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(1st Semester)

PHYSICS

FIRST PAPER

(Mechanics and Thermodynamics)

(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)* Obtain the position vector in two-dimensional Cartesian coordinate system and hence express the component of velocity and acceleration of a particle in the Cartesian coordinate system. 5

(b) What are conservative and non-conservative forces? 2

Or

(c) Establish the Coriolis force and hence give one application of the force. 3+1=4

(d) What is the centre of mass of a particle? Explain the uniqueness of the centre of mass. 1+2=3

2. *(a)* Explain with example the moment of inertia of a body. 2

(b) Calculate the moment of inertia of a rectangular body about an axis passing through the centre. 5

Or

(c) Derive an equation for the variation of mass with velocity. 5

(d) Calculate the speed of a moving particle if the mass is equal to four times its rest mass. 2

3. *(a)* Derive the relation

$$K = \frac{Y}{3(1 - 2\sigma)}$$

Here Y, K and σ are respectively the Young's modulus, bulk modulus and the Poisson's ratio. 4

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(b) Deduce Poiseuille's equation for the flow of liquid through a narrow horizontal tube. 3

Or

(c) Show that the height h through which the liquid of surface tension T will rise in a capillary tube of radius r is given by $h = \dfrac{2T}{r\rho g}\cos\theta$. ($g$ is acceleration due to gravity.) 5

(d) Calculate the height to which a liquid will rise in a capillary tube of radius $0 \cdot 2$ mm with surface tension of the liquid 546×10^{-3} N-m^{-1} and density 800 kg m^{-3}, if the angle of contact of the liquid is 45°. 2

4. *(a)* On the basis of kinetic theory of gas, explain the kinetic interpretation of temperature. 3

(b) Derive the relation $PV^{\gamma} = $ constant in an adiabatic expansion of an ideal gas, where P, V and γ have their usual meanings. 4

Or

(c) Using van der Waal's equation of state, obtain an expression for the critical temperature, pressure and volume. Hence, show that for a van der Waals' gas, the universal gas constant $R = \dfrac{8P_c V_c}{3T_c}$. Here P_c, V_c and T_c are the critical pressure, critical volume and critical temperature respectively. 5

(d) What are thermal conductivity and thermal diffusivity? 2

5. *(a)* State and explain the zeroth law of thermodynamics. 3

(b) What is entropy of substance? Show that the net change in entropy is zero in reversible cycle. 1+3=4

Or

(c) Write the statement of third law of thermodynamics. Explain the impossibility of attaining the absolute zero temperature. 1+2=3

(d) Derive Maxwell's four general relations for thermodynamic system. 4

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Subject Code : PHY/I/01 (R)

Date Stamp ....

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To be filled in by the Candidate

DEGREE 1st 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 1st 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)

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2 0 1 7

(1st Semester)

PHYSICS

FIRST PAPER

(Mechanics and Thermodynamics)

(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. A particle moves in *xy*-plane according to the equation, $x = 4t^2 + 5t + 8$. The acceleration of the particle is

   (a) 2   (   )

   (b) 4   (   )

   (c) 5   (   )

   (d) 8   (   )

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2. Relativity of simultaneity means

   (a) two events always occur at the same time   (   )

   (b) two events always occur at different times   (   )

   (c) two events always occur at the distant place   (   )

   (d) two events always occur at near place   (   )

3. The angle of contact of mercury with glass is

   (a) $> 90°$ (   )

   (b) $< 90°$ (   )

   (c) $90°$ (   )

   (d) $0°$ (   )

4. The real gas possesses

(a) both KE and PE, and cannot be liquefied ( )

(b) both KE and PE, and can be liquefied ( )

(c) only KE and no PE, and can be liquefied ( )

(d) only PE and no KE, and cannot be liquefied ( )

5. When 10 g of ice at 0° C is converted into water, the change in entropy is

(a) $5 \cdot 9 \, \text{cal/K}$ ( )

(b) $2 \cdot 9 \, \text{cal/K}$ ( )

(c) $1 \cdot 9 \, \text{cal/K}$ ( )

(d) $0 \cdot 9 \, \text{cal/K}$ ( )

(4)

(*Marks* : 15)

Give very short answer to the following questions :   3×5=15

1. State and explain the principle of conservation of energy for a system of particles.

2. What is length contraction? A spaceship of length 100 m leaves the earth with a constant velocity of $1 \cdot 5 \times 10^8$ m/s. Calculate the length of the spaceship for a stationary observer on the earth.

3. State and explain Bernoulli's theorem.

4. Calculate the r.m.s. velocity of hydrogen at NTP and also at 2184 °C. Given one litre of hydrogen weighs 0·08987 g at NTP.

5. Explain reversible and irreversible changes in thermodynamics.

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