Menoufia University
Faculty of Engineering
(Shebin El-Kom)
Basic Eng. Sciences Department
First Semester Examination
Date of Exam : 23 / 01/2016

Subject: Physics 1-A
Code: BES 012
Year: Preparatory
Time Allowed: 3 hours
Total Marks: 75
2015 / 2016

**Answer all the following questions:** الامتحان في صفحتين

## Part 1

**Question (1)** (12 Marks)

a) Prove that the general solution of the simple harmonic motion (SHM) is described by sinusoidal functions.

b) Prove that the acceleration of gravity varies with altitude and determine the position at which the acceleration of gravity is vanished from the center of earth.

c) A 8 kg ball suspended motionless under influence of gravity from a spring with a force constant 20N/cm.

i) How much is the spring stretched?

ii) The same spring is sent to the moon and suspended in the same way. How much is the spring stretched and determines the angular frequency.

**Question (2)** (13 Marks)

a) Describe and explain Kepler's second law (Law of areas).

b) Determine the value of poisson's ratio of a cylindrical wire.

c) Describe and explain: i) Young's modulus ii) shear's modulus

d) A satellite moves in a circular orbit around the earth, taking 80min to complete one revolution. The distance from the moon to earth is $4x10^8$m, the moon's orbit is circular, the period of the moon`s rotation about the earth is 28 days and earth radius is $6.37x10^6$m. Calculate the height of the satellite above the earth.

## Part 2

**Question (3)** (12 Marks)

a) If the airplane wings designed such that the velocity of air above the wing is greater than its velocity below the wing. Using Bernoulli's equation, derive an equation for the lift force on the airplane wings, then find the net force on the airplane.

b) A liquid of density 1.2 x $10^3$ kg/$m^3$ flows in a horizontal pipe. The cross-sectional area in one part of the pipe is 50 $cm^2$. When the liquid enters another part of the pipe with cross-sectional area 100 $cm^2$, the pressure as measured by a gauge is 2.0 x $10^4$ $P_a$ higher than it was in the first part.

i) Calculate the velocities of the liquid in the two parts of the pipe.

ii) At what rate does the water flow through the pipe? $\rho_w$=$10^3$ Kg/$m^3$

c) i) How many joules of heat are required to change 1 kg of ice at -20°C to water at 0°C.

ii) If the heat, calculated in part 1, is gained by 1g of water calculate the change in its temperature.

( $c_{water}$ = 4186 J/Kg.°C, $c_{ice}$ = 2.1x$10^3$ J/Kg.°C, $L_f$ = 3.34x$10^5$ J/Kg)

**Question (4)** (13 Marks)

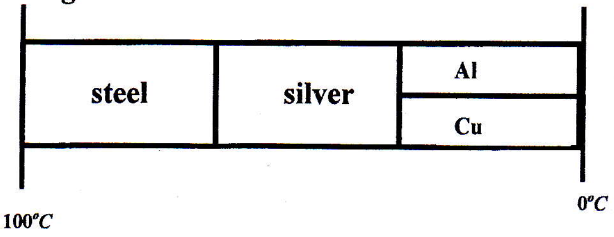
a) What means by:

i) Latent heat of vaporization of water is 2.26 x $10^6$ J/kg.

ii) What happens to the volume rate of blood flow through an artery, if its radius is reduced by 0.25 of its original radius and the length of artery is doubled?

c) A wall consists of steel and silver layers each of 10 cm thickness and $4 cm^2$ square cross- sectional area is welded face to face to copper and aluminum layers, each of thickness 10cm and $2\ cm^2$ square cross- sectional area as shown in the figure. The free end of the steel layer is maintained at 100°C and the other end of the aluminum and copper is maintained at 0°C and wall is thermally insulated to prevent heat loss to air from lower and upper ends. When the energy transfer reaches steady state calculate the total rate of heat flow by conduction (H) through the cross- sectional area of the wall.

*($K_{steel} = 40\ W/.m.^{o}C$ , $K_{copper} = 380\ W/.m.^{o}C$, $K_{aluminium} = 200\ W/.m.^{o}C$, $K_{copper} = 420\ W/.m.^{o}C$)*

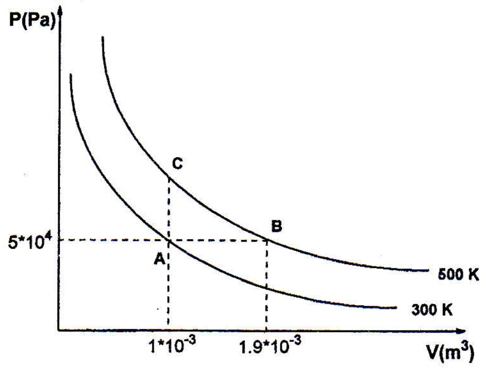



## Part 3

## Question (5) (13 Marks)

a) Find the relation between the volume and linear thermal expansion coefficients in case of an isotropic material? (Derive with mention the related physical concept).

b) The diagram shows curves relating pressure (P) and volume (V) for fixed mass of an ideal monoatomic gas at 300K and 500K. The gas is in a container fitted with a piston which can move with negligible friction. The number of moles of gas is $2.07 \times 10^{-2}$and molar gas constant R=8.314 $JK^{-1}\ mol^{-1}$. Explain how the first law of thermodynamics applies to changes represented on the graph by (i) A to C and (ii) A to B. Calculate the heat energy absorbed in each case. (iii) Explain the difference in the absorbed heat energy between two paths.




c) A steel rod is 4cm in diameter at 25°C. A brass ring has an interior diameter of 3.993cm at 25°C. Consider both of materials are isotropic and the linear expansion coefficients for steel and brass are $11\times10^{-6}$ and $19\times10^{-6}$, respectively. At what common temperature will the ring just slide onto the rod?

## Question 6 (12 Marks)

a) True or false with explain

i) The work done required to take a system from certain initial and final states in case of isobaric process is greater than that required for the same initial and final states using isothermal process.

ii) The change in entropy for certain system is equal to zero when that system subject to isothermal process.

iii) For compression adiabatic process on system, the temperature of the system remains constant.

b) An ideal gas ($n=3\times10^{-2}$) is contained in a cylinder by frictionless piston. The molar gas constant R=8.314 $JK^{-1}\ mol^{-1}$.

i) Find the work done by the gas as it expands from a volume of $0.015 m^3$ to a volume of $0.027\ m^3$ at constant pressure of $2\times10^5$ Pa.

ii) Total change in entropy during the process.

c) Describe with draw the working (cycle) principles of Carnot engine.

| This exam measures the following ILOs | | | | | | | | | | | | | | | | |
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| Question Number | Q2-a | Q2-b | Q1-a | Q1-b | Q3-a | Q4-a | Q1-c | Q6-b,c | Q2-c | Q2-d | Q3-b | Q4-b | Q5-b,c | Q6-a | Q3-c | Q4-c |
| Skills | a1-1 | a1-2 | a2-1 | a2-1 | a1-2 | a1-2 | b4-1 | b4-1 | b2-1 | b4-1 | b4-1 | b4-1 | c9-1 | c9-1 | c4-3 | c3-3 |
| | Knowledge &Understanding Skills | | | | | | Intellectual Skills | | | | | | Professional Skills | | | |

*with our best wishes*