UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT	:	PHYSICS II
CODE	:	DSF 1973
COURSE	:	1DDT, 1DDM, 1DFA, 1DEE
EXAMINATION DATE	:	APRIL / MAY 2010
DURATION	:	2 ½ HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN **PART A** AND **THREE (3)** QUESTIONS IN **PART B**

THIS EXAMINATION PAPER CONSISTS OF **10 PAGES**

PART A

Q1 (a) The electromagnetic spectrums can be classified as follow:

(1)	X-rays	(4)	visible light
(2)	radio waves	(5)	infrared radiation
(3)	gamma rays	(6)	ultraviolet radiation

Sort the list of the spectrum with respect to the ***increment of the frequency***.

(6 marks)

(b) An electromagnetic wave is propagating in a vacuum in the $+x$ direction with electric field, **E** pointing in the $+y$ direction as shown in **Figure Q1(b)**. Maximum electric field, E_o is 5.8×10^{-3} $\mathrm{Vm^{-1}}$. The wavelength is 275 nm, find

(i) the frequency, f.

(ii) the maximum magnetic field, B_o.

(iii) the vector expressions for **E** and **B** as a function of position and time.

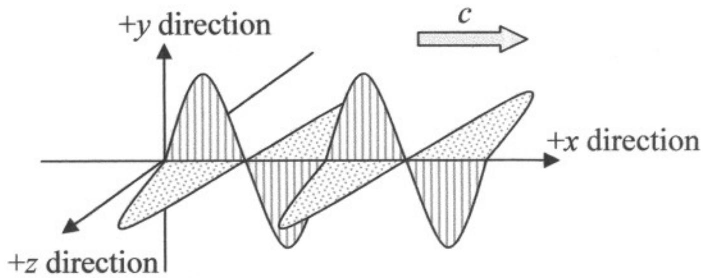


Figure Q1(b)

(6 marks)

(c) A ray of light is reflected from two plane mirror surfaces as shown in the **Figure Q1(c)**. What are the correct values of α and β ?

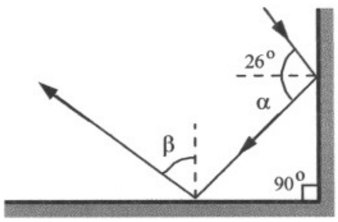


Figure Q1(c)

(4 marks)

(d) A beam of light in the water makes an angle of incidence as it enters a piece of unknown transparent material as illustrated in **Figure Q1(d)**. The beam is refracted at an angle of 40.5° in the material. If the refraction index of water, n = 1.33, find the index of refraction of the unknown material.

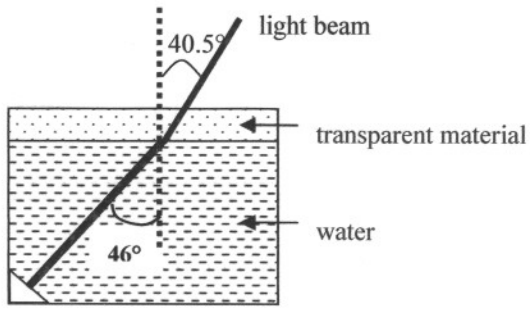


Figure Q1(d)

(4 marks)

Q2 (a) Red laser light passes through a single slit to form a diffraction pattern. If the width of the slit is increased by a factor of two, what happens to the width of the central maximum?
Note: *Assume that the angle* θ *is sufficiently small so that* (sin θ) *is nearly equal to* θ.

(4 marks)

(b) A double slit is illuminated with monochromatic light of wavelength 6.00×10^2 nm. The $m = 0$ and $m = 1$ bright fringes are separated by 3.0 cm on a screen which is located 4.0 m from the slits. What is the separation between the slits, d?

(5 marks)

(c) In two separate double slit experiments, an interference pattern is observed on a screen. In the first experiment, violet light (λ = 754 nm) is used and a second-order bright fringe occurs at the same location as a third-order dark fringe in the second experiment. Determine the wavelength of the light used in the second experiment.

(7 marks)

(d) Light with a wavelength of 644 nm uniformly illuminates a single slit. What is the width of the slit, a if the first-order dark fringe is located at $\theta = 0.13°$?

(4 marks)

PART B

Q3 (a) A 5.0 kg object is hung as in **Figure Q3(a)** from the end of a wire of cross-sectional area 0.010 cm^2. The wire stretches from its original length of 200.00 cm to 200.50 cm.

(i) What is the stress, σ on the wire?
(ii) What is the strain, ε on the wire?
(iii) Determine the Young's modulus, Y of the wire.

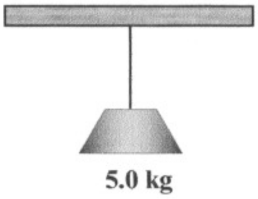


Figure Q3(a)

(6 marks)

(b) The brick shown in **Figure Q3(b)** is glued to the floor. A 4 kN force is applied to the top surface of the brick as shown. If the brick has a shear modulus of 5.4×10^9 Nm^{-2}, how far to the right does the top face move relative to the stationary bottom face?

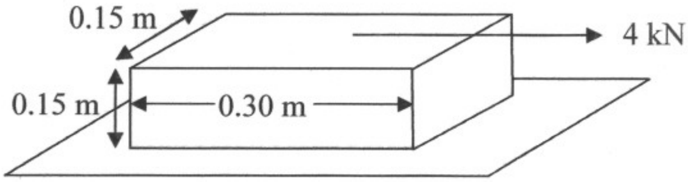


Figure Q3(b)

(7 marks)

(c) The radius of a sphere of lead is 1.00 m on the surface of the earth where the pressure is 1.01×10^5 Nm^{-2}. The sphere is taken by submarine to the deepest part of the ocean to a certain depth and it exposed to a pressure is 1.25×10^8 Nm^{-2}. What is the volume of the sphere at the bottom of the ocean? Given bulk modulus for lead, $B_{lead} = 4.2 \times 10^{10}$ Nm^{-2}.

(7 marks)

Q4 (a) A column of water of height 70.0 cm supports a column of an unknown liquid as suggested in the **Figure Q4(a)**. Assume that both liquids **are at rest** and that the density of water is 1.0×10^3 kgm^{-3}. Determine the density of the unknown liquid.

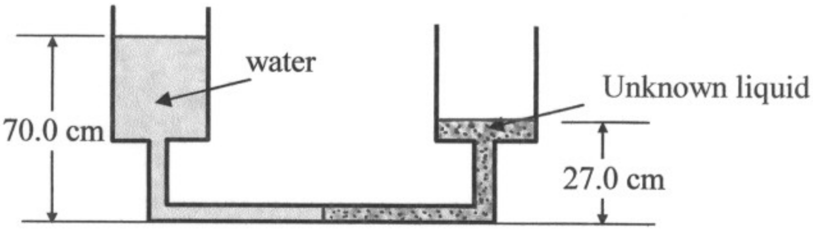


Figure Q4(a)

(7 marks)

(b) In a car lift as shown in **Figure Q4(b)**, compressed air with a gauge pressure of 4.0×10^5 Pa is used to raise a piston with a circular cross-sectional area. If the diameter of the piston is 0.34 m, what is the maximum mass that can be raised using this piston?

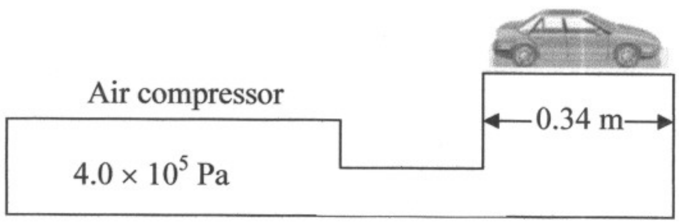


Figure Q4(b)

(6 marks)

(c) A 2-kg block is tied down as shown in the **Figure Q4(c)** and it displaces 5 kg of water. What is the tension in the string? Given density of water, $\rho_\omega = 1000$ kgm^{-3}.

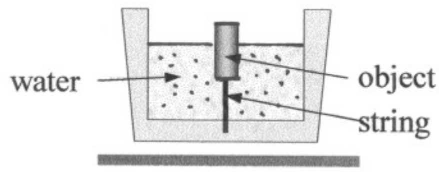


Figure Q4(c)

(7 marks)

Q5 (a) An electronic circuit element made of 23 mg of silicon. The specific heat capacity of silicon is 705 Jkg^{-1}K^{-1}. The electric current through it adds energy at the rate of 7.4×10^{-3} Js^{-1}. If the design does not allow any heat transfer out of the element, find

(i) the thermal energy, Q.
(ii) the temperature increase.

(6 marks)

(b) A man drinks his morning coffee using an aluminum cup which has a mass of 0.12 kg and is initially at 25 °C when he pours in 0.3 kg of coffee initially at 82 °C. Assume that coffee has the same specific heat capacity as water and that there is no heat exchange with the surroundings. Given specific heat for aluminum, $c_{Al} = 910$ $Jkg^{-1}K^{-1}$.

(i) Show the equation involved when the coffee and the cup attain thermal equilibrium.
(ii) Calculate the final temperatures after the two heat change are in equilibrium.

(6 marks)

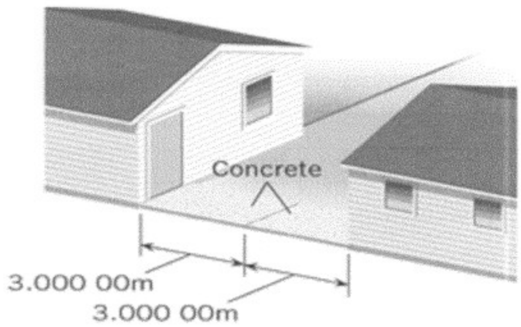
(c) Two metal plates are soldered together. If the area of the plate, $A = 50$ cm^2 and the thickness of both plates are the same, 5 mm. For plate 1, the temperature is 100 °C and its conductivity, k is 48.1 $Wm^{-1}K^{-1}$ while for plate 2 temperature is 30 °C and $k = 68.2$ $Wm^{-1}K^{-1}$. Find

(i) the temperature, T of the soldered junction at thermal equilibrium.
(ii) the heat flow rate through the plates.

(8 marks)

Q6 (a) A concrete sidewalk is constructed between two buildings on a day when the temperature is 25 °C. As the temperature rises to 38 °C, the slabs expand, but no space is provided for thermal expansion. Given linear expansion, $\alpha_{concrete} = 12 \times 10^{-6}$ $°C^{-1}$.

(i) Calculate the linear expansion, ΔL of the concrete sidewalk.
(ii) If the center of the side walk was lifted up by the thermal force as seen in the **Figure Q6(a)**, calculate the distance y.



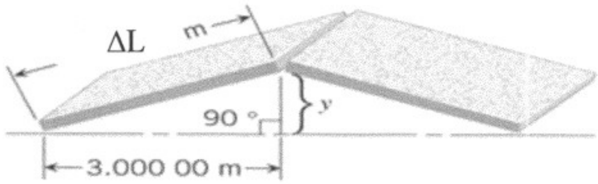


Figure Q6(a)

(7 marks)

(b) A circular hole in an aluminum plate as shown in **Figure Q6(b)** is 2.725 cm in diameter at 0 °C. What is the diameter of the hole if the temperature of the plate is raised to 100 °C? Given the coefficient of area expansion for aluminum, $\beta_{Al} = 46 \times 10^{-6}\,°C^{-1}$.

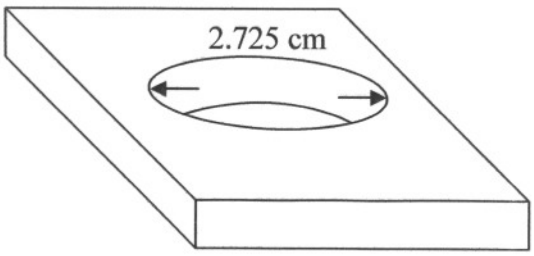


Figure Q6(b)

(7 marks)

(c) A tanker ship is filled with $2.25 \times 10^{5}\ m^{3}$ of gasoline at a refinery in Port Klang, Malaysia where the temperature is 36.5 °C. When the ship arrives in Incheon Port, South Korea the temperature is 5 °C. If the coefficient of volumetric expansion for gasoline, γ is $9.50 \times 10^{-4}\,°C^{-1}$, how much has the volume of the gasoline decreased when it is unloaded at Incheon Port?

(6 marks)

Q7 (a) A progressive wave is represented by the following equation:

$$y = 6 \sin 4\pi(40t + x)$$

where y and x are measured in centimeter and t in seconds.
Determine

(i) the amplitude, A.
(ii) the angular frequency, ω.
(iii) the frequency, f.
(iv) the wavelength, λ.

(8 marks)

(b) The Young's modulus of aluminum, Y_{Al} is 6.9×10^{10} N/m^2. Determine the speed of sound in an aluminum rod. Given the density of aluminum, $\rho_{Al} = 2700$ kg/m^3.

(4 marks)

(c) Standing waves is formed inside a pipe with one open end as illustrated in **Figure Q7(c).** The length of the pipe is 0.5 m.

(i) If third harmonics series of standing wave is occurred inside the pipe, draw an appropriate diagram of this particular standing wave.
(ii) Give a number of the node and antinode should be formed from Q7(c) (i) above.
(iii) What is the distance between the adjacent antinodes and the nodes?
(iv) Calculate the wavelength of the pipe, λ in the third harmonics.

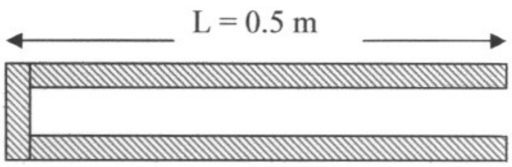


Figure Q7(c)

(8 marks)

LIST OF CONSTANTS

1. Gravity acceleration, $g = 9.81$ m/s^2
2. Speed of light in air, $c = 3 \times 10^8$ m/s
3. Speed of sound, $v_{sound} = 340$ m/s
4. Threshold of sound intensity, $I_o = 1 \times 10^{-12}$ W/m^2
5. Atmospheric pressure, $P_{atm} = 1.0 \times 10^5$ Pa
6. Specific heat of water, $c_{water} = 4200$ Jkg^{-1}K^{-1}
7. Specific heat of ice, $c_{ice} = 2100$ Jkg^{-1}K^{-1}
8. Latent heat of fusion of water, $L_f = 333.7 \times 10^3$ J/kg
10. Latent heat of vaporization of water, $L_v = 2256 \times 10^3$ J/kg
11. Density of seawater, $\rho_{seawater} = 1030$ kg/m^3
12. Density of water, $\rho_{water} = 1000$ kg/m^3

LIST OF FORMULAS

$\frac{F}{A} = Y\frac{\Delta L}{L}$	$\frac{F}{A} = S\frac{\Delta x}{L}$	$\frac{F}{A} = -B\frac{\Delta V}{V}$
$T_F = 1.8T_C + 32^o F$	$\Delta L = \alpha L_o \Delta T$	$\Delta A = \beta A_o \Delta T$
$Q = mc\Delta T = Pt$	$Q = mL_f$	$Q = mL_v$
$\Delta V = \gamma V_o \Delta T$	$\gamma = \gamma_{apparent} + \gamma_{glass}$	$\frac{Q}{t} = \frac{\Delta T}{\sum R_n}$
$\frac{Q}{t} = \kappa A\frac{\Delta T}{d}$	$\Delta P = \frac{F_1}{A_1} = \frac{F_2}{A_2}$	$F = \rho g V$
$P = \frac{F}{A} = \rho g h$	$F_{net} = W - F_B$	$P_{abs} = P_{atm} + \rho g h$
$\rho = \frac{m}{V}$	$W=mg$	$f = \frac{1}{T}$
$\omega = \frac{2\pi}{T} = 2\pi f$	$\lambda = \frac{v}{f}$	$k = \frac{2\pi}{\lambda}$
$v = \frac{\omega}{k}$	$y = A\sin(kx - \omega t)$	$I = \frac{P}{A}$
$\beta = 10\log\left(\frac{I}{I_o}\right)$	$A_{circle} = \pi r^2$	$A_{sphere} = 4\pi r^2$

$v = \sqrt{\frac{T}{\mu}}$	$v_{solid} = \sqrt{\frac{Y}{\rho}}$	$v_{liquid} = \sqrt{\frac{B}{\rho}}$
$\lambda = \frac{2L}{n}$	$f = \frac{nv}{2L}$	$f_o = f_s \frac{(v \pm v_o)}{(v \mp v_s)}$
$n_1 \sin\theta_1 = n_2 \sin\theta_2$	$E_o = cB_o$	$c = \lambda / f$