UNIVERSITY COLLEGE TATI (UC TATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BET 2143
COURSE	: STATIC AND DYNAMIC
SEMESTER/SESSION	: 2-2023/2024
DURATION	: 3 HOURS

Instructions:

1. This booklet contains **4** questions. Answer **ALL** questions.
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 8 PRINTED PAGES INCLUDING COVER PAGE

QUESTION 1

a) Determine the gravitational force acting between two spheres that are touching each other. The mass of each sphere is 200 kg and the radius is 300 mm. (3 marks)

b) Two particles have a mass of 8kg and 12kg, respectively. If they are 800mm apart,

i) Determine the force of gravity acting between them. (3 marks)

ii) Calculate the weight of each particle. (2 marks)

c) The vertical force **F** acts downward at *A* on the two-membered frame shown in Figure 1. Determine the magnitudes of the two components of **F** directed along the axes of AB and AC. Set F=500N. (4 marks)

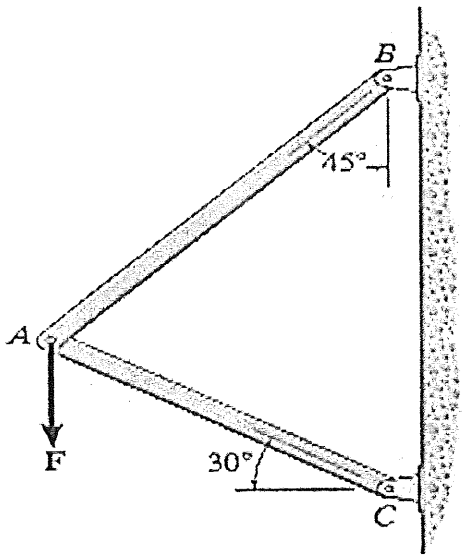

Figure 1

d) Member BC exerts on member AC a force P directed along line BC in Figure 2. Knowing that P must have a 325 N horizontal component, determine

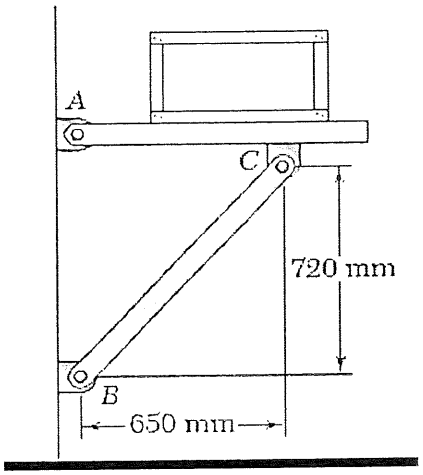

Figure 2

i. the magnitude of the force P (3 marks)

ii. its vertical component. (2 marks)

e) The members of a truss are pin connected at joint O in Figure 3. Determine the magnitude of F_1 and its angle θ for equilibrium. Set $F_2 = 6\ kN$. (5 marks)

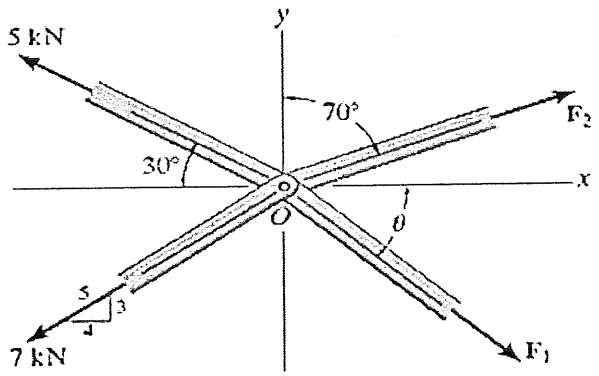

Figure 3

QUESTION 2

a) Determine the resultant moment produced by the forces about point O in Figure 4. (8 marks)

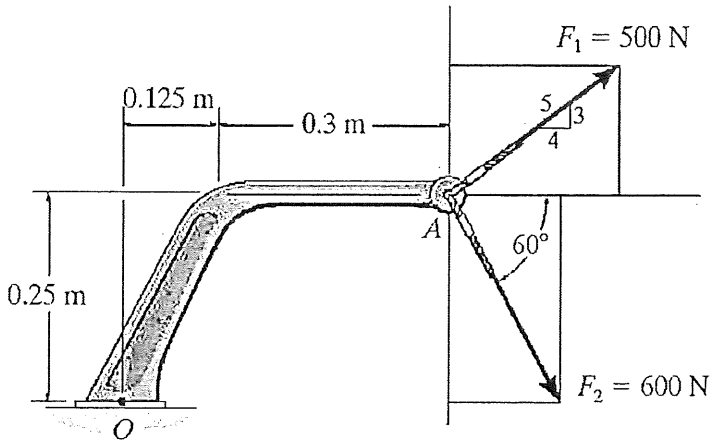

Figure 4

b) Two couples act on the cantilever beam in Figure 5. If $F = 6\ kN$, determine the resultant couple moment. (6 marks)

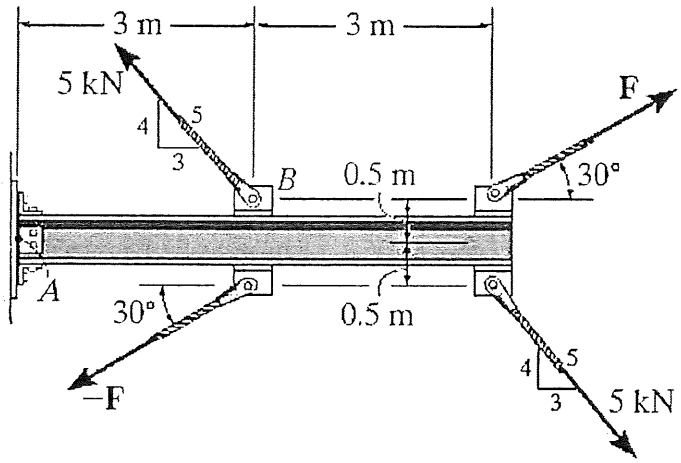

Figure 5

c) Determine the horizontal and vertical components of reaction on the beam caused by the pin at B and the rocker at A in Figure 6. Neglect the weight of the beam. (8 marks)

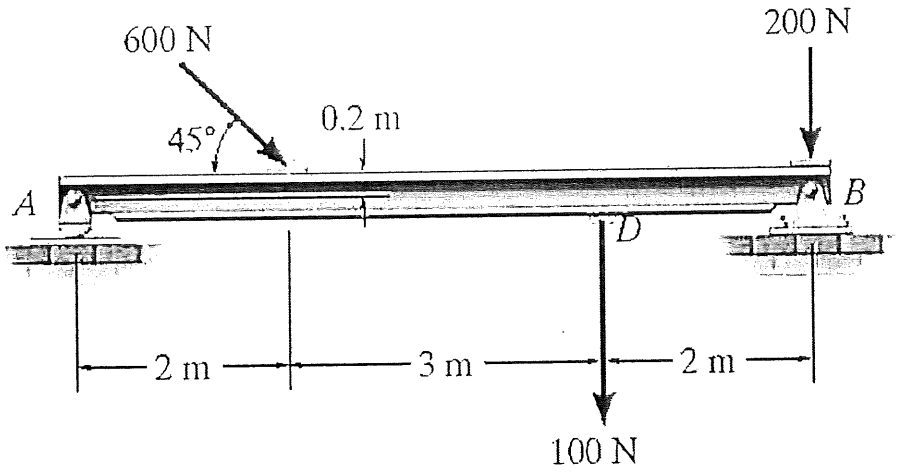

Figure 6

QUESTION 3

a) The motion of a particle is defined by the relation $x = 2t^3 - 15t^2 + 24t + 4$, where x is expressed in meters and t in seconds. Determine:

i. the time when the velocity is zero. (7 marks)

ii. the position and the total distance travelled when the acceleration is zero. (7 marks)

b) The vertical motion of mass *A* is defined by the relation

$$x = 10\sin 2t + 20\cos 2t + 120,$$

where *x* and *t* are expressed in mm and seconds, respectively. Determine;

i. the position, velocity, and acceleration of *A* when *t* = 2 s (7 marks)

ii. the maximum velocity and acceleration of *A*. (7 marks)

QUESTION 4

a) Two blocks are joined by an inextensible cable as shown in Figure 7. If the system is released from rest, determine the velocity of block *A* after it has moved 4 m. Assume that the coefficient of kinetic friction between block *A* and the plane is $\mu k = 0.35$ and that the pulley is weightless and frictionless. (14 marks)

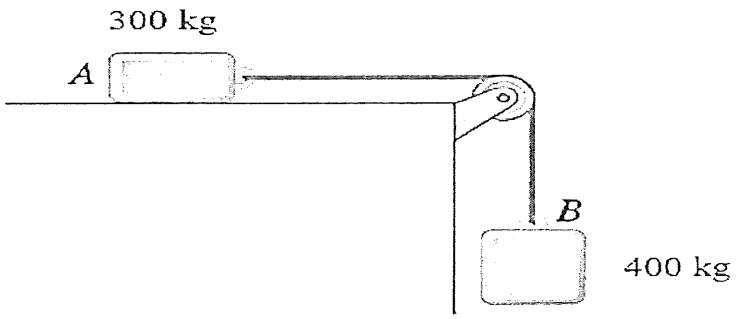

Figure 7

b) A 150 N block rests on a horizontal plane as shown in Figure 8. Find the magnitude of the force **P** required to give the block an acceleration of $10 m/s^2$ to the right. The coefficient of kinetic friction between the block and the plane is $\mu_k = 0.15$.

(14 marks)

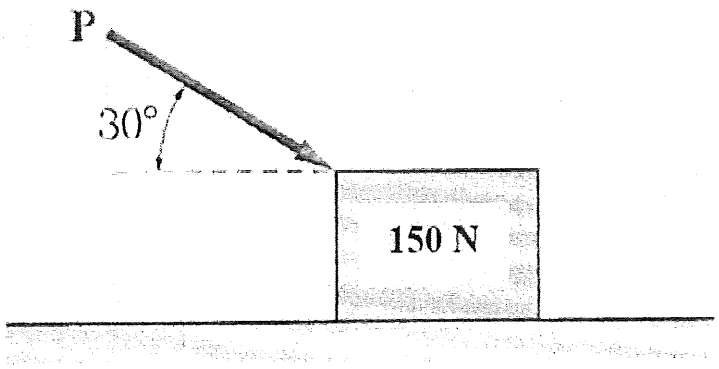

Figure 8

----------End of Question----------

Formula

$$F = G\frac{m_1 m_2}{r^2}$$

$$W = \frac{Gm_1 m_2}{R^2}$$

$$\frac{a}{\sin(A)} = \frac{b}{\sin(B)} = \frac{c}{\sin(C)}$$

$$a^2 = b^2 + c^2 - 2bc\cos(A)$$

$$M = Fd$$

$$F = \mu N = \mu w$$