**2017**

( 5th Semester )

PHYSICS

SEVENTH PAPER

**( Classical Mechanics and Thermal Physics )**

( Revised )

*Full Marks* : 55

*Time* : 2½ hours

( PART : B—DESCRIPTIVE )

( *Marks* : 35 )

*The figures in the margin indicate full marks for the questions*

**1.** *(a)* By reducing a two-body problem to a one-body problem, find the equation of motion of the equivalent one-body. 3

*(b)* Deduce Kepler's third law of planetary motion from Newton's law of gravitation. 4





*Or*

*(a)* Explain the terms 'constraints' and 'generalized coordinates'. 2

*(b)* Using Hamiltonian formulation, obtain the equation of motion for a simple pendulum. 5

**2.** What is Brownian motion? Discuss Einstein's theory of Brownian motion. 1+6=7

*Or*

Deduce the Maxwell-Boltzmann law for the distribution of velocities of the particles of a gas. 7

**3.** *(a)* Define 'viscosity' and 'coefficient of viscosity'. 2

*(b)* Show that the coefficient of viscosity of a gas is $\frac{1}{3} pc$ , where the symbols have their usual meanings. 5

*Or*

Deduce Gibbs' phase rule. Using the phase rule, show that a quantity of water in equilibrium with its vapour in a cylinder fitted with a piston is a univariant system. 7

**4.** *(a)* Derive the relation $S \quad k \ln (E)$, where $S$ entropy and $(E)$ thermodynamic probability. 4

*(b)* Show that for thermodynamics equilibrium of any two systems in contact, the parameter of the two systems must be equal. 3

*Or*

Define ensemble. Explain microcanonical, canonical and grand canonical ensembles with necessary diagrams. 1+6=7

**5.** *(a)* Find the specific heat at constant volume of an ideal gas using M-B energy distribution law. 3

*(b)* Using F-D statistics, determine the Fermi energy of an electron gas in metal. 4

*Or*

Find the expression for the most probable distribution of the particles among various energy levels for a system obeying B-E statistics. 7

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**Subject Code : PHY/V/07 (R)**

**Booklet No. A**

Date Stamp .....

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**To be filled in by the Candidate**

DEGREE 5th Semester
(Arts / Science / Commerce / ..... ) Exam., **2017**

Subject .....

Paper .....

**INSTRUCTIONS TO CANDIDATES**

1. **The Booklet No. of this script should be quoted in the answer script meant for descriptive type questions and vice versa.**
2. **This paper should be ANSWERED FIRST and submitted within** *45 minutes* **of the commencement of the Examination.**
3. **While answering the questions of this booklet, any cutting, erasing, over-writing or furnishing more than one answer is prohibited. Any rough work, if required, should be done only on the main Answer Book. Instructions given in each question should be followed for answering that question only.**

**To be filled in by the Candidate**

DEGREE 5th Semester
(Arts / Science / Commerce / ..... ) Exam., **2017**

Roll No. .....

Regn. No. .....

Subject .....

Paper .....

Descriptive Type

Booklet No. B .....

*Signature of Scrutiniser(s)*

*Signature of Examiner(s)*

*Signature of Invigilator(s)*

**/212**

**2 0 1 7**

( 5th Semester )

# PHYSICS

SEVENTH PAPER

**( Classical Mechanics and Thermal Physics )**

( Revised )

( PART : A—OBJECTIVE )

( *Marks* : 20 )

*The figures in the margin indicate full marks for the questions*

SECTION—I

( *Marks* : 5 )

Put a Tick (✓) mark against the correct answer in the brackets provided : 1×5=5

**1.** If there are no external forces acting on a system of particles, then

*(a)* the total momentum of the system is constant ( )

*(b)* the velocity of centre of mass is constant ( )

*(c)* Both *(a)* and *(b)* ( )

*(d)* Neither *(a)* nor *(b)* ( )

**2.** If $c_{r.m.s.}$ = root-mean-square speed, $c$ = average speed and $c_p$ = most probable speed of the molecules of an ideal gas, then

*(a)* $c_{r.m.s.} = c = c_p$ ( )

*(b)* $c_{r.m.s.} > c > c_p$ ( )

*(c)* $c_{r.m.s.} < c < c_p$ ( )

*(d)* $c_{r.m.s.} > c = c_p$ ( )

**3.** The total heat content of a system is called

*(a)* internal energy ( )

*(b)* Helmholtz free energy ( )

*(c)* enthalpy ( )

*(d)* Gibbs' free energy ( )

**4.** In which of the following ensembles, a system can exchange energy as well as particle?

*(a)* Microcanonical ensemble ( )

*(b)* Canonical ensemble ( )

*(c)* Grand canonical ensemble ( )

*(d)* Both *(b)* and *(c)* ( )

**5.** Particles obeying Pauli's exclusion principle obey

*(a)* M-B statistics ( )

*(b)* F-D statistics ( )

*(c)* B-E statistics ( )

*(d)* Both *(a)* and *(b)* ( )

SECTION—II

( *Marks* : 15 )

Answer the following questions : 3×5=15

**1.** Define central force and non-central force. Give an example of each.

**2.** At what temperature the r.m.s. velocity of oxygen will become one-half of that of hydrogen at NTP?

**3.** What is the importance of *TdS*-equation? Derive the second *TdS*-equation

$$TdS = C_p dT - T(\partial V / \partial T)_p dP$$

**4.** State and explain the principle of equi-apriori probability.

**5.** Define Fermi level and Fermi energy. How is Fermi energy related to Fermi temperature?

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