UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	SOLID MECHANICS 1
COURSE CODE	:	BDA 1042/10402
PROGRAMME	:	BACHELOR OF MECHANICAL ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2012
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER ONLY **FOUR** (4) OUT OF **SIX** (6) QUESTIONS.

THIS PAPER CONSISTS OF SIX (6) PAGES

Q1 (a) Briefly explain a statically indeterminate system with an example. (5 marks)

(b) The 10m long A-36 steel rails on a train track are laid with a small gap between them to allow for thermal expansion as shown in **Figure Q1 (b)**.

(i) Determine the required gap δ so that the rails just touch one another when the temperature is increased from $T_1 = -20\,℃$ to $T_2 = 35\,℃$.

(4 marks)

(ii) Using this gap, what would be the axial force in the rails if the temperature were to rise to $T_3 = 45\,℃$? The cross sectional area of each rail is 3000 mm^2 and E_{st}=200 GPa.

(6 marks)

(c) The assembly consists of two A-36 steel suspender rods *AC* and *BD* attached to the 500 N uniform rigid beam *AB* as shown in **Figure Q1 (c)**. Determine the position x for the 1500 N loading so that the beam remains in a horizontal position both before and after the load is applied. Each rod has a diameter of 12 mm.

(10 marks)

Q2 (a) Construct shear and bending-moment diagrams for the beam loaded with the forces shown in the **Figure Q2(a)**.

(10 marks)

(b) For the beam as shown in **Figure Q2(b),** express the shear force, V and the bending moment, M as a function of x along the horizontal member. From the V & M expression, construct shear and bending-moment diagrams.

(15 marks)

Q3 The beam CD on the utility pole supports the cable having a weight of 600 N. Please refer **Figure Q3**. If point A, B and C can be assumed to be pinned, determine:-

(a) all the reactions at point A and C

(10 marks)

(b) sketch the bending moment diagram of beam

(5 marks)

(c) the maximum bending stress

(10 marks)

Neglect the weight of beam in your calculation.

Q4 A torsional bar of diameter 25 mm as shown in **Figure Q4** is to be used in the suspension system of next Proton model. The modulus of rigidity of bar's material is 70 GPa and the allowable shearing stress is 240 MPa.

(a) Determine whether the magnitude of the diameter is sufficient to withstand a torque of 1000 Nm exerted on the bar by the roadwheel.

(5 marks)

(b) Using the minimum permissible diameter for the torsion bar obtained in (a), what is the maximum angle of twist allowable if the bar length is 2 m.

(5 marks)

(c) If a hollow bar of outside diameter 30 mm is to replace the solid bar in (a), compute the maximum internal diameter.

(7 marks)

(d) By doing so, what percentage saving in weight would be obtained. The length, material and maximum shearing stress of both bars are unchanged.

(8 marks)

Q5 A cylinder is 150 mm mean diameter and 750 mm long with a wall 2 mm thick. It has an internal pressure 0.8 MPa greater than the outside pressure. Calculate the following:-

(a) The circumferential strain
(b) The longitudinal strain
(c) The change in cross sectional area
(d) The change in length
(e) The change in volume

Take E=200GPa and υ=0.25

(25 marks)

Q6 A 13 kN force is applied to the 60 mm diameter post *ABD* at *D* as shown in **Figure Q6.**

(a) Show all the resultant internal loadings at point *A* on the free body diagram of post *ABD*.

(5 marks)

(b) Determine the state of stress that the loading produces at point *H*.

(15 marks)

(c) Sketch the state of stress on an element

(5 marks)

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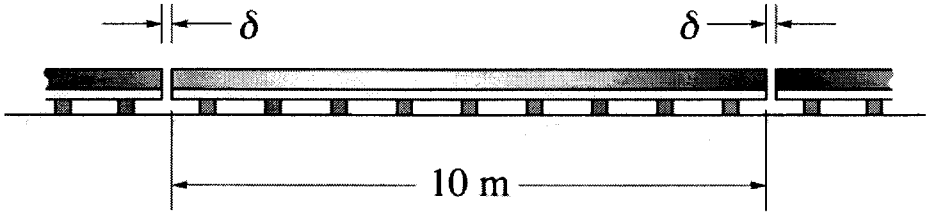

FIGURE Q1 (b)

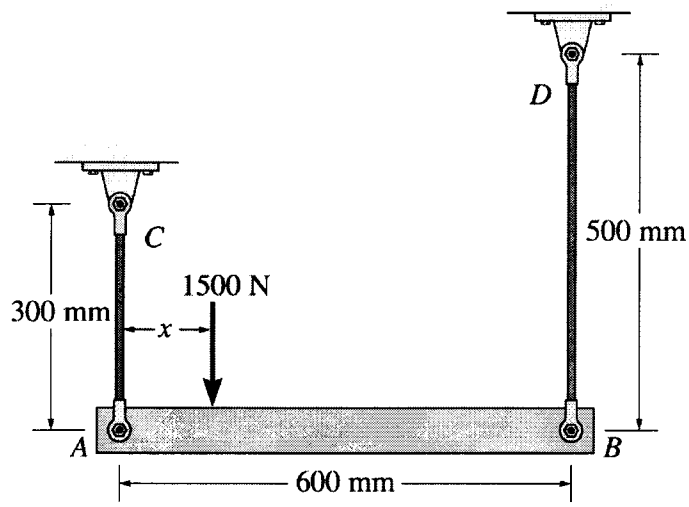

FIGURE Q1 (c)

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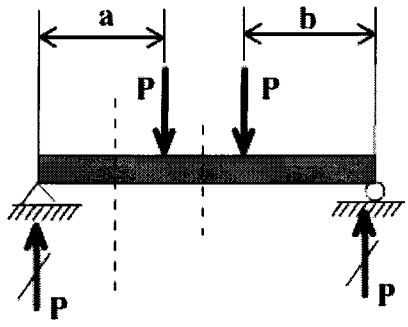

Figure Q2 (a)

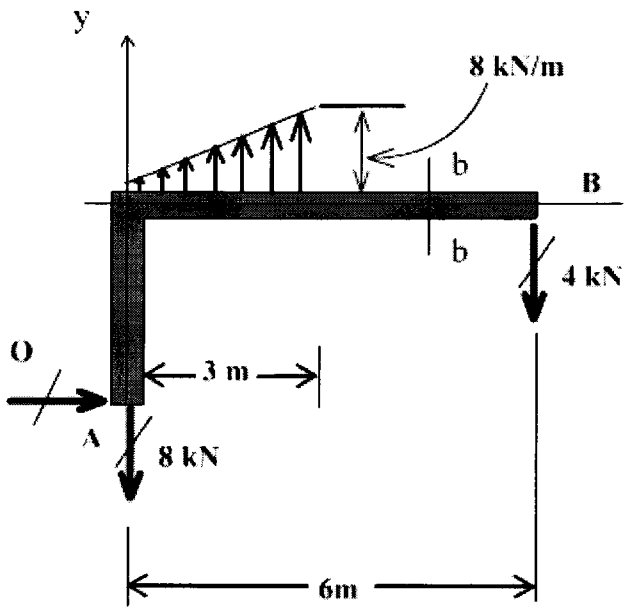

FIGURE Q2 (b)

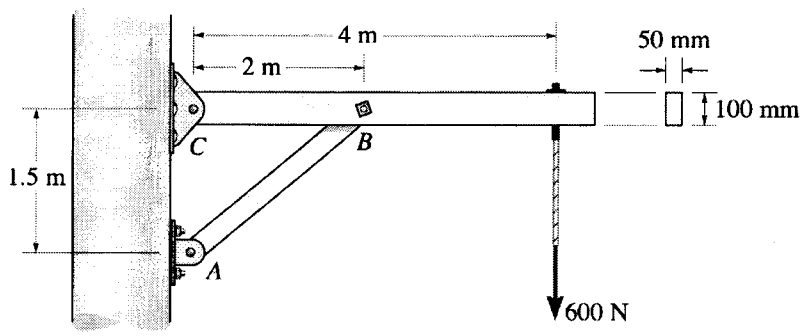

FIGURE Q3

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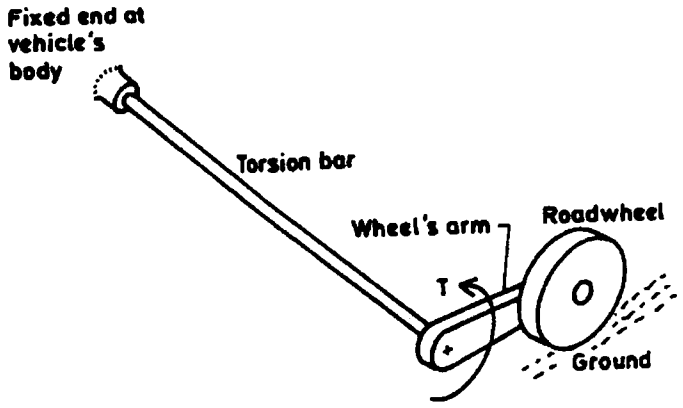

FIGURE Q4

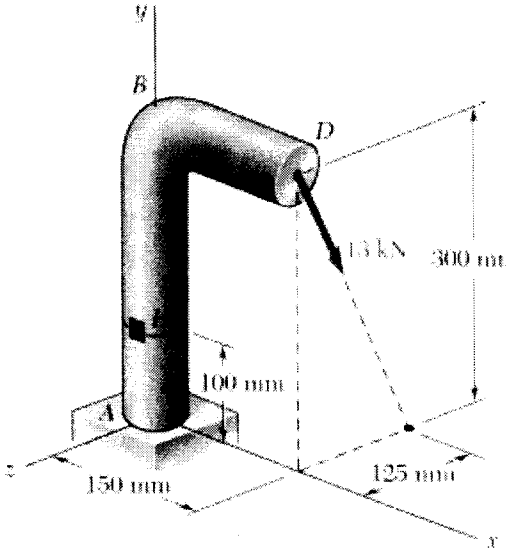

FIGURE Q6