Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	MECHANICS PHYSICS
COURSE CODE	:	BWC 10103
PROGRAMME CODE	:	BWC
EXAMINATION DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) A solid piece of lead has a mass of 23.39 g and a volume of 2.10 cm^3. Calculate the density of lead in SI units.

(4 marks)

(b) A position-time graph for a particle moving along x-axis is shown in **Figure Q1(b)**. Calculate,

(i) the average velocity in the time interval $t = 1.5$ s to $t = 4.0$ s;
(ii) the instantaneous velocity at $t = 3.5$ s;
(iii) the value of t when the velocity is zero.

(9 marks)

(c) A World War II bomber flies horizontally over level territory with a speed of 275 m/s relative to the ground at an altitude of 3.00 km. **Figure Q1 (c)** shows the bombardier releases one bomb.

(i) Calculate the distance of the bomb travel horizontally between its release and its impact on the ground? Ignore the effects of air resistance.
(ii) Calculate the angle from the vertical at the moment of the bomb's release.
(iii) The pilot maintains the plane's original course, altitude, and speed. Suggest the location of plane when the bomb hits the ground.

(12 marks)

Q2 (a) A car runs out of gas while driving down a hill. It rolls through the valley and starts up the other side. The car is moving to the right, and drag and rolling friction are negligible. Choose from **(a)** to **(f)** in **Figure Q2 (a)**, the free-body diagram at the bottom of the valley.

(3 marks)

(b) A 10 000 N shark is supported by a rope attached to a 4.00 m rod that can pivot at the base that shown in **Figure Q2 (b)**. Ignore the weight of the rod. Calculate,

(i) the tension in the cable between the rod and the wall, assuming that the cable is holding the system in the position;
(ii) the horizontal force;
(iii) the vertical force exerted on the base of the rod.

(9 marks)

(c) **Figure Q2 (c)** shows a rider on a Ferris wheel moves in a vertical circle of radius, $r = 12$ m at constant speed, v. The mass of the rider is 75 kg and the time taken to makes one rotation is 15 s.

(i) Calculate the speed, v of the Ferris wheel.

(1 mark)

(ii) Sketch free body diagram and calculate the normal force exerted on the rider at the top of the circle.

(4 marks)

(iii) Sketch free body diagram and calculate the normal force exerted on the rider at the bottom of the circle.

(4 marks)

(iv) Sketch free body diagram and calculate the normal force exerted on the rider at point B.

(4 marks)

Q3 (a) Define briefly the simple harmonic motion system.

(6 marks)

(b) A 200 g block connected to a light spring for which the force constant id 5 N/m is free oscillate on a frictionless horizontal surface which is shown in **Figure Q3 (b)**. The block is displaced 5 cm from equilibrium and released from rest. Calculate,

(i) period of its motion;
(ii) maximum speed of the block;
(iii) maximum acceleration of the block.

(6 marks)

(c) A mass oscillating starts at x = A and has period T. Estimate the time when the objects first pass through x = ½ A.

(8 marks)

(d) On the opening day of the London Millennium Bridge over the River Thames in London, pedestrians noticed a swinging motion of the bridge. Therefore, the bridge was closed for two years. Recommend the solution to solve that problem.

(5 marks)

Q4 (a) Discuss the Kepler's laws.

(2 marks)

(b) Determine **FIVE (5)** examples that used principle of Newton's law of universal gravitation.

(5 marks)

(c) In physics laboratory, a typical Cavendish balance for measuring the gravitational constant, G uses lead spheres with masses of 1.5 kg and 15.0 g whose centers are separated by about 4.5 cm. Calculate the gravitational force between these spheres, treating each as a particle located at the sphere's center. [Given gravitational constant, G is 6.67×10^{-11} Nm^2kg^{-1}]

(6 marks)

(d) After our Sun exhausts its nuclear fuel, its ultimate fate will be to collapse to a star state. In this state, it would have approximately the same mass as it has now, but its radius would be equal to the radius of the Earth. Calculate;

(i) the average density of the star.
(ii) the surface free-fall acceleration.
(iii) the gravitational potential energy associated with a 1.0 kg object at the surface of the star.

(12 marks)

– END OF QUESTIONS –

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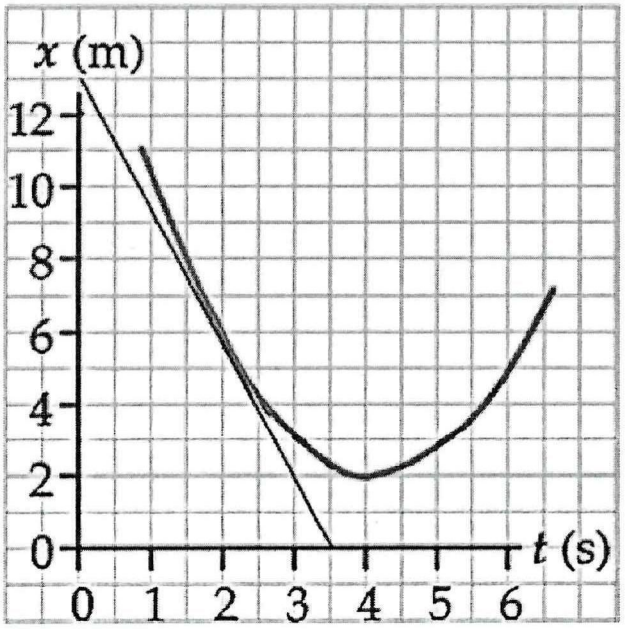

Figure Q1 (b)

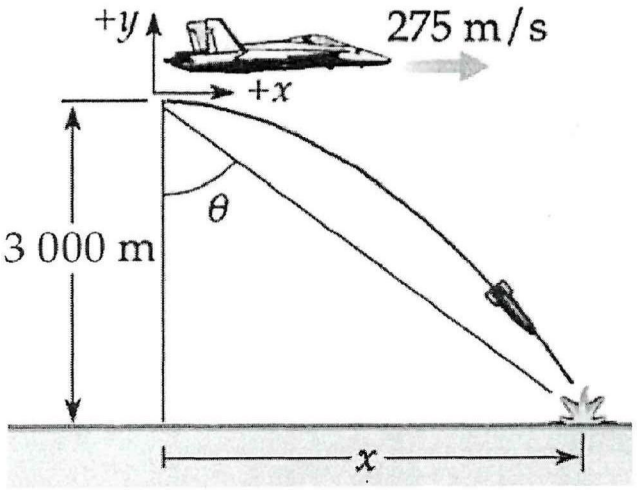

Figure Q1 (c)

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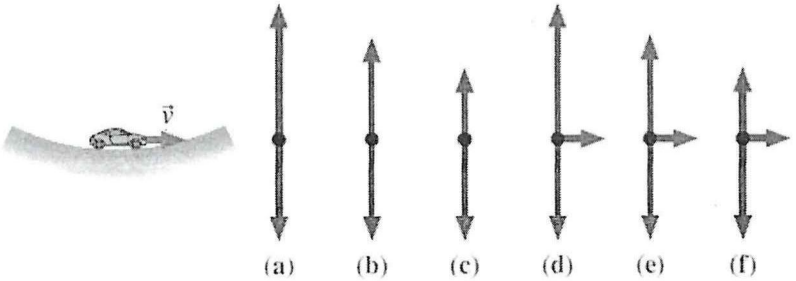

Figure Q2 (a)

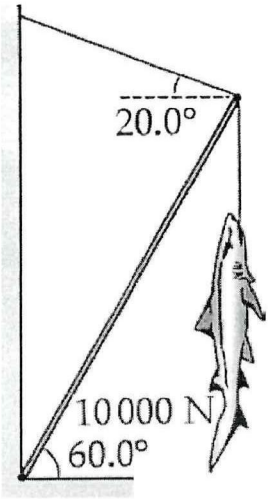

Figure Q2 (b)

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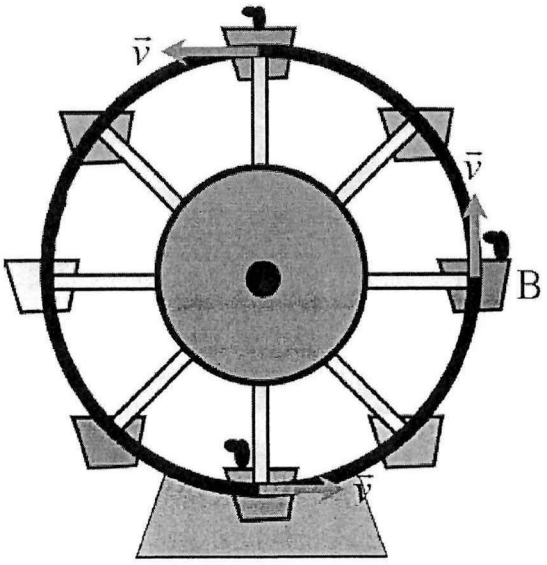

Figure Q2 (c)

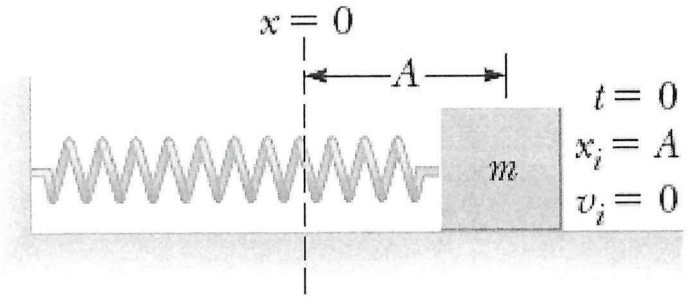

Figure Q3 (b)

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FORMULAE

$F = -G\frac{m_1 m_2}{R^2}$	$\omega = 2\pi f \;\; \omega = \sqrt{\frac{k}{m}}$	$v = \omega A$ $a = \omega^2 A$	$A \cdot B = AB\cos\theta_{AB}$
$A \times B = AB\sin\theta_{AB}$	$F = ma$	$F = -kx$	$F = -kx - bv = ma$
$\frac{d}{dx}(\sin x) = \cos(x)$	$x(t) = A\cos(\omega t)$	$x(t) = x_o \cos\left(\sqrt{\frac{k}{m}}t\right)$	$\rho = \frac{m}{v}$
$\frac{d}{dx}(\cos x) = -\sin(x)$	$V = \frac{4}{3}\pi R^3$	$x = x_o + v_{o_x}t + \frac{1}{2}a_x t^2$	$U = \frac{-Gm_1 m_2}{R}$
$a = \frac{v^2}{r}$	$v = \frac{2\pi r}{T}$	$I_{sphere} = \frac{2}{5}MR^2$	$I_{rod} = \frac{1}{3}ML^2$
$x = \rho\cdot\sin(\varphi)\cdot\cos(\theta) \quad y = \rho\cdot\sin(\varphi)\cdot\sin(\theta)$ $z = \rho\cdot\cos(\varphi)$ $\rho^2 = x^2 + y^2 + z^2 \qquad \tan\left(\theta = \frac{y}{x}\right)$ $\cos(\varphi) = \frac{z}{\sqrt{x^2 + y^2 + z^2}} = \frac{z}{\rho}$		$\nabla f(x,y) = \frac{\partial f}{\partial x}i + \frac{\partial f}{\partial y}j + \frac{\partial f}{\partial z}k$ $\hat{n} = \frac{A}{\lvert A\rvert}$ $C_L = (\alpha_{fc} + \alpha_j)L + \alpha_{cr}$	