G.C.E. A/L Examination November - 2015

Conducted by Field Work Centre, Thondaimanaru
In Collaboration with
Zonal Department of Education Jaffna.

FWC

Grade :- 13 (2016)	Part - II B	Physics - II

Essay

Answer any four Questions

01)

(a) Bernoulli's equation can be written as

$P + 1/2\rho v^2 + \rho gh = constant$

Here all notations have their general meaning

i) State the conditions where Bernoulli's equation will be valid.

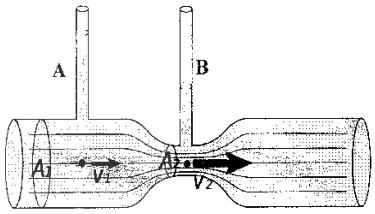
ii) by applying dimensional analysis only to $1/2\rho v^2$ and show that it has the dimension of pressure

iii) state two events that can explained by Bernoulli's equation but not mentioned in this question

iv) draw stream line flow diagram to explain one incident you mention in a(iii).

v) write the equation of continuity and explain the notions in it

(b) the figure shows a simple setup of venture meter. This is used to measure the speed of liquids flowing through pipes. A liquid flows steadily from X to Y in the tube. X, Y are two points in the stream line at the center of the tube.



The pressure and velocity at X and Y are V_1, V_2 and P_1, P_2 respectively. The cross sectional surface area perpendicular to stream line at X and Y are A_1 ,A_2 respectively.

i) draw the water column in tubes A and B, by copying the figure of the venturimeter to your answer sheet.

ii) write Bernoulli's equation at A and B with respect to V_1, V_2 , P_1, $P_2$and density of liquid ρ

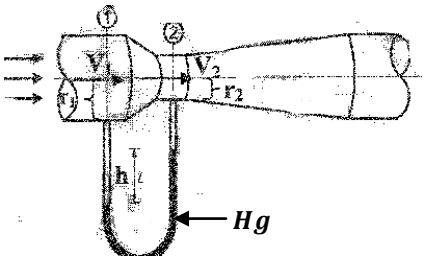
iii) the height of liquid column in tubes A and B are h_1, h_2 respectively. Atmospheric pressure is π cm Hg. State the expression for the pressure P_1, P_2 at points X and Y respectively.

iv) by applying equation of continuity to the cross sections at X, Y and using the equation from a(ii), a(iii), write an expression for the velocity of water flow V_1 with respect to h_1, h_2, A_1, A_2, ρ.

v) the venturimeter is fixed to a tube through which oil flows. The difference between oil level in A and B is 80cm. if the cross sectional area at Y is half of cross sectional area at X, find the velocity of oil flowing through the tube ($g = 10ms^{-2}$)

vi) in the above mentioned tube oil spills out at constant speed through a hole in tube and the speed of oil in the tube is reduced to 1m/s. find the speed of oil flowing through the hole? Consider the radius of cross section at X is 20cm

(c) in a venturimeter air flows from left to right as shown in the figure. Find the difference in the mercury level (h). r_1 = 1cm, r_2 = 0.5cm, v_1 = 15m/s , density of air = 1.3kgm^{-3}, density of mercury = 13.6X10^{3}kgm^{-3}, g =10ms^{-2}



02)

(a)

i) define the angular magnification of astronomical telescope.

ii) if the focal length of eye piece and objective of an astronomical telescope is f_o, f_e respectively, draw the ray diagram for this telescope at normal adjustment

iii) from the ray diagram you drawn derive an expression for angular magnification M in relation to f_o, f_e.

iv) if focal length of eye piece is 6cm and focal length of objective is 60cm, find the angular magnification of telescope?

v) what do you understand by eye ring of a telescope?

vi) in normal adjustment find the distance between eye ring and eye piece in relation to f_o, f_e

vii) by using the expression you obtained in a(vi), write an expression for the angular magnification M in relation to the diameter of objective (D) and diameter of eye ring(d).

viii) by considering that eye is situated very close to eye piece of a telescope at normal adjustment and the diameter of pupil is 3mm. if the light from objective fill the pupil find the diameter of the objective?

ix) when the moon is observed by the above telescope at same adjustment the angle made by the final image with eye is 10^0, find the angle made by moon with naked eye?

(b) Consider a situation where the distance between the objective and eye piece of the above mentioned telescope is 90cm and an object of height 11mm is placed 100cm infront of objective.

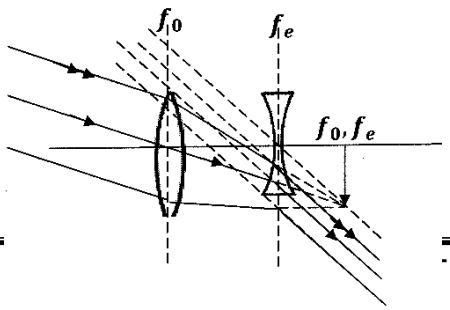
i) find the position of image formed by the objective

ii) find the distance between final image and eye piece?

iii) what is the height of final image?

(c) The figure shows an astronomical telescope made with a convex lens of focal length f_o as objective and a concave lens of focal length f_e as eye piece.

i) on the basis of the diagram derive an expression for the angular magnification of this telescope.



ii) state one advantage and one disadvantage of this telescope.

03)

(a)

i) what do you understand by Doppler's effect?

ii) state two application of Doppler's effect.

iii) when the sound source moving with a speed of V_s follows an observer moving with a speed of V_0, it emits a sound of frequency fHz. Find the apparent frequency heard by the observer in relation to V_s, V_o, f, c. c is the velocity of sound in air.

iv) a bird flying very low with a speed of 20m/s emits a sound of frequency 300Hz. The bird passes a stationary observer. If the speed of sound is 320m/s calculate the change in frequency observed by the observer?

(b) a boat moves towards a hill with speed of 18km/h emitting a sound of frequency 335Hz. Speed of sound in steady air is 340m/s.

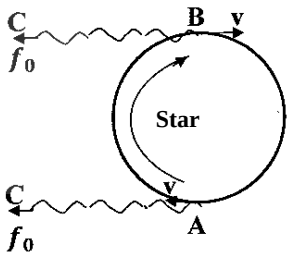
i) what is the apparent frequency heard by a man in the hill

ii) the sound was reflected by the hill. What is the frequency of sound heard by the man in the boat?

iii) if he hears the reflected sound and the direct sound, how many beats will he observe in a second?

iv) if air blows from boat towards the hill with the speed of 5m/s, , how many beats will the man observe in a second?

(c) the rotational speed of a star can be measured from the earth by using Doppler's effect. c – speed of light , v – speed of star's edge, f_o– real frequency of light emitted by star.



i) write an expression for the apparent frequency (f) of light emitted from A as seen from earth in relation to c, v, f_0

ii) write an expression for the apparent frequency (f^1) of light emitted from B as seen from earth in relation to c, v, f_0

iii) if $\Delta f = f - f^1$, show that $\frac{\Delta f}{f_o} = \frac{2V}{C}$, $C >> V$

iv) if $\Delta f/f = 4X10^{-8}$, c = 3 X 10^8, find the rotational speed of the star.

04)

a) Consider a satellite of mass m that rotates the earth in a circle of radius of r.radius and mass of earth is R, M respectively. Consider satellite experience only an attraction from earth.

i) write an expression for the gravitation force acting on satellite and explain the notations used by you.

ii) write an expression for the kinetic energy of the satellite in relation to G, M, m, r

iii) write an expression for the potential energy of the satellite in relation to G, M, m, r

iv) write an expression for the total energy of the satellite in relation to gravitational field strength g, m, r.

v) find the total energy of a satellite of mass 1000kg rotating earth at a distance of 8000km. g =10ms^{-2}, radius of earth of = 6400km

vi) find the minimum energy needed to move the satellite to the orbit from the surface of earth.

b) Geo stationary satellites are those rotating with same time period as that of the plane passing through the equator, in an approximately circular orbit.

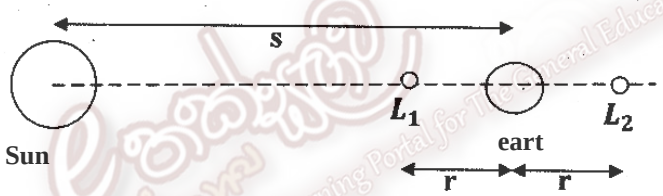
i) find the period of rotation of geo stationary satellite.

ii) if a geo stationary satellite rotates the earth in a radius of r, find an expression for r in relation to T – period of rotation of satellite, R – radius of earth, g – gravitational field strength

iii) can the geo stationary satellites be placed at different heights from the earth surface?

iv) at what distance a geo stationary satellite can placed from the surface of earth? g =10ms^{-2}, radius of earth of = 6400km

c) The places where satellite form earth are placed to examine the outer universe is known as L points. The satellites placed in these points appears to be stationary with respect to sun - earth system. Figure shows two L points L_1, L_2. A satellite is placed at L_2. Consider that satellite is only influenced by the earth and sun.

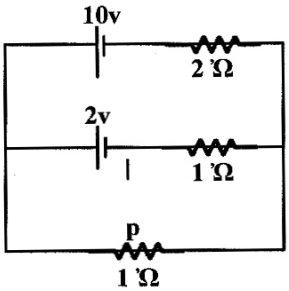


i) find the angular velocity of the satellite?

ii) though the distance to L_1, L_2 are in different distance from sun, how do they have same period of rotation? Write down the expression for the kinetic equations by considering M_s – mass of sun, M_e – mass of earth, mass of satellite placed at L_1 or L_2 is m, ω – angular velocity of the satellite

05)

a) In the figure shown a battery with e.m.f 10V and internal resistance 2Ω, another battery with e.m.f 2V and internal resistance 1Ω are connected parallel to each other. A resistance P of 1Ω is connected across the two cells.

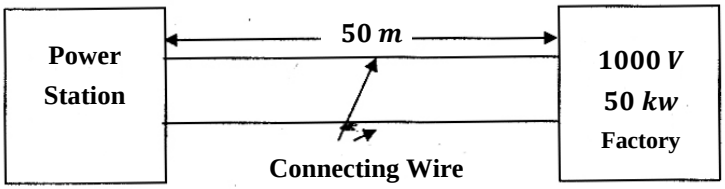


i) find the current through the cells

ii) find the current through the resistance P

iii) find the power wasted in P

b) As shown in figure current of 1000V is supplied to a factory from the direct current power station. The power consumed by the factory is 50kW. The distance between factory and power station is 50. The resistance of wire is 0.04Ω per meter.



i) what is the current passing when all the engines in the factory work with maximum power.

ii) what is the resistance of total wire?

iii) find the difference between voltage at the both ends of generator when the engines function? Neglect the internal resistance of generator

iv) find the power wasted in the carrying wires?

v) find the power generated by the generator?

vi) if the cost of production of 1 unit electricity is rs.20 find the total amount of cost of production of the current used by the factory in one day?

06)

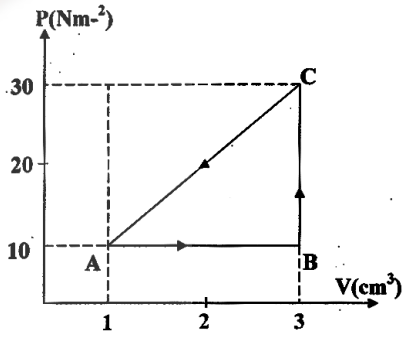
a)

i) write the first law of thermodynamics in mathematical form and identify it's terms.

ii) explain iso-thermal process and adiabatic process.

iii) state the conditions needed for iso – thermal process and adiabatic process

b) An ideal gas is undergone a cyclic procedure of ABCA as shown in the figure. Internal energy of gas at A, B are 20J and 50J respectively. Heat absorbed by gas during BC process is 90J.

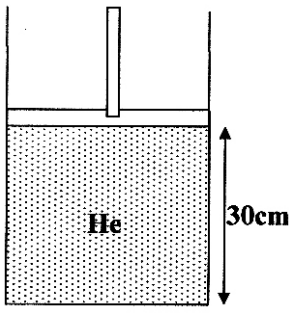


i) what is the internal energy of gas at position C?

ii) what is the amount of heat absorbed by the gas during process AB?

iii) does gas absorb or release heat during the process CA? what will be the amount of heat absorbed/ released?

c) In an insulated cylinder gas is filled and closed by a smooth piston as shown in the figure. Cross sectional area of cylinder is 8 X $10^{-3}m^2$, He gas is filled in the cylinder at a pressure 1 X 10^5Pa and temperature 27^0C. height of gas column is 30cm. heat capacity of cylinder and piston is negligible.



i) find the no. of moles of He in the cylinder? (Molar mass of He = 4g, R = $8.0K^{-1}mol^{-1}$)

ii) find the root mean square speed of molecules of He in cylinder

iii) what is the pressure inside the cylinder when a mass of 806g is placed above the piston?

iv) what is the distance moved by the piston due to the weight?