JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

UNIVERSITY EXAMIMATION FOR THE DEGREE IN SCIENCE IN CONSTRUCTION MANAGEMENT

2ND YEAR 2ND SEMESTER 2022/2023 ACADEMIC YEAR

CENTRE: MAIN CAMPUS

COURSE CODE: TCB 1204

COURSE TITLE: STRUCTURES I

EXAM VENUE: **STREAM: BSc. CONSTRUCTION MGT**

DURATION: 2 HOURS

<u>**Instructions**</u>

1. **Answer question 1 (Compulsory) and ANY other two questions**

2. **Candidates are advised not to write on question paper**

3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**
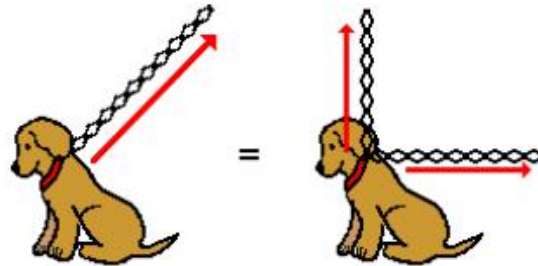
SECTION A: 30 Marks

QUESTION ONE 10 marks

a) With reference to the diagram given answer the following. The arrows shows the direction of forces experienced by the dog

    i.   Name the force principle demonstrated by the diagram **1 mark**

    ii.   Given the inclined force has a magnitude of 55N and has an inclination of 50° from the vertical, determine the two components **3 marks**

    iii.   This type of force is called a dynamic force. *TRUE or FALSE?* **1 mark**

b) Engineering is the application of scientific and technical knowledge to solve human problems. In the application of scientific knowledge (science, technology, mathematics, practical experience) to solve problems, Engineers exercise the following three areas of their analytical abilities **3 marks**

- …….. .
- ………
- ………

c) Define the following mechanical properties of materials **2 marks**

    i.   Fatigue

    ii.   Creep

QUESTION TWO 20 Marks

a) *"If three coplanar forces acting at a point are in equilibrium, then each force is proportional to the sine of the angle between the other two."*

    i.   Name the above force theorem and give its mathematical expression **2 mark**

    ii.   Apply the theorem in the solution of the problem given below **4 marks**

    An electric light fixture weighing 15 N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60° to the horizontal and BC at 45° to the horizontal as shown. Determine the tensions in the strings BC and AC
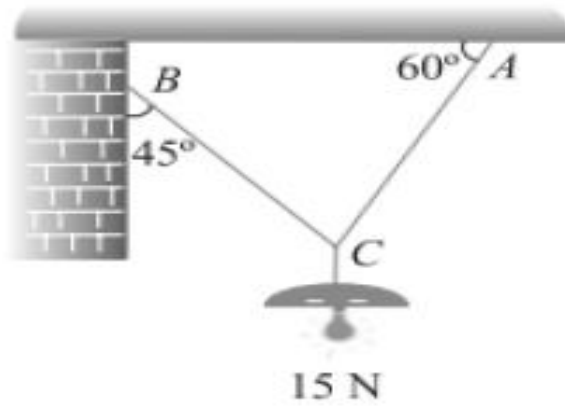
b) **Strength** is one of mechanical properties we have encountered in this course. Answer the following in relation to this property.   **7 marks**

    i.   How can you apply this property in engineering works? **2 marks**

    ii.   Briefly explain the relationship between strength and stress in a material:-

                                                              2 marks

    iii.   Name the three basic classifications of strength: **3 marks**

        ....

        ....

        ....

c) With reference to the figure given below, answer the questions that follow **7 marks**
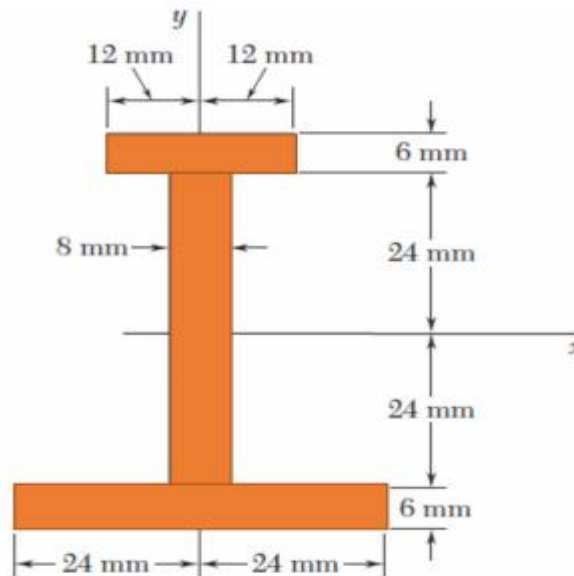
    i.   Determine the second moment of area ($I_{x\text{-}x}$) of the section about the given X-axis **5 marks**
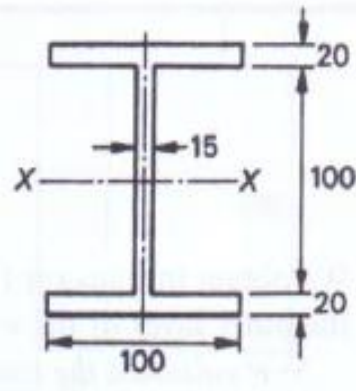
ii.   Determine the Radius of gyration (k_{x-x})of the section about the X-axis **2 marks**

SECTION B: 40 Marks

QUESTION THREE 20 Marks

The steel beam shown here carries a single concentrated load of 30kN at the midpoint and is simply supported. The beam has a span of 3m. The Young's modulus for steel is 200 x 10^3 kN/mm². Answer the questions below

a) Determine the maximum bending moment induced in the beam by the load **3 marks**
b) Determine the location of the neutral axis **7 marks**
c) Compute maximum bending stress induced in the beam by the loading **6 marks**
d) Calculate the radius of curvature at the point of maximum bending moment **4 marks**

QUESTION FOUR 20 Marks

A steel cylinder is enclosed in a copper tube as shown. The cylinder and the tube are compressed between rigid parallel plates by an axial thrust of 420 kN.. Internal diameter is 100mm and external diameter is 200mm. E_s = 2.0 x 10^5 MPa and E_c = 1.2 x 10^5 MPa
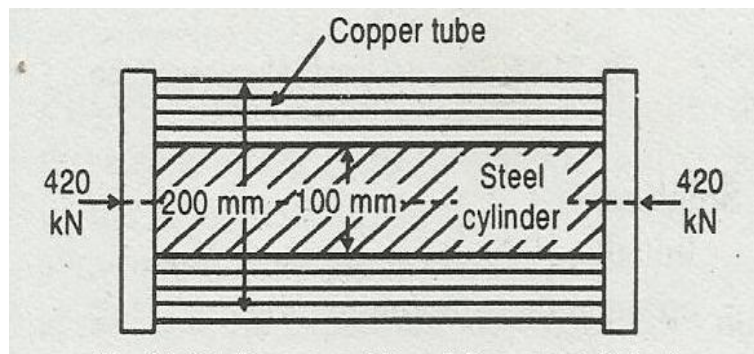
Answer the following in relation to the information given above

a) Compute the areas of steel and copper that carry the loading **4 marks**
b) Determine the stresses induced in steel and in copper **10 marks**
c) Calculate the portions of the load carried by each material **3 marks**
d) Calculate the strains in each material **3 marks**

QUESTION FIVE (20 marks)

A beam is a structural component which is commonly used in engineering in design and construction of structures. Based on this component, answer the questions that follow.

a) Name and briefly describe five types of beams based on support used **10 marks**
  i.   …………
  ii.   …………
  iii. …………
  iv.   …………
  v.   …………
  vi.   …………

b) The simply supported beam shown here below carries two concentrated loads. Neglecting the weight of the beam, answer the questions that follow.
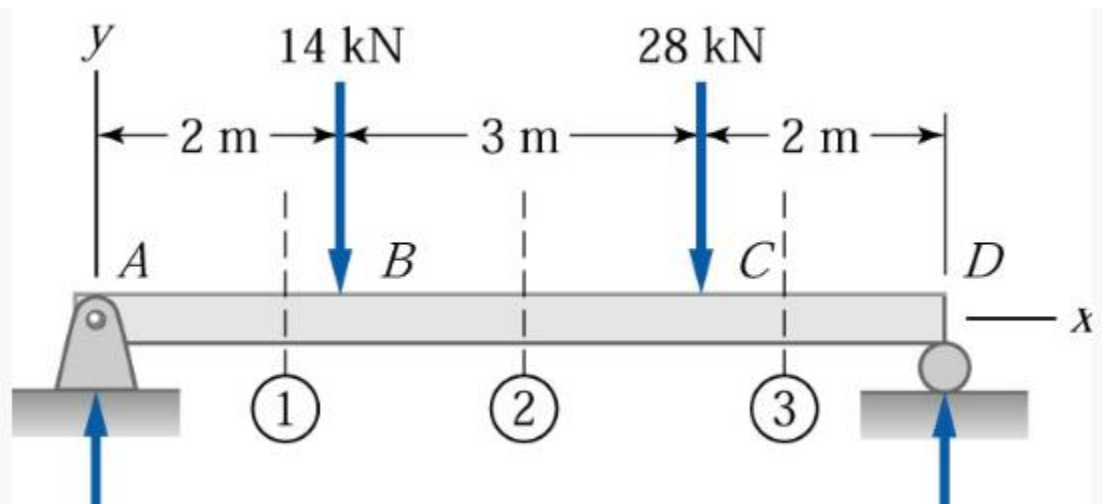
  i. Determine the support reactions R_A and R_D **4 marks**
  ii. Sketch the *loading*, *shear force* and *bending moment* diagrams **6 marks**