Sikkim Public Service Commission

Main Written Examination for the Post of **Assistant Engineer (Civil)**

Civil Engineering

Paper - II

Time Allowed : 3.30 Hrs.

Maximum Marks : 250

INSTRUCTIONS TO CANDIDATES

Read the following instructions carefully before answering the questions :-

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 fill in the Roll Number and Test Booklet Serial Number carefully and without any omission or discrepancy at the appropriate places in the **OMR ANSWER SHEET.**

3. **Use only Black Ball Point Pen to fill the OMR sheet**

4. Do not write anything else on the OMR Answer Sheet except the required information.

5. **This Test Booklet contains three Sections i.e Section A , B and Section C. Section A contains Multiple choice Questions i.e. 75 items in MCQ Mode to be marked in OMR Sheet. Section B and C contains Conventional/Subjective Type of Questions which has to be written in Seperate Answer sheet provided to you.**

6. **All items from Q.1 to Q. 75 carries 2 marks each.**

7. Before you proceed to mark in the Answer Sheet (OMR), you have to fill in some particulars in the Answer Sheet (OMR) as per given instructions.

8. After you have completed filling in all your responses on the Answer Sheet (OMR) and the examination has concluded, you should hand over the Answer Sheet (OMR) and the Seperate conventional Answer sheet to the Invigilator only . You are permitted to take away with you the Test Booklet.

9. **Marking Scheme**

   There will be negative marking 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 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 the 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

Civil Engineer

Paper - II

Section - A

Objective Type Questions **(75 x 2 =150)**

1. **What is the correct sequence of decreasing order effectiveness for different methods of preservation of timber?**
   A. Dipping > Pressure impregnation > Spraying
   B. Spraying > Dipping > Pressure impregnation
   C. Pressure impregnation > Spraying > Dipping
   D. Spraying > Pressure impregnation > Dipping
2. **First class brick shall have a minimum crushing strength of**
   A. 3.5 N/mm^2
   B. 7.5 N/mm^2
   C. 10.5 N/mm^2
   D. 14.5 N/mm^2
3. **Quantity of cement required for 1 cubic meter of concrete of 1:2:4 mix will be**
   A. 6.25 bags
   B. 4.10 bags
   C. 5.50 bags
   D. 6.50 bags
4. **Maximum percentage of steel, as a percentage of gross cross sectional area of column, that can be placed in column is**
   A. 4.0 %
   B. 6.0 %
   C. 0.8 %
   D. 2.0 %
5. **The strength of a concrete cylinder is less than the strength of a concrete cube. This is due to**
   A. The difference in the slenderness ratio of the specimen
   B. The difference in the shape of the cross section of the specimen
   C. The different area of cross section of the cylinder and cube
   D. The difference in the method of testing both types of specimen

6. **Total length of a simply supported RCC beam is 6 m. 8mm dia stirrups have been provided at center to center spacing of 120 mm. Total number of stirrups in the beam shall be**

A. 50

B. 51

C. 49

D. 720

7. **While designing a RCC retaining wall the lateral earth pressure is**

A. Equal to the mass of soil retained

B. Proportional to the height of retaining wall

C. Proportional to the internal friction of soil

D. Equal to the square of the depth of soil

8. **What will be the unit of Strain-energy Density in SI system –**

A. J/m^3

B. $J/m^3.s$

C. $In.lb/in^3$

D. $J.s/m^3$

9. **The deflection at any joint of a perfect frame can be obtained by applying a unit load at the joint in -**

A. Horizontal direction

B. Vertical direction

C. Inclined direction

D. The direction in which the deflection is required

10. **The stress at which extension of a material takes place more quickly as compare to the increase in load is called**

A. Elastic point

B. Yielding point

C. Plastic point

D. Breaking point

11. **Critical section for shear in a fixed beam is considered at**

A. Center of the span of the beam

B. Center of the supports of the beam

C. Center of gravity of the applied loads

D. None of the above

12. **A RCC beam is carrying a large point load that results in high shear force which results in exceeding maximum permissible shear stress. Which of the following is correct**

A. Increasing depth of beam is more suitable

B. Increasing width of beam is more suitable

C. Increasing depth or width will have almost similar effect

D. Increasing shear reinforcement is more suitable

13. **As per IS:456, expansion joint is to be provided in structure, when the length of structure exceeds**

A. 35 m

B. 45 m

C. 55 m

D. 65 m

14. **A RCC beam is 300 mm wide and 450 mm deep. It is designed for the load acting on it and 20 mm dia main reinforcement and 10 mm dia stirrups are to be used. However, it is later found that the beam is failing in bond. Which of the following is the most economical solution to save the beam from failing in bond?**

A. Use 12 mm dia stirrups instead of 10 mm bars

B. Use 12/16 mm bars instead of 25 mm bars

C. Use 8 mm dia stirrups instead of 10 mm bars

D. Use 25/28 mm bars instead of 25 mm bars

15. **Clear cover to the main reinforcement in beam, column and slab shall be**

A. 40mm, 25mm, 20mm

B. 40mm, 20mm, 25mm

C. 40mm, 40mm, 25mm

D. 25 mm, 40mm, 20mm

16. **Two circular columns are of same size and main reinforcement. Circular ties have been provided in one column where as helical ties have been provided in other column. Which column has high load carrying capacity?**

A. Circular column

B. Helical column

C. Both have same load carrying capacity

D. Depends on the diameter of the ties

17. Which kind of failure can be avoided by providing sufficient edge distance?

A. Tension failure of plate

B. Shear failure of plate

C. Shear failure of rivet

D. Tension failure of rivet

18. A simply supported beam, of effective span L, is subjected to a concentrated moment M at its centre. Maximum bending moment in the beam is

A. M

B. M / 4

C. (M x L) / 4

D. M / 2

19. Length of a square vertical column is 300 cm and its side is 2.5 cm. What is the slenderness ratio of the column

A. 360

B. 240

C. 416

D. 574

20. A bar is made of steel and it is 25 cm long. Its diameter is 5 mm. It is heated from 20° C to 50° C, while it is free to expand. The bar will develop

A. Tensile stress

B. No stress

C. Compressive stress

D. Shear stress

21. The stress is 'S' when a body is subjected to a gradual load W on it. If the load is applied suddenly, the stress shall be

A. 2S

B. S

C. 1.5S

D. 4S

22. A beam is simply supported over a span L and it is carrying a total UDL of W over the whole span. If a prop is placed at the center of the beam such that the top level of the prop is same as the level of end supports. The reaction of the prop will be

A. W / 2

B. W / 4

C. 3 W / 8

D. 5 W / 8

23. A multi storey building has floor to floor height is 3300 mm. If the riser is 150 mm then the number of treads required for each storey is

A. 21

B. 22

C. 23

D. 24

24. As per Indian standards, the formwork from of column can be removed

A. Within 30 minutes of casting

B. About 24 hours after casting

C. Minimum 2 days after casting

D. At 28 days after casting

25. Rolled steel beams are designated by Indian standard series and its

A. Depth of section and weight per meter

B. Weight per meter and flange width

C. Flange width and weight per meter

D. Weight per meter and depth of section

26. Beams supporting steps of a stair are generally known as

A. Spandrel beam

B. Winder beam

C. Step beam

D. Stringer beam

27. Efficiency of a riveted joint having the minimum pitch as per IS:800 is –

A. 40 %

B. 50 %

C. 60 %

D. 70 %

28. For a compression member with double angle section, which of the following sections will give larger value of minimum radius of gyration?

A. Equal angles back to back

B. Unequal legged angles with long legs back to back

C. Unequal legged angles with short legs back to back

D. Both (b) or (c)

29. Cracks at bottom face of a simply supported beam are observed. The cracks are along the span and are concentrated near the mid span of the beam. The reason of the cracks may be

A. Area of main reinforcement in beam is less than required area of main reinforcement

B. Area of main reinforcement in beam is more than required area of main reinforcement

C. Shear stirrups dia or spacing is less than the required dia or spacing of shear stirrups

D. Shear stirrups dia or spacing is more than the required dia or spacing of shear stirrups

30. Which of the following is correct explanation of development of state of pure shear

A. Tension in one direction and equal compression in perpendicular direction

B. Equal compression in two mutually perpendicular directions

C. Equal tension in two mutually perpendicular directions

D. None of the above

31. A beam of triangular cross section is placed such that one side of the triangle is horizontal and the apex of the triangle is below the horizontal side. Maximum shear intensity in the section at any particular location will be

A. At the horizontal side

B. Below the neutral axis

C. Above the neutral axis

D. At the neutral axis

32. Crippling load for a long column will be maximum when

A. Both ends are hinged

B. One end is hinged and other is fixed

C. One end is fixed and other is free

D. Both ends are fixed

33. **If a stream function is given by $\phi = x^3 - y^3$, then**

A. It is an unsteady, an irrotational flow case

B. A potential function exists

C. It is a steady, an irrotational flow

D. It is a possible flow, rotational flow case

34. **For locating a distant object visible from two transit stations, which method can be preferred**

A. Distance from the two stations

B. Angles from the two stations

C. Both distance and angles from the two stations

D. Distance from one station and angle from the other station

35. **A sewer line is laid from manhole A to manhole B which are 250 m apart and along a gradient of 1 in 125. If the reduced level of the invert at A is 205.75 m and the height of the boning rod is 3 m, the reduced level of the sight rail at B is**

A. 208.75

B. 211.75

C. 203.75

D. 206.75

36. **In order to orient a plane table at a station with the help of two points that are inaccessible, following method is adopted**

A. Two point problem

B. Intersection

C. Resection

D. Radiation

37. **Lateral earth pressure on a retaining wall is**

A. Equal to the mass of soil retained

B. Proportional to the height of retaining wall

C. Proportional to the internal friction of soil

D. Equal to the square of the depth of soil

38. Ultimate bearing capacity of soil is

A. Total load on the bearing area

B. Net load on the bearing area

C. Load at which soil is fully compacted

D. Load at which soil fails

39. A moist soil sample of volume 60 cubic cm, weighs 108 gram and its dried weight is 86.4 grams. If its absolute density is 2.52, the degree of saturation is

A. 54%

B. 64%

C. 74%

D. 84%

40. The pressure drop in a 15 cm dia horizontal pipe is 100 kPa in a distance of10 m. The shear stress in the pipe walls in kPa is

A. 0.375

B. 6.67

C. 10.0

D. 37.5

41. If the coefficient of active earth pressure is 0.4, the coefficient of passive pressure is

A. 0.6

B. 2.5

C. 4.0

D. 0.4

42. In a rectangular channel, the Froude numbers corresponding to the alternate depths are 0.5 and 2.0 respectively. The ratio of corresponding alternate depths are

A. 2.00

B. 2.67

C. 4.67

D. 5.33

43. Staff readings on pegs x and y from X stations are 1.755 and 2.85 m, respectively. From station Y on staff head at Y and X are 0.655 and 1.560 m. respectively. If reduced level of X is 104.32 m, the reduced level of Y is

A. 103.320 m

B. 103.225 m

C. 103.415 m

D. 105.415 m

44. A 6-hr unit hydrograph is triangular in shape with abase of 75 hr and a peak discharge of 12 m^3/ s. This unit hydrograph refers to a catchment of area, in km^2

A. 65

B. 162

C. 320

D. 1800

45. The reduced level of a floor is 100.000 m. The staff reading on the floor is 1.505 m and inverted staff reading against the roof is 3.795 m, the floor level below the slab is

A. 2.290 m

B. 5.300 m

C. 3.795 m

D. 1.505 m

46. Survey of a piece of land is being carried out. Out of the following errors, which one may be either cumulating positive or cumulating negative error

A. Sag

B. Erroneous length of chain

C. Bad ranging

D. Bad straightening

47. A water tank partially filled with water is being carried on a truck with a constant horizontal acceleration. The level of water

A. Rises on the front side of the tank

B. Falls on the back sides of the tank

C. Remains the same at both sides of the tank

D. Rises on the back side and falls on the front side

48. The distance between successive steps for measuring along a hill in order to achieve higher accuracy shall

A. Decrease with increase of slope

B. Increase with increase of slope

C. Decrease with decrease of slope

D. Independent of the slope

49. A canal is to be carried over a natural drainage. Which structure will you provide at this place

A. A syphon

B. An aqueduct

C. A bridge

D. A cross-drainage structure

50. Which of the following is provided in water supply main to avoid the pressure due to water hammer?

A. Pressure relief valve

B. Sluice valve

C. Air valve

D. Hammer valve

51. The correct order of water treatment is

A. Coagulation, Disinfection, Filtration, Aeration,

B. Aeration, Coagulation, Filtration, Disinfection

C. Disinfection, Aeration, Coagulation, Filtration

D. Filtration, Coagulation, Disinfection, Aeration

52. Which of the following error is not completely eliminated in reciprocal leveling

A. Refraction

B. Earth's curvature

C. Non-adjustment of line of collimation

D. Non-adjustment of the bubble tube

53. A double stack system is

A. Two separate pipes for hot and cold water supply

B. Two separate pipes for drainage of toilet and kitchen waste

C. Two separate pipes for waste water and water supply

D. Two separate pipes for drainage of soil waste and waste water

54. Length of a 50 m chain is short by 0.05 m. What kind of error will it introduce

A. Positive cumulative error

B. Negative cumulative error

C. Negative compensating error

D. Positive compensating error

55. A non-cohesive soil has a porosity of 30% and relative density of soil particles is 2.70. The value of critical exit gradient for this soil is

A. 0.81

B. 1.0

C. 1.19

D. 1.89

56. Which of the following is not a water borne disease

A. Dysentery

B. Cholera

C. Typhoid

D. Maleria

57. An 8 hour storm had 8 cm of rainfall, and the resulting runoff was 4 cm. If the ô – index remains at the same value, a rainfall of 12 cm in a 15 hour storm produces a runoff in this catchment of

A. 4.5 cm

B. 6.0 cm

C. 8.0 cm

D. 10.5 cm

58. Ratio of inertia force to elastic force is known as

A. Froude number

B. Weber number

C. Reynolds number

D. Mach number

59. A piece of wood having weight 5 kg floats in water with 60% of its volume in the liquid. The specific gravity of wood is

A. 0.4

B. 0.5

C. 0.6

D. 0.83

60. Ratio of quantity of water stored in the root zone of the crops to the quantity of water actually delivered in the field is known as

A. Water storage efficiency

B. Water use efficiency

C. Water application efficiency

D. Water conveyance efficiency

61. As per Indian standards maximum permissible limit for fluoride in drinking water is

A. 0.5 mg/litre

B. 1.5 mg/litre

C. 2.5 mg/litre

D. 5.0 mg/litre

62. The best method for disinfection of water of swimming pool is

A. By potassium permanganate

B. By chlorination

C. Lime treatment

D. Ultra violet rays treatment

63. Disinfection depends on pH of water such that the disinfection efficiency is

A. Highest at pH of 7

B. Increases at higher pH value of water

C. Reduces at higher pH value of water

D. None of the above

64. Layout of distribution system for city with roads of rectangular pattern and for irregularly growing town shall be

A. Grid iron system and Radial system

B. Grid iron system and Dead end system

C. Radial system and Grid iron system

D. Radial system and Dead end system

65. Correct order of Biochemical oxygen demand (BOD), Chemical oxygen demand (COD) and Theoretical oxygen demand (TOD) is

A. BOD > COD > TOD

B. TOD > COD > BOD

C. BOD > TOD > COD

D. COD > BOD > TOD

66. Water seal of traps is preserved by installation of which pipe in the house drainage system?

A. Vent pipe

B. Drain pipe

C. Anti-siphonage pipe

D. Waste pipe

67. Which trap is connected to sewerage line and collects water from wash basins?

A. Gully trap

B. P or S trap

C. Nahani trap

D. Bottle trap

68. Two triangulation signals of 6.75 m each, are to be just visible over the ground mutually, what is the maximum distance between their locations on the ground surface ?

A. 10 km

B. 20 km

C. 30 km

D. 40 km

69. Drop manholes are provided in the sewerage system when there is

A. Change in the size of sewers

B. Change in the alignment of sewer line

C. Change in the elevation of ground level

D. Change from gravity to pressure system

70. Population of a town in three consecutive years is 5000, 7000 and 8400, respectively. The population of the town in the fourth consecutive year according to geometrical increase method is

A. 10920

B. 10100

C. 9800

D. 9500

71. The gas from sludge digestion tank is mainly composed of

A. Carbon dioxide

B. Nitrogen

C. Methane

D. Hydrogen sulphide

72. The 'Lag distance' is the distance travelled by the road vehicle is called

A. perception time

B. volition time

C. emotion time

D. total reaction time

73. Soundness test is performed to know the behavior of aggregates against

A. weathering action

B. corrosion

C. fatigue

D. creep

74. The aggregate crushing value of the coarse aggregates used for concrete pavements at surface (i.e. for wearing surfaces) should not exceed

A. 15%

B. 30%

C. 45%

D. 60%

75. As per IRC recommendations for stopping sight distance at 30 km/hr design speed is

A. 20 m

B. 30 m

C. 40 m

D. 60 m

Section - B

Short Answer Type (Attempt any 10) **(5×10 = 50)**

Q.1 Explain Center of Gravity and Moment of Inertia. A circular plate of diameter 0.75m is immersed in a liquid of relative density 0.8 with its plane making an angle of 30° with the horizontal. The center of the plate is at a depth of 1.5 m below the free surface. Calculate the total force on one side of the plate and location of centre of pressure.

Q.2 Enumerate assumptions made in the derivation of torsion formulae. The angle of twist of a 5 m length of shaft whose diameter is 80 mm is observed to be 0.06 radian when the shaft is revolving at 4Hz. If shear modulus of material 'G' = 80 GPa, find the Power transmitted and the maximum shear stress induced.

Q.3 Explain any one method of Seasoning of Timber with neat sketch.

Q.4 Draw neat sketch of Right hand turn out and label it.

Q.5 A 20 cm well penetrates 30 m below static water table (GWT). After a long period of pumping a rate of 1800 liters per minute, the drawdowns in the observation wells at 12 m and 36 m from the pumped well are 1.2 m and 0.5 m respectively. Determine (i) Transmissibility of aquifer, (ii) the drawdown in the pumped well assuming R = 300 m and (iii) the specific capacity of the well.

Q.6 A rectangular channel has a width of 1.8 m and carries a discharge of 1.8 cumecs at a depth of 0.2 m. Calculate (i) the specific energy, (ii) depth alternate to the existing depth, and, (iii) Froude's numbers at alternate depths.

Q.7 Enumerate the characteristics of contours.

Q.8 What do you understand by Remote Sensing? Discuss the Image/ picture elements used in Image interpretation.

Q.9 Differentiate between web buckling and web crippling.

A bridge truss diagonal carries an axial pull of 500 kN; and is to be connected to a gusset plate 22 mm thick by a double cover butt joint with 22 mm dia. Rivets. Determine the thickness of the tie bar assuming its width as 250 mm. Design the joint and its efficiency. For rivets 'f_s' in double shear = 100 N/ mm^2, $f_{bearing}$ = 300 N/ mm^2, f_t for plate = $0.6f_y$, f_y = 260 N/ mm^2.

Q.10 Differentiate between compaction and consolidation.

A sample of sand above water table was found to have a natural moisture content of 15% and a unit weight of 18.84 kN/ m^2. Laboratory test on dried sample indicated values of 0.5 and 0.85 for minimum and maximum void ratios respectively for densest and loosest states. Calculate the degree of saturation and the relative density. Assume G = 2.65.

Q.11 On a two way traffic road, the speed of overtaking and overtaken vehicles are 65 and 40 kmph respectively. If average acceleration of overtaking vehicle is 0.92 m/ s^2, determine –

(i) safe overtaking sight distance, indicating the details of overtaking operation by a sketch and

(ii) the minimum length of overtaking zone and show the details of overtaking zone by a neat sketch.

Q.12 Explain the importance of water-cement Ratio and what do you understand by workability of concrete mix. Explain Slump Cone method.

Q.13 Explain and prove Maxwell's law of reciprocal deflection.

Q.14 Draw neat sketches of 1½ brick English and Flemish bond. Also, draw neat sketches of Random Rubble, Square Rubble and Ashlar Masonry

Section - C

Essay Type (25 × **2 = 50)**

Q.1 The stream flows due to three successive storms of 2.9, 4.9 and 3.9 cm of 6 hours duration each on a basin are given below. The area of basin is 118.8 km^2. Assuming s constant base flow of 20 cumec, derive 6 hour unit hydrograph for the basin. The average storm loss of 0.15 cm/ hr can be assumed.

Time (hr)	0	3	6	9	12	15	18	21	24	27	30	33
Flow (Cumec)	20	50	92	140	199	202	204	144	84.5	45.5	29	30

Q.2 Find the reduced level of a church spire C from the following observations taken from two stations A and B, 50m apart

Angle BAC = 60°

Angle ABC = 50°

Angle of elevation from A to the top of spire =30°

Angle of elevation from B to the top of spire =29°

Staff reading from A on the bench mark of reduced level 20.000m = 2.5 m

Staff reading from B on the same bench mark =0.500 m

Q.3 Determine the total float, free float and critical path for the installation project represented by the network shown in Figure below. The estimated duration in days for the activities are shown in Figure.

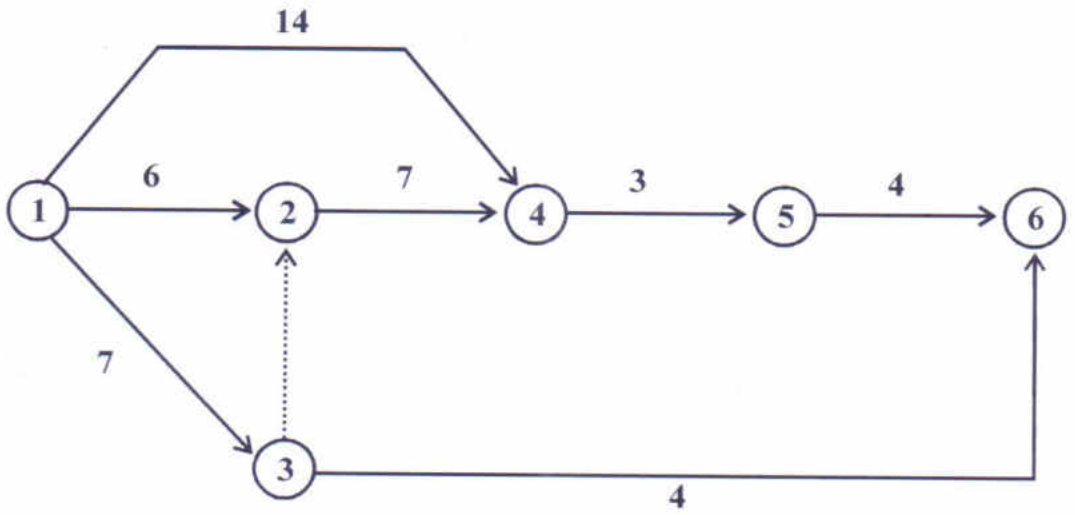

Fig. Q. 3

Q.4 Design filter units and under-drainage system of a Rapid sand filter for a town having a total filtered water requirement of 5 million liters of water per day. Assume 3% of filtered water is used for washing; 30 minutes are lost every day for washing the filter, filtration rate 5000 litres/ hr/ m^2 of filter area. Assume suitable data if required.

Q.5 A vertical load W is applied to rigid cantilever frame as shown in Figure below. Assuming EI to be constant throughout the frame, determine the horizontal and vertical displacement of point C. Neglect axial deformations if any.

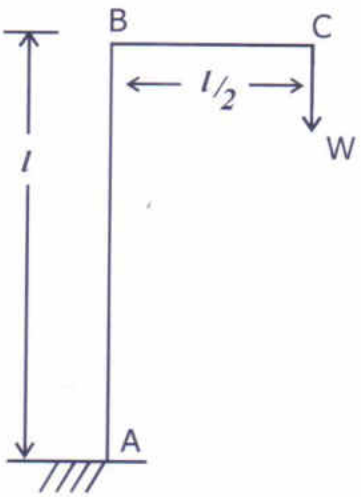

Fig. Q. 5