UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2015/2016

COURSE NAME	:	PHYSICS TECHNOLOGY
COURSE CODE	:	BWM 12603
PROGRAM	:	1 BNA/BNB/BNN
EXAMINATION DATE	:	DECEMBER 2015 / JANUARY 2016
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN PART A. ANSWER ONLY **THREE (3)** QUESTIONS IN PART B

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

PART A:

Q1 (a) A progressive wave, frequency 1000Hz and amplitude 12 cm is propagating from left to right with velocity $200ms^{-1}$
(i) Calculate the wavelength of this wave.
(ii) Write a wave equation for this wave.

(6 marks)

(b) A rope of mass 220g and length 1.6m has one of its end fixed to a wall and the other one end is forced to vibrate transversely with a frequency of 30Hz. If the rope is stretched to 120N, calculate the velocity and wavelength of the wave produced.

(4 marks)

(c) **Figure Q1 (c) (i)** shows a graph of displacement; *y* versus time, *t* and **Figure Q1(c) (ii)** shows a graph of displacement, *y* versus distance, *x* of a progressive wave.

From the graph, deduce
(i) the angular velocity
(ii) the wavelength
(iii) the wave propagation velocity
(iv) the particle vibration velocity when displaced vertically 1.5 cm from the equilibrium position
(v) the equation to represent the displacement of this progressive wave.

(10 marks)

Q2 (a) Define the specific heat capacity. How much heat is needed to raise the temperature of a block of copper (weighing 0.5 kg) from 0°C to 100° C ?
(specific hear capacity for copper, c = 386 J / kg °C)

(4 marks)

(b) Compare the energy needed to raise the temperature of 1kg of water from 20°C to 100°C and the energy needed to boil 1 kg of water at 100°C.

$(c_{water} = 4200\ J\ kg^{-1}\ K^{-1})$

$(L_{water} = 2260\ kJ\ kg^{-1}.)$

(8 marks)

(c) A copper cup holds some cold water at 4°C. The copper cup weighs 140g while the water weighs 80g. If 100g of hot water, at 90°C is added, what will be the final temperature of the water?
$(c_{copper} = 390\ J/kgK\ )(\ c_{water} = 4200\ J\ kg^{-1}\ K^{-1)}.$

(8 marks)

PART B:

Q3 (a) State Archimedes' principle. A boy measures a block volume of 500 g of mass using these equipment. If the acceleration due to gravity is 10 m/s^2 find the difference between the block weight and the Archimedes' force.

(6marks)

(b) A fish swims at 15 m of depth from water surface. If the density of water is 1000 kg/m^3 and the atmospheric pressure is 10^5 N/m, find:

(a) fluid pressure (hydrostatic pressure) at the depth 15 m
(b) total pressure at the depth 15 m

(8 marks)

(c) A tube U filled with mercury and a kind of oil, the final configuration as shown in **Figure 3 a).** If h_2 is 27.2 cm, density of oil 0.8 gr/cm^3 and density of mercury is 13.6 g/cm^3, find the height of mercury (h_1) about line reference.

(6marks)

Q4 (a) An iron pipe is 300 m long at room temperature 20 °C. If the pipe is to be used as a steam pipe, how much allowance must be made for expansion?
($\alpha_{iron} = 1.2 \times 10^{-5}/°C$)

(3 marks)

(b) A brass disk has a hole 80mm in diameter punched in its center at 70 °F. If the disk is placed in boiling water, what will be the new area of the hole?
($\alpha_{brass} = 1.0 \times 10^{-5}/°F$)

(10 marks)

(c) On a hot day in Las Vegas, an oil trucker loaded 37000 L of diesel fuel. He encountered cold weather on the way to Payson, Utah, where the temperature was 23.0 K lower than in Las Vegas, and where he delivered his entire load. How many litres did he deliver? The coefficient of volume expansion for diesel fuel is $9.50 \times 10^{-4}/°C$, and the coefficient of linear expansion for his truck tank is $11 \times 10^{-6}/°C$.

(7 marks)

Q5 (a) A block is pushed at constant speed through a rough surface with a force of 25 N as shown in **Figure Q5 (a).**

(i) sketch free body diagram of the block
(ii) Calculate the normal reaction on the block.
(iii) Calculate the coefficient of kinetic friction.

(8 marks)

(b) A lift of mass 1500 kg is supported by a cable. Calculate the tension in the cable when the lift is

(i) Accelerating uniformly downwards at 2.0 ms^{-2}
(ii) Moving upwards with a uniform velocity of 5.0 ms^{-1}

(6 marks)

(c) Find the components of vector *C* of the **Figure Q5 (c)** when the vectors A and B is given as below.

$A = 5m; \theta = 60°$ above the x axis
$B = 4m; \theta = 20°$ above the x axis

(6 marks)

Q6 (a) A 700 kg lift is moving upwards for 4.0 s with constant acceleration until it reaches its final speed of 16.0m s^{-1}. Given I hp = 746 W

(i) Calculate the force exerted by the motor
(ii) Find the instantaneous power in horse power (hp) of the motor at t=4.0 s.

(6 marks)

(b) A car of mass 1030 kg moves with speed of 5.0 m s-1. If it is accelerated at the rate of 2.20 m s-2 for 12s , calculate

(i) the change in kinetic energy
(ii) the power of the car

(4 marks)

(c) In an experiment a spring is compressed 1.6 mm by a force 6 N. Now this spring is compressed by 25 mm and a ball bearing of mass 5 g is placed at one end of the spring as shown figure Q6

(i) How much of energy is stored in the spring when it is compressed by 25 cm?

(3 marks)

(ii) Explain why the ball can maintain a constant horizontal velocity after being released.

(4 marks)

(iii) If the ball bearing moves up a vertical frictionless circular track of radius 5 cm, calculate the speed of the ball bearing at the highest point of the track.

(3 marks)

- **END OF QUESTION** -

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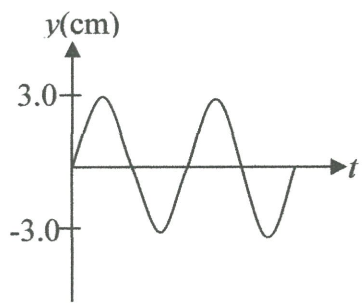

Figure Q1 c (i)

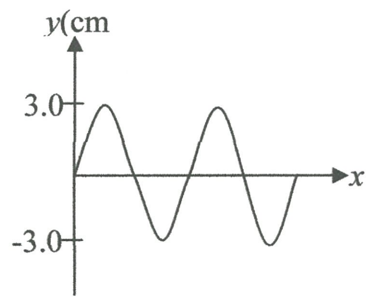

Figure Q1 c (ii)

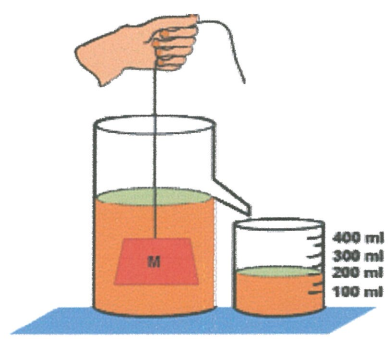

Figure Q3 (a)

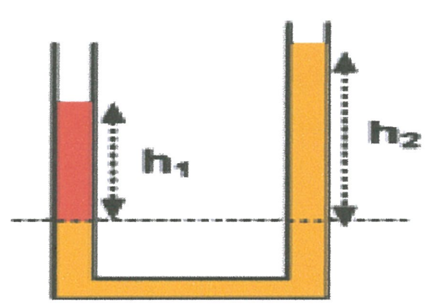

Figure Q3 (c)

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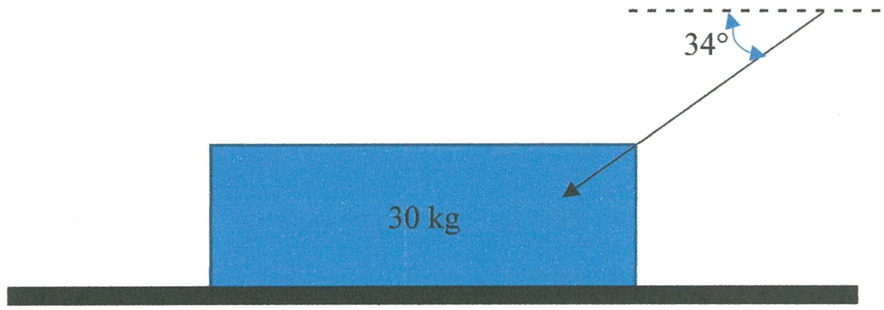

Figure Q5 (a)

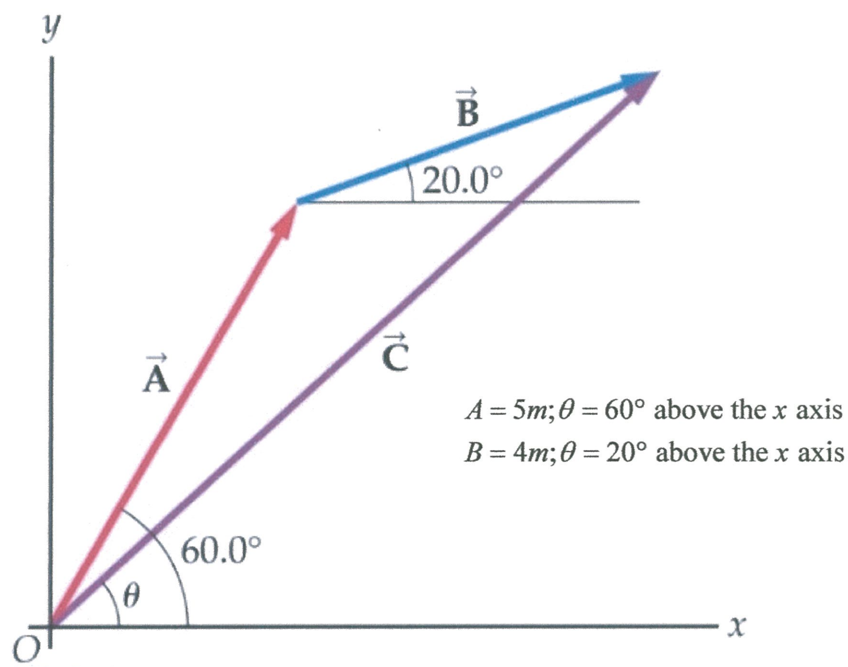

Figure Q5 (c)

FORMULA

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

FORMULA

NEWTONIAN MECHANICS

$v = v_0 + at$

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

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

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

$F_{fric} \leq \mu N$

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

$\tau = rF \sin\theta$

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

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

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

$\Delta U_g = mgh$

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

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

$P = Fv\cos\theta$

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

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

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

a = acceleration
F = force
f = frequency
h = height
J = impulse
K = kinetic energy
k = spring constant
ℓ = 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
μ = coefficient of friction
θ = angle
τ = torque

FLUID MECHANICS AND THERMAL PHYSICS

$\rho = m/V$

$P = P_0 + \rho gh$

$F_{buoy} = \rho Vg$

$A_1v_1 = A_2v_2$

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

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

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

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

$PV = nRT = Nk_BT$

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

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

$W = -P\Delta V$

$\Delta U = Q + W$

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

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

A = area
e = efficiency
F = force
h = depth
H = rate of heat transfer
k = thermal conductivity
K_{avg} = average molecular kinetic energy
ℓ = 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
α = coefficient of linear expansion
μ = mass of molecule
ρ = density