2022

(November)

PHYSICS

(Honours)

[PHY 05 (T-B)]

(Classical Mechanics, Electrodynamics, Statistical Physics, Energy Sources)

Marks : 56

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer Question No. **1** which is compulsory, and *any* **four** from the rest

1. *(a)* Calculate the change of melting point of ice produced by one atmosphere increase of pressure. Given that latent heat of ice = 80 cal/gm and specific volume of ice and water of 0 °C are 1·091 cm^3 and 1·0 cm^3 respectively. 3

(b) Calculate the r.m.s. velocity of a molecule of Hg vapour at 300 K. Given mass of an atom of Hg is 200 a.m.u. 3

(c) A bag contains 8 red, 7 green and 5 yellow balls. The balls are drawn at a random from the bag. What is the probability of selecting *(i)* green ball and *(ii)* red or yellow ball? 2

2. (a) What is meant by the term 'constraint'? Explain d' Alembert's principle and derive Lagrange equations of motion from it. 1+2+4=7

(b) What are generalized coordinates? Derive Hamilton's canonical equations of motion in generalized coordinates. 1+4=5

3. (a) Consider a dielectric sphere in a uniform electric field $\vec{E}_0$. Calculate the potential inside and outside the sphere. 7

(b) Obtain differential form of Gauss' law and hence derive the Laplace's and Poisson's equations. 3+1+1=5

4. (a) Define magnetic vector potential $\vec{A}$. Derive Poisson's equation for $\vec{A}$ in terms of current density with explanation. 2+4=6

(b) Write Maxwell's equations for electromagnetic waves in free space. Establish the orthogonality of $\vec{E}$ and $\vec{B}$ with respect to the propagation vector. 2+4=6

5. (a) Derive first and second TdS equation. 4

(b) Show that the mean and variance of Poisson distribution are same. 3

(c) Establish Liouville's theorem and discuss its physical significance. 4+1=5

6. (a) Derive Maxwell's distribution of molecular speed with calculation of mean velocity, r.m.s. velocity and most probable velocity. 4+1+1+1=7

(b) Apply Bose-Einstein statistics to deduce Planck's radiation law. 5

7. (a) Classify the methods of solar energy storage. Describe the electrical storage system. 1+3=4

(b) What do you mean by solar greenhouse? Explain the main types of greenhouse. 1+4=5

(c) What are renewable and non-renewable energy sources? Give two examples of each. 1+1+1=3

8. (a) What is Gaussian distribution? Obtain an expression for it. 2+5=7

(b) State and prove the law of equipartition of energy. 1+4=5

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