CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMD26402**
SUBJECT TITLE	:	**STATIC AND DYNAMICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN MARINE ENGINEERING**
TIME / DURATION	:	**9.00AM – 11.30AM (2 HOURS 30 MINUTES)**
DATE	:	**30 JUNE 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL THREE (3) questions in Section A. For Section B, answer TWO (2) question ONLY.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language only.
7. Formula has been appended for your reference.

THERE ARE 12 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

With reference to the equilibrium of particles.

a) Two tugboats, A and B, are pulling a disabled ship at point C with forces F_A=2 kN and F_B=3 kN, respectively. The force from Tugboat A acts at an angle of 30° from the positive x-axis, while the force from Tugboat B acts at an angle of θ=45 below the x-axis, as shown in the diagram.

i. Resolve the forces F_A and F_B into their respective x and y components.

(5 marks)

ii. Determine the magnitude and direction (measured clockwise from the positive x-axis) of the resultant force acting at point C.

(5 marks)

Justify each step in your solution with appropriate vector resolution and graphical interpretation.

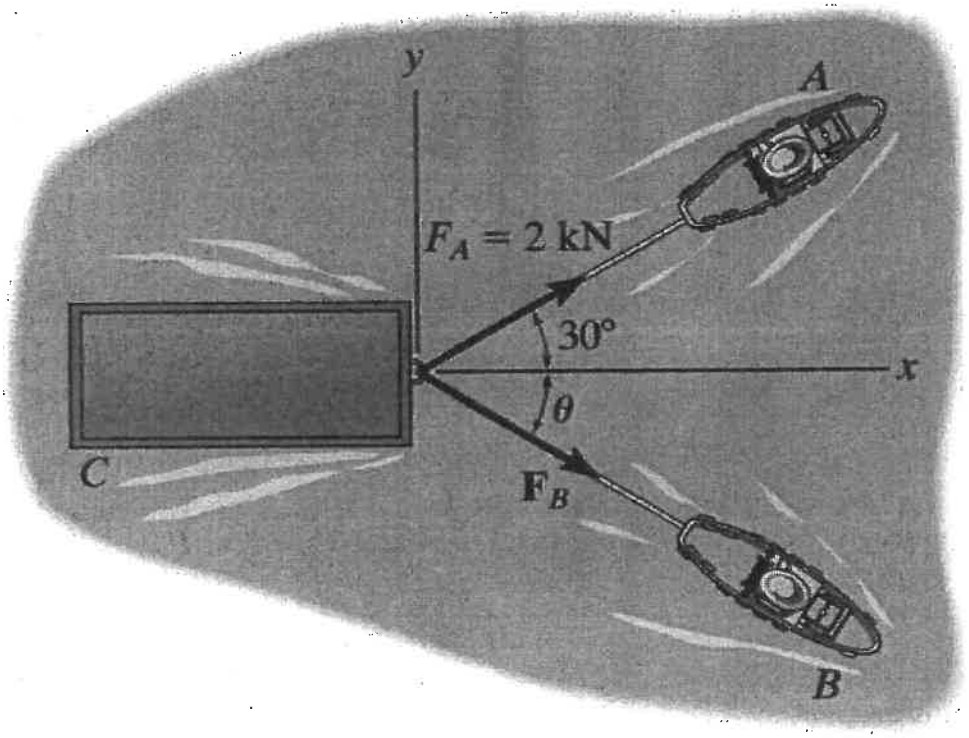


Figure 1

b) Two forces in Figure 2 act at a ring as shown: an 800 N force acts vertically upward, and a 600 N force acts at an angle of 30° below the horizontal.

i. Resolve both forces into their x and y components using appropriate vector principles.

(5 marks)

ii. Calculate the magnitude and direction of the resultant force acting at the ring. Express the direction counterclockwise from the positive x-axis.

(5 marks)

Support your answer with diagrams or a free-body sketch, and explain the steps used in determining vector addition.

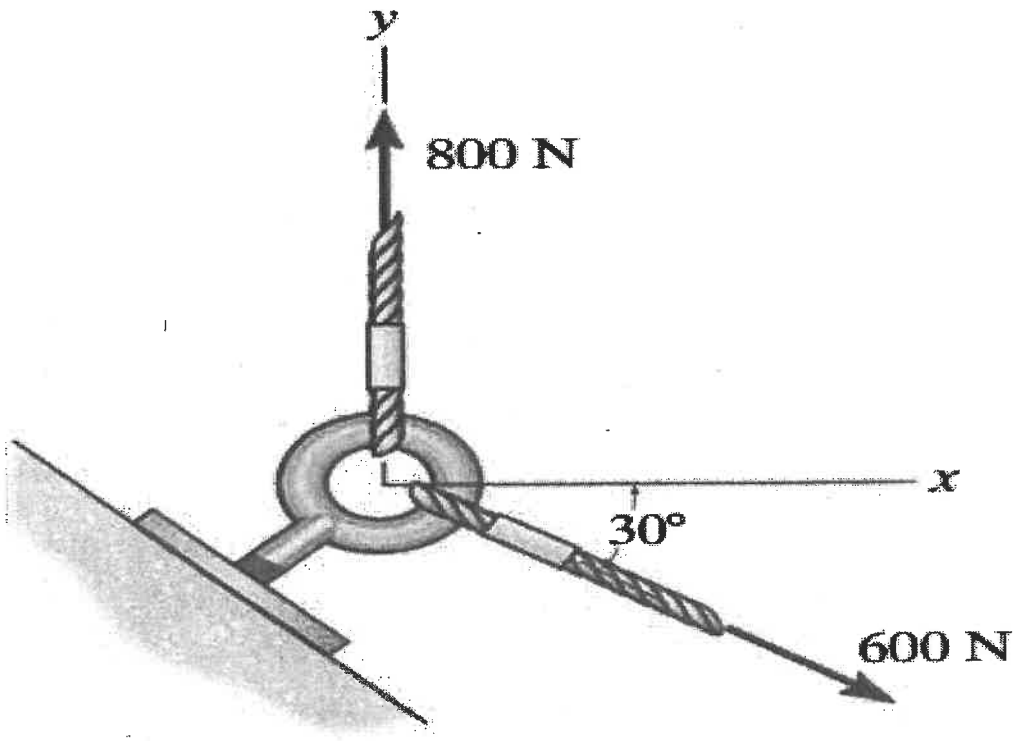


Figure 2

Question 2

With reference to Addition of coplanar forces

a) Three forces are. Three forces act on corbel support as shown:

- F1=700 lb acting at 30° below the horizontal,
- F2=400 lb acting vertically downward, and
- F3=600 lb acting along a cable inclined at a 3-4-5 triangle slope.

i. Resolve all three forces into their respective x and y components based on their directions.

(5 marks)

ii. Determine the magnitude and direction of the resultant force acting on the corbel. Express the direction counterclockwise from the positive x-axis.

(5 marks)

Show clear working steps and appropriate use of vector addition principles.

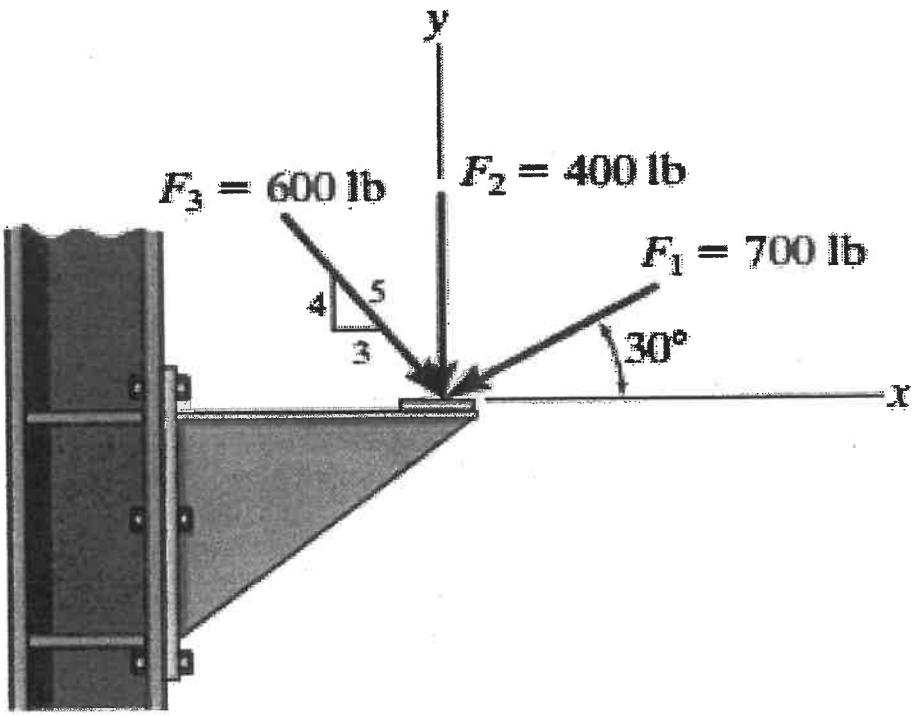


Figure 3

b) A bracket is subjected to three forces as shown in Figure 4:

- A 90 lb force directed along a cable defined by the 3-4-5 triangle,
- A 50 lb force acting horizontally to the left, and
- An unknown force F acting at an angle θ from the x-axis.

It is known that the resultant force acting on the bracket is 80 lb, and it is directed along the u-axis, which is inclined at 45° from the horizontal.

i. Resolve all known forces into their rectangular components and express the resultant in terms of x and y directions.

(5 marks)

ii. Determine the magnitude of force F and its direction θ, such that the resultant of all forces lies along the u-axis and has a magnitude of 80 lb.

(5 marks)

Provide proper justification and vector resolution in your explanation.

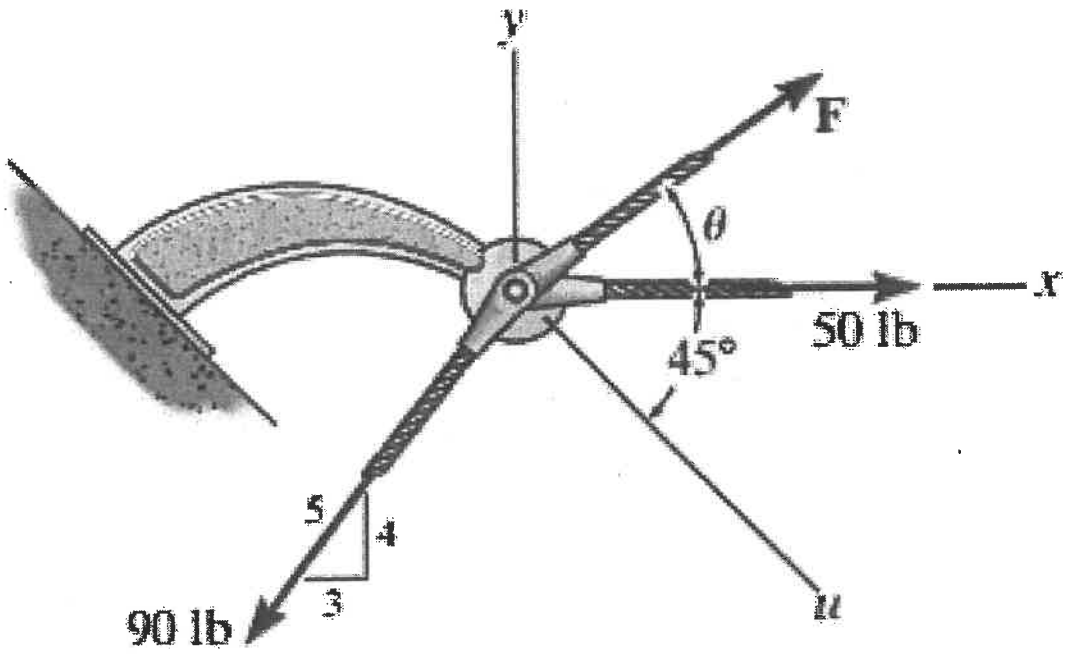


Figure 4

Question 3

With reference to the equilibrium of particles.

a) The towing pendant AB is subjected to the force of 50 kN exerted by a tugboat as shown in Figure 5. If the ship is moving forward at constant velocity,

i. Determine the tension in cable BC

(5 marks)

ii. Determine the tension in cable BD

(5 marks)

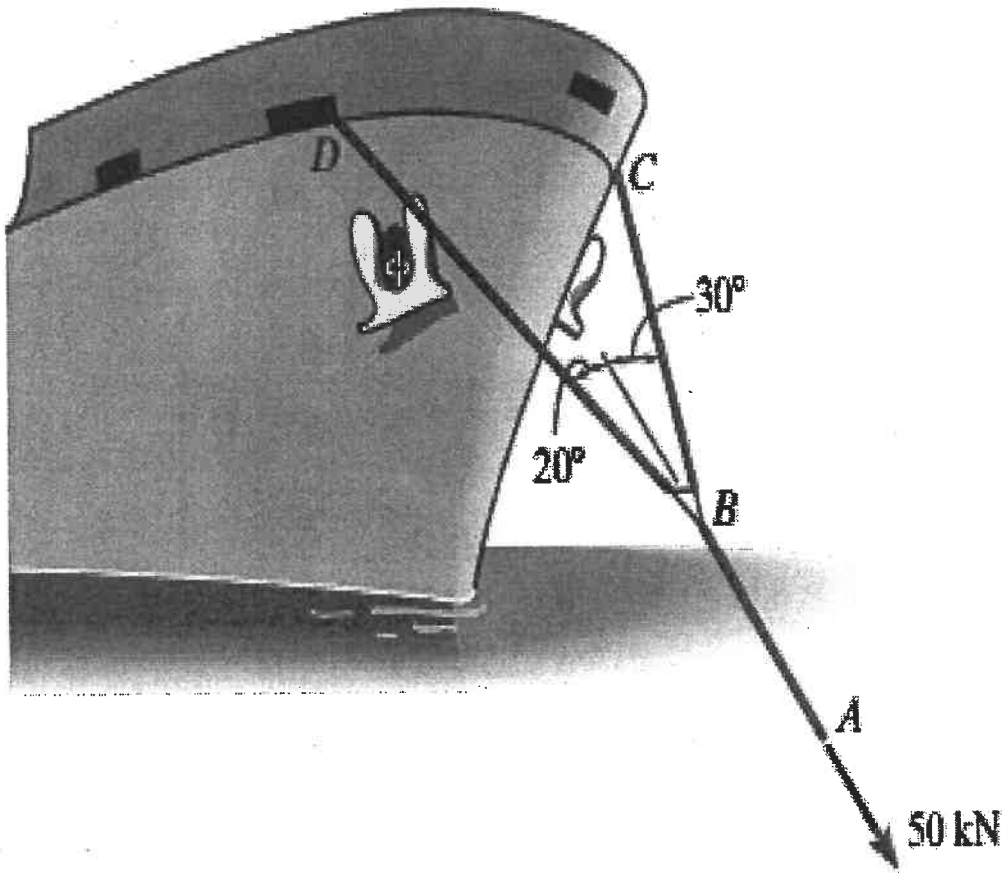


Figure 5

b) A crate weighing 550 lb in Figure 6 is suspended from point A and supported by two cables: cable AB, which is inclined at 30° from the horizontal, and cable AC, which follows a 3-4-5 slope.

i. Determine the tension in cable AB.

(5marks)

ii. Determine the tension in cable AC.

(5 marks)

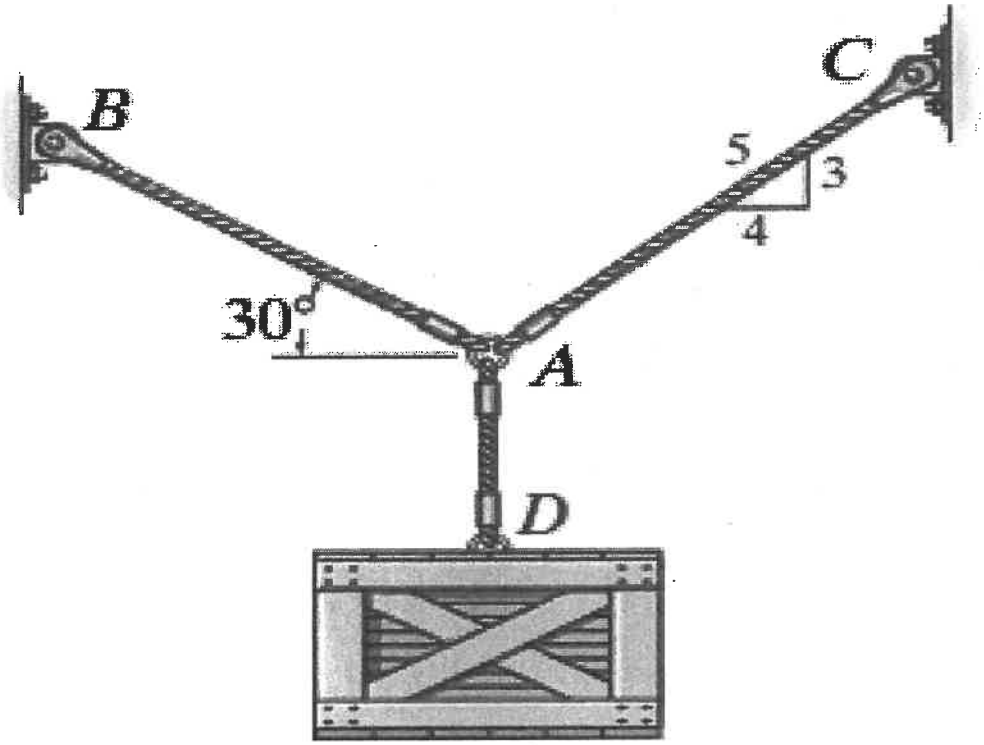


Figure 6

SECTION B (Total: 40 marks)

INSTRUCTION: Answer only TWO (2) questions.
Please use the answer booklet provided.

Question 4

With reference to Rectilinear Kinematics of dynamics

A bicycle travels in a straight line, and its position-time relationship is represented by the graph in Figure 7. For the time interval $0 \leq t \leq 30$ s, the motion is described by two functions:

- $s=t^2$ for $0 \leq t \leq 10$s
- $s=20t - 100$ for $10 \leq t \leq 30$ s

(a) construct velocity vs time (v - t) graph, and

(10 marks)

(b) construct acceleration vs time (a - t) graph

(10 marks)

for the entire interval $0 \leq t \leq 30$ s

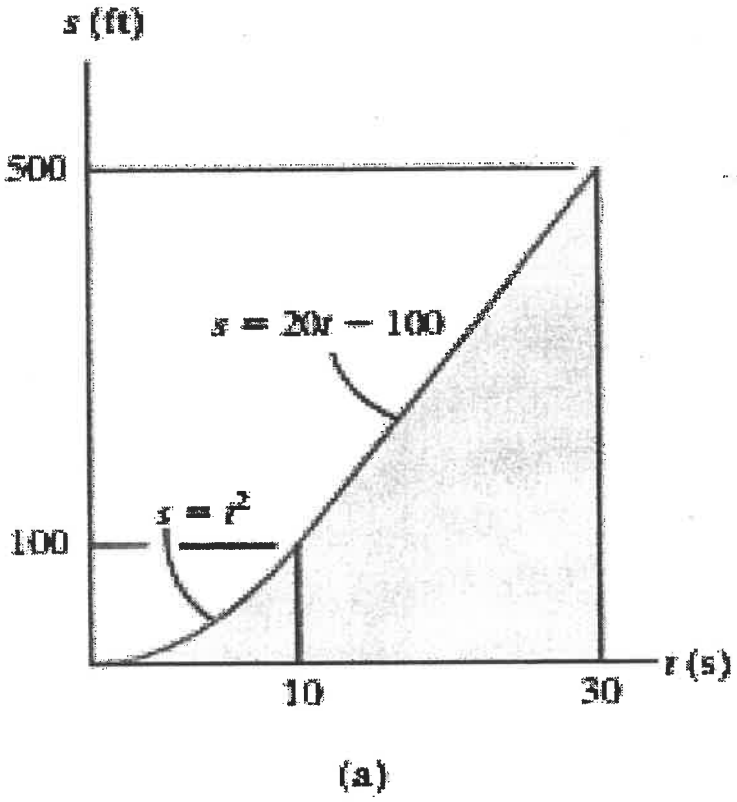


Figure 7

Question 5

With reference to the curvilinear motion.

(a) A boat moves along a circular path with a radius of 40 m. Its speed at any time t (in seconds) is given by the equation: $v(t)=0.0625t^2$ m/s.
Determine the magnitude of the total acceleration of the boat when t=10 s.

(10 marks)

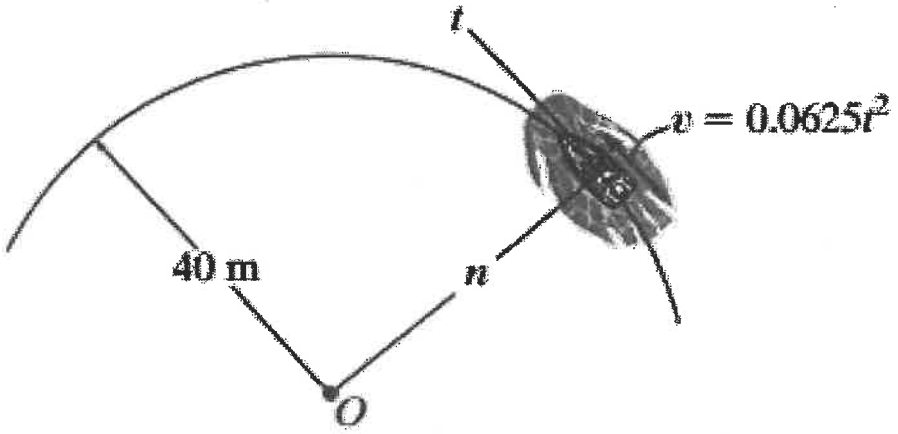


Figure 8

(b) A car in Figure 9 is moving along a curved road with a radius of 50 m. Its speed at any point along the path is given by the equation: v = (2s) m/s. where S is the distance traveled in meters. Determine the magnitude of the car's total acceleration when the distance traveled is s=10 m.

(10 marks)

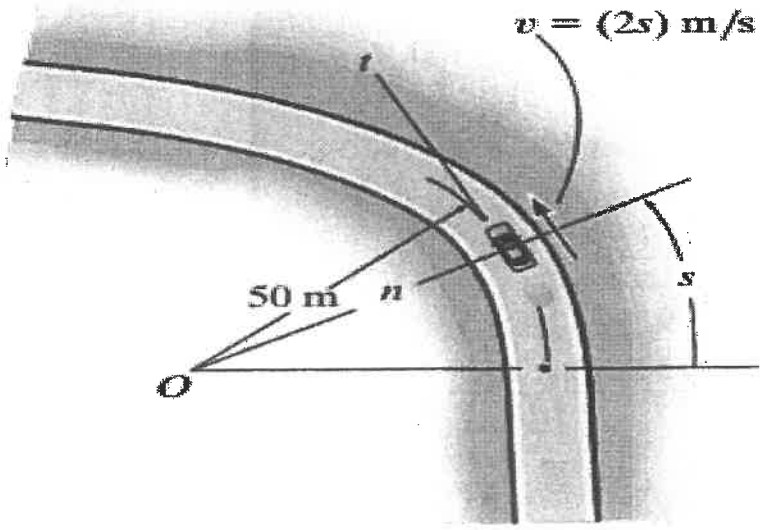


Figure 9

Question 6

With reference to Force and acceleration.

a) A 25-kg block is placed on a smooth horizontal surface and connected to a spring with stiffness k=200 N/m as shown in Figure 10. The spring is initially unstretched when the block is at position A. Two horizontal forces of 100 N each act on both sides of the block as shown. When the block has moved a distance s=0.4 m from position A, determine:

i. The elongation of the spring and the resulting spring force.

(5 marks)

ii. The acceleration of the block at this position, taking into account the net force acting on it.

(5 marks)

Assume the contact surface is smooth and neglect friction. Provide proper reasoning and steps in your solution.

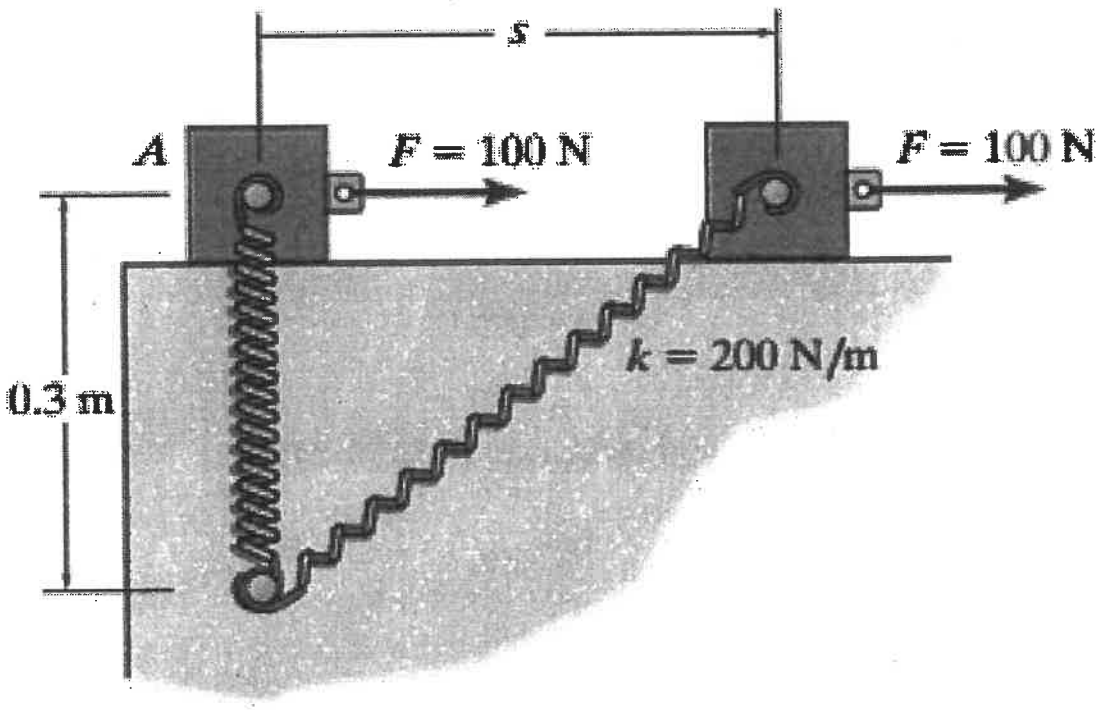


Figure 10

b) If motor *M in Figure 11* exerts a force of $F = (10t^2 + 100)$ N on the cable, where t is in seconds, determine the velocity of the 25-kg crate when $t = 4$ s. The coefficients of static and kinetic friction between the crate and the plane are $\mu_s = 0.3$ and $\mu_k = 0.25$, respectively. The crate is initially at rest.

(10 marks)

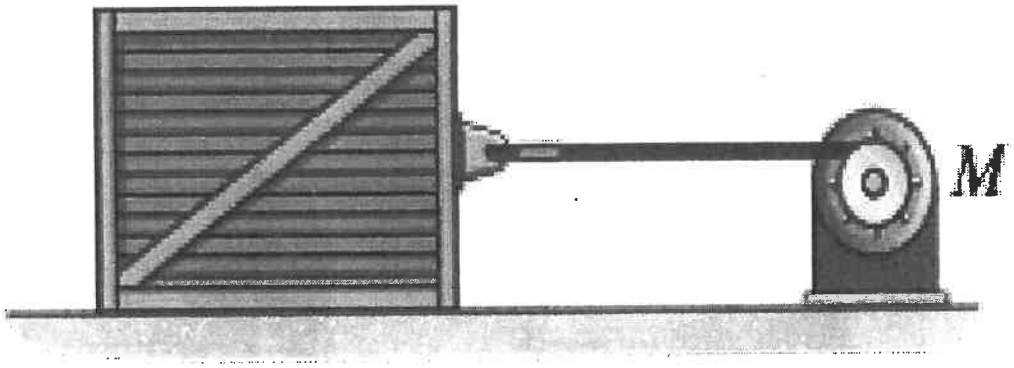
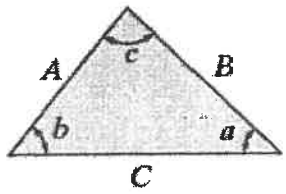


Figure 11

END OF EXAMINATION PAPER

Appendix 1 Formulae

$F_s = ks$ $v = v_o + a_c t$ $s = s_o + v_o t + (1/2)\, a_c t^2$ $v^2 = (v_o)^2 + 2a_c(s - s_o)$	$\sum mv_1 = \sum mv_2$ $T_1 + \sum U_{1-2} = T_2$ $e = \dfrac{(v_B)_2 - (v_A)_2}{(v_A)_1 - (v_B)_1}$
$\bar{x} = \dfrac{\sum \tilde{x}A}{\sum A}$ $\bar{y} = \dfrac{\sum \tilde{y}A}{\sum A}$	$k_{x'} = \sqrt{\dfrac{I_{x'}}{A}}$
$a_n = \dfrac{v^2}{\rho}$ $a_t = v = \dfrac{dv}{dt} =$ $a = \sqrt{a_t^2 + a_n^2}$	$I_x = I_x + A(d_y)^2$ $x_B = x_A + (v_A)_x t$ $y_B = y_A + (v_A)_y t + \frac{1}{2} a_y t^2$
	Cosine law: $C = \sqrt{A^2 + B^2 - 2AB\cos c}$ Sine law: $\dfrac{A}{\sin a} = \dfrac{B}{\sin b} = \dfrac{C}{\sin c}$
$F_{Rx} = \sum F_x$ $F_{Ry} = \sum F_y$	$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2}$ and $\theta = \tan^{-1}\left\lvert\dfrac{F_{Ry}}{F_{Rx}}\right\rvert$