

**UNIVERSITY COLLEGE TATI (UC TATI)****FINAL EXAMINATION QUESTION BOOKLET**

COURSE CODE	: BMT 2093
COURSE	: STATIC AND STRENGTH OF MATERIAL
SEMESTER/SESSION	: 2-2023/2024
DURATION	: 3 HOURS

**Instructions:**

1. This booklet contains **4** 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, raise up your hands and ask the invigilator.

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

**THIS BOOKLET CONTAINS 10 PRINTED PAGES INCLUDING COVER PAGE**

## QUESTION 1

- a) Two particles have a mass of 6kg and 10kg, respectively. The particles are placed 600 mm apart, determine the force of gravity acting between them. Compare this result with the weight of each particle.
- Find the force of gravity acting between them. (3 marks)
  - Compare this result with the weight of each particle. (4 marks)
- b) The plate is subjected to the two forces at A and B as shown. If  $\theta = 60^\circ$ , compute;
- the magnitude of the resultant of these two forces (3 marks)
  - the direction measured from the horizontal. (3 marks)

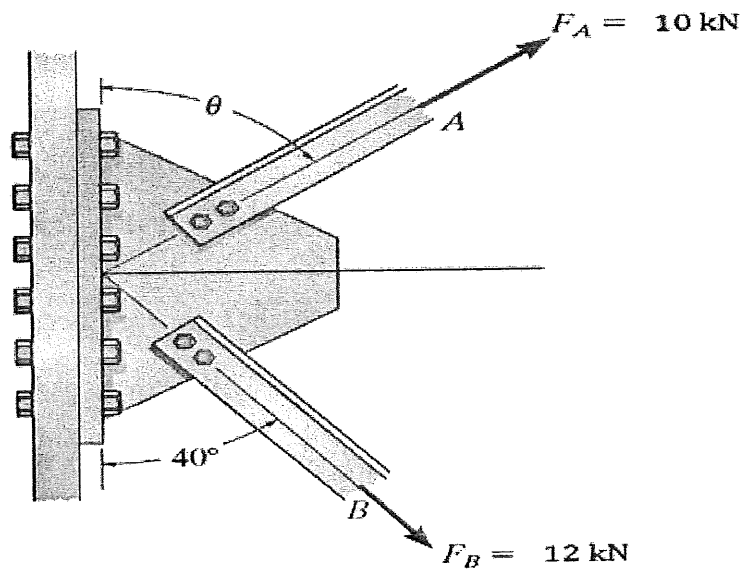


Figure 1

- c) Three force  $F_1$ ,  $F_2$  and  $F_3$  acting on a support as shown in Figure 2.
- Compute the components in  $x$  – direction (5 marks)
  - Compute the components in  $y$  –direction (4 marks)

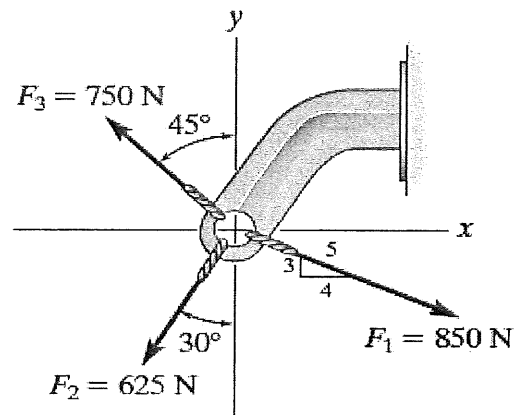


Figure 2

## QUESTION 2

- a) A force of 7000 N acts on a structure as shown in Figure 3. Compute the moment of the force about point O. (6 marks)

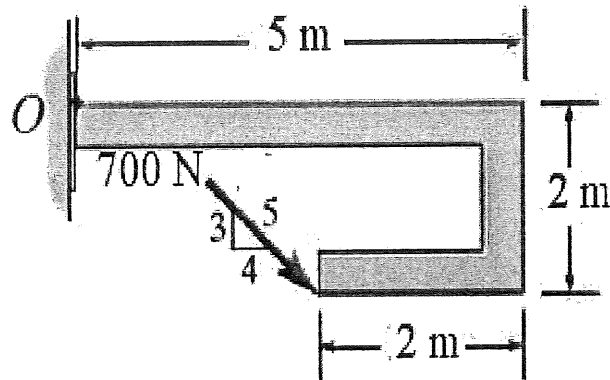


Figure 3

- b) Compute the moment of the force about point O as shown in Figure 4.

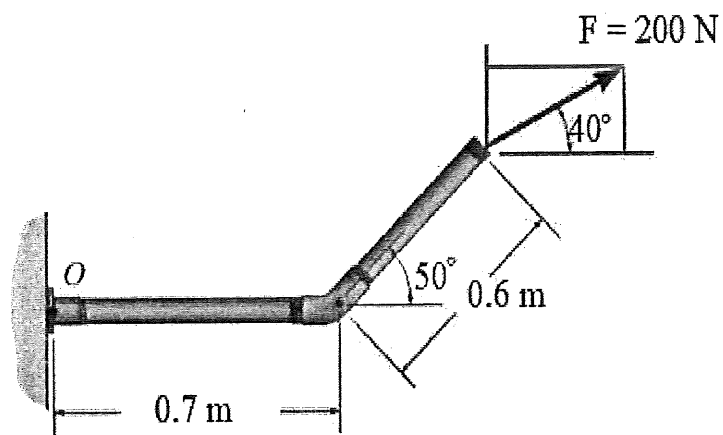


Figure 4

(8 marks)

- c) A fixed crane as shown in Figure 5 has a mass of 2000 kg and used to lift a 4800 kg crate. It is held in place by a pin A and a rocker at B. The center of gravity of the crane is located at C. Compute the components of the reaction at A and B.

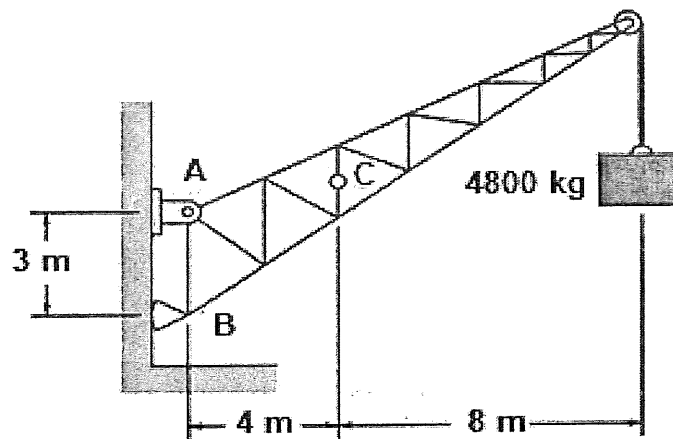


Figure 5

(7 marks)

- d) i. Describe distributive forces. (2 marks)
- ii. Explain 3 (three) examples of distributive forces in terms of force distribution and intensity. (6 marks)

**QUESTION 3**

- a) i. Trusses are structures that are commonly used in steel buildings for roof and bridges. Describe the characteristics of a truss.  
(4 marks)
- ii. Simple trusses are constructed from a base triangle by adding two members at a time. List 3 (three) examples of simple trusses for bridges.  
(3 marks)
- b) A steel column with 5 m long and 0.6 m in diameter is used to carry a 180 MN load. Given that the modulus of elasticity is 250G Pa, compute;
- i. The compressive stress  
(3 marks)
- ii. The compressive strain  
(2 marks)
- iii. The amount of column compression  
(2 marks)
- c) A punch must cut a hole 30 mm diameter in a sheet of steel 4 mm thick. The ultimate shear stress is 70 MPa. Compute the force required.  
(4 marks)

- d) A rope coupling device as shown in Figure 6 uses a pin 8 mm diameter to link the two parts. If the shear stress in the pin must not exceed 75 MPa, compute the maximum force allowed in the ropes.

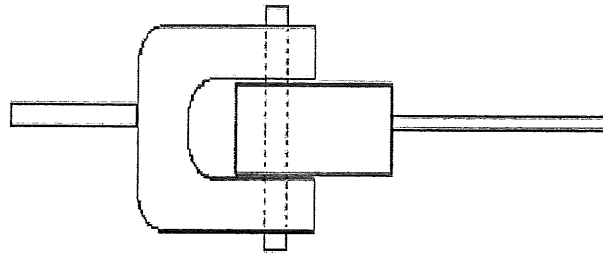


Figure 6

(3 marks)

- e) A shaft is made of solid round bar 50 mm diameter and 0.95 m long. The shear stress must not exceed 320 MPa. Take  $G=90$  GPa, compute the following;

i. The maximum torque that should be transmitted.

(4 marks)

ii. The angle of twist which will occur.

(3 marks)

**QUESTION 4**

- a) Calculate the shear force and bending moment for the beam subjected to a concentrated load as shown in the Figure 7, then draw the shear force diagram (SFD) and bending moment diagram (BMD).

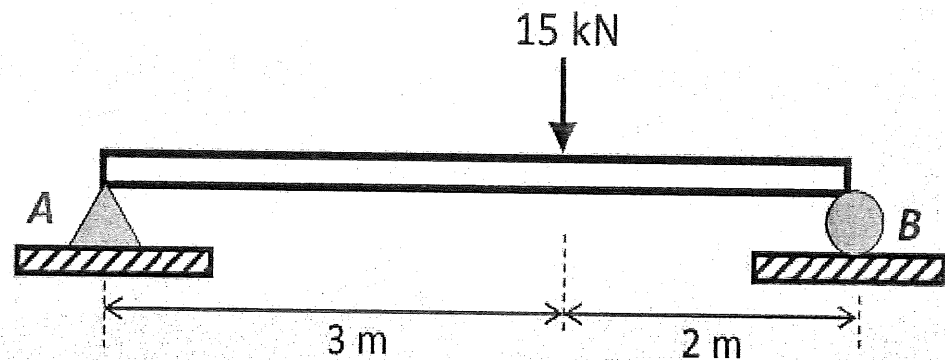


Figure 7

(14 marks)

- b) Describe the following terms. Use a diagram if necessary.

i. Neutral axis of a beam

(3 marks)

ii. Centre of gravity

(2 marks)

iii. Centroid

(2 marks)

-----End of Question-----

**RUBRIC**

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

**Formula**

$$W = \frac{Gm_1m_2}{R^2}$$

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$$

$$a^2 = b^2 + c^2 - 2bc \cos(A)$$

$$M = Fd$$

$$A = \pi r^2$$

$$\sigma = \frac{F}{A}$$

$$\varepsilon = \frac{x}{L}$$

$$E = \frac{\varepsilon}{\sigma}$$

$$A = \pi dt$$

$$\tau = \frac{F}{A}$$

$$\tau = \frac{F}{2A}$$

$$J = \frac{\pi D^4}{32}$$

$$\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{r}$$

**Constant**

Universal gravitational constant,  $G = 6.673(10^{-11})m^3 / (kg \cdot s^2)$

Mass of earth,  $m_e = 5.976 (10^{24})kg$

Radius of earth,  $R = 6371(10^3) m$

Acceleration of gravity,  $g = 9.81 m/s^2$