The Open University of Sri Lanka
B.Sc. Degree Programme – Level III
Final Examination 2009/2010
Physics for Biology Students PCU 1271
Duration- 3hrs

Date : 01.07.2010 **Time:9.30am - 12.30pm**

Answer six questions by selecting three from A & B part separately.

Part A

01. **(a)** State the law of conservation of linear momentum and deduce it by using Newton's 2nd Law of motion.

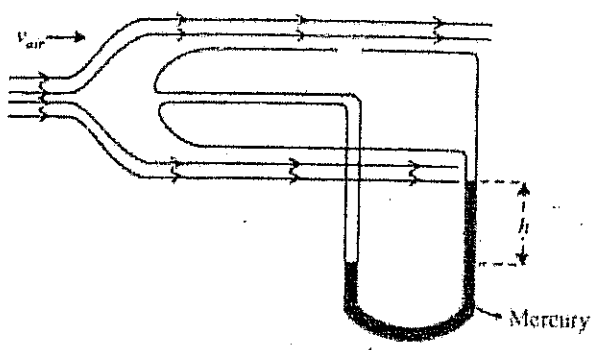
(b) A man of mass 495 kg stands on a frozen pond (with no friction) near to a wall. He throws a ball of mass 0.50 kg with a speed of 10 ms^{-1} relative to the ground at the wall and then catches the ball after it rebounds from the wall.
(i) How fast is he moving after he catches the ball?
(ii) How many times does the man have to go through this process until his speed reaches 1 ms^{-1} relative to the ground?

(c) Explain the difference between the elastic and inelastic collisions of the balls.

(d) Give the magnitude and direction of the net force acting on and draw the free body diagram for the followings.
(i) a drop of rain falling down with a constant speed.
(ii) a cork of mass 10 g floating on water.
(iii) a stone of mass 0.1kg just after is dropped from the window of a train running with a constant acceleration of 1ms^{-2}.

02. **(a)** State that the Bernoulli's Theorem and conditions which should be satisfied for the theorem.

(b) A Pitot tube is shown in figure. The fluid in the tube is mercury of density 13600 kgm^{-3} and the difference in levels of mercury in the tube (h) is 6 cm.
What is the speed of air flow? Density of air is 1.25 kg/m^{-3}.



(c) An iron ball has an air space in it. Its weight is 1 kg in air and 0.6 kg in water. Find the volume of the space in the ball. Density of iron is 7200 kgm^{-3}.

(d) Roofs of the huts are blown off during storms. Why?

03. (a) State the Newton's law of Gravitation.

(b) Derive an expression for the followings.
(i) Gravitational field's intensity on the earth surface.
(ii) Total energy of a satellite.
(iii) Escape velocity on the earth.

(c) An artificial satellite is moving in a circular orbit around the earth with a speed equal to half of 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 the earth, find the speed with which it hits the surface of the earth.

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

(b) Eight equal drops of water are falling in air with a steady velocity of 0.1ms^{-1}. If the drops recombine to form a single drop,
(i) Derive an expression for the relation between two radii of drops.
(ii) What should be the new terminal velocity?

(c) What is the effect of temperature on the coefficient of viscosity of a liquid?

(d) How does the dimensions of the needle of a syringe control the flow rate while administering an injection?

Part B

05. (a) Define the term of black body. What is meant by black body radiation?

(b) State Stefan's Law with regard to a blackbody. Sketch graphs showing the distribution of energy in the spectrum of black body radiation at three temperatures and indicate which curve corresponds to the highest temperature.

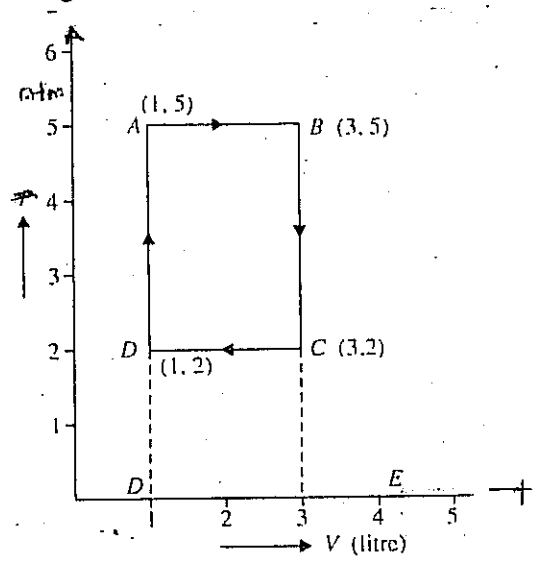
(c) What is the heat lost from the body of a person per hour whose body temperature is 37^0C and the surrounding temperature is 20^0C?
The emissivity of the skin is 0.92 and the surface area of the skin is 1.6 m^2. (Assume that the person is unclothed)

(d) Write down the Wien's Displacement Law. Calculate the temperature of the colour of the sun assuming that the wave length of maximum intensity in the solar spectrum is 0.48 micron and the Wien's constant is 0.288 x 10^{-3} mK.

06. **(a)** Explain the Doppler effect and two applications of Doppler effect.

(b) The speed of an ambulance on a highway is 34 ms^{-1}. The frequency of the sound emitted by its siren is 500 Hz.
Calculate the frequency heard by the driver in a car travelling at 72 kmh^{-1} in the opposite direction.
(i) before passing and
(ii) after passing (v =340 ms^{-1}) the ambulance.

07. **(a)** What is the first law of thermodynamics? One mole of an ideal gas under goes a cyclic change ABCD. Calculate from the diagram. (P is in atm and V is litre)



Calculate,

(i) Work done along AB,BC,CD and DA.
(ii) the net work done in the cyclic process.
(iii) the efficiency of the cyclic process.
(iv) the net change in internal energy of the gas in the cyclic process (atm = 1.01×10^5 Nm^{-2}.)

08. **(a)** State the Faraday's law of Electro magnetic induction and the Lenze's law.

(b) A circular disc with radius r is rotating with a uniform angular velocity ω around an axis through its centre perpendicular to its plane in a uniform magnetic field B which is perpendicular to the surface of the disc. Derive an expression for the induced Electro-motive force between the axis and the circumference.

(c) Two long straight parallel wires are separated by a distance 2a. If the wires are carrying equal currents in opposite direction, what is the flux density in the plane of the wire at a point
(i) midway between them
(ii) at a distance "a" above the upper wire.
Find the force between the two wires.