Universiti Tun Hussein Onn Malaysia

# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2015/2016

| | | |
|---|---|---|
| COURSE NAME | : | STATIC AND DYNAMIC |
| COURSE CODE | : | BFC10103/BFC1022 |
| PROGRAMME CODE | : | BFF |
| EXAMINATION DATE | : | JUNE/JULY 2016 |
| DURATION | : | 3 HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS IN SECTION A AND **THREE (3)** QUESTIONS FROM SECTION B |

THIS QUESTION PAPER CONSISTS OF **TEN (10)** PAGES

**SECTION A**

**Q1** (a) List and explain briefly **THREE (3)** principles of Newton's laws of motion.

(6 marks)

(b) A lifting crane is connected with a frictionless pulley, to pull a loaded brick basket from the ground level with tensioning force of 1500 N, as shown in **FIGURE Q1**.

i) Draw the free body diagram.

(3 marks)

ii) Calculate the height of the mass will reach after 10 seconds of lifting from the ground level.

(6 marks)

(c) A collision of 2000 kg car (A) and an 1850 kg car (B) has remained both cars together due to the oil spill on the road. Car A was travelling 60 km/h to the north and car B was travelling to the west at 70 km/h, at the time of impact.

i) Draw the free body diagram.

(2 marks)

ii) Calculate the height of the mass will reach after 10 seconds of lifting from the ground level. Analyze the resultant velocity and direction of both cars at the final momentum.

(6 marks)

(d) By using your own words, explain how the influence of dynamic forces could cause damage to civil engineering structures?

(2marks)

**SECTION B**

**Q2** (a) Define resultant of forces and discuss with example its application in real life.

(6 mark)

(b) Four forces are acting on the bolt as shown in **FIGURE Q2(a)**. Calculate the magnitude and the direction of resultant force on the bolt.

(9marks)

(c) Two forces P and Q of magnitude P=80kN and Q=70kN are applied to the aircraft connection as shown in **FIGURE Q2(b)**. Knowing that the connection is in equilibrium, determine the tensions T1 and T2.

(10 marks)

**Q3** (a) Explain the concept of moment and couples.

(6 marks)

(b) **FIGURE Q3** shows a 135N vertical force P applied at A to the bracket shown, which is held by screws at B and C.

(i) Locate the free body diagram.

(3 marks)

(ii) Calculate the force acting when replace P is replaced with an equivalent force couple system at B.

(8 marks)

(iii) Develop the two (2) horizontal forces at B and C that are equivalent to the couple obtained in Q1 (b)

(8 marks)

**Q4** (a) Give an explanation of a free body diagram.

(3 marks)

(b) List **SIX (6)** static equilibrium equations for a three dimensions system.

(3 marks)

(c) Draw complete free body diagram of the structure in **FIGURE Q4(a)**, and determine all reactions at joint A and B.

(6 marks)

(d) Draw the free body diagram of the system in **FIGURE Q4(b)**. Determine force P for impending motion to the left if the coefficient of friction for all surfaces is 0.15.

(8 marks)

(e) Why engineers consider static equilibrium important in building design and construction? Explain the reason with examples.

(5 marks)

**Q5** (a) List and explain **THREE (3)** main types of centroid.

(4 marks)

(b) **FIGURE Q5** shows a composite section.

(i) Determine the centroid of the composite section.

(8 marks)

(ii) Locate the coordinate of the centroid based on the axis given.

(1 mark)

(iii) Calculate moment of inertia about x-axis.

(10 marks)

(iv) Explain the application of second moment of area in structural engineering field.

(2 marks)

**- END OF QUESTION -**

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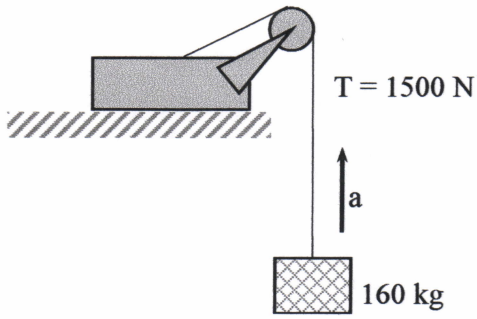


**FIGURE Q1**

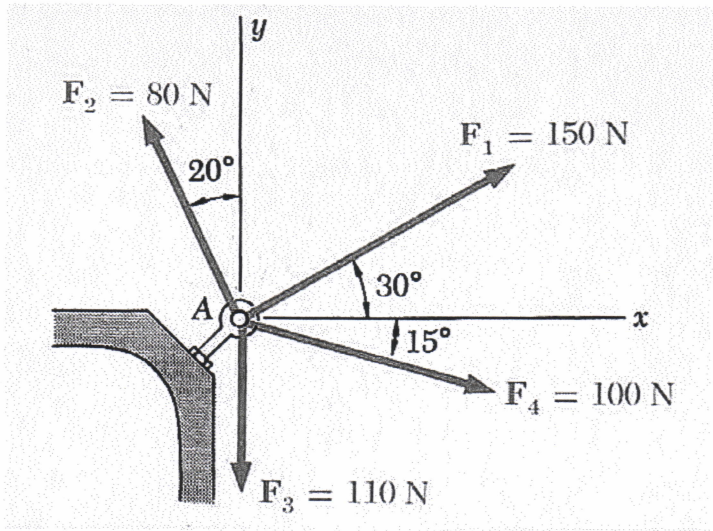


**FIGURE Q2(a)**

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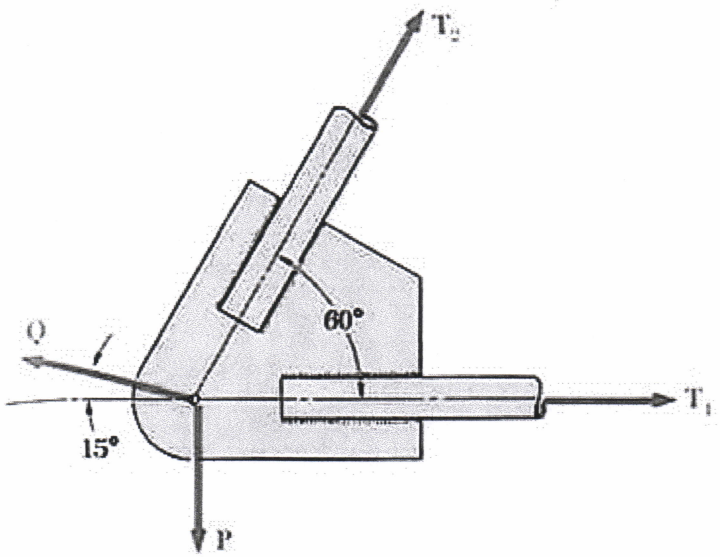


**FIGURE Q2(b)**

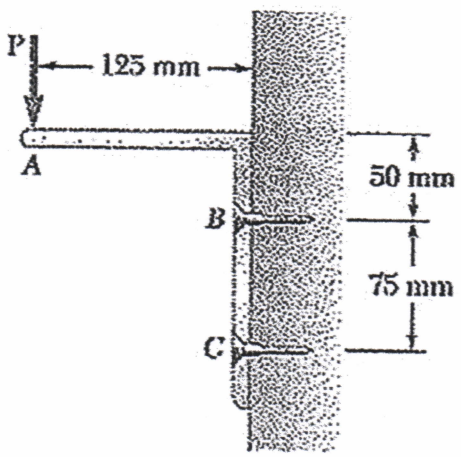


**FIGURE Q3**

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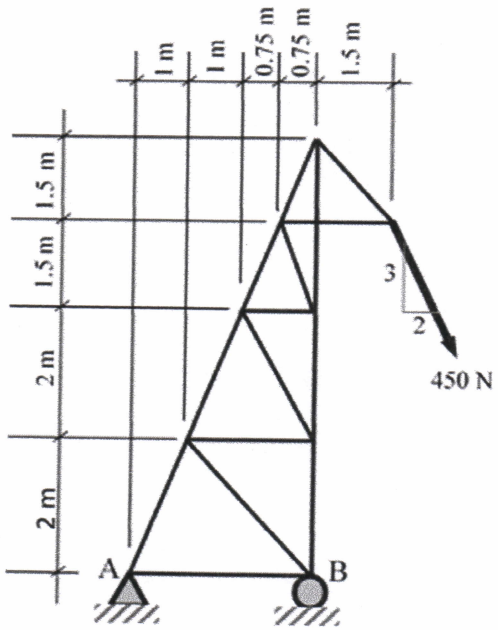


**FIGURE Q4(a)**

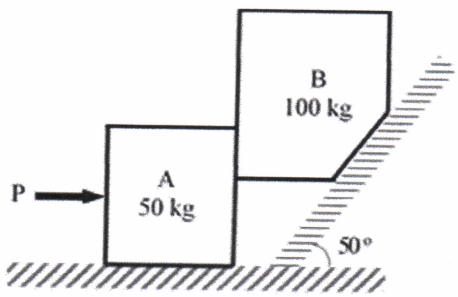


**FIGURE Q4(b)**

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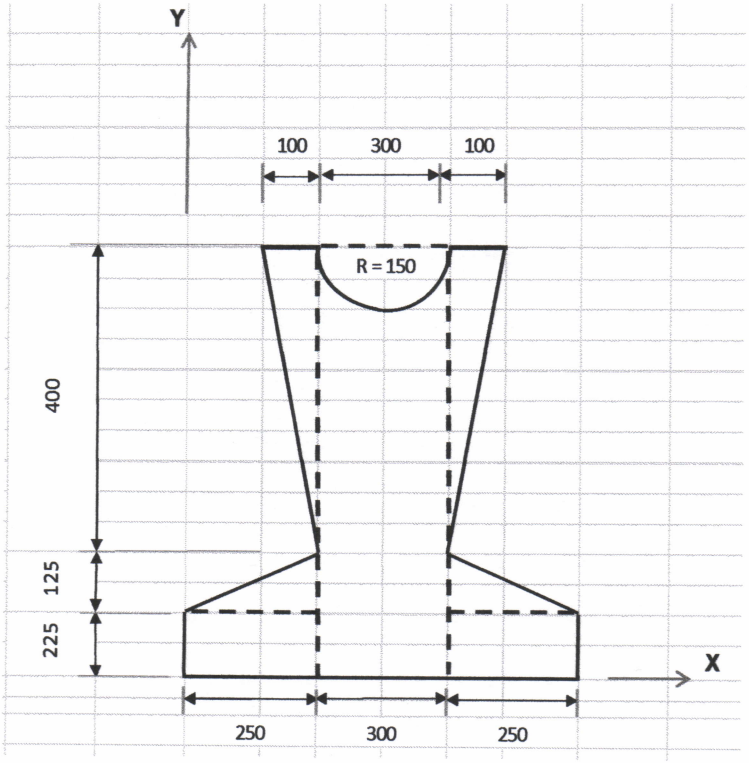


**FIGURE Q5**

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**Table 1 : Centroid**

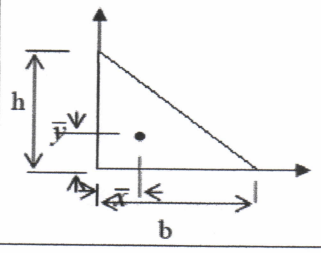
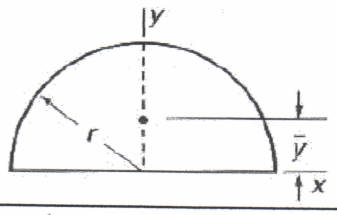
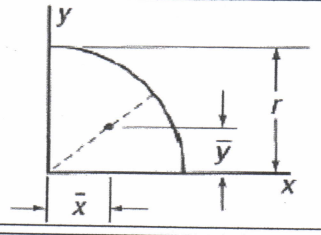
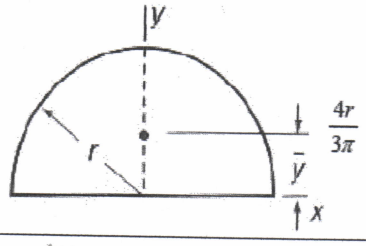
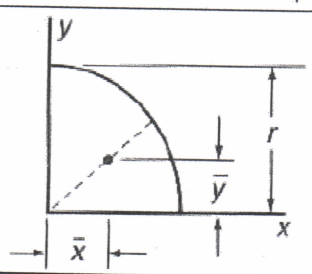
| | SHAPE | $\bar{x}$ | $\bar{y}$ | A |
|---|---|---|---|---|
| Triangle |   | $\frac{b}{3}$ | $\frac{h}{3}$ | $\frac{1}{2}bh$ |
| Semicircle |   | 0 | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{2}$ |
| Quarter circle |   | $\frac{4r}{3\pi}$ | $\frac{4r}{3\pi}$ | $\frac{\pi r^2}{4}$ |

**Table 2 : Moment of Inertia**

| | | |
|---|---|---|
| Semicircle |   | $I_x = I_y = \frac{1}{8}\pi r^4$ <br> $J = \frac{1}{4}\pi r^4$ |
| Quarter circle |   | $I_x = I_y = \frac{1}{16}\pi r^4$ <br> $J = \frac{1}{8}\pi r^4$ |

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## LIST OF EQUATION

$$s = v_0 t + \frac{1}{2} a t^2$$

$$v = v_0 + at$$

$$v^2 = v_0^{\ 2} + 2as$$

Hooke's Law

$$U = \tfrac{1}{2} Fx \quad @ \tfrac{1}{2} Fs$$

$$= \tfrac{1}{2} kx^2$$

$$= \tfrac{1}{2} k(\Delta x)^2$$

Second Newton Law

$$F = ma$$

$$F - F_g = ma$$

Energy, power, work

$$E = mgh$$

$$E = \tfrac{1}{2} mv^2$$

$$P = \frac{Work}{time} = \frac{W(J)}{T(s)} = Fv$$

$$Work = \frac{1}{2} F \cdot (\Delta x)^2$$