THE OPEN UNIVERSITY OF SRI LANKA

DEPARTMENT OF PHYSICS

B.SC. DEGREE PROGRAMME – 2011/2012

LEVEL 03

PHYSICS FOR BIOLOGY STUDENTS – PCU 1271/PSU 1244

FINAL EXAMINATION

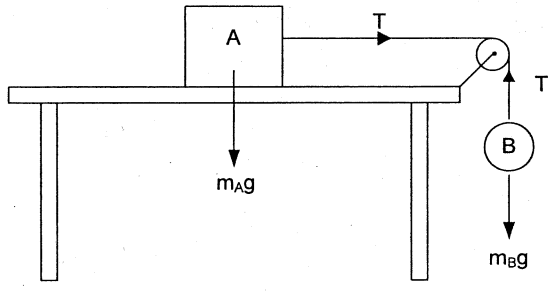
Time allowed: Three hours (3 hrs.)

Date: 19th November 2012 **Time: 1.30 pm – 4.30pm**

Answer SIX (06) questions only.

(1) (a) State Newton's Laws of motion.

(b)



(i) Consider the setup shown in the figure. The coefficient of sliding friction between block A and the table is 0.2. The mass of block A is 25 kg and the mass of block B is 15 kg. How far will block B drop in the first 3 seconds after the system is released?

(ii) How large a horizontal force in addition to T must pull on block A to give it an acceleration of 0.75 ms^{-2} towards the left?

(c) The coefficient of sliding friction between the tires of a car and the road surface is $\mu = 0.5$. The driver brakes sharply and locks the wheels.

If the velocity of the car before braking was $v_0 = 60$ km hr^{-1}, how much time will the car take to stop? What is the stopping distance?

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

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

(c) A 50 g mass vibrates in simple harmonic motion at the end of a light spring. The amplitude of the motion is 12 cm and the period is 1.7 seconds. Find

(i) the frequency
(ii) the spring constant
(iii) the maximum speed of the mass
(iv) the maximum acceleration of the mass
(v) the speed when the displacement x is 6 cm.
(vi) the acceleration when x = 6 cm

(3) (a) Describe an experimental method to find the focal length of a concave mirror.

(b) A small object is placed at right angles to the axis of a concave mirror so as to form:

(i) a real image
(ii) a virtual image, twice as long as the object.

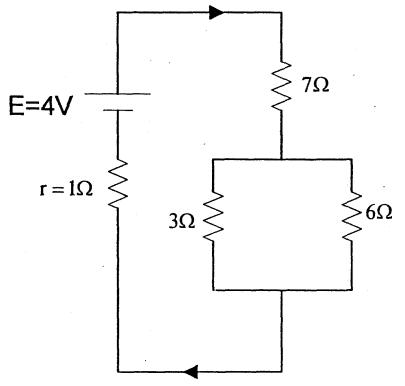
If the radius of curvature of the mirror is R, what is the distance between the two images?

(c) A pole 4 m long is laid along the principal axis of a convex mirror of focal length 1 m. The end of the pole nearer the mirror is 2 m from it. Find the length of the image of the pole.

(4) (a) State Ohm's Law and Kirchhoff's Laws.

(b) A wire of radius 0.1 mm carries a current of 10 mA. The resistivity of its material is 45 μΩ cm. If the resistance of the wire is 10Ω, find the applied voltage and its length.

(c) Calculate the current, potential difference and power supplied to each resistor of the circuit shown in figure. The cell has an e.m.f. of 4V and its internal resistance is 1Ω.



(5) (a) Explain the difference between reactance and impedance.

(b) Derive an expression for the impedance of a LR circuit connected to an a.c. power supply. Obtain an expression for the phase relationship between the current and voltage.

(c) A coil of negligible resistance and inductance 0.02 H is in series with a wire of zero inductance and resistance 12 Ω. An e.m.f. of 130 V, 40 Hz is applied across the above series circuit.

Calculate,
(i) the current in the circuit
(ii) the potential difference across the resistor
(iii) the potential difference across the inductor
(iv) the angle of lag (phase difference)

(6) (a) State the Faraday's law of electromagnetic induction and the Lenz's law.

(b) A square wire loop of 8 cm on a side is placed perpendicular to a magnetic field of 5×10^{-3} Tesla.

(i) What is the magnetic flux through the loop?
(ii) If the field drops to 0 in 0.1 seconds, what average emf is induced in the loop during this time?

(c) A metal aircraft with a wing span of 40 m flies with a constant speed of 1000 km hr^{-1} in a direction due east at a constant altitude in a region, where the vertical component of the Earth's magnetic field is 1.8×10^{-5} Tesla. Find the potential difference in Volts that exists between the wing tips.

(7) (a) Distinguish between adiabatic and isothermal changes.

(b) A quantity of $O_2\,(\gamma=1.4)$ is compressed to occupy a volume of 3 litres at 10 atm pressure and 27°C. If it is allowed to expand adiabatically to one atmosphere pressure find the new volume and temperature.

(c) Calculate the root mean square velocities of the gases given below.

(i) H_2 gas at 0°C
(ii) H_2 gas at 50°C
(iii) O_2 gas at 0°C

Molecular weight of $H_2 = 0.002$kg
Molecular weight of $O_2 = 0.032$kg

The gas constant $R = 8.31$ J $mole^{-1}K^{-1}$

(8) (a) Define the terms specific heat capacity and latent of fusion.

(b) A total of 0.8 kg of water at 20°C is placed in a 1 kW electric kettle. How long a time is needed to raise the temperature of the water to 100°C? (The specific heat capacity of water = 4200 J $kg^{-1}K^{-1}$)

(c) (i) A student seals 200 g of ice-cold water in a glass of vacuum flask (Thermos flask) and finds that it warms up by 3.5 K in one hour. The specific heat capacity of water is 4200 $Jkg^{-1}K^{-1}$. Calculate the average rate of heat flow into the flask in Watts.

(ii) To check this result over a longer period, the student fills the flask with equal amount of ice and water, all at 0°C, and leaves it for four hours. The specific latent heat of fusion of ice is 0.33 $MJkg^{-1}$. How much ice would you expect to have melted at the end of the four hours?

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