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T.B.C. : B-FRF-M-BUA

Test Booklet Series

Serial No.

# TEST BOOKLET

## CIVIL ENGINEERING

### Paper I

A

Time Allowed : Two Hours

Maximum Marks : 200

## INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET *DOES NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. PLEASE NOTE THAT IT IS THE CANDIDATE'S RESPONSIBILITY TO ENCODE AND FILL IN THE ROLL NUMBER AND TEST BOOKLET SERIES CODE A, B, C OR D CAREFULLY AND WITHOUT ANY OMISSION OR DISCREPANCY AT THE APPROPRIATE PLACES IN THE *OMR* ANSWER SHEET. ANY OMISSION/DISCREPANCY WILL RENDER THE ANSWER SHEET LIABLE FOR REJECTION.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write *anything else* on the Test Booklet.
4. This Test Booklet contains 120 items (questions). Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case, you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose *ONLY ONE* response for each item.
5. You have to mark your responses *ONLY* on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator *only the Answer Sheet*. You are permitted to take away with you the Test Booklet.
9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for wrong answers :**  
**THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE.**
  - (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.33)** of the marks assigned to that question will be deducted as penalty.
  - (ii) If a candidate gives more than one answer, it will be treated as **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
  - (iii) If a question is left blank i.e. no answer is given by the candidate, there will be **no penalty** for that question.

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1. Which of the following statements are correct ?

1. Knots in a tree affect the continuity of fibres.
2. Nail knots do not influence the strength of timber.
3. Druxiness of wood is not a defect.
4. Tall trees with twisted fibres give good timber for poles.

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

2. Excrescences in wood are :

1. Defects found in trees
2. Formed due to injuries inflicted on trees when they are growing
3. Defects which render wood suitable as firewood only

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

3. What treatment is adopted for making timber fire-resistant ?

- (a) ASCU treatment  
(b) Abel's process  
(c) Creosoting  
(d) Tarring

4. Deterioration of structure of timber due to dry rot is :

1. Caused by fungi
2. Due to dry-spell after heavy rains
3. Due to attack of termites
4. Indicated by surface stripes on scantlings

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

5. Alternate wetting and drying of timber :

1. Results in shrinkage and swelling
2. Brings about wet rot onset
3. Increases the durability
4. Causes transmission of spores from germination

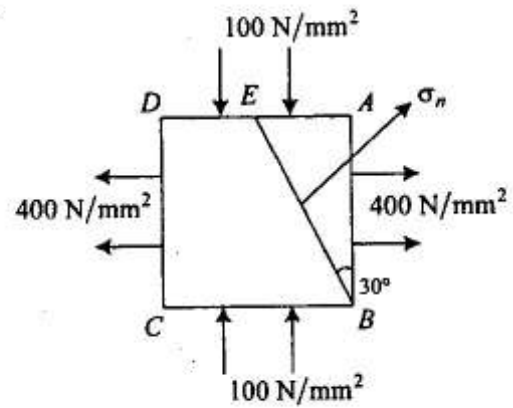
- (a) 1, 2, 3 and 4  
(b) 1, 2 and 4 only  
(c) 1, 2 and 3 only  
(d) 2, 3 and 4 only

6. As per I.S. classification, the minimum compressive strength of a first class brick should be

- (a) 75 kg/cm<sup>2</sup>  
(b) 100 kg/cm<sup>2</sup>  
(c) 125 kg/cm<sup>2</sup>  
(d) 150 kg/cm<sup>2</sup>

7. When provided with alternating courses of (a) all headers and (b) all stretchers, the front elevation of such brick masonry is designated as
- English bond
  - Single Flemish bond
  - Double Flemish bond
  - Rat-trap bond
8. I.S. Code specifies that the compressive strength of brick shall be determined by keeping the brick :
- On edge
  - On bed
  - After soaking in water for 2 hrs
  - After soaking in water for 24 hrs
- 1 and 2
  - 2 and 3
  - 3 and 4
  - 2 and 4
9. Soundness test of cement is carried out to determine its
- alumina content
  - iron oxide content
  - free lime content
  - durability under sea water
10. The objectives of producing cement include :
- Incorporating industrial wastes
  - Increasing free lime
  - Increasing fineness
  - Saving energy needed in the process
- 1, 2, 3 and 4
  - 1, 3 and 4 only
  - 1, 2 and 4 only
  - 2, 3 and 4 only

11.



The principal stresses in  $\text{N/mm}^2$  on a rectangular element are shown in the above figure. The intensity of normal stress  $\sigma_n$  on the oblique plane  $BE$  is

- $125 \text{ N/mm}^2$
- $425 \text{ N/mm}^2$
- $375 \text{ N/mm}^2$
- $250 \text{ N/mm}^2$

12. The strength of concrete depends on :

- Type of mortar
- Proportion between coarse and fine aggregates
- Water cement ratio
- Temperature at time of mixing

- 1 and 2
- 2 and 3
- 2 and 4
- 3 only

13. Consider the following statements :

1. Strength of structural concrete is absolutely dependent upon water-cement ratio.
2. Increase in temperature during curing period improves the strength, especially for aluminous cements.
3. The concern for onset of fatigue in concrete can be overcome by increasing design loads in limit state design.
4. Even though concrete gains strength after 28 days, such increase is not considered at design stage.

Which of these statements are correct ?

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

14. The workability of concrete is assessed through :

1. Slump test
2. Compaction factor test
3. Setting time of cement
4. Le-Chatelier's apparatus

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

15. Consider the following statements as describing the Rheological behaviour of fresh concrete :

1. Newtonian
2. Non-Newtonian
3. Ratio of shear stress to shear rate is constant
4. Ratio of shear stress to shear rate depends upon the shear rate

Which of these statements are correct ?

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

16. Which of the following tests compares the dynamic modulus of elasticity of samples of concrete ?

- (a) Compression test
- (b) Ultrasonic pulse velocity test
- (c) Split test
- (d) Tension test

17. UPV method in nondestructive testing for concrete is used to determine :

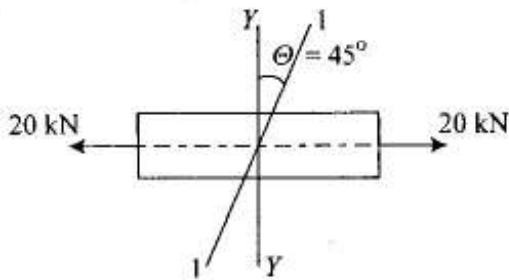
1. Compressive strength
2. Existence of voids
3. Tensile strength
4. Static modulus of concrete
5. Dynamic modulus of concrete

- (a) 1, 2, 3 and 4
- (b) 1 and 3 only
- (c) 2 and 5 only
- (d) 3 and 5 only

18. A mild steel rod tapers uniformly from 24 mm dia. to 12 mm dia. over its length of 400 mm. The rod when held vertical is subjected to an axial tensile load of 12 kN.  $E = 2 \times 10^5 \text{ N/mm}^2$ . The extension of the rod in mm would be

- (a)  $\frac{3\pi}{2}$
- (b)  $\frac{2}{3\pi}$
- (c)  $\frac{\pi}{3}$
- (d)  $\frac{1}{3\pi}$

19.



A mild steel bar of square cross-section has a sectional area  $200 \text{ mm}^2$ . It is subjected to an axial force of  $20 \text{ kN}$  as shown in the above figure. The intensity of the normal tensile stress is  $\text{N/mm}^2$  on the oblique plane 1-1 at  $45^\circ$  with the  $YY$ -axis which is normal to the longitudinal axis will be

- (a) 25
- (b) 50
- (c) 75
- (d) 100

20. Poisson's ratio of a material is 0.3. Then the ratio of Young's modulus to bulk modulus is

- (a) 0.6
- (b) 0.8
- (c) 1.2
- (d) 1.4

21. The relationship between Young's Modulus  $E$ , Modulus of Rigidity  $C$  and Bulk Modulus  $K$  in an elastic material is given by the relation

- (a)  $E = \frac{9KC}{3K + C}$
- (b)  $E = \frac{3KC}{3K + C}$

(c)  $E = \frac{9KC}{9K + C}$

(d)  $E = \frac{3KC}{9K + C}$

22. Which of the following statements are correct ?

1. In a ductile material elastic deformation is more predominant than plastic one.
2. Brittleness is not an absolute property of a metal.
3. Rate of loading has no influence in changing the behaviour of a metal from 'ductile' to 'brittle' at low temperatures.
4. Under hydrostatic compression, a brittle metal may change into a ductile one.

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

23. The total deflection of a structure when subjected simultaneously to different sets of loading is equal to the sum of the deflections under each such set of loads as if acting separately on the structure. Which one of the following justifies this statement ?

- (a) Elastic limit is not exceeded
- (b) Elastic limit including buckling is not exceeded
- (c) Limit state is not exceeded
- (d) Proportional limit without buckling is not exceeded

24. A rectangular bar of cross-sectional area  $A$  is subjected to an axial tensile load  $P$ . The maximum shear stress will occur on a plane at  $X^\circ$  to any normal cross-section where  $X^\circ$  is

- (a)  $90^\circ$
- (b)  $270^\circ$
- (c)  $180^\circ$
- (d)  $45^\circ$

25. A solid circular shaft has been subjected to a pure torsion moment. The ratio of maximum shear stress to maximum normal stress at any point would be

- (a) 1 : 2
- (b) 1 : 1
- (c) 2 : 3
- (d) 2 : 1

26. Which of the following statements are correct ?

1. All load carrying members transmit load through basic modes of tension, compression, torsion and shear only.
2. Beams carry transverse loads.
3. Combined loading is a complicated loading.
4. Nature of internal forces decides the aspect of combined loading.

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

27. A rectangular beam of dimensions  $b \times d$  is to be cut from a circular log of wood of diameter  $D$ . For the beam to be strongest in bending, the dimensions will be

- (a)  $\frac{D}{\sqrt{2}}$  and  $D\sqrt{\frac{2}{3}}$
- (b)  $\frac{D}{\sqrt{3}}$  and  $D\sqrt{\frac{2}{3}}$
- (c)  $\frac{D}{\sqrt{2}}$  and  $\sqrt{\frac{2D}{3}}$
- (d)  $\frac{D}{\sqrt{3}}$  and  $\sqrt{\frac{2D}{3}}$

28. Which of the following statements are correct ?

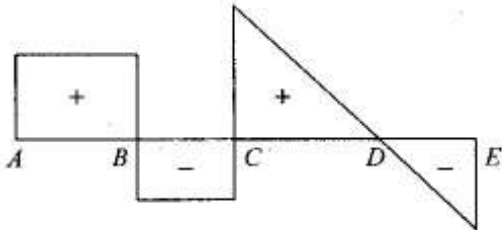
1. Experimental results on thin-walled tubes show that maximum normal stress theory is valid.
2. Normal stress theory is valid in case of brittle materials.
3. In case of pure shear, St. Venant's theory is more valid than other theories.
4. Tresca's theory is very closely substantiated by experimental results.
5. In maximum stress theory, the yield locus is a hexagon.

- (a) 1, 2 and 3
- (b) 2, 4 and 5
- (c) 1, 2 and 4
- (d) 2, 3 and 4

29. A thin cylindrical shell made of mild steel plate is 1000 mm in diameter. It is to be subjected to an internal pressure of  $2 \text{ N/mm}^2$ . If the material yields at  $200 \text{ N/mm}^2$ , the thickness of the plate in mm on the basis of Rankine's theory of failure with assuming a factor of safety of 3 would be

- (a) 10
- (b) 12
- (c) 15
- (d) 18

30.



Consider the following statements with reference to a continuous beam supported at  $A$ ,  $C$  and  $E$  for which shear force diagram is shown in the above figure.

There is :

1. A concentrated load acting at point  $B$ .
2. A concentrated load acting at point  $D$ .
3. A uniformly distributed load acting on the portion  $CE$ .

Which of these statements are correct ?

- (a) 1, 2 and 3
  - (b) 1 and 2 only
  - (c) 2 and 3 only
  - (d) 1 and 3 only
31. Which of the following loads should be applied on a simply supported beam, so that the shear force is constant throughout its span ?
- (a) U.D.L. over the entire span
  - (b) Two concentrated loads equally spaced in the span
  - (c) A central concentrated load and a U.D.L. over the entire span
  - (d) A couple anywhere in the span

32. A simply supported rolled steel joist of I-section has flange width 250 mm and overall depth 600 mm. Its moment of inertia  $I_{xx} = 12 \times 10^8 \text{ mm}^4$ . The steel joist is used as a beam over a simply supported span of 6 m. It carries a load of 40 kN/m including its self weight throughout the span. The maximum stress induced in the beam in  $\text{N/mm}^2$  due to bending would be

- (a) 30
- (b) 90
- (c) 45
- (d) 60

33. Which of the following terms represents the torque that produces a twist of one radian in a shaft of unit length ?

- (a) Torsional stress
- (b) Torsional rigidity
- (c) Flexural rigidity
- (d) Moment of resistance

34. A 60 mm dia. shaft is subjected to a torque of 6 kN-m.  $C = 8 \times 10^4 \text{ N/mm}^2$ . The maximum shear stress induced in the shaft in  $\text{N/mm}^2$  will be

- (a)  $\frac{8000}{9\pi}$
- (b)  $\frac{4000}{9\pi}$
- (c)  $\frac{12000}{9\pi}$
- (d)  $\frac{16000}{9\pi}$

35. A water main 160 cm dia. contains water at a pressure head of 200 m. Take weight of water to be  $1000 \text{ kg/m}^3$ . The thickness of the metal shell required for the water main, given that the maximum permissible stress in the metal is  $400 \text{ kg/cm}^2$ , will be

- (a) 1 cm
- (b) 2 cm
- (c) 3 cm
- (d) 4 cm

36. Which of the following statements is/are correct ?

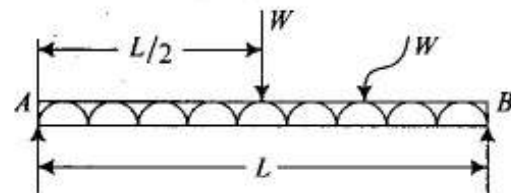
1. For statically determinate structures, magnitudes for maximum effects due to a series of concentrated loads can be established with the aid of influence lines.
2. Cables in suspension bridges will not take the parabolic shape if uniformly loaded along the horizontal span.
3. In a three-hinged arch structure, the normal force, shear and moment at any section are not influenced by the horizontal reaction at the support.

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

37. A three-hinged arch of span  $L$  and rise  $R$  is subjected to a concentrated load  $P$  at the crown-point. The horizontal thrust at the support is

- (a)  $\frac{PL}{4R}$
- (b)  $\frac{PL}{R}$
- (c)  $\frac{PR}{L}$
- (d)  $\frac{PL}{3R}$

38.

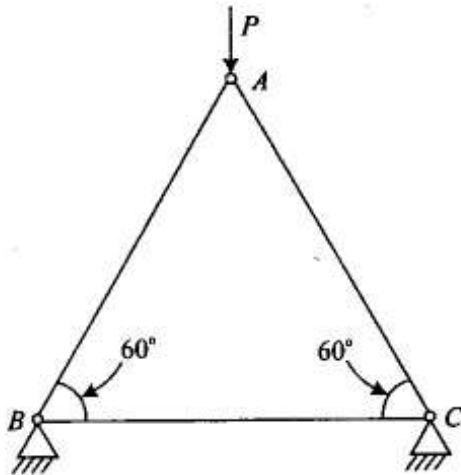


A simply supported beam of span  $L$  shown in the above figure is subjected to a concentrated load  $W$  at its mid-span and also to a uniformly distributed load equivalent to  $W$ . It has a flexural rigidity of  $EI$ . What is the total deflection at its mid-point ?

- (a)  $\frac{5}{384} \frac{WL^3}{EI}$
- (b)  $\frac{9}{384} \frac{WL^3}{EI}$
- (c)  $\frac{13}{384} \frac{WL^3}{EI}$
- (d)  $\frac{18}{384} \frac{WL^3}{EI}$



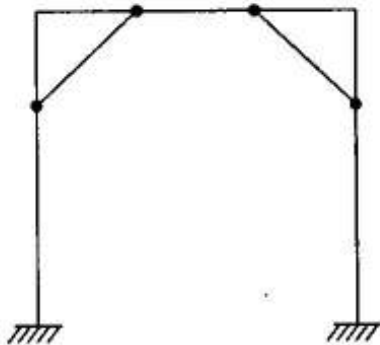
39.



The force in member  $BC$  is

- (a)  $\frac{P}{2\sqrt{2}}$
- (b) zero
- (c)  $\frac{2P}{\sqrt{3}}$
- (d)  $\frac{P\sqrt{3}}{2}$

40.



The degree of static indeterminacy for the rigid frame as shown above is

- (a) 3
- (b) 4
- (c) 5
- (d) 6

41. Clockwise moments are applied to both the ends of a uniform simply supported beam. If the ratio of the rotation of two ends is 2, then the ratio of the applied moments will be

- (a)  $\frac{5}{4}$
- (b)  $\frac{7}{5}$
- (c)  $\frac{5}{3}$
- (d)  $\frac{3}{2}$

42. Which of the following statements are correct ?

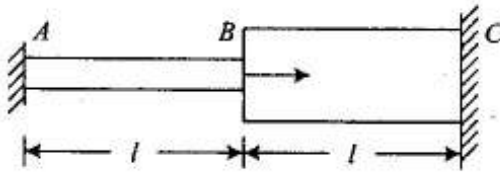
1. It is common practice to discount the influence of axial thrust on bending stiffness of members of frames.
2. In a portal frame of single bay, the columns have different thermal coefficients of expansion. If the whole frame is subjected to a same temperature, there will be a component of deformation in the vertical direction.
3. The flexibility method of analysis cannot be used to solve any kind of indeterminate structural problem.

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

43. Stiffness method of structural analysis starts with

- (a) force-deformation relations
- (b) equilibrium condition
- (c) compatible deformation
- (d) equilibrium state of internal stress components

44.



A stepped circular shaft is fixed at A and C as shown in the above figure. The diameter of the shaft along BC is twice that of as along AB. The torsional rigidity of AB is  $GJ$ . The torque required for unit twist at B is

(a)  $\frac{2GJ}{l}$

(b)  $\frac{5GJ}{l}$

(c)  $\frac{9GJ}{l}$

(d)  $\frac{17GJ}{l}$

45. The force required to produce a unit displacement (translation without rotation) at either one-third point of a fixed beam of span  $l$  and of uniform flexural rigidity  $EI$  is

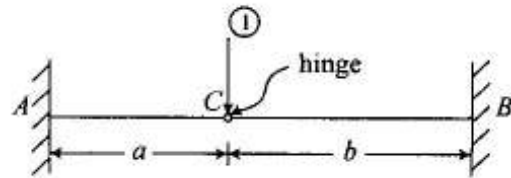
(a)  $\frac{729 EI}{l^3}$

(b)  $\frac{724 EI}{l^3}$

(c)  $\frac{724 EI}{3l^3}$

(d)  $\frac{729 EI}{2l^3}$

46.



The stiffness coefficient  $k_{11}$  for the beam as shown above is

(a)  $EI\left(\frac{1}{a^3} + \frac{1}{b^3}\right)$

(b)  $2EI\left(\frac{1}{a^3} + \frac{1}{b^3}\right)$

(c)  $3EI\left(\frac{1}{a^3} + \frac{1}{b^3}\right)$

(d)  $4EI\left(\frac{1}{a^3} + \frac{1}{b^3}\right)$

47. For which one of the following cases is the Muller-Breslau principle applicable to get influence line ?

(a) Reaction at the ends of a simple beam

(b) Bending moment at a section

(c) Shear force at a section

(d) Forces and moments at any section

48. The area of influence diagram for the reaction at the hinged end of a uniform propped cantilever beam of span  $l$  is

(a)  $\frac{3l}{8}$

(b)  $\frac{l}{2}$

(c)  $\frac{l}{4}$

(d)  $\frac{l}{8}$

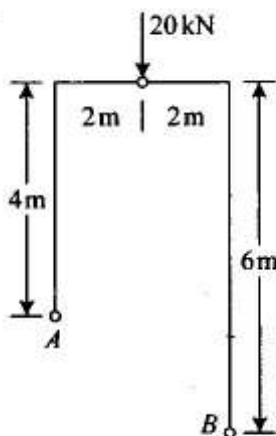
49. Consider the following statements :

1. The virtual work method is preferred to the equilibrium method for the determination of collapse load in a structure.
2. The number of plastic hinges required for the total collapse of a statically indeterminate structure is one less than the degree of indeterminacy of the structure.
3. In a large system the uniformly distributed load can be replaced by a number of concentrated loads to simplify the plastic analysis.

Which of these statements are correct ?

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

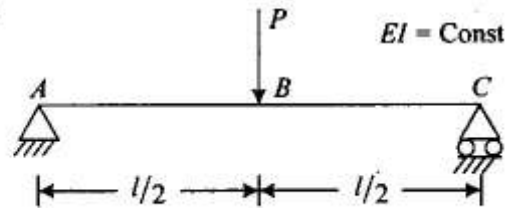
50.



For the frame shown above, what is the horizontal thrust at A ?

- (a) 5 kN
- (b) 8 kN
- (c) 10 kN
- (d) 12 kN

51.

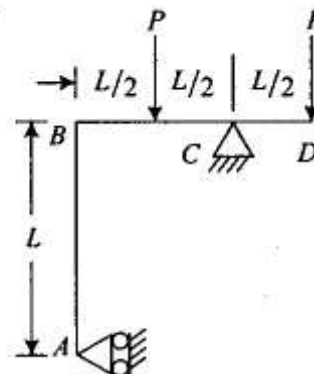


Mid-span deflection for the beam-load system shown above can be obtained by

1. Area-moment method
2. Energy method
3. Generalized three moment equation
4. Conjugate beam method

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

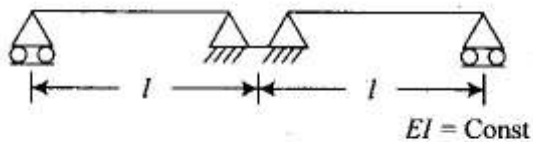
52.



A frame ABCD is supported by a roller at A and is on a hinge at C as shown in the above figure. The reaction at the roller end A is given by

- (a)  $P$
- (b)  $2P$
- (c)  $P/2$
- (d) zero

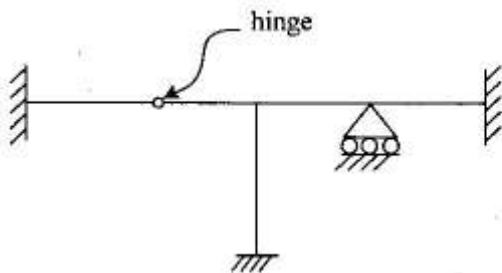
53.



Dead load of the beams is  $\omega/2$  per unit run. Live load on the beams is  $\omega/2$  per unit run. The two segments are hoisted on simple supports; and then continuity is established at the mid-support before live load is applied. The design mid-span moment is

- (a)  $\frac{\omega l^2}{8}$
- (b)  $\frac{\omega l^2}{16}$
- (c)  $\frac{\omega l^2}{32}$
- (d)  $\frac{3\omega l^2}{32}$

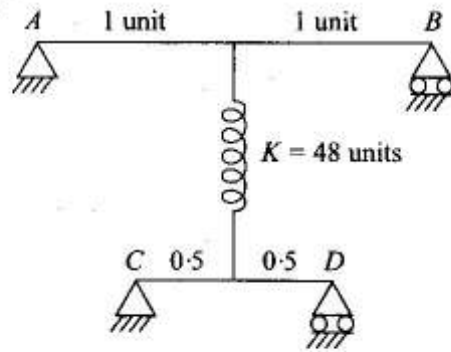
54.



The static indeterminacy of the frame shown above is

- (a) 4
- (b) 6
- (c) 8
- (d) 10

55.



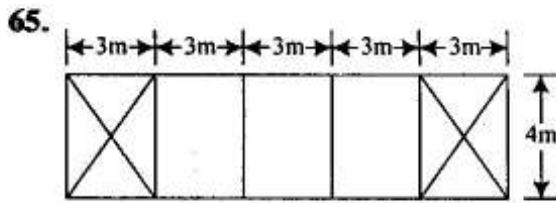
The equivalent spring constant for the set up shown in the above figure, where  $EI = \text{unity}$  throughout, is

- (a) 30 units
- (b) 36 units
- (c) 40 units
- (d) 48 units

56. Which one of the following four shapes for a compound column of the same effective height formed with two equal angles has the largest axial compressive load carrying capacity ?

- (a)
- (b)
- (c)
- (d)

57. Two angles of *ISA*  $100 \times 100 \times 6$  have been used as a tie member. The angles are welded on either side of a gusset and tag welded over its length. The maximum length of the member is : (For *ISA*  $100 \times 100 \times 6$ , Area =  $2334 \text{ mm}^2$  and  $Y_{xx} = 30 \text{ mm}$ )
- 5.4 m
  - 6.0 m
  - 12.0 m
  - 24.0 m
58. A crane with two wheels per side has a capacity of 50 kN. Weight of the crane is 100 kN, weight of the trolley is 10 kN and the span is 12 m. The maximum static wheel load with hook clearance of 1.0 m from the wheel is
- 50 kN
  - 52.5 kN
  - 55 kN
  - 60 kN
59. Gantry girders are designed to resist :
- Lateral loads
  - Longitudinal loads
  - Vertical loads
- 1 and 2 only
  - 1 and 3 only
  - 2 and 3 only
  - 1, 2 and 3
60. The effective width of outstand in compound steel columns for design purposes is equal to
- half the flange width
  - distance of the free edge from the rivet line
  - distance of the free edge from the stiffeners
  - distance of the free edge to the nearest row of rivets
61. For a steel built-up column subjected to an axial force of 1200 kN, the lacing system is to be designed for resisting transverse shear of
- 15 kN
  - 20 kN
  - 25 kN
  - 30 kN
62. At a certain location of a plate girder of web size  $1000 \text{ mm} \times 10 \text{ mm}$ , a pair of bearing stiffeners  $100 \text{ mm} \times 5 \text{ mm}$  is welded. The effective area of bearing stiffeners is
- $1000 \text{ mm}^2$
  - $2000 \text{ mm}^2$
  - $3000 \text{ mm}^2$
  - $5000 \text{ mm}^2$
63. *ISMB* 250 ( $Z_e = 410 \times 10^3$ )  $\text{mm}^3$  has been chosen as a beam cross-section to resist a bending moment. Two plates  $100 \text{ mm} \times 10 \text{ mm}$  are welded to each flange to enhance the moment capacity. The enhanced moment capacity is
- 71.5 kNm
  - 79.5 kNm
  - 99.0 kNm
  - 148.0 kNm
64. A monorail crane runs on an I-section of span 6 m, which is simply supported. Estimate the deflection for crane capacity of 20 kN, crab weight of 4 kN, impact factor of 25% and  $EI = 10 \times 10^{12} \text{ N-mm}^2$ . Deflection due to self-weight is neglected.
- 6 mm
  - 9 mm
  - 12 mm
  - 18 mm



An industrial building with 5 bays each 3 m wide has columns of height 4 m. The two end bays are braced by rods as shown in the above figure. Each column carries an axial load of 120 kN. The design force for each brace is

- (a) 6 kN
- (b) 9 kN
- (c) 15 kN
- (d) 30 kN

66. Which of the following statements are correct ?

1. In a steel compound column section, the width will be smaller when they are placed face to face than when they are placed back to back.
2. In the design of steel compound columns the length of battens are normally longer than the lacings.
3. Lacings in a steel compound column are designed as slender compression members.

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

67. Bearing stiffeners in plate girders are provided to

- (a) decrease the effective depth of web
- (b) transfer the load from the top flange to the bottom flange
- (c) prevent buckling of web
- (d) increase the bearing capacity of the flange

68. Which of the following statements is/are correct ?

1. A steel structure designer can guarantee the safety of the structure.
2. Working stress method of design of steel structures offers a safer and economical structure.
3. Strength and serviceability of a structure cannot be predicted on account of several unforeseen factors.

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

69. Which one of the following states falls under the 'Limit state of Serviceability' as per IS-456 ?

- (a) Stability under load
- (b) Loss of equilibrium of a structure
- (c) Floor vibration
- (d) Formation of mechanism

70. Splicing of rebars in RCC beams can be done at a section where

- (a) bending moment is zero
- (b) bending moment is less than half of the maximum bending moment in beam
- (c) bending moment is maximum
- (d) shear force is zero

71. Which of the following statements are correct ?

1. The conventional rigid frame system of columns and beams works well for carrying both vertical and lateral loads for buildings up to 28 storeys height.
2. A shear wall does not provide stability against lateral loads.
3. Drying shrinkage is caused by the evaporation of water from concrete stored in unsaturated air.

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

72. As per IS-456 : 2000, side face reinforcement in a beam is provided where depth of the web exceeds

- (a) 750 mm
- (b) 250 mm
- (c) 500 mm
- (d) 1000 mm

73. Factor of safety is the ratio of

- (a) tensile stress to working stress
- (b) compressive stress to working stress
- (c) bending stress to working stress
- (d) yield stress to working stress

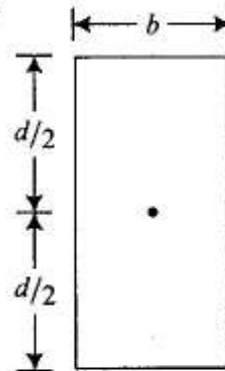
74. Consider the following statements for prediction of yield lines in a reinforced concrete slab :

1. They represent the axis of rotation.
2. They will propagate outward from a point load.
3. They are straight lines between two intersecting planes.
4. They end at the boundary of the slab or at another yield line.

Which of these statements are correct ?

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

75.



The above figure represents a section of a pre-stressed beam. For a no-tension design where  $\sigma_c$  is the permissible stress in concrete, the total moment carrying capacity is

- (a)  $\frac{bd^2\sigma_c}{3}$
- (b)  $\frac{bd^2\sigma_c}{4}$
- (c)  $\frac{bd^2\sigma_c}{6}$
- (d)  $\frac{bd^2\sigma_c}{12}$

76. Spalling stresses are produced in post-tensioned pre-stressed concrete members because of

- (a) bursting force
- (b) highly concentrated tendon force
- (c) inadequate anchor block
- (d) maximum shear zone

77. Which of the following statements are correct ?

- 1. Splices in flexural members should not be at sections where the BM is more than 50% of the moment of resistance.
- 2. Normal lap splines can be used for all types of bars irrespective of the sizes.
- 3. Where bars of two different diameters are to be spliced, the lap length shall be calculated on the basis of the diameter of the smaller bar.

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

78. A concordant cable profile in pre-stressed concrete is

- (a) parallel to the beam axis
- (b) one which coincides with the centroidal axis of beam
- (c) one which does not cause secondary stresses
- (d) one which eliminates primary stresses

79. Which of the following factors would greatly affect the attainment of best possible strength of the concrete mix produced using the weigh-batcher ?

- 1. Moisture content in the sand and gravel
- 2. Inadequate or excess use of approved admixtures
- 3. Speed of rotation of the drum
- 4. Non-emptying of the drum as fully as possible

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

80. The initial cost of equipment is Rs. 1100, salvage value is Rs. 100 and life of equipment is 5 years. The rate of interest for sinking fund is 8%. The yearly depreciation by straight line method is

- (a) Rs. 200
- (b) Rs. 400
- (c) Rs. 600
- (d) Rs. 800

81. In a construction project, the cost-slope of an activity is an indication of

- (a) extra-time needed
- (b) extra cost needed
- (c) reduction of duration of critical activity
- (d) crashing of an activity



82. Which of the following statements are correct ?

Tilting type concrete mixers are preferred *in situ* :

1. Because problem of clogging the opening is avoided.
2. For large constructions only.
3. Because they are suitable for dry mix.
4. Whenever the rated capacity is more than 200 litres.

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

83. An equipment for use in construction activity is purchased now for Rs. 15000, and is used continuously on the job. The annual OMR costs assignable as lump sum at the respective year beginning are Rs. 5000. The equipment will be used for 5 years after which its salvage value is estimated to then be Rs. 1000. The equivalent annual cost as reckoned at the end of each year when MACR is 10% for which SFF for 5 years is 0.1638 is

- (a) Rs. 7800  
 (b) Rs. 8000  
 (c) Rs. 8793  
 (d) Rs. 8957

84. Which of the following statements are correct ?

1. Drag lines are superior to hoes in excavation jobs.
2. Hoes are more rigid than power shovels.
3. For deeper excavations power shovels give lesser output than hoes.
4. Hoes exert greater tooth power as compared to draglines.

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

85. If the free haul distance is 200 m, the cost of borrow (including excavation and hauling) is Rs. 4/m<sup>3</sup> at station. Cost of haulage beyond free haul is Rs. 0.75/m<sup>3</sup> per station-meter. The limit of economical haul distance is

- (a) 160 m  
 (b) 260 m  
 (c) 360 m  
 (d) 460 m

86. A four-wheel tractor whose operating weight is 15,000 kg is pulled along a level haul road at a uniform speed by another tractor. The average tension in the toe cable is 675 kg. The rolling resistance of the haul road is

- (a) 25 kg/t  
 (b) 35 kg/t  
 (c) 45 kg/t  
 (d) 55 kg/t

87. A four-cycle gasoline engine when tested at temperature 35°C and pressure of 740 mm of Hg was found to develop 75 HP. Its horse power at standard condition is

- (a)  $75 \times \frac{308}{288.5} \times \frac{740}{760}$   
 (b)  $75 \times \frac{288}{308} \times \frac{760}{740}$   
 (c)  $75 \times \sqrt{\frac{308}{288.5}} \times \sqrt{\frac{740}{760}}$   
 (d)  $75 \times \frac{760}{740} \times \sqrt{\frac{308}{288.5}}$

88. Given that SPCAF, for 10%, for 1, 2 and 3 years are respectively, 1.1000, 1.2100 and 1.3310, what is C.R.F. for 10% for 3 years ?
- 0.7513
  - 0.5187
  - 0.3021
  - 0.4021
89. An equipment costs Rs. 25000 to purchase now. It will be used continuously for 8 years. At the end, its salvage value is estimated to be Rs. 1600. Its residual book value at the beginning of the 6th year of its use, by the straight line method of depreciation is
- Rs. 6250
  - Rs. 9375
  - Rs. 10375
  - Rs. 7450
90. Which of the following statements are correct in respect of a linked-bar chart ?
- Any activity can be shown split into several sub-parts if so desirable.
  - Inter-linkages between WBS groups can be depicted.
  - Mandatory pauses between activities are also always demonstrated on the chart.
  - Scheduling of material procurement can optionally enhance the utility.
- 1 and 2
  - 2 and 3
  - 3 and 4
  - 1 and 4
91. Consider the following statements pertaining to CPM net work analysis :
- It is event-oriented method.
  - It is activity-oriented method.
  - Time and cost are controlling factors.
  - Time alone is controlling factor.
- Which of these statements are correct ?
- 1 and 2
  - 2 and 3
  - 3 and 4
  - 1 and 4
92. Which of the following *do not* characterize the critical path ?
- Falls on a single straight line between start and end nodes
  - Has no dummies
  - Indicates the minimum feasible duration for the complete project
  - Indicates the maximum sensible duration in which to complete the project
  - Has no parallel sub-paths between any two nodes on it
- 2, 4 and 5
  - 1, 2 and 5
  - 2, 3 and 4
  - 1, 3 and 4
93. In a critical path network, which of the following are involved ?
- A series of interconnected activities
  - Considerations for uncertainties in time estimate
  - A logical sequence of activities is provided
  - The node number at the arrow head is numerically smaller than that at tail end
- 1 and 2
  - 2 and 3
  - 3 and 4
  - 1 and 3

94. Which one of the following relates to determination of critical path in PERT ?
- Event-oriented slack
  - Activity-oriented slack
  - Event-oriented float
  - Activity-oriented float
95. PERT calculations yield a project length of 70 weeks with a variance of 9 weeks. The number of weeks required to complete the project with a probability of 95% (probability factor for 95% = 1.647) is
- 73.94 weeks
  - 74.94 weeks
  - 75.94 weeks
  - 76.94 weeks
96. A linear project is split into six identical activities, each having  $a$ ,  $m$  and  $b$  durations of 4, 8 and 10 days, which results in the standard deviation of the duration for the complete project being  $X_1$  days. As an alternative attempt at project planning, the earlier-split six activities are clubbed as (1st and 2nd), (3rd and 4th) and (5th and 6th), thus needing to consider only three (now-modified) activities; and the standard deviation of the duration for the complete project is now reported as  $X_2$  days. What will be the ratio  $\frac{X_2}{X_1}$  ?
- $\frac{2}{3}$
  - $\frac{7}{6}$
  - $\frac{5}{6}$
  - 1
97. A father notes that his teenage son uses the telephone. He takes no less than 5 minutes for a call and sometimes as much as an hour. 20 minutes calls are more frequent than calls of any other duration. Considered as a PERT activity a phone call's expected duration in minutes is
- $20\frac{1}{6}$
  - $22\frac{1}{6}$
  - $24\frac{1}{6}$
  - $26\frac{1}{6}$
98. A project is estimated to cost Rs. 100 million inclusive of 20% thereof as cost of direct labour. However, 60% of the labour hours budgeted for is non-productive. If 15% of such wasted labour hours are intended to be curtailed by improved methods of control, then the resulting savings in labour cost would be
- Rs. 1.2 m
  - Rs. 1.5 m
  - Rs. 1.8 m
  - Rs. 2.0 m
99. Consider the following statements regarding resource allocation/adjustment :
- Economical utilization of resources.
  - Adjustment of resources to have least variation in resource histogram.
  - Gradual increase in resources.
  - Activities are so rescheduled that maximum projected need for any resource does not cross the limit of available resources.
- Which of these statements are correct ?
- 1 and 2
  - 2 and 3
  - 3 and 4
  - 2 and 4

100. There is a task involving  $160 \text{ m}^2$  of fixing timber formwork for the roof slab of a single-storey building. The time earmarked for completion is four days, working eight hours per day. If a workers' team consisting of two skilled workers and an unskilled worker can install the formwork at the rate of  $1.25 \text{ m}^2/\text{hr}$ , then the number of teams required is

- (a) 3
- (b) 4
- (c) 5
- (d) 6

**Directions :**

Each of the next Twenty (20) items consists of two statements, one labelled as the 'Statement (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below :

**Codes :**

- (a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)
- (b) Both Statement (I) and Statement (II) are individually true but Statement (II) is *NOT* the correct explanation of Statement (I)
- (c) Statement (I) is true but Statement (II) is false
- (d) Statement (I) is false but Statement (II) is true

101. Statement (I) : Weight batching method does not produce concrete of required strength.

Statement (II) : Bulking of aggregates does not influence the weight batching method.

102. Statement (I) : Shutter vibrators are preferred over needle vibrators for pre-stressed precast beams for bridges.

Statement (II) : Needle vibrators may get choked by the leaking-in of cement paste.

103. Statement (I) : In concreting for large roof slabs, internal vibrators are preferred.

Statement (II) : External vibrators consume more energy and disturb the formwork.

104. Statement (I) : In the erection of tall buildings, tower crane is preferred.

Statement (II) : Tower crane is a combination crane and it is suitable when the area is small and congested.

105. Statement (I) : For short distance hauls, dumpers are well suited.

Statement (II) : Dumpers have the advantage of larger capacity of 5 cu-m or more, and they are hauled by power units.

**106. Statement (I) :** Power shovels mounted on trawlers are universally used for excavating earth.

**Statement (II) :** They have a dipper with hard teeth to break even hard rocks.

**107. Statement (I) :** Draw-bar pull exerted in crawler-tractors overlaps between different speed ranges, which latter are achieved by operating in different gears.

**Statement (II) :** Variations in rolling resistance of ground surfaces and the grade of the surfaces rolled on, influence the magnitude of the needed draw-bar pull.

**108. Statement (I) :** A wheel type tractor with a scraper is employed to move earth for short hauls.

**Statement (II) :** Wheel type tractor moves faster than crawler type tractor.

**109. Statement (I) :** Diaphragm pump is very popular in constructions requiring dewatering of trenches.

**Statement (II) :** Diaphragm pump is more adaptable in performance than other types of pumps.

**110. Statement (I) :** An air vessel on the suction side of a reciprocating pump contributes much to increase in efficiency.

**Statement (II) :** Water gets sucked into the pump cylinder faster.

**111. Statement (I) :** Negative slip is a possibility in reciprocating pumps.

**Statement (II) :** Non-cavitations in a long suction pipe with simultaneously a short delivery pipe may cause the delivery valve to open before the discharge stroke starts.

**112. Statement (I) :** Reciprocating pumps may have more severe restrictions on their suction piping system than centrifugal pumps.

**Statement (II) :** Centrifugal pumps can have the advantage of axial balancing to alleviate possible axial thrust at the eye of the pump.

**113. Statement (I) :** A bar chart may look awkward when demonstrating the works to be executed for external finishes in multi-storey constructions.

**Statement (II) :** External scaffolding can be dismantled in a top-to-down sequence only.

**114. Statement (I) :** When LSS is drawn as a squared-diagram, the respective total float for each sub-path will be shown in full at the head-end of that sub-path.

**Statement (II) :** By considering LS for scheduling, the spare time is pushed to the head-end.

**115. Statement (I) :** Interdependence between various events is shown on a milestone chart.

**Statement (II) :** Milestones are key events in time which occur as the project progresses.

**116. Statement (I) :** Probabilistic activity durations may yet be relevantly assigned even when work outputs have been standardized for labour gangs for the specified project.

**Statement (II) :** Results of work-study are dependent on rest allowances and work ratings.

**117. Statement (I) :** PERT network is event-oriented and it does not reflect on time or resources.

**Statement (II) :** Planners can decide about the uncertainties involved in time duration while planning itself.

**118. Statement (I) :** When developing the time-cost study of a project as a whole, the time-cost relationships of every activity therein may have necessarily to be inputted.

**Statement (II) :** Any project is constituted by all the activities therein.

**119. Statement (I) :** Inherent weakness of finished plain concrete is the presence of micro-cracks at the aggregate interface. It is minimized by placing fibres in the concrete mix.

**Statement (II) :** The fibres help to transfer all incidental loads at the internal micro-cracks.

**120. Statement (I) :** When an equipment is used at a reduced post of service, the ROR cannot be uniquely determined even when the log book of the equipment has been maintained regularly.

**Statement (II) :** OMR expenditure may be very much reduced when used in reduced post of service.

**SPACE FOR ROUGH WORK**

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