Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION

SEMESTER II

SESSION 2018 / 2019

COURSE NAME	:	STATICS
COURCE CODE	:	BDA 10203
PROGRAMME	:	BDD
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION :	:	PART A: ANSWER **THREE (3)** QUESTIONS **ONLY**
		PART B: ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

PART A (OPTIONAL):
Answer **THREE (3)** questions **ONLY**.

Q1. (a) Represent each of the following combinations of units in the correct SI form.

(i) Mg/ms (3 marks)

(ii) N/mm (3 marks)

(iii) mN/(kg·μs) (3 marks)

(b) Represent each of the following to three significant figures and express each answer in SI units using an appropriate prefix:

(i) $S_1 = 8653$ ms (2 marks)

(ii) $S_2 = 8368$ N (2 marks)

(iii) $S_3 = 0.8934$ kg (2 marks)

(c) Two particles have masses $m_1 = 8$ kg and $m_2 = 12$ kg, respectively. If they are a distance 800 mm apart, determine the force of gravity, F acting between them. Given $F = G(m_1 m_2)/r^2$ and $G = 66.73\times10^{-12}$ m^3/(kg·s^2).

(5 marks)

Q2. (a) Astronauts in the space shuttle use radar to determine the magnitudes and direction cosines of the position vectors of two satellites A and B as shown in **Figure Q2 (a)**. The vector $\mathbf{r}_A$ from the shuttle to satellite A has a magnitude of 2 km, and direction cosines $\cos\alpha = 0.768$, $\cos\beta = 0.384$, $\cos\gamma = 0.512$. The vector $\mathbf{r}_B$ from the shuttle to satellite B has a magnitude of 4 km and direction cosines $\cos\alpha = 0.743$, $\cos\beta = 0.557$, $\cos\gamma = 0.371$. Determine the distance between the satellites.

(5 marks)

(b) **Figure Q2 (b)** shows the 70 m tall tower is supported by three cables that exert forces F_{AB}, F_{AC}, and F_{AD} on it. The magnitude of each force is 2 kN. Express the total force exerted on the tower by the three cables in terms of scalar components. Determine:-

(i) The position vectors corresponding to the cables.

(3 marks)

(ii) The unit vectors corresponding to these position vector.

(4 marks)

(iii) The total force exerted on the tower by three cables in terms of scalar components.

(8 Marks)

Q3. (a) The boom shown in **Figure Q3 (a)** is supported by a ball-and-socket joint at *A* and a guy wire at *B*. If the 5 kN loads lie in a plane which is parallel to the *x*–*y* plane,

(i) Draw the free body diagram of the boom.

(4 marks)

(ii) Determine the *x*, *y*, *z* components of reaction at *A* and the tension in the cable at *B*.

(8 marks)

(b) **Figure Q3 (b)** shows a 50 kg paper roll has a center of mass at G and rests on the smooth blade of the paper hauler.

(i) Draw the free-body diagram of the paper roll.

(4 marks)

(ii) Determine the normal reaction at *A* and *B*.

(4 marks)

Q4. (a) Explain briefly about a zero-force member.

(2 marks)

(b) The Howe bridge truss shown in **Figure Q4** is subjected to the loading shown.

(i) Determine the force in members HD, CD, and GD, and state if the members are in tension or compression.

(9 marks)

(ii) Determine the force in members HI, HB, and BC, and state if the members are in tension or compression.

(9 marks)

PART B (COMPULSORY):

Answer **ALL** questions.

Q5. The composite plate is made from both steel (A) and brass (B) segments as shown in **Figure Q5**. Given the density of steel, $\rho_A = 7.85$ Mg/m^3 and brass, $\rho_B = 8.74$ Mg/m^3. Determine:

(a) total mass of the plate.

(8 marks)

(b) location $(\bar{x}, \bar{y}, \bar{z})$ of its mass center G.

(12 marks)

Q6. (a) The crate has a mass of 50 kg and the coefficient of static friction between the crate and the plane is $\mu_s = 0.25$ as shown in **Figure Q6(a)**.

(i) Draw the free-body diagram of the crate to push it up the plane.

(4 marks)

(ii) Determine the minimum force P required to push the crate up the plane.

(6 marks)

(b) The coefficient of static friction at A is $\mu_s = 0.4$ and the collar at B is smooth so it only exerts a horizontal force on the pipe, as shown in **Figure Q6(b)**. Neglect the mass of the bracket.

(i) Draw the free-body diagram of the bracket.

(4 marks)

(ii) Determine the minimum distance so that the bracket can support the cylinder of any mass without slipping.

(6 marks)

- END OF QUESTION –

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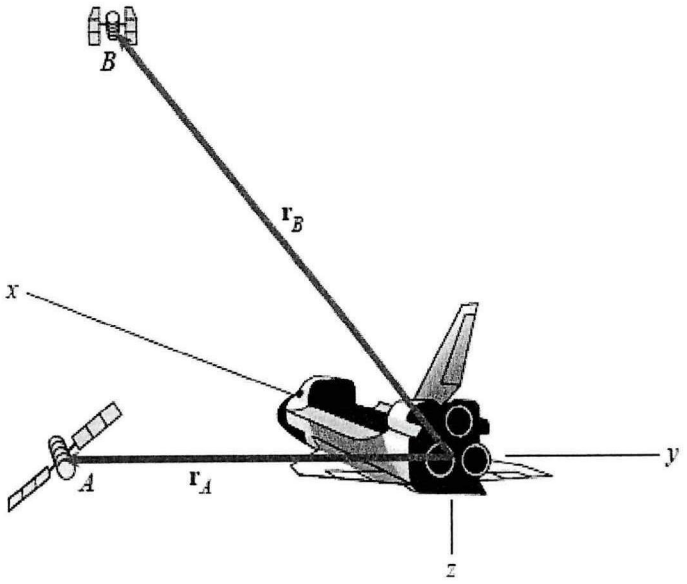

Figure Q2 (a)

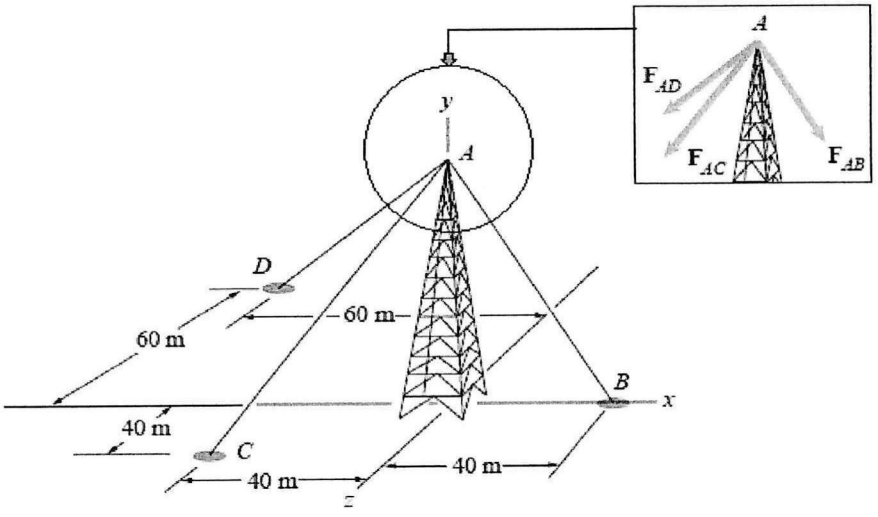

Figure Q2 (b)

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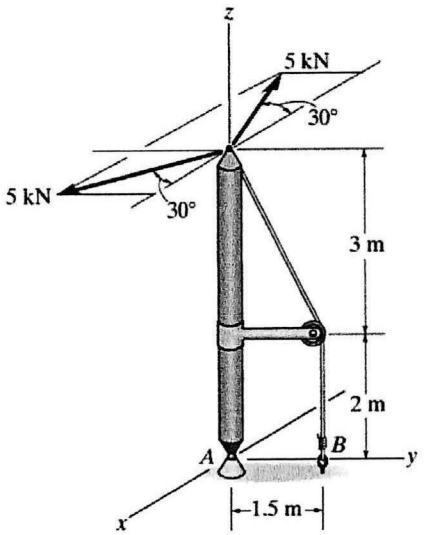

Figure Q3 (a)

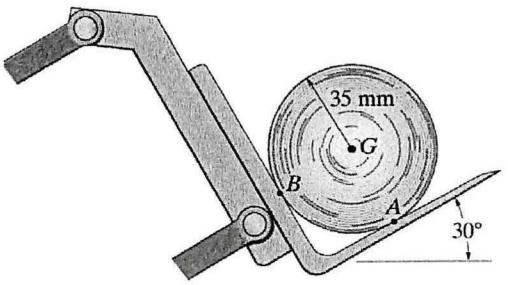

Figure Q3 (b)

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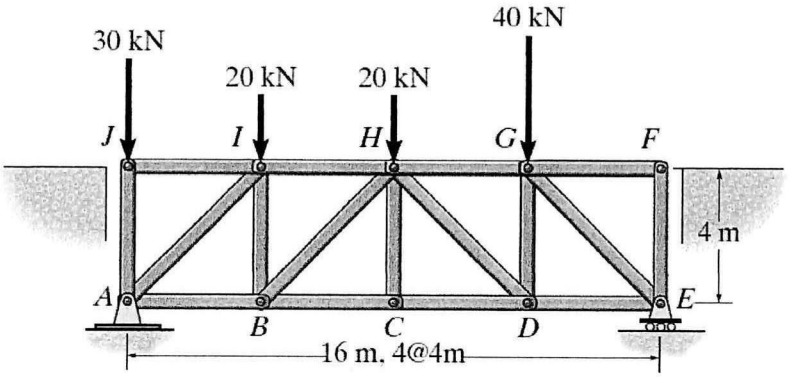

Figure Q4

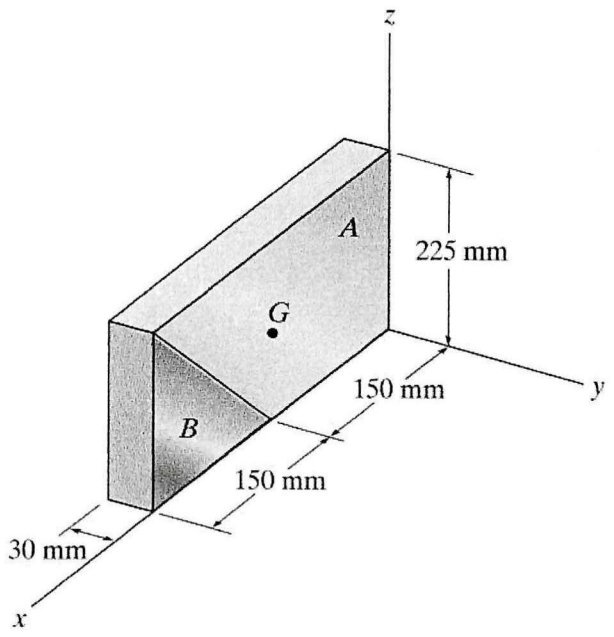

Figure Q5

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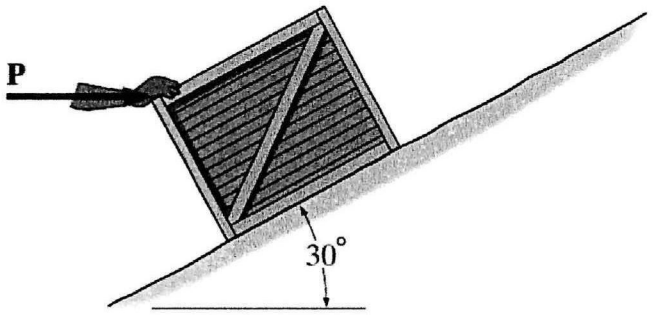

Figure Q6(a)

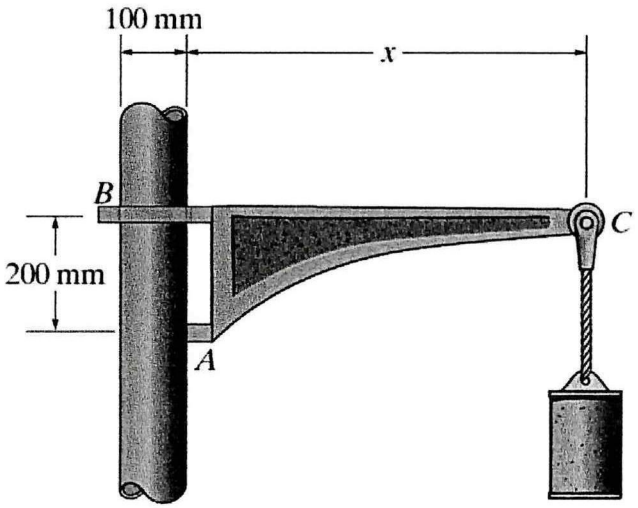

Figure Q6(b)