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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

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

COURSE NAME : STATICS  
COURSE CODE : BNT 10303  
PROGRAMME CODE : BNT  
EXAMINATION DATE : JAN / FEBRUARY 2021  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY  
OPEN BOOK EXAMINATION

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THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

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- Q1** (a) **Figure Q1(a)** shows a lamp of weight 20 kg is supported by using several cords which in equilibrium state. Calculate the tension developed in cords  $DE$ ,  $DC$ ,  $CA$  and  $CB$ .  
(7 marks)
- (b) **Figure Q1(b)** shows a pot and its contents have a total weight of 50 kg. It is supported by three cables which are  $AB$ ,  $AC$  and  $AD$ .
- (i) Draw a free body diagram of the system  
(3 marks)
- (ii) Calculate the unit vector  $u_{AB}$ ,  $u_{AC}$  and  $u_{AD}$  along three points on that line.  
(6 marks)
- (iii) Calculate the force in the supporting cables of  $F_{AB}$ ,  $F_{AC}$  and  $F_{AD}$  when the system is in equilibrium.  
(4 marks)
- Q2** (a) Define the meaning of a varignon's theorem on moment concept and give **ONE (1)** example.  
(3 marks)
- (b) **Figure Q2(b)** shows a door supported by a chain  $BA$ . The chain  $BA$  exerted a force of 20 N.
- (i) Calculate the force unit vector,  $u_{BA}$  and its force,  $F_{BA}$  in Cartesian vector.  
(10 marks)
- (ii) Calculate the moment of force  $F_{BA}$  about point  $O$  in Cartesian vector.  
(4 marks)
- (iii) Calculate magnitude of the moment about the  $x$ -axis using triple scalar product.  
(3 marks)

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- Q3** (a) **Figure Q3(a)** shows a truck with the weights of the various components.
- (i) Calculate the equivalent resultant force. (3 marks)
  - (ii) Calculate the location of equivalent resultant force measured from point *B*. (3 marks)
- (b) **Figure Q3(b)** shows the articulated crane boom has a weight of 125 kg and acting at the center of gravity at *G*. It is supported a load of 600 kg.
- (i) Draw a free body diagram (FBD) of the crane boom. (4 marks)
  - (ii) Calculate the force acting at the pin *A* and the force in the hydraulic cylinder *BC*. (10 marks)
- Q4** (a) Define zero force members in simple trusses model. (2 marks)
- (b) Determine the force in each member of truss and state if the members are in tension or compression. Set  $P_1 = 0$  kN and  $P_2 = 20$  kN. The trusses is illustrated in **Figure Q4(b)**. (*hint: apply method of joint, assume: pin G acting force only at x-axis*).
- (i) Calculate the force in member *GB*, *AF* and *AB*. (8 marks)
  - (ii) Calculate the force in member *BF* and *BC*. (2 marks)
  - (iii) Calculate the force in member *FC* and *FE*. (2 marks)
  - (iv) Calculate the force in member *ED*, *EC* and *DC*. (3 marks)
  - (v) State whether all the members are in tension (T) or compression (C). (3 marks)

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- Q5** (a) Draw an example of reaction force on a pin type support and define a two-force member. (4 marks)
- (b) **Figure Q5(b)** shows a tractor boom supports the uniform mass of 700 kg in the bucket which has a center of mass at  $G$  and this system is in equilibrium. The boom supported by two hydraulic cylinders which are hydraulics  $AB$  and  $CD$ . (*hint: The load is supported equally on each side of the tractor by a similar mechanism*)
- (i) Draw a free body diagram of a bucket only. (2 marks)
- (ii) Draw a free body diagram of the whole boom system. (2 marks)
- (iii) Calculate the force in hydraulic cylinder  $AB$  and resultant force at pin  $E$ . (6 marks)
- (iv) Calculate the force in hydraulic cylinder  $CD$  and resultant force at pin  $F$ . (6 marks)
- Q6** (a) Define a wedge in friction principle and describe **ONE (1)** example application of wedge and draw its free body diagram. (4 marks)
- (b) **Figure Q6(b)** shows the man tried to pulls a cord with a force large enough to just to move the crate. The crate weighted of 80 kg and the coefficient of static friction between floor and crate is  $\mu_s = 0.3$ . (*hint: The pulleys are frictionless*)
- (i) Draw the free body diagram of the cables and the crate. (5 marks)
- (ii) Calculate the angle,  $\theta$  between the crate and the cord  $B$ . (8 marks)
- (iii) Calculate the reaction force at cord  $B$  and determine the smallest force,  $F_H$  the man must exert. (3 marks)

-END OF QUESTIONS -

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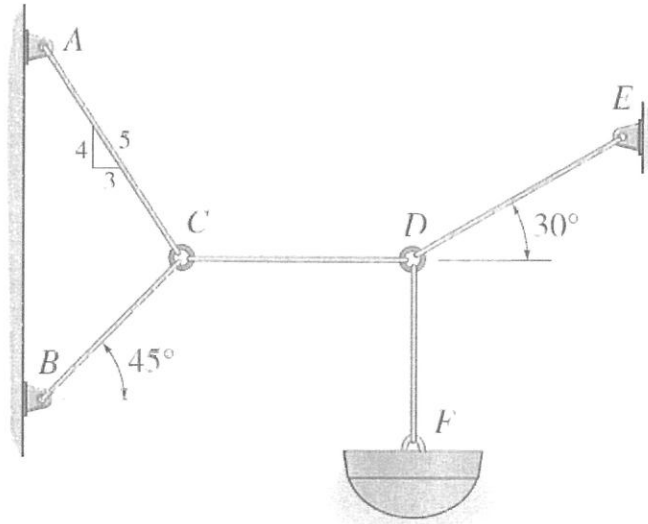


Figure Q1(a)

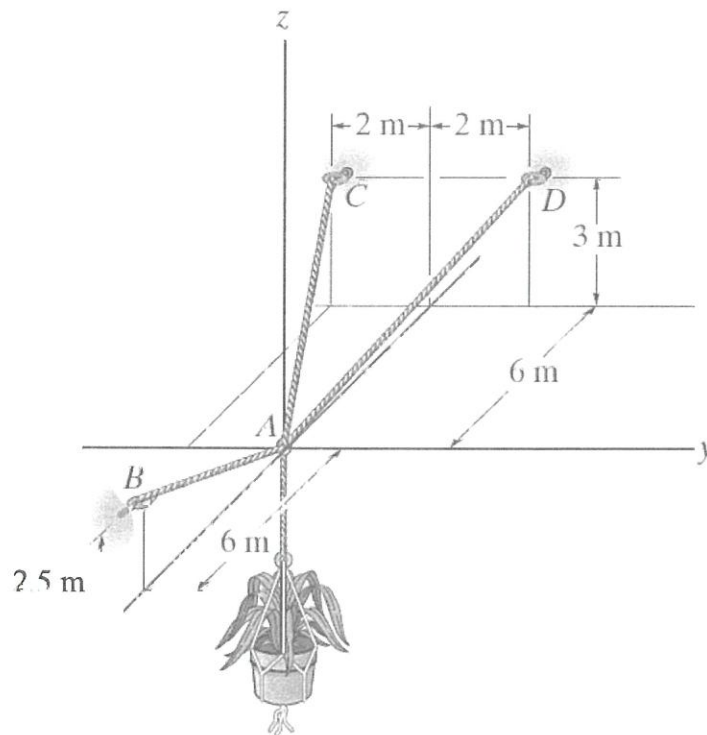


Figure Q1(b)

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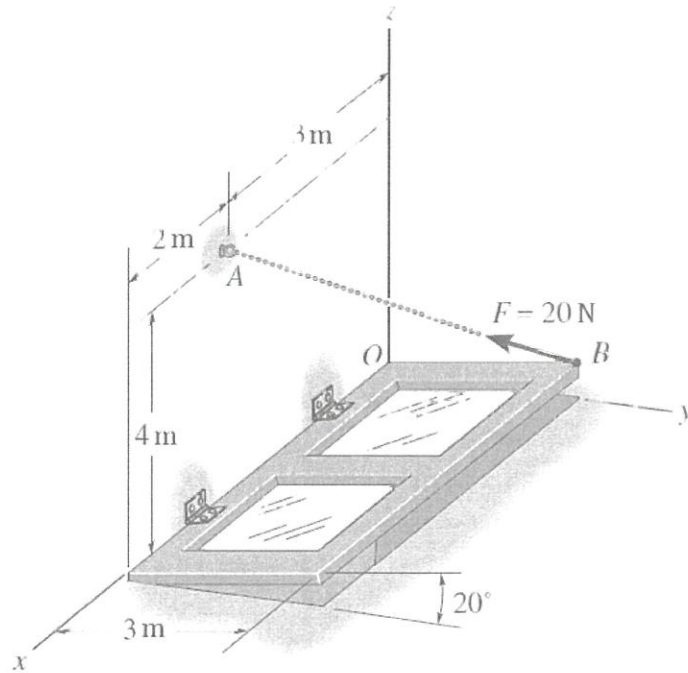


Figure Q2(b)

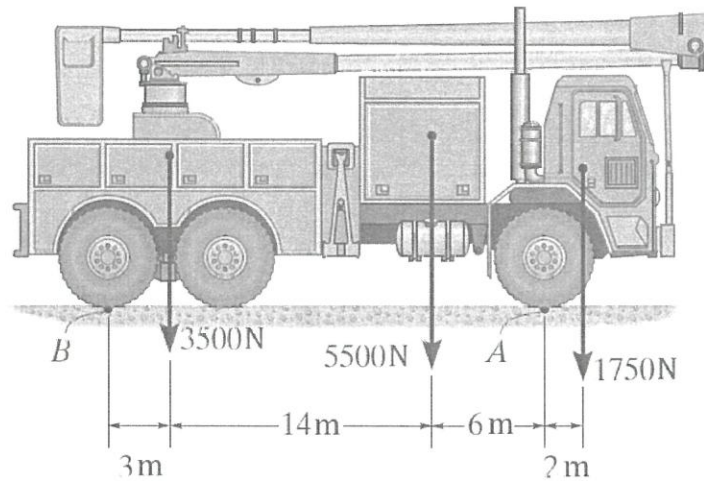


Figure Q3(a)

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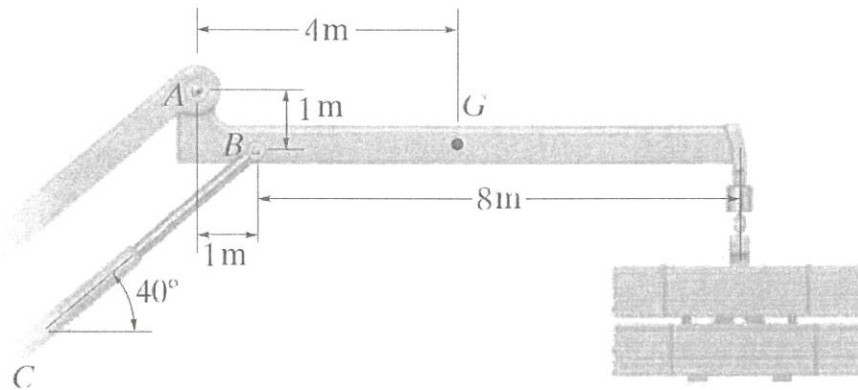


Figure Q3(b)

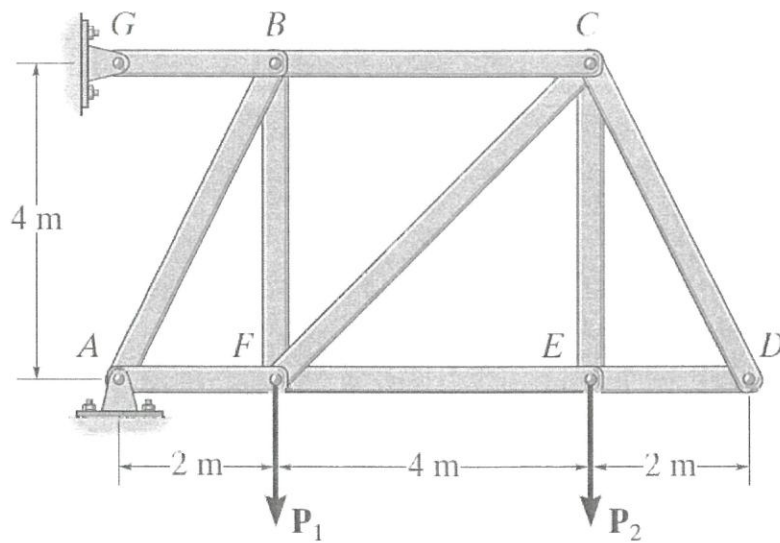


Figure Q4(b)

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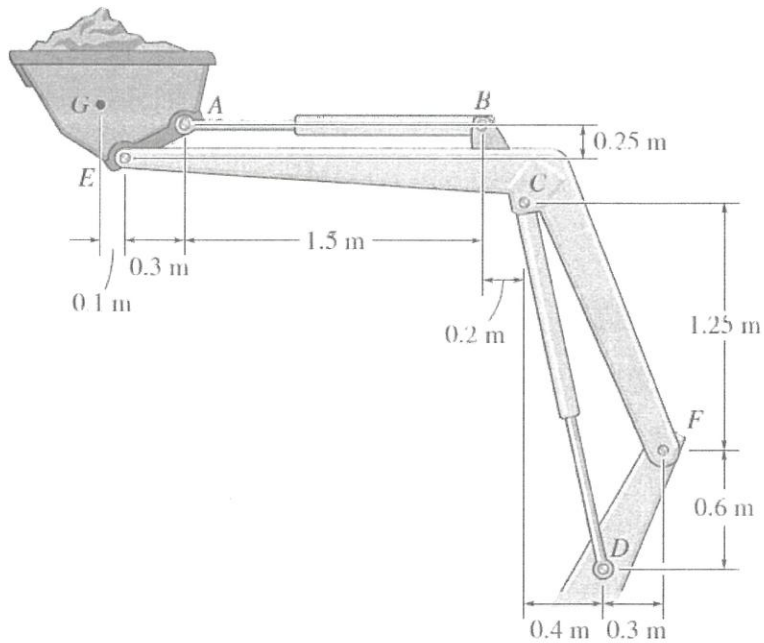


Figure Q5(b)

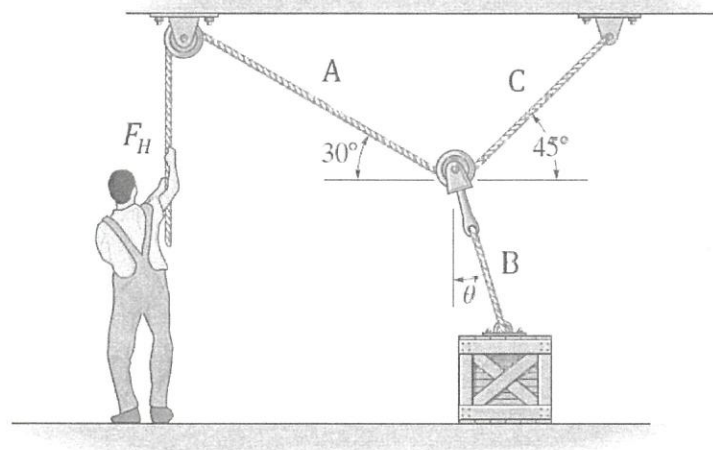


Figure Q6(b)

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