

RAMAKRISHNA MISSION VIDYAMANDIRA

(A Residential Autonomous College)

Belur Math, Howrah

B.A./B.Sc. 1st Semester (July – December 2010)

Mid-Semester Examination, September 2010

Date: 08.09.2010

Physics (General)

Full Marks 25

Time: 11 am – 12 noon

Answer all questions.

1. a) If the magnitude of a vector $\vec{a}(t)$ is constant w.r.t. time t , show that $\frac{d\vec{a}}{dt}$ is perpendicular to \vec{a} . 2
- b) State Gauss' divergence theorem in vector calculus. 2
- c) Prove that $\oint_S \vec{r} \cdot d\vec{S} = 3V$ where V is the volume enclosed by the surface S and \vec{r} is a position vector. 2
- d) Find the value of x such that the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + x\hat{j} + 5\hat{k}$ are coplanar. 3
- e) If \vec{w} is a constant vector and \vec{r} is a position vector such that $\vec{v} = \vec{w} \times \vec{r}$, then prove that $\nabla \cdot \vec{v} = 2\vec{w}$. 3
2. a) What are the critical constants of a gas? Calculate the value of critical volume (V_c) in terms of the constants of van-der Waal's equation of state. 4
- b) Find the value of rms velocity of Helium gas molecules at 290 K. 2
[$R = 8.31 \text{ JK}^{-1} \text{ mole}^{-1}$].
3. a) State Maxwell's law of velocity distribution of molecules. Plot it graphically. Specify the most probable velocity in this graph and deduce its expression. 4
- b) The temperature gradient in the earth crust is $32^\circ \text{C.km}^{-1}$ and the mean conductivity of the rocks is 33.6 S.I. unit. Calculate the daily loss of heat by the earth by conduction. [Radius of earth = 6400 km.] 3