



**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**FACULTY OF ENGINEERING**  
**DEPARTMENT OF CIVIL AND WATER ENGINEERING**  
**ENGINEERING MECHANICS**  
**ECW 1204**

**Examination Paper**  
**Oct 2024**

This examination question paper consists of 6 pages.

**Time Allowed:** 3 Hours  
**Total Marks:** 100  
**Examiner's Name:** Felix Mudhindi  
Saneliso Ncube

**INSTRUCTIONS**

1. Answer any 4 questions of your choice.
2. Use of calculators is permissible.

**SPECIAL REQUIREMENTS**

Graph papers.

**MARK ALLOCATION**

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
<b>TOTAL POSSIBLE MARKS</b>	<b>100</b>

### QUESTION 1

- a) Calculate the support reactions in terms of  $w$  and  $L$ . **(1 Mark)**
- b) Formulate the Shear Force and Bending Moment equations at any point  $\chi$  along the simply supported beam in terms of  $w$ ,  $L$  and  $\chi$  **(6 Marks)**
- c) Draw the shear force and bending moment diagrams for the beam **(5 Marks)**

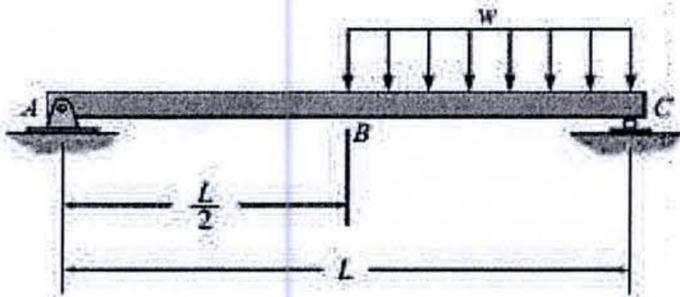


Figure 1.1

- d) Draw the shear force and bending-moment diagrams for the beam and loading shown in Fig 1.2 **(11 Marks)**
- e) i) Determine the maximum absolute value of the shear force **(1 Mark)**
- (ii) Determine the maximum absolute value of the bending moment **(1 Mark)**

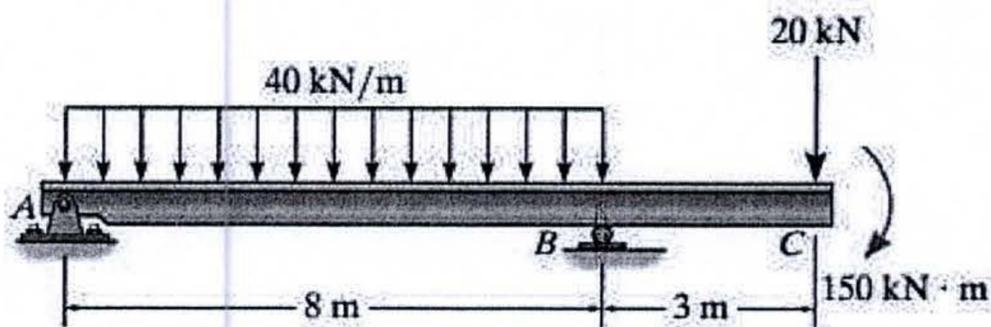


Figure 1.2

## QUESTION 2

The truss shown in **Figure 2.1** below is pinned to the floor at point A, and supported by a roller at point D. Determine the force to all members of the truss and state if the members are in tension or compression. **(25 Marks).**

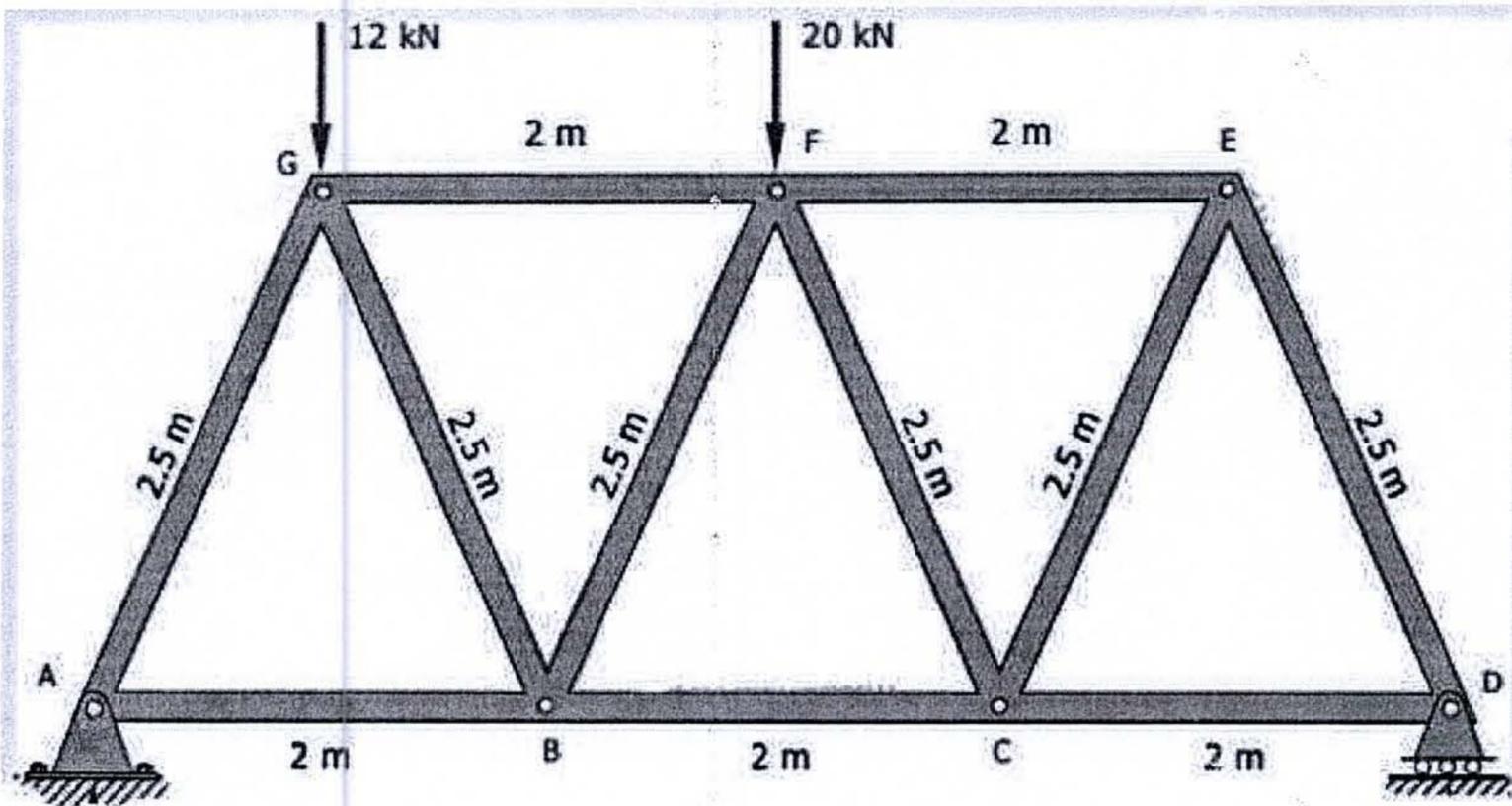


Figure 2.1

## QUESTION 3

a) Derive the following equations from first principles, stating the initial and final conditions of motion.

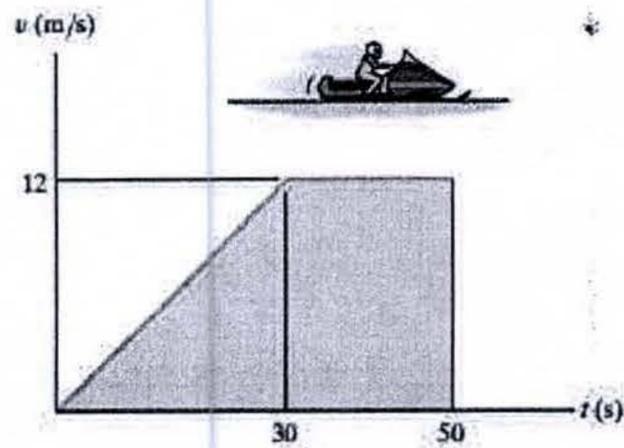
i.  $v = v_0 + at$  **(2 Marks)**

ii.  $x = x_0 + v_0t + \frac{1}{2}at^2$  **(3 Marks)**

iii.  $v^2 = v_0^2 + 2a(x-x_0)$  **(4 Marks)**

b) A particle has an initial speed of **27m/s**. If it experiences a deceleration of  $a = (-6t) \text{ m/s}^2$  where  $t$  is in seconds, determine its velocity, after it has travelled 10 m. How much time does this take? **(6 Marks)**

- c) The snowmobile moves along a straight course according to the  $v-t$  graph shown below.



Construct the  $s-t$  and  $a-t$  graphs for the same 50-s time interval. When  $t=0$ ,  $s=0$

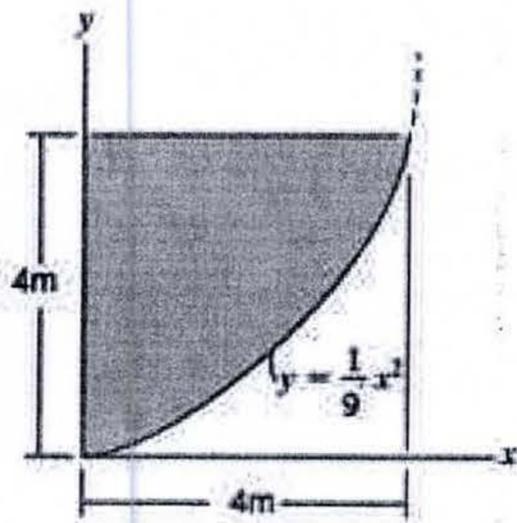
**(10 Marks)**

#### QUESTION 04

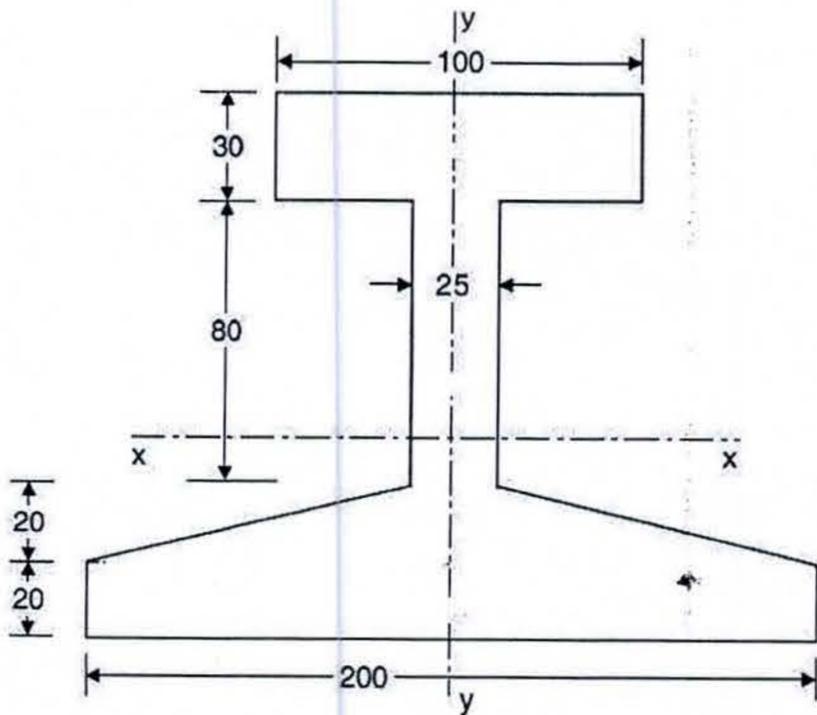
- a) Draw a well-labelled, stress -strain graph for ductile materials **(4 Marks)**
- b) Explain the four stages of deformation from your diagram. **(8 Marks)**
- c) A Circular rod of diameter 18mm and 510mm long is subjected to a tensile force of 40KN. The modulus of elasticity for steel may be taken as  $200\text{KN/mm}^2$ . Calculate stress, strain and elongation of the rod due to applied loads **(6 Marks)**
- d) A uniform ladder weighing 100N and 5 meters long has lower end B resting on the ground and the upper end A resting against a vertical wall. The inclination of the ladder with horizontal is  $60^\circ$ . If the coefficient of friction at all surfaces of contact is 0.25, determine how much distance up along the ladder a man weighing 600N can ascent without causing it to slip. **(7 Marks)**

**QUESTION 05**

- a) State the Parallel axis theorem **(2 Marks)**
- b) Derive from first principles the Moment of Inertia of a rectangular body about the x-axis and about the y-axis. **(6 Marks)**
- c) Locate the centroid of the shaded area  $\bar{x}$ , **(5 Marks)**



- d) Determine the moment of inertia of the built-up section shown in **Figure 5.1** about its centroidal axis x-x and y-y. **(12 Marks)**



**Figure 5.1**

**THE END**