INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: DIPLOMA IN ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 1/SEMESTER 1

COURSE CODE: DEE1105

NAME: MECHANICAL ENGINEERING SCIENCE I

DATE: 2025-04-16

TIME: 9:00AM-12:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully

2. The time allowed for this examination is STRICTLY three hours

3. Read each question carefully before you attempt and allocate your time equally between all the Sections

4. Write clearly and legibly. Illegible handwriting cannot be marked

5. Number the questions you have attempted

6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks

7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

# Section A Attempt any 2 questions in Section A

Question 1:

a. Determine the magnitude and direction of the resultant of the forces 470N and 538N having the same line of action but acting in opposite directions. (05 marks)
b. Use the triangle of forces method to determine the magnitude and direction of the resultant of the forces given.
      i.   13N at 0° and 25N at 30° (10 marks)
   ii.   5N at 60° and 8N at 90° (10 marks)

Question 2:

ï»¿a. Explain the following terms as applied in static force analysis (02 marks each)
      i.   Vector quantity
      ii.   Scalar quantity
      iii.   Coplanar forces
      iv.   Equilibrium
      v.   Stable Equilibrium
      vi.   Unstable Equilibrium
      vii.   Neutral Equilibrium
      viii. Concurrent forces
b. Give two examples of each vector quantity and scalar quantity (04 marks)
c. Determine the resultant force of two forces of 5kN and 8kN,
      i.   Acting in the same direction and having the same line of action (02 marks)
      ii.   Acting in opposite directions but having the same line of action. (03 marks)

Question 3:
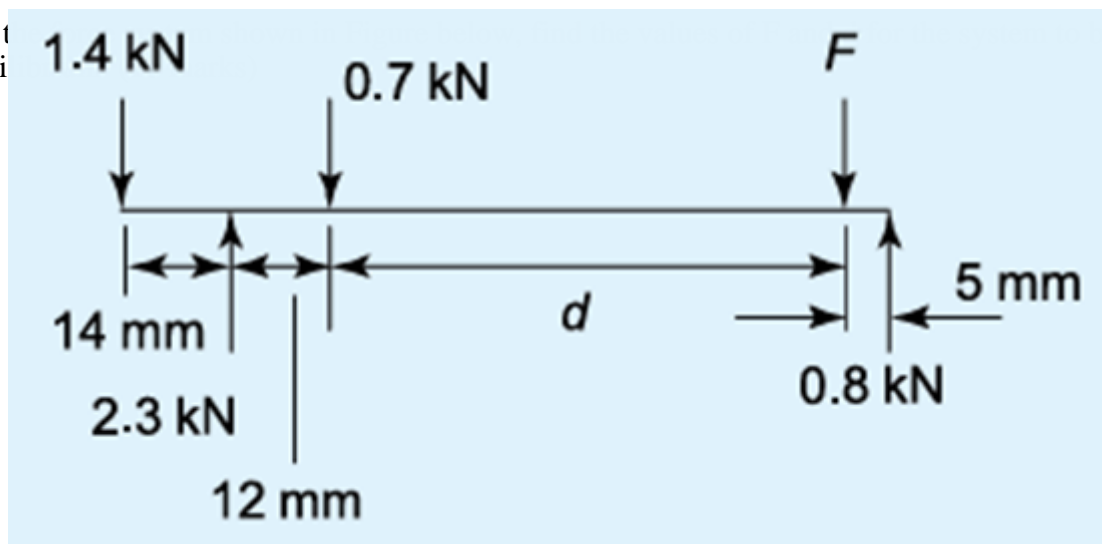
a. For t   in
    equi

a.
    For the beam shown in below calculate
      i.   The force acting on support A (08 marks)

      ii.   Distance d, neglecting any forces arising from the mass of the beam (07 marks)
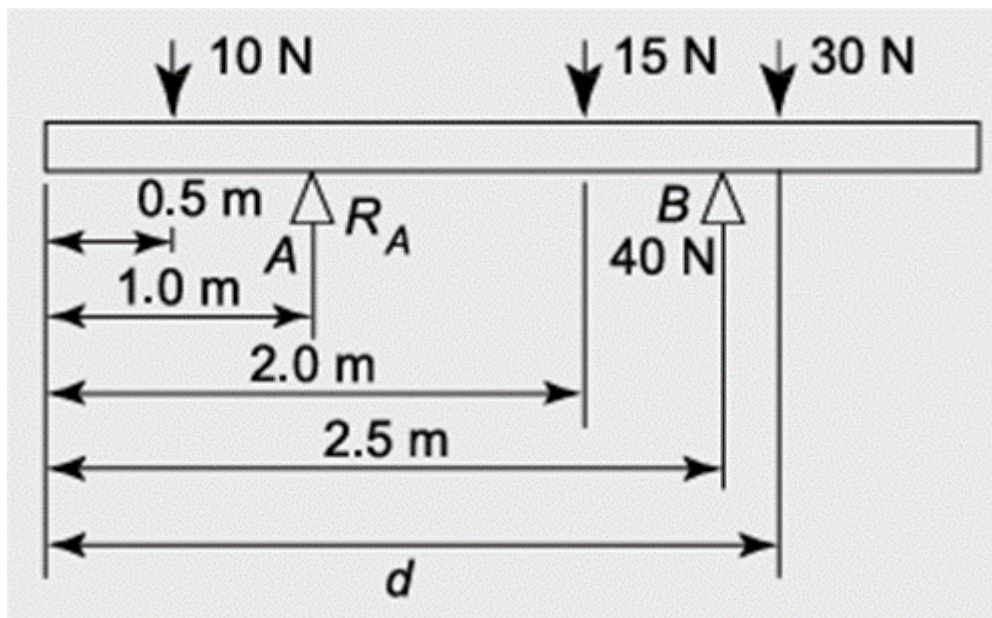
Question 4:

a. Define the term *power* (02 marks)
b. 10kJ of work is done by a force in moving a body uniformly through 125 m in 50 s.
   Determine
       i.   The value of the force (03 marks)
       ii.   The power (03 marks)
c. A planting machine has a cutting stroke of 2m and the stroke takes 4 seconds. If the constant resistance to the cutting tool is 900N, calculate for each cutting stroke
       i.   The power consumed at the tool point (05 marks)
       ii.   The power input to the system if the efficiency of the system is 75%. (05 marks)
d. A lorry is travelling at a constant velocity of 72km/h. The force resisting motion is 800N.
   Calculate the tractive power necessary to keep the lorry moving at this speed. (07 marks)
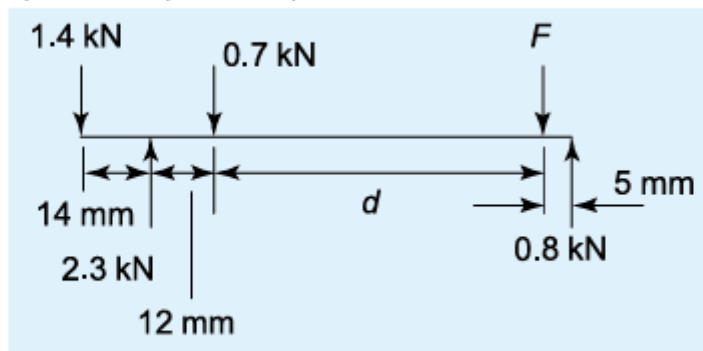
Section B Attempt 2 questions

Question 1:

a. Explain the term the following terms (02 Marks each)
       i.   Work
       ii.   Energy
       iii.   Power
b. Outline for different forms of energy you know (04 Marks)
c. State the principle of conservation of energy (02 Marks)
d. Outline four examples of energy conversions that you know (04 Marks)
e. 4kJ of energy are supplied to a machine used for lifting a mass. The force required is 800N. If the machine has an efficiency of 50%, to what height will it lift the mass? (09 Marks)

Question 2:

a. For the force system shown in Figure below, find the values of F and d for the system to be in equilibrium (10 marks)


1.4 kN 0.7 kN F

14 mm

2.3 kN

12 mm

d

5 mm

0.8 kN

b. For the beam shown in below calculate
   i.   The force acting on support A (08 marks)
   ii. Distance d, neglecting any forces arising from the mass of the beam (07 marks)

10 N   15 N   30 N

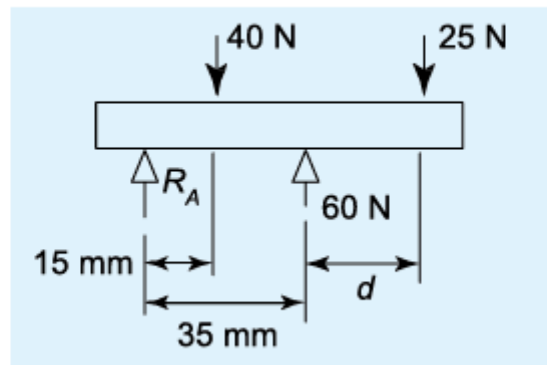0.5 m R_A B
   A   40 N
1.0 m

2.0 m

2.5 m

d
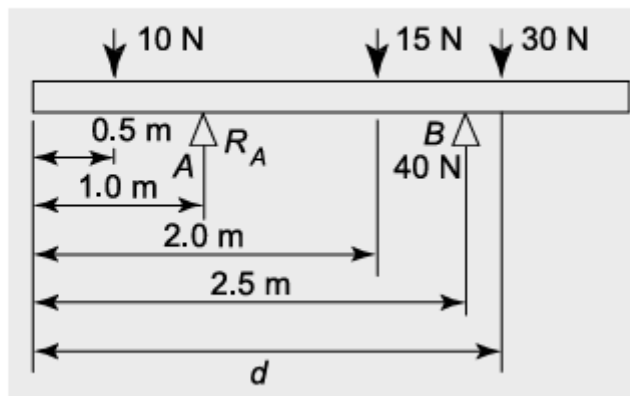
Question 3:

a. For the centrally supported uniform beam shown in Figure below, determine the values of forces F1 and F2 when the beam is in equilibrium. (10 marks)
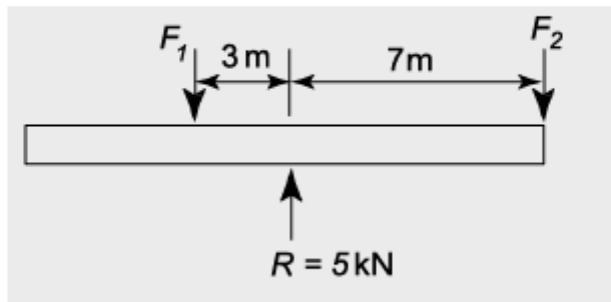
b. The forces acting on a beam are as shown in Figure below. Neglecting the mass of the beam, find the value of RA and distance d when the beam is in equilibrium. (15 marks)

Question 4:

a. Calculate the work done when a force of 40N pushes an object a distance of 500m in the same direction as the force. (05 marks)

b. A spring requires a force of 10N to cause an extension of 50mm. Determine the work done in extending the spring
   i.   From zero to 30mm (07 marks)
   ii. From 30mm to 50mm. (08 marks)

c. Calculate the work done when a mass of 20 kg is lifted vertically through a distance of 5.0 m. Assume that the acceleration due to gravity is 9.81 m/s^2. (05 marks)