

Sundarban Mahavidyalaya
Part-I (1+1+1 system)
Intermediate Examination 2020
Subject:Physics; Paper:IIA
Full Marks:50; Time:2 hrs

Answer Question No. 1 and any four questions from the rest

1 Answer any five questions of the following:

2X5

- 1.1 What do you mean by the mean free path of gas molecules?
- 1.2 Prove the Avogadro's hypothesis from the perfect gas pressure equation.
- 1.3 Determine the area of a circle of radius "a" by using plane polar coordinates.
- 1.4 Give the assumptions of the kinetic theory of gases.
- 1.5 How many degrees of freedom does a rigid body have?
- 1.6 State the parallel axes theorem of moment of inertia.
- 1.7 The trajectory of a particle of mass m moving on a plane is given by $X = X_0 \sin(\omega t)$ and $Y = Y_0 \cos(\omega t)$. Hence compute the force acting on that particle.

2 Question No. 2 of Unit-03

- 2.1 Prove the Clapeyron's equation from perfect gas pressure equation.
- 2.2 At what temperature will the r.m.s speed of a gas be half its value at 0°C
- 2.3 Deduce the survival equation from the concept of mean free path.
- 2.4 Prove the Boyle's law from the perfect gas pressure equation.
- 2.5 Making use of Maxwell distribution function, find the mean of the reciprocal of velocity of the molecules in an ideal gas at the temperature T, if m be the mass of a molecule

2 + 2 + 3 + 1 + 2

3 Question No. 3 of Unit-03

- 3.1 A particle is moving along a curve in a plane. Derive expression for the radial and transverse component of velocity and acceleration. Prove that for the motion of a particle in a plane $\vec{v} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta}$ and $\vec{a} = (\ddot{r} - r\dot{\theta}^2)\hat{r} + (\dot{r}\dot{\theta} + 2\dot{r}\dot{\theta})\hat{\theta}$ where the letters have their usual meaning

5 + 5

4 Question No. 4 of Unit-03

- 4.1 Write the maxwells velocity distribution law.
- 4.2 From the Maxwell velocity distribution law, find the value of the root mean square velocity.
- 4.3 Deduce the perfect gas pressure equation.
- 4.4 Find the distribution of energy among the molecules using Maxwell speed distribution equation.

2 + 2 + 3 + 3

5 Question No. 5 of Unit-03

- 5.1 A particle is moving on a cylindrical polar co-ordinate system. Hence determine its velocity and acceleration components.
- 5.2 Prove that the force field $\vec{E} = (yz - y)\hat{i} + (xz - x - 1)\hat{j} + (xy - 2z)\hat{k}$ is conservative. Hence find out corresponding scaler potential.

5 + (2 + 3)

6 Question No. 6 of Unit-03

- 6.1 A rigid body is rotating about a certain axis passing through it. Hence find out its moment of inertia tensor.
- 6.2 A circular shaped plate of radius a is rolling on a horizontal plane. Hence find out its total energy. Also calculate its radius of gyration of that rolling body.

5 + (3 + 2)

7 Question No. 7 of Unit-03

- 7.1 Calculate the diameter of molecule of Benzene if $n = 2.79 \times 10^{19}$ molecules per c.c. and mean free path λ for Benzene $= 2.2 \times 10^{-8} \text{ cm}$.
- 7.2 Calculate the mean free path of a gas molecule of diameter 3.2 \AA . The number of molecules per unit volume is $2.5 \times 10^{25} \text{ m}^{-3}$

5 + 5