



UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
MARCH 2025 SEMESTER SESSION

SUBJECT CODE : LGB24203

SUBJECT TITLE : DYNAMICS

PROGRAMME NAME : BACHELOR IN ENGINEERING TECHNOLOGY
(FOR MPU: PROGRAMME LEVEL) (OFFSHORE) WITH HONOURS

TIME / DURATION : 2.00 PM - 5.00 PM
(3 HOURS)

DATE : 23 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 in Section A.
4. Answer **ONLY FOUR (4)** questions in Section A.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Answer should be written in blue or black ink except for sketching, graphic and illustration.
8. Formulae table has been appended for your reference.

THERE ARE 9 PAGES OF QUESTIONS, INCLUDING THIS PAGE

SECTION A (Total: 100 marks)

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

Question 1

With reference to the kinetic of a particle.

- a) A sphere is fired downwards into a medium with an initial speed of 27 m/s. If it experiences a deceleration of $a = (-6t) \text{ m/s}^2$, where t is in seconds, calculate the distance traveled before it stops.

(10 marks)

- b) A bicyclist starts from rest and after traveling along a straight path a distance of 20 m reaches a speed of 30 km/h. Calculate his acceleration if it is constant. Also, how long does it take to reach the speed of 30 km/h?

(10 marks)

Question 2

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

Figure 1 shows a truck carries a 200 kg crate on a level surface with a static friction coefficient of $\mu = 0.3$.

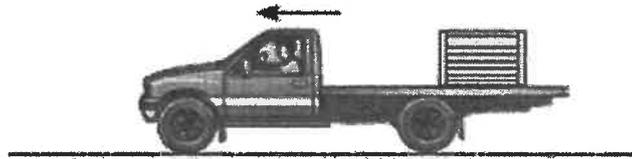


Figure 1: A truck carries a 200 kg crate.

- i. Draw and labeled free body diagram showing all the external force that act on the object
(5 marks)

- ii. Determine the shortest time for the truck to reach a speed of 60 km h, starting from rest with constant acceleration, so that the crate does not slip. Determine the velocity of the crate.
(15 marks)

Question 3

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

- a) Figure 2 shows two forces act on a 100 kg crate resting on a horizontal plane. Given that the crate starts from rest and the surface has a kinetic friction coefficient of $\mu_k = 0.2$

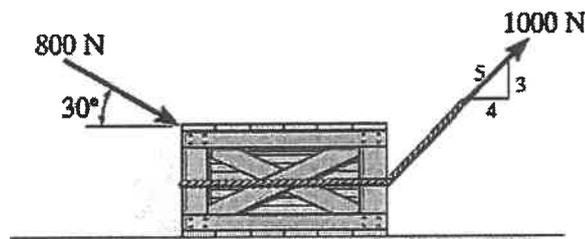


Figure 2: A crate is subjected to the action of the two forces.

- i. Draw and labeled free body diagram showing all the external force that act on the object (2marks)
- ii. Determine the distance it slides in order to attain a speed of 6m/s (8 marks)

- b) Figure 3 shows a motor lifts a 60 kg crate vertically at a steady speed of 2.50 m/s to a height of 5 meters in 2 seconds. Given that the motor's indicated power is 3.2 kW.

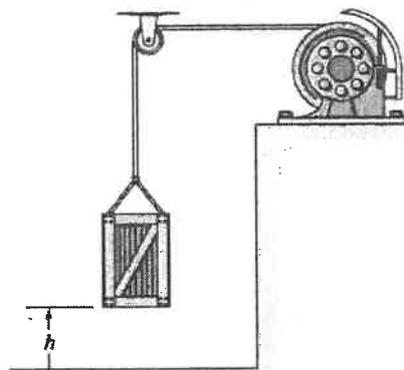


Figure 3: A crate is lifted using a motor.

- i. Draw and labeled free body diagram showing all the external force that act on the object (2marks)
- ii. Determine the power efficiency (8 marks)

Question 4

With reference to the kinetic of a particle: principle of impulse and momentum & conservation of linear momentum:

- a) Figure 4 shows the 50 000 kg tugboat accelerates uniformly from rest over 35 seconds. The propeller provides the propulsion force F which gives the tugboat forward motion, whereas the barge moves freely. The barge has a mass of 75 000 kg.

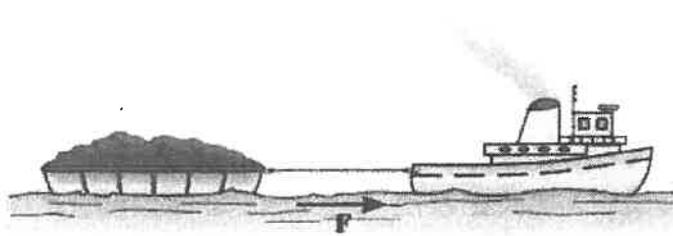


Figure 4: Propeller force acting on tugboat with attached barge

- i. Calculate the tension force of the rope, F_T on the barge. (5 marks)
 - ii. Determine F acting on the tugboat (5 marks)
- b) A 5 kg block as shown in Figure 5 is moving at 14 m/s when it is 6 meters away from a wall. Given the coefficient of kinetic friction between the block and the horizontal plane is $\mu_k = 0.3$. Determine the impulse of the wall on the block necessary to stop the block. Neglect the friction impulse acting on the block during the collision.

(10 marks)

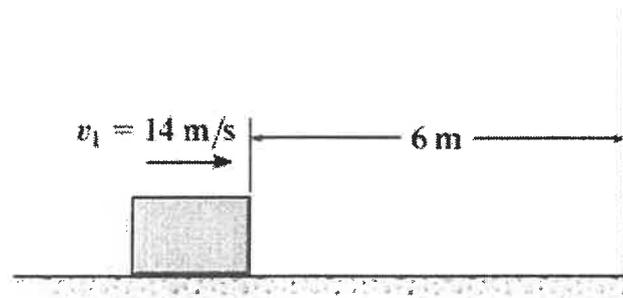


Figure 5: A block moves with a velocity of 14m/s

Question 5

With reference to power transmission by belts and gears

An open belt drive has two pulleys having diameters of 1.2 m and 0.5 m. The pulley shafts are parallel to each other with axes 4 m apart. The mass of the belt is 1 kg per meter in length. The tension is not allowed to exceed 2000 N. The larger pulley is the driving pulley, and it rotates at 200 rpm. The speed of the driven pulley is 450 rpm due to the belt slip. The coefficient of friction is 0.3.

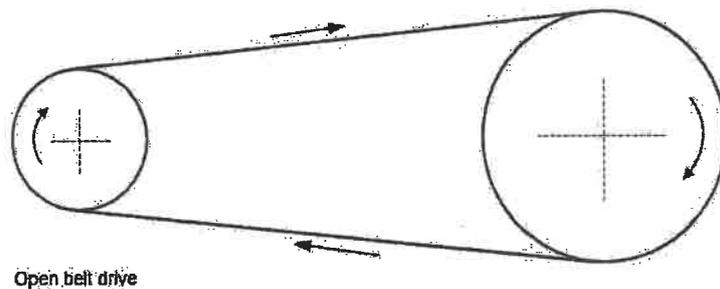


Figure 6: Open belt drive with driving pulley

Determine:

- i. power transmitted (8 marks)
- ii. power lost in friction (8 marks)
- iii. the efficiency of the drive. (4 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

Kinematics Particle Rectilinear Motion:	
<u>Variable a</u>	<u>Constant $a = a_c$</u>
$a = \frac{dv}{dt}$	$v = v_0 + a_c t$
$v = \frac{ds}{dt}$	$s = s_0 + v_0 t + \frac{1}{2} a_c t^2$
$a ds = v dv$	$v^2 = v_0^2 + 2a_c(s - s_0)$

Equations of motion: $\sum F = ma$	Principles of Work and Energy: $T_1 + \sum U_{1-2} = T_2$
Kinetic Energy Particle: $T = \frac{1}{2}mv^2$	Work Variable force $U_F = \int F \cos \theta ds$ Constant force $U_F = (F_c \cos \theta) \Delta s$ Work = Force x distance
Power and efficiency: $P = \frac{dU}{dt} = \mathbf{F} \cdot \mathbf{v}$ $\epsilon = \frac{P_{out}}{P_{in}} = \frac{U_{out}}{U_{in}}$ $\epsilon = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$	Conservation of Energy Theorem $T_1 + V_1 = T_2 + V_2$

Principles of Linear Impulse and Momentum:

<i>Particle</i>	$mv_1 + \Sigma \int \mathbf{F} dt = mv_2$
<i>Rigid Body</i>	$m(\mathbf{v}_G)_1 + \Sigma \int \mathbf{F} dt = m(\mathbf{v}_G)_2$

Conservation of Linear Momentum:

$$m_A(\mathbf{v}_{A1}) + m_B(\mathbf{v}_{B1}) = m_A(\mathbf{v}_{A2}) + m_B(\mathbf{v}_{B2})$$

Kinetics of a rigid body

$$T_1 + U_{1 \rightarrow 2} = T_2$$

T_1, T_2 = initial and final total kinetic energy of particles forming body

$U_{1 \rightarrow 2}$ = total work of internal and external forces acting on particles of body.

For spring,

$$(T_1) + \left(M\theta - \frac{1}{2}ks^2 \right) = (T_2)$$

$$T = \frac{1}{2} \bar{I} \omega^2$$

power transmission by belts and gears

$$\omega_1 = \frac{2\pi N_1}{60}$$

$$\text{Velocity of the belt } (V) = 20.93 \times \frac{1.2}{2}$$

$$\text{Centrifugal tension } (T_C) = m V^2$$

$$\text{Active tension on tight side } (T_1) = T_{\max} - T_C$$

$$\theta = 180 - 2\beta$$

$$\frac{T_1}{T_2} = e^{\mu \theta}$$

$$\text{Power transmitted } (P) = T_1 \left(1 - \frac{1}{2.43}\right) \times 12.56$$

$$(b) \quad \text{Power output} = T_1 \left(1 - \frac{1}{2.43}\right) \times \frac{\omega_2 d_2}{2} \text{ W}$$

$$\text{Efficiency of the drive} = \frac{\text{Power transmitted}}{\text{Power input}}$$