UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2011/2012

COURSE NAME	:	BASIC ENGINEERING SCIENCE
COURSE CODE	:	BSF 2812
PROGRAMME	:	4 BPC
DATE	:	JUNE 2012
DURATION	:	2 HOURS
INSTRUCTION	:	ANSWER ALL **FIVE (5)** QUESTIONS.

THIS EXAMINATION PAPER CONSISTS OF **7 PAGES**

Q1 (a) An object is pulled on a horizontal plane with a force, F of 15 N along x axis. Given the acceleration, a of the object is 1.0 ms^{-2} and friction coefficient, μ between the object and the plane is 0.50, what is the mass, m of the object.

(4 marks)

(b) **Figure Q1(b)** shows a force acts on m_2 is 50 N (F = 50 N) and friction coefficient, μ between m_2 and the surface is 0.75,

(i) Draw a Free Body Diagram (FBD) for each object (m_1 and m_2) in the system.

(ii) Find the acceleration, a and tension, T of the string in the system.

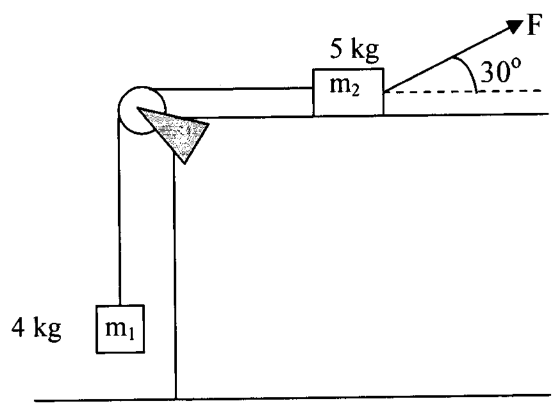

Figure Q1(b)

(16 marks)

Q2 (a) A concrete block is pulled 8.0 m across a frictionless surface by a rope. The tension in the rope is 50 N and the net work done on the block is 400 J. What angle does the rope make with the horizontal.

(4 marks)

(b) A car with a mass, m of 1250 kg moves from rest to reach a speed of 30 m/s. Calculate,

(i) the initial kinetic energy, K_i.
(ii) the final kinetic energy, K_f.
(iii) the work done, W by the car.

(9 marks)

(c) A car with a mass, m of 1000 kg can accelerate from rest to a speed, v of 20 ms^{-1} in 10.0 s. What is the average power, P must the car produce to cause this acceleration. Give the answer in horse power.
Given 1hp = 746W and ignore friction losses.

(7 marks)

Q3 (b) Define the Archimedes' Principle.

(3 marks)

(b) The system shown in **Figure Q3(b)** has a mass, m of 800 kg at cylinder A with a cross sectional area, A of 850 cm^2. The piston, B has a cross sectional area, A of 35 cm^2 and negligible weight. If the system is filled with an oil (ρ = 0.78 g/cm^3), find the force, F required to hold both the cylinder and piston in equilibrium at point H.

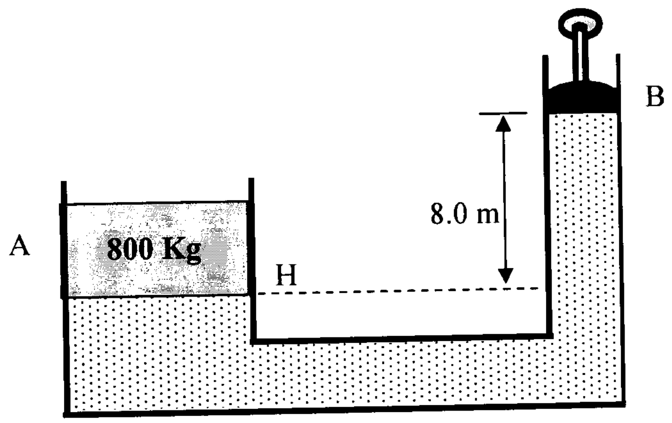

Figure Q3 (b)

(7 marks)

(c) A wood with an area, A of 0.75 m^2 and height, h of 3.5 m is floating freely on a lake. Given the density of wood, ρ_{wood} = 700 kg/m^3, density of water, ρ_{water} = 1000 kg/m^3 and gravitional acceleration, g = 9.8 m/s^2, determine,

(i) the volume, V of the wood.
(ii) the weight, W of wood floating on the water.
(iii) the buoyancy force, F_b.
(iv) the volume, V of water displaced.

(10 marks)

Q4 (a) A large sponge has forces, F of magnitude 15 N applied in opposite directions of two opposite faces of area, A 45 cm^2. Given the thickness of the sponge (L) is 2.5 cm and the deformation angle (γ) is 10.0°. Calculate,

(i) the displacement of surface, Δx.
(ii) the shear stress, σ.
(iii) the shear strain, ε.
(iv) the shear modulus of the sponge, S.

(12 marks)

(b) The coefficient of linear expansion, α of brass is 1.9×10^{-5} °C^{-1}. At 25.0° C, a hole in a sheet of brass has an area, A of 1.2 mm^2. Find the increase in the hole area, ΔA at 30.0°C.

(3 marks)

(c) A cylindrical brass container with a base area, A of 85.0 cm^2 and height, h of 15.0 cm is filled to the brim with water when the system is at 25.0° C. How much water overflows when the temperature of the water and container is raised to 100.0°C. Given β_{water} = 207×10^{-6} K^{-1} and β_{brass} = 57×10^{-6} K^{-1}.

(5 marks)

Q5 (a) Give the definition for 'specific heat (c)' and 'latern heat (L)'.

(4 marks)

(b) A 250 cm^3 of water at 95°C is poured into 200 g glass cup initially at 25°C. What will be the final temperature of the mixture when equilibrium is reached, assuming no heat flows to surroundings.
Given c_{water} = 4.186 kJ/kgK and c_{cup} = 0.75 kJ/kgK.

(7 marks)

(c) A transverse wave with frequency, f of 0.8 Hz and speed, v of 150 m/s is illustrated in **Figure Q6(c)**. Determine,

(i) the amplitude, A.
(ii) the period, T.
(iii) the wavelength, λ.
(iv) wave number, k.
of the wave.

(9 marks)

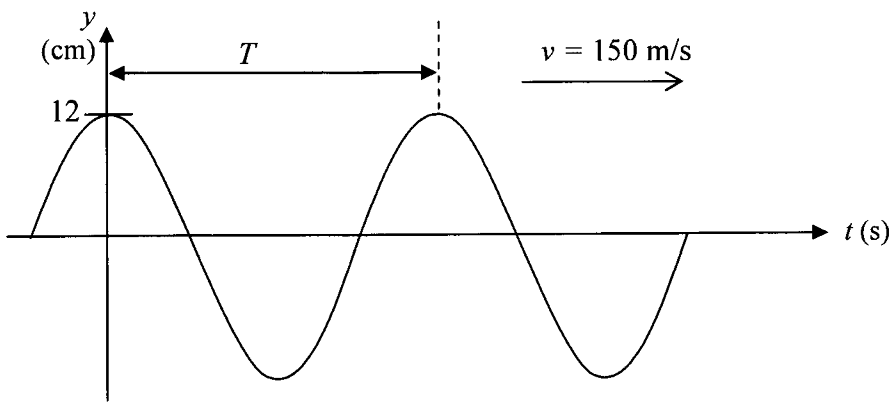

Figure Q6(c)

LIST OF CONSTANTS

1. Acceleration of gravity, $g = 10$ m/s^2
2. Coefficient of linear expansion of steel, $\alpha_{steel} = 12 \times 10^{-6}\,°C^{-1}$
3. Coefficient of volume expansion of glass, $\gamma_{glass} = 28 \times 10^{-6}\,°C^{-1}$
4. Coefficient of volume expansion of water, $\gamma_{water} = 207 \times 10^{-6}\,°C^{-1}$
5. Specific heats of iron, $c_{iron} = 450$ J/kg.°C
6. Atmospheric pressure, $P_{atm} = 1.0 \times 10^5$ Pa
7. Specific heat of water, $c_{water} = 4.186$ kJkg^{-1}K^{-1}
8. Specific heat of ice, $c_{ice} = 2.1$ kJkg^{-1}K^{-1}
9. Specific heat of steam, $c_{steam} = 2.01$ kJkg^{-1}K^{-1}
10. Latent heat of fusion of water, $L_f = 333.7$ kJ/kg
11. Latent heat of evaporation of water, $L_v = 2{,}256$ kJ/kg
12. Coefficient of thermal conduction of asbestos, $\kappa_{asbestos} = 0.17$ Wm^{-1}K^{-1}
13. Coefficient of thermal conduction of copper, $\kappa_{copper} = 401$ Wm^{-1}K^{-1}.
14. Density of sea water, $\rho_{sea} = 1030$ kg/m^3
15. Density of water (fresh water), $\rho_{water} = 1000$ kg/m^3
16. Young's modulus of copper, $Y_{copper} = 120 \times 10^9$ Pa
17. Young's modulus of steel, $Y_{steel} = 200 \times 10^9$ Pa

LIST OF FORMULAS

$\Delta L = \alpha L_0 \Delta T$	$T_K = T(K/°C) + 273.15K$	$PE_{spring} = {}^1/_2 kx^2$
$\Delta A = 2\alpha A_0 \Delta T$	$R = d/\kappa A$	$W = Fs\cos\theta$
$\Delta V = \beta V_0 \Delta T$	$Q = \kappa A \Delta T t/d$	$\Delta U = -W$
$\gamma_{apparent} = \gamma_{absolute} - \gamma_{glass}$	$v = f\lambda = \omega/k = (\tau/\mu)^{1/2}$	$\Delta K = W$
$V_{apparent} = V_{absolute} - V_{glass}$	$\mu = m/L$	$P = W/t$
$PV = nRT = Nk_BT$	$\omega = 2\pi f$	$\omega^2 = k/m$
$N = M/m$	$f = 1/T$	$\rho = m/V$
$n = N/N_A$	$k = 2\pi/\lambda$	$P = F/A = \rho gh$
$R = N_A k$	$f = nv/2L$	$P_{absolute} = P_{gauge} + P_{atm}$
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$F = ma$	$F_B = \rho gV$
$Q = mc\Delta T$	$F_f = \mu_k N$ $F_f = \mu_s N$	$\frac{F}{A} = Y\frac{\Delta L}{L}$
$Q = L_f m$	$U = mgh$	$\frac{F}{A} = S\frac{\Delta x}{L}$
$Q = L_v m$	$K = \frac{1}{2}mv^2$	$\Delta P = -B\frac{\Delta V}{V}$
$T_c = \frac{T_F - 32°F}{1.8°F/°C}$	$W_{spring} = {}^1/_2 kx_i^2 - {}^1/_2 kx_f^2$	