Uva Wellassa University, Sri Lanka
B.Tech. Degree Programme - 2006/07
End Semester Examination- Semester 1
January -2008

PHY201-2 General Physics

Answer Any Four (4) Questions

Time: Two (02) Hours

1. A cylinder of radius a and radius of gyration K rolls without slipping down and inclined plane of angle α and length l, starting from rest at the top of the incline. Show that the angular acceleration of the cylinder is

$$\frac{a}{(a^2 + K^2)} g\sin\alpha$$

Prove that when it reaches the bottom of the incline its speed will be

$$\left(\frac{2a^2}{(a^2+K^2)} gl\sin\alpha\right)^{1/2}$$

and work done by the friction is $\frac{MK^2}{(a^2+K^2)} gl\sin\alpha$, where M is the mass of the cylinder (gravitation acceleration = g).

2. A Young's double slits interference experiment consists of two slits d apart. Interference fringes observed at a plane D ($D>>d$) distance away from the plane of slits. If the slits are illuminated with monochromatic light of wavelength λ,

   (i) What is the "order" of the central fringe?

   (ii) Is it intensity maximum or minimum? Explain your answer giving conditions for interference.

   (iii) Obtain an expression for the angular position θ_n of the n^{th} intensity maximum.

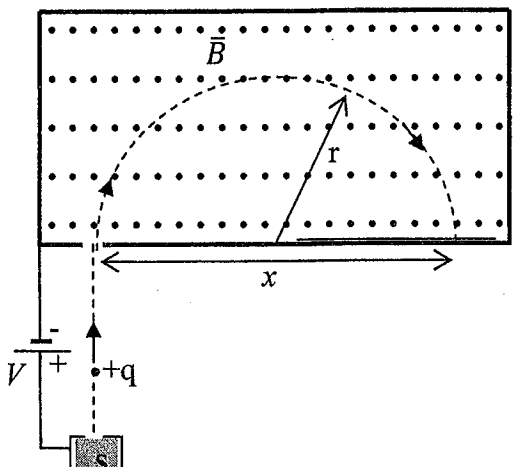
   (iv) Write down the expression for the angular position of the n^{th} intensity minimum.

   (v) Now the slits are illuminated with light that consists of two wavelengths. One wavelength is known to be *436nm*. On the screen, the fourth minimum of the *436nm* light coincide with the third maximum of the other light. Determine the unknown wavelength.

3. What conditions are required for a system to have simple harmonic motion?
In order to maintain the same periodic time of a pendulum, in the Earth and in the Moon what parameter should be changed? Is it the length of the pendulum or mass of the pendulum? Explain briefly using necessary equations.

What are Lissajou's figures?
A particle is subjected to two harmonic motions in directions at right angles to each other and they are given by
$x = 2\cos(2\omega t)\ and$
$y = 3\cos(\omega t - \pi/4)$
Obtain the expression for the resultant motion. Also use the graphical method to show the resultant motion.

4. "Mass spectrometer" can be used to measure the mass of an ion. An ion of mass m (to be measured) and charge q is produced in source S as shown in following figure.



Initially, stationary ion is accelerated by the electric field due to a potential difference V. The ion leaves S and enters a separator chamber in which a uniform magnetic field $\bar{B}$ is applied perpendicular to the path of the ion. The magnetic field causes the ion to move in a semicircle, striking a photographic plate at distance x from the entry slit.

(i) Show that the mass of the ion is given by $m = \frac{B^2qx^2}{8V}$;where q is the charge of the ion.

(ii) Two ions having same charge but slightly difference masses (Δm) were inserted to the mass spectrometer. Show that $\Delta m \approx B\left(\frac{mq}{2V}\right)^{1/2}\Delta x$
here m is the mass of one type of ion and Δx is the difference between the two signs obtained on the photographic plate.

Mass of one of isotopes of Cl^+ (by removing an electron) is 35a.m.u. Find the mass of the heavy isotopes using following spectroscopic data.
Δx= 8.35mm V= 7.3×10^3V B= 0.5T e= 1.602×10^{-19}C 1a.m.u=1.67×10^{-27}kg

5. Write short notes on any <u>two(2)</u> of the following topics.

   a. Doppler effect and its applications

   b. How photocopy machine works

   c. Simple harmonic oscillations in an Electrical system

   d. Single slit diffraction and resolving power of Telescope