UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	:	**PHYSICS FOR ENGINEERING TECHNOLOGY**
COURSE CODE	:	**BWM 12603**
PROGRAMME	:	**1 BNN, BNB, BNL**
EXAMINATION DATE	:	**DECEMBER 2012 / JANUARY 2013**
DURATION	:	**2½ HOURS**
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

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

PART A

S1 a) Define Specific Heat Capacity and Latent Heat Capacity. What are the differences between Specific Heat Capacity and Latent Heat Capacity?

(4 marks)

b) A bag of lead (Plumbum) pellets (specific heat capacity, $c = 128\ J\ kg^{-1}°C^{-1}$) is dropped from a height of 10 m. Upon impact, 50% of the kinetic energy of the bag is turned into thermal energy dissipated throughout the lead bag. Calculate the change in temperature of the lead.

(6 marks)

c) How much energy is required to change a 50 g ice cube at -10 °C to steam at 150 °C?

(10 marks)

Q2 a) Define and give examples of :

(i) Longitudinal Waves
(ii) Electromagnetic Waves

(5 marks)

b) A 0.80 kg mass hangs from a spring. When an additional 0.20 kg mass is added, the spring elongates another 3.0 cm. What is the period of oscillation of the spring?

(6 marks)

c) A spring is stretched 0.15 m when a mass of 0.35 kg is hung on it as in **Figure Q2 (c-i)**. The spring is then set up horizontally with the 0.35 kg mass resting on a frictionless table as **Figure Q2 (c-ii)**. The spring is compressed 0.15 m from equilibrium and then released from that point.

(i) Determine the spring constant k and angular frequency ω of the oscillation.

(ii) What is the amplitude of the horizontal oscillation, A?

(iii) Find the maximum velocity, v_{max} and maximum acceleration, a_{max} of the oscillation.

(9 marks)

PART B

Q3 a) State the three Newton's Law of Motion.

(5 marks)

b) Two blocks of mass m_A = 20 kg and m_B = 5 kg are connected by a massless cable wound around a massless pulley. A force F is applied to block A causing it to slide over a horizontal surface with kinetic coefficient of friction μ_{k1} = 0.25, while block B slides over block A with μ_{k2} = 0.15, as shown in **Figure Q3 (b).**

(i) What force is needed to move block A with constant speed?

(ii) (8 marks)

(iii) If the cable can sustain a maximum tension of 100 N, what is the maximum force F_{max} allowable without breaking the cable?

(7 marks)

Q4 a) A quartz sphere is 8.75 cm in diameter. What will be its change in volume if it is heated from 30 °C to 200 °C? The coefficient of linear expansion of the quartz is $0.4 \times 10^{-6}\ K^{-1}$.

(6 marks)

b) Two thermally insulated tanks of equal volume $V_1 = V_2 = 1\ m^3$, are connected by a thermally insulated partition. The two tanks communicate through a valve which initially closed. The two tanks contain two samples of the same ideal and monoatomic gas as shown in **Figure Q4 (b)**.

(i) What are the temperatures T_1 and T_2 of the two tanks?

(ii) What are the internal energies U_1 and U_2 of the gas in the two tanks?

(10 marks)

c) A steel rod has a length of exactly 20 cm at 30 °C. How much longer is it at 50 °C? [Use α steel = 11×10^{-6}/ °C]

(4 marks)

Q5 a) Distinguish between elastic and plastic behavior of a solid.

(4 marks)

b) A force of 5000 N is applied outwardly to each end of a 5.0 m long rod with a radius of 34.0 cm and a Young's modulus of $125 \times 10^8\ N/m^2$. Find the elongation of the rod.

(3 marks)

c) A steel wire is 7.0 m long and has a mass of 100 g. It is under tension of 900 N. What is the speed of transverse wave pulse on this wire?

(3 marks)

d) A wave pulse propagates along a wire in the positive x direction at 20 ms^{-1}. What will the pulse velocity be:

(i) if we double the length of the wire keeping the tension and the mass per unit length constant?

(ii) double the tension while holding the length and mass per unit length constant?

(iii) double the mass per unit length while holding the other variables constant?

(10 Marks)

Q6 a) Define what is work and power. State its SI units.

(4 marks)

b) A 15.0 kg block is dragged over a rough, horizontal surface by a 70.0 N force acting at 20° above the horizontal. The block is displaced 5.0 m and the coefficient of kinetic friction is 0.30 as shown in **Figure Q6(b)**.

(i) Find the work done by the 70.0 N force.

(ii) Find the work done by the normal force.

(iii) What is the energy loss due to friction?

(6 marks)

c) A 1500 kg car accelerates uniformly from rest to 10 ms^{-1} in 3.0 s. Find

(i) distance in this time interval.

(ii) the work done on the car this time interval.

(iii) the average power of the car's engine.

Given $Distance = \left(\frac{v+v_o}{2}\right)t$

(10 marks)

~ END OF QUESTION ~

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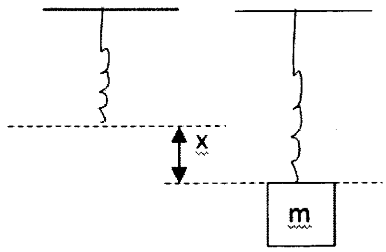

Figure Q2(c-i)

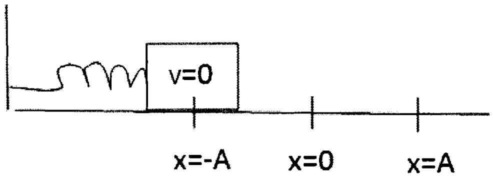

Figure Q2(c-ii)

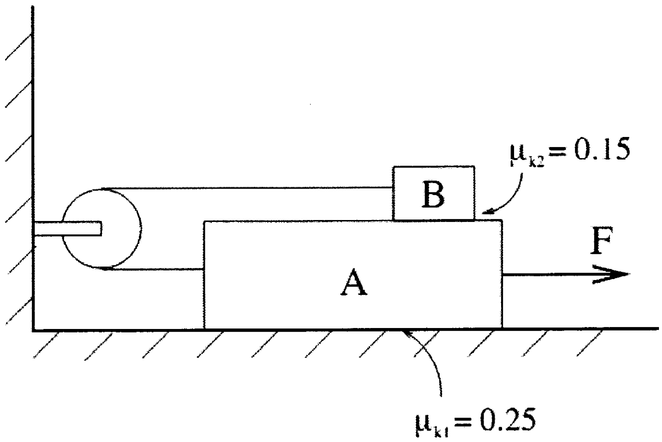

Figure Q3(b)

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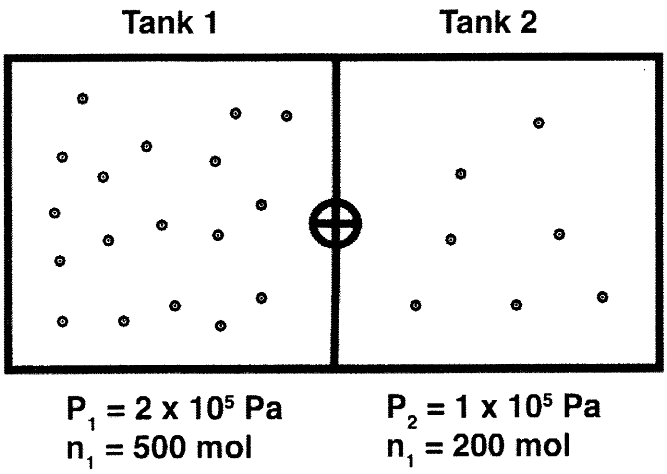

FIGURE Q4(b)

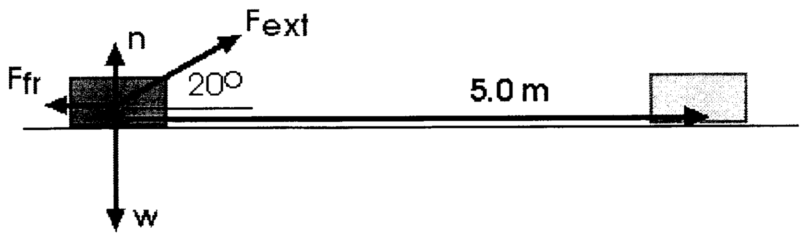

Figure Q6(b).

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	$P = m \cdot v$
$c_{ice} = c_{steam} = 2093$ J/kg℃	$c_{water} = 4186$ J/kg℃	$L_v = 2.26\times10^6$ J/kg℃ $L_f = 333\times10^3$ J/kg℃
$W = F \cdot s = Fs\cos\theta$	$E_u = \frac{1}{2}kx^2 = \frac{1}{2}m\omega^2x^2$	$s = r\theta$
$K = \frac{1}{2}mv^2$	$E_J = E_k + E_u = \frac{1}{2}m\omega^2A^2$	$v = r\omega$
$U = mgh$	$R = \sqrt{R_x^2 + R_y^2}$	$a = r\alpha$
$\Delta K = -\Delta U$	$\theta = \tan^{-1}\left(\frac{R_y}{R_x}\right)$	$\omega = \frac{d\theta}{dt}$
$W_n = \Delta K$	$v = u + at$	$\alpha = \frac{d\omega}{dt}$
$\frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = -(mgh_2 - mgh_1)$	$s = ut + \frac{1}{2}at^2$	$a_c = \frac{v^2}{r} = \omega^2 r$
$a = -\omega^2 \cdot x$	$v^2 = u^2 + 2as$	$a = r\sqrt{\omega^4 + \alpha^2}$
$f = \frac{1}{T} = \frac{\omega}{2\pi}$	$\sum F = ma$	$\omega = \omega_o + \alpha t$
$v = \omega\sqrt{A^2 - x^2}$	$W = mg$	$\theta = \omega_o t + \frac{1}{2}\alpha \cdot t^2$
$E_k = \frac{1}{2}mv^2 = \frac{1}{2}m\omega^2(A^2 - x^2)$	$f_k = \mu_k . N$ $f_s = \mu_s . N$	$\omega^2 = \omega_o^2 + 2\alpha \cdot \Delta\theta$

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
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

$\rho = m/V$

$P = P_0 + \rho gh$

$F_{buoy} = \rho Vg$

$A_1 v_1 = A_2 v_2$

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

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

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

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

$PV = nRT = Nk_B T$

$K_{avg} = \frac{3}{2}k_B T$

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

$W = -P\Delta V$

$\Delta U = Q + W$

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

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

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