# UNIVERSITI TUN HUSSEIN ONN MALAYSIA

## FINAL EXAMINATION
## SEMESTER II
## SESSION 2012/2013

| | | |
|---|---|---|
| COURSE NAME | : | PHYSICS FOR ENGINEERING TECHNOLOGY |
| COURSE CODE | : | BWM 12603 |
| PROGRAMME | : | BND |
| EXAMINATION DATE | : | JUNE 2013 |
| DURATION | : | 2 HOURS 30 MINUTES |
| INSTRUCTION | : | ANSWER ALL QUESTIONS IN PART A. ANSWER ONLY 3 QUESTIONS IN PART B |

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

**PART A: Answer all questions.**

**Q1** a) Calculate the vertical displacement at t = 0.1 s and x = 0.2 m for
i) $y = 0.15 \sin(16\pi t - 5\pi x)$
ii) $y = 0.15 \sin(5\pi x - 16\pi t)$

(4 marks)

b) A string of linear mass density 480 g/m is under a tension of 48 N. A wave of frequency 200 Hz and amplitude 4.0mm travels down the string. At what rate does the wave transport energy?

(7 marks)

c) The wavelength and period of a wave are 15 cm and 0.03 s respectively.

i) Calculate the phase difference between two points of the wave separated by a
distance of 7 cm.
ii) Calculate the velocity of this wave
iii) How much is the change in phase for a particle after 0.04 s

(9 marks)

**2** a) A 2.15-gram cashew nut is burned. The heat released raises the temperature of a 100.0-gram sample of water from 18.2°C to 31.5°C. The mass of the nut after the experiment is 1.78 grams. Determine the calorie content of the nut in Calories/gram. Assume that the water is only able to absorb 25% of the heat released by the burning nut. Given 1.00 Calorie=4.18 kJ.

(9 marks)

b) A 1.0 kg luminium block has an initial temperature of 10.0°C. What will the final temperature of the luminium block be if $3.0 \times 10^4$ J of heat is added?

(4 marks)

c) A 0.50 kg block of metal with an initial temperature of 54.5°C is dropped into a container holding 1.1 kg of water at 20.0°C. If the final temperature of the block water system is 21.4°C, what is the specific heat of the metal? Assume the container can be ignored, and that no heat is exchanged with the surroundings.

(7 marks)

**PART B : Please answer 3 questions only.**

Q3 a) State the Archimedes' principle.
A block of wood floats in a container of water, sealed and transported to the moon. How would the same block of wood float in the same sealed container of water on the surface of the moon?

(4 marks)

b) A huge rising balloon has a volume of 2300 $m^3$ and is filled with hot air with a density of 0.92 kg $m^{-3}$. The cold air surrounding the balloon has a density of 1.29 kg $m^{-3}$. How much load can the balloon carry?

(6 marks)

c) In a hydraulic car lift, the input piston has a radius of $r_1$ = 0.0120 m and a negligible weight. The output plunger has a radius of $r_2$ = 0.150 m. The combined weight of the car and the plunger is $F_2$ = 20 500 N. The lift uses hydraulic oil that has a density of 8.00 × 102 kg/m3. What input force $F_1$ is needed to support the car and the output plunger when the bottom surfaces of the piston and plunger are at

(i) the same level and
(ii) the levels with h = 1.10 m?

(10 marks)

Q4 a) Suppose your 60.0-L (15.9-gal) steel gasoline tank is full of gas, so both the tank and the gasoline have a temperature of 15.0°C. How much gasoline has spilled by the time they warm to 35.0°C?

(6 marks)

b) As a result of a temperature rise of 32 °C a bar with a crack at its centre buckles upward, as shown in Figure Q4 (b). If the fixed distance between the ends of the bar is 3.77 m and the coefficient of linear expansion of the bar is $2.5x10^{-5}$ $K^{-1}$, find the rise at the centre.

(8 marks)

c) A hole with a diameter of 0.85 cm is drilled into a steel plate. At 30.0°C, the hole exactly accommodates an aluminum rod of the same diameter. What is the spacing between the plate and the rod when they are cooled to 0.0°C?

(6 marks)

**Q5** a) The velocity of a body of mass m that has been acted upon by a force F for a time t is given by Ft=mv. Show that this equation is dimensionally correct.

(6 marks)

b) An airplane flies due south at 175 km/hwith respect to the air. There is a wind blowing at 85km/h to the east relative tothe ground. What are the plane's speed and direction with respect to the ground?

(4 marks)

c) Lilian and Chrissy are going to sleepover night in their tree house and are using some ropes to pull up a box containing their pillows and blankets,which have a total mass of 3.20 kg. The girls stand on different branches, as shown in **Figure 5 (c)** , and pull at the angles and with the forces indicated. Find the x- and y-components of the net force on the box.

(10 marks)

Q6 a) A bicycle rider pushes a bicycle that has amass of 13 kg up a steep hill. The incline is 25° andthe road is 275 m long, as shownin Figure. The rider pushes the bikeparallel to the road with a force of 25 N.

i. How much work does the rider do on the bike?
ii. How much work is done by the force ofgravity on the bike?

(7 marks)

b) A 2.00-g bullet, moving at 538 m/s,strikes a 0.250-kg piece of wood at reston a frictionless table. The bullet sticks inthe wood, and the combined mass movesslowly down the table.

i) Draw energy bar graphs and momentum vectors for the collision.
ii) Find the speed of the system after the collision.
iii) Find the kinetic energy of the system before the collision.
iv) Find the kinetic energy of the system after the collision.
v) What percentage of the system's original kinetic energy was lost?

(13 marks)

**-END OF QUESTION-**

**FINAL EXAMINATION**

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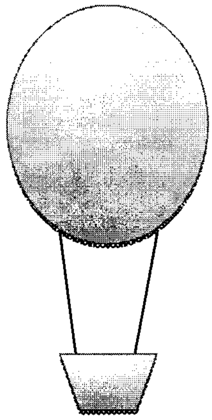

**Figure Q3(b)**

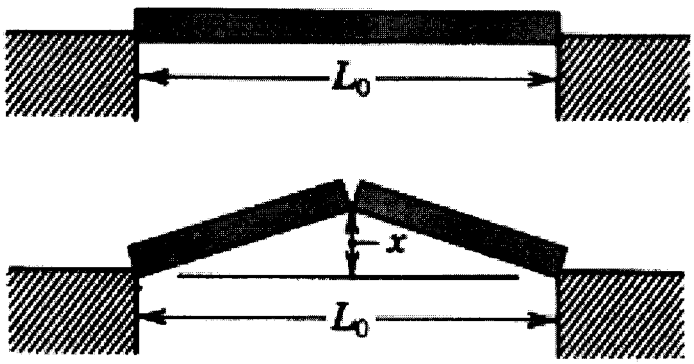


**Figure Q4(b)**

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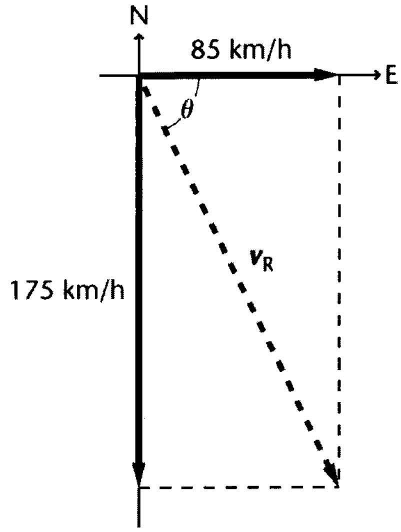


**Figure Q5 (b)**

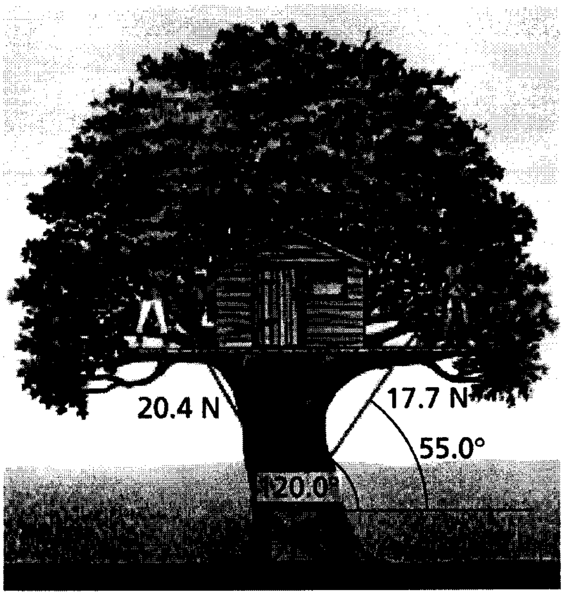


**Figure 5 (c)**

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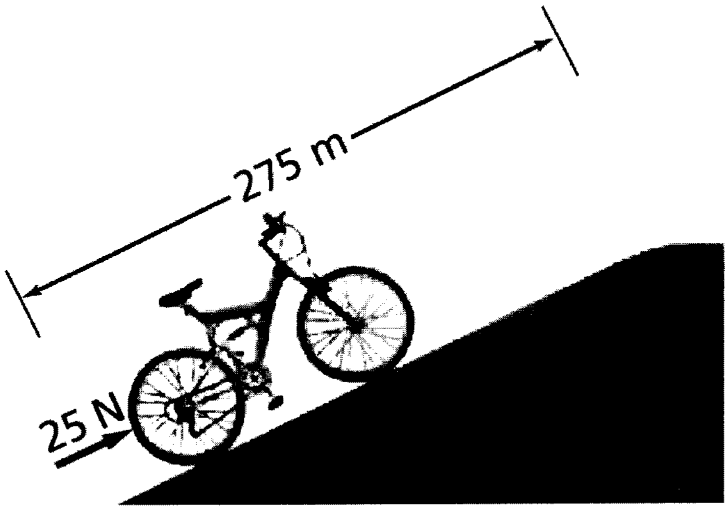


**Figure Q6 (a)**

**FORMULA**

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

## NEWTONIAN MECHANICS

$v = v_0 + at$

$x = x_0 + v_0 t + \frac{1}{2}at^2$

$v^2 = v_0^2 + 2a(x - x_0)$

$\sum \mathbf{F} = \mathbf{F}_{net} = m\mathbf{a}$

$F_{fric} \le \mu N$

$a_c = \frac{v^2}{r}$

$\tau = rF \sin\theta$

$\mathbf{p} = m\mathbf{v}$

$\mathbf{J} = \mathbf{F}\Delta t = \Delta\mathbf{p}$

$K = \frac{1}{2}mv^2$

$\Delta U_g = mgh$

$W = F\Delta r \cos\theta$

$P_{avg} = \frac{W}{\Delta t}$

$P = Fv\cos\theta$

$\mathbf{F}_s = -k\mathbf{x}$

$U_s = \frac{1}{2}kx^2$

$T_s = 2\pi\sqrt{\frac{m}{k}}$

$a$ = acceleration
$F$ = force
$f$ = frequency
$h$ = height
$J$ = impulse
$K$ = kinetic energy
$k$ = spring constant
$\ell$ = length
$m$ = mass
$N$ = normal force
$P$ = power
$p$ = momentum
$r$ = radius or distance
$T$ = period
$t$ = time
$U$ = potential energy
$v$ = velocity or speed
$W$ = work done on a system
$x$ = position
$\mu$ = coefficient of friction
$\theta$ = angle
$\tau$ = torque

## FLUID MECHANICS AND THERMAL PHYSICS

$\rho = m/V$

$P = P_0 + \rho gh$

$F_{buoy} = \rho Vg$

$A_1 v_1 = A_2 v_2$

$P + \rho gy + \frac{1}{2}\rho v^2 = \text{const.}$

$\Delta\ell = \alpha\ell_0\Delta T$

$H = \frac{kA\Delta T}{L}$

$P = \frac{F}{A}$

$PV = nRT = Nk_BT$

$K_{avg} = \frac{3}{2}k_BT$

$v_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3k_BT}{\mu}}$

$W = -P\Delta V$

$\Delta U = Q + W$

$e = \left|\frac{W}{Q_H}\right|$

$e_c = \frac{T_H - T_C}{T_H}$

$A$ = area
$e$ = efficiency
$F$ = force
$h$ = depth
$H$ = rate of heat transfer
$k$ = thermal conductivity
$K_{avg}$ = average molecular kinetic energy
$\ell$ = length
$L$ = thickness
$m$ = mass
$M$ = molar mass
$n$ = number of moles
$N$ = number of molecules
$P$ = pressure
$Q$ = heat transferred to a system
$T$ = temperature
$U$ = internal energy
$V$ = volume
$v$ = velocity or speed
$v_{rms}$ = root-mean-square velocity
$W$ = work done on a system
$y$ = height
$\alpha$ = coefficient of linear expansion
$\mu$ = mass of molecule
$\rho$ = density