Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BNR 17003
PROGRAMME CODE	:	BND / BNE / BNF
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTIONS	1.	ANSWER ALL QUESTIONS
	2.	THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
	3.	STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

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

Q1 (a) Two forces act on the screw eye as in **Figure Q1(a)**. If $F_1 = 400$ N and $F_2 = 600$ N, determine the angle θ $(0 \leq \theta \leq 180)$ between them, so that the resultant force has a magnitude of $F_R = 800$ N.

(5 marks)

(b) **Figure Q1(b)** shows four forces acting on a particle. Determine the magnitude and direction θ of $\boldsymbol{F}$ so that the particle is in equilibrium.

(8 marks)

(c) Determine the moment of each of the three forces acting on the beam about point B as shown in **Figure Q1(c).**

(5 marks)

(d) Define a couple in moment of a couple and provide formula applied.

(2 marks)

Q2 (a) The ends of the triangular plate, as shown in **Figure Q2(a)**, are subjected to three couples. Determine the magnitude of the force $\boldsymbol{F}$ so that the resultant couple moment is 400 N.m clockwise.

(4 marks)

(b) **Figure Q2(b)** shows a force system given $F_1 = 300$ N, $F_2 = 500$ N, and $F_3 = 400$ N.

(i) Replace the force system acting on the frame by an equivalent resultant force.

(4 marks)

(ii) Determine the direction of the equivalent resultant force.

(2 marks)

(c) Replace the loading by a single resultant force, and specify the location of the force measured from point O as referred to **Figure Q2(c)**.

(10 marks)

Q3 (a) Given beam with the forces acted on it $F = 4$ kN as shows in **Figure Q3(a).**

(i) Draw the FBD for the beam shows all unknown forces at the support reaction.

(3 marks)

(ii) Determine the vertical and horizontal components of reaction at the pin A and and the reaction of the rocker B on the beam.

(6 marks)

(b) Given loading on the truss as shown in **Figure Q3(b)**. By applying method of section, determine the force on members *BE*, *EF*, and *CB* and state if the members are in tension or compression.

(11 marks)

Q4 (a) A particle is moving along a straight line with the acceleration $a = (12t - 3t^{1/2})$ m/s, where t is in seconds. Determine the velocity and the position of the particle as a function of time. When $t = 0$, $v = 0$ and $s = 15$ m.

(4 marks)

(b) A car starts from rest and with constant acceleration achieves a velocity of 15 m/s when it travels a distance of 200 m. Determine the acceleration of the car and the time required.

(4 marks)

(c) Ball *A* is thrown vertically upward from the top of a 30-m-high-building with an initial velocity of 5 m/s. At the same instant, another ball *B* is thrown upward from the ground with an initial velocity of 20 m/s. Determine;

(i) the height from the ground.

(7 marks)

(ii) the time when balls *A* and *B* pass each other.

(5 marks)

Q5 (a) Blocks *A* and *B* have a mass of 10 kg and 100 kg mass, respectively, as shown in **Figure Q5(a)**. Determine the distance *B* travels when it is released from rest to the point where its speed becomes 2 m/s by the applied principle of work and energy.

(8 marks)

(b) You are appointed as a project engineer required to design a cannonball that is able to build projectile throwers and measure the motion using the sensors as shown in **Figure Q5(b)**. The mass of 100g projectile throwers successfully can travel in the horizontal plane with a speed of $v = 240$ m/s at the angle of 20°. Calculate;

(i) the height of this projectile bullet after 20 seconds.

(3 marks)

(ii) how far will the projectile bullet go (*Sx*) before hitting the ground.

(5 marks)

(iii) the maximum height (*h*) of the projectile bullet throwers.

(4 marks)

-END OF QUESTIONS –

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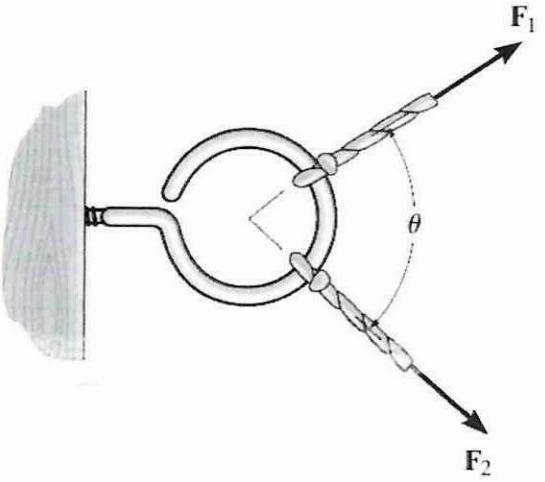

Figure Q1(a)

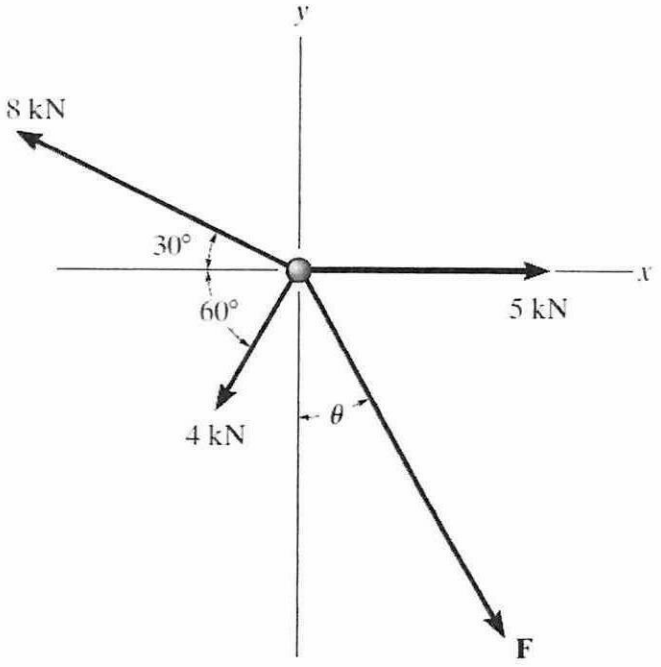

Figure Q1(b)

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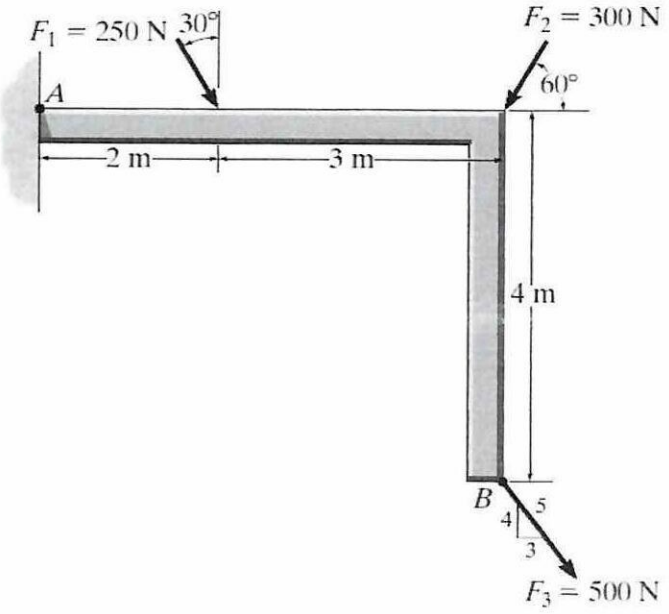

Figure Q1(c)

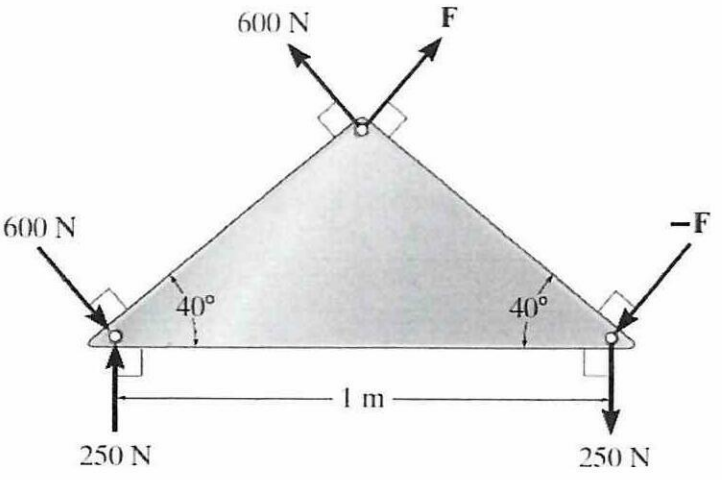

Figure Q2(a)

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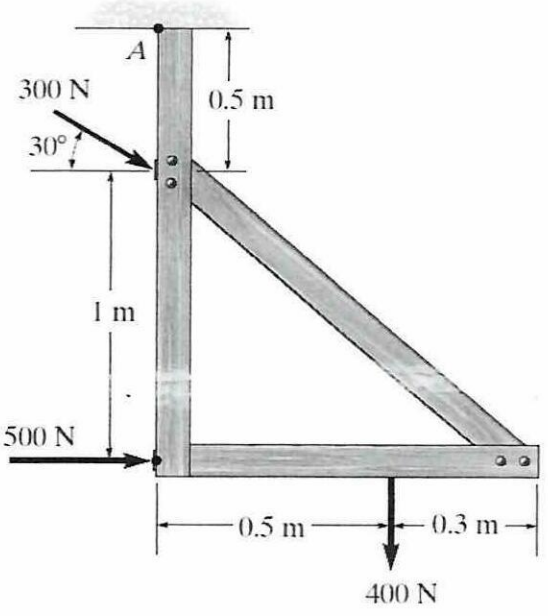

Figure Q2(b)

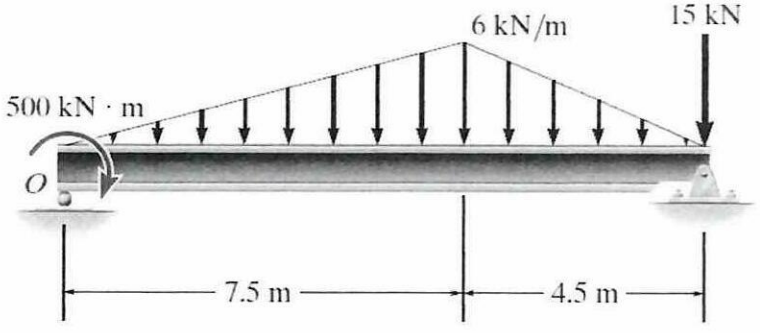

Figure Q2(c)

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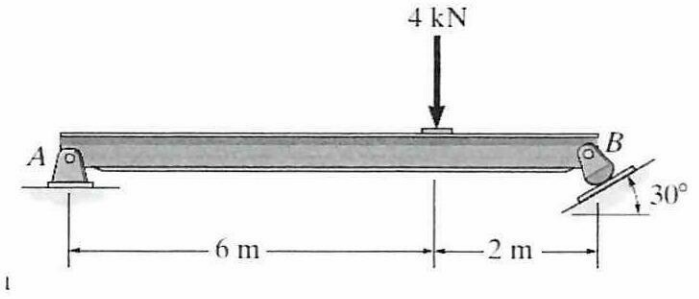

Figure Q3(a)

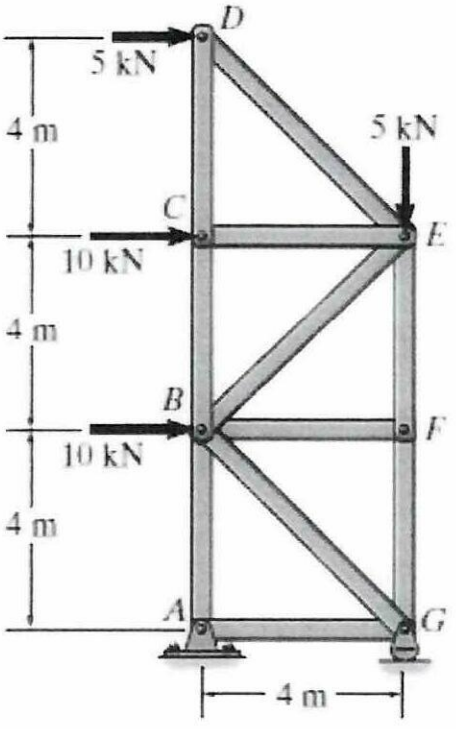

Figure Q3(b)

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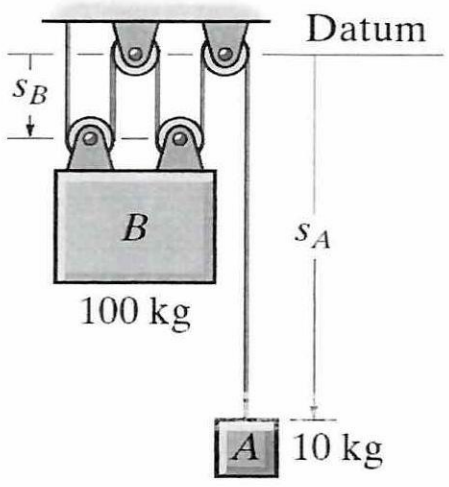

Figure Q5(a)

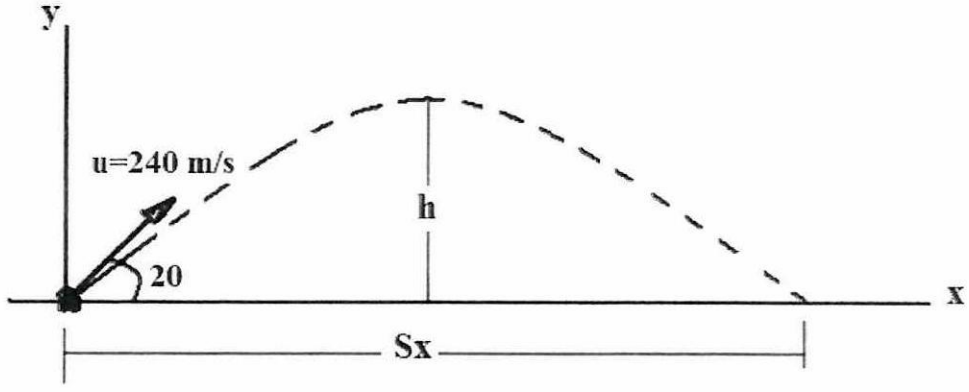

Figure Q5(b)