UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER 1
SESSION 2010/2011

COURSE	:	BASIC ENGINEERING SCIENCE
CODE	:	BSF2812/BWF21702
PROGRAMME	:	2 BPC
DATE	:	NOVEMBER/ DECEMBER 2010
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY

THIS EXAMINATION PAPER CONSISTS OF **7 PAGES**

ANSWER FIVE (5) QUESTIONS ONLY

Q1 (a) List <u>two (2)</u> basic quantities and <u>two (2)</u> derived quantities and their SI units.

(5 marks)

(b) Hamid driving a lorry with speed 60 km/h. What is the speed in m/s?

(5 marks)

(c) Two forces $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$ with magnitudes 30 N and 50 N respectively, act on a point A. The force $\boldsymbol{F_1}$ acts at an angle 30° to the horizontal and force $\boldsymbol{F_2}$ acts at 45° to the horizontal as in **Figure Q1 (c)**. What is the

(i) x- and y-components for the forces $\boldsymbol{F_1}$ and $\boldsymbol{F_2}$?

(ii) resultant (magnitude and direction)?

(10 marks)

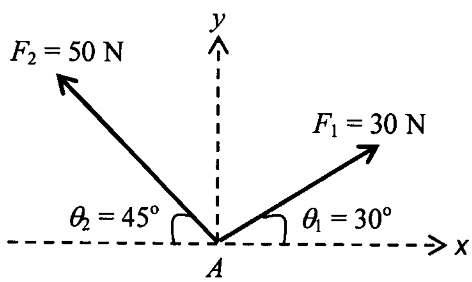

Figure Q1 (c)

Q2 (a) A boy pulls a container full of bananas with force, $\boldsymbol{F}$ 150 N along a horizontal floor. The container has a mass of 5 kg and the friction force, $\boldsymbol{f}$ between the container and the floor is 10 N.

(i) Draw a free body diagram (FBD) and label the forces acted on the container.

(ii) Calculate the net force, $\boldsymbol{F}_{\text{Net}}$ on the container.

(iii) What is the acceleration of the container?

(iv) What is the Newton's law does this system obey?

(12 marks)

(b) A car with a mass of 800 kg is moving with constant speed 20 m/s. What is the

(i) kinetic energy, K of the car?

(ii) momentum, p of the car?

(6 marks)

(c) Rahim does work of 300 J in 10 s. What is his power?

(2 marks)

Q3 (a) (i) State the Pascal's Principle.

(ii) In a hydraulic lift, if the area of the smaller piston is 0.5 m^2 and the area of the larger piston is 5.0 m^2, what weight can the larger piston support when a force of 200 N is applied to the smaller piston?

(7 marks)

(b) Archimedes' Principle states that fluid exerts an upward buoyant force on a submerged object is equal in magnitude to the volume of fluid displaced by the object. Is this a correct statement? If not, correct the statement.

(3 marks)

(c) A wood with an area of 0.5 m^2 and height of 3.0 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 gravity acceleration, g =10 m/s^2, determine the

(i) volume of the wood.

(ii) weight of wood floating on the water.

(iii) buoyancy force.

(iv) volume of water displaced.

(10 marks)

Q4 (a) (i) States Hooke's Law on elasticity.

(ii) By using one example, explain the shear deformation.

(7 marks)

(b) A steel rod 2.0 m long has a cross sectional area of 0.50×10^{-4} m^2. The rod is now hung by one end from a support structure, and a 600 kg weight is hung from the rod's lower end, causing it to elongate 2.0 mm. What is the

(i) stress of the rod?

(ii) strain of the rod?

(iii) Young's modulus of the rod?

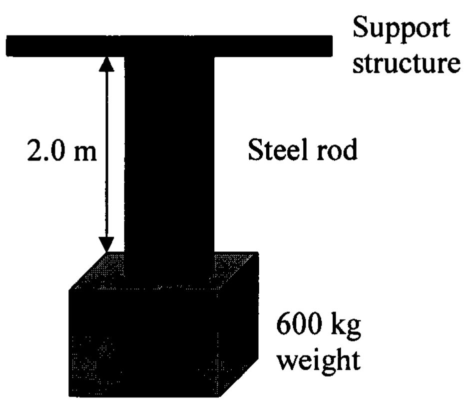

Figure Q4 (b)

(9 marks)

(c) A copper sphere of bulk modulus 130 GPa is subjected to 100 MPa of pressure. By what fraction does the volume of the sphere change?

(4 marks)

Q5 (a) (i) Expansion joint is very important for the roadbed, as shown in **Figure Q5(a).** Explain the importance of the expansion joint based on your knowledge in thermal expansion.

(ii) A highway made of concrete slabs is 15 m long at 20.0°C. If the temperature range at the location of the highway is from -20.0°C to 40.0°C, what size of expansion gap should be left at 40.0°C to prevent buckling of the highway? Given the coefficient of linear expansion of concrete, $\alpha_{concrete} = 12 \times 10^{-6}\ ^{\circ}C^{-1}$.

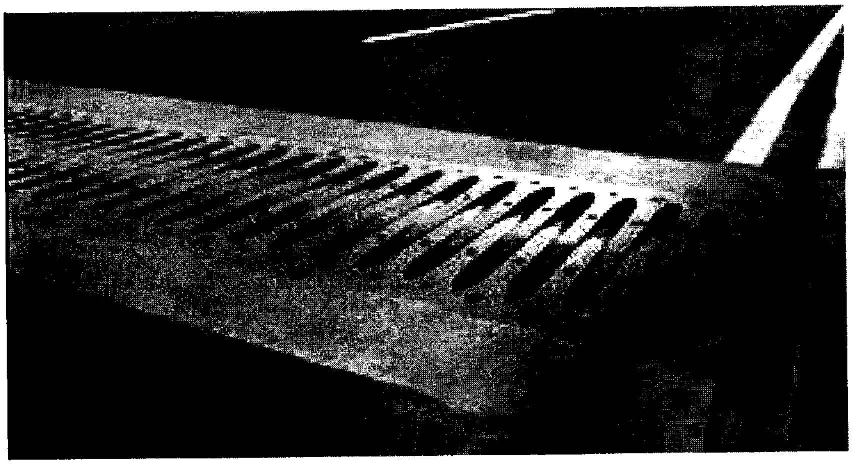

Figure Q5(a)

(6 marks)

(b) (i) Explain what is meant by heat?

(ii) The temperature in a car under hot afternoon is 65°C. What is the temperature in Kelvin and Fahrenheit?

(7 marks)

(c) (i) What is the difference between <u>latent heat of vaporization, L_v</u> and <u>latent heat of fusion, L_f</u>?

(ii) An ice cube at 0 °C has a mass of 0.5 kg. How much heat is required to change the ice completely into water at 0 °C? Given the latent heat of fusion of water, L_{water} = 333.7 kJ/kg.

(7 marks)

Q6 (a) (i) What is the main factor that distinguishes the mechanical waves from the electromagnetic waves?

(ii) By using an example, explain what is meant by the transverse waves?

(iii) By sketching a simple diagram, explain what is amplitude and wavelength?

(11 marks)

(b) A transverse wave with frequency of 0.2 Hz and speed of 100 m/s is illustrated in **Figure Q6(b)**. Find

(i) the amplitude, A.

(ii) the period, T.

(iii) the wavelength, λ.

(iv) wave number, k.

(9 marks)

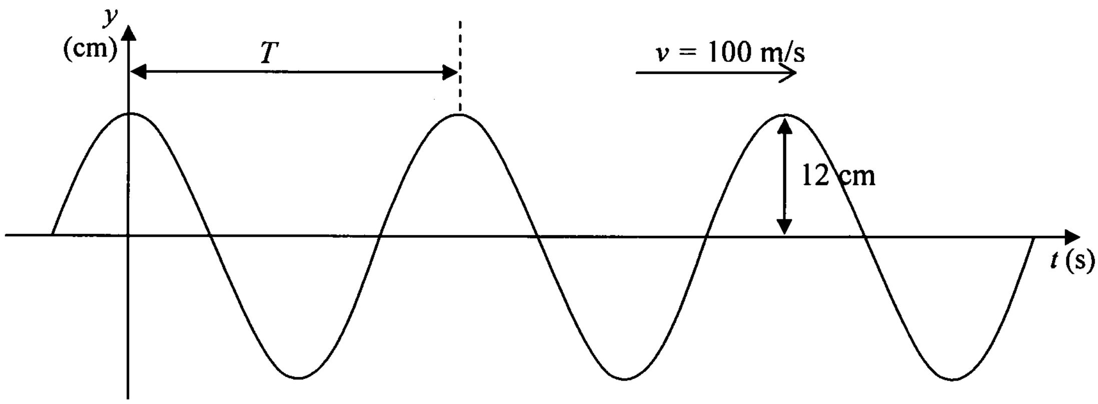

Figure Q6 (b)

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

$\Delta L = \alpha L_0 \Delta T$	$T_K = T(K/°C) + 273.15K$	$PE_{spring} = {}^1/_2kx^2$
$\Delta A = 2\alpha A_0 \Delta T$	$R = d/\kappa A$	$W = Fs\cos\theta$
$\Delta V = \beta V_0 \Delta T$	$Q = \kappa A \Delta T t/d$	$\Delta U = -W$
$\gamma_{apparent} = \gamma_{absolute} - \gamma_{glass}$	$v = f\lambda = \omega/k = (\tau/\mu)^{1/2}$	$\Delta K = W$
$V_{apparent} = V_{absolute} - V_{glass}$	$\mu = m/L$	$P = W/t$
$PV = nRT = Nk_BT$	$\omega = 2\pi f$	$\omega^2 = k/m$
$N = M/m$	$f = 1/T$	$\rho = m/V$
$n = N/N_A$	$k = 2\pi/\lambda$	$P = F/A = \rho gh$
$R = N_A k$	$f = nv/2L$	$P_{absolute} = P_{gauge} + P_{atm}$
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$	$F = ma$	$F_B = \rho gV$
$Q = mc\Delta T$	$F_f = \mu_k N$ $F_f = \mu_s N$	$\frac{F}{A} = Y\frac{\Delta L}{L}$
$Q = L_f m$	$U = mgh$	$\frac{F}{A} = S\frac{\Delta x}{L}$
$Q = L_v m$	$K = \frac{1}{2}mv^2$	$\Delta P = -B\frac{\Delta V}{V}$
$T_c = \frac{T_F - 32°F}{1.8°F/°C}$	$W_{spring} = {}^1/_2kx_i^2 - {}^1/_2kx_f^2$	