UNIVERSITI KUALA LUMPUR
KAMPUS CAWANGAN MALAYSIAN SPANISH INSTITUTE

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	SCB12103 (V2)
COURSE TITLE	:	ENGINEERING MECHANICS
PROGRAMME NAME	:	BACHELOR OF ENGINEERING TECHNOLOGY (HONS) IN MECHANICAL (AUTOMOTIVE)
DATE	:	29 JANUARY 2026
TIME	:	9:00AM - 12:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☑ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

Question 1

Consider a mechanical system consisting of a rigid rod AB, supported at one end by a roller A and at the other end by a smooth collar B. The collar is fixed to the rod AB but is permitted to move freely along another rod CD. The system is subjected to external forces and moments. For this mechanical structure, determine the support reactions at roller A and the smooth collar B. Assume the rod AB to be of negligible mass, and consider the sliding motion of the collar along rod CD. Please provide a detailed analysis, considering the equilibrium of forces and moments, and include any relevant assumptions or considerations necessary for solving the problem.

Refer Below - Figure1 : A Mechanical System with smooth collar B .

(20 marks)

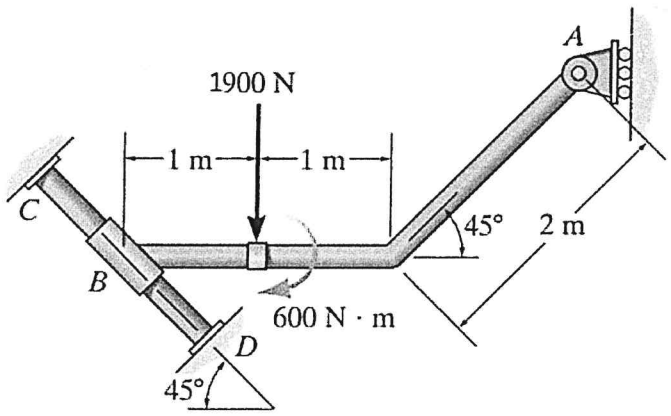

Figure 1: A Mechanical System with smooth collar B

Question 2

Determine the force in each member of the truss F_{CB}, F_{CD}, F_{DB} and F_{DA}. State if the members are in tension or compression. Set external force P1 = 20 kN and P2 = 10 kN. Sketch a Free Body Diagram at Joint C and Joint D only, with label all known and unknown forces for each member of truss. Finally, sketch a complete Internal Force FBD for this truss.
Refer Below - Figure2 : A Simple Truss .

(20 marks)

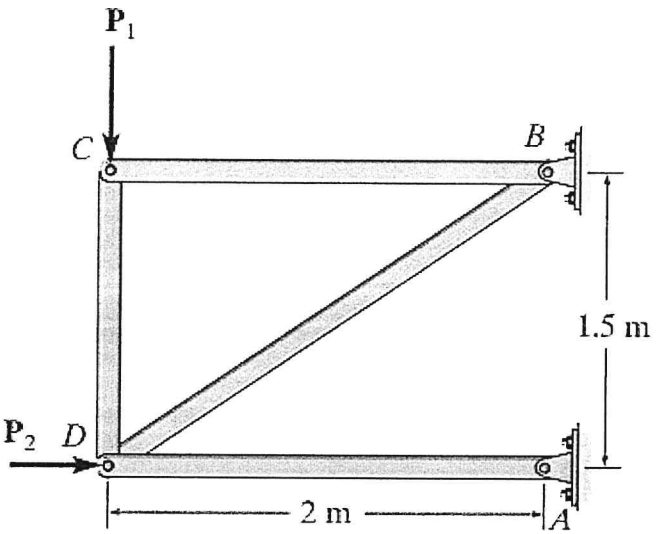

Figure 2: A Simple Truss

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Calculate the velocity, v_A of cylinder A given that the rope is being reeled in toward the motor M at a consistent velocity rate, v_M = 10 m/s. Write the equation showing how you derive the relationship between the total length, L of the rope and the velocity of cylinder A. Provide a clear Free Body Diagram (FBD) illustrating the lengths of rope segments S_A and S_M in your diagram.

Refer Below - Figure3 : Cylinder A being reeled by Motor M .

(20 marks)

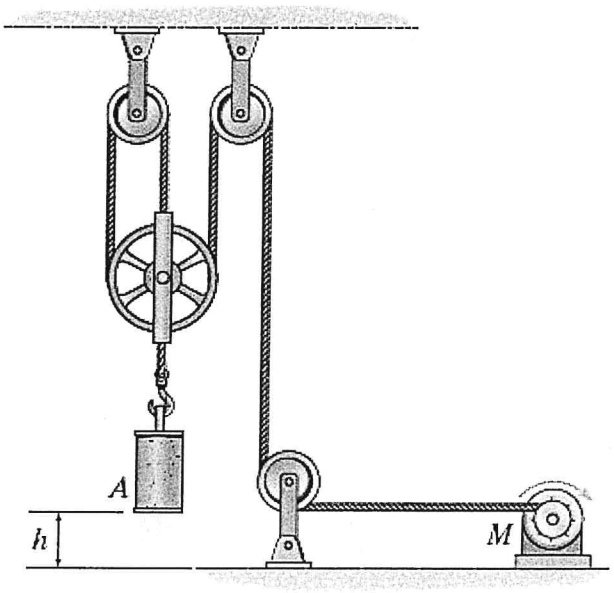

Figure 3: Cylinder A being reeled by Motor M

Question 2

A 50-kg crate is initially at rest and is subjected to a horizontal force P, as it moves over a flat surface. The crate travels a distance of 5 meters to the right, reaching a final velocity of 4 m/s. The coefficient of kinetic friction between the crate and the surface is μk=0.3. Determine the the acceleration of the crate by using Kinematics equation and magnitude of the horizontal force P, acting on the crate. Assume that the only forces acting on the crate are the applied force P, the frictional force, and the weight of the crate. You need to draw a Free Body Diagram (FBD) of all forces acting on the crate.

Refer Below - Figure4 : 50kg Crate .

(20 marks)

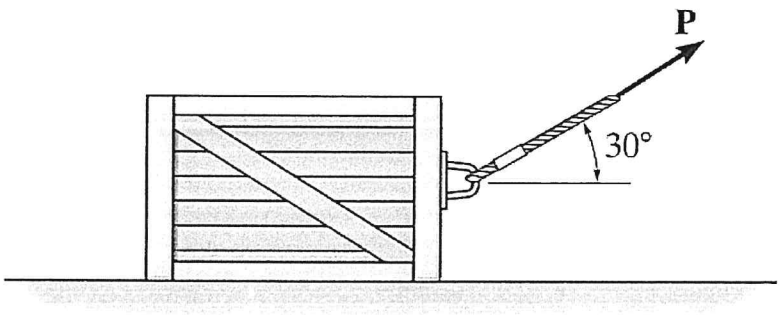

Figure 4: 50kg Crate

Question 3

A motor hoists a 60 kg crate at a constant velocity to a height h = 5 m in 2 seconds. If the indicated power (power input) of the motor is 3.2 kW, determine the motor's efficiency. Analyze whether the system is efficient or not. You may start by calculate the velocity of the crate and then draw a Free Body Diagram (FBD) of the crate. [Hint: Power = Force x Velocity and Effciency = Power Output / Power Input]

Refer Below - Figure5 : A 60kg Crate hoisted by Motor .

(20 marks)

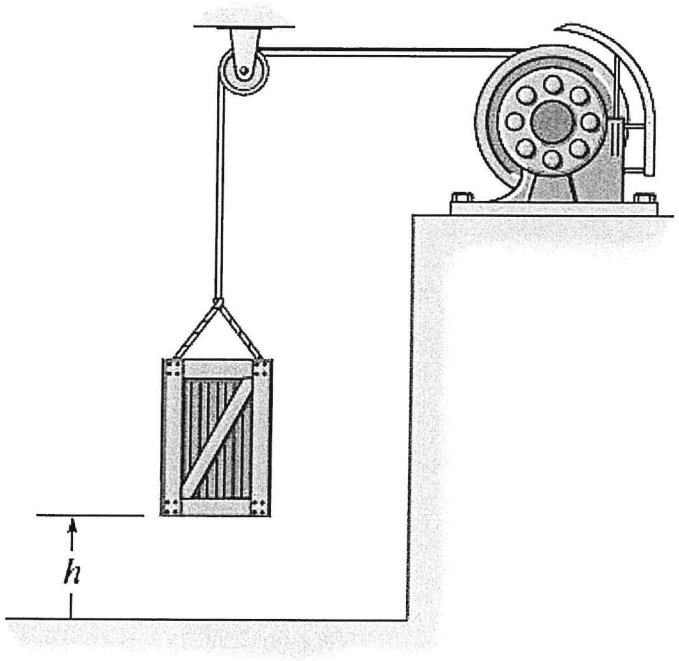

Figure 5: A 60kg Crate hoisted by Motor

Question 4

An automobile has a mass of 2 Mg and its center of mass is located at point G. The front and rear brakes of the vehicle are locked, preventing any motion between the tires and the road surface. The coefficient of static friction, μs between the tires and the road is 0.3. Determine the towing force F required to move the vehicle under these conditions.

Refer Below - Figure6 : 2Mg Car .

(20 marks)

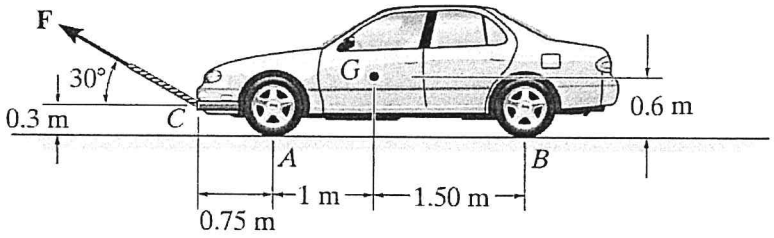

Figure 6: 2Mg Car

END OF EXAMINATION PAPER

APPENDIX

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

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

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

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$$

$$\cos\alpha = \frac{A_x}{A} \qquad \cos\beta = \frac{A_y}{A} \qquad \cos\gamma = \frac{A_z}{A}$$

$$F = \sqrt{F_x^2 + F_y^2 + F_z^2}$$

$$\vec{M}_O = \vec{r}X\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

$$F_s = \mu_s N$$

$$\phi_s = \tan^{-1}\left(\frac{F_s}{N}\right) = \tan^{-1}\left(\frac{\mu_s N}{N}\right) = \tan^{-1}\mu_s$$

$$\sum F_x = ma_x$$
$$\sum F_y = ma_y$$
$$\sum F_z = ma_z$$

$$\vec{v}_B = \vec{v}_A + \vec{v}_{B/A}$$
$$\vec{a}_B = \vec{a}_A + \vec{a}_{B/A}$$

$$v = v_0 + a_c t$$
$$s = s_0 + v_0 t + \frac{1}{2}a_c t^2$$
$$v^2 = v_0^2 + 2a_c(s - s_0)$$
$$vdv = ads$$

$$v = v_0 + a_c t; \qquad v_x = (v_0)_x$$
$$x = x_0 + v_0 t + \frac{1}{2}a_c t^2; \qquad x = x_0 + (v_0)_x t$$
$$v^2 = v_0^2 + 2a_c(s - s_0); \qquad v_x = (v_0)_x$$

$$v = v_0 + a_c t; \qquad v_y = (v_0)_y - gt$$
$$y = y_0 + v_0 t + \frac{1}{2}a_c t^2; \qquad y = y_0 + (v_0)_y t - \frac{1}{2}gt^2$$
$$v^2 = v_0^2 + 2a_c(y - y_0); \qquad v_x = (v_0)_y^2 - 2g(y - y_0)$$

$$\sum F_t = ma_t$$
$$\sum F_n = ma_n$$
$$\sum F_b = 0$$

$$a = \sqrt{a_t^2 + a_n^2} \qquad a_n = \frac{v^2}{\rho}$$

$$\omega = \frac{d\theta}{dt} \qquad \alpha = \frac{d\omega}{dt} \qquad \alpha = \frac{d^2\theta}{dt^2}$$

$$\omega = \omega_0 + \alpha_c t$$
$$\theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha_c t^2$$
$$\omega^2 = \omega_0^2 + 2\alpha_c(\theta - \theta_0)$$
$$\alpha d\theta = \omega d\omega$$

$$a = \sqrt{a_t^2 + a_n^2}$$

$$v = r\omega \qquad a_t = \alpha r \qquad a_n = \omega^2 r$$