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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021**

COURSE NAME : DYNAMICS

COURSE CODE : BDA 20103

PROGRAMME : BDD

EXAMINATION DATE : JULY 2021

DURATION : 3 HOURS

INSTRUCTION : PART A: ANSWER ALL QUESTIONS
PART B: ANSWER THREE (3)
QUESTIONS ONLY

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

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PART A (COMPULSORY):

Answer ALL questions.

- Q1 (a)** The bar shown in **Figure Q1(a)** has a mass of 15 kg and is subjected to a couple moment of $M = 70 \text{ Nm}$ and a force $P = (200M) \text{ N}$ applied to the end of the bar. The spring has unstretched length of 0.4 m and remain in the vertical position due to roller guide at B .

Note; Use your last three digit of matrix number to determine the value of force P as follows;

Example of matrix number, CD190234

$$M = (2+3+4) = 9$$

$$\text{Therefore, } P = 200M = 200+9 = 209 \text{ N}$$

- (i) Draw the free body diagram of the bar to account for all the forces that act on it. (2 marks)

- (ii) Determine the total work done by all the forces acting on the bar when it has rotated downward from $\theta = 0^\circ$ to $\theta = 90^\circ$. (8 marks)

- (b) **Figure Q1(b)** shows the 10 kg rod AB which is constrained so that its end of slider block B move along the fixed guide. The rod is initially at rest when $\theta = 0^\circ$. If the slider block A is acted upon by a vertical force $P = (90M) \text{ N}$;

Note; Use your last three digit of matrix number to determine the value of force P as follows;

Example of matrix number, CD190234

$$M = (2+3+4) = 9$$

$$\text{Therefore, } P = 90M \text{ N, } = 90+9 = 99 \text{ N}$$

- (i) Draw kinematic diagram of the rod at $\theta = 0^\circ$ and $\theta = 30^\circ$ respectively. (2 marks)
- (ii) Determine the initial and final kinetic energy. (4 marks)
- (ii) Calculate the angular velocity of the rod at the instant $\theta = 30^\circ$ (4 marks)

- Q2.** **Figure Q2** shows the rod AB is subjected to speed decreasing of 19 m/s and velocity of v in unit m/s. Given the angle θ is 60° ,

- (a) Calculate the angular velocity ω of rod CD and state its direction. (10 marks)
- (b) Determine the angular acceleration α of rod CD and state its direction. (10 marks)

Use your matrix number to get the value of velocity of v (m/s) as in example.

Example: If your matrix number is AD190005, use the 4 numbers at the end of your matrix number to be the value of velocity of v . Thus, velocity of v is 5 m/s.

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

- Q3** **Figure Q3** shows the flight of the helicopter as it takes off from A to B . At the instant shown the horizontal position of the helicopter is defined by $x = (15t)$ m, where t is in seconds. If the equation of the path is $y = (x^2/25) + 4$, and the air resistance is neglected,
- (a). Determine the distance of the helicopter from the origin at A when $t = 4$ s. (6 marks)
 - (b). Find the magnitude and direction of the velocity when $t = 4$ s. (7 marks)
 - (c). Calculate the magnitude and direction of the acceleration when $t = 4$ s. (7 marks)
- Q4.** (a) Explain the meaning of spring force and the graph of spring force against position (5 marks)
- (b) The 8735 kg helicopter is takes off vertically with its rotor exerting a constant upward thrust of 117 kN. Determine how far it has risen if its velocity is 11 m/s. (5 marks)
- (c) In **Figure Q4 (c)**, the 30 N block is moving up the smooth inclined surface at velocity and constant force of 2 m/s and 15 N, respectively.
- (i). Draw the kinetic diagram of all forces exerted on box (2 marks)
 - (ii). Calculate the velocity of the block when it has moved 1 m up the surface from its present position. (8 marks)
- Q5.** **Figure Q5** shows the rod AB rotates clockwise and has an angular velocity and angular acceleration of 10 rad/s and 6 rad/s² respectively. The length of link AB is 130 cm while the horizontal distance between point A and C is 80 cm. The slider C is moving up the incline plane at the instant shown. By considering on the above circumstances;
- (a) Calculate the velocity of point B at the instant. (3 marks)
 - (b) Determine the velocity and angular velocity of slider block C at the instant. (7 marks)
 - (c) Find the acceleration of point B at the instant. (3 marks)
 - (d) Determine the acceleration and angular acceleration of slider block C at the instant. (7 marks)
- Q6.** The thin plate with four holes as shown in **Figure Q6** has a mass per unit area of 33 kg/m². The radius r for each hole is 50 mm. The thin plate has the dimension of 400 mm x 400 mm and suspended at pin at A .

- (a) Calculate the mass moment of inertia of the thin plate with four holes about an axis passing through its mass centre G , I_G . (13 marks)
- (b) Determine the mass moment of inertia of the thin plate with four holes about an axis perpendicular to the page and passing through point A , I_A . (7 marks)

-END OF QUESTION-

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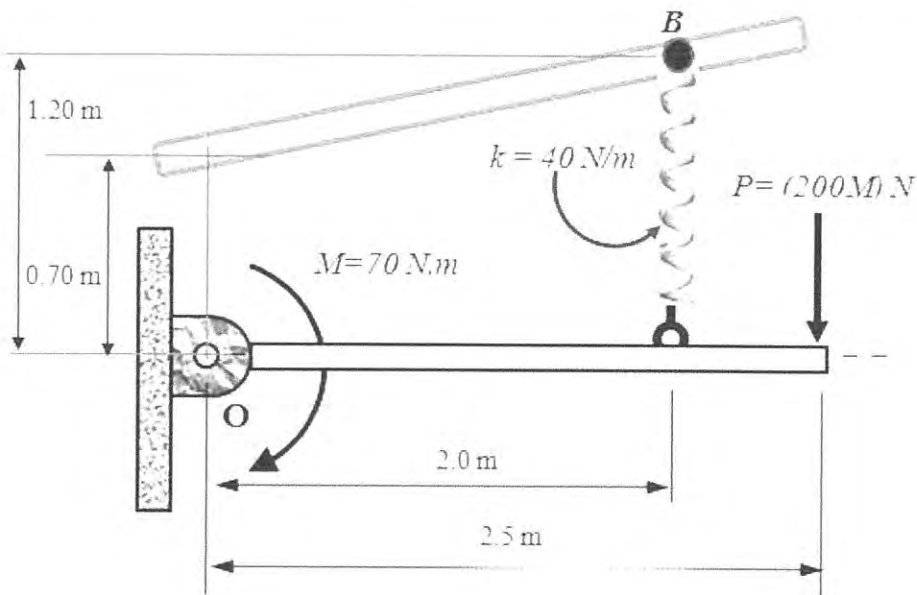


Figure Q1(a)

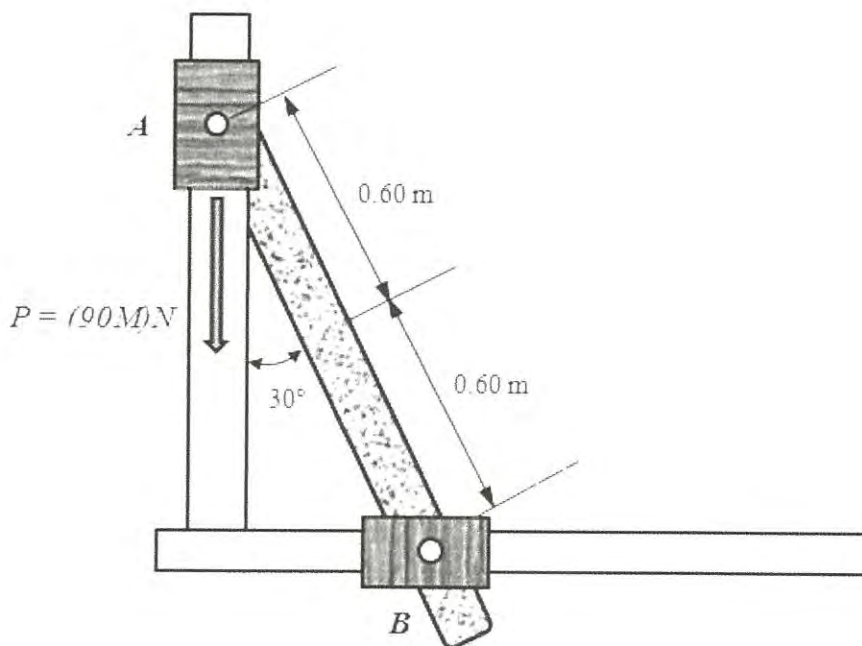


Figure Q1 (b)

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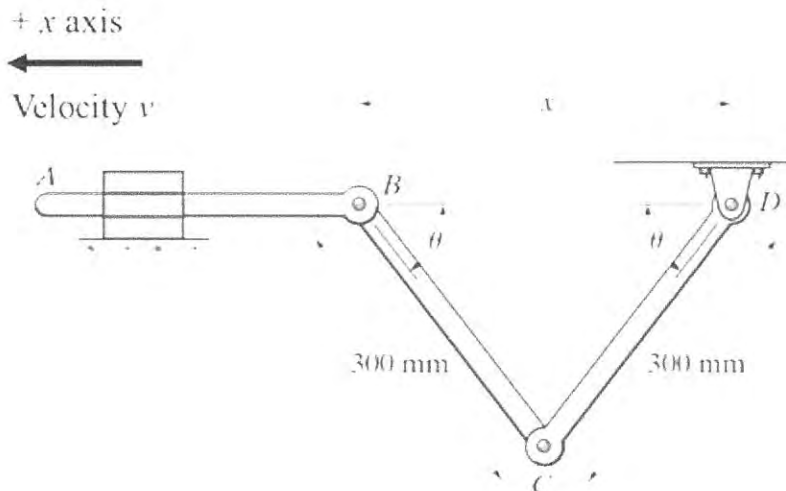


Figure Q2

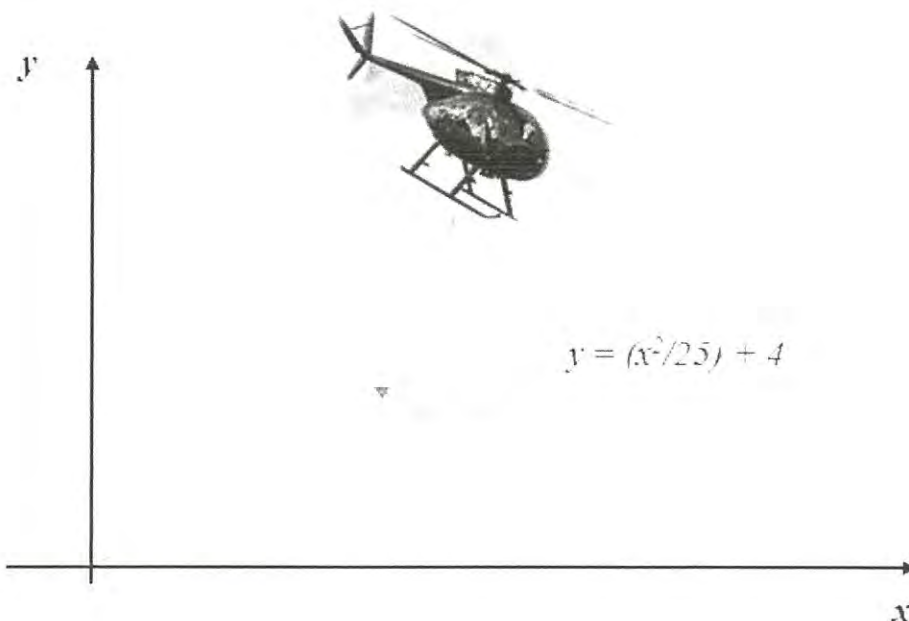


Figure Q3

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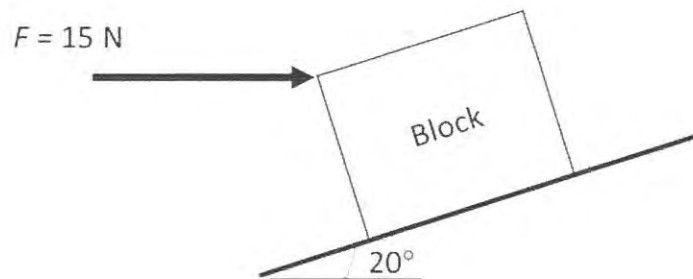


Figure Q4

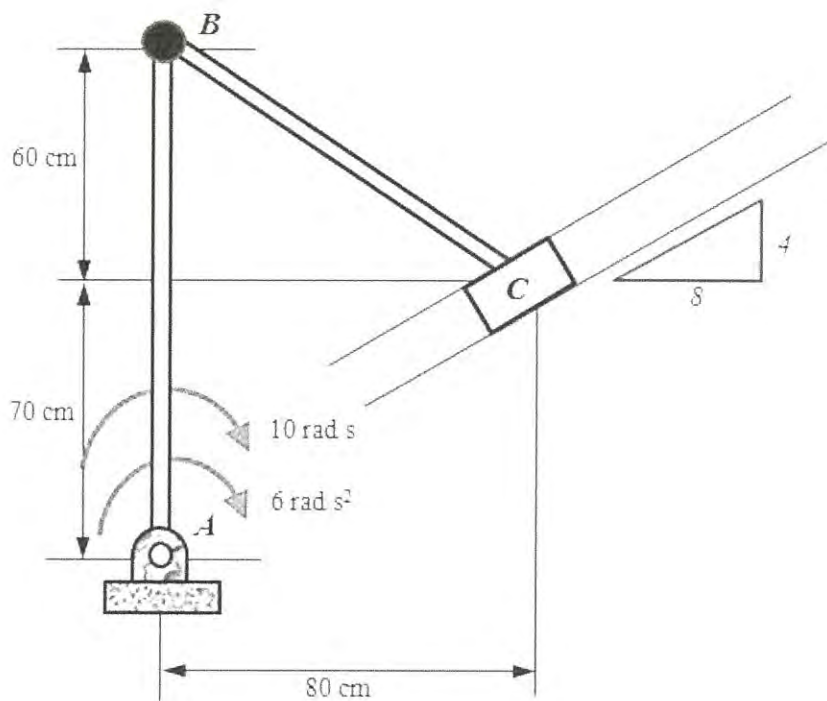


Figure Q5

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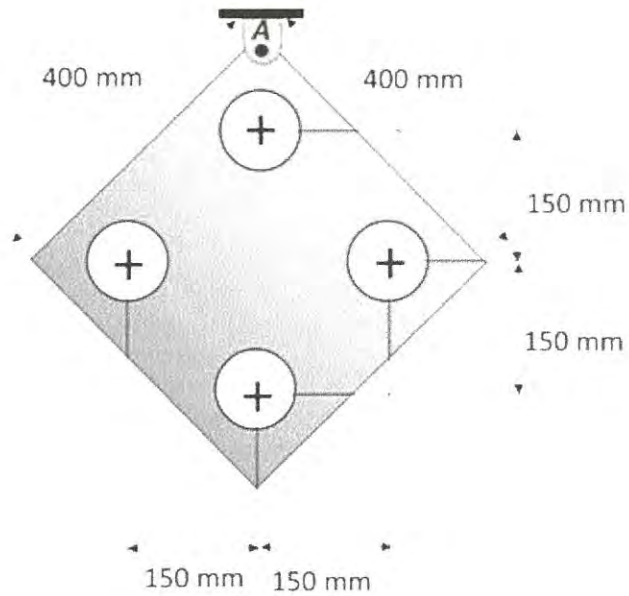


Figure Q6