Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	PHYSICS
COURSE CODE	:	BWD 10902
PROGRAMME CODE	:	BWD
EXAMINATION DATE	:	DECEMBER 2019 / JANUARY 2020
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 (a) Mimi walks from Point P to Point Q as shown in **Figure Q1(a)**. The curved part of her path is a semicircle.

(i) What is the magnitude of her displacement from point P to point Q?

(4 marks)

(ii) What is the total distance that Mimi travelled?

(3 marks)

(b) The displacement s of an object is given by the equation $s = At^2 - Bt$, where t refers to time.

(i) What are the dimensions of constants A and B?

(6 marks)

(ii) What are the SI units for the constants A and B?

(2 marks)

(c) A person standing on the edge of a cliff throws a stone straight up with an initial velocity of 13.0 m s^{-1}. The stone misses the edge of the cliff as it falls back to earth.

(i) Calculate the position of the stone for time 1.00 s, and 3.00 s after it is thrown.

(5 marks)

(i) Sketch the vertical position versus time and velocity versus time for the stone from the moment it leaves the person's hand until it falls back to earth.

(5 marks)

Q2 (a) Define centripetal acceleration and centripetal force.

(4 marks)

(b) Calculate the angular velocity of a 0.3 m radius tyre when the car travels at 15.0 m s^{-1} as shown in **Figure Q2 (b)**

(3 marks)

(c) A car with mass 900 kg moves at curve of road with radius 500 m at speed of 25 m s^{-1} as shown in **Figure Q2 (c).**

(i) Draw a free body diagram of forces acting on the car.

(4 marks)

(ii) Calculate the magnitude of the centripetal acceleration of a car following a curve of the road.

(4 marks)

(iii) Calculate the centripetal force exerted by the car.

(4 marks)

(iv) Find the minimum coefficient of static friction between the tyres and the road. (6 marks)

Q3 (a) A horizontal force of 160 N is needed to pull a 50.0 kg box across the horizontal floor at constant speed.

(i) What is the normal force on the box? (3 marks)

(ii) What is the coefficient of kinetic friction between the floor and the box? (2 marks)

(b) A box of mass m is placed on a smooth incline that makes an angle θ with the horizontal, as shown in **Figure Q3(b)**

(i) Determine an equation for a normal force on the box. (3 marks)

(ii) Determine an equation for acceleration of the box. (3 marks)

(iii) Evaluate **Q3b(i)** and **Q3b(ii)** for a mass $m = 10$ kg and an incline of $\theta = 30°$. (4 marks)

(c) Two blocks with mass $m_1 = 15$ kg and $m_2 = 12$ kg are connected by a light string on a smooth pulley as illustrated in **Figure Q3(c)**. The system is released and the block m_2 is falling down and pulling block m_1 to the right. The frictional force acting on the block m_1 is 20 N.

(i) Draw a free-body diagram (FBD) for the forces acting on this system. (4 marks)

(ii) Calculate the acceleration, a of the system. (3 marks)

(iii) Calculate the tension, T on the string. (3 marks)

Q4 (a) A ball with mass 2.0 kg moves with a speed of 4.0 m s^{-1}, hits a wall in the $+x$ direction. It then bounces backward with the same speed in the $-x$ direction.

(i) Define the law of conservation of linear momentum.

(1 mark)

(ii) What is the momentum of the ball before and after the collision?

(3 marks)

(iii) What is the change in momentum of the ball after the collision?

(3 marks)

(b) (i) Differentiate between an elastic collision in one dimension with an inelastic collision.

(3 marks)

(ii) A 10,000 kg railroad car, A, travelling at a speed of 24.0 m s^{-1} strikes an identical car, B, at rest. If the cars lock together as a result of the collision, how much of the initial kinetic energy is transformed to thermal or other forms of energy?

(4 marks)

(c) Newton's law of universal gravitation is given by,

$$F = G\frac{m_1 m_2}{r^2}$$

where G is the gravitational constant, $G = 6.67 \times 10^{-11}$ N.m^2/kg^2

(i) What Newton had concluded from the equation above?

(2 marks)

(ii) What is the force of gravity acting on a 2000 kg spacecraft when it orbits two Earth radii from the Earth's center (that is, a distance $r_E = 6380$ km above the Earth's surface)? The mass of the Earth is $m_E = 5.98 \times 10^{24}$ kg.

(6 marks)

(d) You are an astronaut in the space shuttle pursuing a satellite in need of repair. You find yourself in a circular orbit of the same radius as the satellite, but 30 km behind it. How will you catch up with it?

(3 marks)

– **END OF QUESTIONS** –

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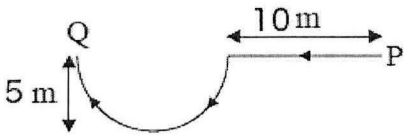

Figure Q1(a)

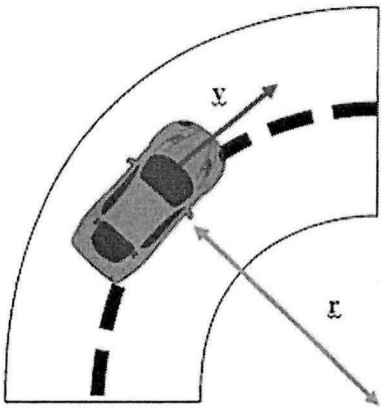

Figure Q2(b)

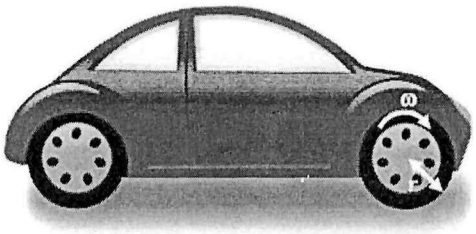

Figure Q2(c)

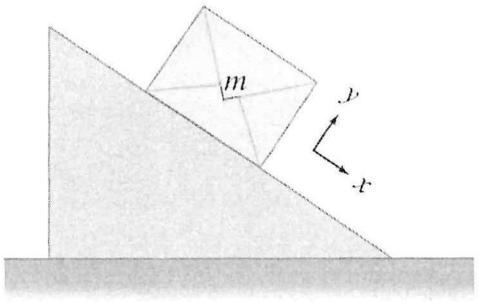

Figure Q3(b)

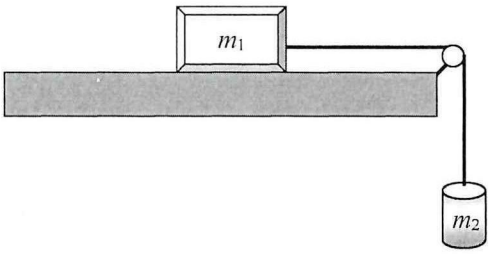

Figure Q3(c)

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Gravity acceleration, $g = 9.81\ m/s^2$	1 feet = 12 in 1 feet =30.48cm=0.3048 m 1 mi = 1.609 km	$P = m \cdot v$
$W = F \cdot s = Fs\cos\theta$	$E_u = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2 x^2$	$s = r\theta$
$K = \frac{1}{2}mv^2$	$E_J = E_k + E_u = \frac{1}{2}m\omega^2 A^2$	$v = r\omega$
$U = mgh$	$R = \sqrt{R_x^2 + R_y^2}$	$a = r\alpha$
$\Delta K = -\Delta U$	$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$	$\omega = \frac{d\theta}{dt}$
$W_n = \Delta K$	$v = u + at$	$\alpha = \frac{d\omega}{dt}$
$\frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = -(mgh_2 - mgh_1)$	$s = ut + \frac{1}{2}at^2$	$a_c = \frac{v^2}{r} = \omega^2 r$
$a = -\omega^2 \cdot x$	$v^2 = u^2 + 2as$	$a = r\sqrt{\omega^4 + \alpha^2}$
$f = \frac{1}{T} = \frac{\omega}{2\pi}$	$\sum F = ma$	$\omega = \omega_o + \alpha t$
$v = \omega\sqrt{A^2 - x^2}$	$W = mg$	$\theta = \omega_o t + \frac{1}{2}\alpha \cdot t^2$
$E_k = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$	$f_k = \mu_k \cdot N \qquad f_s = \mu_s \cdot N$	$\omega^2 = \omega_o^2 + 2\alpha \cdot \Delta\theta$