

2014

(1st Semester)

PHYSICS

FIRST PAPER

(Mechanics and Thermodynamics)

(Regular)

Full Marks : 55

Time : 2 hours

(PART : B—DESCRIPTIVE)

(Marks : 35)

The figures in the margin indicate full marks  
for the questions

1. (a) Define gravitational field and potential.  
Derive an expression for the potential  
due to a sphere of uniform density at an  
external point. 1+4=5
- (b) Calculate the mass of the earth from the  
given data : 2

Radius of the earth =  $6 \times 10^8$  cm

$$g = 980 \text{ cm/s}^2$$

$$G = 6.6 \times 10^{-8} \text{ cm}^3 \text{ gm}^{-1} \text{ s}^{-2}$$

G15—650/20a

(Turn Over)

*Or*

Derive an expression for Coriolis force.  
Mention two of its applications.  $5+2=7$

2. Find the moment of inertia of solid cylinder about—  
 (a) its own axis;  
 (b) an axis perpendicular to its own axis at the mid-point of the cylinder.  $4+3=7$

*Or*

Write down Einstein's basic postulates for the special theory of relativity. Derive the relativistic formulae for momentum and energy.  $1+3+3=7$

3. (a) State and prove Bernoulli's theorem.  $5$   
 (b) Radius of a pipe decreases from 10 cm to 5 cm. If velocity of fluid at wider portion is 4 m/s, what is its velocity at the narrow portion?  $2$

*Or*

- (a) Find the expression for terminal velocity of a spherical body falling through a viscous medium.  $5$   
 (b) Explain the significance of Reynolds' number.  $2$

4. Discuss the nature of van der Waals' forces in a real gas. Using van der Waals' correction, obtain the real gas equation.  $2+5=7$

*Or*

- (a) Find the expression for the differential equation of rectilinear flow of heat before steady state is reached.  $4$
- (b) What are the specific heats of gases? How are they related?  $2+1=3$

5. Derive Maxwell's thermodynamic relations.  $7$

*Or*

- (a) What is the thermodynamic scale of temperature? Write the significance of absolute zero temperature in the scale.  $2+1=3$
- (b) Calculate the change in entropy when 5 kg of water at  $100^{\circ}\text{C}$  is converted into steam at the same temperature (latent heat of steam = 540 cal/gm).  $4$

2014  
( 1st Semester )

**PHYSICS**

FIRST PAPER

( Mechanics and Thermodynamics )

( Regular )

( 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 :  $1 \times 5 = 5$

1. In an inelastic collision

- (a) kinetic energy is conserved ( )
- (b) momentum is conserved ( )
- (c) kinetic energy and momentum are conserved ( )
- (d) kinetic energy and momentum are not conserved ( )

2. The moment of inertia of an elliptical disc about an axis through its centre and perpendicular to its plane is

(a)  $\frac{1}{4} M(a + b)$  ( )

(b)  $\frac{1}{4} M(a^2 + b^2)$  ( )

(c)  $4 M(a + b)$  ( )

(d)  $4 M(a^2 + b^2)$  ( )

3. Which of the following statements is true?

(a) The molecules at the surface of a liquid posses minimum potential energy ( )

(b) In a curved liquid surface, pressure on the concave side is greater than on convex side ( )

(c) Angle of contact between liquid and solid may have any value between  $0^\circ$  and  $360^\circ$  ( )

(d) All of the above ( )

4. The r.m.s. velocity of the molecule of an ideal gas is proportional to

(a)  $T$

(b)  $T^2$

(c)  $T^{-1}$

(d)  $T^{1/2}$

5. The efficiency of a Carnot engine (where the symbols have their usual meanings) is

(a)  $\left(1 - \frac{T_1}{T_2}\right)$

(b)  $\left(1 - \frac{T_2}{T_1}\right)$

(c)  $\left(\frac{T_2}{T_1} - 1\right)$

(d)  $\left(\frac{T_1}{T_2} - 1\right)$

( 4 )

SECTION-II  
( Marks : 15 )

Give very short answers to the following questions :  $3 \times 5 = 15$

1. The polar coordinates of a particle moving in a plane are given by  $r = a \sin \omega t$  and  $\theta = \omega t$ . Find the radial and transverse components of velocity.

( 5 )

2. What are inertial and non-inertial frames?

Inertial frame

Non-inertial frame

Inertial frame is one which does not have any acceleration.

Non-inertial frame is one which has acceleration.

Newton's law of motion is valid in inertial frame.

Newton's law of motion is not valid in non-inertial frame.

Newton's law of motion is not valid in non-inertial frame.

Newton's law of motion is valid in non-inertial frame.

Q. The efficiency of a Carnot engine (where the symbols have their usual meanings) is

$$\textcircled{1} \quad \left(1 - \frac{T_2}{T_1}\right)$$

$$\textcircled{2} \quad \left(1 - \frac{T_1}{T_2}\right)$$

$$\textcircled{3} \quad \left(\frac{T_1}{T_2} - 1\right)$$

$$\textcircled{4} \quad \left(\frac{T_2}{T_1} - 1\right)$$

( 6 )

3. What do you understand by surface tension and surface energy?

Give very short answers to the following questions (any 3) : 2x5=15

1. The polar coordinates of a particle moving in a plane are given by  $r = a \sin \omega t$  and  $\theta = \omega t$ . Find the radial and transverse components of velocity.

4. Obtain the reduced equation of state for real gas.

several ones won't make our examination  
ridiculous for it will be uploaded

## PHYSICS

## FIRST PAPER

(Mechanics and Thermodynamics) 100

(Regular) 100

(Part I-A—OBJECTIVE) 20

(Marks : 20)

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

## SECTION—I

## OBJECTIVE

(Marks : 5)

Put a Tick (✓) mark against the correct answer in the brackets provided.

1. In an elastic collision

(A) kinetic energy is conserved.

(B) momentum is conserved.

(C) kinetic energy and momentum are conserved.

(D) kinetic energy and momentum are not conserved.

5. State the Kelvin-Planck statement of second law of thermodynamics and explain how zero degree absolute temperature is not attainable.

- Q. Which of the following statements is true?
- The reduction in the surface of a liquid produces minimum potential energy.
  - In a curved liquid surface, pressure on the concave side is greater than on convex side.
  - Angle of contact between liquid and solid may have any value between  $0^\circ$  and  $360^\circ$ .
  - All of the above
- ★★★