UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: DTM 1073
COURSE	: STATICS & DYNAMICS
SEMESTER/SESSION	: SEMESTER 2 – 2023/2024
TIME	: 3 HOURS

Instructions:

1. This booklet consists of **5** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, ask the invigilator / Instructor

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

Answer **ALL** questions.

QUESTION 1

a) **Describe** definition of scalar and vector (4 marks)

b) **Explain** the following Newton's Law

I. First Newton's Law (2 marks)

II. Second Newton's Law (2 marks)

III. Third Newton's Law (2 marks)

c) By sketching, **explain** the concept of moment. (4 marks)

d) **List** two (2) conditions that system/rigid body is in statics equilibrium. (4 marks)

QUESTION 2

a) Three (3) forces act on a point A as shown in Figure 1. **Compute** for each its component force F_x and F_y and the resultant/magnitude force at A. (8 marks)

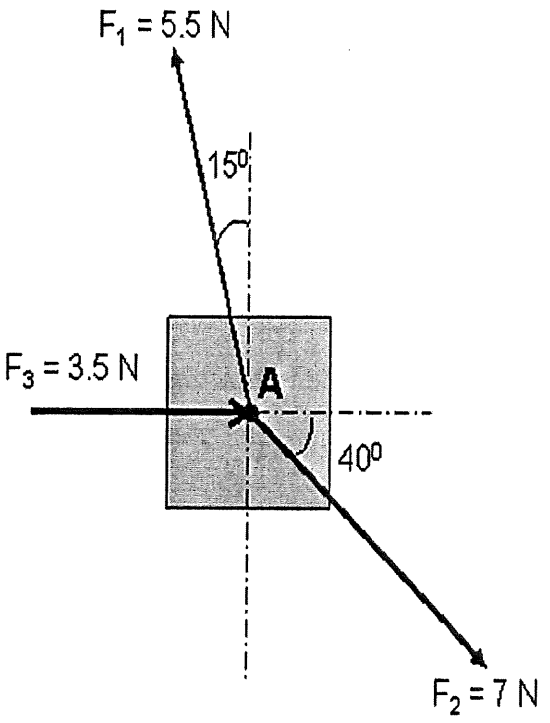


Figure 1

b) **Solve** the force **F** as shown in Figure 2. (6 marks)

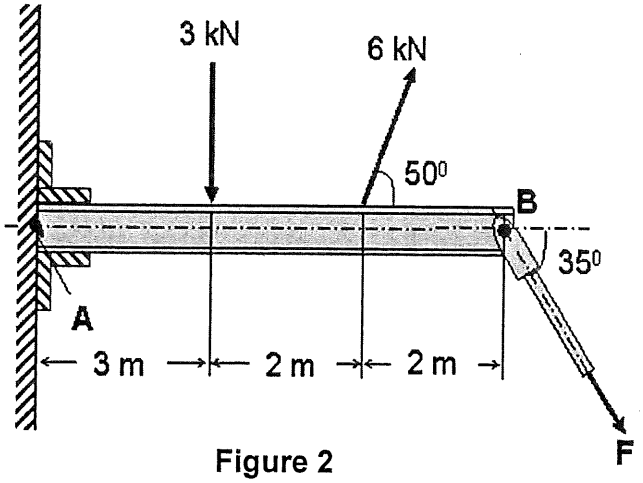


Figure 2

c) A beam weight of 5 N hang with a cable BD and a block mass of 8 kg hang at the end (C) of beam as shown in Figure 3. **Calculate** the Tension in cable BD and reaction force at support A. (8 marks)

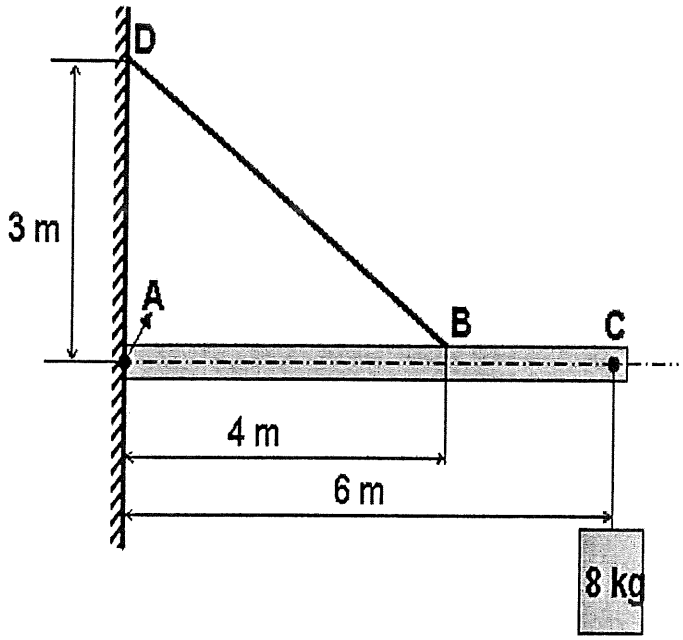


Figure 3

QUESTION 3

a) By using method of joint, **compute** the force in each member *AC, AB* and *BC* of the truss shown in Figure 4 and state if the members are in tension (T) or compression (C). (9 marks)

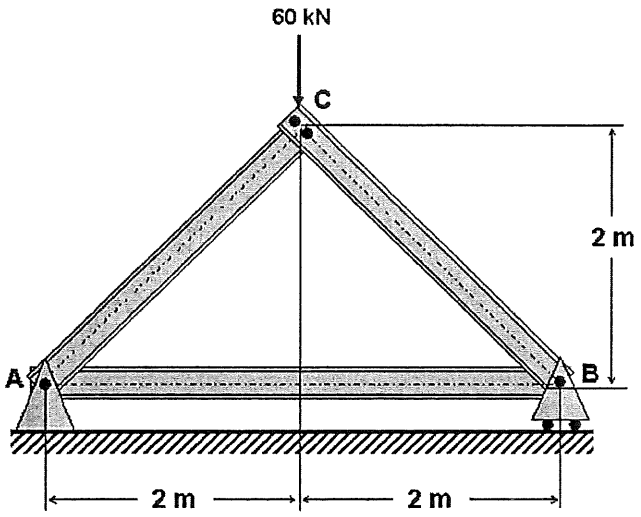


Figure 4

b) By using method of section, **compute** the force in member *AC* and *BC* of the truss shown in Figure 5 and state if the members are in Tension (T) or Compression (C). (9 marks)

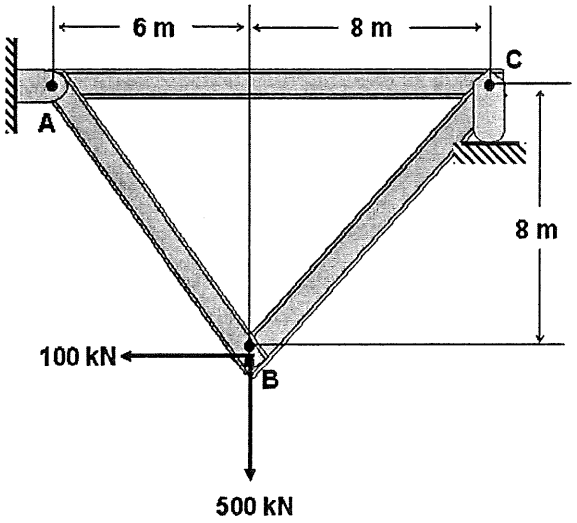


Figure 5

QUESTION 4

a) A 7kg box m_1 pulls a 5.5kg box m_2. A lightweight, flexible cable is connected both boxes over frictionless and mass less pulley as shown in Figure 6 The coefficient of friction between table and box m_2 is 0.25.

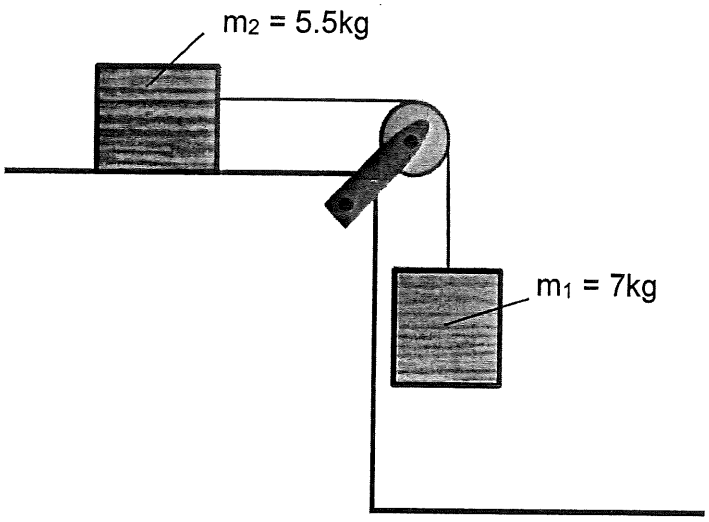


Figure 6

i. **Explain** the frictional force (F_f). (4 marks)

ii. **Sketch** the free body diagram (FBD) for both boxes. (6 marks)

iii. **Compute** the friction force (F_f) acts on the box m_2. (5 marks)

iv. If the boxes are initially at rest, **compute** acceleration and the tension in the cable. (6 marks)

v. Start from rest, **find** the distance that m_2 moves with constant acceleration in t = 2.5 sec. (3 marks)

QUESTION 5

a) A speedboat starts from rest and acceleration at +2.0 m/s^2 for 8.0 s. At the end of this time, the boat continues for an additional 7.0 s with an acceleration of +0.52 m/s^2. Following this, the boat accelerates at –1.5 m/s^2 for 9.0 s. **Calculate**

i) The velocity of the boat at t = 24.0 s? (6 marks)

ii) The total displacement of the boat. (6 marks)

b) A locomotive is accelerating at 1.6 m/s^2. It passes through a 20.0 m wide crossing in a time of 2.4 s. After the locomotive leaves the crossing, **calculate** the time is required until its speed reaches 32 m/s. (6 marks)

----------**END OF QUESTION**----------

Rubric:

Criteria	Marks
All questions answered will be marked according to the answer scheme.	/100

FORMULA

Static Equilibrium:

$$\sum F_X = 0$$
$$\sum F_Y = 0$$
$$\sum M = 0$$

Newton's 2nd Law:

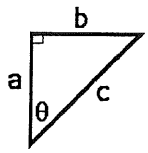
$$\sum F = ma$$

Friction Force:

$$F_f = \mu F_N$$

Equation of Linear Motion:

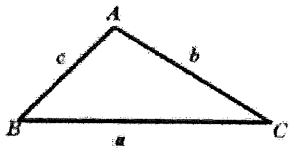
$v = v_0 + at$
$v^2 = v_0^2 + 2as$
$s = v_0 t + \frac{1}{2} at^2$
$s = \frac{1}{2}(v_0 + v)t$



a=side adjacent to angle Θ
b=side opposite to angle Θ
c=hypotenuse of triangle

$\sin\Theta = \frac{b}{c}$ $\cos\Theta = \frac{a}{c}$ $\tan\Theta = \frac{b}{a}$

Cosine Rule



$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$c^2 = b^2 + a^2 - 2ab\cos C$$

Which one to use depends whether the unknown is a length or an angle

The formula can be rearranged to:

$$\cos A = \frac{b^2 + c^2 - a^2}{2bc}$$
$$\cos B = \frac{a^2 + c^2 - b^2}{2ac}$$
$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$