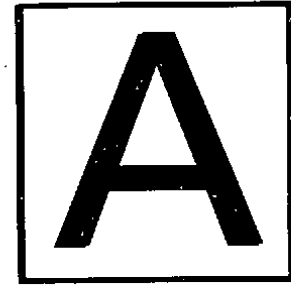


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T.B.C. : Q-GUG-K-DFA

Test Booklet Series

Serial No 018789



TEST BOOKLET  
CIVIL ENGINEERING  
PAPER I

Time Allowed : Two Hours

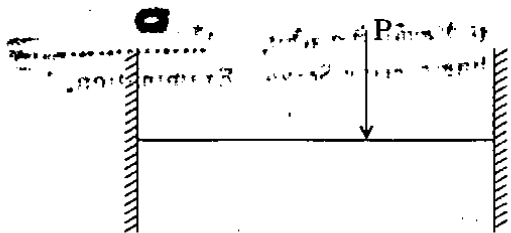
Maximum Marks : 200

INSTRUCTIONS

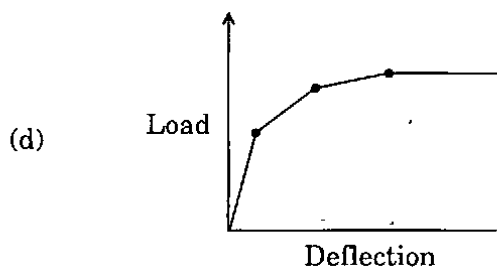
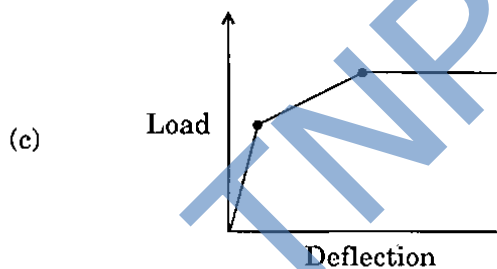
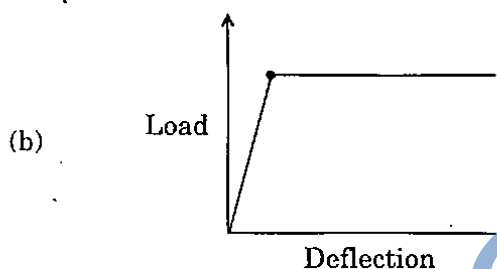
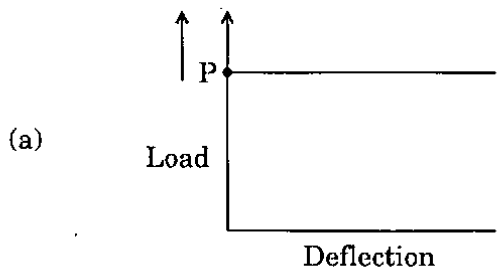
1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES **NOT** HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES A, B, C, OR D AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
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 all 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 IN THE OBJECTIVE TYPE QUESTION PAPERS.
  - (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 a **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.

DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO

1.



Which one of the following diagrams corresponds to the load-deflection characteristics upto plastic collapse of the beam shown ?



2.

At the location of a plastic hinge,

- (a) Radius of curvature is infinite
- (b) Curvature is infinite
- (c) Moment is infinite
- (d) Flexible stress is infinite

3.

Consider the following stipulations in designing a laced column :

- 1. Single lacing systems on opposite planes shall preferably be in the same direction so that one is the shadow of the other.
- 2. Lacing bar should be a flat section.
- 3. The slenderness ratio of the lacing bars for compression shall not exceed 180.
- 4. Laced compression members are to be provided with tie plates at ends.

Which of the above observations is/are correct ?

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

4.

At a section along the span of a welded plate girder, in which the web is spliced, the bending moment at a section is  $M$ . The girder is comprised of top flange; web and bottom flange plates all of equal areas. The share of the bending moment taken by splice plates would be

- (a)  $M$
- (b)  $\frac{M}{3}$
- (c)  $\frac{M}{7}$
- (d)  $\frac{M}{13}$

5. A steel plate is 300 mm wide and 10 mm thick. A rivet of nominal diameter 18 mm is driven. The net sectional area of the plate is

- (a) 1800 mm<sup>2</sup>
- (b) 2805 mm<sup>2</sup>
- (c) 2820 mm<sup>2</sup>
- (d) 3242 mm<sup>2</sup>

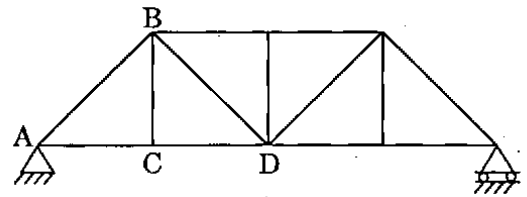
6. For an I-beam, the shape factor is 1.12; the factor of safety in bending stress is 1.5. If the allowable stress is increased by 20% for wind or earthquake loads, then the load factor is

- (a) 1.10
- (b) 1.25
- (c) 1.35
- (d) 1.40

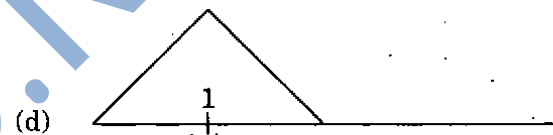
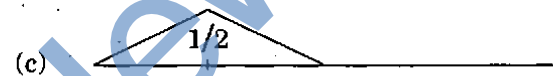
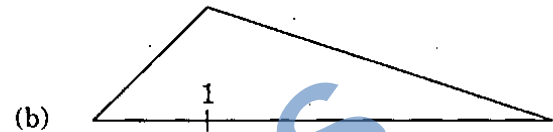
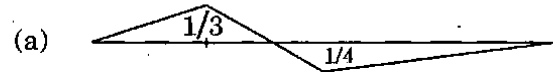
7. PERT calculations yield a project length of 60 weeks with a variance of 9 weeks. Probability factor corresponding to 95% probability is 1.647; then the number of weeks required to complete the project with a probability of 95% is

- (a) 60.94
- (b) 62.94
- (c) 64.94
- (d) 66.94

8.



The influence line for force in member BC is



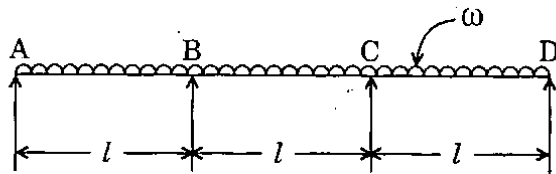
9. Consider the following statements :

1. PERT is activity-oriented and adopts deterministic approach.
2. CPM is event-oriented and adopts probabilistic approach.
3. PERT is event-oriented and adopts probabilistic approach.

Which of the above statements is/are correct ?

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

10.



For the continuous beam shown, what is the reaction at A at collapse, by plastic analysis ?

- (a)  $\frac{5 \omega l}{12}$
- (b)  $\frac{\omega l}{2}$
- (c)  $\frac{7 \omega l}{12}$
- (d)  $\frac{13 \omega l}{24}$

11. Consider the following statements :

1. Shape factor
2. Length of the beam
3. Type of loading
4. Yield strength of material

Which of these affect the influence length of plastic hinge in a beam ?

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

12. In PERT analysis, the time estimates of activities correspond to

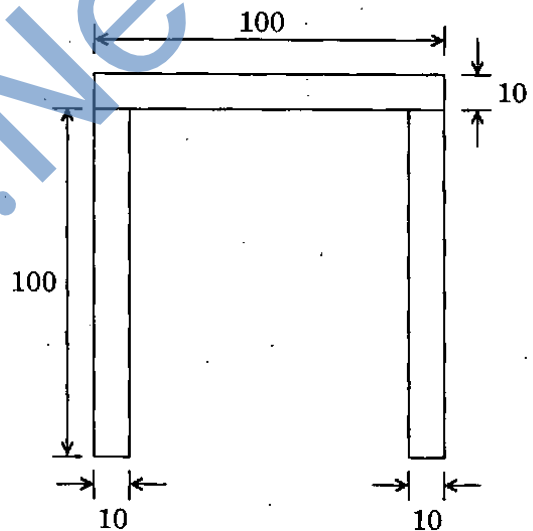
- (a) Normal distribution
- (b) Poisson's distribution
- (c)  $\beta$ -distribution
- (d) Binomial distribution

13.

A propped cantilever of span L is subjected to a concentrated load at midspan. If  $M_P$  is the plastic moment capacity of the beam, the value of collapse load will be

- (a)  $\frac{12 M_P}{L}$
- (b)  $\frac{8 M_P}{L}$
- (c)  $\frac{6 M_P}{L}$
- (d)  $\frac{4 M_P}{L}$

14.



The identical rectangle strips are joined to form a "hat" section. What is the plastic moment capacity ?

- (a)  $50 \times 10^3 \sigma_y$
- (b)  $100 \times 10^3 \sigma_y$
- (c)  $155 \times 10^3 \sigma_y$
- (d)  $300 \times 10^3 \sigma_y$

Where  $\sigma_y$  is Yield strength of steel

15. A father notes that when his teenage daughter uses the telephone she takes no less than 5 minutes for a call but sometimes as much as an hour. 15 minutes calls are more frequent than calls of any other duration. If the daughter's calls were to be represented as an activity in PERT project, the expected duration of each phone call is

- (a)  $14\frac{5}{6}$  minutes
- (b)  $16\frac{5}{6}$  minutes
- (c)  $18\frac{5}{6}$  minutes
- (d)  $20\frac{5}{6}$  minutes

16. The maximum longitudinal pitch allowed in bolted joints of tension members is

- (a) 16 times the diameter of the bolt
- (b) 32 times the diameter of the bolt
- (c) 16 times the thickness of the plate
- (d) 32 times the thickness of the plate

17. The base plate of a roof truss is attached to the concrete pier with the help of 16 mm diameter mild steel anchor bolts of grade  $f_y = 250$  MPa. What is the maximum pull the base can be subjected to, if the root area of bolt = 0.75 times shank area ?

- (a) 30 kN
- (b) 67.5 kN
- (c) 90 kN
- (d) 120 kN

18. Consider the following conditions with respect to plastic analysis :

1. Sum of internal and external forces and moments must be equal to zero.
2. At ultimate collapse load, the number of plastic hinges must be just enough to form a mechanism.

Which of the above conditions is/are correct ?

- (a) 1 only
- (b) 2 only
- (c) Neither 1 nor 2
- (d) Both 1 and 2

19. Poisson's ratio is defined as the ratio of

- (a) Longitudinal stress and longitudinal strain
- (b) Lateral strain and longitudinal strain
- (c) Longitudinal stress and lateral stress
- (d) Lateral stress and longitudinal stress

20.



The influence line diagram for the support moment at A of the fixed beam AB of constant EI is

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

21. The use of 'Concordant cables' in prestressed continuous beams induces

- (a) Initial support reactions
- (b) No initial support reactions
- (c) Excess cracking
- (d) Excess deflection

22. Which one of the following is *not* required in concrete mix-design ?

- (a) Degree of quality control of concrete
- (b) Workability of concrete
- (c) Characteristic compressive strength of concrete at 28 days
- (d) Initial setting time of cement

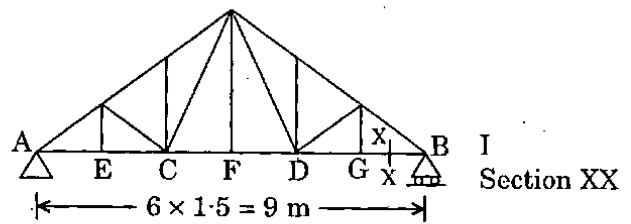
23. The absolute maximum bending moment that a simply supported girder of span 10 m experiences when two concentrated loads 20 kN and 30 kN spaced 2 m apart (30 kN as leading at the right) crosses the girder from left to right, is

- (a) 112.2 kN-m
- (b) 96.6 kN-m
- (c) 136.8 kN-m
- (d) 105.8 kN-m

24. A solid shaft rotating at 180 rpm is subjected to a mean torque of 5000 Nm. What is the power transmitted by the shaft in kW ?

- (a)  $25 \pi$
- (b)  $20 \pi$
- (c)  $60 \pi$
- (d)  $30 \pi$

25.



For the roof truss shown in figure, bottom chord is of ISMB 200 [ $r_x = 83$  mm,  $r_y = 22$  mm].

Bottom chord bracings are available at C and D. Bottom member AE will be in compression due to wind. What is the critical slenderness ratio used for the design of member AE ?

- (a) 18
- (b) 36
- (c) 68
- (d) 136

26. Consider the following statements :

In a simply supported beam subjected to uniformly distributed load throughout the length, at which points is the stress due to (i) Flexure and (ii) Shear equal to zero selectively :

1. At support section at neutral fibre.
2. At mid span section at neutral fibre.
3. At mid span section at top fibre.
4. At support section at bottom fibre.

Which of the above statements is/are correct ?

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

27. Consider the following statements :  
 Ultrasonic pulse velocity test to measure the strength of concrete is
- Used to measure the strength of wet concrete.
  - Used to obtain estimate of concrete strength of finished concrete elements.
  - A destructive test.
  - A non-destructive test.
- Which of the above statements is/are correct ?
- 2 only
  - 1 and 3
  - 2 and 4
  - 3 and 4
28. A solid shaft has length and diameter ' $L_s$ ' and ' $D$ ' respectively. A hollow shaft of length  $L_h$ , external diameter ' $D$ ', and internal diameter ' $d$ ' respectively. Both are of the same material. The ratio of torsional stiffness of hollow shaft to that of solid shaft is
- $\left[ 1 + \left( \frac{d}{D} \right)^4 \right] \cdot \frac{L_s}{L_h}$
  - $\left[ 1 - \left( \frac{d}{D} \right)^4 \right] \cdot \frac{L_h}{L_s}$
  - $\left[ 1 - \left( \frac{d}{D} \right)^4 \right] \cdot \frac{L_s}{L_h}$
  - $\left[ 1 - \left( \frac{D}{d} \right)^4 \right] \cdot \frac{L_s}{L_h}$
29. A live load 20 kN/m, 6 m long, moves on a simply supported girder AB 12 m long. For maximum bending moment to occur at 4 m from left end A, where will the head of load be, as measured from A ?
- 4 m
  - 6 m
  - 8 m
  - 10 m
30. A building with a gabled roof will experience pressure on its leeward slope which is
- Always positive
  - Always negative
  - Sometimes positive and otherwise negative
  - Zero
31. The live load for a sloping roof with slope  $15^\circ$ , where access is not provided to the roof, is taken as
- 0.65 kN/m<sup>2</sup>
  - 0.75 kN/m<sup>2</sup>
  - 1.35 kN/m<sup>2</sup>
  - 1.50 kN/m<sup>2</sup>
32. The batten plates used to connect the components of a built-up column are designed to resist
- Longitudinal shear only
  - Transverse shear only
  - Longitudinal shear and moment arising from transverse shear
  - Vertical shear only
33. The duration of any activity in case of a PERT programme is calculated as a weighted average of three time estimates namely the optimistic time  $t_o$ , the pessimistic time  $t_p$  and the most probable time  $t_m$ , which is given as
- $\left( \frac{t_o + t_m + 4t_p}{6} \right)$
  - $\left( \frac{t_o + 4t_m + t_p}{6} \right)$
  - $\left( \frac{4t_o + t_m + t_p}{6} \right)$
  - $\left( \frac{3t_o + 2t_m + t_p}{6} \right)$

34. In ISMC 400 channels placed back to back at a spacing of 26 cm carry an axial load of 160 tonnes. The lacing system should be designed to resist a transverse shear of

- (a) 16 tonnes
- (b) 12 tonnes
- (c) 8 tonnes
- (d) 4 tonnes

35. Consider the following statements of network :

1. Only one time estimate is required for each activity.
2. Three time estimates for each activity.
3. Time and cost are both controlling factors.
4. It is built-up of event-oriented diagram.

Which of the above statements are correctly applicable to CPM network ?

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

36. If a simply supported concrete beam, prestressed with a force of 2500 kN, is designed by load balancing concept for an effective span of 10 m and to carry a total load of 40 kN/m, the central dip of the cable profile should be

- (a) 100 mm
- (b) 200 mm
- (c) 300 mm
- (d) 400 mm

37. A circular shaft which has a diameter of 100 mm is subjected to a torque of 5 kN-m. The shear stress, in  $\text{N/mm}^2$ , induced in the shaft would be

- (a)  $\frac{160}{\pi}$
- (b)  $\frac{120}{\pi}$
- (c)  $\frac{125}{\pi}$
- (d)  $\frac{80}{\pi}$

38. Match List I with List II and select the correct answer using the code given below the lists :

*List I*  
(Type)

*List II*  
(Recommended  
Slenderness ratio)

- |                                  |              |
|----------------------------------|--------------|
| A. Single angle in roof trusses  | 1. 80 - 150  |
| B. Double angles in roof trusses | 2. 30 - 60   |
| C. Single I section in columns   | 3. 100 - 180 |
| D. Double I section in columns   | 4. 60 - 100  |

Code :

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



39. Flexibility matrix for a beam element is written in the form :

$$[A] = \frac{L^3}{6EI} \begin{bmatrix} 2 & 5 \\ 5 & 16 \end{bmatrix}$$

What is the corresponding stiffness matrix ?

(a)  $\frac{6EI}{L^3} \begin{bmatrix} 16 & 5 \\ 5 & 2 \end{bmatrix}$

(b)  $\frac{6EI}{7L^3} \begin{bmatrix} 16 & 5 \\ 5 & 2 \end{bmatrix}$

(c)  $\frac{6EI}{L^3} \begin{bmatrix} 16 & -5 \\ -5 & 2 \end{bmatrix}$

(d)  $\frac{6EI}{7L^3} \begin{bmatrix} 16 & -5 \\ -5 & 2 \end{bmatrix}$

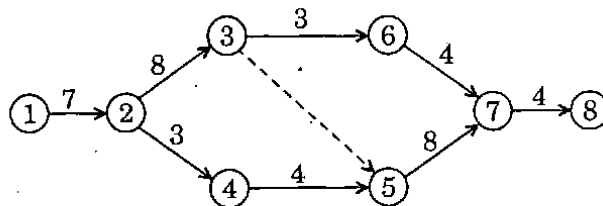
40. Consider the following statements relating to structural analysis :

1. Flexibility matrix and its transpose are equal.
2. Elements of main diagonal of stiffness matrix are always positive.
3. For unstable structures, coefficients in leading diagonal matrix can be negative.

Which of the above statements is/are correct ?

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

41.



In the above network, the duration of activities are written along their arrows. The critical path of the activities is along

- (a) 1 - 2 - 3 - 5 - 7 - 8  
 (b) 1 - 2 - 3 - 6 - 7 - 8  
 (c) 1 - 2 - 4 - 5 - 7 - 8  
 (d) 1 - 2 - 3 - 4 - 5 - 7 - 8

42. Flexibility matrix for a beam element is

$$[F] = \frac{1}{EI} \begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$$

What is the corresponding stiffness matrix [S] ?

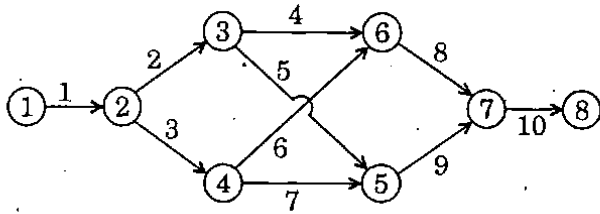
(a)  $[S] = \frac{EI}{63} \begin{bmatrix} 36 & -9 \\ -9 & 4 \end{bmatrix}$

(b)  $[S] = \frac{EI}{63} \begin{bmatrix} 36 & 9 \\ 9 & 4 \end{bmatrix}$

(c)  $[S] = \frac{EI}{63} \begin{bmatrix} 4 & -9 \\ -9 & 36 \end{bmatrix}$

(d)  $[S] = \frac{EI}{63} \begin{bmatrix} 4 & 9 \\ 9 & 36 \end{bmatrix}$

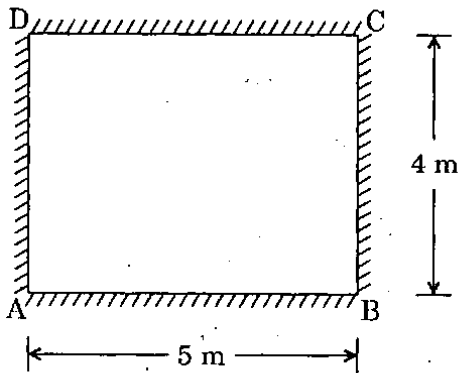
43.



The above figure indicates a project network; the number at each activity represents its normal duration in days. The critical path is along

- (a) 1 - 2 - 3 - 6 - 7 - 8
- (b) 1 - 2 - 4 - 5 - 7 - 8
- (c) 1 - 2 - 3 - 5 - 7 - 8
- (d) 1 - 2 - 4 - 6 - 7 - 8

44.



The RC slab, simply supported on all edges as in above figure, is subjected to a total UDL of  $12 \text{ kN/m}^2$ . The maximum shear force/unit length along the edge 'BC' is

- (a) 16 kN
- (b) 12 kN
- (c) 8 kN
- (d) 30 kN

45. Consider the following statements about the air entraining admixture in concrete :

- 1. Improve workability
- 2. Improve durability
- 3. Reduce segregation during placing
- 4. Decrease concrete density

Which of the above statements are correct ?

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

46. Which one of the following is relevant to Activity on Node (AON) ?

- (a) Dummy activities may be many
- (b) There will be no dummy activities
- (c) It is used for quite complex project
- (d) It is easier to associate with time flow of activities

47. Consider the following activities :

- 1. Pouring of concrete
- 2. Erection of formwork
- 3. Curing of concrete
- 4. Removal of formwork

What is the correct sequence on a network of these activities ?

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

48. A solid circular shaft subjected to a torque  $T$  produces maximum shear stress  $f_s$ , which is the maximum principal value in the material. The corresponding diameter of the shaft should be

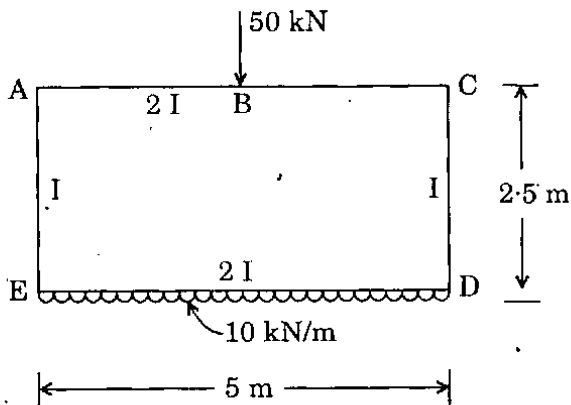
(a)  $\sqrt[3]{\frac{\pi \cdot f_s}{16 \cdot T}}$

(b)  $\sqrt[3]{\frac{32 \cdot T}{\pi \cdot f_s}}$

(c)  $\sqrt[3]{\frac{\pi}{16 \cdot T \cdot f_s}}$

(d)  $\sqrt[3]{\frac{16 \cdot T}{\pi \cdot f_s}}$

49.



The distribution factors for members AE and AC of the box section are

- (a) 0.5 and 0.5  
 (b) 0.6 and 0.4  
 (c) 0.25 and 0.75  
 (d) 1 and zero
50. A steel beam is replaced by a corresponding aluminium beam of same cross-sectional shape and dimensions, and is subjected to same loading. The maximum bending stress will
- (a) Be unaltered  
 (b) Increase  
 (c) Decrease  
 (d) Vary in proportion to their modulus of elasticity
51. A building contractor discovers from his record that in the last 200 slab castings his mixer machine broke down 21 times. During each breakdown, he had to pay on an average about Rs. 2,500 for idle labour. A standby mixer machine, if hired on the day of slab casting, would cost him Rs. 200 per day. The expected loss is more than the mitigation expense of hiring the mixer by
- (a) Rs. 151.50  
 (b) Rs. 241.50  
 (c) Rs. 262.50  
 (d) Rs. 283.50

52. Consider the following statements :

Admixtures are added to concrete to

1. Increase its strength.
2. Reduce heat of hydration.
3. Delay the setting of cement.
4. Reduce water-cement ratio.

Which of the above statements is/are correct ?

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

53. A beam of symmetrical I-section, made of structural steel has an overall depth of 300 mm. If the flange stresses developed at the top and bottom of the beam are  $1200 \text{ kg/cm}^2$  and  $300 \text{ kg/cm}^2$  respectively, then the depth of neutral axis from the top of the beam would be

- (a) 250 mm  
 (b) 240 mm  
 (c) 200 mm  
 (d) 180 mm

54. Consider the following statements :

1. Strength of concrete cube is inversely proportional to water-cement ratio.
2. A rich concrete mix gives a higher strength than a lean concrete mix since it has more cement content.
3. Shrinkage cracks on concrete surface are due to excess water in mix.

Which of the above statements is/are correct ?

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

55. The load carrying capacity of a column designed by working stress method is 500 kN. The ultimate collapse load of the column is

- (a) 500 kN
- (b) 662.5 kN
- (c) 750 kN
- (d) 1100 kN

56. Consider the following statements :

1. The crushing strength of concrete is fully governed by water-cement ratio.
2. Vibration has no effect on strength of concrete at high water-cement ratios.
3. Workability of concrete is affected by improper grading of aggregates.

Which of the above statements is/are correct ?

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

57. Consider the following statements regarding the slope of cost-time curve :

1. It is given by difference between normal cost and crash cost divided by crash time.
2. It is given by difference between crash cost and normal cost divided by difference between crash time and normal time.
3. It is given by difference of crash cost and normal cost divided by normal time.
4. It is given by crash cost divided by crash time.

Which of the above statements is/are correct ?

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

58. If P is the percentage of water required for determination of normal consistency of cement, then percentage of water to be added for determination of initial setting time is

- (a) 0.70 P
- (b) 0.75 P
- (c) 0.80 P
- (d) 0.85 P

59. Consider the following statements in work breakdown structure :

1. It is a graphical representation of entire programme.
2. The Top-Down approach to planning is adopted.
3. The Down-Top approach to planning is adopted.
4. It is suitable for complex projects.

Which of the above statements is/are correct ?

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

60. Consider the following statements :

Entrainment of air in concrete is done so as to

1. Increase the workability.
2. Increase the strength.
3. Increase the resistance to freezing and thawing.

Which of the above statements is/are correct ?

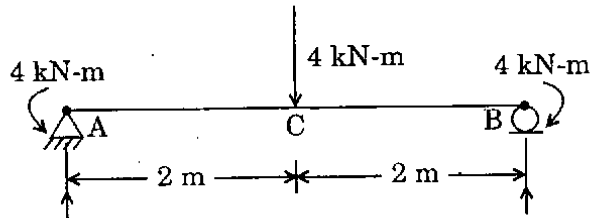
- (a) 1, 2 and 3
- (b) 1 only
- (c) 1 and 3 only
- (d) 3 only

61. Consider the following statements :
1. In work-breakdown structure top-down approach is adopted.
  2. Bar-chart depicts interdependencies of activities.
  3. Controlling can be better achieved in milestone chart.

Which of the above statements are correct ?

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

62.



A simply supported beam is loaded as in figure. The bending moment at C is

- (a) 4 kN-m (Sagging)
- (b) 4 kN-m (Hogging)
- (c) 8 kN-m (Sagging)
- (d) Zero

63. If the Euler load for a steel column is 1000 kN and crushing load is 1500 kN, the Rankine load is equal to

- (a) 2500 kN
- (b) 1500 kN
- (c) 1000 kN
- (d) 600 kN

64. A simply supported beam of T-section is subjected to a uniformly distributed load acting vertically downward. Its neutral axis is located at 25 mm from the top of the flange and the total depth of the section is 100 mm. The ratio of maximum tensile stress to maximum compressive stress in the beam is

- (a) 2.0
- (b) 2.5
- (c) 3.0
- (d) 4.0

65. A two-dimensional stress system has like stresses  $\sigma_x = 100 \text{ N/mm}^2$  and  $\sigma_y = 200 \text{ N/mm}^2$  in two mutually perpendicular directions. The x, y co-ordinates of the centre of the Mohr's circle are

- (a) (0, 150)
- (b) (150, 0)
- (c) (-50, 0)
- (d) (50, 0)

66. A cement bag contains 0.035 cubic meter of cement by volume. How many bags will one tonne of cement comprise ?

- (a) 16
- (b) 17
- (c) 18
- (d) 20

67. Consider the following statements :

1. Total float can affect all activities in the chain.
2. Free float can affect only the preceding activities.
3. Independent float affects only the particular concerned activity.

Which of the above statements is/are correct ?

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

68. Consider the following statements :

1. Cambium layer is between sapwood and heartwood.
2. Heartwood is otherwise termed as deadwood.
3. Timber used for construction is obtained from heartwood.

Which of the above statements is/are correct ?

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

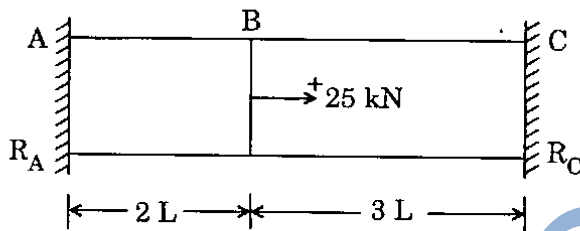
69. Consider the following statements :

1. The resources are considered to be unlimited.
2. The resources are considered to be limited.
3. The start times of some of the activities are so shifted within their available floats that the uniform demand is created for the resources.

Which of the above statements is/are correct ?

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

70.



A prismatic bar ABC is subjected to an axial load of 25 kN; the reactions  $R_A$  and  $R_C$  will be

- (a)  $R_A = -10$  kN and  $R_C = -15$  kN
- (b)  $R_A = 10$  kN and  $R_C = -35$  kN
- (c)  $R_A = -15$  kN and  $R_C = -10$  kN
- (d)  $R_A = 15$  kN and  $R_C = -40$  kN

71. The capacity of a single ISA  $100 \times 100 \times 10$  mm as tension member connected by one leg only using 6 rivets of 20 mm diameter is

- (a) 333 kN
- (b) 253 kN
- (c) 238 kN
- (d) 210 kN

The allowable stress is  $150 \text{ N/mm}^2$ .

72. Consider the following statements :

1. Strength of brick masonry is influenced by type of mortar.
2. Brick masonry with lime mortar achieves full strength earlier than cement mortar masonry.
3. Mortar strength decides the strength of masonry.

Which of the above statements is/are correct ?

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

73. A single-acting reciprocating pump has a stroke of 30 cm, speed of 115 rpm and a piston of 30 cm diameter. It discharges 39 l.p.s. through a height of 15 m. The slip of the pump is

- (a) 2.8%
- (b) 3.2%
- (c) 3.6%
- (d) 4.0%

74. Consider the following statements for a beam of rectangular cross-section and uniform flexural rigidity EI subjected to pure bending :

1. The bending stresses have the maximum magnitude at the top and bottom of the cross-section.
2. The bending stresses vary linearly through the depth of the cross-section.
3. The bending stresses vary parabolically through the depth of the cross-section.

Which of the above statements is/are correct ?

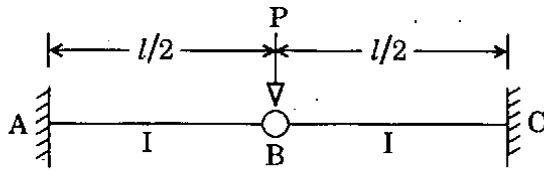
- (a) 1, 2 and 3
- (b) 1 only
- (c) 2 only
- (d) 1 and 2 only

75. If the load acting on a commonly conventional sized RC column increases continuously from zero to higher magnitudes, the magnitude of the uniaxial ultimate moment that can be allowed on the column

- (a) Increases
- (b) Decreases
- (c) Increases and then decreases
- (d) Remains constant

76. In RCC beams, as the percentage areas of tensile steel increases
- Depth of neutral axis increases
  - Depth of neutral axis decreases
  - Depth of neutral axis does not change
  - Lever arm increases
77. The average compressive strength of a burnt clay brick is less than  $12.5 \text{ N/mm}^2$ . The allowable rating of efflorescence is
- Moderate
  - Serious
  - Heavy
  - Zero
78. Two beams carrying identical loads, simply supported, are having same depth but beam A has double the width as compared to that of beam B. The ratio of the strength of beam A to that of beam B is
- $\frac{1}{2}$
  - $\frac{1}{4}$
  - 2
  - 4
79. Shear span is defined as the zone where
- Bending moment is zero
  - Shear force is zero
  - Shear force is constant
  - Bending moment is constant
80. If the hinged end of a propped cantilever of span  $L$  settles by an amount  $\delta$ , then the rotation of the hinged end will be
- $\frac{\delta}{L}$
  - $\frac{2\delta}{L}$
  - $\frac{3\delta}{2L}$
  - $\frac{4\delta}{3L}$
81. The correct statement in respect of a centrifugal pump is
- The discharge varies in direct proportion to speed as also square of the diameter
  - The head varies as the square of the speed as also of the square of the diameter
  - The discharge varies in inverse proportion to speed as also the cube of the diameter
  - The power varies as the head and square of the diameter
82. Consider the following statements :
- Bricks lose their strength by 25% when soaked in water.
  - Minimum crushing strength of brick in buildings should be  $35 \text{ kg/cm}^2$ .
  - The size of modular type bricks is  $20 \text{ cm} \times 10 \text{ cm} \times 10 \text{ cm}$  including mortar thickness.
- Which of the above statements are correct ?
- 1, 2 and 3
  - 1 and 2 only
  - 1 and 3 only
  - 2 and 3 only
83. The limit of proportionality in the material of a structural steel member, when subjected to simple tension, is  $280 \text{ N/mm}^2$ . The principal stresses in the member are  $\sigma_1 = 122 \text{ N/mm}^2$  (Tensile) and  $\sigma_2 = 60 \text{ N/mm}^2$  (Compressive).  $\mu = 0.3$ . According to maximum strain theory, the factor of safety is
- 2.5
  - 1.5
  - 2
  - 3

84.



What is the deflection at the hinge for the beam shown ?

- (a) 0  
 (b)  $\frac{Pl^3}{3EI}$   
 (c)  $\frac{Pl^3}{24EI}$   
 (d)  $\frac{Pl^3}{48EI}$

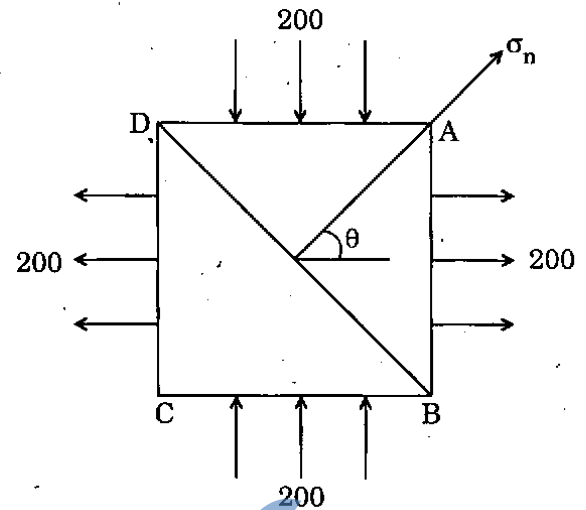
85. A bolt designated as Hex bolt M 16 × 70-NL will have

- (a) Diameter of 16 mm  
 (b) Diameter of 70 mm  
 (c) Length of 16 mm  
 (d) Cross-sectional area of  $16 \times 70 \text{ cm}^2$

86. In the limit state method, balanced design of a reinforced concrete beam gives

- (a) Smallest concrete section and maximum area of reinforcement  
 (b) Largest concrete section and maximum area of reinforcement  
 (c) Smallest concrete section and minimum area of reinforcement  
 (d) Largest concrete section and minimum area of reinforcement

87.



A square element is subjected to principal stresses in  $\text{N/mm}^2$  as in figure. The intensity of normal stress  $\sigma_n$  on plane BD is

- (a)  $200\sqrt{2}$   
 (b) 100  
 (c) 200  
 (d) 0

88. A crawler-tractor weighs 9 ton and a rubber-tyred tractor capable of exerting the same maximum drawbar pull weighs 7.5 ton. 65% of weight of the latter is carried by the two driving wheels. Tractive coefficient for crawler track and rubber tyre is respectively 0.48 and 0.90. Which tractor is more suitable for use where the running surface is concrete ?

- (a) Crawler-tractor  
 (b) Rubber-tyred tractor  
 (c) Either  
 (d) Neither

89. The advantage in using plywood is that the

- (a) Tensile strength is equal in all directions  
 (b) Higher tensile strength in longer direction  
 (c) Higher tensile strength in shorter direction  
 (d) Lower tensile strength in longer direction



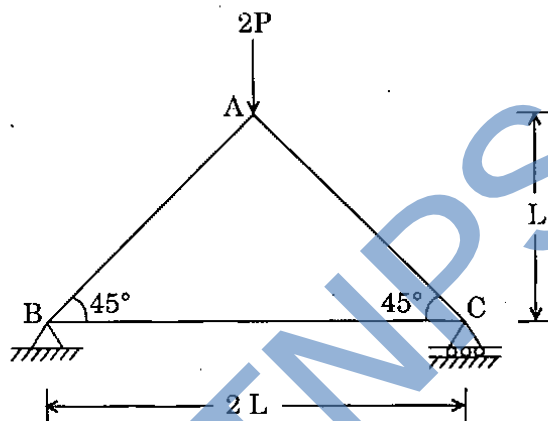
90. Consider the following statements :  
If there is a state of pure shear  $\tau$  at a point then

1. The Mohr's circle is tangential to the y-axis.
2. The centre of the Mohr's circle coincides with the origin.
3. Unlike principal stresses are each numerically equal to  $\tau$ .
4. Principal stresses are like.

Which of the above statements is/are correct ?

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

91.



A simple plane truss acted upon by a load  $2P$  at the apex  $A$  is shown. The axial force in the member  $AB$  is

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

92. A four-wheel tractor whose operating weight is  $13,000 \text{ kg}$  is pulled along a haul road having a slope of  $4\%$  at a uniform speed with a rolling resistance of  $10 \text{ kg/ton}$  for  $1\%$  slope. The tension in the toe cable is  $1105 \text{ kg}$ . The rolling resistance of the haul road is

- (a)  $35 \text{ kg/ton}$
- (b)  $45 \text{ kg/ton}$
- (c)  $55 \text{ kg/ton}$
- (d)  $65 \text{ kg/ton}$

93. On a particular construction project, the contractor on an average employed  $100$  workers with  $50$  hours per week. The project lasted for  $35$  weeks and during this period,  $14$  disabling injuries occurred. The injury-frequency rate is

- (a)  $6$
- (b)  $7$
- (c)  $8$
- (d)  $9$

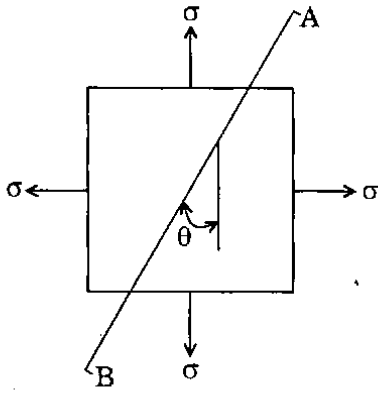
94. The maximum percent of moment redistribution allowed in RCC beams is

- (a)  $10\%$
- (b)  $20\%$
- (c)  $30\%$
- (d)  $40\%$

95. A structural member carrying a pull of  $700 \text{ kN}$  is connected to a gusset plate using rivets of  $20 \text{ mm}$  diameter. If the pull required for shearing the rivets, to crush the rivets and to tear the plate per pitch length are  $60 \text{ kN}$ ,  $35 \text{ kN}$  and  $70 \text{ kN}$  respectively, then the number of rivets required is

- (a)  $12$
- (b)  $18$
- (c)  $20$
- (d)  $22$

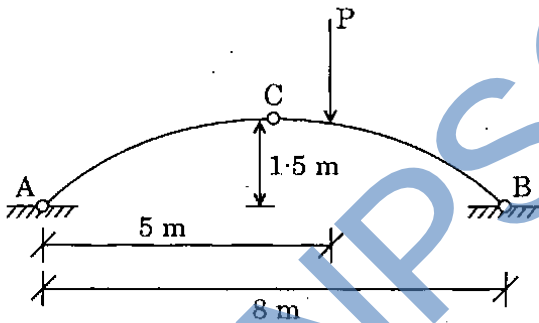
96.



A point in two-dimensional stress state subjected to biaxial stress is shown in figure. What is the normal stress acting on the plane AB ?

- (a) Zero
- (b)  $\sigma$
- (c)  $\sigma \cos^2 \theta$
- (d)  $\sigma \sin \theta \cdot \cos \theta$

97.



A three-hinged symmetrical arch is loaded as shown in figure. Which one of the following is the magnitude of the correct horizontal thrust ?

- (a)  $\frac{4}{3} P$
- (b)  $P$
- (c)  $\frac{3}{4} P$
- (d)  $\frac{3}{8} P$

98. Which one of the following statements is correct as regards tensile strength of wood ?

- (a) Minimum in the direction parallel to the grains
- (b) Maximum in the direction parallel to the grains
- (c) Maximum in the direction across the grains
- (d) Same in all directions

99. Consider the following characteristics regarding timber :

1. Stronger variety
2. Ability to take very smooth finish
3. Toughness
4. Difficult to season

Which of the above characteristics is/are essential for timber to be used as beams ?

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

100. A unit of equipment costs Rs. 25 Lakh and has a life of 5 years with no salvage value. The average annual cost of this equipment, based on straight-line depreciation is

- (a) Rs. 5 Lakh
- (b) Rs. 10 Lakh
- (c) Rs. 15 Lakh
- (d) Rs. 20 Lakh

**Directions :** Each of the next twenty (20) items consists 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 codes given below :

**Codes :**

- (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

101. **Assertion (A) :** A hollow circular shaft has more power transmitting capacity than a solid shaft of same material and same weight per unit length.

**Reason (R) :** In a circular shaft, shear stress developed at a point due to torsion is proportional to its radial distance from the centre of the shaft.

102. **Assertion (A) :** Load deflection characteristics of a fixed beam subjected to uniformly distributed load is linear up to collapse.

**Reason (R) :** Except at the zones of plastic hinge, rest of the components are in the elastic range.

103. **Assertion (A) :** Low heat cement is used in the construction of large dams.

**Reason (R) :** Very high compressive strength is achieved by low heat cement in 28 days.

104. **Assertion (A) :** Higher strength is achieved when superplasticizer is added to cement concrete mix.

**Reason (R) :** By adding superplasticizer, the quantity of mixing water is reduced.

105. **Assertion (A) :** In order to obtain higher degree of workability in cement concrete, both water content and proportion of cement should be increased.

**Reason (R) :** Increase in water-cement ratio decreases the strength of cement concrete; a mix with higher workability must have higher proportion of cement in it.

106. **Assertion (A) :** The principle of superposition is valid whenever the strain or stress to be obtained is directly proportional to the applied loads.

**Reason (R) :** Strain energy depends on the product of stress and strain.

107. **Assertion (A) :** Force method of analysis is not convenient for computer programming.

**Reason (R) :** Band width of flexibility matrix is much larger compared to that of stiffness matrix.

108. **Assertion (A) :** The moment distribution and slope-deflection methods of structural analysis are essentially stiffness methods.

**Reason (R) :** In the moment distribution method, the slope-deflection equations are solved without writing them explicitly.

109. **Assertion (A) :** Compared to rectangular hollow section, circular hollow section possesses more plastic moment of resistance over its yield moment.

**Reason (R) :** Circular hollow section has higher shape factor than rectangular hollow section.

110. *Assertion (A)* : In a helically reinforced concrete column, the concrete core is subjected to triaxial state of stress.  
*Reason (R)* : Helically reinforced concrete columns are very much suitable for earthquake resistant structures.
111. *Assertion (A)* : In the case of mild steel, the tensile strength (expressed as per unit area) of smaller diameter bars are more than that of larger diameter bars.  
*Reason (R)* : In the case of smaller diameter mild steel bars, the ratio of outer hard core to total area (outer hard core + inner soft core) is more.
112. *Assertion (A)* : The behaviour of an over-reinforced beam is more ductile than that of under-reinforced beam.  
*Reason (R)* : Over-reinforced beam contains more steel and steel is more ductile than concrete.
113. *Assertion (A)* : Activity-on-node network eliminates the use of dummy activities.  
*Reason (R)* : It is self-sufficient as it contains all activity times on the nodes itself.
114. *Assertion (A)* : A 'dummy' job is assigned 'zero' time to perform.  
*Reason (R)* : It is used mainly to specify precedence relationship.
115. *Assertion (A)* : The time-grid diagram facilitates to readout the float for any activity by inspecting the diagram.  
*Reason (R)* : In the time-grid diagram, floats are represented by broken horizontal lines as appropriate.
116. *Assertion (A)* : The probability of completion of a multi-path project at the expected project completion duration is 50%.  
*Reason (R)* : The standard deviate for the critical path duration is zero.
117. *Assertion (A)* : In the analysis of statically determinate planar trusses by the method of joints, not more than two unknown bar forces can be determined.  
*Reason (R)* : There are only two equations of force equilibrium available for a co-planar concurrent system.
118. *Assertion (A)* : A drag line is a suitable equipment for excavating or digging earth and depositing it on nearby bank.  
*Reason (R)* : In drag-line, there is no need of a separate hauling unit.
119. *Assertion (A)* : Mueller – Breslau principle is a most widely used method to determine qualitative influence lines in an indeterminate structure.  
*Reason (R)* : The determination of the qualitative influence lines is often of great value in ascertaining the most severe stresses at specified sections of a structure.
120. *Assertion (A)* : Losses in prestress in pre-tensioned beams are more than the losses in post-tensioned beams.  
*Reason (R)* : This is partially due to the effect of elastic shortening.