Uva Wellassa University, Sri Lanka
End Semester Examination – March 2012
SCT 151-1 Physics I

Uva Wellassa University

Duration: One (01) hour

Total **04** Questions
25 marks for each question.
Answer **ALL** questions

01). (a) State Newton's laws of motion and explain them.
(b) What is "Conservation of momentum" ?
(c) A firecracker with a mass of 100 g , initially at rest, explodes into 3 parts. One part with a mass of 25 g moves along the x-axis at 75 ms^{-1}. One part with mass of 34 g moves along the y-axis at 52 ms^{-1}. What is the velocity of the third part?

02). A disc is mounted on a bearing as shown in the figure (Fig. Q2) below.

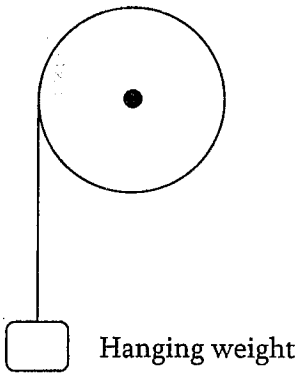

Fig. Q2

The hanging weight produces a constant torque on the disc. The disc rotates with a uniform angular acceleration, α.
The disc is released from rest and the time taken for five complete rotations while accelerating is measured with a stopwatch. The experiment is repeated seven times and the readings are shown below.

Experiment	Time t for five rotations / s
1	9.80
2	9.42
3	9.66
4	9.93
5	9.92
6	9.35
7	9.63

(a) Find the mean time t and the period of the oscillation.

(b) The equation for the angular displacement of an object accelerating uniformly from rest is given by

$$\theta = \frac{1}{2}\alpha t^2$$

Use the mean time t to calculate the angular acceleration α.

(c) The moment of inertia I of the disc is given by

$$I = \frac{mgr}{(\alpha + \alpha_d)}$$

where m is the mass of the hanging weight, g is the acceleration due to gravity, r is the radial arm of the accelerating torque, and α_d is the angular deceleration of the moving disc due to the frictional torque after the hanging mass is removed. Calculate the value of I.

$m = 0.011$ kg

$r = 0.012$ m

$\alpha_d = 0.050$ rad s^{-2}

$g = 9.81$ m s^{-2}

03). (a) Two vectors are given by $\bar{a} = 4.0\underline{i} - 3.0\underline{j} + 1.0\underline{k}$, $\bar{b} = -1.0\underline{i} + 1.0\underline{j} + 4.0\underline{k}$ in unit vector notation. Find

i. $\bar{a} + \bar{b}$

ii. $\bar{a} - \bar{b}$

iii. A third vector $\bar{c}$ such that $\bar{a} - \bar{b} + \bar{c} = 0$

(b) i. Define Curl and divergence of a vector

ii. If A is any vector, show that $\nabla . (\nabla \times \mathbf{A}) = 0$

04). (a) (i) Draw an arrangement of point charges which gives a point in space where the electrostatic potential is zero and the electric field strength is non zero. Indicate the point concerned.

(ii) Draw an arrangement of point charges which gives a point in space where th electrostatic potential is non zero and the electric field intensity is zero. Indicate the point concerned.

(b) Two protons are separated by a very large distance. They are projected towards each other along the same straight line with equal speeds.

(i) The protons are momentarily at rest at a minimum separation r_{min}. Write down an expression for the electrostatic potential at one proton due to the field of the other.

(ii) Hence write down an expression for the electrostatic potential energy when the separation is r_{min}

(iii) Given that r_{min} is 5.0×10^{-15} m find the initial speed of the protons, stating any principle that you use in your calculation.

(iv) Calculate the potential difference required to accelerate protons in a linear electrostatic accelerator in order to achieve the speed determined in (b) (iii).