UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
MARCH 2025 SEMESTER SESSION

SUBJECT CODE	:	**LGB13403**
SUBJECT TITLE	:	**STATICS AND DYNAMICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR OF ENGINEERING TECHNOLOGY (OFFSHORE) WITH HONOURS** **BACHELOR OF ENGINEERING TECHNOLOGY (NAVAL ARCHITECTURE AND SHIPBUILDING) WITH HONOURS**
TIME / DURATION	:	**2.00 PM - 5.00 PM (3 HOURS)**
DATE	:	**25 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 **ONE (1) section A**.
4. Answer **ALL** question in Section A.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Formula table has been appended for your reference.

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 100 marks)

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

Question 1

With reference to the force vectors.

a) Figure 1 shows the link is subjected to two forces $F_1$and F_2.

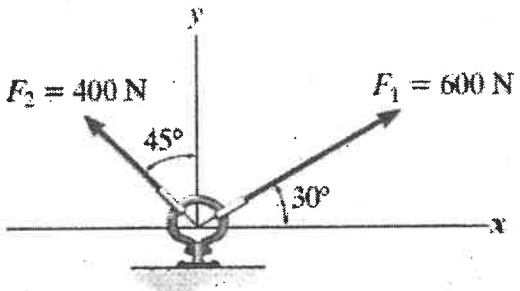


Figure 1: Two forces acting on an object.

i. Calculate the x-component and y-component of all forces.

(4 marks)

ii. Calculate the magnitude of the resultant force and its direction.

(6 marks)

b) An object is subjected to two forces, F_1 and F_2 as shown in Figure 2. If the magnitude of the resultant force is to be 500 N, directed along the positive *y* axis, determine the magnitude of force F_1 and its direction θ

(10 marks)

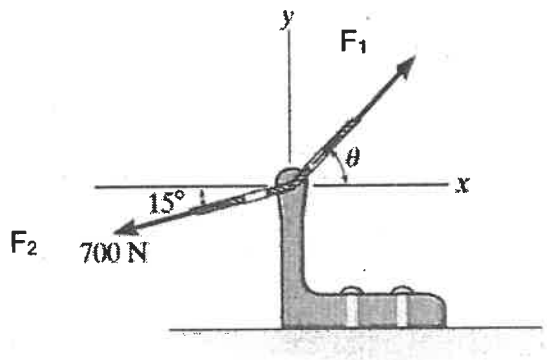


Figure 2: Two forces gives a resultant force of 500 N

Question 2

With reference to the equilibrium of a particle and a rigid body

a) The towing pendant AB is subjected to the force of 50 kN exerted by a tugboat.

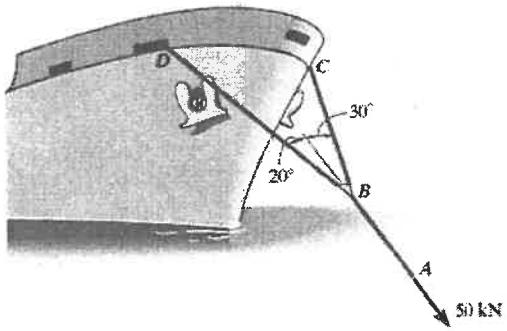


Figure 3: Towing load applied by tugboat on cable AB

i. Illustrate a free body diagram indicating all the acting forces.

(4 marks)

ii. Calculate the force in each of the bridles, F_{BC} and F_{BD}, if the ship is moving forward with constant velocity.

(6 marks)

b) Figure 4 shows a 10 kg cylinder connected to pinned cables at points A and B.

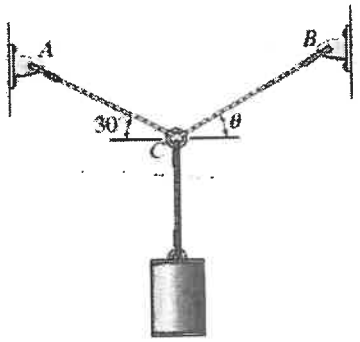


Figure 4: Cable support system for a 10 kg mass cylinder.

i. Illustrate a free body diagram indicating all the acting forces.

(4 marks)

ii. Determine the tension developed in wires F_{CA} and F_{CB} required for equilibrium of the 10kg cylinder. Take $\theta = 40°$.

(6 marks)

Question 3

With reference to the kinetic of a particle: Force, acceleration & Newtons Law.

The motor pulls the cable with constant acceleration, causing the 20 kg crate to travel 6 m in 3s, starting from rest.

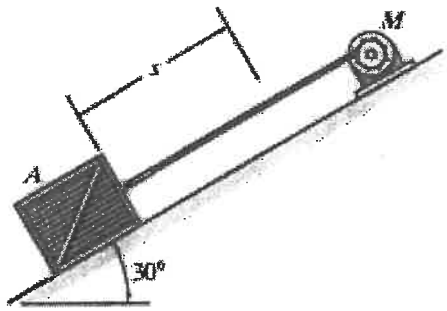


Figure 5: A crate pulled by a motor along an inclined plane

i. Illustrate a free body diagram showing all the external force that act on the crate.

(5 marks)

ii. Calculate normal force, F_N

(5 marks)

iii. Find the tension developed in the cable. The coefficient of kinetic friction between the crate and the plane is $\mu_k = 0.3$.

(10 marks)

Question 4

With reference to the kinetic of a particle: Work, power, and energy.

The material hoist and the load have a total mass of 800 kg and the counterweight *C* has a mass of 150 kg. At a given instant, the hoist has an upward velocity of 2 m/s and an acceleration of 1.5 m/s^2.

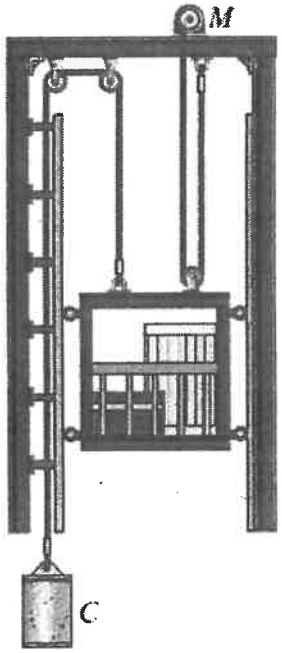


Figure 6: A vertical hoist lifting a load, connected by pulleys and a rope to a counterweight labeled C.

i. Illustrate a free body diagram.

(4 marks)

ii. Calculate all the tension force involved.

(10 marks)

iii. Determine the power generated by the motor M at this instant if it operates with an efficiency of $\epsilon = 0.8$.

(6 marks)

Question 5

With reference to the kinetic of a particle: impulse and momentum:

a) Figure 7 illustrates a 50 kg crate being pulled by a constant force, P. Starting from rest, the crate reaches a speed of 10 m/s in 5 seconds.

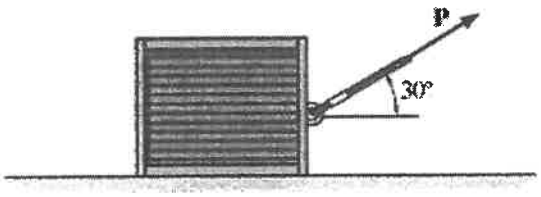


Figure 7: A crate pulled by constant force on rough surface.

i. Illustrate a free body diagram showing all the external force that act on the crate.

(5 marks)

ii. Determine the tension developed in the cable and normal force, F_N. The coefficient of kinetic friction between the crate and the ground is $\mu_k = 0.2$.

(15 marks)

END OF EXAMINATION PAPER

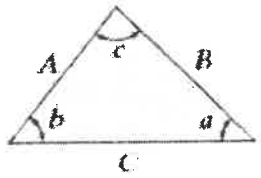
APPENDIX

1. TABLE OF FORMULAE

Multiple	Exponential form	Prefix	SI Symbol
1 000 000 000	10^9	giga	G
1 000 000	10^6	mega	M
1000	10^3	kilo	k
Submultiple			
0.001	10^{-3}	Mili	m
0.000 001	10^{-6}	Micro	μ
0.000 000 001	10^{-9}	nano	n

Vector:

Parallelogram Law:



Cosine law:

$$C = \sqrt{A^2 + B^2 - 2AB\cos c}$$

Sine law:

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

Pythagorean Theorem:

$$F_R = \sqrt{F_{Rx}^2 + F_{Ry}^2} \quad \text{and} \quad \theta = \tan^{-1}\left|\frac{F_{Ry}}{F_{Rx}}\right|$$

Kinematics

Particle Rectilinear Motion:

Variable a	*Constant* $a = a_c$
$a = \frac{dv}{dt}$	$v = v_0 + a_c t$
$v = \frac{ds}{dt}$	$s = s_0 + v_0 t + \frac{1}{2} a_c t^2$
$a\,ds = v\,dv$	$v^2 = v_0^2 + 2a_c(s - s_0)$

Equations of motion:	Principles of Work and Energy:
$\sum F = ma$	$T_1 + \Sigma U_{1-2} = T_2$
Kinetic Energy Particle: $T = \frac{1}{2} mv^2$	***Work*** *Variable force* $U_F = \int F \cos\theta \, ds$ *Constant force* $U_F = (F_c \cos\theta)\,\Delta s$
Power and efficiency: $P = \frac{dU}{dt} = \mathbf{F} \cdot \mathbf{v}$ $\varepsilon = \frac{P_{out}}{P_{in}} = \frac{U_{out}}{U_{in}}$	Conservation of Energy Theorem $T_1 + V_1 = T_2 + V_2$

Principles of Linear Impulse and Momentum:

Particle	$m\mathbf{v}_1 + \Sigma \int \mathbf{F}\,dt = m\mathbf{v}_2$
Rigid Body	$m(\mathbf{v}_G)_1 + \Sigma \int \mathbf{F}\,dt = m(\mathbf{v}_G)_2$