opening.
- Spray nozzles results in through mixing of entire drum content within short time.

End of Solution

Q.100 In the acceptance criteria for concrete in accordance with IS 456 : 2000, the variation in strength of individual specimen should not be more than
(a) ±30% of the average   (b) ±25% of the average
(c) ±15% of the average   (d) ±20% of the average

Ans. **(c)**

Clause 15.4 IS 456 : 2000, the test result of sample shall be average of strength of three specimen. The individual variation should not be more than ±15% of the average.

End of Solution

Q.101 Which one of the following is NOT required for concrete mix design?
(a) Maximum free water-cement ratio by weight
(b) Degree of workability of concrete
(c) Initial setting time of cement
(d) Maximum /minimum cement content

Ans. **(c)**

Design mix requirements are as follows:
- Grade of concrete
- Type of cement
- Type and size of aggregate
- Nominal maximum size aggregate
- Type of mixing and curing water
- Maximum free water cement ratio by weight
- Degree of workability
- Maximum/minimum cement content
- Air content
- Type of admixture
- Maximum/minimum density of concrete and temperature of fresh concrete

End of Solution

Q.102 Which one of the following statements is NOT correct in respect of wet process of manufacturing of cement?
(a) It requires longer kilns
(b) It produces more homogenous mix
(c) It is less responsive to a variable clinker demand
(d) It is high cost of excavating and grinding raw materials

Ans. **(d)**

The chief advantage of wet process is the low cost of excavation and grinding raw material, homogeneity of slurry, economical utilisation of fuel.
On the other hand the longer klin, less responsive to a variable clinker demand then short klin which can be used in dry process.

End of Solution

Q.103 The compaction factor test of cement concrete is performed to determine its
(a) porosity   (b) percentage voids
(c) strength   (d) workability

Ans. **(d)**

Slump test, compaction factor test, Vee-bee test, flow table test etc are workability test of concrete.

End of Solution

Q.104 Which one of the following is obtained by burning kankar or clayey lime-stones?
(a) Hydraulic lime
(b) Quick lime
(c) Fat lime
(d) White lime

Ans. **(a)**

Hydraulic lime obtained by burning kankar and lime stone contains 5-30% clay (small portion of clay).

End of Solution

Q.105 Slaked fat lime is used to prepare mortar for
(a) plastering
(b) masonry construction
(c) pointing
(d) reinforced brickwork

Ans. **(a)**

Fat lime (Class-C) used for finishing coat in plastering, white washing and with pozzolana in mortar.

For masonry mortar semi-hydraulic lime, kankar lime can be used.

End of Solution

Q.106 Consider the following statements regarding the slabs:
1. When the longer span to shorter span ratio is greater than or equal to two, it is a two-way slab.
2. In one-way slab, the load transfer is chiefly by bending in the shorter direction.
3. In two-way slabs, the load transferred by bending in both orthogonal directions.
Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 3 only
(c) 2 and 3 only
(d) 1 and 3 only

Ans. **(c)**

If $\dfrac{L_y}{L_x} \geq 2$, it is one way slab.

End of Solution

Q.107 Which one of the following statements is NOT correct in reinforced concrete design?
(a) In the cracked section, concrete below the neutral axis is neglected in calculations
(b) When section is subjected to external loading, resisting moment is developed due to compression in concrete and tension in steel
(c) In the cracked section, the steel area below the neutral axis is converted into equivalent concrete area
(d) The neutral axis depth does not depend on the modular ratio

Ans. (d)

Neutral axis depends on modular ratio as follows:

$$\frac{B \cdot x_a^2}{2} = m \cdot A_{st}(d - x_a)$$

Q.108 A concrete beam is post-tensioned by a cable carrying an initial stress of 1000 N/mm². The slip at the jacking end was observed to be 5 mm. The modulus of elasticity of steel is 210 kN/mm². What is the percentage loss of stress due to anchorage slip if the length of the beam is 30 m?

    (a) 3.5%
    (b) 35%
    (c) 0.35%
    (d) 30.5%

Ans. (a)

Loss due to anchorage slip

$$\frac{dL}{L} \times E_s = \frac{5}{30000} \times 210 \times 1000 = 35 \text{ N/mm}^2$$

$$\text{Percentage loss} = \frac{35}{1000} \times 100 = 3.5\%$$

Q.109 The Indian Standard (IS) code used for design of prestressed concrete is

    (a) IS 4326 : 2013
    (b) IS 3920 : 2012
    (c) IS 6512 : 2013
    (d) IS 1343 : 2012

Ans. (d)

Q.110 Which one of the following statements is NOT correct related to the earthquake resistant design?

    (a) Overall depth of a beam should not be greater than one-fourth of the clear span
    (b) The percentage tensile reinforcement should not exceed 2.5
    (c) The reinforcement resisting positive moments at a joint face must be less than half the negative moment reinforcement
    (d) The width to depth ratio should be more than 0.30 to avoid lateral instability

Ans. (c)

Refer IS: 13920

    (a) Clause 6.1.4 the depth D of the member shall preferably be not more than 1/4 of the clear span.
    (b) Clause 6.2.2 the maximum steel ratio on any face at any section, shall not exceed $\rho_{max} = 0.025$.

(c) Clause 6.2.3 the positive steel at a joint face must be at least equal to half the negative steel at that face.

(d) Clause 6.1.2 the member shall preferably have a width-to-depth ratio of more than 0.3.

End of Solution

Q.111 Consider the following statements related to isolation concepts in earthquake resistant design:

1. Development of shock-isolation concepts are generally applied to earthquake resistant structures.

2. The shock-isolation concept is a radical departure from current seismic design practice.

3. The successful implementation of shock-isolation concept will ensure the simplification in the design of tall reinforced concrete structures.

Which of the above statements are correct?

(a) 1 and 2 only   (b) 2 and 3 only

(c) 1 and 3 only   (d) 1, 2 and 3

Ans. **(b)**

- Base isolation are not used generally in all buildings it is use in few building only.
- Base isolation will not allow the transfer of vibration in building structure during earthquake.

End of Solution

Q.112 Dozer primarily is

(a) a pushing unit   (b) a lifting unit

(c) a digging unit   (d) a pulling unit

Ans. **(a)**

Dozers are primarily used a pushing purposes.

End of Solution

Q.113 The process of breaking a major project into its major and sub systems and discrete activities which can be identified easily is called

(a) Line of balance technique

(b) Work break system

(c) Milestone chart technique

(d) PERT technique

Ans. **(b)**

End of Solution

Q.114 Which one of the following statements is NOT correct in respect of stages of construction?
(a) Conceptual stage is before study and evaluation
(b) Construction stage is after tendering stage
(c) Design stage is after tendering stage
(d) Study and evaluation stage is before design stage

Ans. **(c)**

Q.115 In a construction project, generally 50% of total project cost is attributed to
(a) Equipment cost only
(b) Material cost only
(c) Manpower cost only
(d) Material plus equipment cost

Ans. **(b)**

Q.116 Consider the following statements regarding the advantages of planning to the contractor:
  1. The program provides a standard, by which actual work can be measured.
  2. The program provides a pre-conceived plan for the whole job as well as for various stages of the work.
  Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

Ans. **(c)**

Q.117 Arrange the stages of construction of highway projects in correct sequence:
  1. Cleaning site of work or construction
  2. Construction of drainage work such as culvert etc.
  3. Earth work
  4. Construction of road and its shoulders
  Select the correct answer using the code given below:
(a) 1, 2, 3, 4
(b) 1, 3, 2, 4
(c) 2, 1, 4, 3
(d) 3, 4, 1, 2

Ans. **(a)**

Q.118 Return on Investment method is useful for
(a) Economic analysis of project
(b) Ecological analysis of project
(c) Financial analysis of project
(d) Commercial analysis of project

Ans. **(c)**
    Return on investment is a useful method for financial analysis of a project.

Q.119 To measure the performance of project against established target and identify deviation from the target are part of which one of the following management functions?
(a) Planning
(b) Directing
(c) Coordinating
(d) Controlling

Ans. **(d)**

Controlling is more essential where we require less deviation in project.

Q.120 In bar chart, the length of bar shows
(a) materials required for large scale projects
(b) time required to complete that activity
(c) interdependencies of project
(d) critical activities of the project

Ans. **(b)**

Length of bar represent activity completion time whereas width of bar has no significance.

Q.121 What is the effective length of a steel prismatic compression member for which, the translation and rotation are restricted at both the ends?
(a) 0.80 L
(b) 1.00 L
(c) 1.20 L
(d) 0.65 L

Ans. **(d)**

$\Delta = 0, \theta = 0$

$L_e = 0.65\,L$

$\Delta = 0, \theta = 0$
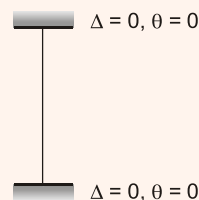
Q.122 By considering the net area as A_n, ultimate stress as f_u and the partial safety factor as γ_{ml}, the IS code formula for preliminary design of a tension member for design strength due to rupture (T_{dn}) of the critical section is

(a) $T_{dn} = \dfrac{\alpha A_n f_u}{2\gamma_{ml}}$

(b) $T_{dn} = \dfrac{A_n f_u}{\alpha\gamma_{ml}}$

(c) $T_{dn} = \dfrac{\gamma_{ml} A_n f_u}{\alpha}$

(d) $T_{dn} = \dfrac{\alpha A_n f_u}{\gamma_{ml}}$

Ans. **(d)**

$$T_{dn} = \frac{\alpha A_n f_u}{\gamma_{ml}}$$

α = 0.8 for welded section and section having more than 6 bolts.

Q.123 Consider the following statements regarding the classification of beams:
    1. Floor beams are often referred to as girders.
    2. Joist is a beam supporting floor construction but not a major beam.
    3. Rafter is a roof beam, usually supported by roof truss.
    Which of the above statements are correct?
    (a) 1 and 2 only   (b) 1 and 3 only
   (c) 2 and 3 only   (d) 1, 2 and 3

Ans. (a)
- Girders are major load carrying beams and minor beams over girders are joists.
- Beam over roof truss is purlin and beams resting on purlins are called rafter.

End of Solution

Q.124 A simply supported steel beam of 8 m long and subjected to a uniformly distributed load of 10 kN/m. What is the maximum bending stress (f_b) of the member at a distance of 50 mm from the neutral axis? (Take $I = 10 \times 10^5$ mm^4)
    (a) 400 N/mm^2 (b) 4000 N/mm^2
    (c) 800 N/mm^2 (d) 8000 N/mm^2

Ans. (b)
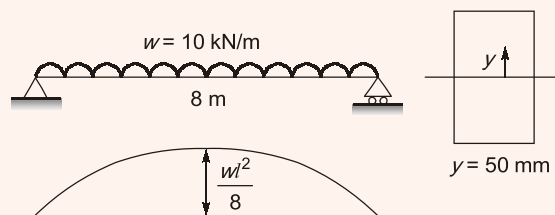
$$\sigma = \frac{M_{max}Y}{1} = \frac{\left(\frac{10 \times 8^2}{8}\right) \times 10^6}{10 \times 10^5} \times 50 = 4000 \text{ N/mm}^2$$

End of Solution

Q.125 Arrange the following steps involved in the design of beam-columns in a correct sequence:
    1. Determine the factored loads and moments acting on the beam-column using a first-order elastic analysis.
    2. Choose an initial section and calculate the necessary section properties.
    3. Classify the cross-section as per the IS code.
    4. Find out the bending strength of the cross-section about the major and minor axis of the member.
    Select the correct answer using the code given below:
    (a) 2, 3, 1, 4   (b) 3, 1, 2, 4
    (c) 1, 2, 3, 4   (d) 4, 3, 2, 1

Ans. (c)

End of Solution

Q.126 What is the approximate value of the tensile strength governed by yielding of the cross-section of a roof truss diagonal $100 \times 75 \times 6$ mm ($f_y = 250$ MPa) connected to the gusset plate by 4 mm welds as shown in figure? (Take partial safety factor as 1.10)
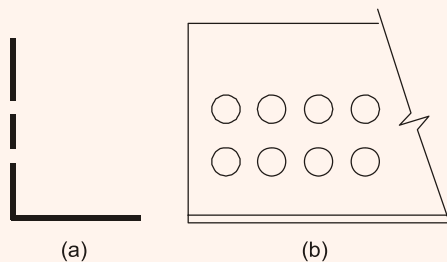

4 mm weld, 140 mm long

100

$A_g = 1010$ mm^2

75

Weld 310 mm long
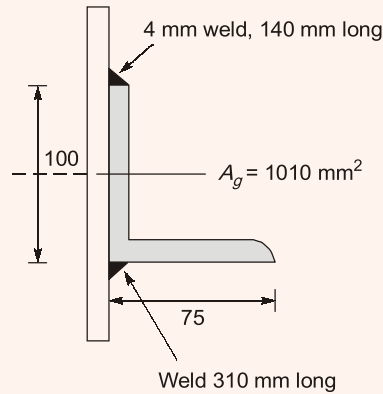
(a) 230 kN (b) 23 kN
(c) 320 kN (d) 32 kN

Ans. **(a)**

$$T_{dg} = \frac{A_g f_y}{\gamma_{m0}} = \frac{(100 + 75 - 6) \times 6 \times 250}{1.1} = 230 \text{ kN}$$

End of Solution

Q.127 A tension member is made up of a single angle 200 mm $\times$ 150 mm $\times$ 15 mm with a gross area of 30 cm^2. Two rows of 18 mm diameter bolts (take hole diameter = 20 mm) are used (as shown in figure (a) and (b)). What is the net area?


(a)   (b)

(a) 2460 mm^2 (b) 2500 mm^2
(c) 2400 mm^2 (d) 2560 mm^2

Ans. **(c)**

$A_n = A_g$ – Bolt hole area   (A_g = Gross area of connected leg)
    $= 3000 - (2 \times 20 \times 15)$
    $= 2400$ mm^2

End of Solution

Q.128 In a plate girder subjected to a bending moment of 200 kNm, the width and thickness of flange are 200 mm and 10 mm respectively. What is the economical depth of the girder by assuming the moment is resisted by the flange only? (Take f_y = 250 MPa)

(a) 800 mm   (b) 400 mm

(c) 500 mm   (d) 700 mm

Ans. **(b)**
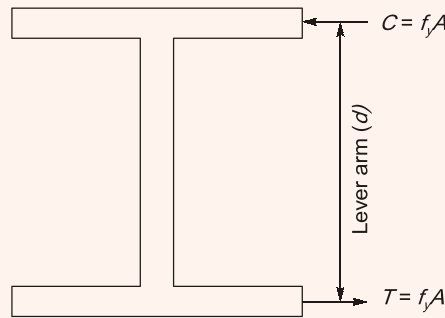
M = 200 kNm, b_F = 200 mm, t_F = 10 mm, f_y = 250 MPa

$$M = C \times \text{Lever arm} = T \times \text{Lever arm}$$

$$M = f_y\, b_F t_F \times d_1$$

$$d = \frac{M}{f_y b_F t_F} = \frac{200 \times 10^6}{250 \times 200 \times 10} = 400 \text{ mm}$$

End of Solution

Q.129 Which one of the following statements is NOT correct regarding gross section yielding?

(a) Generally, a tension member without bolt holes can resist loads up to the ultimate load without failure

(b) A tension member when subjected to an ultimate load will deform considerably in the longitudinal direction

(c) A structure becomes more serviceable under the large deformation

(d) The IS code limits design strength by substituting a partial safety factor of 1.10 for failure in tension

Ans. **(c)**

Under large deformation a structure cannot be serviceable.

End of Solution

Directions for the following five (05) items: Read the following information and answer the **five** items that follow:

A singly reinforced concrete beam with an effective span of 4 m has a rectangular cross section with a width of 300 mm and an overall depth of 550 mm. The beam is reinforced with steel of Fe-415 grade of area 250 mm² at an effective depth of 500 mm. The self-weight with dead load of the beam is 4 kN/m. Consider M-15 grade concrete and σ_{cbc} = 5 MPa; σ_{st} = 230 MPa.

Q.130 What is the bending moment due to dead load?

(a) 8000 Nm
(b) 80 kNm
(c) 32 kNm
(d) 3200 Nm

Ans. **(a)**

L_{eff} = 4 m

d = 500 mm   D = 550 mm

Fe415

B = 300 mm
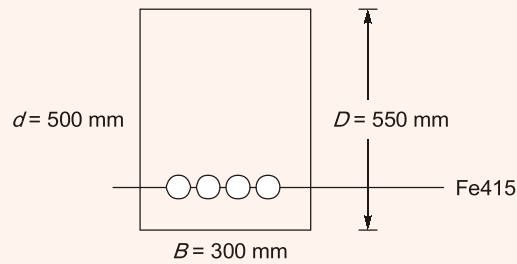
A_{st} = 250 mm²

w_d = 4 kN/m

M-15:

σ_{cbc} = 5 N/mm²

σ_{st} = 230 N/mm²

Bending moment due to DL

$$= \frac{w_d \cdot L_e^2}{8} \text{ (Assuming simply supported)}$$

$$= \frac{4 \times 4^2}{8} = 8 \text{ kN-m} = 8000 \text{ N-m}$$

End of Solution

Q.131 What is the modular ratio?

(a) $\dfrac{28}{3}$
(b) $\dfrac{40}{3}$

(c) $\dfrac{56}{3}$
(d) $\dfrac{86}{3}$

Ans. **(c)**

Modular ratio: $m = \dfrac{280}{3 \cdot \sigma_{cbc}} = \dfrac{280}{3 \times 5} = \dfrac{56}{3}$

End of Solution

Q.132 What is the depth of critical neutral axis?

(a) 134.33 mm
(b) 124.33 mm
(c) 154.33 mm
(d) 144.33 mm

Ans. (d)

Depth of critical neutral axis

$$x_c = \frac{mc}{t+mc} \times d = \frac{\frac{56}{3} \times 5}{\left(230 + \frac{56}{3} \times 5\right)} \times 500 = 144.33 \text{ mm}$$

End of Solution

Q.133 What is the moment of resistance of the section if the actual depth of neutral axis is 100 mm?

(a) 36.83 kNm   (b) 26.83 kNm

(c) 16.83 kNm   (d) 46.83 kNm

Ans. (b)

$$x_a < x_c$$

Under reinforcement section

$$c_a < \sigma_{cbc}$$
$$t_a = \sigma_{st}$$

For under reinforcement section MR can be found from tension side directly

If actual depth of NA = 100 mm

$$\text{MR} = B \cdot x_a \cdot \frac{c_a}{2} \cdot \left(d - \frac{x_a}{3}\right)$$

$$= t_a \times A_{st} \cdot \left(d - \frac{x_a}{3}\right)$$

$$= 230 \times 250 \times \frac{\left(500 - \frac{100}{3}\right)}{1000000} = 26.833 \text{ kN-m}$$

End of Solution

Q.134 What is the permissible live load on the beam?

(a) 13.43 kN/m   (b) 9.43 kN/m

(c) 8.43 kN/m   (d) 6.43 kN/m

Ans. (b)

Permissible live load on beam:

$$\text{BM} = \text{MR} = 26.83 = \frac{w_{total}l_e^2}{8}$$

$$w_{total} = \frac{26.83 \times 8}{4^2} = 13.417 = w_d + w_L$$

$$w_L = \text{Live load}$$
$$= 13.42 - 4.0$$
$$= 9.42 \text{ kN/m}$$

End of Solution

Q.135 A section is said to be under-reinforced when
  (a) the depth of actual neutral axis is greater than the depth of critical neutral axis
  (b) the depth of actual neutral axis is less than the depth of critical neutral axis
  (c) the depth of actual neutral axis is equal to the depth of critical neutral axis
  (d) it is not related to the depth of neutral axis

Ans. **(b)**

  When $x_a < x_c$
 • It is called under-reinforced section.

End of Solution

Q.136 Which one of the following statements is NOT correct regarding the relationships between bending moment, shear force and applied load?
  (a) The rate of change of shear force along a beam is equal to the distributed load
  (b) The rate of change of bending moment along a beam is equal to the shear force
  (c) The rate of change of bending moment along a beam is equal to the distributed load
  (d) The shear force and bending moment at free end is always zero

Ans. **(c)**

  The rate of change of bending moment along a beam is equal to the shear force (not distributed load).

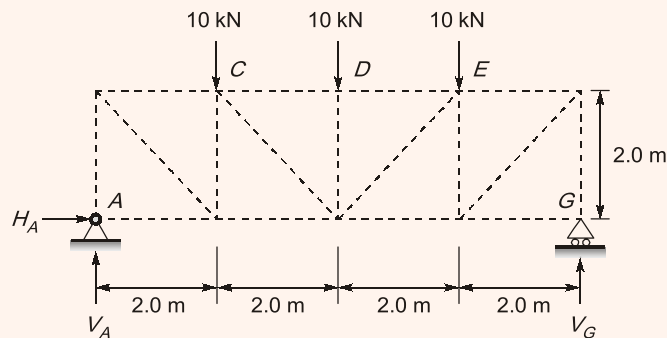*End of Solution*

Q.137 What is the support reaction V_G from the following figure?
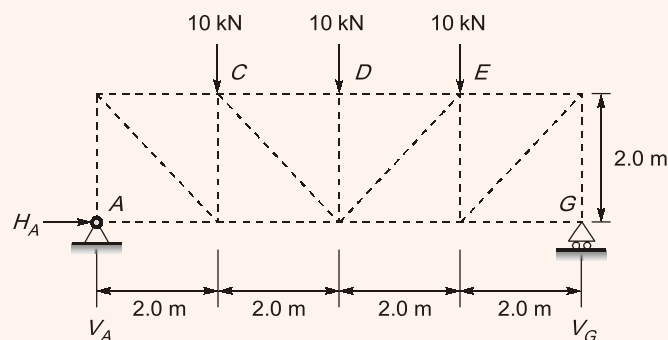
  (a) 15 kN (upward)   (b) 20 kN (upward)
  (c) 15 kN (downward)   (d) 20 kN (downward)

Ans. (a)

$$\Sigma M_A = 0$$

$$\Rightarrow \quad -V_G \times 8 + 10 \times 2 + 10 \times 4 + 10 \times 8 = 0$$

$$\therefore \quad V_G = \frac{20 + 40 + 60}{8} = 15 \text{ kN (upward)}$$

Alternatively

Due to symmetry,

$$V_A = V_Q = \frac{30}{2} = 15 \text{ kN}$$

End of Solution

Q.138 Consider the following assumptions for pure bending theory:
1. The material is heterogeneous and isotropic.
2. The stress is purely longitudinal and local effects near concentrated loads will be neglected.
3. The radius of curvature is large compared with the dimensions of the cross-section.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (b)

The material is homogeneous and isotropic.

End of Solution

Q.139 For a fixed-connected collar type of support connection in coplanar structures, the number of unknown(s) is/are
(a) three and the reactions are two, forces and a moment component
(b) one and the reaction is a moment component
(c) two and the reactions are two forces (one horizontal and one vertical)
(d) two and the reactions are a force and a moment

Ans. (d)
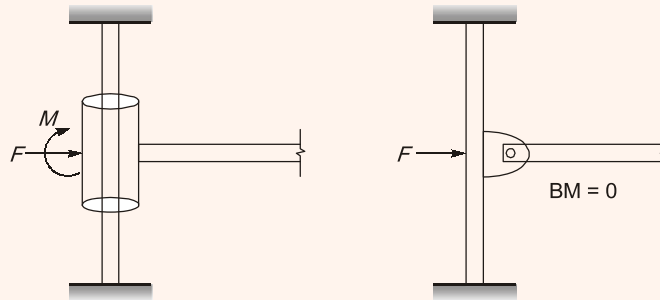
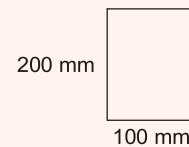∴ Two reactions i.e. one force and one moment.

End of Solution

Q.140 For a rectangular beam of 4 m long with 100 mm wide and 200 mm deep, it carries a shear force of 100 kN. What is the maximum shear stress (τ_{max}) due to the bending of rectangular section

(a) 2.5 N/mm²   (b) 5 N/mm²

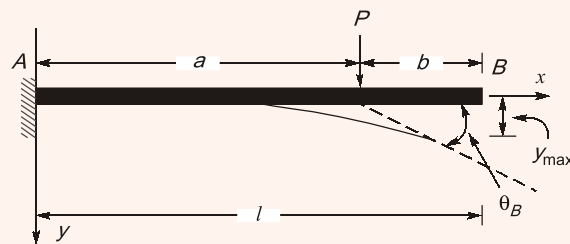(c) 7.5 N/mm²   (d) 10 N/mm²

Ans. (c)

$$\tau_{max} = \frac{3}{2}\tau_{avg}$$

$$= \frac{3}{2}\left[\frac{100\times10^3}{200\times100}\right] = 7.5 \text{ MPa}$$

End of Solution

Q.141 What is the maximum deflection (y_{max}) for a cantilever beam of span *l* subjected to a point load acting at a distance *a* from the fixed end as shown in figure? (Take Young's modulus as *E* and moment of inertia of beam section as *I*)
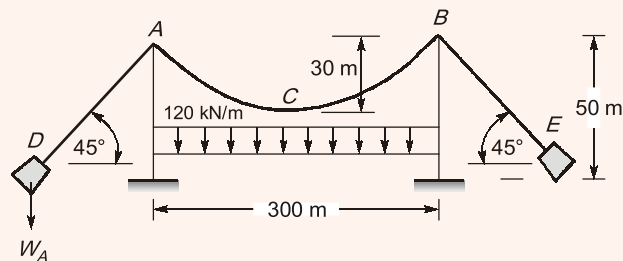

(a) $y_{max} = \dfrac{Pa^2}{6EI}(3l-a)$ (b) $y_{max} = \dfrac{Pa^2}{3EI}(3l-a)$

(c) $y_{max} = \dfrac{3Pa^2}{2EI}(3l-a)$ (d) $y_{max} = \dfrac{Pa^2}{2EI}(3l-a)$

Ans. (a)

$$\Delta = \frac{Pa^3}{3EI} + \frac{Pa^2}{2EI} \times b = \frac{Pa^2}{EI}\left[\frac{a}{3} + \frac{b}{2}\right]$$

$$= \frac{Pa^2}{EI}\left[\frac{a}{3} + \frac{l-a}{2}\right] = \frac{Pa^2}{EI}\left[\frac{2a + 3l - 3a}{6}\right]$$

$$= \frac{Pa^2}{EI}\left[\frac{3l-a}{6}\right] = \frac{Pa^2}{6EI}[3l-a]$$
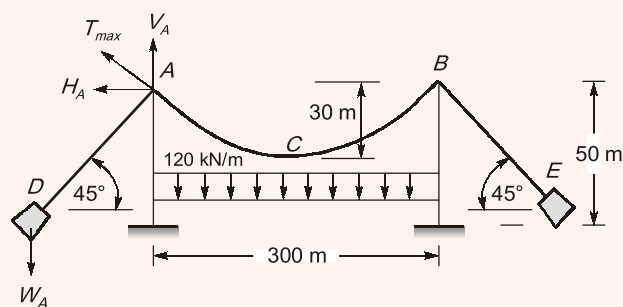
End of Solution

Q.142 What is the maximum tension (approximately) in the cable as shown in figure, if it carries a uniform horizontally distributed load of intensity 120 kN/m?

(a) 48.5 kN (b) 48.5 MN
(c) 485 kN (d) 4850 N

Ans. (b)

$$H_A = \frac{wl^2}{8h} = \frac{120 \times 300^2}{8 \times 300} = 45000 \text{ kN}$$

$$V_A = \frac{wl^2}{2} = \frac{120 \times 300}{20} = 18000 \text{ kN}$$

$$T_{max} = \sqrt{H_A^2 + V_A^2}$$

$$= \sqrt{(45000)^2 + (18000)^2}$$
$$= 48466.48 \text{ kN}$$
$$= 48.5 \text{ MN}$$

End of Solution

Q.143 Consider the following statements:
1. For a given load, the deflection of an indeterminate structure is smaller than that of determinate structure.
2. For a given load, the maximum stress of an indeterminate structure is higher than that of determinate structure.
3. For a given load, the maximum stress of an indeterminate structure is smaller than that of determinate structure.

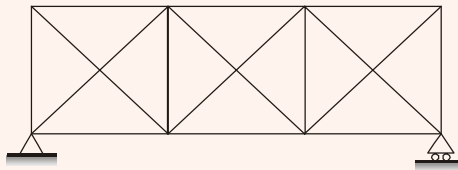Which of the above statements is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 3 only

Ans. **(c)**

Stress and deflection in indeterminate structure is smaller then determinate structure.

End of Solution

Q.144 What is the degree of kinematic indeterminacy of the truss as shown in figure?

(a) 10
(b) 11
(c) 12
(d) 13

Ans. **(d)**

$$D_k = 2j - r_e - m$$
$$= 2 \times 8 - 3 = 0$$
$$= 13$$

End of Solution

Q.145 Which one of the following statements is NOT correct?
(a) The influence lines are constructed for establishing the maximum design forces at critical sections produced by moving loads.
(b) As a moving load passes over a structure, the internal forces at each point in the structure do not vary.
(c) To ensure the safety of a structure, the capacity of section should be greater than or equal to all the combination of loads.
(d) The maximum deflection occurs at the centre of a simply supported beam, when a concentrated load applied at the mid-span.

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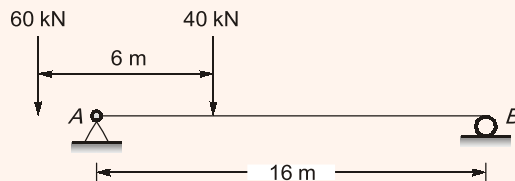
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Ans. **(b)**

Internal force may vary in magnitude as well as direction when a moving load passes over a structure.
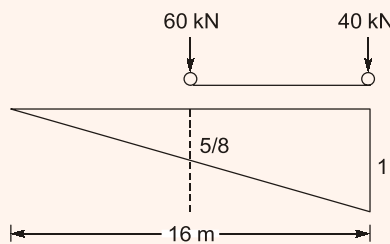
End of Solution

Q.146 Two loads of 40 kN and 60 kN are moving towards support *B* as shown in figure. What is the maximum negative shear force at *B*?

(a) −77.5 kN   (b) −7.75 kN
(c) −37.5 kN   (d) −3.75 kN

Ans. **(a)**

$$S.F.|_{max} = 60 \times \frac{5}{8} + 40 \times 1$$

$$= -77.5 \text{ kN}$$

End of Solution

Q.147 Consider the following statements related to the uses of computer programs in the structural analysis:
1. To analyze a truss with rigid joints would be a lengthy computation by the classical methods of analysis.
2. The rigid joints (in truss analysis) are assumed to be pinned joints by the designers to simplify the problem.
3. The computer programs enable to consider the real situation (rigid joints) and also give the accurate results in a quick time.

Which of the above statements are correct?
(a) 1 and 2 only   (b) 2 and 3 only
(c) 1 and 3 only   (d) 1, 2 and 3

Ans. **(d)**

End of Solution

Q.148 If the load is transmitted by bolts or rivets through some but not all the cross-sectional elements of the member, the effective area A_e is computed by using net area A_n and the reduction coefficient U as

(a) $A_e = U\,A_n$

(b) $A_e = \dfrac{A_n}{U}$

(c) $A_e = 0.87U\,A_n$

(d) $A_e = 0.66U\,A_n$

Ans. **(a)**

For calculating the effective area, the reduction coefficient is applied to the net area for accounting the shear lag.
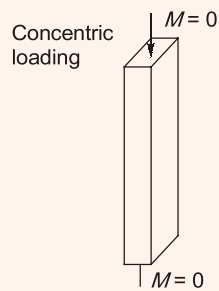
$\therefore$ $A_e = UA_n$

End of Solution

Q.149 If the net end moments of a compression member are zero then such member is called

(a) beam column

(b) axially loaded column

(c) a truss

(d) a girder

Ans. **(b)**

End of Solution

Q.150 Consider the following factors that affect the behavior of a column under a compression load:

1. The stress-strain properties remain constant throughout the section.
2. The column may not be perfectly straight as the load is applied to it.
3. End conditions may vary from case to case.

Which of the above statements are being ignored in the Euler approach?

(a) 1 and 2 only

(b) 1 and 3 only

(c) 2 and 3 only

(d) 1, 2 and 3

Ans. **(a)**

$$P_{Euler} = \frac{\pi^2 EI}{\left(l_{eff}\right)^2}$$

l_{eff} various with different end conditions.

End of Solution

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