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THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME _ LEVEL III

FINAL EXAMINATIONS – /2008/2009

PHYSICS FOR BIOLOGY STUDENTS – PSU 1244

DURATION: THREE (3) HOURS

DATE: 22nd JANUARY, 2009 TIME – 9.30a.m – 12.30p.m

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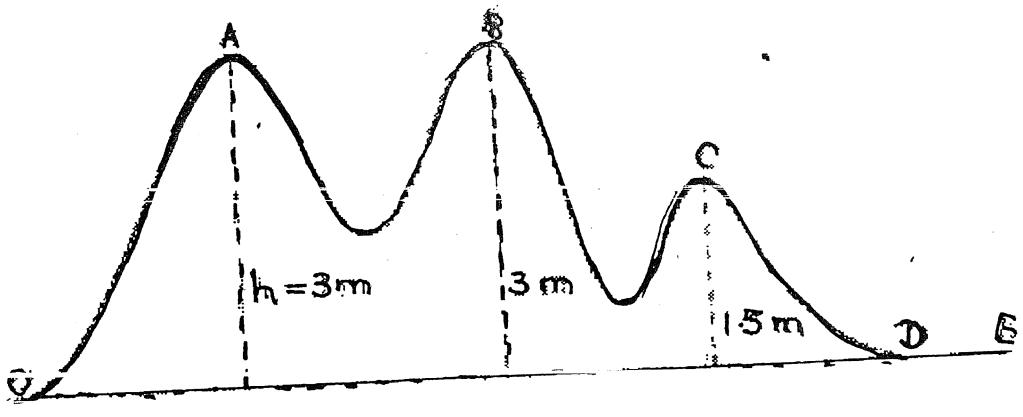
Answer SIX questions only

1. (a) Define work, power and energy.
   (b) How do you find the work done by a varying force?
   (c) Define Kinetic Energy (*K.E.*) and Potential Energy (*P.E.*). Derive an expression for *K.E* and *P.E.*
   (d) State the law of conservation of energy.
   (e) A small ball of mass 100g starts at the point A with a speed 2 m/s and moves along a frictionless track as shown in the figure below.
      (i) What is the total energy of the ball at *A*?
      (ii) What is the velocity of the ball at *B*?
      (iii) What is the K.E of the ball at *C*?
      (iv) What is the velocity of the ball at *C*?
      (v) Suppose that there was friction along the path *DE*, then calculate the distance travelled by the ball before coming to rest (Coeff. of friction = 0.2)

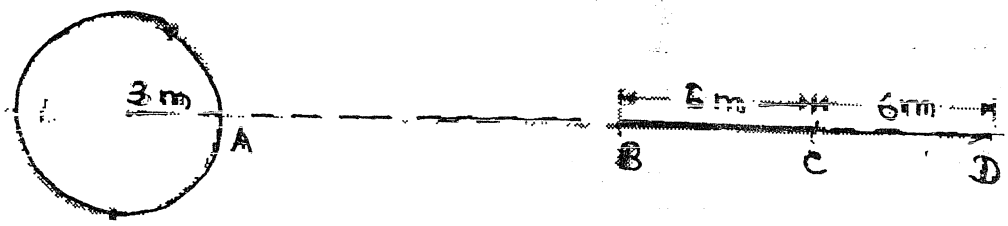


2. (a) What is Doppler effect?

The frequency n of a source of sound appears to be n' to a stationary listener when the source is moving with velocity V_e away from him. The velocity of sound is V. Write an expression for n' in terms of n, V and V_e.

(b) Distinguish between the characteristics of progressive and stationary waves. Use diagrams to illustrate your answer.

(c) A source of sound is moving along a circular orbit of radius 3 m with an angular velocity of 10 rad/s. A sound detector located far away from the source is executing linear Simple Harmonic Motion (S.H.M) along the line BD (see Figure) with an amplitude $BC = CD =$ 6m. The frequency of oscillation of the detector is $5/\pi$ per second. The source is at the point A when the detector is at the point B. If the source emits a continuous sound wave of frequency 340 Hz, find the maximum and the minimum frequencies recorded by the detector.



3. (a) What is meant by (i) an adiabatic and (ii) an isothermal change of state of a gas.
An ideal gas is expanded adiabatically from volume V_1 to volume V_2 is then compressed isothermally to its original volume V_1 . Draw the P-V curves representing the above changes. How will you show in your graph the net work done by the gas?

(b) One mole of an ideal gas undergoes a cyclic change ABCD. Calculate from the diagram. (P is in atm. And V in litre) (See Figure)

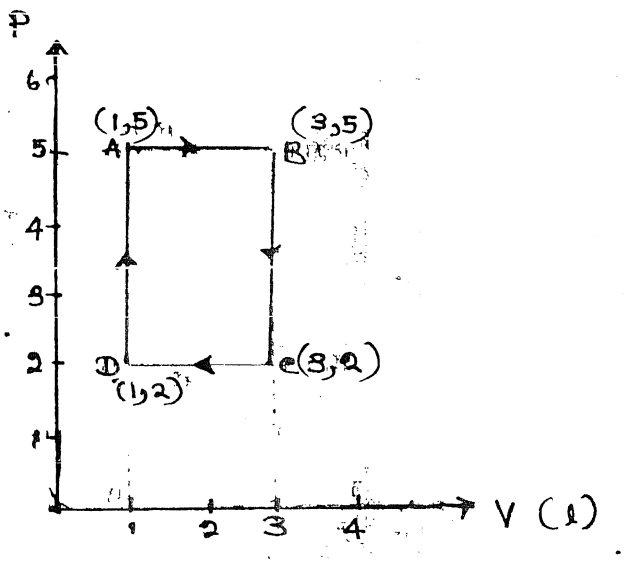
(i) Work done along AB, BC, CD and DA.

(ii) What is the net work done in the process?

(iii) What is the efficiency of the process?

(iv) What is the net change in internal energy of the gas?

Given 1 atm = $1.01 \times 10^5 Nm^{-2}$



4. (a) A satellite of mass m is moving in a circular or orbit of radius R around the earth. The radius of the earth is r and the acceleration due to gravity at the surface of the earth is g. Obtain expressions for the following:

(i) The acceleration due to gravity at a distance R from the centre of the earth.

(ii) The linear speed of the satellite

(iii) The periodic time of the satellite

(b) An artificial satellite is moving in a circular orbit around the earth with a speed equal to half the magnitude of the escape velocity from the surface of the earth.

(i) Determine the height of the satellite above the earth's surface.

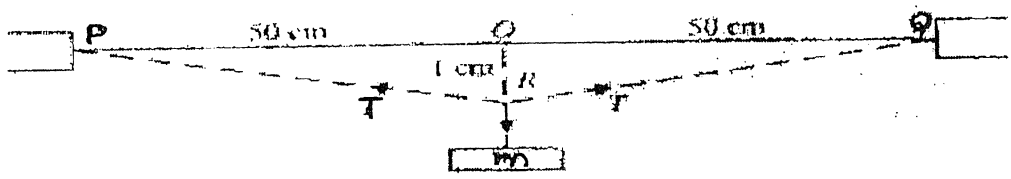
(ii) If the satellite is suddenly stopped in its orbit and allowed to fall freely on to the earth, find the speed with which it hits the surface of the earth.

5. (a) (i) State Hooke's law.

(ii) Draw a labeled graph of tensile stress against tensile strain for a metal wire upto the breaking point. Show on your graph the region in which Hooke's law is true.

What is the significance of the area between the graph and the strain axis within the Hooke's law region?

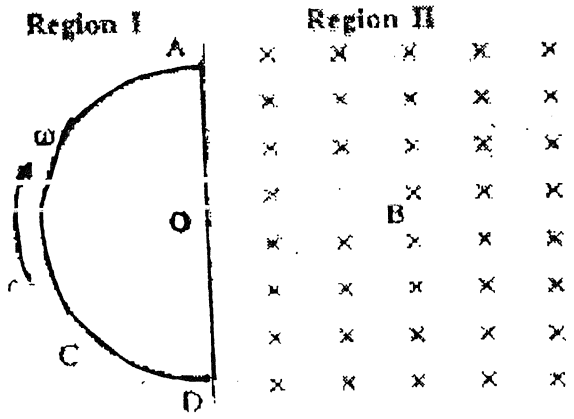
(b) A steel wire of diameter 0.8 mm and length 1m is clamped firmly at two points P and Q which are one metre apart and in the same horizontal plane. A body is hung from the middle point of the wire, such that the middle point sags 1 cm lower from the original position as shown in figure. Calculate the mass of the body. $Y = 2 \times 10^{11}$ N/m^2.



6. (a) How is the capacitance of a parallel plate capacitor modified if
   (i) a conducting slab is inserted between plates
   (ii) a dielectric slab is inserted between the plates.

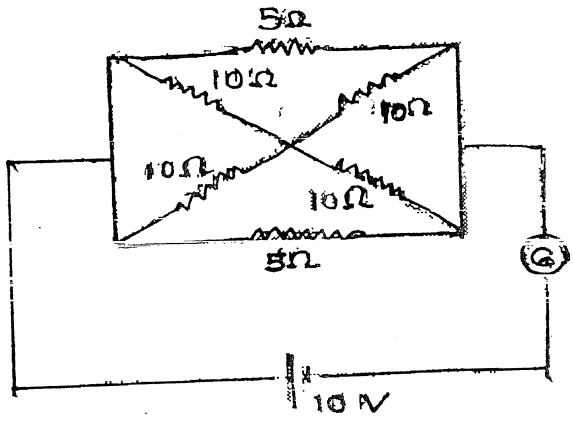
   (b) A parallel plate capacitor of capacity "C" remains connected across a supply voltage of "V" volts, now a dielectric slab of dielectric constant "K" completely fills the space between two plates. What will be the new
   (i) Capacitance
   (ii) Potential difference between plates
   (iii) Charge stored
   (iv) Electric field between plates and
   (v) Energy stored in capacitor.

7. Space is divided by the line AD into two regions. Region 1 is field free and region II has a uniform magnetic field B directed into the plane of the paper. ACD is a semicircular conducting loop of radius r with centre at O, the plane of the loop being in the plane of the paper. The loop is now made to rotate with a constant angular velocity ω about an axis passing through O and perpendicular to the plane of the paper. The effective resistance of the loop is R.
   (i) Obtain an expression for the magnitude of the induced current in the loop.
   (ii) Show the direction of the current when the loop is entering into the region II.
   (iii) Plot a graph between the induced emf and the time of rotation for two periods of rotation.



8. (a) (i) Define resistively of a conductor. How does it vary with temperature?

(ii) Find the current flowing through the ammeter shown in the circuit. Assuming negligible resistance for ammeter.



(b) (i) Two copper wires of length l_1, l_2 and cross section A_1, A_2 are connected in series across a battery. How does the ratio of drift velocity of electrons in them depend on their

* length and

** cross section.

(ii) Write down the expression for the Resistance of wire with parameter length (l) cross sectional area A and resistivity of wire (p)