Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	SOLID MECHANICS 2
COURSE CODE	:	BDA 20903
PROGRAMME	:	2 BDD
EXAMINATION DATE	:	JUNE 2019/ JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 The steel bracket with $E_{steel} = 200GPa$ and $\nu_{steel} = 0.3$ in **Figure Q1** is subjected to external loadings. Due to the given loadings, the readings from the gauges at point A (on the surface of the bracket) shows:

$$\varepsilon_a = 600x10^{-6}, \quad \varepsilon_b = 450x10^{-6}, \quad \varepsilon_c = -75x10^{-6}$$

Referring to the given measurement, determine:

(i) the principal strains at point A

(12 marks)

(ii) the corresponding principal stresses at point A

(8 marks)

Q2 An overhanging beam is roller-supported at point *B* and pin-supported at point *D* is loaded as shown in **Figure Q2**. Determine the deflection at point *C* if *EI* is constant.

(20 marks)

Q3 A steel pipe is pin-supported at its ends. It is 2 m long and has an outer diameter of 50 mm. The material of pipe has a modulus of elasticity of 210 GPa and yield strength of 260 MPa. If it is subjected by axial compressive load of 180 kN, determine:

(i) the smallest thickness of pipe so that it can support an axial load without buckling.

(12 marks)

(ii) the smallest thickness of pipe so that it can support an axial load without buckling by using a factor of safety with respect to buckling of 2.

(8 marks)

Q4 (a) A simply supported beam is loaded as shown in **Figure Q4 (a)**. Determine the bending strain energy stored in the beam if *EI* is constant.

(10 marks)

(b) An over-hanging beam is loaded as shown in **Figure Q4 (b)**. If E = 210GPa and $I = 126x10^6$ mm^4, determine the angle at point A.

(10 marks)

Q5 **Figure Q5** shows a cross section of composite cylinder that is made by shrinking a tube of 320 mm internal diameter and 40 mm thick over another tube of 320 mm external diameter and 40 mm thick. The radial pressure at the common surface, after shrinking is 160 MPa. Suppose the compound cylinder is subjected to an internal fluid pressure of 1000 MPa, determine:

(i) the hoop stresses at inner radius and outer radius of inner cylinder, and

(10 marks)

(ii) the hoop stresses at inner radius and outer radius of outer cylinder.

(10 marks)

Q6 The shaft is made of steel having a proportional limit of 360 MPa in tension or compression and subjected by a load of 15 kN as shown in **Figure Q6**. If a factor of safety of 2.0 with respect to failure by yielding is specified. According to the Maximum-Shear-Stress Theory and the Maximum-Distortion-Energy Theory of failures:

(i) Explain these theories of failure

(4 marks)

(ii) Determine the principles of these theories

(4 marks)

(iii) Determine the minimum permissible diameter, D according to these theories.

(12 marks)

-END OF QUESTION-

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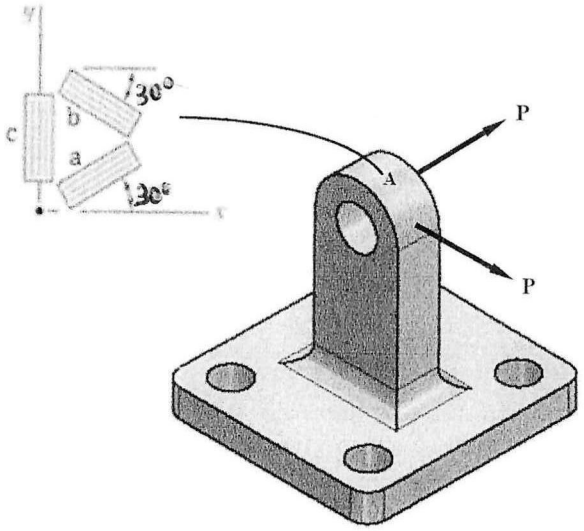

Figure Q1

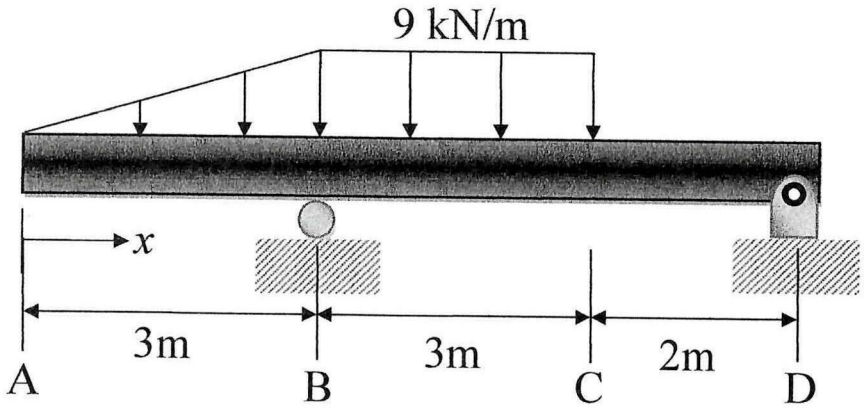

Figure Q2

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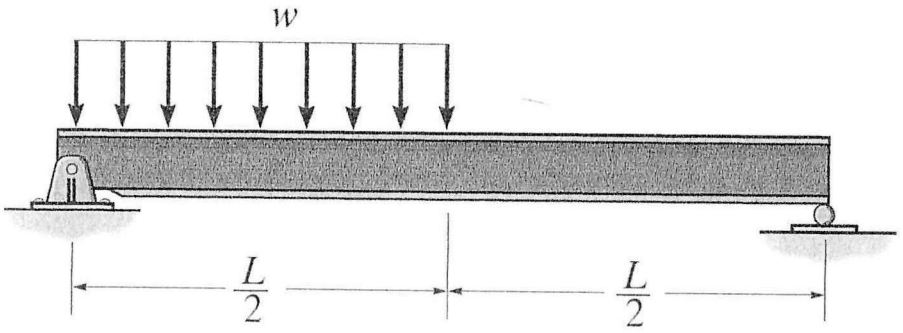

Figure Q4 (a)

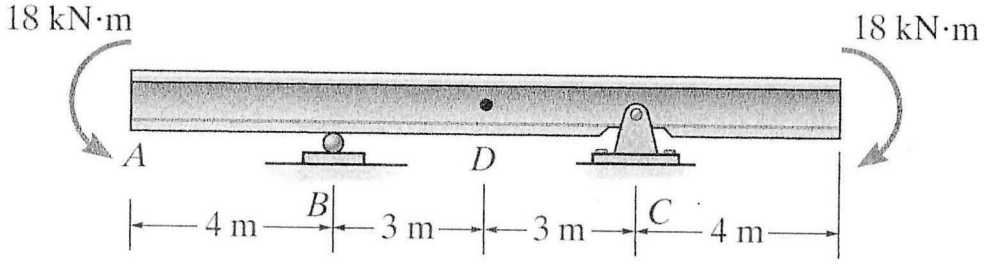

Figure Q4 (b)

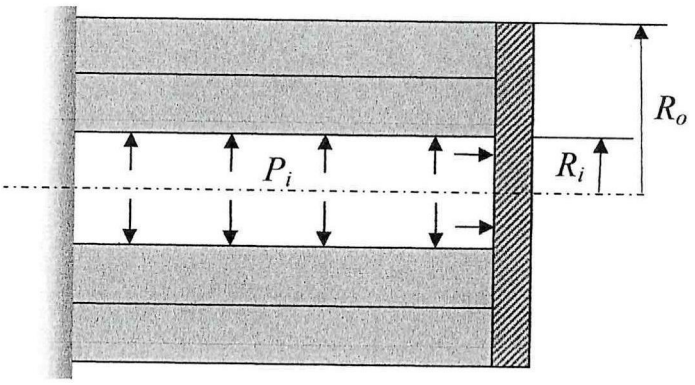

Figure Q5

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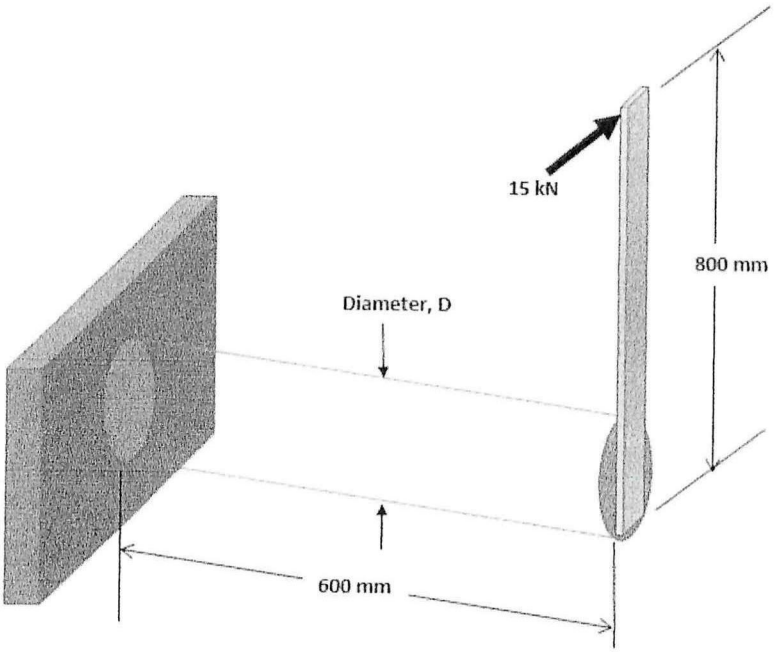

Figure Q6