Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	SOLID MECHANICS
COURSE CODE	:	BBM 30303
PROGRAMME CODE	:	BBA/ BBD/ BBG
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER **FIVE (5)** QUESTIONS OUT OF SIX QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 A short column has a rectangular cross section with sides in the ratio 1:2 as shown in **Figure Q1** below. It is subjected by concentrated axial load of 1200 kN and the material's yield strength and modulus of elasticity is 250 MPa and 200 GPa respectively, determine:

(a) The minimum dimension of B so that the column does not fail.

(8 marks)

(b) The change in length of column if original length, L is 200 mm.

(6 marks)

(c) Also the column would not be designed to the limit of its failure stress but need to incorporate safety factor = 2 against yielding, what should be new dimension of B.

(6 marks)

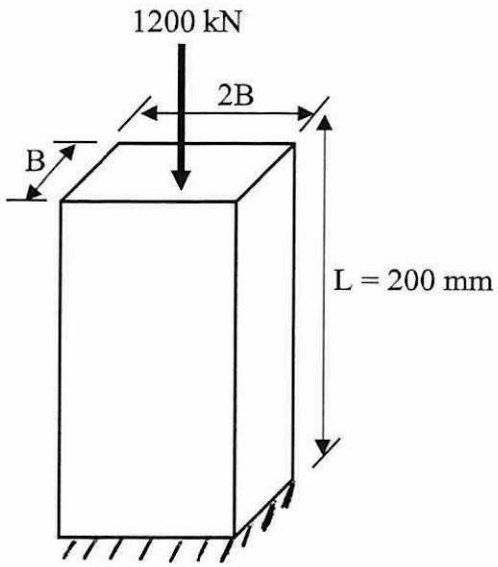

Figure Q1

Q2 A beam as shown in **Figure Q2** has a length of 10 m and simply-supported at point A and B. The beam is loaded with distributed load from point A to B and concentrated load at C.

(a) Determine the shear force and bending moment for both segment of beam as a function of x.

(10 marks)

(b) Draw the shear force and bending moment diagrams for the beam and state the main values on both diagrams.

(10 marks)

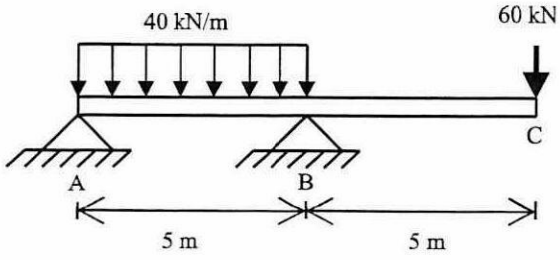

Figure Q2

Q3 The horizontal bar AB of a swing set shown in **Figure Q3** is made of steel pipe of 50 mm inner diameter with 5 mm thickness. Two steel wires with diameter of 3 mm are also being used to hang the swing. If the allowable stress of steel is 250 MPa, compute:-

(a) The reaction force at both ends A and B.

(4 marks)

(b) The maximum bending moment and their location

(6 marks)

(c) What is the maximum mass of a person who may safely use the swing with a safety factor of 4? (10 marks)

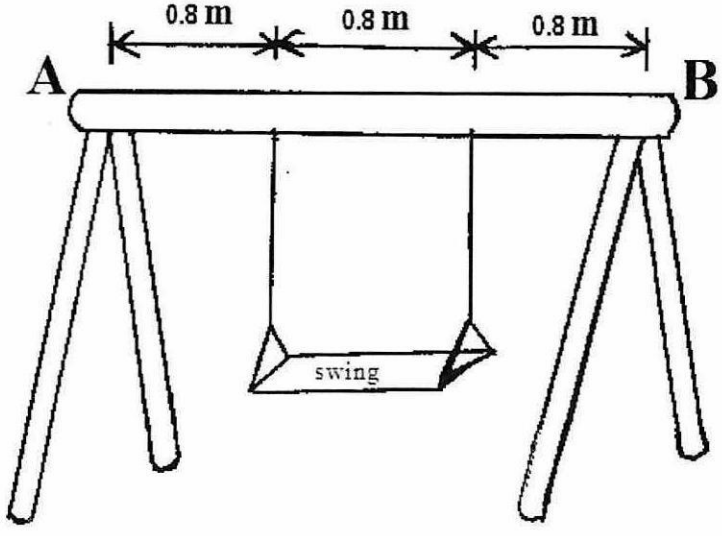

Figure Q3

Q4 The solid shaft AB as shown in **Figure Q4** to which the handle is attached is made of C83400 red brass and has a diameter of 20 mm. The shaft's allowable shear stress = 45 MPa and modulus of rigidity, G = 40 GPa. The shaft is fixed at A. Determine:-

(a) The maximum couple forces F that can be applied to the handle just before the material starts to fail.

(5 marks)

(b) What is the angle of twist of the handle.

(5 marks)

(c) If the solid shaft is replaced by hollow shaft with external diameter of 25 mm, what should be the maximum internal diameter.

(10 marks)

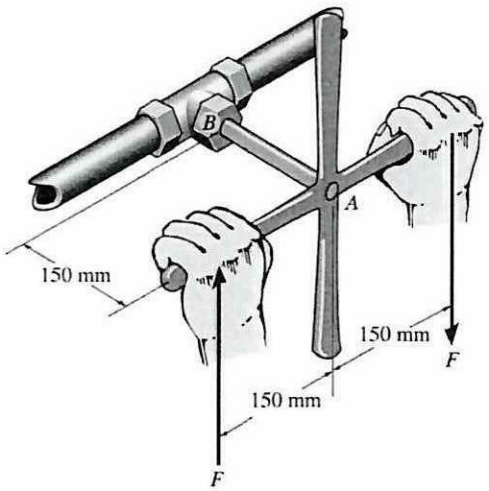

Figure Q4

Q5 Air pressure in the cylinder as shown in **Figure Q5** is increased by exerting forces P = 2 kN on the two pistons, each having a radius of 45 mm. If the cylinder has a wall thickness of 2 mm,

(a) Determine the state of stress in the wall of cylinder.

(10 marks)

(b) In the other design problem, determine the maximum force P that can be exerted on each of the two pistons so that the hoop stress component in the cylinder does not exceed 3 MPa.

(10 marks)

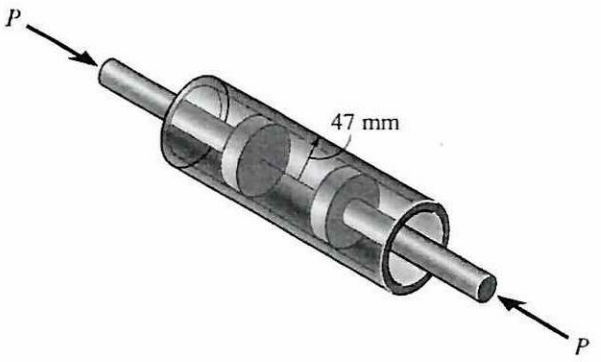

Figure Q5

Q6 The state of stress at a point is shown on the element in **Figure Q6** below. Determine,

(a) The principal stresses.

(10 marks)

(b) The maximum in-plane shear stress and average normal stress at the point.

(10 marks)

Specify the orientation of the element in each case.

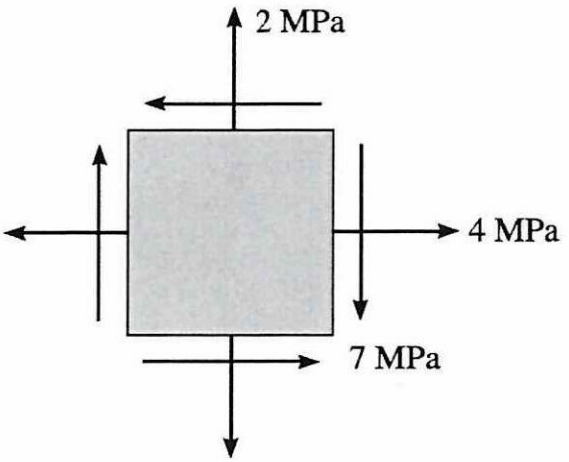

Figure Q6

- END OF QUESTION –