Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	PHYSICS I
COURSE CODE	:	DAS 14103
PROGRAMME	:	1 DAA / 1 DAM / 1 DAE / 1 DAU
EXAMINATION DATE	:	DECEMBER 2015/ JANUARY 2016
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	SECTION A : ANSWER **ALL** QUESTIONS SECTION B : ANSWER **TWO (2)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 (a) A car of mass 1400.0 kg under the following circumstances (a) the car climbs a 10° (a fairly steep hill) hill at a steady 80 kmh^{-1} and (b) the car accelerates along a level road from 90 kmh^{-1} to 100 kmh^{-1} in 6.0 s to pass another car. Assume that the average retarding force of the car is F_R = 700 N throughout as shown in **Figure Q1 (a)**.
[Given one horsepower (hp) is defined as 550 ft.lb/s which equal 746 watts]

(i) Define power and its SI unit

(3 marks)

(ii) Calculate the power for situation (a) and (b). Answer in hp.

(9 marks)

(b) A 1000.0 kg roller - coaster car moves from point A as shown in **Figure Q1 (b)** to point B and then to point C.

(i) Calculate the gravitational potential energy at B and C relative to point A.

(4 marks)

(ii) Calculate the change in potential energy when it goes from B to C.

(3 marks)

(iii) Repeat part (i) and (ii) but take the reference point (y = 0) to be at a point C.

(6 marks)

Q2 A spring is mounted horizontally on an air track with the left end held stationary. Aminah's attach a spring balanced to the free end of the spring, pull toward the right, and measure the elongation. 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 as shown in **Figure Q2 (i)**. When she remove the spring balance and attach a 0.80 kg object to the end, pull it a distance of 0.040 m as shown in **Figure Q2 (ii)**. Release it and watch it oscillate in simple harmonic motion (SMH).

(a) Define simple harmonic motion (SHM)

(3 marks)

(b) Calculate the maximum and minimum velocity, v_{max} and v_{min} attained by the vibrating object.

(4 marks)

(c) Calculate the maximum and minimum acceleration, a_{max} and a_{min}

(4 marks)

(d) Find spring constant (k), amplitude (A) and angular velocity (ω)

(6 marks)

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

(8 marks)

SECTION B

Q3 (a) Kinetic energy is given by $KE = \frac{1}{2}mv^2$ while work done on an object is given by work, $W = Fs\cos\theta$. Given ***m*** is the mass, ***v*** is the velocity, ***F*** is the force, ***c*** is the speed of light and ***s*** is the displacement.

(i) State the difference between base quantity and derived quantity.

(2 marks)

(ii) Show that the both equations are equivalent and its SI units.

(6 marks)

(iii) If energy E is given by Einstein's famous equation $E = mc^2$. Determine the value of E for an electron.

(4 marks)

(b) A pack of five arctic wolves are fighting over the carcass of a dead polar bear. A top view the magnitude and direction of the five forces are shown in **Figure Q3 (b)**.

(i) Determine the horizontal force acting upon the carcass, F_x.

(4 marks)

(ii) Determine the vertical force acting upon the carcass, F_y.

(4 marks)

(ii) Determine the net force, F_{net} and the direction acting upon the carcass.

(5 marks)

Q4 (a) A ball is thrown from the top of a building is given an initial velocity of 10.0 ms^{-1} straight upward. The building is 30.0 m high and the ball just misses the edge of the roof on its way down as shown in **Figure Q4 (a)**.
[Use $g = 9.81\ ms^{-2}$ throughout]

(i) Determine the maximum height of the stone from point A.

(2 marks)

(ii) Determine the time taken from point A to C.

(3 marks)

(iii) Determine the time taken from point A to D

(3 marks)

(iv) Determine the total distance before the ball hits the ground.

(2 marks)

(v) Determine the velocity of the stone when it reaches point D.

(2 marks)

(b) A trained dolphin leaps from the water with an initial speed of 18.0 ms^{-1}. It jumps directly toward a ball held by the trainer a horizontal distance of 5.50 m away and a vertical distance of 4.10 m above the water. In an absence of gravity the dolphin would move in a straight line to the ball and catch it but because of gravity the dolphin follows a parabolic path well below the ball's initial position as shown in **Figure Q4 (b)**. [Use $g = 9.81\ ms^{-2}$ throughout]

(i) Determine the angle at which the dolphin leaves the water.

(3 marks)

(ii) Determine the time it takes for the dolphin when the x position of the dolphin, x_d is equal to 5.50 m

(3 marks)

(iii) Calculate the y position of the dolphin, $y_{dolphin}$ and the position of the ball, y_{ball} at t in **Q4(b)(ii)**

(7 marks)

Q5 (a) A box of mass $m_2 = 10.0$ kg rest on a surface inclined $\theta = 37°$ to the horizontal. It is connected by a light weight cord, which passes over a mass less and frictionless pulley, to a second box of mass m_1 which hangs freely as shown in **Figure Q5 (a).** If the coefficient of static friction is 0.4, determine the values of m_1 will keep the system at rest. Assume being pulled.

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

(4 marks)

(ii) Determine what range of values of m_2 will keep the system at rest.

(12 marks)

(b) A 26.20 kg dog is running northward at 2.70 ms^{-1}, while a 5.30 kg cat is running eastward at 3.04 ms^{-1}. Their 74.00 kg owner has the same momentum as the two pets taken together. Find the direction and magnitude of the owner's velocity. Determine the magnitude of the owner's velocity.

(9 marks)

Q6 (a) The platter of the hard disk of a computer rotates at 5400 rpm (revolutions per minute). The reading of the drive is located 3.0 cm from the rotation axis. [Given 1 Hz is equal to 1 rev/s]

(i) Calculate the angular velocity of the disk

(3 marks)

(ii) Calculate the speed of the disk.

(2 marks)

(iii) Calculate the linear acceleration

(4 marks)

(iv) If a single bit requires 5.0 μm of length along the motion direction, calculate how many bits per second can the writing head write when it is 3.0 cm from the axis.

(3 marks)

(b) An old phonograph record rotates clockwise at 33 ½ rpm (revolution per minute). If a CD rotates at 210 rpm and it slows down uniformly to 100 rpm while making 10 revolutions.

(i) Define angular acceleration.

(2 marks)

(ii) Calculate the angular velocity for phonograph. Answer in rad per second ($rads^{-1}$).

(2 marks)

(iii) Calculate the angular acceleration for the CD. Answer in rad per second per second ($rads^{-2}$).

(4 marks)

(iv) Calculate the time required to turn through these 10 revolutions.

(5 marks)

- END OF QUESTION -

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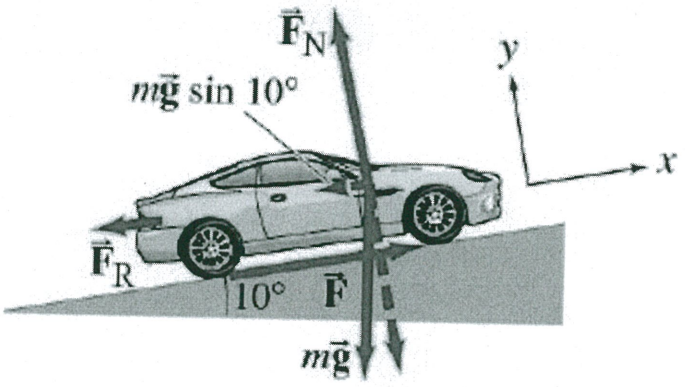

Figure Q1 (a)

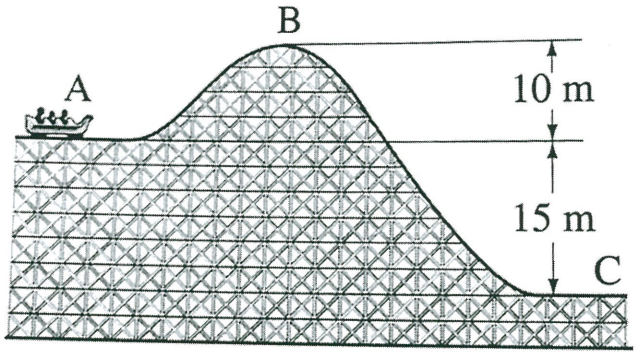

Figure Q1 (b)

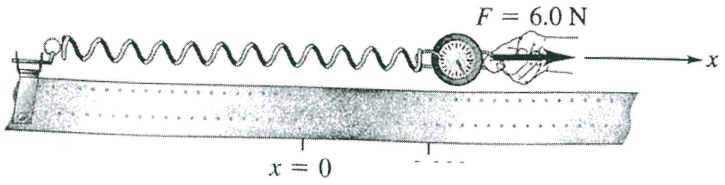

Figure Q2 (i)

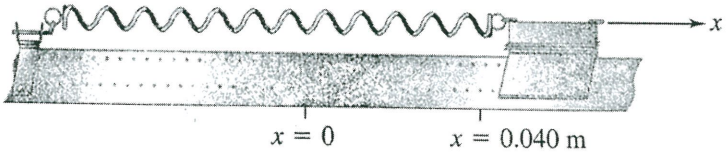

Figure Q2 (ii)

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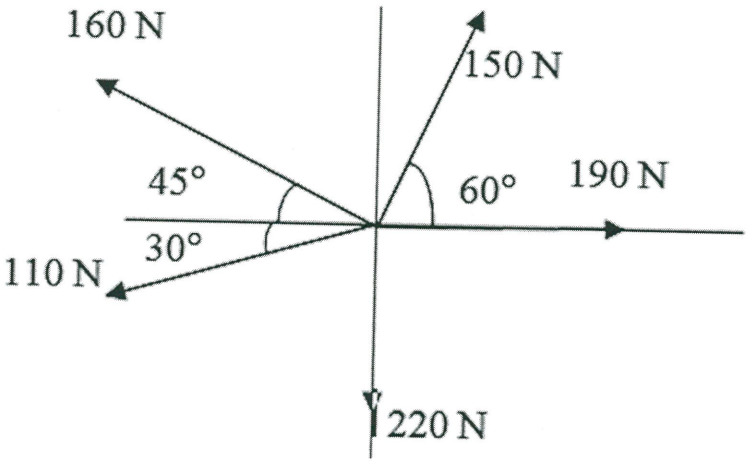

Figure Q3 (b)

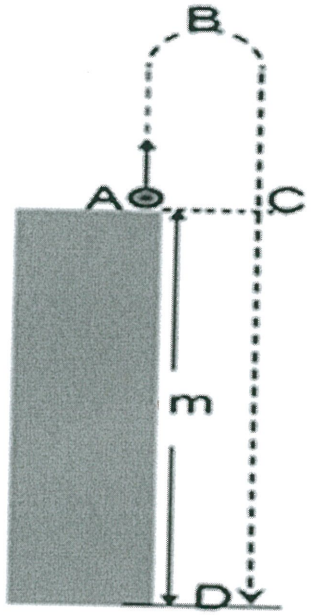

Figure Q4 (a)

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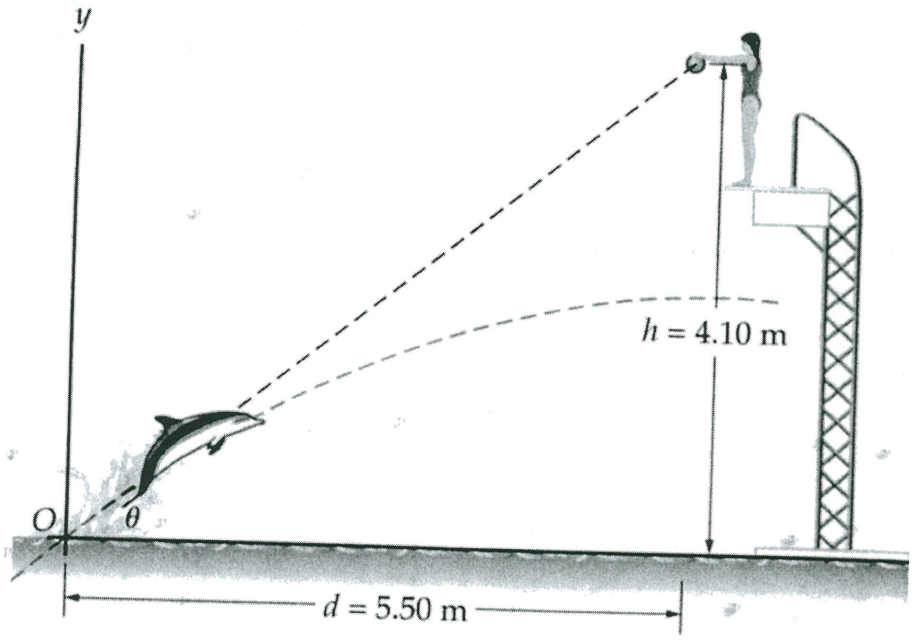

Figure Q4 (b)

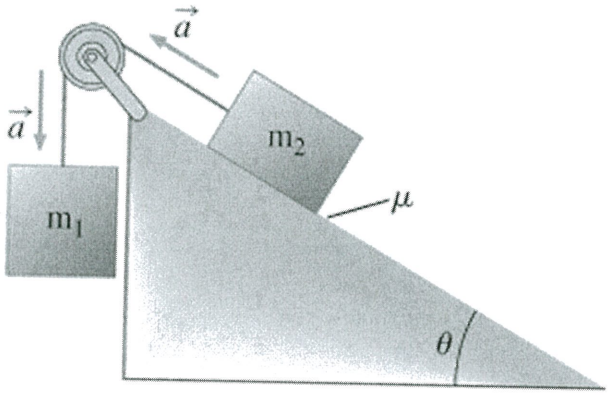

Figure Q5 (a)

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Formula

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