# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER I
## SESSION 2013/2014

| | | |
|---|---|---|
| COURSE NAME | : | PHYSIC 1 |
| COURSE CODE | : | DAS 14103 |
| PROGRAMME | : | 1 DAA / 1 DAM / 1 DAE / 1 DAU |
| EXAMINATION DATE | : | DECEMBER 2013/JANUARY 2014 |
| DURATION | : | 2 ½ HOURS |
| INSTRUCTION | : | ANSWER **ALL** QUESTIONS IN SECTION A AND **TWO (2)** QUESTIONS IN SECTION B |

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

## SECTION A

**Q1** (a) The power, P required to overcome external resistance when a vehicle is travelling at a speed v is given by the expression

$$\mathbf{P} = \boldsymbol{a}\mathbf{v} + \boldsymbol{b}\mathbf{v}^2$$

Where $a$ and $b$ are constants. [Given Power = work done / time taken]

(i) State the definition of power.
(ii) Determine the P dimensions and its SI units.
(iii) Find the dimensions for the constants $a$ and its SI units.
(iv) Find the dimensions for the constants $b$ and its SI units.

( 10 marks)

(b) A 330 kg piano slides 3.6 m down a 28° inclined and is kept from accelerating by a man who is pushing back on it parallel to the incline as shown in **Figure Q1(b)**. The effective coefficient of kinetic friction is 0.40. Answer in 2 decimal places.

Given the force exerted by the man using the equation,

$$F_p = mg \sin\theta - F_f = mg\,(\sin\theta - \mu_k \cos\theta)$$

Determine the

(i) Force exerted by the man, $F_p$.
(ii) work done by the man on the piano, $W$.
(iii) work done by friction force, $W_f$.
(iv) work done by the gravity, $W_g$.
(v) net work done on the piano, $W_{nett}$.

(15 marks)

**Q2** (a) Which of the following statement is **TRUE** or **FALSE** for a body in Simple Harmonic Motion

(i) Oscillation with no friction forces acting on the system is damped oscillation.

(ii) The acceleration of a body undergoing simple harmonic motion is directly proportional to the displacement of the oscillation and always points towards the equilibrium position.

(iii) The velocity of un-damped Simple Harmonic Motion is maximum when the displacement is equal to the amplitude of the oscillation.

(iv) The kinetic energy of the body undergoing SHM is maximum when it reaches equilibrium position.

(v) Period is the time for two complete oscillations for an object moving with SHM.

(vi) Angular displacement is the change of time of a rotating body as measured through which it rotates.

(6 marks)

(b) It is known that a load with a mass of 200 g will stretch a spring 10.0 cm. The spring is then stretched an additional 5.0 cm and released. Determine the

(i) spring constant $k$ of oscillation
(ii) angular frequency, $\omega$ of oscillation
(iii) amplitude, A, of oscillation
(iv) period, $T$ of oscillation
(v) frequency, $f$ of oscillation
(vi) maximum velocity, $v_{max}$
(vii) maximum acceleration, $a_{max}$
(viii) Write equation for the displacement of $x$ as a function of time.
(ix) Velocity at t = 0.20 s.

(19 marks)

## SECTION B

**Q3** (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 Q3 (a)**. Determine the

(i) maximum height of the stone from point A.
(ii) time taken from point A to C.
(iii) time taken from point A to D.
(iv) velocity of the stone when it reaches point D.

(12 marks)

(b) A trained dolphin leaps from the water with an initial speed of 12 $ms^{-1}$. 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 Q3 (b)**. Determine the

(i) angle at which the dolphin leaves the water.
(ii) time it takes for the dolphin when the $x$ position of the dolphin, $x_d$ is equal to 5.50 m.
(iii) $y$ position of the dolphin, $y_d$ at $t$ in **Q3(b)(ii)**.
(iv) $y$ position of the ball, $y_b$ at $t$ in **Q3(b)(ii)**.
Given the ball equation of motion is $y_b = h - \frac{1}{2} gt^2$, Use $g = 9.81\ ms^{-2}$ throughout]

(13 marks)

**Q4** (a) A traction device employing three pulleys is applied to a broken leg as shown in **Figure Q4 (a)**. The middle pulley is attached to the sole of the foot and a mass m is supplies the tension in the ropes. Find the value of the mass m if the force on the sole of the foot by the middle pulley is to be 165N. Determine the

(i) force along the horizontal motion, $F_x$.
(ii) force along the vertical motion, $F_y$.
(iii) tension, T in the system.
(iv) mass of the object, $m$.

(12 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 three forces are shown in **Figure Q4 (b).**

(i) Find the force along horizontal motion, $F_x$.
(ii) Find the force along vertical motion, $F_y$.
(iii) Determine the resultant or net force acting upon the carcass.
(iv) Determine the direction of the net force acting upon the carcass.
(v) Find the acceleration of the 750 kg polar bear carcass.

(13 marks)

**Q5** (a) Define

(i) Angular displacement.
(ii) Angular velocity.
(iii) Angular acceleration.

(6 marks)

(b) A bicycle wheel has an initial angular velocity of 1.50 rads$^{-1}$.
Given:

$$\omega_0 = 1.50\frac{\text{rad}}{\text{s}}, \alpha = 0.3\frac{\text{rad}}{\text{s}^2}, t = 2.5 \text{ s}$$

(i) If its angular acceleration is constant and equals to 0.30 rad$^{-2}$, what is its angular velocity at t = 2.50 s?
(ii) Through what angle has the wheel turned between $t = 0$ and $t = 2.50$ s?

(6 marks)

(c) 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. Find the

(i) angular velocity for phonograph, give the answer in rad per second
(ii) angular accerelation for the CD, give the answer in rad per second per second (rads$^{-2}$).
(iii) From **Q5 (c)(ii)**, find the time required to turn through these 10 revolutions.

(13 marks)

**- END OF QUESTION -**

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**FIGURE Q1(b)**

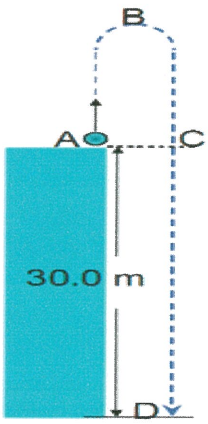


**FIGURE Q3(a)**

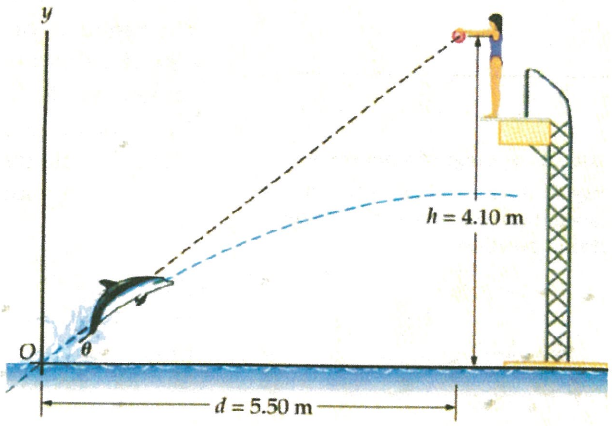


**FIGURE Q3(c)**

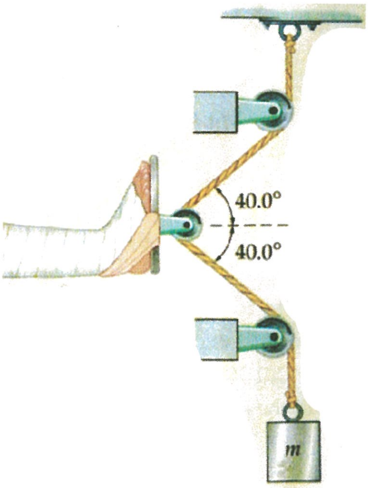


**FIGURE Q4 (a)**

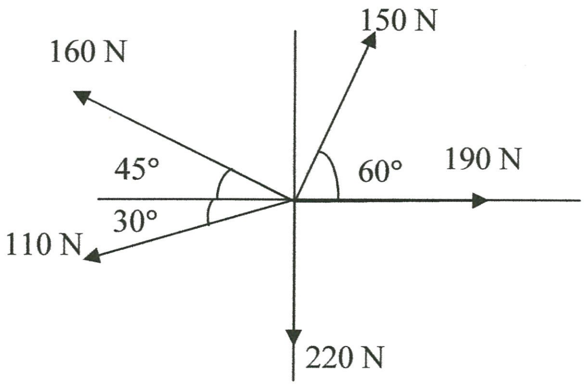


**FIGURE Q4 (b)**

## FORMULA

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COURSE : PHYSICS 1    COURSE CODE : DAS 14103

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