Sample Paper

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CE: Civil Engineering

Q.No. 1 A runway is being constructed in a new airport as per the International Civil Aviation Organization (ICAO) recommendations. The elevation and the airport reference temperature of this airport are 535 m above the mean sea level and 22.65°C. respectively. Consider the effective gradient of the runway as 1%. The length of runway required for a design-aircraft under the standard conditions is 2000 m. Within the framework of applying sequential corrections as per the ICAO recommendations, the length of nmway corrected for the temperature is

(A) 2223 m

(B) 2250 m

(C) 2500 m

(D) 2750 m

Answer: (C)

Q.No. 2 Group I gives a list of test methods and test apparatus for evaluating some of the properties of Ordinary Portland Cement (OPC) and concrete. Group II gives the list of these properties.

Group I	Group II
P. Le Chatelier test	1. Soundness of OPC
Q. Vee-Bee test	2. Consistency and setting time of OPC
R. Blaine air permeability test	3. Consistency or workability of concrete
S. The Vicat apparatus	4. Fineness of OPC

The correct match of the items in Group I with the items in Group II is

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

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

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

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

Answer: (A)

Q.No. 3 Following are the statements related to the stress paths in a triaxial testing of soils: P. If $\sigma 1 = \sigma 3$, the stress point lies at the origin of the p-q plot. Q. If $\sigma 1 = \sigma 3$, the stress point lies on the p-axis of the p-q plot. R. If $\sigma 1 = \sigma 3$, both the stress points p and q are positive. For the above statements, the correct combination is

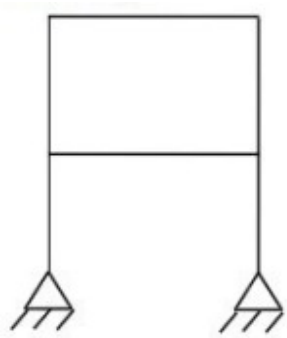
(A) P-False; Q-True; R-True

(B) P-True; Q-False; R-True

(C) P-False; Q-True; R-False

(D) P-True; Q-False; R-False

Answer: (A)



Q.No. 4 Consider the frame shown in the figure: If the axial and shear deformations in different members of the frame are assumed to be negligible, the reduction in the degree of kinematical indeterminacy would be equal to

(A) 5

(B) 6

(C) 7

(D) 8

Answer: (B)

Q.No. 5 The Los Angeles test for stone aggregates is used to examine

(A) abrasion resistance

(B) crushing strength

(C) soundness

(D) specific gravity

Answer: (A)

Q.No. 6 A camera with a focal length of 20 cm fitted in an aircraft is used for taking vertical aerial photographs of a terrain. The average elevation of the terrain is 1200 m above mean sea level (MSL). What is the height above MSL at which an aircraft must fly in order to get the aerial photographs at a scale of 1:8000?

(A) 2600 m

(B) 2800 m

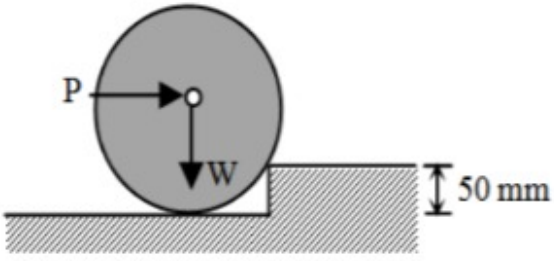
(C) 3000 m

(D) 3200 m

Answer: (B)

Q.No. 7 A cylinder of radius 250 mm and weight, W = 10 kN is rolled up an obstacle of height 50 mm by applying a horizontal force P at its centre as shown in the figure.

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All interfaces are assumed frictionless. The minimum value of P is

(A) 4.5 kN

(B) 5.0 kN

(C) 6.0 kN

(D) 7.5 kN

Answer: (D)

Q.No. 8 The solution of the equation $x\frac{dy}{dx} + y = 0$ passing through the point (1,1) is

(A) x

(B) x2

(C) x -1

(D) x -2

Answer: (C)

Q.No. 9 Alkalinity of water, in equivalent/litre (eq/litre), is given by $\{HCO_3^-\} + 2\{CO_3^{2-}\} + \{OH^-\} - \{H^+\}$ Where, { } represents concentration in mol/litre. For a water sample, the concentrations of $HC0_3$-= 2 x 10_{-3} mol/litre,$C0_3^{2-}$ = 3.04 x 10_{-4} mol/litre and the pH of water = 9.0. The atomic weights are: Ca = 40; C = 12; and O = 16. If the concentration of OH^- and H^+ are NEGLECTED, the alkalinity of the water sample (in mg/litre as $CaC0^3$), is

(A) 130.4

(B) 100.0

(C) 50.0

(D) 65.2

Answer: (A)

Q.No. 10 What is curl of the vector field $2x^2y\mathbf{i} + 5z^2\mathbf{j} - 4yz\mathbf{k}$?

(A) $6z\mathbf{i} + 4x\mathbf{j} - 2x^2\mathbf{k}$

(B) $6z\mathbf{i} - 8xy\mathbf{j} + 2x^2y\mathbf{k}$

(C) $-14z\mathbf{i} + 6y\mathbf{j} + 2x^2\mathbf{k}$

(D) $-14z\mathbf{i} - 2x^2\mathbf{k}$

Answer: (D)

Q.No. 11 As per IS 456:2000, the pH value of water for concrete mix shall NOT be less than

(A) 4.5

(B) 5.0

(C) 5.5

(D) 6.0

Answer: (D)

Q.No. 12 The value of $\lim_{x\to\infty} \frac{\sqrt{9x^2+2020}}{x+7}$ is

(A) 7/9

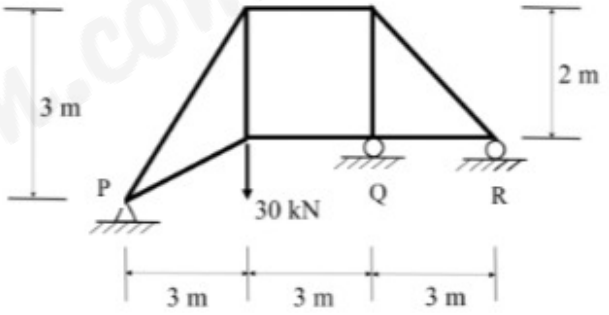
(B) 1

(C) 3

(D) indeterminable

Answer: (C)

Q.No. 13 Consider the pin-jointed plane truss shown in the figure (not drawn to scale). Let R_P, R_Q, and R_R denote the vertical reactions (upward positive) applied by the supports at P, Q, and R, respectively, on the truss.



The correct combination of R_P, R_Q, R_R is represented by

(A) (30, -30, 30) kN

(B) (20, 0, 10) kN

(C) (10, 30, -10) kN

(D) (0, 60, -30) kN

Answer: (A)

Q.No. 14 The value of the function f(x) is given at n distinct values of x and its value is to be interpolated at the point x*, using all the n points. The estimate is obtained first by the Lagrange polynomial, denoted by IL, and then by the Newton polynomial, denoted by IN. Which one of the following statements is correct?

(A) I_L is always greater than I_n

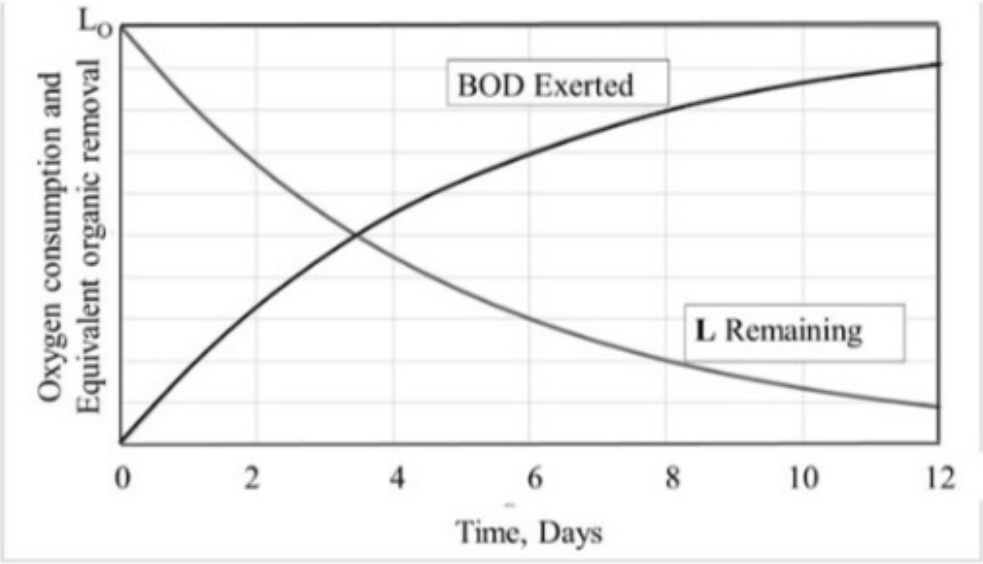
(B) I_L and I_n are always equal

(C) I_L is always less than I_N

(D) No definite relation exists between I_L and I_N

Answer: (B)

Q.No. 15 The relationship between oxygen consumption and equivalent biodegradable organic removal (i.e., BOD) in a closed container with respect to time is shown in the figure Assume that the rate of oxygen consumption is directly proportional to the amount of degradable organic matter and is expressed as, $\frac{dL_t}{dt} = -kL_t$ where, L_t, (in mg/litre) is the oxygen equivalent of the organics remaining at time t and k (in d^{-1}) is the degradation rate constant. L_0 is the oxygen equivalent of organic matter at time, t = 0. In the above context, the correct expression is



(A) $BOD_5 = L_5$

(B) $BOD_t = L_0 - L_t$

(C) $L_0 = L_t e^{kt}$

(D) $L_t (1- e^{kt})$

Answer: (B)

Q.No. 16 Which one of the following matrices is singular?

(A) $\begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$

(B) $\begin{bmatrix} 3 & 2 \\ 2 & 3 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & 4 \\ 3 & 6 \end{bmatrix}$

(D) $\begin{bmatrix} 4 & 3 \\ 6 & 2 \end{bmatrix}$

Answer: (C)

Q.No. 17 An elastic bar of length L. uniform cross sectional area A. coefficient of thermal expansion α, and Young's modulus E is fixed at the two ends. The temperature of the bar is increased by T. resulting in an axial stress σ. Keeping all other parameters unchanged. if the length of the bar is doubled the axial stress would be

(A) σ

(B) 2 σ

(C) 0.5 σ

(D) 0.25 α σ

Answer: (A)

Q.No. 18 Which one of the following is NOT a correct statement?

(A) The function $x\sqrt{x}$, (x>0), has the global maxima at $x = e$

(B) The function $x\sqrt{x}$, (x>0), has the global minima at $x = e$

(C) The function x^3 has neither global minima nor global maxima

(D) The function $|x|$ has the global minima at $x = 0$

Answer: (B)

Q.No. 19 The ratio of the plastic moment capacity of a beam section to its yield moment capacity is termed as

(A) aspect ratio

(B) load factor

(C) shape factor

(D) slenderness ratio

Answer: (C)

Q.No. 20 Dupuit's assumptions are valid for

(A) artesian aquifer

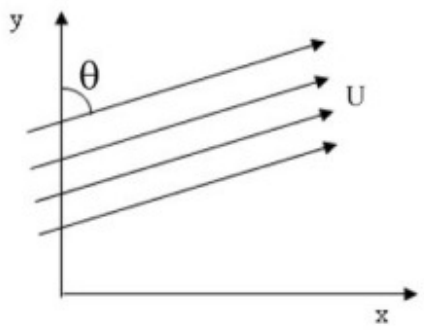
(B) confined aquifer

(C) leaky aquifer

(D) unconfined aquifer

Answer: (D)

Q.No. 21 Uniform flow with velocity U makes an angle θ with the y-axis, as shown in the figure



The velocity potential (Φ), is

(A) ±U(xsinθ + ycosθ)

(B) ±U(ysinθ - xcosθ)

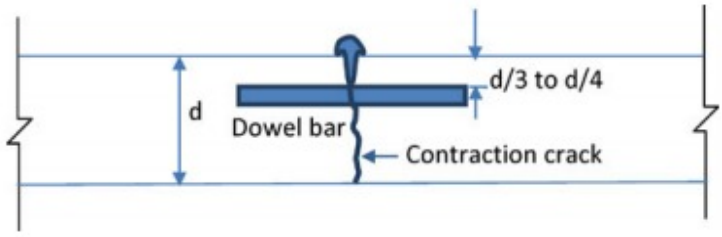
(C) ±U(xsinθ - ycosθ)

(D) ±U(ysinθ + xcosθ)

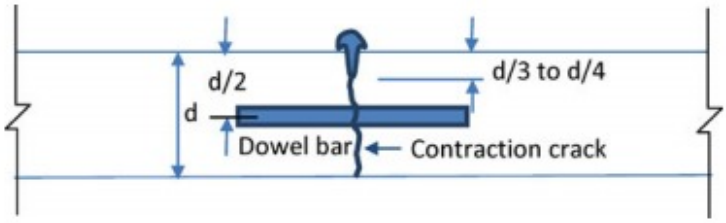
Answer: (A)

Q.No. 22 A dowel bar is placed at a contraction joint. When contraction occurs, the concrete slab cracks at predetermined location(s). Identify the arrangement, which shows the correct placement of dowel bar and the place of occurrence of the contraction crack(s).

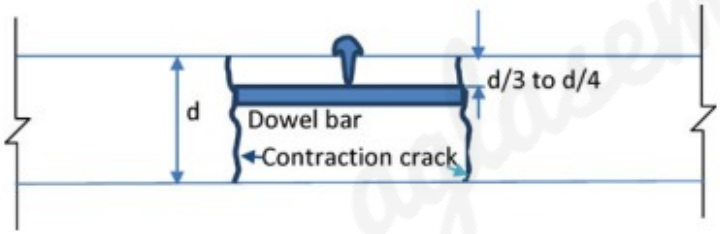
(A)



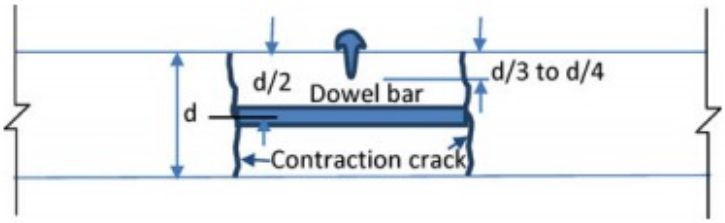
(B)



(C)



(D)



Answer: (B)

Q.No. 23 Muskingum method is used in

(A) hydrologic reservoir routing

(B) hydrologic channel routing

(C) hydraulic channel routing

(D) hydraulic reservoir routing

Answer: (B)

Q.No. 24 A soil sample is subjected to a hydrostatic pressure σ . The Mohr circle for any point in the soil sample would be

(A) a circle of radius o and center at the origin

(B) a circle Of radius 0 and center at a distance 0 from the origin

(C) a point at a distance o from the origin

(D) a circle of diameter G and center at the ori

Answer: (C)

Q.No. 25 A uniformly distributed line load of 500 kN/m is acting on the ground surface. Based on Boussinesq's theory, the ratio of vertical stress at a depth 2 m to that at 4 m. right below the line of loading, is

(A) 0.25

(B) 0.5

(C) 2.0

(D) 4.0

Answer: (C)

Q.No. 26 A water supply scheme transports 10 MLD (Million Litres per Day) water through a 450 mm diameter pipeline for a distance of 2.5 km. A chlorine dose of 3.50 mg/litre is applied at the starting point of the pipeline to attain a certain level Of disinfection at the downstream end. It is decided to increase the flow rate from 10 MLD to 13 MLD in the pipeline. Assume exponent for concentration, n = 0.86. With this increased flow, in order to attain the same level of disinfection, the chlorine dose(in mg/litre) to be applied at the starting point should be

(A) 3.95

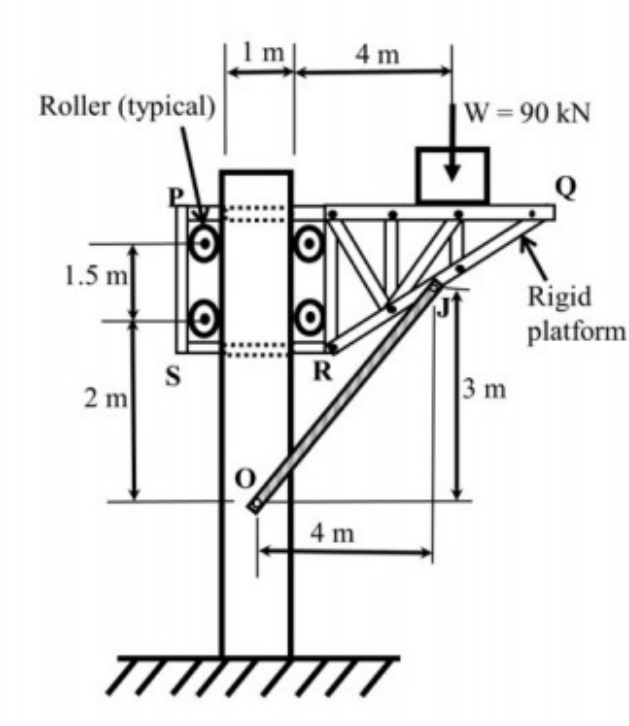
(B) 4.40

(C) 4.75

(D) 5.55

Answer: (C)

Q.No. 27 A rigid weightless platform PQRS shown in the figure (not drawn to the scale) can slide freely in the vertical direction. The platform is held in position by the weightless member OJ and four weightless, frictionless rollers. Points O and J are pin connections. A block of 90 kN rests on the platform as shown in the figure



The magnitude of horizontal component of the reaction (in kN) at pin O, is

(A) 90

(B) 120

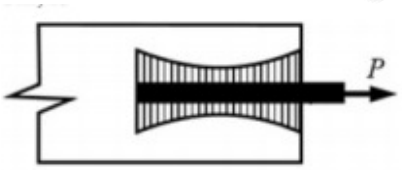
(C) 150

(D) 180

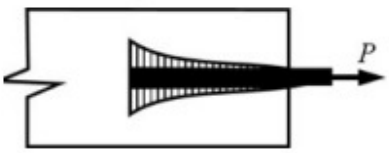
Answer: (B)

Q.No. 28 A reinforcing steel bar, partially embedded in concrete, is subjected to a tensile force P. The figure that appropriately represents the distribution of the magnitude of bond Stress (represented as hatched region), along the embedded length of the bar, is

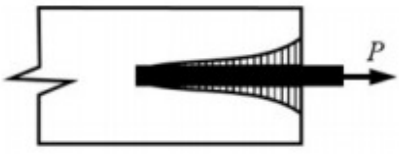
(A)



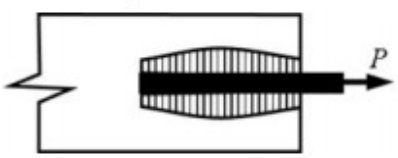
(B)



(C)



(D)



Answer: (C)

Q.No. 29 The matrix P is the inverse of a matrix Q. If I denote the identity matrix. which one of the following options is correct?

(A) PQ = I but QP ≠ I

(B) QP = I but PQ ≠ I

(C) PQ = I and QP = I

(D) PQ - QP = I

Answer: (C)

Q.No. 30 A 3 m high vertical earth retaining wall retains a dry granular backfill with angle of internal friction of 30° and unit weight of 20 kN/m3. If the wall is prevented from yielding (no movement), the total horizontal thrust (in kN per unit length) on the wall is

(A) 0

(B) 30

(C) 45

(D) 270

Answer: (C)

Q.No. 31 Consider a two-dimensional flow through isotropic soil along x direction and z direction. If h is the hydraulic head, the Laplace's equation of continuity is expressed as

(A) $\frac{\partial h}{\partial x}+\frac{\partial h}{\partial z}=0$

(B) $\frac{\partial h}{\partial x}+\frac{\partial h}{\partial x}\frac{\partial h}{\partial z}+\frac{\partial h}{\partial z}=0$

(C) $\frac{\partial^2 h}{\partial x^2}+\frac{\partial^2 h}{\partial z^2}=0$

(D) $\frac{\partial^2 h}{\partial x^2}+\frac{\partial^2 h}{\partial x \partial z}+\frac{\partial^2 h}{\partial z^2}=0$

Answer: (C)

Q.No. 32 The Laplace transform F(s) of the exponential function, $f(t)=e^{at}$ when $t \geq 0$, where a is a constant and $(s-a)>0$, is

(A) $\frac{1}{s+a}$

(B) $\frac{1}{s-a}$

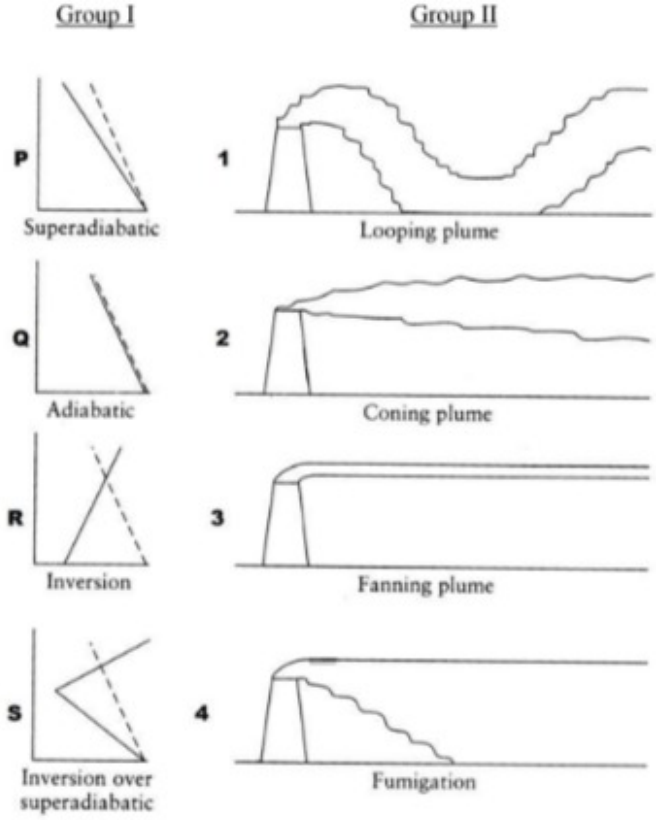
(C) $\frac{1}{a-s}$

(D) ∞

Answer: (B)

Q.No. 33 In the figures, Group I represents the atmospheric temperature profiles (P, Q, R and S) and Group II represents dispersion of pollutants from a smoke stack (1, 2, 3 and 4). In the figures of Group I, the dashed line

represents the dry adiabatic lapse rate, whereas the horizontal axis represents temperature and the vertical axis represents the altitude. The correct match is



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

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

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

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

Answer: (A)

Q.No. 34 An inflow hydrograph is routed through a reservoir to produce an outflow hydrograph. The peak flow of the inflow hydrograph is PI and the time of occurrence of the peak is t_1. The peak flow of the outflow hydrograph is P_o and the time of occurrence of the peak is tO. Which one of the following statements is correct?

(A) $P_1 < P_0$ and $t_1 < t_o$

(B) $P_1 < P_o$ and $t_1 > t_o$

(C) $P_1 > P_o$ and $t_1 < t_o$

(D) $P_1 > P_o$ and $t_1 > t_o$

Answer: (C)

Q.No. 35 A flexible pavement has the following class of loads during a particular hour of the day. i. 80 buses with 2-axles (each axle load of 40 kN); ii. 160 trucks with 2-axles (front and rear axle loads of 40 kN and 80 kN, respectively) The equivalent standard axle load repetitions for this vehicle combination as per IRC:37- 2012 would be

(A) 180

(B) 240

(C) 250

(D) 320

Answer: (A)

Q.No. 36 Consider the following statements related to the pore pressure parameters, A and B: P. A always lies between 0 and 1.0 Q. A can be less than 0 or greater than 1.0 R. B always lies between 0 and 1.0 S. B can be less than 0 or greater than 1.0 For these statements, which one of the following options is correct?

(A) P and R

(B) P and S

(C) Q and R

(D) Q and S

Answer: (C)

Q.No. 37 A bitumen sample has been graded as VG30 as per IS : 73-2013. The '30' in the grade means that

(A) penetration of bitumen at 25°C is between 20 and 40

(B) viscosity of bitumen at 60°C is between 2400 and 3600 Poise

(C) ductility of bitumen at 27°C is more than 30 cm

(D) elastic recovery of bitumen at 15°C is more than 30%

Answer: (B)

Q.No. 38 The following partial differential equation is defined for u:u (x,y)
$\frac{\partial u}{\partial y} = \frac{\partial^2 u}{\partial x^2}; \quad y \geq 0; \quad x_1 \leq x \leq x_2$ The set of auxiliary conditions necessary to solve the equation uniquely, is

(A) three initial conditions

(B) three boundary conditions

(C) two initial conditions and one boundary condition

(D) one initial condition and two boundary conditions

Answer: (D)

Q.No. 39 The value of the integral $\int_0^{\pi} x \cos^2 x \, dx$ is

(A) $\pi^2/8$

(B) $\pi^2/4$

(C) $\pi^2/2$

(D) π^2

Answer: (B)

Q.No. 40 The deformation in concrete due to sustained loading is

(A) creep

(B) hydration

(C) segregation

(D) shrinkage

Answer: (A)

Q.No. 41 Soil deposit formed due to transportation by wind is termed as

(A) aeolian deposit

(B) alluvial deposit

(C) estuarine deposit

(D) lacustrine deposit

Answer: (A)

Q.No. 42 The width of a square footing and the diameter of a circular footing are equal. If both the footings are placed on the surface of sandy soil, the ratio of the ultimate bearing capacity of circular footing to that of square footing will be

(A) 4/3

(B) 1

(C) 3/4

(D) 2/3

Answer: (C)

Q.No. 43 Let G be the specific gravity of soil solids, w the water content in the soil sample.γw the unit weight of water, and γd the dry unit weight of the soil. The equation for the zero air voids line in a compaction test plot is

(A) γd = Gγw/1+Gw

(B) γd = Gγw/Gw

(C) γd = Gw/1 + γw

(D) γd = Gw/1 - γw

Answer: (A)

Q.No. 44 Which one of the following is a secondary pollutant?

(A) Ozone

(B) Carbon Monoxide

(C) Hydrocarbon

(D) Volatile Organic Carbon (VOC)

Answer: (A)

Q.No. 45 In a two-dimensional stress analysis, the state of stress at a point P is $[\sigma] = \begin{bmatrix} \sigma_{xx} & \tau_{xy} \\ \tau_{xy} & \sigma_{yy} \end{bmatrix}$ The necessary and sufficient condition for existence of the state of pure shear at the point p, is

(A) $\sigma_{xx}\sigma_{yy} - \tau_{xy}^2 = 0$

(B) $\tau_{xy} = 0$

(C) $\sigma_{xx} + \sigma_{yy} = 0$

(D) $(\sigma_{xx} - \sigma_{yy})^2 + 4\tau_{xy}^2 = 0$

Answer: (C)

Q.No. 46 For the hottest month of the year at the proposed airport site, the monthly mean of the average daily temperature is 39°C. The monthly mean of the maximum daily temperature is 48°C for the same month of the year. From the given information, the calculated Airport Reference Temperature (in °C), is

(A) 36

(B) 39

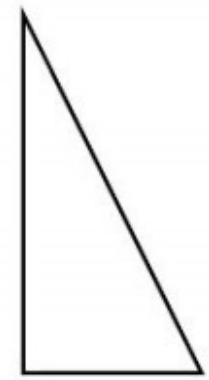
(C) 42

(D) 48

Answer: (C)

Q.No. 47 Consider a rigid retaining wall with partially submerged cohesionless backfill with a surcharge. Which one of the following diagrams closely represents the Rankine's active earth pressure distribution against this wall?

(A)



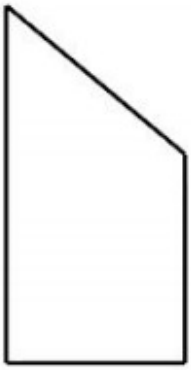
(B)



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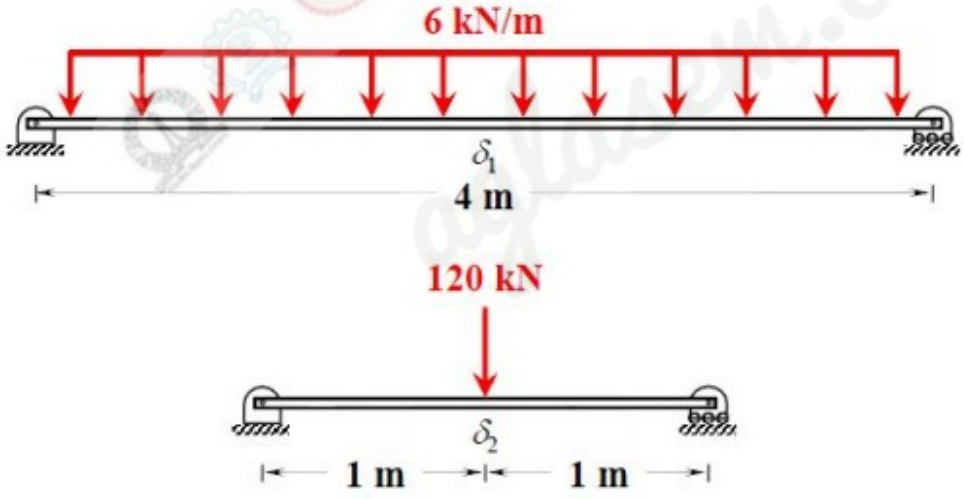
(C)



(D)

Answer: (A)

Q.No. 48 Two prismatic beams having the same flexural rigidity of 1000 kN-m2 are shown in the figures.



If the mid-span deflections of these beams are denoted by δ1 and δ2 (as indicated in the figures). the correct option is

(A) δ1 = δ2

(B) δ1 < δ2

(C) δ1 > δ2

(D) δ1 >> δ2

Answer: (A)

Q.No. 49 A closed thin-walled tube has thickness, *t*, mean enclosed area within the boundary of the centerline of tube's thickness, A_m , and shear stress, τ. Torsional moment of resistance, T, of the section would be

(A) $0.5\tau A_m t$

(B) $\tau A_m t$

(C) $2\tau A_m t$

(D) $4\tau A_m t$

Answer: (C)

Q.No. 50 According to IS 456 - 2000, which one of the following statements about the depth of neutral axis $X_{u,bal}$ for a balanced reinforced concrete section is correct?

(A) $X_{u,bal}$ depends on the grade of concrete only.

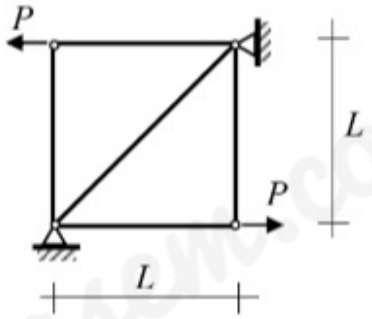
(B) $X_{u,bal}$ depends on the grade of steel only.

(C) $X_{u,bal}$ depends on both the grade of concrete and grade of steel.

(D) $X_{u,bal}$ does not depend on the grade of concrete and grade of steel.

Answer: (B)

Q.No. 51 All the members of the planar truss (see figure), have the same properties in terms of area of cross-section (A) and modulus of elasticity (E). For the loads shown on the truss, the statement that correctly represents the nature of forces in the members of the truss is:



(A) There are 3 members in tension, and 2 members in compression

(B) There are 2 members in tension, 2 members in compression, and 1 zero-force member

(C) There are 2 members in tension, 1 member in compression, and 2 zero-force members

(D) There are 2 members in tension, and 3 zero-force members

Answer: (D)

Q.No. 52 In a soil investigation work at a site, Standard Penetration Test (SPY) was conducted at every I .5 m interval up to 30 m depth. At 3 m depth, the observed number of hammer blows for three successive 150 mm penetrations were 8, 6 and 9, respectively. The SPT N-value at 3 m depth, is

(A) 23

(B) 17

(C) 15

(D) 14

Answer: (C)

Q.No. 53 A body floating in a liquid is in a stable state of equilibrium if its

(A) metacentre lies above its centre of gravity

(B) metacentre lies below its centre of gravity

(C) metacentre coincides with its centre of gravity

(D) centre Of gravity is below its centre of bouyancy

Answer: (A)

Q.No. 54 A car follows a slow moving truck (travelling at a speed of 10 m/s) on a two-lane two-way highway. The car reduces its speed to 10 m/s and follows the truck maintaining a distance of 16 m from the truck. On finding a clear gap in the opposing traffic stream, the car accelerates at an average rate of 4 m/s^2, overtakes the truck and returns to its original lane. When it returns to its original lane, the distance between the car and the truck is 16 m. The total distance covered by the car during this period (from the time it leaves its lane and subsequently returns to its lane after overtaking) is

(A) 64 m

(B) 72 m

(C) 128 m

(D) 144 m

Answer: (B)

Q.No. 55 A rapid sand filter comprising a number of filter beds is required to produce 99 MLD of potable water. Consider water loss during backwashing as 5%, rate of filtration as 6.0 m/h and length to width ratio of filter bed as 1.35. The width of each filter bed is to be kept equal to 5.2 m. One additional filter bed is to be provided to take care of break-down, repair and maintenance. The total number of filter beds required will be

(A) 19

(B) 20

(C) 21

(D) 22

Answer: (C)

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