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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
(ONLINE)  
SEMESTER II  
SESSION 2019/2020**

COURSE NAME : ENGINEERING MECHANICS  
COURSE CODE : BDU 10503  
PROGRAMME CODE : BDC / BDM  
EXAMINATION DATE : JULY 2020  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER **ONLY TWO (2)** QUESTIONS  
FROM **SECTION A** AND **TWO (2)**  
QUESTIONS FROM **SECTION B**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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**SECTION A**

- Q1** (a) Explain the difference between ‘mass’ and ‘weight’ of a body. (3 marks)
- (b) **Figure Q1(b)** indicates a force **F** is acting from point A to point B. Determine:  
 (i) the Cartesian vector expression for force **F**  
 (ii) the coordinate direction angles for force **F** (12 marks)
- (c) **Figure Q1(c)** shows that the ship O measures the positions of the ship A and the aircraft B and obtains the coordinates shown. Examine the figure and determine the angle  $\theta$  between the lines of sight OA and OB. (10 marks)

- Q2** (a) Replace the force system shown in **Figure Q2(a)** by a single resultant force. Determine:  
 (i) the magnitude of the resultant force  
 (ii) the direction of the resultant force  
 (iii) the couple moment acting on point O (10 marks)
- (b) Due to an unequal distribution of fuel in the wing tanks, the centers of gravity for the aircraft fuselage A and wings B and C are located as shown in **Figure Q2(b)**. The weights of these components are:  $W_A = 45\ 000\ lb$ ,  $W_B = 3000\ lb$ ,  $W_C = 6000\ lb$ .  
 (i) Draw a free body diagram for this case  
 (ii) Define the appropriate moment and force expressions  
 (iii) Determine the normal reactions of the wheels D, E, and F on the ground (15 marks)

- Q3** A truss is subjected to two loads as shown in **Figure Q3**.  $P_1$  and  $P_2$  are in  $kN$ . By setting  $P_1 =$  the last digit of your IC number (if your IC ends with 0, use  $3kN$ ) and  $P_2 =$  your month of birth:
- (a) sketch the free-body diagram of each joint (5 mark)
- (b) determine the force in each member of the truss (15 marks)
- (c) state if the members are in tension or compression (5 marks)

Please provide your full IC number for this question.

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## SECTION B

- Q4** (a) Describe briefly the following terms.
- (i) Kinematic
  - (ii) Kinetic
- (4 marks)
- (b) **Figure Q4(b)** shows a particle is travelling at a speed of 120 m/s then decreasing to 40 m/s<sup>2</sup> when it reaches point A. Determine:
- (i) the magnitude of its acceleration when it is at point A
  - (ii) the direction of the particle measured from the x axis when it reached point A
- (10 marks)
- (c) At the instant shown in **Figure Q4(c)**, car A has a speed of 20 km/h, which is being increased at the rate of 300 km/h<sup>2</sup> as the car enters an expressway. At the same instant, car B is decelerating at 250 km/h<sup>2</sup> while traveling forward at 100 km/h. Determine the velocity and acceleration of A with respect to B.
- (11 marks)
- Q5** (a) Describe the following term:
- (i) Energy
  - (ii) Work
  - (iii) Power
- (6 marks)
- (b) The velocity of the water jet discharging from the orifice in **Figure Q5(b)** can be obtained from  $v = \sqrt{2gh}$  where  $h$  is the depth of the orifice from the free water surface given in meter. Assume the value for  $h$  is equal to the last digit of your IC number (if your IC ends with 0, use  $h = 2$  m). Determine:
- (i) the time for a particle of water leaving the orifice to reach point B
  - (ii) the horizontal distance  $x$  where it hits the surface
- Please provide your full IC number for this question.
- (7 marks)
- (c) **Figure Q5(c)** indicates two cars traveling at different directions. Car B is traveling at velocity of 30 m/s while Car A is traveling at 50 m/s. Car A is increasing its speed at 4 m/s<sup>2</sup>, whereas the speed of B is decreasing at 5 m/s<sup>2</sup>. If the radius of curvature at B is 150 m, determine:
- (i) the velocity of B with respect to A
  - (ii) the acceleration of B with respect to A
- (12 marks)

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- Q6** (a) Describe briefly the following terms.
- (i) Impulse
  - (ii) Conservation of momentum
  - (iii) Conservation of energy
- (6 marks)
- (b) A 0.03-lb bullet traveling at 1300 ft/s strikes the 10-lb wooden block and exits the other side at 50 ft/s as shown in **Figure Q6(b)**. The coefficient of kinetic friction between the block and the surface is  $\mu_k = 0.5$ . Determine:
- (i) the speed of the block just after the bullet exits the block
  - (ii) the average normal force on the block if the bullet passes through it in 1 ms
  - (iii) the time the block slides before it stops
- (9 marks)
- (c) The 10 kg block shown in **Figure Q6(c)** rests on the smooth incline. If the spring is originally stretched 0.5 m. Determine the total work done by all the forces acting on the block when a horizontal force  $P = 400$  N pushes the block up the plane  $s = 2$  m.
- (10 marks)

– END OF QUESTIONS –

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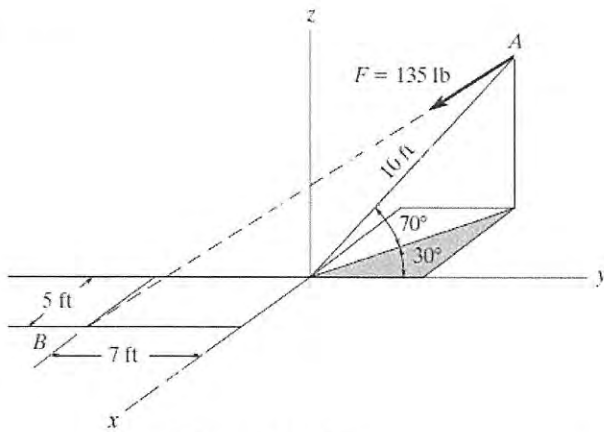


Figure Q1(b)

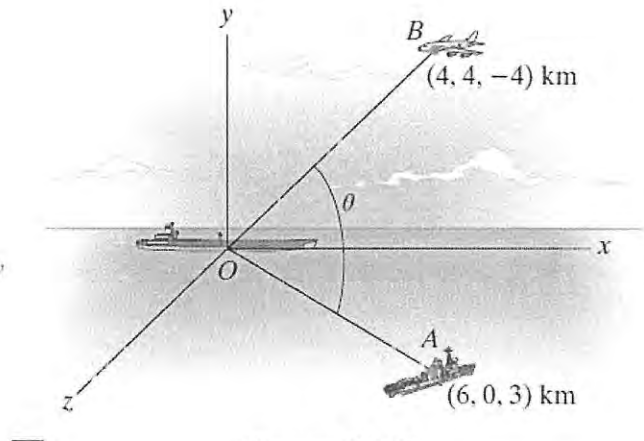


Figure Q1(c)

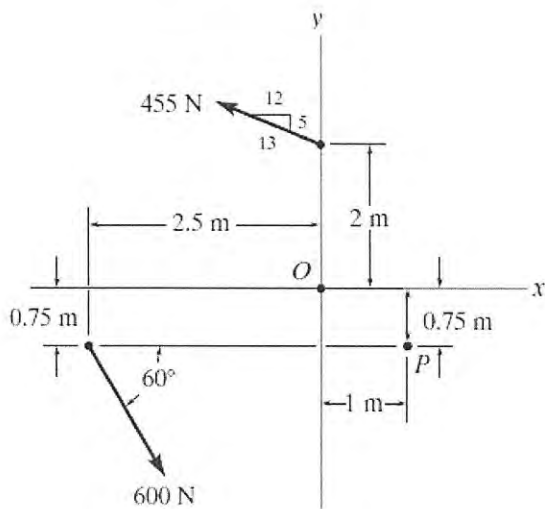


Figure Q2(a)

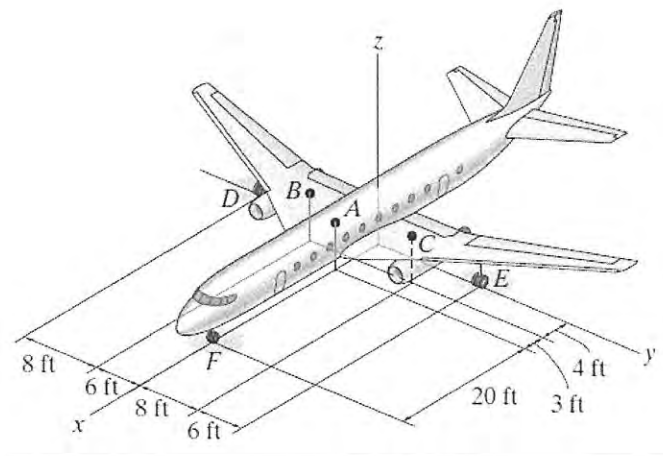


Figure Q2(b)

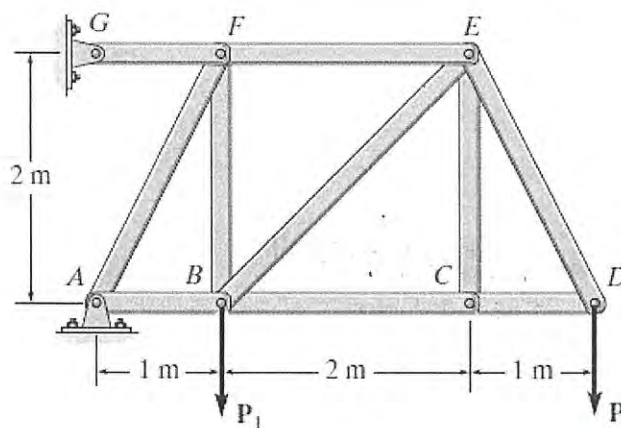


Figure Q3

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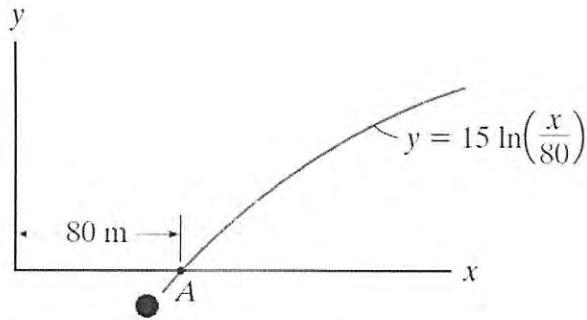


Figure Q4(b)

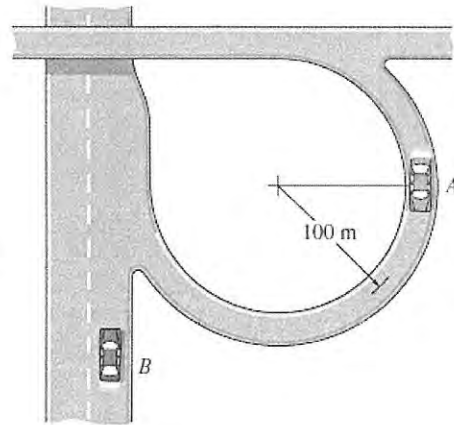


Figure Q4(c)

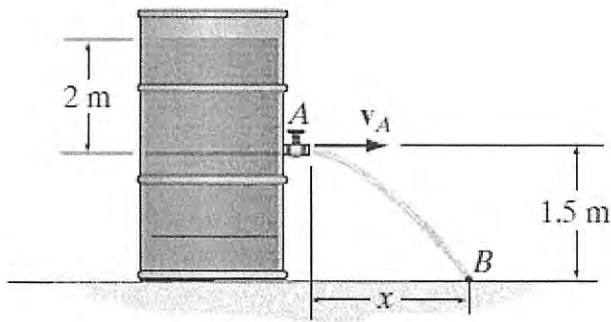


Figure Q5(b)

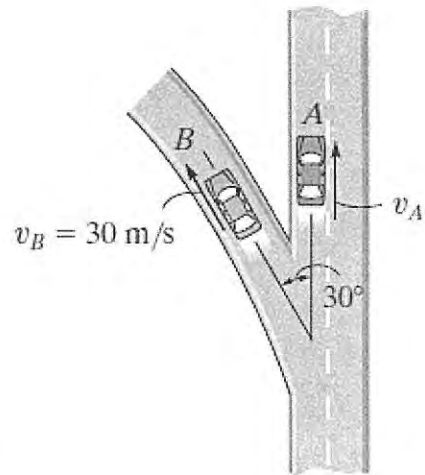


Figure Q5(c)

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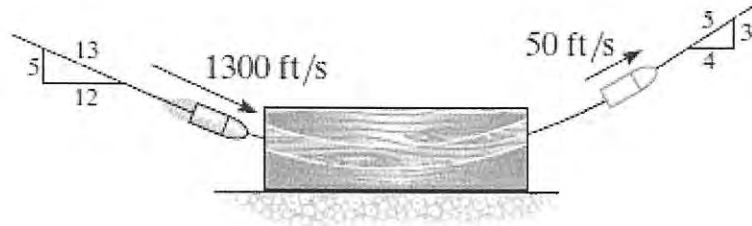


Figure Q6(b)

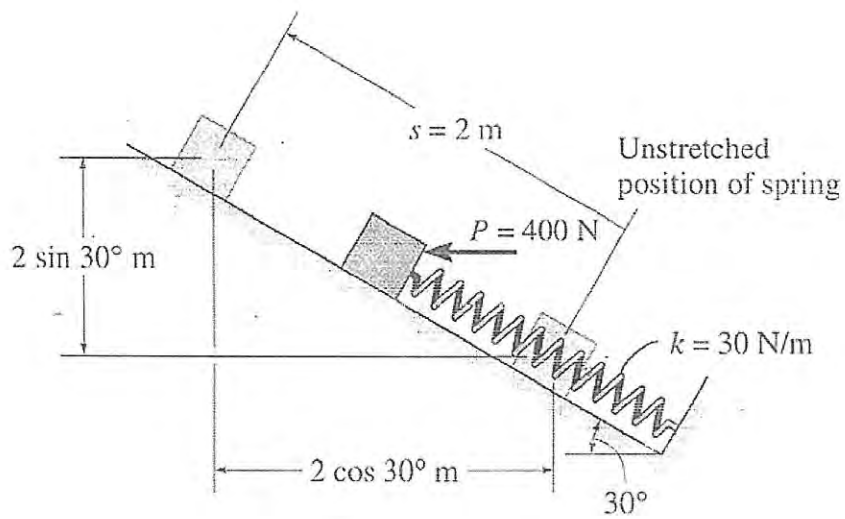


Figure Q6(c)

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