# UNIVERSITI KUALA LUMPUR
## Malaysian Institute of Marine Engineering Technology

## FINAL EXAMINATION

## OCTOBER 2025 SEMESTER SESSION

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|---|---|
| **SUBJECT CODE** | : **LGD22103** |
| **SUBJECT TITLE** | : **STATICS AND DYNAMICS** |
| **PROGRAMME NAME** (FOR MPU: PROGRAMME LEVEL) | : **DIPLOMA OF ENGINEERING TECHNOLOGY (NAVAL ARCHITECTURE AND SHIPBUILDING)** |
| **TIME / DURATION** | : **2.00 PM – 5.00 PM (3 HOURS)** |
| **DATE** | : **27 JANUARY 2026** |

### INSTRUCTIONS TO CANDIDATES

1. Please **CAREFULLY** read 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)** questions **ONLY**.
5. Please write your answer on the answer booklet provided.
6. Answer all questions in English language only.
7. Formula is appended for your reference.

**THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS COVER PAGE.**

**SECTION A (Total: 60 marks)**

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

**Question 1**

With reference to the force vectors

Figure 1 shows a plate which subjected to the two forces at A and B. Given $\theta = 60°$.

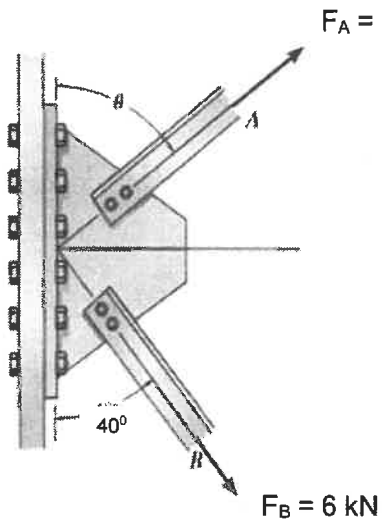



Figure 1:

i. Draw free body diagram.

(4 marks)

ii. Determine the magnitude of the resultant force, $F_R$ and its direction, $\theta$ measured clockwise from the horizontal.

(16 marks)

**Question 2**

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

a) Figure 2 shows supported beam with a pin support at A and a rocker support at B resting on a 30° inclined surface. A concentrated load of 4 kN acts downward on the beam, located 6 m from support A and 2 m from support B.

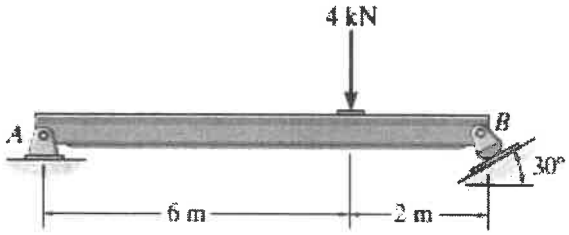



Figure 2: Pin support and rocker support.

i. Draw free body diagram

(4 marks)

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

(6 marks)

b) The device shown is used to straighten the frames of wrecked autos. Determine the tension of each segment of the chain, i.e., AB and BC, if the force which the hydraulic cylinder DB exerts on point B is 3.50 kN, as shown in Figure 3.

(10 marks)

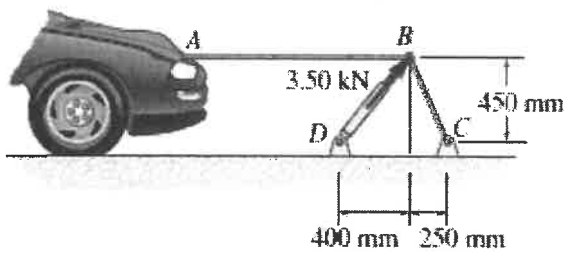



Figure 3: Tension distribution in chain segments AB and BC

**Question 3**

With reference to the force, acceleration & Newtons Law.

Figure 4 shows 50 kg crate initially at rest moves 5 m to the right and reaches a velocity of 4 m/s. The coefficient of kinetic friction between the crate and the ground is $\mu_k = 0.3$.

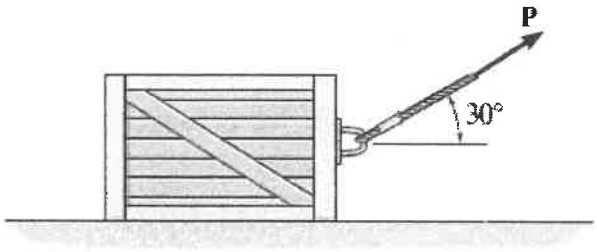



Figure 4: Dynamics of a crate subjected to an applied force, P

i. Draw free body diagram

(5 marks)

ii. Calculate acceleration of the crate.

(5 marks)

iii. Determine the magnitude of the applied force $P$.

(10 marks)

**SECTION B (Total: 40 marks)**

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

**Question 4**

With reference to the force vectors: Scalar Notation

The pin joint shown is subjected to two applied forces as indicated.

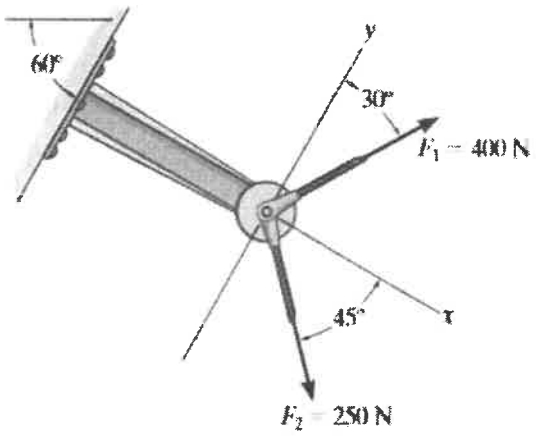



Figure 5: Concurrent force system acting on a pin joint

i. Calculate the x-component and y-component of all forces, $F_1$ and $F_2$.

(8 marks)

ii. Calculate the magnitude of the resultant force, $F_R$ and its direction measured counterclockwise from the positive x axis

(12 marks)

**Question 5**

With reference to the kinetics of a particle

a) A ball is released from rest from the top of a building and takes 3 s to reach the ground. Determine the height of the building and the velocity of the ball when it strikes the ground.

(10 marks)

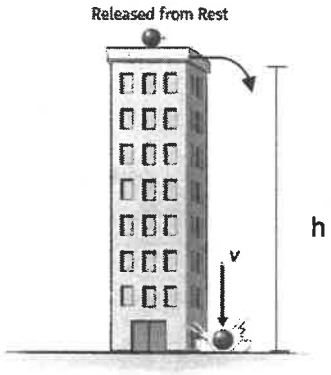



Figure 6: Free-fall motion of a ball released from a building

b) During a test a rocket travels upward at 75 m/s, and when it is 40 m from the ground its engine fails. Determine the maximum height $S_B$ reached by the rocket and its speed just before it hits the ground. Take the acceleration due to gravity as 9.81m/s².

(10 marks)

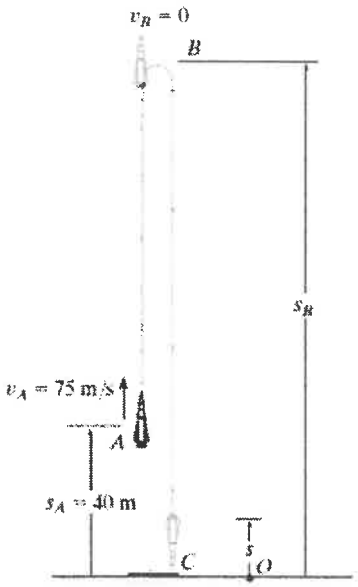



Figure 7: Upward and downward motion of a rocket under gravity

**Question 6**

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

a) Under a constant thrust of T = 40kN, the 1500 kg dragster reaches its maximum speed of in 8 s starting from rest. Determine the average drag resistance, $F_D$ during this period of time.

(5 marks)


Figure 8: Dragster

b) The three freight cars *A*, *B*, and *C* have masses of 10 Mg, 5 Mg, and 20 Mg, respectively. They are traveling along the track with the velocities shown. Car *A* collides with car *B* first, followed by car *C*. If the three cars couple together after collision, determine the common velocity of the cars after the two collisions have taken place.

(15 marks)

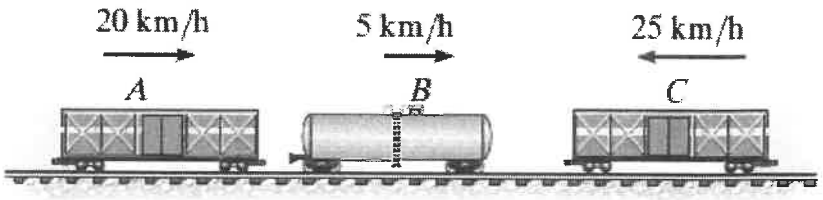



Figure 9: Train Cars A, B, and C moving with different velocities

**END OF EXAMINATION PAPER**

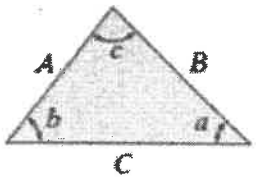
## APPENDIX

### 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:

$$\sum F = ma$$

Principles of Work and Energy:

$$T_1 + \Sigma U_{1-2} = T_2$$

Kinetic Energy

Particle:

$$T = \frac{1}{2} m v^2$$

*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* | $m(\mathbf{v}_G)_1 + \Sigma \int \mathbf{F}\,dt = m(\mathbf{v}_G)_2$ |

Conservation of Linear Momentum:

$$m_A(v_{A1}) + m_B(v_{B1}) = (m_A + m_B)\,v_2$$