1. Choose the most appropriate word from the options given below to complete the following sentence. A person suffering from Alzheimer's disease _____ short-term memory loss.
A. experienced
B. unexperienced
C. is experiencing
D. experiences

2. Choose the most appropriate word from the options given below to complete the following sentence. _____ is the key to their happiness; they are satisfied with what they have.
A. Contentment
B. Ambition
C. Perseverance
D. Hunger

3. Which of the following options is the closest in meaning to the sentence below?
"As a woman, I have no country."
A. Women have no country
B. Women are not citizens of any country
C. Women's solidarity knows no national boundaries
D. Women of all countries have equal legal rights

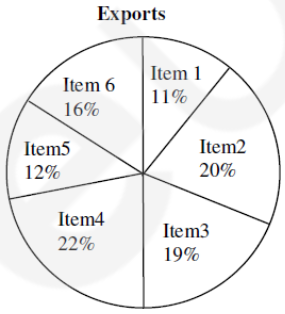
4. In any given year, the probability of an earthquake greater than Magnitude 6 occuring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is _____ years.
A. 50
B. 20
C. 25
D. 40

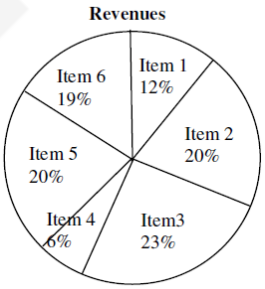
5. The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?
A. 3-4 years
B. 4-5 years
C. 5-6 years
D. 6-7 years

6. In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?
Statements:
1) Shiv is younger to Riaz.
2) Shiv is elder to Som.
A. Statement 1 by itself determines the eldest child
B. Statement 2 by itself determines the eldest child
C. Statement 1 and 2 are both required to determine the eldest child
D. Statement 1 and 2 are not sufficient to determine the eldest child

7. Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artifact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis. From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier
The main point of the paragraph is:
A. The twenty-first century is a digital world
B. Big data is obsessed with exactness
C. Exactitude is not critical in dealing with big data
D. Sparse data leads to a bias in the analysis

8. The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of export of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?





A. 1:2
B. 2:1
C. 1:4
D. 4:1

9. X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km of P. What is the distance between X and Q in km?
A. 1
B. $\sqrt{2}$
C. $\sqrt{3}$
D. 2

10. 10% of the population in a town in HIV+. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV + individuals 95% of the time, and HIV - individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____
A. 0.40
B. 0.50

C. 0.49
D. 0.47

11. A fair (unbiased) coin was tossed four times in succession and resulted in the following outcomes: (i) Head, (ii) Head, (iii) Head, (iv) Head. The probability of obtaining a "Tail" when the coin is tossed again is
A. 0
B. $\frac{1}{2}$
C. $\frac{4}{5}$
D. $\frac{1}{5}$

12. The determinant of matrix $\begin{bmatrix} 0 & 1 & 2 & 3 \\ 1 & 0 & 3 & 0 \\ 2 & 3 & 0 & 1 \\ 3 & 0 & 1 & 2 \end{bmatrix}$ is _____

A. 88
B. 44
C. 66
D. 22

13. $z = \frac{2-3i}{-5+i}$ can be expressed as
A. -0.5-0.5i
B. -0.5+0.5i
C. 0.5-0.5i
D. 0.5+0.5i

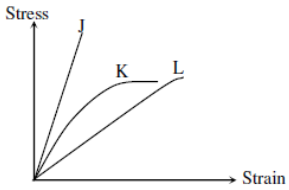
14. The integrating factor for the differential equation $\frac{dP}{dt}+k_2P=k_1L_0e^{-k_1t}$ is
A. e^{-k_1t}
B. e^{-k_2t}
C. e^{k_1t}
D. e^{k_2t}

15. If {x} is a continuous, real valued random variable defined over the interval (-∞, +∞) and its occurrence is defined by the density function given as:

$f(x)=\frac{1}{\sqrt{2\pi}*b}e^{\frac{1}{2}\left(\frac{x-a}{b}\right)^2}$ where 'a' and 'b' are the statistical attributes of the random variable {x}. The value of the integral $\int_{-\infty}^{a}\frac{1}{\sqrt{2\pi}*b}e^{\frac{1}{2}\left(\frac{x-a}{b}\right)^2}$ dx is

A. 1
B. 0.5
C. π
D. $\frac{\pi}{2}$

16. Group I contains representative stress-strain curves as shown in the figure, while Group II given the list of materials. Match the stress-strain curves with the corresponding materials.



Group I	Group II
(p) Curve J	(1) Cement paste
(q) Curve K	(2) Coarse aggregate
(r) Curve L	(3) Concrete

A. P-1; Q-3; R-2
B. P-2; Q-3; R-1
C. P-3; Q-1; R-2
D. P-3; Q-2; R-1

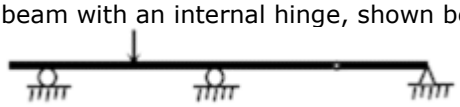
17. The first moment of area about the axis of bending for a beam cross-section is
A. moment of inertia
B. section modulus
C. shape factor
D. polar moment of inertia

18. Polar moment of inertia (I_p), in cm^4, of a rectangular section having width, b=2 and depth, d=6 cm is _____
A. 22
B. 44
C. 20
D. 40

19. The target means strength f_{cm} for concrete mix design obtained from the characteristic strength f_{ck} and standard deviation σ, as defined in IS:456-2000, is
A. f_{ck} +1.35σ
B. f_{ck} +1.45σ
C. f_{ck} +1.55σ
D. f_{ck} +1.65σ

20. The modulus of elasticity, $E=5000\sqrt{f_{ck}}$ where f_{ck} is the characteristic compressive strength of concrete, specified in IS:456-2000 is based on
A. tangent modulus
B. initial tangent modulus
C. secant modulus
D. chord modulus

21. The static indeterminacy of the two-span continuous beam with an internal hinge, shown below, is _____



A. 0
B. 1
C. 2
D. -1

22. As per Indian Standard Soil Classification System (IS: 1498-1970), an expression for A-line is
A. $I_p=0.73(w_L - 20)$
B. $I_P=0.70(w_L - 20)$
C. $I_p=0.73(w_L - 10)$
D. $I_p=0.70(w_L – 10)$

23. The clay mineral primarily governing the swelling behavior of Black Cotton soil is
A. Halloysite
B. Illite
C. Kaolinite
D. Montmorillonite

24. The contact pressure for a rigid footing resting on clay at the center and the edges are respectively
A. maximum and zero
B. maximum and maximum
C. zero and maximum
D. minimum and maximum

25. A certain soil has the following properties: Gs=2.71, n=40% and w=20%. The degree of saturation of soil (rounded off to the nearest percent) is _____
A. 61
B. 81
C. 83
D. 68

26. A plane flow has velocity components $u=\frac{x}{T_1}$, $v=-\frac{y}{T_2}$ and w=0 and x, y and z directions respectively, where $T_1(\neq 0)$ and $T_2(\neq 0)$ are constants having the dimensions of time. The given flow is incompressible if
A. $T_1=-T_2$
B. $T_1=-\frac{T_2}{2}$
C. $T_1=\frac{T_2}{2}$
D. $T_1=T_2$

27. Group I lists a few devices while Group II provides information about their uses. Match the devices with their corresponding use.

Group I	Group II
(p) Anemometer	(1) Capillary potential of soil water
(q) Hygrometer	(2) Fluid velocity at a specific point in the flow stream
(r) Pitot Tube	(3) Water vapour content of air
(s) Tensiometer	(4) Wind speed

A. P-1; Q-2; R-3; S-4
B. P-2; Q-1; R-4; S-3
C. P-4; Q-2; R-1; S-3
D. P-4; Q-3; R-2; S-1

28. An isolated 3-h rainfall event on a small catchment produces a hydrograph peak and point of inflection on the falling limb of the hydrograph at 7 hours and 8.5 hours respectively, after the start of the rainfall. Assuming, no losses and no base flow contribution, the time of concentration (in hours) for this catchment is approximately
A. 8.5
B. 7.0
C. 6.5
D. 5.5

29. The Muskingum Model of routing a flood through a stream reach is expressed as $O_2=K_0I_2+K_1I_1+K_20_1$, where K_0, K_1 and K_2 are the routing coefficients for the concerned reach, I_1 and I_2 are the inflows to reach, and O_1 and O_2 are the outflows from the reach corresponding to time step 1 and 2 respectively. The sum of K_0, K_1 and K_2 of the model is
A. -1
B. -0.5
C. 0.5
D. 1

30. The dominating microorganisms in an activated sludge process reactor are
A. aerobic heterotrophs
B. anaerobic heterotrophs
C. autotrophs
D. phototrophs

31. The two air pollution control devices that are usually used to remove very fine particles from the flue gas are
A. Cyclone and Venturi Scrubber
B. Cyclone and Packed Scrubber
C. Electrostatic Precipitator and Fabric Filter
D. Settling Chamber and Tray Scrubber

32. The average spacing between vehicles in a traffic stream is 50 m, then the density (in veh/km) of the stream is_____
A. 10
B. 15
C. 25
D. 20

33. A road is being designed for a speed of 110 km/hr on a horizontal curve with a super elevation of 8%. If the coefficient of side friction is 0.10, the minimum radius of the curve (in m) required for safe vehicular movement is
A. 115.0
B. 152.3
C. 264.3
D. 528.5

34. The survey carried out to delineate natural features, such as hills, rivers, forests and manmade features, such as towns, villages, buildings, roads, transmission lines and canals is classified as
A. engineering survey
B. geological survey
C. land survey
D. topographic survey

35. The expression $\lim_{\alpha\to 0}\frac{x^{\alpha}-1}{a}$ is equal to
A. log x
B. 0
C. x log x
D. ∞

36. An observer counts 240 veh/h at a specific highway location. Assume that the vehicle arrival at the location is Poisson distributed, the probability of having one vehicle arriving over a 30 seconds time interval is _____.
A. 0.27
B. 0.28
C. 0.29
D. 0.30

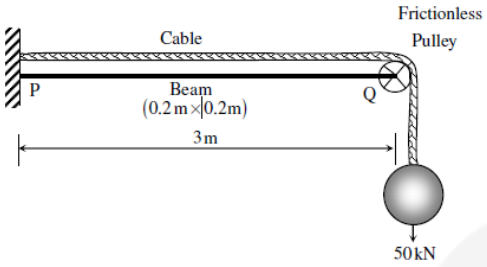
37. The rank of matrix $\begin{bmatrix} 6 & 0 & 4 & 4 \\ -2 & 14 & 8 & 18 \\ 14 & -14 & 0 & -10 \end{bmatrix}$ is_____

A. 1
B. 0
C. 2
D. 3

38. Water is flowing at a steady rate through a homogeneous and saturated horizontal soil strip of 10 m length. The strip is being subjected to a constant water head(H) of 5 m at the beginning and 1 m at the end. If the governing equation of flow in the soil strip is $\frac{d^2H}{dx^2}=0$ (where x is the distance along the soil strip), the value of H (in m) at the middle of the strip is _____

A. 3
B. 2
C. 0.5
D. 4

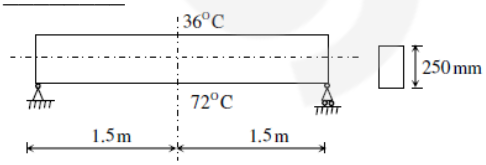
39. The values of axial stress (σ) in kN/m^2, bending moment (M) in kNm, and shear force (V) in kN acting at point P for the arrangement shown in the figure are respectively



A. 1000, 75 and 25
B. 1250, 150 and 50
C. 1500, 225 and 75
D. 1750, 300 and 100

40. The beam of an overall depth 250 mm (shown below) is used in a building subjected to two different thermal environments. The temperatures at the top and bottom surfaces of the beam are 36°C and 72°C respectively. Considering coefficient of thermal expansion (□) as 1.50x10^{-5} per °C, the vertical deflection of the beam (in mm) at its mid=-span due to temperature gradient is

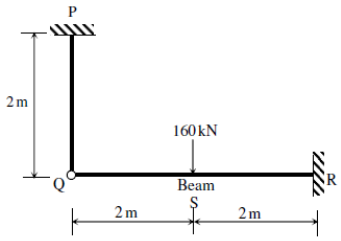
_____



A. 0.0024
B. 2.4
C. 0.0050
D. 5.0

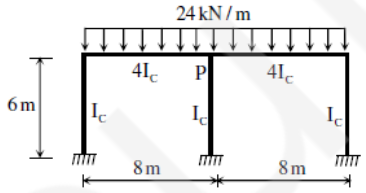
41. The axial load (I kN) in the member PQ for the arrangement/assembly shown in the figure given below is

_____



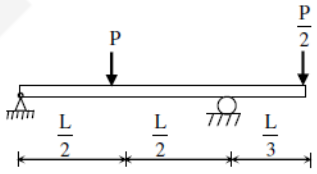
A. 50
B. 55
C. 65
D. NOT

42. Considering the symmetry of a rigid frame as shown below, the magnitude of the bending moment (in kNm) at P (preferably using the moment distributing method) is



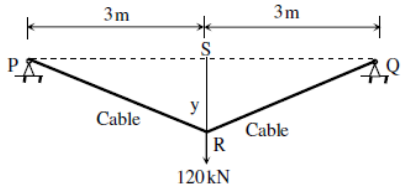
A. 170
B. 172
C. 176
D. 178

43. A prismatic beam (as shown below) has plastic moment capacity of Mp, then the collapse load P of the beam is



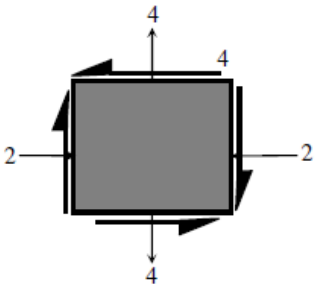
A. $\frac{2M_P}{L}$
B. $\frac{4M_P}{L}$
C. $\frac{6M_P}{L}$
D. $\frac{8M_P}{L}$

44. The tension (in kN) in a 10m long cable, shown in figure, neglecting its self-weight is



A. 120
B. 75
C. 60
D. 45

45. For the state of stresses (in MPa) shown in the figure below, the maximum shear stress (in MPa) is _____



A. 10 B. -5
C. -10 D. 5

46. An infinitely long slope is made up of a c-φ soil having the properties: cohesion (c)=20 kPa, and dry unit weight (γ_d)= 16kN/m^3. The angle of inclination and critical height of the slope are 40° and 5 m, respectively. To maintain the limiting equilibrium, the angle of internal friction of the soil (in degree) is _____
A. 22.4
B. 22.8
C. 23.4
D. NOT

47. Group I enlists in-situ field tests carried out for soil exploration, while Group II provides a list of parameters for sub-soil strength characterization. Math the type of tests with the characterization parameters

Group I	Group II
(P) Pressure meter Test (PMT)	(1) Menard's modulus (E_m)
(Q) Static Cone Penetration Test (SCPT)	(2) Number of blows (N)
(R) Standard Penetration Test (SPT)	(3) Skin resistance (f_c)
(S) Vane Shear Test (VST)	(4) Undrained cohesion (c_u)

A. P-1; Q-3; R-2; S-4 B. P-1; Q-2; R-3; S-4
C. P-2; Q-3; R-4; S-1 D. P-4; Q-1; R-2; S-3

48. A single vertical friction pile of diameter 500 mm and length 20 m is subjected to a vertical compressive load. The pile is embedded in a homogeneous sandy stratum where: angle of internal friction is =30°, dry unit weight (Υ_d)= 20 kN/m^3 and angle of wall friction is 2ϕ/3. Considering the coefficient of lateral earth pressure (K)=2.7 and the bearing capacity factor (Nq)=25, the ultimate bearing capacity of the pile (in kN) is_____
A. 196.56
B. 1965.6
C. 617.5
D. 6175

49. A circular raft foundation of 20 m diameter and 1.6m thick is provided for a tank that applies a bearing pressure of 110 kPa on sandy soil with Young's modulus, E,' = 30 MPa and Poisson's ration, $\upsilon_s = 0.3$. The raft is made of concrete (E_C=30 GPa and $\upsilon_c = 0.15$). Considering the raft as rigid, the elastic settlement (in mm) is
A. 50.96
B. 53.36
C. 63.72
D. 66.71

50. A horizontal nozzle of 30 mm diameter discharges a steady jet of water into the atmosphere at a rate of 15 liters per second. The diameter of inlet to the nozzle is 100 mm. The jet Impinges normal to a flat stationary plate held close to the nozzle end. Neglecting air friction and considering the density of water as 1000 kg/m^3, force exerted by the jet (in N) on the plate is _____
A. 318.3 B. 328.3
C. 328.3 D. 338.3

51. A venturimeter having a throat diameter of 0.1 m is used to estimate the flow rate of a horizontal pipe having a diameter of 0.2 m. For an observed pressure difference of 2 m of water head and coefficient of discharge equal to unity, assuming that the energy losses are negligible, the flow rate (in m^3/s) through the pipe is approximately equal to
A. 0.500 B. 0.150
C. 0.050 D. 0.015

52. A rectangular channel of 2.5 m width is carrying a discharge of 4 m^3/s. Considering that acceleration due to gravity as 9.81 m/s^2, the velocity of flow (in m/s) corresponding to the critical depth (at which the specific energy is minimum) is _____
A. 1.5
B. 0.5
C. 2.5
D. 1

53. Irrigation water is to be provided to a crop in a field to bring the moisture content of the soil from the existing 18% to the field capacity of the soil at 28%. The effective root zone of the crop is 70 cm. If the densities of the soil and water are 1.3 g/cm^3 and 1.0 g/cm^3 respectively, the depth of irrigation water (in mm) required for irrigating the crop is _____
A. 9.1 B. 8.1
C. 7.1 D. N.O.T

54. With reference to a standard Cartesian (x, y) plane, the parabolic velocity distribution profile of fully developed laminar flow in x-direction between two parallel, stationary and identical plates that are separated by distance, h, is given by the expression

$$u = -\frac{h^2}{8\mu}\frac{dp}{dx}\left[1-4\left(\frac{y}{h}\right)^2\right]$$

In this equation, the y=0 axis lies equidistant between the plates at a distance h/2 from the two plates, p is the pressure variable and μ is the dynamic viscosity term. The maximum and average velocities are, respectively

A. $u_{max} = -\frac{h^2}{8\mu}\frac{dp}{dx}$ and $u_{average} = \frac{2}{3}u_{max}$

B. $u_{max} = \frac{h^2}{8\mu}\frac{dp}{dx}$ and $u_{average} = \frac{2}{3}u_{max}$

C. $u_{max} = -\frac{h^2}{8\mu}\frac{dp}{dx}$ and $u_{average} = \frac{3}{8}u_{max}$

D. $u_{max} = \frac{h^2}{8\mu}\frac{dp}{dx}$ and $u_{average} = \frac{3}{8}u_{max}$

55. A suspension of sand like particles in water with particles of diameter 0.10 mm and below is flowing into a settling tank at 0.10 m^3/s. Assume g=9.81 m/s^2, specific gravity of particles=2.65, and kinematic vescosity of water=1.0105×10^{-2} cm^2/s. The minimum surface area (in m^2) required for this settling tank to remove particles of size 0.06 mm and above with 100% efficiency is_____
A. 30.21
B. 31.21
C. 32.21
D. 33.21

56. A surface water treatment plant operates round the clock with a flow rate of 35 m^3/min. The water temperature is 15 °C and jar testing indicated an alum dosage of 25 mg/1 with flocculation at a Gt value of 4×10^4 producing optimal result. The alum quantity required for 30 days (in kg) of operation of the plant is _____
A. 378
B. 3780
C. 37800
D. 378000

57. An effluent at a flow rate of 2670 m^3/d from a sewage treatment plant is to be disinfected. The laboratory data of disinfection studies with a chlorine dosage of 15 mg/l yield the model $N_t=N_0e^{-0.145t}$ where N_t= number of micro-organisms surviving at time t (in min.) and N_O= number of micro-organism present initially (at t=0). The volume of disinfection unit (in m^3) required to achieve a 98% kill of micro-organisms is_____
A. 35
B. 50
C. 45
D. 85

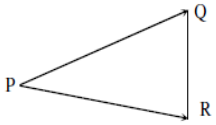
58. A waste water stream (flow=2 m^3/s, ultimate BOD=90 mg/l) is joining a small river (flow=12 m^3/s, ultimate BOD=5 mg/l). Both water streams get mixed up instantaneously. Cross sectional area of the river is 50 m^2. Assuming the de-oxygenation rate constant, k'=0.25/day the BOD (in mg/l) of the river water, 10 km downstream of the mixing point is
A. 1.68
B. 12.63
C. 15.46
D. 1.37

59. In a Marshall sample, the bulk specific gravity of mix and aggregates are 2.324 and 2.546 respectively. The sample includes 5% of bitumen (by total weight of mix) of specific gravity 1.10. The theoretical maximum specific gravity of mix is 2.441. The void filled with bitumen (VFB) in the Marshall sample (in %) is _____
A. 68.82
B. 66.82
C. 65.52
D. 67

60. On a section of a highway the speed-density relationship is linear and is given by $v = \left[80 - \frac{2}{3}k\right]$; where v is in km/h and k is in veh/km. The capacity (in veh/h) of this section of the highway would be
A. 1200
B. 2400
C. 4800
D. 9600

61. A pre-timed four phase signal has critical lane flow rate for the first three phases as 200, 187 and 210 veh/hr with saturation flow rate of 1800 veh/hr/lane for all phases. The lost time is given as 4 seconds for each phase. If the cycle length is 60 seconds, the effective green time (in seconds) of the fourth phase is _____
A. 15.74
B. 15.84
C. 15.64
D. 15.94

62. A tachometer was placed at point P to estimate the horizontal distances PQ and PR. The corresponding stadia intercepts with the telescope kept horizontal, are 0.320 m and 0.210 m, respectively. The ∠ QPR is measured to be 61°30' 30". If the stadia multiplication constant=100 and stadia addition constant=0.10 m, the horizontal distance (in m) between the points Q and R is _____



A. 21.1
B. 32.1
C. 28.8
D. NOT

63. The chainage of the intersection point of two straights is 1585.60 m and the angle of intersection is 140°. If the radius of a circular curve is 600.00 m, the tangent distance (in m) and length of the curve (in m), respectively are
A. 418.88 and 1466.08
B. 218.38 and 1648.49
C. 218.38 and 418.88
D. 418.88 and 218.38

64. The flexural tensile strength of M25 grade of concrete, in N/mm^2, as per IS:456-2000 is
A. 0.5
B. 5
C. 2.25
D. 3.5

65. A student riding a bicycle on a 5 km one-way street takes 40 minutes to reach home. The student stopped for 15 minutes during this ride. 60 vehicles overtook the student (assume the number of vehicles overtaken by the student is zero) during the ride and 45 vehicles while the student stopped. The speed of vehicle stream on that road (in km/hr) is
A. 7.5
B. 12
C. 40
D. 60

***