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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	PHYSICS MECHANICS
COURSE CODE	:	DAU 10103
PROGRAMME CODE	:	DAU
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	2 HOURS AND 30 MINUTES
INSTRUCTIONS	:	1. **PART A**: ANSWER ALL QUESTIONS. **PART B:** ANSWER **TWO (2)** QUESTIONS ONLY. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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PART A

Q1 (a) A stationary object of mass 3500 g is pulled upwards by a constant force of magnitude 50 N. The object has moved upwards through 5 m. Calculate:

(i) the total force acting on the object.

(3 marks)

(ii) the total work acting on the object.

(2 marks)

(iii) the velocity of the object.

(3 marks)

(b) A box is pulled across the horizontal surface at constant velocity with an applied force of 150 N at an angle of 30° above the horizontal as illustrated in **Figure Q1(b)**. Given the mass of the box is 10 kg, the coefficient of kinetic friction between the box and the surface is 0.25 and the distance that the box being pulled is 2.5 m.

(i) Sketch the free body diagram of the system.

(4 marks)

(ii) Calculate the total work acting on the box.

(10 marks)

(c) Refer to **Figure Q1(c)** - A 200 kg steel ball 55 m above the bottom of a dip starting to roll from rest at a point A. If track AB has a smooth surface, calculate the speed of the ball at point B located at the ground level.

(3 marks)

Q2 A spring is mounted horizontally on an air track with the left end held stationary. Rosie attaches a spring balanced to the free end of the spring as shown in **Figure Q2(a)**, and then pull towards the right side, and measure the elongation of the spring. She determines that the stretching force is proportionally to the displacement and that a force of 6.0 N causes an elongation of 0.035 m. Rosie's then removes the spring balance and attach a 0.80-kg object and pull the spring to a distance of 0.040 m before releasing it and leave the spring to oscillates in simple harmonic motion as shown in **Figure Q2(b)**.

(i) Define simple harmonic motion (SHM) and give **one (1)** example of SHM system.

(3 marks)

(ii) Calculate the spring constant (k), amplitude (A), frequency (f), and angular velocity (ω)

(8 marks)

(iii) Calculate the maximum velocity, v_{max}

(3 marks)

(iv) Calculate the maximum acceleration, a_{max}

(3 marks)

(v) Calculate the velocity and acceleration when the object has moved halfway to the center from its initial position.

(8 marks)

PART B

Q3 (a) **Figure Q3(a)** shows the displacement-time graph for the linear motion of a bike from point A to point F.

(i) From the graph, analyze qualitatively the motion of the bike from point A to point F.

(10 marks)

(ii) Draw a graph of velocity-time to represent the analysis made in **Q3(a)(i)**.

(5 marks)

(b) A pitcher tosses a baseball up along a vertical axis, with an initial speed of 15 ms^{-1}. Calculate:

(i) the time taken for the ball to reach its maximum height.

(4 marks)

(ii) the maximum height that the ball can reach from the release point.

(4 marks)

(iii) the time of flight of the ball.

(2 marks)

Q4 (a) An object is launched at a velocity of 20 ms^{-1} in a direction making an angle of 25° upward with the horizontal. Calculate:

(i) the time taken of the object to reach the maximum height.

(6 marks)

(ii) the maximum height reached by the object.

(4 marks)

(iii) the total flight time of the object.

(2 marks)

(iv) the horizontal range of the object.

(5 marks)

(v) the magnitude of the velocity of the object just before it hits the ground.

(5 marks)

(b) Define the term projectile motion and give **one (1)** example of projectile motion.

(3 marks)

Q5 (a) A wooden disc is thrown horizontally at 850 rpm. It turns 1350 revolutions in a straight line before it comes to stop.

(i) Calculate the angular acceleration of the wooden disc. State the final answer in rads^{-2} unit.

(6 marks)

(ii) If the radius of the disc is 6 cm, calculate the total acceleration of the wooden disc.

(6 marks)

(b) A 90 cm radius roulette wheel is initially turning at 3 revs^{-1} then slows down uniformly before it is finally stop after turning 26 revolutions. Calculate:

(i) the initial angular velocity and the angular displacement in its SI unit.

(4 marks)

(ii) the time taken for the wheel to stop.

(3 marks)

(iii) the angular acceleration and the tangential acceleration of the wheel.

(6 marks)

-END OF QUESTIONS –

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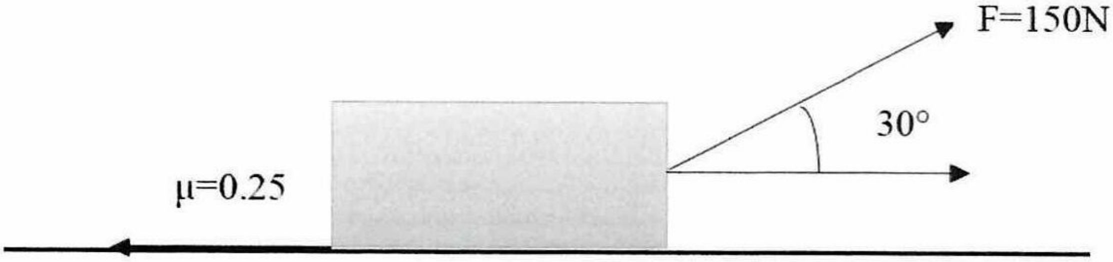

Figure Q1(b)

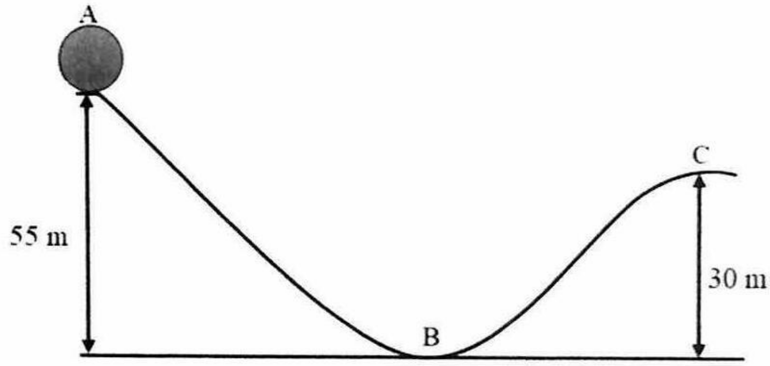

Figure Q1(c)

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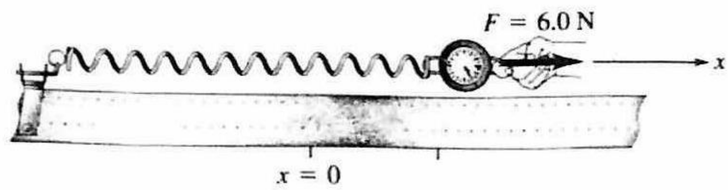

Figure Q2(a)

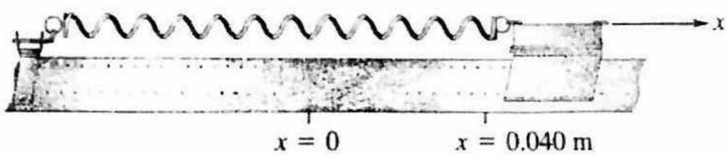

Figure Q2(b)

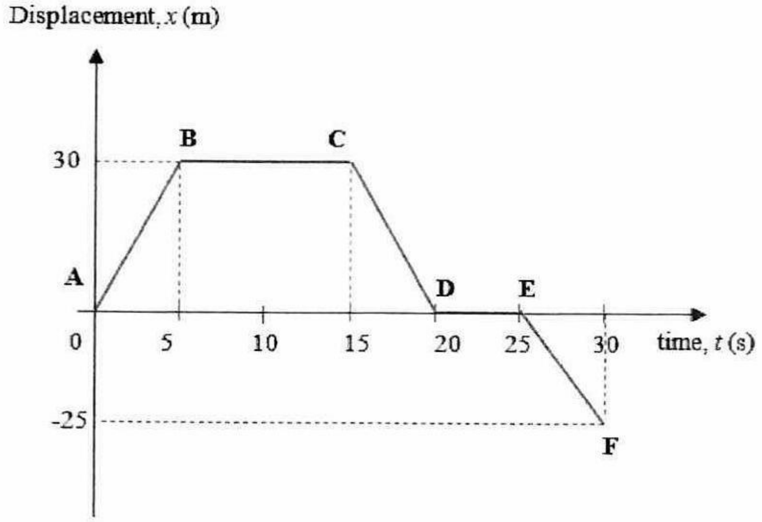

Figure Q3(a)

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LIST OF FORMULAE

Gravity acceleration, $g = 9.81\ m/s^2$	$V_{sphere} = 4/3\ \pi\ r^3$	$\vec{p} = m\vec{v}$
$W = F \cdot s = Fs \cos\theta$	$E_u = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2 x^2$	$s = r\theta$
$K = \frac{1}{2}mv^2$	$E_J = E_k + E_u = \frac{1}{2}m\omega^2 A^2$	$v = r\omega$
$U = mgh$	$R = \sqrt{R_x^2 + R_y^2}$	$a = r\alpha$
$\Delta K = -\Delta U$	$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$	$\omega = \frac{d\theta}{dt}$
$W_n = \Delta K$	$v = u + at$	$\alpha = \frac{d\omega}{dt}$
$\frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = -(mgh_2 - mgh_1)$	$s = ut + \frac{1}{2}at^2$	$a_c = \frac{v^2}{r} = \omega^2 r$
$a = -\omega^2 \cdot x$	$v^2 = u^2 + 2as$	$a = r\sqrt{\omega^4 + \alpha^2}$
$f = \frac{1}{T} = \frac{\omega}{2\pi}$	$\sum F = ma$	$\omega = \omega_o + \alpha t$
$v = \omega\sqrt{A^2 - x^2}$	$W = mg$	$\theta = \omega_o t + \frac{1}{2}\alpha \cdot t^2$
$E_k = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$	$f_k = \mu_k \cdot N;\ f_s = \mu_s \cdot N$	$\omega^2 = \omega_o^2 + 2\alpha \cdot \Delta\theta$