C.S.E.

CIVIL ENGINEERING – 2005

(PRELIMINARY)

Time Allowed : Two Hours *Maximum Marks : 300*

1. **Match List-I *(Soil)* with List-II *(Discription)* and select the correct answer using the code given below the Lists:**

	List–I		List–II
A.	Lacustrine	1.	A glacial clay characterized by distinctly marked annual deposite of sediments
B.	Peat	2.	Part of glacial drift which is directly deposited by ice
C.	Till	3.	An organic soil formed of vegetational matter
D.	Varved Clay	4.	A soil which is deposited in lakes

	A	B	C	D		A	B	C	D
(a)	4	3	2	1	(b)	2	1	4	3
(c)	4	1	2	3	(d)	2	3	4	1

2. **What is caused by the addition of coarser particles like sand or silt to clay?**
   (a) Decrease in liquid limit and increase in plasticity index
   (b) Decrease in liquid limit and no change in plasticity index
   (c) Decrease in both liquid limit and plasticity index
   (d) Increase in both liquid limit and plasticity index

3. **Match List–I *(Different types of Soil)* with List–II *(Group Symbol of IS Classification)* and select the correct answer using the code given below the Lists:**

	List-I		List-II
A.	Well-graded gravel sand mixture with little or no fines	1.	ML
B.	Poorly-graded sands or gravelly sand little or no fines	2.	CH
C.	Inorganic silts and very fine sands or clayey silts with low plasticity	3.	GW

D. Inorganic clays of high plasticity 4. SP

	A	B	C	D		A	B	C	D
(a)	2	1	4	3	(b)	3	4	1	2
(c)	2	4	1	3	(d)	3	1	4	2

4. **What is the type of soil structure having arrangement of soil particles with a 'face-to-face' or parallel orientation generally recognized as?**
   (a) Honeycomb structure (b) Single-grained structure
   (c) Flocculent structure (d) Dispersed structure

5. **Saturated unit weight of a soil is 20 kN/m³ and unit weight of water is 10 kN/m³. If the ground-water table is at the surface of soil and lateral earth pressure coefficient of soil is 0.4, effective lateral strees at 10 m depth will be**
   (a) –20 kPa (b) 40 kPa
   (c) 80 kPa (d) 180 kPa

6. **The flow net for an earthen dam with 30 m water depth consists of 25 potential drops and 5 flow channels. If the discharge per metre length of dam is 0.00018 m³/s, then what is the coefficient of permeability of dam materials ?**
   (a) 3×10^{-3} cm/s (b) 6×10^{-3} cm/s
   (c) 3×10^{-2} cm/s (d) None of the above

7. **In a three-layered soil water flows parallel to stratification. The thickness of the middle layer is twice that of top and bottom layer. The coefficient of permeability of middle layer (2k) is twice that of top and bottom layer (k). What is the average coefficient of permeability for this flow ?**
   (a) k (b) 1.33 k
   (c) 1.5 k (d) 0.66 k

8. **Consider the following statements :**
   1. Hydraulic gradient required to initiate **'quick'** condition is independent of the ratio of volume **of voids** to volume of solids in a soil mass.
   2. Initiation of piping under hydraulic structures can be

prevented by increasing the length of flow path of water.

3. Seepage pressure is independent of the coeficient of permeability.

Which of the statements given above are correct?

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

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

9. **Match List–I *(Nomenclature)* with List–II *(Associated With)* and select the correct answer using the code given below the Lists:**

List-I	List-II
A. Isobar	1. Pore pressure
B. Isochrone	2. Seepage
C. Conjugate plane	3. External loading
D. Concentric parabola	4. Shear strength

	A	B	C	D
(a)	4	1	3	2
(c)	4	2	3	1

	A	B	C	D
(b)	3	2	4	1
(d)	3	1	4	2

10. **If the time required for 50% consolidation of a remoulded sample of clay with single drainage is 4 hours, then what is the time required to consolidate the same sample of clay with same degree of consolidation but with double drainage ?**

(a) 1 hour (b) 2 hours

(c) 6 hours (d) 8 hours

11. **Consider the following processes involved in consoli--dation :**

1. Void reduction
2. Pore pressure development
3. Seepage of water
4. Creep

What is the correct sequence of the processes given above?

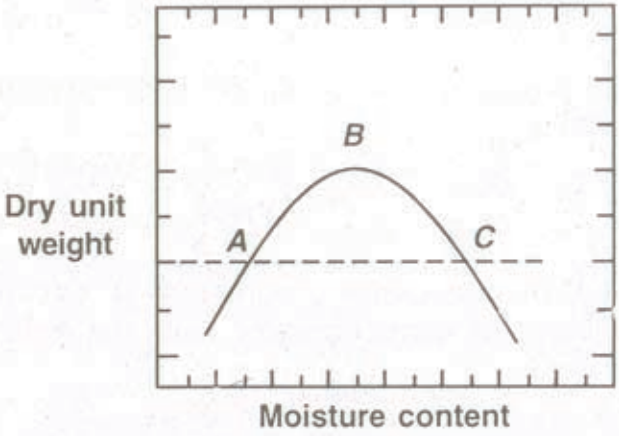
(a) 4 – 1 – 3 – 2

(b) 2 – 3 – 1 – 4

(c) 4 – 3 – 1 – 2

(d) 2 – 1 – 3 – 4

12.



Points *A, B* and *C* correspond to three compaction states of a silty soil on the compaction curve given above.

Which one of the following is correct in respect of permeability of the soil for the states *A, B* and *C* ?

(a) A > B, B < C (b) A < B, B > C

(c) A = C > B (d) A < B = C

13. **Which one of the following expresses the degree of disturbance of undisturbed clay sample due to remoulding ?**

(a) Thixotropy (b) Dilatancy

(c) Sensitivity (d) Plasticity

14. **When a dense sandy soil is sheared, what does it exhibit ?**

(a) Thixotropy (b) Dilatancy

(c) Swelling (d) Bulking

15. **During the first stage of triaxial test when the cell pressure is increased from 0.10 N/mm² to 0.26 N/mm², the pore water pressure increases from 0.07 N/mm² to 0.15 N/mm². What is the value of the Skempton's pore pressure parameter *B* ?**

(a) 0.5 (b) –0.5 (c) -2.0 (d) –2.0

16. **During a site reconnaissance survey, it was observed that 10 m height of soil is standing without any lateral support. What is the cohesive strength of soil with ø=0 and Y=20 kN/m³ ?**

(a) 100 kPa (b) 50 kPa
(c) 25 kPa (d) 200 kPa

17. **Which of the following is *not* related to design of pile foundations ?**
(a) Pull-out test (b) Cyclic loading
(c) Plate-load test (d) Integrity test

18. **Loading of a saturated fine-grained soil results in the following processes :**
1. Shear failure 2. Immediate settlement
3. Pore pressure generation
4. Volumetric deformation
What is the correct sequence of the processes given above?
(a) 1 – 4 – 3 – 2 (b) 2 – 3 – 4 – 1
(c) 1 – 3 – 4 – 2 (d) 2 – 4 – 3 – 1

19. **Dolphin is a type of which one of the following ?**
(a) Pile foundation (b) Isolated footing
(c) Raft foundation (d) Caisson

20. **What is the super-elevation for a horizontal highway curve of radius 500 m and speed 100 kmph in mixed traffic condition ?**
(a) 8.9% (b) 6.2% (c) 0 (d) 7%

21. **What is the innermost portion of approach zone which is the most critical portion from obstruction viewpoint, called ?**
(a) Outer horizontal surface (b) Conical surface
(c) Inner horizontal surface (d) Clear zone

22. **According to ICAO recommendations, what is the rate of elevation correction for the runway length above MSL?**
(a) 1% for every 100 m of elevation above MSL
(b) 7% for every 300 m of elevation above MSL
(c) 2% for every 500 m of elevation above MSL
(d) 2% for every 300 m of elevation above MSL

23. **What does the Wind Rose Diagram (WRD) for orientation of airport runway give ?**
(a) Direction of wind
(b) Direction and duration of wind

(c) Direction, duration and intensity of wind
(d) None of the above

24. What is the recommended grade of tar for grouting purpose ?

(a) RT-1 (b) RT-2 (c) RT-3 (d) RT-5

25. Match List–I *(Type of Pavement)* with List–II *(Camber)* and select the correct answer using the code given below:

List-I	List-II
A. Cement concrete	1. 4.0%
B. Water-bound macadam	2. 3.0%
C. Thin bituminous	3. 2.5%
D. Earth	4. 2.0%

	A	B	C	D
(a)	3	1	4	2
(c)	3	2	4	1

	A	B	C	D
(b)	4	2	3	1
(d)	4	1	3	2

26. What is the value of camber rate that should be provided in case of WBM pavement surface in an area of heavy rainfall ?

(a) 1 in 30 (b) 1 in 48
(c) 1 in 60 (d) 1 in 72

27. Consider the following statements :

1. An ascending gradient of 1 in 100 meets an ascending gradient of 1 in 120 to form a valley curve.
2. A falling gradient of 1 in 75 meets a falling gradient of 1 in 50 to form a summit curve.
3. The length of summit curve is determined on the basis of headlight sight distance.

Which of the statements given above is/are correct ?

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

28. Match List-I *(Highway Survey)* with List-II *(Outcome)* and select the correct answer using the code given below :

List-I	List-II
A. Map study	1. Best alignment of road
B. Reconnaissance	2. Grade line and central line of road

C. Preliminary survey
D. Detailed survey

3. Cross-drainage locations
4. Obligatory points

	A	B	C	D
(a)	1	2	4	3
(b)	4	3	1	2
(c)	1	3	4	2
(d)	4	2	1	3

29. **Match List–I *(Material)* with List–II *(Property)* and select the correct answer using the code given below the Lists:**

List-I	List-II
A. Asphalt	1. Coal distilled in the absence of air
B. Cutback bitumen	2. Bitumen dissolved in aqueous medium
C. Bitumen emulsion	3. Bitumen with volatile diluent
D. Tar	4. Bitumen along with some proportion of minerals

	A	B	C	D
(a)	2	3	4	1
(b)	4	1	2	3
(c)	2	1	4	3
(d)	4	3	2	1

30. **Which one of the following statements is correct with respect to rigid pavements ?**
(a) Vertical stresses are transmitted to the lower layer through the points of contact in granular structure
(b) Vertical compressive strees is maximum on the pavement surface directly under the wheel load
(c) Lower layers have to take lesser magnitudes of strees
(d) Stresses on rigid pavements are transmitted to a wider area of sub-grade

31. **Which one of the following statements is correct ?**
Maximum service volume of a road is defined as the total number of vehicles that
(a) can pass a given point in a specified period of time
(b) can be accommodated on a unit length of road
(c) can pass a given point in unit time
(d) None of the above three

32. **Which one of the following statements is correct ?**
Cant deficiency is the difference between

(a) actual cant provided at the time of construction and the at the time of renewal
(b) the equilibrium cant necessary for the maximum permissible speed and actual cant provided
(c) cant required at maximum speed and minimum speed
(d) two parallel rails after 10 years

33. Consider the following locations of a turnout :

1. Tongue rail
2. Lead rail
3. Toe of switch
4. Crossing

Which is the correct sequence for a train to pass over the turnout from the facing direction ?

(a) 3 – 1 – 2 – 4
(b) 4 – 2 – 1 – 3
(c) 3 – 2 – 1 – 4
(d) 4 – 1 – 2 – 3

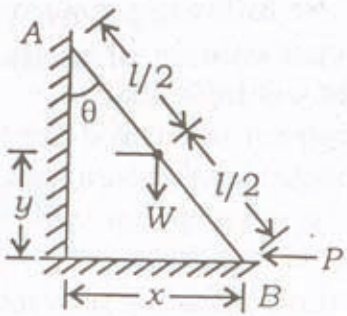
34. Wearing locations of rails and their reasons are listed below :

1.	Wear at end of rails	:	Loose fish bolts
2.	Wear at sides of rail head	:	Constant brake application
3.	Wear on the top of rail head on tangent track	:	Rigidity of wheel base
4.	Wear on top of rail head on curves	:	Lesser area of contact between wheel and rail

Which of the pairs given above are correctly matched ?

(a) 1 and 4
(b) 1 and 2
(c) 2 and 3
(d) 1, 2, 3 and 4

35.

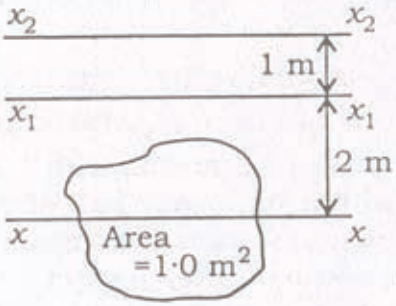


A ladder AB of weight W and length l is held in equilibrium by a horizontal force P as shown in the figure given above. Assuming the ladder to be idealized as a homogeneous rigid bar and the surfaces to be smooth, which one of the following is correct ?

(a) $P = \frac{1}{2} W \tan\theta$ (b) $P = \frac{1}{2} W \operatorname{cosec}\theta$

(c) $P = \frac{1}{2} W \cos\theta$ (d) $P = 2W \cos\theta$

36.



xx, x_1x_1 and x_2x_2 are parallel axes of which xx is the centroidal axis. If moment of inertia of the figure about x_1x_1 axis is 10 m^4, what is the moment of inertia of the figure about x_2x_2 axis ?

(a) 10 m^4 (b) 11 m^4 (c) 14 m^4 (d) 15 m^4

37. How many revolutions a shaft has to rotate to achieve a rated speed of 30 hertz in 4 seconds ?

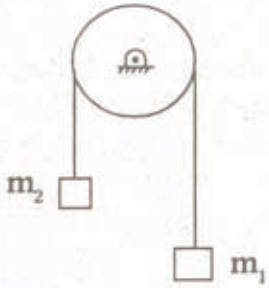
(a) 15 (b) 30 (c) 60 (d) 120

38. A projectile is fired horizontally with a velocity of 6 m/s from a point of height h m above and 12 m away from an object. What is the value of h required so that projectile hits the object ?

(a) 4.9 m (b) 9.8 m

(c) 6 m (d) 19.6 m

39.



Two bodies of masses m_1 and m_2 are connected by a light inextensible string passing over a small smooth fixed pulley; $m_1 > m_2$. What is the acceleration of the system ?

(a) $g(m_1 + m_2)/(m_1 - m_2)$ (b) $g(2m_1 + m_2)/(m_1 - 2m_2)$

(c) $g(m_1 + 2m_2)/(2m_1 - m_2)$ (d) $g(m_1 - m_2)/(m_1 + m_2)$

40. **A ball of mass 1 kg moving with a velocity 2 m/s collides directly with a stationary ball of mass 2 kg. If the first ball comes to rest after the impact, what is the velocity of the second ball after impact ?**

(a) 1.0 m/s (b) Zero

(c) 2 m/s (d) 0.5 m/s

41. **A mass *m* is suspended from a massless spring of spring constant *k*. The spring is cut in half and the same mass is suspended form one of the halves. If the frequency of oscillations in the first case is *f*, then what is the frequency in the second case ?**

(a) $\sqrt{2}\,f$ (b) f

(c) f / 2 (d) $f/\sqrt{2}$

42. **Consider the following statements regarding tensile test diagrams for carbon steels with varying carbon contents:**

As the carbon content increases

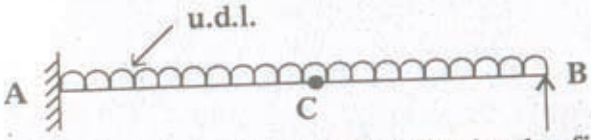
1. the ultimate strength of steel decreases.
2. the elongation before fracture increases.
3. the ductility of the metal decreases.
4. the ultimate strength of steel increases.

Which of the statements given above are correct ?

(a) 3 and 4 (b) 1 and 3

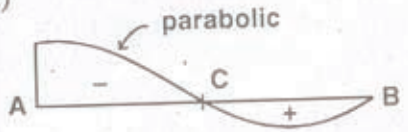
(c) 1, 2 and 3 (d) 1 and 2

43.

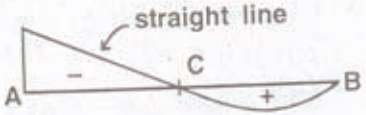


A propped cantilever beam shown in the figure given above is having internal hinge at its mid-span. Which one of the following is the shape of bending moment diagram for the given loading ?

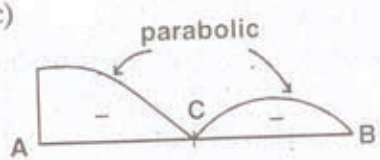
(a)



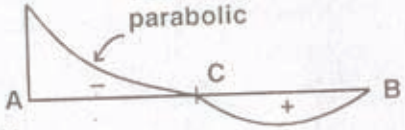
(b)



(c)



(d)



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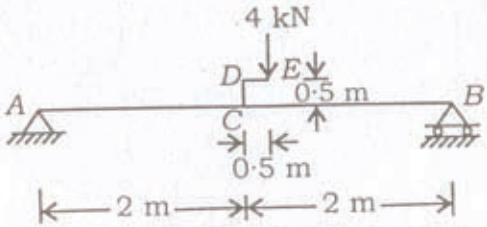
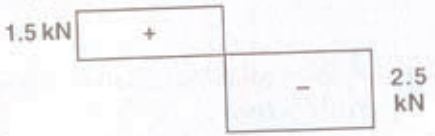


A simply supported beam AB is loaded as shown in the figure given above. CDE is a rigid member. A load 4kN is applied at E. Which one of the following is the SFD for the beam ?

(a)

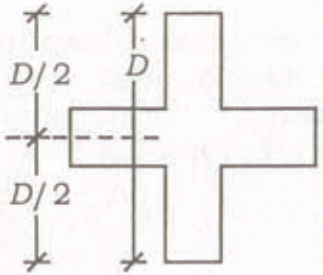
(b)



(c)

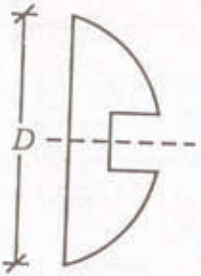
(d)

45.

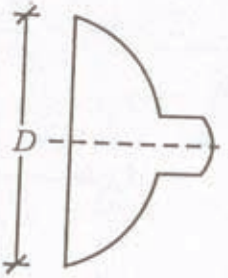


The cross-section of a beam in bending is as shown in the figure given above. It is subjected to a shear force acting in the plane of cross-section. Which among the following figures shows the correct shear stress distribution across the depth of the cross-section of the beam ?

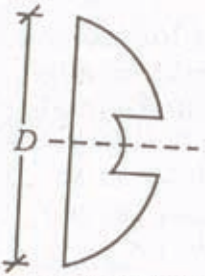
(a)



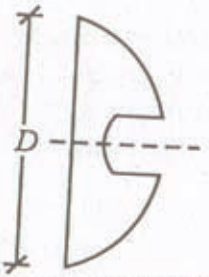
(b)



(c)



(d)



46. **A beam of uniform strength refers which one of the following ?**

(a) A beam in which extreme fibre stresses are same at all cross-section along the length of the beam

(b) A beam in which the moment of inertia about the axis of bending is constant at all cross-sections of the beam

(c) A beam in which the distribution of bending stress across the depth of cross-section is uniform at all cross-sections of the beam

(d) A beam in which the bending stress is uniform at the maximum bending moment cross-section

47. **A simply supported beam *AB* of span *L* is subjected to a concentrated load *W* at the centre *C* of the span. According to Mohr's moment area method, which of the following gives the deflection under the load?**

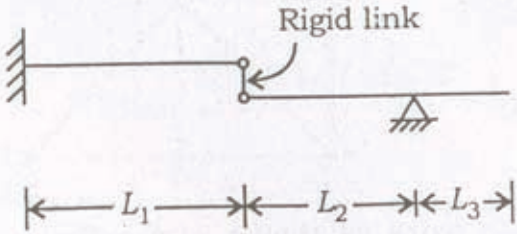
(a) Moment of the area of *M/EI* diagram between *A* and *C* taken about *C*

(b) Moment of the area of *M/EI* diagram between *A* and *B* taken about *B*

(c) Moment of the area of *M/EI* diagram between *A* and *C* taken about *A*

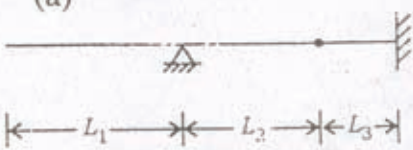
(d) Moment of the area of *M/EI* diagram between *A* and *C* taken about *A*

48.

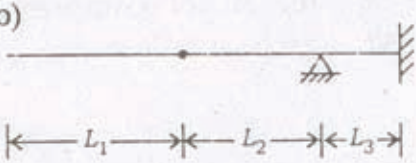


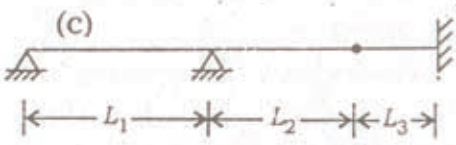
For the beam shown in the figure given above, which among the following is the conjugate beam?

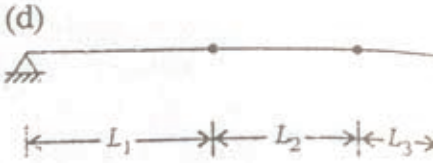
(a)



(b)







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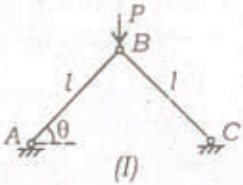
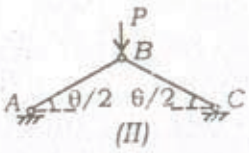




Which one of the following is the correct statemer regarding the force and deflection at point *B* in trusse *I* and *II* shown in the figures given above ?

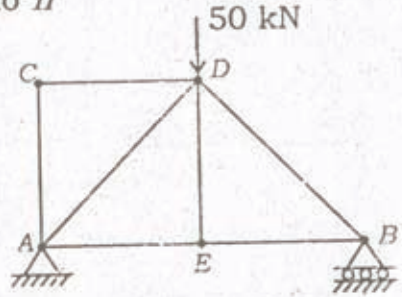
(a) *I* will have less member force and less deflection at compared to *II*

(b) *I* will have less member force and more deflection a *B* compared to *II*

(c) *I* will have more member force and more deflection a *B* compared to *II*

(d) *I* will have more member force and less deflection a *B* compared to *II*

50.

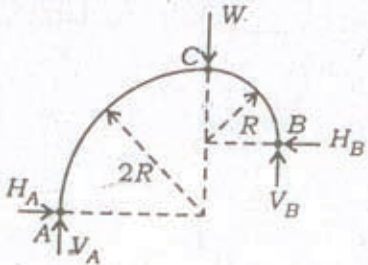


In a truss work as shown in the figure given abov what is the force induced in the member *DE* ?

(a) 50 kN (tensile) (b) Zero

(c) 50 kN (compressive) (d) 25 kN (compressive)

51.



A three-hinged circular arch ACB is formed by two quadrants of circles AC and BC of radii $2R$ and R respectively with C as crown, as shown in the figure given above.

Consider the following in respect of the reactive forces developed at supports A and B due to concentrated load at the crown :

1. Line of action of reaction R_A at A is inclined at 45^0 to the horizontal.
2. $V_A = V_B = W/2$
3. $H_B = 2H_A$
4. $H_A = H_B = W/2$

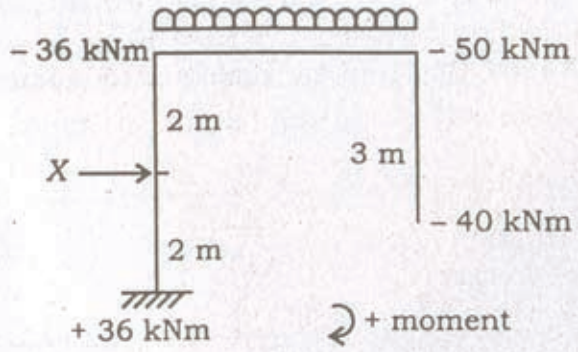
Which of the above is/are correct ?

(a) 1 and 3 (b) 2 and 3
(c) 1, 2 and 4 (d) 4 only

52. A symmetrical three-hinged parabolic arch of span L and rise h is hinged at springings and crown. It is subjected to a u.d.l. w throughout the span. What is the bending moment at a section $L/4$ from the left support?

(a) $wL^2/8$ (b) $wL^2/16$
(c) $wL^2/8h$ (d) Zero

53.



Final moment values got through the analysis of a portal frame have been shown in the figure given above. What is the value of X ?

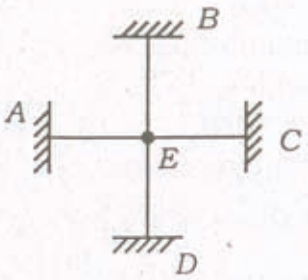
(a) 96 kN (b) 60 kN (c) 30 kN (d) 24 kN

54. A horizontal fixed beam AB of length L has uniform

flexural rigidity *EI*. During loading the right support *A* rotates through an angle θ clockwise. What is the distance of the point of contraflexure from the left support ?

(a) L/3 (b) 3L/10 (c) L/2 (d) 2L/3

55.



Four identical beams *AE, BE, CE* and *DE* have been rigidly jointed at *E*. The point *C* slips and rotates along with member firmly fixed at *E*. Which one of the following is correct ?

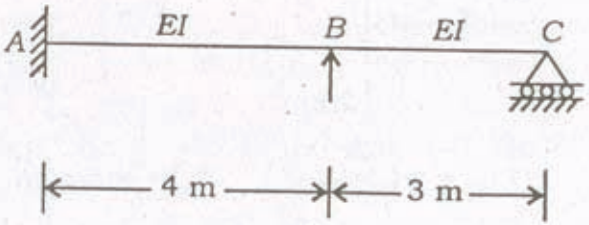
(a) There is no moment on the members

(b) Except at *C*, there is no moment on the members of frame

(c) Except at *C* and *E* for member *EC*, no moment will be on other members

(d) All the members are subjected to moment

56.

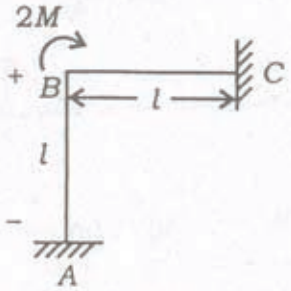


What are the distribution factors at joint *B* for the members *BA* and *BC* respectively, in the figure given above ?

(a) 0.57 and 0.43 (b) 0.43 and 0.57

(c) 0.50 and 0.50 (d) 0.36 and 0.64

57.

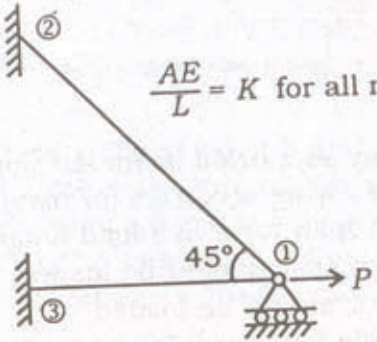


Members *AB* and *BC* in the figure shown above are identical. Due to a moment *2M* applied at *B*, what is the value of axial force in the member *AB* ?

(a) M/l (compression) (b) M/l (tension)

(c) $1.5M/l$ (compression) (d) $1.5M/l$ (tension)

58.

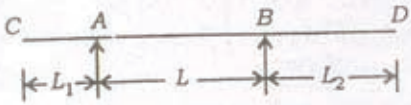


What is the horizontal displacement of joint ①, due to load *P* ?

(a) P/K (b) $P/\{(1+\sqrt{2})K\}$

(c) $P/\{\sqrt{2}(1+\sqrt{2})K\}$ (d) $P/\{1.5K\}$

59.

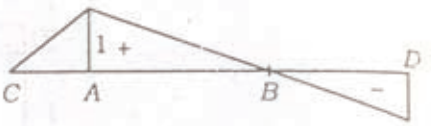


Which one of the following is the influence line for

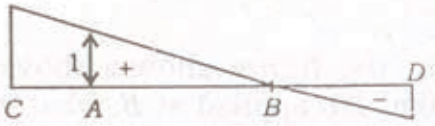
reaction at A of the beam shown in the figure given above ?

(a)

(b)

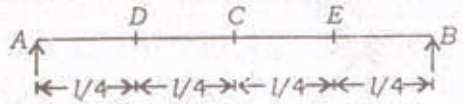


(c)



(d)

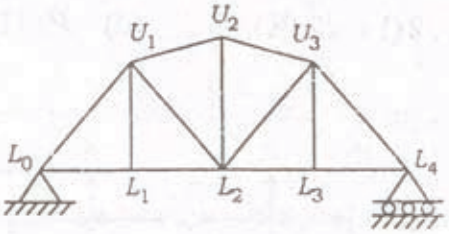
60.



For the simply supported beam AB shown above, which one of the following is correct for maximum shear at the centre of the span for a live load longer than the span?

(a) The entire span should be loaded
(b) The half span AC be loaded
(c) The middle half span DE be loaded
(d) The quarter span AD should be loaded

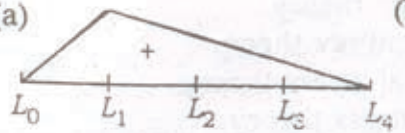
61.



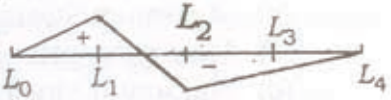
Which one of the following is the influence line for the

force in the member U_1L_2 of the plane pin-jointed frame shown in the figure given above?

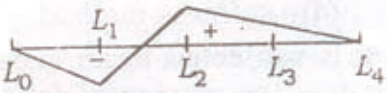
(a)



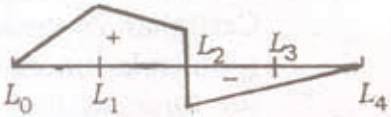
(b)



(c)



(d)



+ Tension
− Compression

62. A car is moving at 40 m/s along a curve of 1 km radius. If the total acceleration is *not* to exceed 2 m/s², what is the maximum rate at which its speed can be decreased?
(a) 2 m/s² (b) 1.6 m/s²
(c) 1.2 m/s² (d) 1.0 m/s²

63. A horizontal fixed *AB* is fixed at both its ends *A* and *B*. During loading, the right support sinks by an amount δ. Flexural rigidity of the beam is uniform and is equal to *EI*. Length of the beam is *L*. What is the moment developed at the centre of the beam due to sinking of the support ?
(a) $6EI\delta / L^2$ (b) Zero
(c) $3EI\delta / L^2$ (d) $12EI\delta / L^2$

64. Consider the following statements :
1. Hansen's equation accounts for influence of depth, shape and inclination of load.
2. Local shear failure takes place in dense and/or very dense sand and also in stiff and hard clays.
3. The region of failure of soil below foundations consists of three different zones.

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

65. **Which one of the following theories of failure is suitable for cast iron ?**
(a) Shear strain energy theory
(b) Maximum strain energy theory
(c) Maximum principal stress theory
(d) Maximum shear stress theory

66. **Which one of the following statements is correct ?**
Castigliano's theorem falls under the category of
(a) displacement method (b) equilibrium method
(c) force method (d) stiffness method

67. **A simply supported beam is subjected to an eccentric concentrated load. Where does the maximum deflection of the beam due to the applied load occur ?**
(a) Directly under the load
(b) At the centre of the beam
(c) Between the load point and nearest end support
(d) Between the load point and centre of the beam

68. **Which one of the following statements is correct ?**
The portal method of structural analysis is generally suitable for
(a) tall buildings (b) low-rise buildings
(c) low-rise buildings with uniform framing
(d) low-rise buildings with non-uniform framing

69. **The optimistic, most likely and pessimistic time estimates of an activity are 5, 10 and 21 days respectively. What are the expected time and standard deviation respectively ?**
(a) 12, 3 (b) 11, 4
(c) 11, 2.67 (d) 10, 16

70. **In PERT, the total time duration along the critical path for the project completion time is probabilistic. It is usually presumed to follow which one of the following?**
(a) Beta distribution (b) Poisson distribution
(c) Normal distribution (d) Log-normal distribution

71. **Consider the following statements : Total float is**
1. the time span by which the starting (or finishing) of

an activity can be delayed without delaying the completion of the project.

2. difference between maximum time available and the actual time required to perform the activity.
3. difference between its earliest finish time and the earliest start time of its successor activity.

Which among the following is/are correct ?

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

72. Which one of the following is the correct instance of amenability to ladder network development ?

(a) Certain activities are done periodically
(b) Self-similar constructions cannot be or need not be, simultaneous at several locations in a project
(c) The project can be broken down into units or sequences of activities which can be further devolved into nearly similar repeated components or sub-activities
(d) Repetitive use of non-consumed resources is called for and can accordingly be made

73. Consider the following statements :

A critical activity in a CPM network has

1. the longest duration of all activities.
2. zero total float.
3. zero free float.
4. the shortest duration of all activities.

Which of the statements given above are correct ?

(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 3 and 4

74. A uniform simply supported beam is subjected to a clockwise moment M at the left end. What is the moment required at the right end so that rotation of the right end is zero ?

(a) $2M$ (b) M (c) $M/2$ (d) $M/3$

75. Consider the following statements with reference to oxidation ponds :

1. They require high initial investments.
2. They have low operational cost.

3. They are also called stabilization ponds.

Which of the statements given above are correct ?

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

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

76. **Match List–I *(Treatment Process)* with List–II *(Classification)* and select the correct answer using the code given below the Lists:**

List-I	List-II
A. Trickling filter	1. Anaerobic attached
B. Activated sludge process	2. Aerobic attached
C. Dispersion trench	3. Aerobic suspended
D. Septic tank	4. Anaerobic suspended

	A	B	C	D		A	B	C	D
(a)	2	4	1	3	(b)	1	3	2	4
(c)	2	3	1	4	(d)	1	4	2	3

77. **Match List–I *(Treatment Unit)* with List–II *(Function)* and select the correct answer using the code given below:**

List-I	List-II
A. Aeration	1. Suspended matters
B. Softening	2. Colours, odours, taste
C. Coagulation	3. Colloidal dissolved matters, bacteria
D. Filtration	4. Hardness

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	2	1	4	3
(c)	3	1	4	2	(d)	2	4	1	3

78. **Which one of the following statements is *not* correct ?**

(a) In combined sewerage system, one set of sewer is laid for both sanitary sewage and storm water

(b) In separate system, the design of sewage system is economical

(c) In separate system, self-cleaning velocities are not available and occasional flushing is required

(d) As the sewage is diluted by storm water in combined sewage system, cost of treatment is low

79. **Consider the following statements :**

1. Primary sludge is to be treated with an anaerobic digester.
2. Secondary sludge is the living biomass.
3. Sludge volume gets decreased with increase in water content of sludge.
4. Sludge consists of higher solids content than the moisture content.

Which of the statements given above is/are correct ?

(a) 1 and 4 (b) 2 and 3
(c) 2 only (d) 3 and 4

80. **A sewer, 1000 mm in diameter, is laid at a slope to obtain a velocity of 0.8 m/s when running full. Assuming Manning's *n* as constant, what is the velocity in this sewer if it is running half full ?**

(a) 0.2 m/s (b) 0.4 m/s
(c) 0.6 m/s (d) 0.8 m/s

81. **Match List-I *(Layout)* with List-II *(Suitable For)* and select the correct answer using the code given below:**

List-I	List-II
A. Tree system	1. Satisfactory water supply, but not much used in India
B. Grid iron system	2. Well-planned sector of city
C. Ring system	3. For towns with rectangular road layout
D. Radial system	4. For irregularly developed towns

	A	B	C	D
(a)	2	3	4	1
(c)	2	1	4	3

	A	B	C	D
(b)	4	1	2	3
(d)	4	3	2	1

82. **Which of the following statements is *not* correct ?**

(a) Chlorides in potable water may be present from 300 ppm to 500 ppm
(b) In order to be safe against pathogenic bacteria residual chlorine should remain between 0.05 ppm and 0.20 ppm
(c) Presence of iron and manganese in excess of 0.3 ppm

in drinking water is objectionable
(d) pH value for pure water is nearly 7

83. Which one of the following related to domestic potable water quality is correct ?
(a) Turbidity (on SILICA scale) is 15–20 ppm or mg/lit
(b) Colour (on COBALT scale) is 15–25 ppm or mg/lit
(c) Hardness (expressed as $CaCo_3$ equivalent) is 75–115 ppm or mg/lit
(d) BOD is 20 ppm or mg/lit

84. Match List–I *(Unit of Treatment)* with List–II *(Type of Settling Process)* and select the correct answer using the code given below the Lists:

List-I	List-II
A. Grit chamber	1. Zone & compression settling
B. Sludge blanket clarifier	2. Flocculent settling
C. Clariflocculator	3. Discrete settling
D. Secondary settling tank (ASP)	4. Zone settling (principally)

	A	B	C	D
(a)	1	4	2	3
(c)	1	2	4	3

	A	B	C	D
(b)	3	2	4	1
(d)	3	4	2	1

85. Match List–I *(Type of Filter)* with List–II *(Filtering Characteristic)* and select the correct answer using the code given below the Lists:

List-I	List-II
A. Slow sand filter	1. Filtered water comes out under pressure and no lifting device is necessary to lift water
B. Rapid sand filter	2. Removes 98–99% bacteria
C. Pressure filter	3. Rate of filtration is 4500 lit/ (m^2 hr)

	A	B	C
(a)	2	1	3
(c)	2	3	1

	A	B	C
(b)	3	1	2
(d)	3	2	1

86. **Consider the following statements :**
1. PVC pipes provide smoother internal surface than the RCC pipes.
2. C value of PVC pipes is lower than that of CI pipes.
3. When large diameter (>1500 mm) pipes are required, the choice of material is limited to Prestressed Concrete pipes and Steel pipes.

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

87. **Consider the following statements :**
1. Most colloidal particles in water are negatively charged.
2. The surface charge on colloidal particles is the major contributor to their long-term stability.

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

88. **Consider the following statements in respect of a steady two-dimensional rotational flow :**
1. Continuity equation is satisfied and streamlines can be drawn.
2. Both stream function and velocity potential function exist.

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

89. **Consider the following statements in respect of the critical depth of flow in a prismatical rectangular channel :**
1. For known specific energy, the discharge is minimum.
2. For known discharge, the specific energy is minimum.

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

90. **The sequent depth ratio in a hydraulic jump formed in a horizontal rectangular channel is 16.48. The flow is**

supercritical. What is the value of the Froude number of flow ?

(a) 4.0 (b) 8.0 (c) 12.0 (d) 120.0

91. What is the ratio of the lift coefficient to drag coefficient of an aerofoil section at stall ?

(a) 1.5 (b) 3 (c) 15 (d) 30

92. A pipeline, 2000 m long, carries water. Velocity of propagation of pressure wave is 1000 m/s. If the valve at the downstream end is instantaneously closed at time $t = 0$, negative water hammer pressure at the valve will last for

(a) 0–4 s (b) 2–4 s

(c) 4–8 s (d) 8–12 s

93. Match List–I with List–II and select the correct answer using the code given below the Lists:

List-I	List-II
A. Streamlines coming closer	1. Sink
B. Streamlines with increasing spacing	2. Source
C. Streamlines converging radially	3. Accelerating flow
D. Streamlines diverging radially	4. Decelerating flow

	A	B	C	D		A	B	C	D
(a)	3	2	1	4	(b)	1	4	3	2
(c)	3	4	1	2	(d)	1	2	3	4

94. As per Lacey's regime equation, what is the flow velocity proportional to ?

(a) $(Qf^2)^{1/3}$ (b) $(Qf^2)^{1/6}$

(c) Q / f^2 (d) $(Q / f^2)^{1/6}$

where Q is the discharge and f is the Lacey's silt factor.

95. A very tiny sphere is settling down in a viscous fluid at Reynolds number = 0.2. What is the value of its drag coefficient ?

(a) 320 (b) 120 (c) 80 (d) 5

96. **Which one of the following statements is correct ?**
As the depth of immersion of a vertical plane surface increases, the location of centre of pressure
(a) comes closer to the centre of gravity of the area
(b) moves apart from the centre of gravity of the area
(c) ultimately coincides with the centre of gravity of the area
(d) remains unaffected

97. **Non-colloidal liquids are**
(a) Newtonian fluids (b) plastic fluids
(c) ideal fluids (d) dilatant fluids

98. **Match List–I with List–II and select the correct answer using the code given below the Lists:**

List-I	*List-II*
A. Activated sludge	1. Is done in settling tank with detention time 1–1.5 hr
B. Primary treatment	2. Very active and can treat fresh sewage
C. Sludge index	3. Estimation of quality of return sludge
D. Return sludge	4. Active sludge obtained from final settling tank

	A	B	C	D
(a)	2	3	1	4
(c)	2	1	3	4

	A	B	C	D
(b)	4	1	3	2
(d)	4	3	1	2

99. **Match List–I *(Appurtenance)* with List–II *(Function in Water Supply)* and select the correct answer using the code given below the Lists:**

List-I	*List-II*
A. Drop Manhole	1. Carrying sewage flow below depressions
B. Inverted Siphon	2. Connecting higher level branch sewer to lower level main sewer
C. Manhole	3. Transporting sewage from basements to higher level sewer
D. Air Ejector	4. Connecting branch sewer to lower level main sewer

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	2	1	4	3
(c)	3	1	4	2	(d)	2	4	1	3

100. A right circular cylinder open at top, is filled with liquid of specific gravity 1.6 and is rotated about its vertical axis at such a speed that half the liquid spills out. What is the pressure at the centre of bottom ?

(a) Zero

(b) $\frac{1}{4}$th of the value, when the cylinder was full

(c) $\frac{1}{2}$th of the value, when the cylinder was full

(d) The same as before the cylinder was rotated

101. Which of the following rules should be followed while doing the resource scheduling ?

1. CPM network logic must be maintained.
2. Activities on the critical paths must use a normal crew size.
3. Activities on the non-critical path must use minimum crew size.

Select the correct answer using the code given below :

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

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

102. Which one of the following statements is correct ?

The principle of superposition is applicable to

(a) non-linear behaviour of material and small displacement theory

(b) non-linear behaviour of material and large displacement theory

(c) linear elastic behaviour of material and small displacement theory

(d) linear elastic behaviour of material and large displacement theory

103. Consider the following steps in conducting consolidated drained triaxial test :

1. Opening of the drainage valve
2. Application of the back pressure
3. Application of the cell pressure
4. Shearing

Which one of the following is the correct sequence of the steps given above ?

(a) 1 – 3 – 2 – 4 (b) 2 – 4 – 1 – 3
(c) 1 – 4 – 2 – 3 (d) 2 – 3 – 1 – 4

104. In which situation can ladder network be employed more conveniently ?

(a) More than one activity can be started concurrently
(b) There is linear sequential flow of activities
(c) The project involves overlapping activities
(d) There are more than one dangling event

105. What is the discharge corresponding to a critical depth of 1.20 m in a 3.0 m wide rectangular channel ?

(a) 4.12 m^3/s (b) 4.94 m^3/s
(c) 8.24 m^3/s (d) 12.35 m^3/s

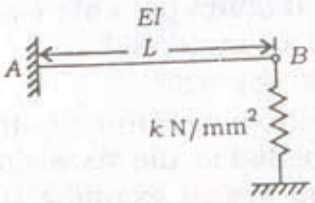
106. Why are gate valves provided in distribution system ?

(a) To minimize the flow pressure in the network
(b) To maximize the usage of the distribution system
(c) To control the flow in the pipe network
(d) To identify the loss through illegal connections

107. What are the gases produced by landfills primarily comprised of ?

(a) Carbon monoxide and hydrogen sulphide
(b) Methane and carbon dioxide
(c) Sulphur dioxide and nitrogen dioxide
(d) Ethane and oxygen

108.

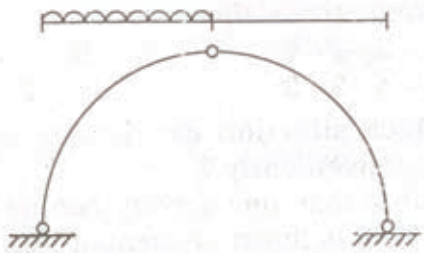


What is the stiffness constant associated with the system shown above when a concentrated load is placed at B?

(a) $48EI/L^3 + k$ (b) $24EI/L^3 + k$

(c) $12EI/L^3 + k$ (d) $3EI/L^3 + k$

109.



For the three-hinged parabolic arch shown above, which one among the following represents bending moment?

(a)

(b)

(c)

(d)

110. A cantilever has rectangular cross-section and supports concentrated load at its free end initially. If depth and width of the beam section are doubled, the deflection at free end of the cantilever will reduce to what percentage of the initial deflection?

(a) 20% (b) 15.72% (c) 9.57% (d) 6.25%

111. What is the maximum possible value of Poisson's ratio for a non-dilatant material?

(a) 0.67 (b) 0.50 (c) 0.33 (d) 0.25

Directions : The following nine (9) items consist of two statements : one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the code given below :

(a) Both A and R are individually true and R is the correct explanation of A

(b) Both A and R are individually true but R is ***not*** the correct explanation of A

(c) A is true but R is false (d) A is false but R is true

112. **Assertion (A)** : The surface overflow rate (SOR) of the sedimentation basin is numerically equal to the flow divided by its plan area.

Reason (R) : SOR physically represents the settling velocity of the slowest settling particles that are 100% removed in an ideal settling basin.

113. **Assertion (A)** : Location of the elevated service reservoir (ESR) at the centre of the distribution area is helpful in equitable distribution of water to the consumers even when the distribution area is large.

Reason (R) : For equitable distribution of water to the city, sufficient number of ESRs shall be provided to limit the area to be served by each of the ESRs.

114. **Assertion (A)** : PERT is a deterministic model.

Reason (R) : PERT makes the assumption that the optimistic ad pessimistic times are about equally likely to occur.

115. **Assertion (A)** : In a three-hinged arch subjected to uniformly distributed load over the span, with rise in temperature horizontal thrust at supports will increase.

Reason (R) : Rise in temperature increases length of the arch.

116. **Assertion (A)** : While the other elements of the flexibility matrix may be positive or negative, the elements lying on the

leading diagonal are always positive.

Reason (R) : The displacement at any coordinate due to a unit force at that coordinate is always in the direction of the unit force.

117. Assertion (A) : In a two-hinged arch, shape of the bending moment diagram will correspond to shape of the arch due to temperature rise.

Reason (R) : Hinges at supports will exert only horizontal thrust on the supports.

118. Assertion (A) : Cant deficiency occurs when train travels around a curve at speed higher than the equilibrium speed.

Reason (R) : Cant deficiency is the difference between the actual cant and the theoretical cant.

119. Assertion (A) : Taylor's stability charts are used for sudden drawdown condition

Reason (R) : Taylor's stability charts are vary only for total stress analysis.

120. Assertion (A) : Rankine's earth pressure theory is a simplified form of Coulomb's earth pressure theory.

Reason (R) : Coulomb's theory considers effects of pore pressures.