CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
FEBRUARY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LMB30703** / LMB22903
SUBJECT TITLE	:	**DYNAMICS**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**BACHELOR IN MARINE ENGINEERING TECHNOLOGY (BME)**
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 section A and B, answer all in question A and **THREE (3)** in section B.
4. Please write your answers on the answer booklet provided.
5. Answer **ALL** questions in English language **ONLY**.
6. Formula table has been appended for your reference.

THERE ARE 8 PAGES OF QUESTIONS, EXCLUDING THIS PAGE

SECTION A (Total: 40 marks)

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

Question 1

With reference to force and acceleration.

(a) If motor M 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)

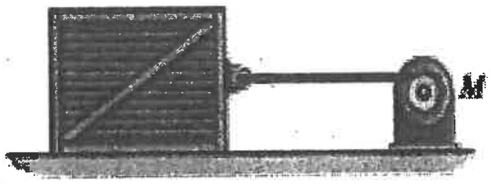

Figure 1

(b) The spring has a stiffness k = 200 N/m and is unstretched when the 25-kg block is at A. determine the acceleration of the block when s=0.4 m. the contact surface between the block and the plane is smooth.

(10 marks)

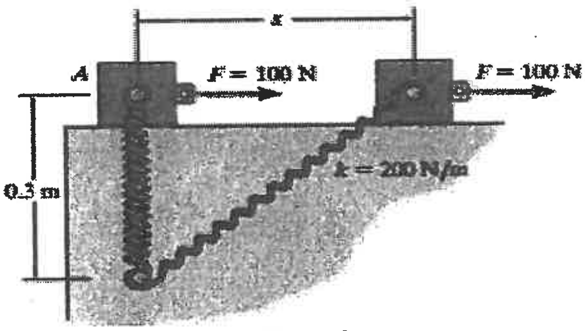

Figure 2

Question 2

With reference to work, power, and energy.

(a) If the motor exerts a constant force of 300 N on the cable, determine the speed of the 20-kg crate when it travels 2= 10 m up the plane, starting from rest. The coefficient of kinetic friction between the crate and the plane is $\mu_k = 0.3$

(10 marks)

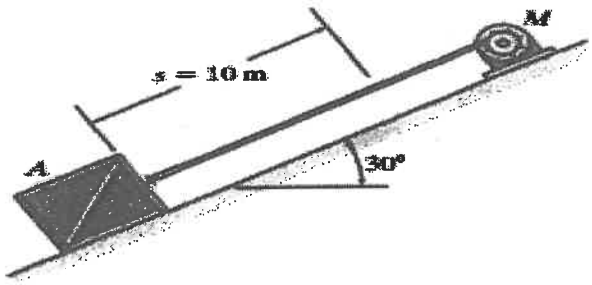

Figure 3

(b) The spring is placed between the wall and the 10-kg block. If the block is subjected to a force of F= 500 N, determine its velocity when s= 0.5 m. when s = 0, the block is at rest and the spring is uncompressed. The contact surface is smooth.

(10 marks)

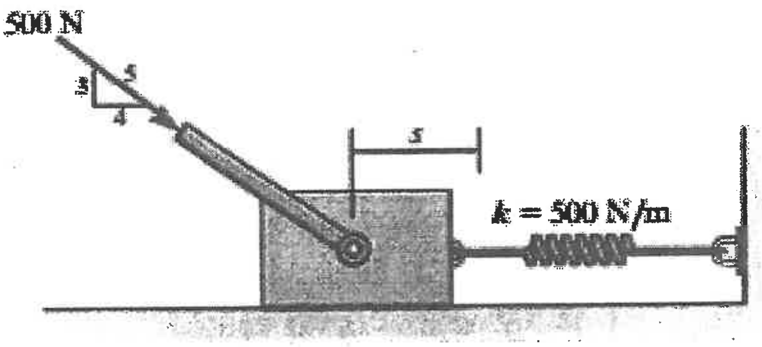

Figure 4

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.
Please use the answer booklet provided.

Question 3

With reference to power and efficiency.

An automobile having a mass of 2 Mg travels up a 7% slope at a constant speed of v = 100 km/h. if mechanical friction and wind resistance are neglected, determine the power developed by the engine if the automobile has an efficiency $\varepsilon = 0.65$.

(20 marks)

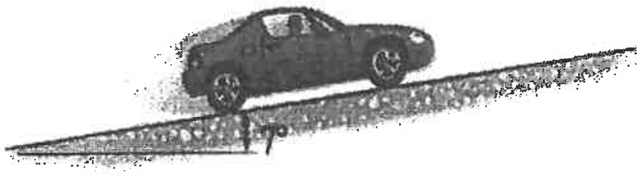

Figure 5

Question 4

With reference to impulse and momentum

The 0.5 kg ball strikes the rough ground and rebounds with the velocities shown. Determine the magnitude of the impulse and the ground exerts on the ball. Assume that the ball does not slip when it strikes the ground and neglect the size of the ball and the impulse produced by the weight of the ball.

(20 marks)

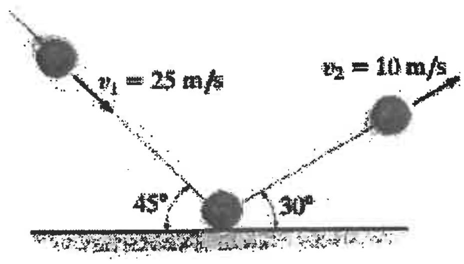

Figure 6

Question 5

With reference to conservation of linear momentum.

The spring is fixed to block A and block B is pressed against the spring. If the spring is compressed s = 200 mm and then the blocks are released, determine their velocity at the instant block B loses contact with the spring. The masses of blocks A and B are 10 kg and 15 kg, respectively.

(20 marks)

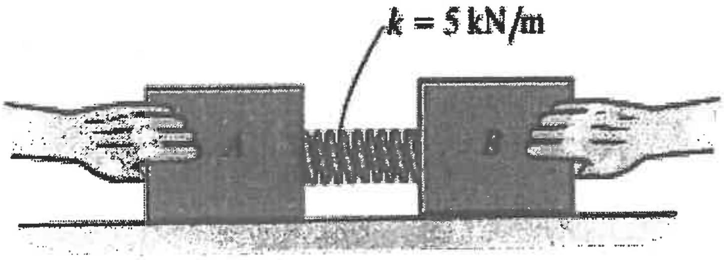

Figure 7

Question 6

With reference to kinematics of rigid body.

(a) When the gear rotates 20 revolutions, it achieves an angular velocity of $\omega = 30$ rad/s, starting from rest. Determine its constant angular acceleration and the time required.

(10 marks)

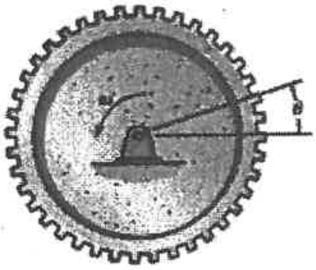

Figure 8

(b) The bucket is hoisted by the rope that wraps around a drum wheel. If the angular displacement of the wheel is $\Theta = (0.5t^3 + 15t)$ rad, where t is in seconds, determine the velocity and acceleration of the bucket when $t = 3$ s.

(10 marks)

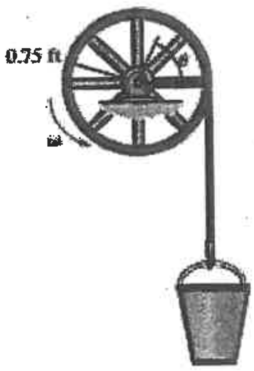

Figure 9

END OF QUESTION

List of formula

$T_1 + \Sigma U_{1-2} = T_2$
$a_t = \dot{v} \quad a_t\,ds = v\,dv$ • If a_t is constant, $a_t = (a_t)_c$, the above equations, when integrated, yield $s = s_0 + v_0 t + \frac{1}{2}(a_t)_c t^2$ $v = v_0 + (a_t)_c t$ $v^2 = v_0^2 + 2(a_t)_c(s - s_0)$ Normal Acceleration. • The normal component of acceleration is the result of the time rate of change in the *direction* of the velocity. This component is *always* directed toward the center of curvature of the path, i.e., along the positive *n* axis. • The magnitude of this component is determined from $a_n = \frac{v^2}{\rho}$ • If the path is expressed as $y = f(x)$, the radius of curvature ρ at any point on the path is determined from the equation $\rho = \frac{[1 + (dy/dx)^2]^{3/2}}{\lvert d^2y/dx^2 \rvert}$ The derivation of this result is given in any standard calculus text.
$m(v_x)_1 + \Sigma \int_{t_1}^{t_2} F_x\,dt = m(v_x)_2$ $m(v_y)_1 + \Sigma \int_{t_1}^{t_2} F_y\,dt = m(v_y)_2$ $m(v_z)_1 + \Sigma \int_{t_1}^{t_2} F_z\,dt = m(v_z)_2$
$\omega = \frac{d\theta}{dt} \quad \alpha = \frac{d\omega}{dt} \quad \alpha\,d\theta = \omega\,d\omega$ • If the body's angular acceleration is *constant*, then the following equations can be used: $\omega = \omega_0 + \alpha_c t$ $\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha_c t^2$ $\omega^2 = \omega_0^2 + 2\alpha_c(\theta - \theta_0)$ • Once the solution is obtained, the sense of θ, ω, and α is determined from the algebraic signs of their numerical quantities. Motion of Point *P*. • In most cases the velocity of *P* and its two components of acceleration can be determined from the scalar equations $v = \omega r$ $a_t = \alpha r$ $a_n = \omega^2 r$
Kinetic energy $T_2 = \frac{1}{2} I_O \omega_2^2$

Principle of Work and Energy. $\{T_1\} + \{\Sigma U_{1-2}\} = \{T_2\}$ $\{T_1\} + \left\{M\theta - \frac{1}{2}ks^2\right\} = \{T_2\}$
$I_y = \int F_y \, dt$ impulse
$P = \mathbf{F} \cdot \mathbf{v}$ Power $\text{power input} = \frac{\text{power output}}{\varepsilon}$ $(\overset{+}{\rightarrow}) \quad m_A(v_A)_1 + m_B(v_B)_1 = m_A(v_A)_2 + m_B(v_B)_2$ Conservation of momentum