Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2013/2014

COURSE NAME	:	BASIC ENGINEERING SCIENCE
COURSE CODE	:	BPD 24002/BWM 21702/BSF 2812
PROGRAMME	:	2 BPC
EXAMINATION DATE	:	DECEMBER 2013/JANUARY 2014
DURATION	:	2 HOURS
INSTRUCTION	:	A) ANSWER **ALL** QUESTIONS
		B) ANSWER **TWO (2)** QUESTIONS ONLY

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

SECTION A

Q1 (a) The speed of sound in air at 20°C is 344m/s.

(i) Calculate the wavelength of a sound wave with a frequency of 32.0 Hz.
(3 marks)

(ii) Calculate the frequency of a wave with a wavelength of 1.22m?
(3 marks)

(b) A fisherman notices that his boat is moving up and down periodically owing to waves on the surface of the water. It takes 3.0 s for boat to travel from its highest point to its lowest, a total distance of 8.00m. The fisherman sees that the wave crests are spaced 8.0 m apart.

(i) Calculate the speed of waves travelling?
(3 marks)

(ii) Calculate the amplitude of each wave?
(2 marks)

(c) Figure **Q1** shows the graph of sinusoidal wave travelling in second, s. Given the wavelength of the wave is 0.15 m.

(i) Calculate the period.
(2 marks)

(ii) Calculate the frequency.
(3 marks)

(iii) Calculate the speed of the wave.
(3 marks)

(iv) Calculate angular frequency.
(3 marks)

(v) Shows the equation of the travelling wave.
(3 marks)

Q2 (a) A steel bridge is built in the summer when the temperature is 32.0°C. At the time of construction its length is 80.0m ($\alpha_{steel} = 1.25 \times 10^{-4}\ C^{-1}$).

Calculate the length of the bridge on a cold winter day when the temperature is -8.0°C.

(6 marks)

(b) A glass flask with a volume 180 cm^3 is filled to the brim with mercury at 25°C. Given the coefficient of volume expansion, β of the glass is $1.2 \times 10^{-5}\ K^{-1}$ and mercury is $18 \times 10^{-5}\ K^{-1}$.

Calculate the mercury overflows when the temperature of the system is raised to 100°C.

(7 marks)

(c) Figure **Q2** shows bimetallic strip, brass and iron in room temperature, 25°C. They have 0.5 m long. Given linear expansion, $\alpha_{Brass} = 19 \times 10^{-6}\ C^{-1}$ and $\alpha_{iron} = 12 \times 10^{-6} C^{-1}$.

(i) Calculate the final length if the brass and iron heated to 50°C.

(6 marks)

(ii) Calculate the changes in length if they had been cooled to 10°C.

(4 marks)

(iii) Explain with sketches when the bimetallic strip in the Figure Q2 is affected in case of heated and cooled.

(2 marks)

SECTION B

Q3 (a) Describe;

(i) Work, W.

(ii) Potential energy, U.

(iii) Power, P.

(6 marks)

(b) As part of a charity fund-raising drive, a Chicago marathon runner with mass 50.0kg runs up the stairs to the top of the tower, with height 443 m in 15.0 minutes.

Calculate the average power output.

(5 marks)

(c) Farmer John hitches his tractor to a sled loaded with firewood and pulls it a distance of 20 m along level ground. The tractor exerts a constant 5000 N force at angle of 36.9° above horizontal. There is a 3500 N friction force opposing the motion.

(i) Calculate the work done by the tractor.

(3 marks)

(ii) Calculate the work done by the friction force.

(3 marks)

(iii) Calculate the final speed if the initial speed v_i=2.0 m/s, and the total mass of sled and load is 14, 700 N.

(8 marks)

Q4 (a) Describe **THREE (3)** types of the deformation in elastic modulus.

(6 marks)

(b) The volume of the oil container in a certain hydraulic press is 0.25 m^3. Given the Bulk Modulus of the oil is B= 5.0 x 10^9 Pa.

Calculate the decrease in the volume of the oil when it is subjected to a pressure increase $\Delta P = 1.6 \times 10^7$ Pa.

(6 marks)

(c) A small elevator of mass 550 kg hangs from a steel cable 3.0 m long. The wires making up the cable have a total cross-section area of 0.20 cm^2, and with this load cable stretches to 3.40 m long.

(i) Calculate stress of the steel cable.

(5 marks)

(ii) Calculate strain of the steel cable.

(5 marks)

(iii) Calculate Young's modulus for the steel in the cable.

(3 marks)

Q5 (a) Describe;

(i) Density, ρ.

(ii) Specific gravity, s.g.

(4 marks)

(b) A rectangular block has dimensions 5.0 m width, 30.0 m length and 15.0 m height.

Calculate;

(i) The density of the rectangular block.

(3 marks)

(ii) The specific gravity of the rectangular block.

(2 marks)

(c) The pistons of a hydraulic automobile lift are 0.30 m and 0.5 m in diameter.

Calculate the force applied to the small piston if the mass of a car if 900 kg.

(6 marks)

(d) A solar water heating system uses solar panels on the roof, 12.0 m above the storage tank. The pressure at the level of the panels is one atmosphere. Given 1atm is 1.013×10^5 Pa.

Calculate;

(i) The absolute pressure in the tank.

(7 marks)

(ii) The gauge pressure.

(3 marks)

- END OF QUESTION -

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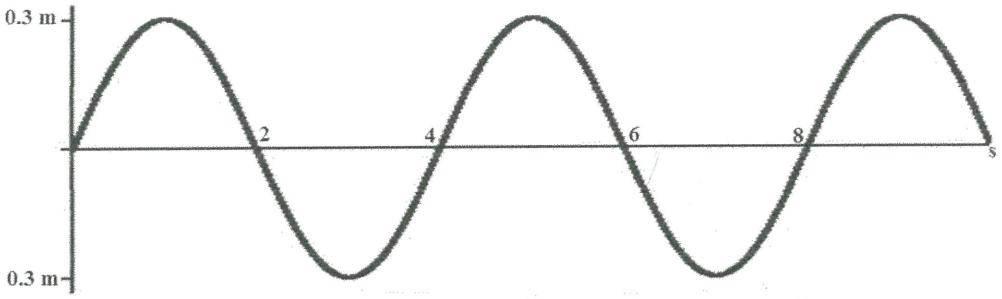

FIGURE Q1

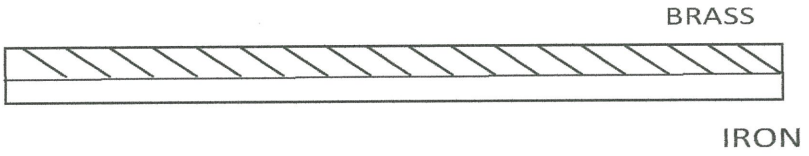

FIGURE Q2

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Lists of formula and constants:

Gravitational acceleration = 10 m/s^2
Density of water = 1000 kg/m^3
Atmosphere pressure = 1.013 x10^5 pa

$\rho = \frac{m}{v}$	$p = \frac{F}{A}$	$P = P_{atm} + \rho gh$	$\frac{F_1}{A_1} = \frac{F_2}{A_2}$
$s.g = \frac{density\ of\ substance}{density\ of\ water}$	$W = Fs$	$W = Fs\cos\theta$	$W_{tot} = K_f - K_i$
$K = \frac{1}{2}mv^2$	$P_{av} = \frac{\Delta W}{\Delta t}$	$w = mg$	$\Delta L = \alpha L_0 \Delta T$
$y(x,t) = A\sin(kx - \omega t)$	$k = \frac{2\pi}{\lambda}$	$T = \frac{1}{f}$	$\omega = 2\pi f$
$\Delta V = -\frac{V_o \Delta P}{B}$	$Y = \frac{F/A}{\Delta l/l_o}$	$\sigma = \frac{F}{A}$	$\varepsilon = \frac{\Delta l}{l_o}$
$F = ma$	$\Delta L = \alpha L_o \Delta T$	$\Delta A = 2\alpha A_o \Delta T$	$\Delta V = \beta V_o \Delta T$
$v = \frac{\lambda}{T} = f\lambda$	$P = Fv$		