RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FIRST SEMESTER EXAMINATION, DECEMBER 2012

FIRST YEAR

Date : 24/12/2012 **PHYSICS (General)**

Time : 11 am – 1 pm Paper : I Full Marks : 50

Group – A

Answer **any two** questions from question 1-4

1. a) State Gauss Divergence theorem.
   b) For what value of c(scalar) the magnitude of the vector $\vec{\alpha} = c(3\hat{i} - 6\hat{j} + \hat{k})$ is of 3 unit.
   c) Find the work done by a force of magnitude 15 units in displacing a particle at a point (1,1,1) to a point (2,1,3). Given that the force acts along $\vec{i} + 2\vec{j} + 2\vec{k}$.
   d) If $\vec{A}$ is a vector of constant magnitude, show that $\frac{d\vec{A}}{dt}$ is perpendicular to $\vec{A}$. [2+2+4+2]

2. a) Define conservative force. Give an example of non-conservative force.
   b) Explain why a rotating platform is slowed down when a man standing on it, stretches his arms.
   c) Find the radial and transverse acceleration of a particle moving in a circular path. [(2+1)+2+5]

3. a) State and prove perpendicular axes theorem of moment of inertia for a laminar body.
   b) What is radius of gyration? Is it a constant quantity for a rigid body?
   c) Find the moment of inertia of a solid sphere rotating about any of its diameters. [(1+3)+2+4]

4. a) Deduce an expression for the gravitational potential at a point inside a solid sphere.
   b) Why lighter gases like hydrogen and helium are rare in the earth's atmosphere?
   c) Find the escape velocity from Jupiter, G = $6{\cdot}66 \times 10^{-11}$ SI unit, mass of Jupiter = $1{\cdot}9 \times 10^{27}$ Kg and radius of Jupiter = 71,300 Km. [5+2+3]

Answer **any one** question from Question 5-6

5. a) If $\vec{V} = \vec{\omega} \times \vec{r}$ then prove that $\vec{\nabla} \times \vec{V} = 2\vec{\omega}$ where $\vec{\omega}$ is constant vector.
   b) Explain what do you understand by 'gravitational potential and intensity of gravitational field. [3+2]

6. a) Establish the relation between torque and angular acceleration of a rigid body.
   b) A solid cylinder of mass 10kg, length 25·4 cm and diameter 4 cm can rotate about its own axis. Calculate the kinetic energy necessary to rotate the cylinder at 300 r.p.m. [2+3]

Group – B

Answer **any two** questions from questions 7-10

7. a) Mention basic assumptions of kinetic theory of gases.
   b) Under what condition of temperature and pressure, a real gas behaves like an ideal gas.
   c) Find the number of degrees of freedom of a rigid diatomic molecule.
   d) State and explain the principle of equipartition of energy for a dynamic system at thermal equilibrium.
   e) Using the law of equipartition of energy, find the value of ratio of specific heats of a diatomic gas.[2+2+2+2+2]

8. a) What do you understand by steady state in case of conduction of heat?
   b) Find out the solution of Fourier equation for rectilinear flow of heat through a conductor in steady state.

c) The thickness of ice on a lake is 5 cm and the temperature of the air above is –20°C. Find the time taken for the thickness of ice to be doubled. [Thermal conductivity of ice = 0·005 CGS unit; density of ice = 0·91 g/cm^3; latent heat of fusion of ice = 80 cal/g] Deduce the required relation. [1+3+(3+3)]

9. a) What do you mean by state functions of a system. Name two such functions.
   b) Write down the general form of the first law of thermodynamics. Introduce the concept of internal energy.
   c) Establish the relation between V and T for a perfect gas in an adiabatic process. [(2+1)+4+3]

10. a) What is a blackbody?
    b) State Stefan's law of radiation.
    c) An electrical bulb of power 40W has an average temperature 2500°C. Length of the filament is 10 cm and its diameter is 0·01 mm. If all the heat is radiated, then find out emissive power of the filament. [Stefan's constant $\sigma = 5{\cdot}67 \times 10^{-5}$ cgs unit]
    d) Draw a graph to illustrate the energy distribution in the spectrum of blackbody radiation at a particular temperature. Mention the characteristics of the change in this graph with the variation of temperature. [1+2+3+(2+2)]

Answer **any one** question from Question 11-12

11. a) Draw the velocity distribution curve of molecules of an ideal gas at a given temperature and indicate the most probable velocity, average velocity and r.m.s. velocity.
    b) Distinguish between gas and vapour using the concept of critical temperature. [3+2]

12. a) Express critical pressure and temperature in terms of Van der Waal's constants.
    b) Using critical temperature T_{cr} = 5·30K, critical pressure P_{cr} = 2·25 atm, calculate the Van der Waal's constants for 1 mole of helium gas. [R = 8·31 J mol^{-1}K^{-1}; 1 atm = 1·013×10^5 Nm^{-2}] [2+3]

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