No. of Printed Pages : 7

ET-105(A)

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) / BTCLEVI / BTMEVI / BTELVI / BTECVI / BTCSVI

Term-End Examination

01370 **December, 2014**

ET-105(A) : PHYSICS

Time : 3 hours *Maximum Marks : 70*

Note : *All questions are* ***compulsory****. Internal choices are provided. Assume missing data suitably, if any. Symbols have their usual meanings.*

1. (a) Calculate the moment of inertia of a uniform solid cylinder about an axis normal to the axis of the cylinder passing through the centre of mass. *6*

OR

Show that the acceleration vector of a rigid body rotating about an axis fixed in space is given by

$$\vec{a} = \vec{\alpha} \times \vec{r} + \vec{\omega} \times (\vec{\omega} \times \vec{r})$$

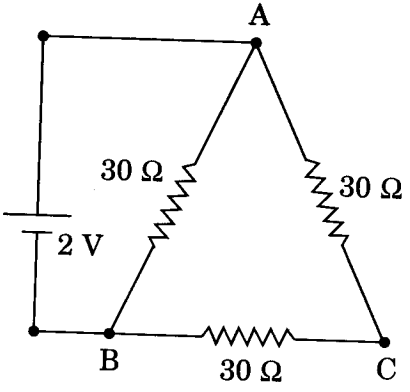
where $\vec{\alpha}$ is the angular acceleration.

(b) A billiard ball of mass m and radius r is hit by a cue at a distance h above the centre. As a result the ball acquires a speed v_0 immediately. If $h = \frac{2}{5} r$, show that the final velocity of the ball is also v_0. *4*

(c) A pendulum has T = 2 s. It is taken to a place where the value of g is 4% lower. How much time will the pendulum gain or lose in a 24-hour interval ? 4

OR

Calculate the effective value of the resistance in the following circuit. How much current is drawn from the battery ?



2. (a) In a fusion reaction two He^3 nuclei, each of mass 3·014932 u, an α-particle of mass 4·001506 u is formed and two protons, each of mass 1·007276 u, are liberated. Find the energy released is MeV in the reaction. ($u = 1{\cdot}660539 \times 10^{-27}$ kg) 6

OR

A pendulum of length 1 m is pulled aside by an angle of 5°. Calculate the speed of the bob as it passes the mean position and the maximum speed attained by the pendulum ($g = 9{\cdot}8\ m/s^2$).

(b) Show that the kinetic energy of a system of particles can be written as *4*

$$T = \frac{1}{2} M v_c^2 + \frac{1}{2} \sum_{i=1}^{N} m_i\, u_i^2$$

where M is the total mass of the system, v_c is the velocity of the centre of mass, m_i is the mass of the i^{th} particle and u_i is the velocity of the i^{th} particle.

(c) A mass spring has the constant k = 20 N/m and m = 0·2 kg. It is executing SHM. When it is at a distance of 12 cm from the equilibrium position, its speed is 1·6 m/s. Find the amplitude and phase of SHM. *4*

OR

Write down the second order differential equation for u which satisfies the solution $u(x, t) = f(x - vt)$. Show by direct substitution that the differential equation satisfies the general solution

$$u(x, t) = \alpha\, f(x + vt) + \beta\, f(x - vt)$$

where α and β are constants.

3. (a) For an ideal gas undergoing an adiabatic process, show that the coefficient of bulk modulus is given by

$$B = \gamma P$$

where γ is the ratio of specific heats and P is the pressure of the gas. *6*

OR

For a medium of refractive index μ and for wavelength λ_0 in vacuum, show that

$$\frac{1}{v_g} = \frac{1}{v} - \frac{\lambda_0}{c}\frac{d\mu}{d\lambda_0}$$

where v_g and v are respectively the group and phase velocities.

(b) Define interference and explain why we need only coherent waves to get interference fringes. In Young's experiment calculate the path difference between the waves emanating from the two slits. *4*

(c) A diffraction grating has 5000 lines/cm. Calculate the angular separation for wavelengths 589·0 nm and 589·6 nm in the first order. Explain the reasons for decrease in intensity with increase of the order of spectrum. *4*

OR

What are Newton's rings and how are they formed ? Discuss Newton's rings experiment. Get an expression for the radii of the rings of maxima and minima.

4. (a) Calculate the electric field at a point due to an infinite charged sheet having a uniform charge density. *6*

OR

An electric dipole is placed in an electric field $\vec{E}$ at an angle θ_0 to $\vec{E}$. Show that the work done in changing its direction to θ is

$$W = pE (\cos \theta_0 - \cos \theta)$$

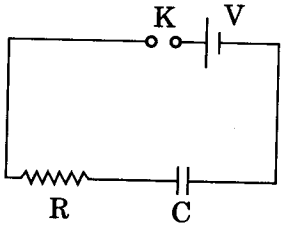
(b) Define drift velocity and state its relationship with the electric current density. Copper has $8{\cdot}5 \times 10^{28}$ free electrons per unit volume. If current density in a copper wire is 10^5 A/m^2, what is the drift velocity of electrons in copper ? *4*

(c) State Gauss' law and explain its importance in electrostatics giving one example. *4*

OR

State Ampere's law and demonstrate its validity in a simple case.

5. (a) Consider the VCR circuit shown. Initially C is not charged. Discuss how the charge on C and the current in the circuit vary when the key K is closed. *4*



OR

A constant electric field is directed along y-axis. A particle of mass m and charge q is projected at an angle θ to the x-axis with velocity v_0. Show that the motion of the particle is a parabola.

(b) Obtain equation governing the electromagnetic waves. Show that in vacuum they travel with velocity $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$. *6*

(c) A bulb is marked 60 W and 220 V. If it is connected to 240 V d.c. supply, what power would it deliver ? *4*

OR

Calculate the equivalent capacitance of the circuit shown. All capacities are expressed in μF.