THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF PHYSICS
B.SC. DEGREE PROGRAMME- Level 03
FINAL EXAMINATION – 2015/2016
PHYSICS FOR BIOLOGY STUDENTS – PCU 1271/PSU 1244
Duration : Three (3) Hours

Date: 16/01/2017 **Time :** 1.30 pm – 4.30 pm

Answer Six questions only

(1) (a) (i) State Bernoulli's Principle

(ii) Explain the phenomena's of streamline flow and turbulent flow.

(b) A tank of large area is filled with water to a depth of 0.3 m. A hole of 5 cm^2 cross-section in the bottom allows water to drain out in a continuous stream. What is the rate at which water flows out of the tank in m^3s^{-1} ?

(c) In a hurricane, the air (density 1.2 kg m^{-3}) is blowing over the roof of a house at a speed of 110 km hr^{-1}.

(i) What is the pressure difference between inside and outside that tends to lift the roof?

(ii) What would be the lifting force on a roof area of 10^2 m?

(2) (a) (i) Define linear momentum and state the law of conservation of momentum.

(ii) Explain what is meant by an elastic collision and inelastic collision.

(b) Two pendulum bobs, A and B hang side by side in contact with one another at rest, each supported by a thread of 2 m long. A has mass 0.2 kg and B has mass 0.08 kg. Bob A is then pulled to one side with its thread taut until it is 0.1 m higher. Then it is released so it collides with B. After the collision, B gains 0.15 m of height.

Calculate,

(i) the speed of A before impact
(ii) the speed of B just after impact
(iii) the speed of A just after impact
(iv) the height gained by A after impact
(v) the loss of kinetic energy as a result of the impact.

(3) (a) State Hooke's law.

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

(c) A steel wire of length 4.7 m and cross-section $3.0\times10^{-5}\,m^2$ is stretched by the same amount as a copper wire of length 3.5 m and cross-section $4.0\times10^{-5}\,m^2$ under a given load. What is the ratio of Young's modulus of steel to that of copper?

(4) (a) Explain the terms half-life and activity in radioactivity.

(b) (i) Show that the activity A of a radioactive isotope at a given time t can be denoted by $A = A_0e^{-\lambda t}$, where λ is the decay constant and A_0 is the activity at $t = 0$.

(ii) Hence, deduce the equation $t_{\frac{1}{2}} = \frac{ln2}{\lambda}$ for the half-life of a radioactive isotope.

(c) A freshly prepared sample of a radioactive isotope X contains 10^{20} atoms. The half-life of the isotope is 12 hours. Calculate,

(i) the initial activity of the radioactive isotope.
(ii) the number of radioactive atoms of X remaining after one hour.
(iii) the number of radioactive atoms of X remaining after 24 hours.

(5) (a) State Newton's law of gravitation.

(b) A satellite of mass m is moving in a circular 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.

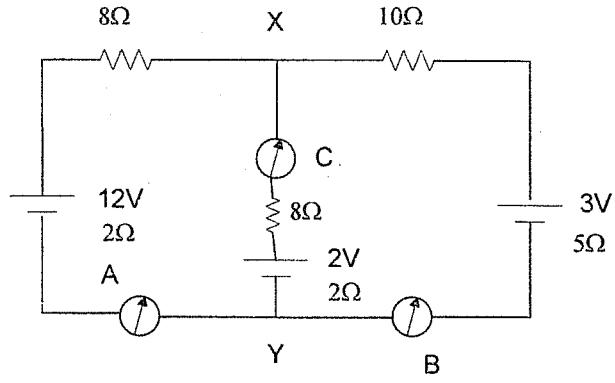
(i) The acceleration due to gravity at a distance r from the centre of Earth.
(ii) The linear speed of the satellite.
(iii) The periodic time of the satellite.

(c) What is the orbital velocity of an artificial satellite revolving round the Earth at a height 100 km from the surface of the Earth? R = 6400 km, $g = 9.8\,ms^{-2}$

(6) (a) Explain clearly the difference between e.m.f and potential difference.

(b) State the Kirchchoff's network laws, and point out that each is essentially a statement of a conservation law.

(c)



Find for the above circuit,

(i) the readings on the ammeters *A, B* and *C* (of negligible resistance)

(ii) the potential difference between *X* and *Y*.

(iii) the power dissipated as heat in the circuit.

(iv) the power delivered by the 12V cell.

(7) (a) Write the characteristics of simple harmonic motion.

(b) Drive an expression for the period of oscillation of a simple pendulum.

(c) Sketch graph showing the variation of (i) the kinetic energy (ii) the potential energy and (iii) the total energy of a simple harmonic oscillation with displacement.

(d) A particle executes simple harmonic motion with an amplitude of 10 cm and a period of 5 seconds. Find the velocity and acceleration of the particle at a distance 5 cm from the equilibrium position.

(8) (a) Define the centripetal force. What is the work done by the centripetal force on a body moving along a circular path.

(b) A particle P of mass 1 kg is attached to one end of a light inextensible string of length 0.3 m. The other end of the string is fixed to a point o of a smooth horizontal table. P moves with speed 5 ms^{-1} in a circle on the table. Calculate the tension in the string.

© A particle P of mass 0.5 kg rests on a rough horizontal disc at a distance of 0.25 m from the centre. When the disc is rotating with angular speed 5 rad s^{-1} , P is on the point of slipping. Calculate the value of the coefficient of friction between P and the disc.