CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMD25802**
SUBJECT TITLE	:	**STATIC AND DYNAMICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN MARINE ENGINEERING**
TIME / DURATION	:	**2.00 PM - 4.30 PM (2 HOURS 30 MINUTES)**
DATE	:	**28 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, and **TWO (2)** questions ONLY in Section B.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Formula is appended for your reference.

THERE ARE 11 PAGES OF QUESTIONS, EXCLUDING 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 tow a barge such that the resultant force exerted by both is 3 kN and acts entirely along the positive x-axis. Given that tugboat A exerts a force of 2 kN at an angle of 30° above the x-axis, determine:

i. The magnitude of the force F_B applied by tugboat B, and

(5 marks)

ii. The direction angle θ of this force, measured below the x-axis.

(5 marks)

*Provide your graphical sketching in your solution.

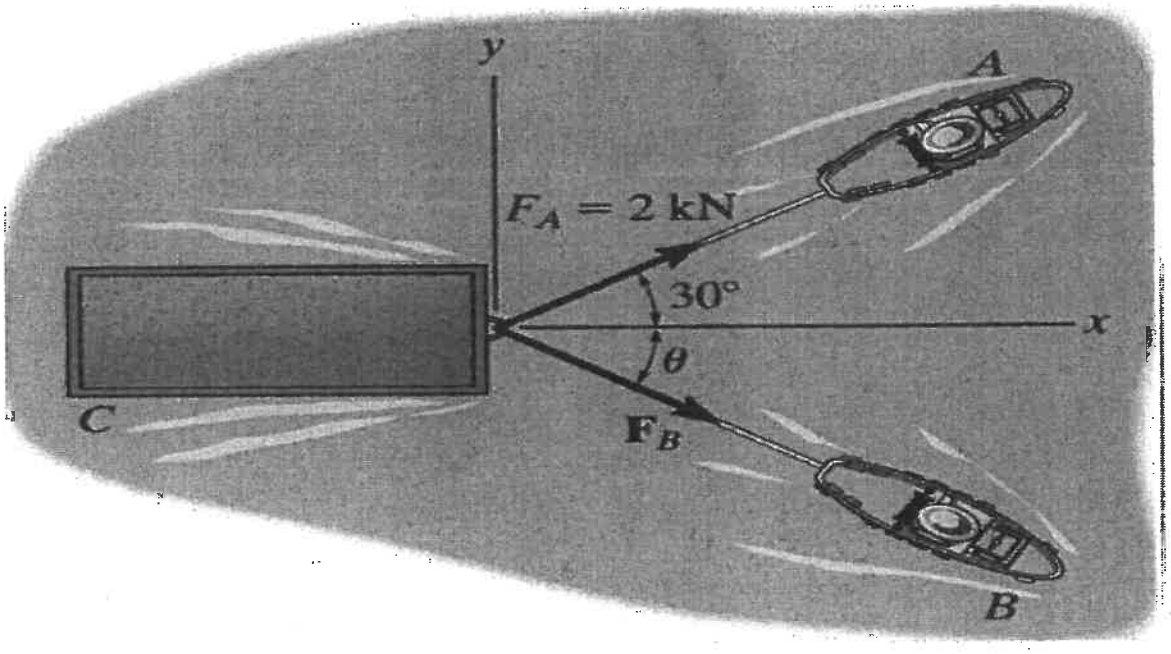


Figure 1

b) Two forces are applied to a screw eye as shown in the figure. A 6 kN force is directed at an angle of 60° above the negative x-axis, and a 2 kN force is applied at an angle of 45° below the positive x-axis.

i. Determine the magnitude of the resultant force acting on the screw eye.

(5 marks)

ii. Determine the direction of the resultant force measured clockwise from the positive x-axis.

(5 marks)

*Provide your graphical sketching in your solution.

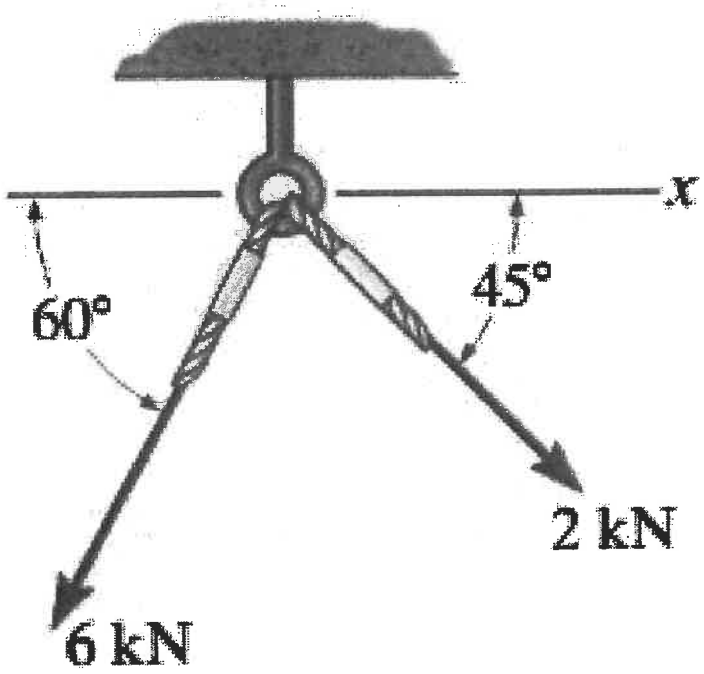


Figure 2

Question 2

With reference to Addition of coplanar forces

a) Three forces are acting on a post as shown in figure 3. Force F_1=300 N acts vertically upward along the y-axis. Force F_2=450 is applied at an angle of 45° above the negative x-axis, while force F_3=600 N acts along a cable inclined with a slope ratio of 3:4, directed toward the positive x-axis and negative y-axis. Resolve each of these forces into their respective x and y components.

(10 marks)

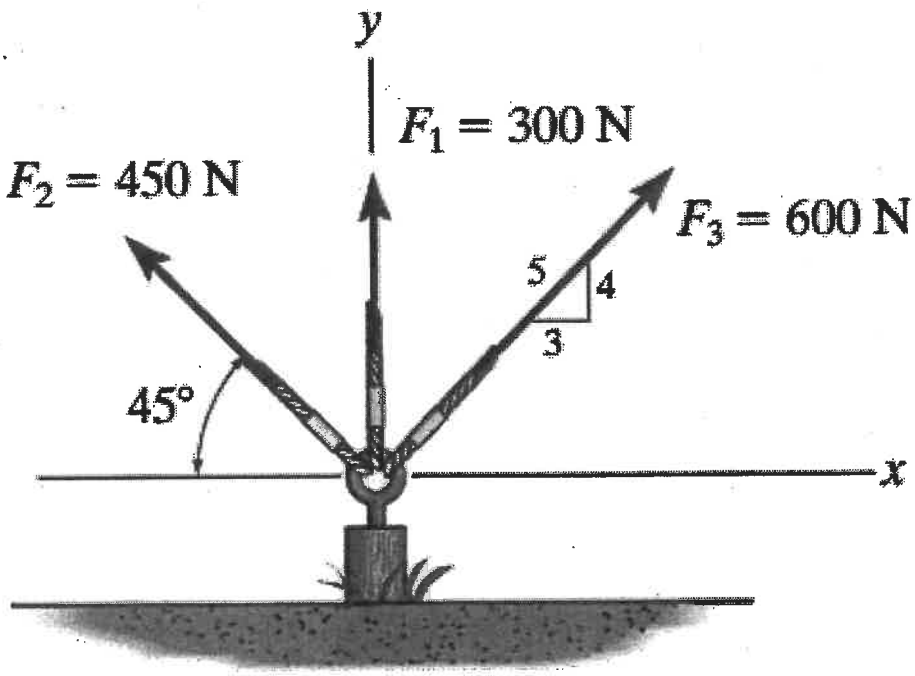


Figure 3

b) If the resultant force acting on the bracket in Figure 4 is to be 750 N directed along the positive x-axis, answer the following:

i. Determine the magnitude of the unknown force F.

(5 marks)

ii. Determine the direction angle θ of force F, measured counterclockwise from the x-axis.

(5 marks)

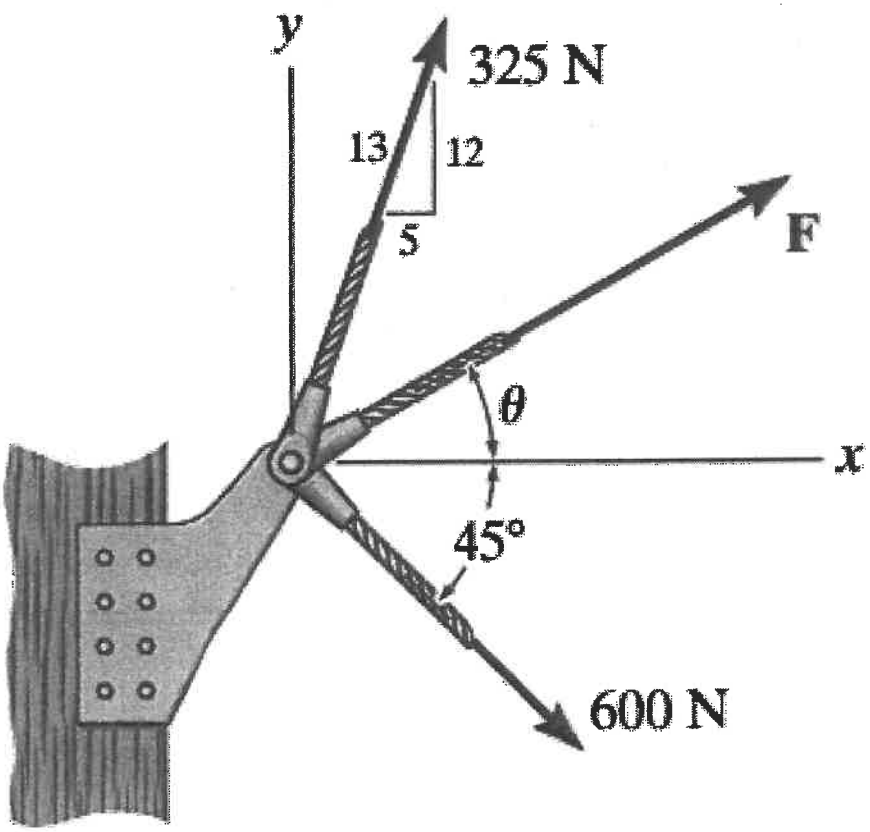


Figure 4

Question 3

With reference to the equilibrium of particles.

a) A 60-kg cylinder is suspended from point B as shown in the figure. The cylinder is supported by two cables: BA, which is inclined at a 3-4-5 slope, and BC, which forms a 45° angle with the horizontal. Determine the tension forces in cables BA and BC required to keep the system in equilibrium.

i. Determine the tension in cable BA

(5 marks)

ii. Determine the tension in cable BC.

(5 marks)

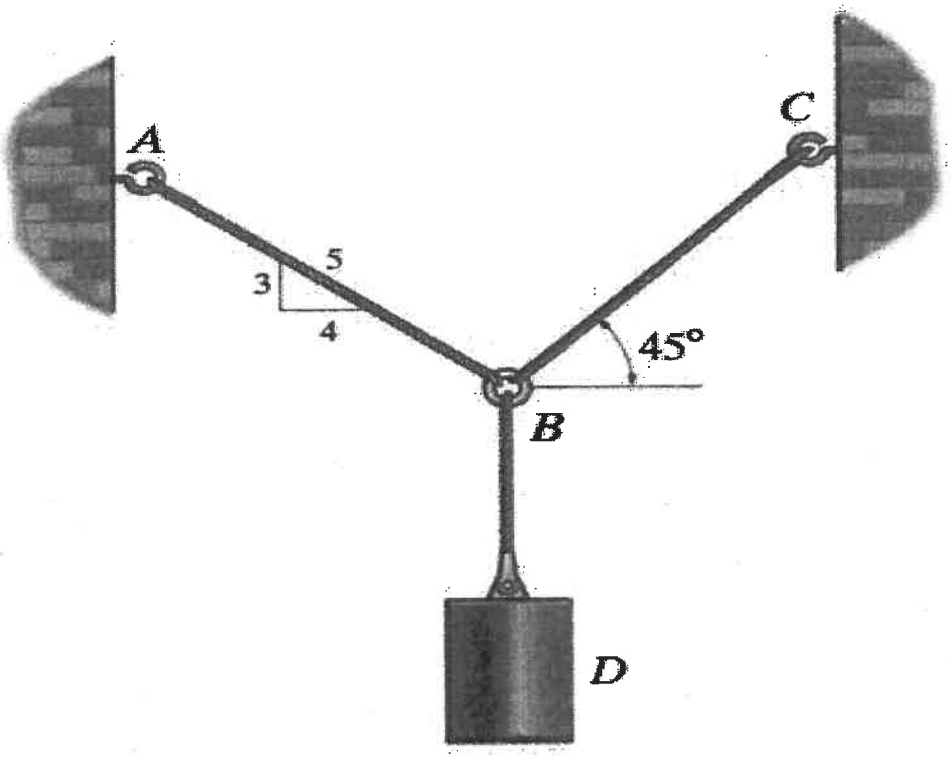


Figure 5

b) A 5-kg block is suspended from a frictionless pulley at point B, which hangs from a cord connected between supports A and C. The horizontal distance between A and C is 0.8 m, and the vertical sag of the cord at point B is 0.15 m.

i. Construct the free-body diagram of the system and resolve the geometry involved to find the angles or slope of the cord segments.

(5marks)

ii. Determine the tension force in the cord segment ABC that supports the pulley and the suspended weight. Assume the pulley has negligible size and mass.

(5 marks)

Provide proper justification using equilibrium equations and vector components in your solution.

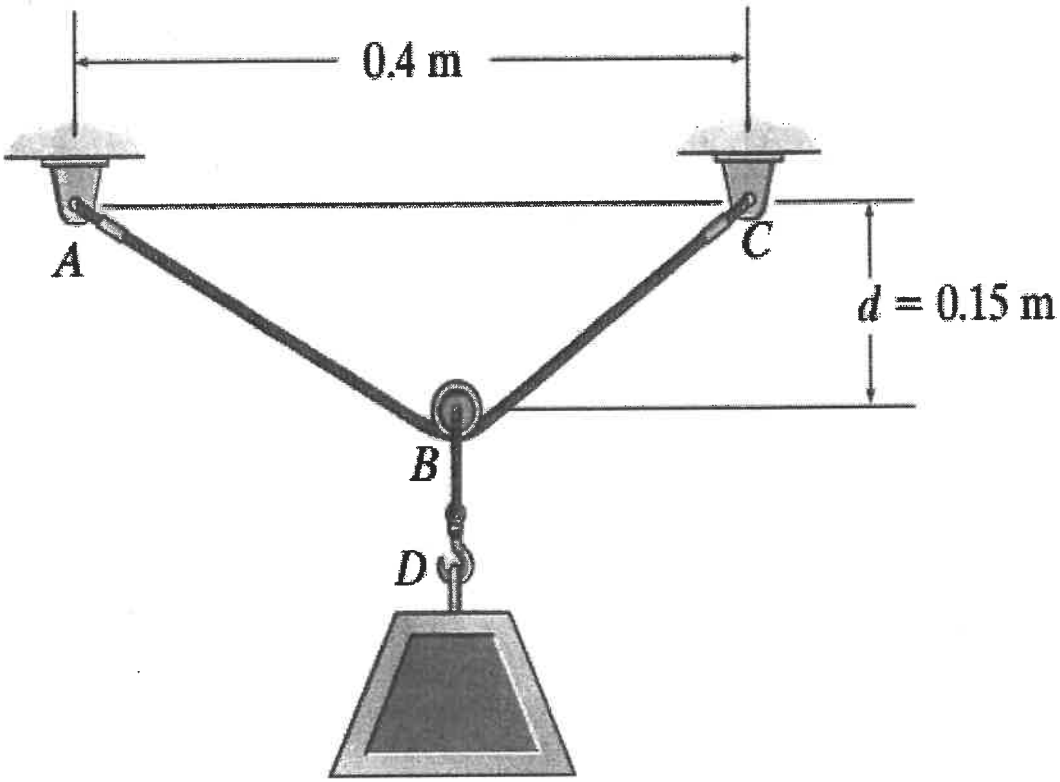


Figure 6

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

Construct the corresponding

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

(10 marks)

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

(10 marks)

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

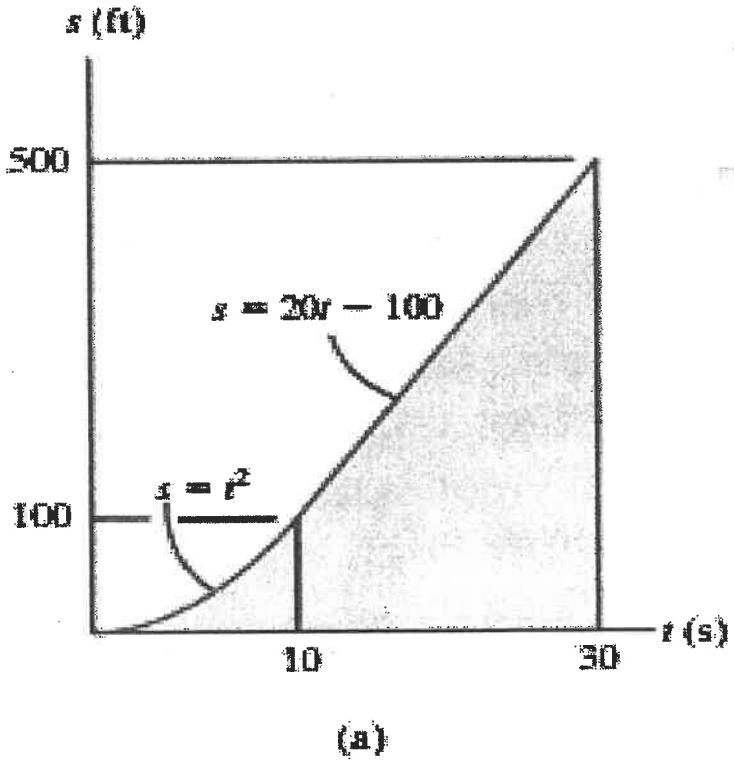


Figure 7

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)

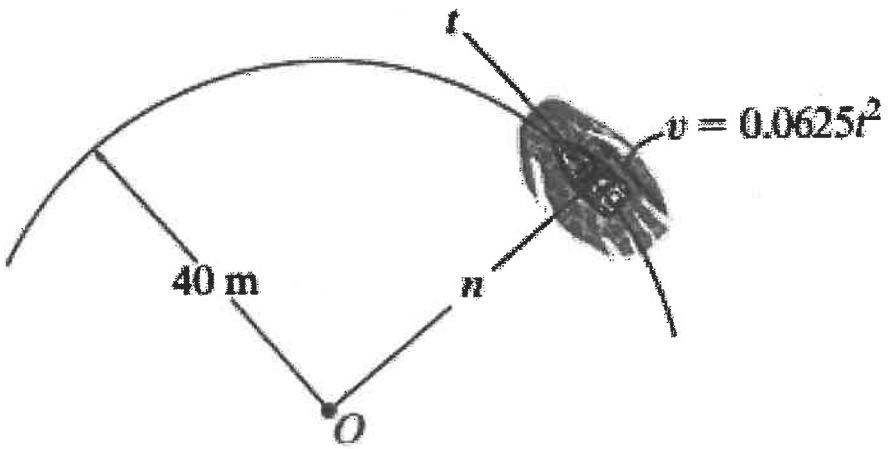


Figure 8

(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)

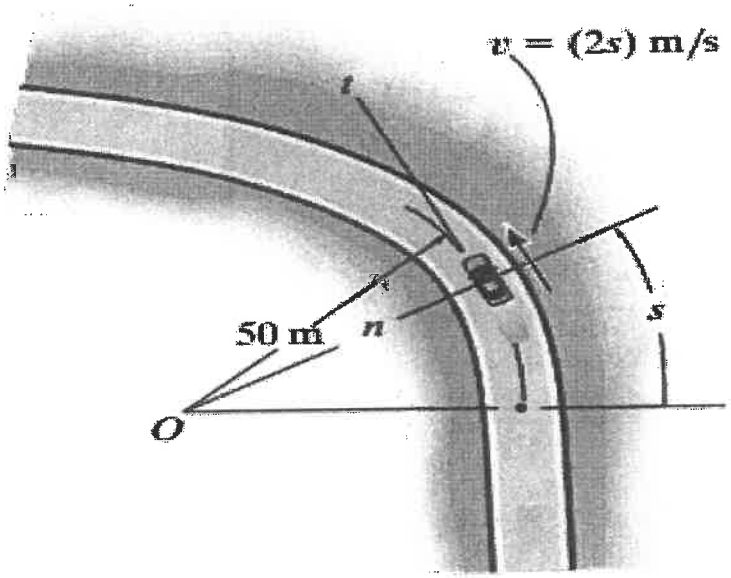


Figure 9

Question 6

With reference to Force and acceleration.

a) The motor winds in the cable with a constant acceleration, such that the 20-kg crate moves a distance
s = 6 m in 3 s, starting from rest. The coefficient of kinetic friction between the crate and the plane is μ_k = 0.3. Determine the tension developed in the cable in Figure 10.

(10 marks)

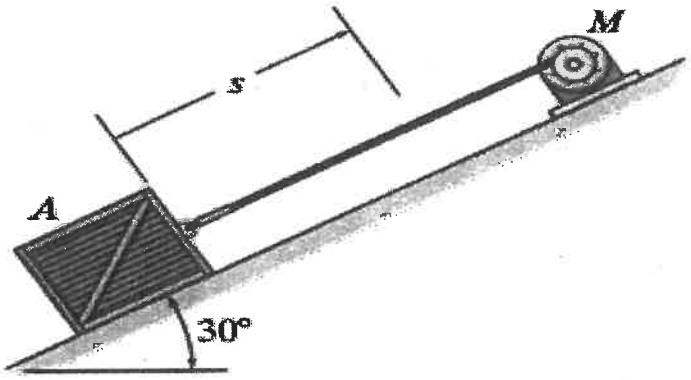


Figure 10

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 μ_s = 0.3 and μ_k = 0.25, respectively. The crate is initially at rest.

(10 marks)

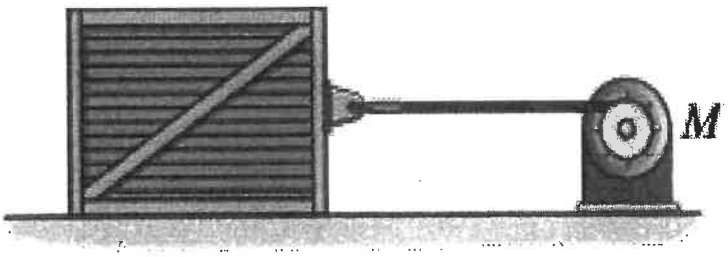
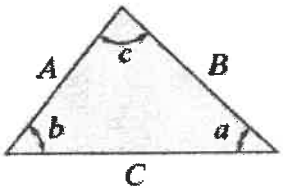


Figure 11

END OF EXAMINATION PAPER

~~Appendix 1 Formulae~~

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