CUD

2006

PHYSICS - I (Optional)

Standard : Degree | *Total Marks : 200*

Nature : Conventional | *Duration : 3 Hours*

Note : 000054

(i) *Answers must be written in* ***English*** *only.*

(ii) *Question* ***No. 1*** *is* ***Compulsory.*** *Of the remaining questions, attempt* ***any four*** *selecting one question from* ***each section.***

(iii) *Figures to the* ***RIGHT*** *indicate marks of the respective question.*

(iv) *Sign at the beginning indicates the different part of the question.*

(v) *Make suitable assumptions, wherever be necessary and state the same.*

(vi) *Number of optional questions upto the prescribed number in the order in which they have been solved will only be assessed. Excess answers will not be assessed.*

(vii) *Credit will be given for orderly, concise and effective writing.*

(viii) *Candidate should not write roll number, any name (including their own), signature, address or any indication of their identity anywhere inside the answer book otherwise he will be penalised.*

(ix) *For each slab of 10 and 15 marks, the examinee is expected to write answers in 125 and 200 words respectively.*

1. ***Answer any four of the following (10 Marks each) :***

(a) Define '*Centre of mass*' for a system of N particles. **10**
Discuss the elastic and inelastic collisions in one dimension.
Illustrate the principles of conservation of linear momentum and energy in elastic collision of two particles having different masses.

(b) What is Reverberation ? Discuss its implications for a good auditorium. **10**
Obtain Sabine's formula for reverberation time.

(c) Specify the concept of a quarter wave plate. **10**
Quartz has the refractive indices 1.533 and 1.544, calculate the thickness of a quarter wave plate for sodium light ($\lambda = 5890A^{\circ}$).

(d) What the term '*Pollutants*' does signify ? **10**
Discuss their role in producing air pollution.
What measures India has been taking to minimise it ?
Give the meaning of '*Green house effect*'.

(e) Describe the layerwise structure of atmosphere. **10**
'Ozone layer surrounding the earth is a boon to its habitants'. - Comment on the statement.
What is meant by Ozone depletion ? Give an account of its consequences.

P.T.O.

Marks

SECTION - A

2. (a) State and explain Kepler's laws of motion. **15**

Explain the state of weightlessness in a satellite.

Find the expression for escape velocity of a rocket shooted upwards.

(b) Show that the relation **10**

$$\frac{3}{n}+\frac{1}{K}=\frac{9}{y}$$

between elastic constants - Young's modulus (Y), Bulk modulus (K) and modulus of rigidity (n), holds true.

(c) Give the meaningful explanation to the term 'Surface Tension'. Find its units and dimensions. **15**

Show that the excess pressure inside a liquid surface is greater than its outside one.

Find the excess pressure inside a soap bubble.

A 0.02 cm. liquid column balances the excess pressure inside a soap bubble of radius 7.5 mm. Determine density of the liquid.

(S.T. of soap solution = 0.03 N/m)

3. (a) Explain the terms - Gravitational field and potential. **15**

Calculate the gravitational field and potential at an external point due to uniform solid sphere.

Find the gravitational field due to moon at its surface.

(Data supplied - Mass of moon $= 7.36 \times 10^{22}$kg,

Radius of moon $= 1.74 \times 10^{6}$ m.

Grav. Conslt. $G = 6.67 \times 10^{-11}$ N - m^2/kg^2)

(b) What is meant by the term *'Bending Moment'*. **10**

Find an expression for Young's modulus (Y) of the material of horizontal beam clamped at one end and loaded at the other.

(c) Clarify the concepts of *'stream line flow'* and *'viscosity'* with relevant expressions. **15**

Obtain an expression for the terminal velocity of a spherical body falling through a liquid.

Discuss Stoke's method for the determination of coefficient of viscosity of a liquid.

A gas bubble of diameter 2 cm rises steadily through a solution of density 1.75 gm/cc at the rate of 0.35 cm/sec. Calculate the coefficient of viscosity of the solution, neglecting the density of gas.

Marks

SECTION - B

4. (a) Explain the physical implications of Galilean transformations, establish Galilean invariance. **15**

Describe Michelson - Morley experiment.

What the negative result of M - M experiment does signify ?

(b) Differentiate between transverse, longitudinal and stationary waves. **15**

Establish the laws of transverse vibrations of a string.

How they can be verified in the laboratory.

Two similar sonometer wires of the same material, under the same tension, produce 2 beats per sec. The length of one wire is 50 cm and that of the other is 50.1 cm. Calculate the frequencies of two wires.

(c) Explain *'Limits of Human Audibility'* with the help of Wegel diagram. **10**

Give an account of the recording and reproduction of sound.

5. (a) Discuss the variation of mass with velocity ($v \leq c$) and its effect. **15**

Assuming LT^s, establish *'Velocity Addition Theorem'*, also show that the ultimate speed of a material object is speed of light *'c'*.

In the laboratory, two particles are observed to travel in opposite directions with speed 2.8×10^{10} cm/sec. Get the relative speed of the particles.

(b) What we do understand by Free, Damped and Forced oscillations. **15**

Give the theory of forced vibrations and discuss sharpness of resonance.

(c) Describe the characteristics of musical sound with illustrations. **10**

Define Bel, Decibel with reference to loudness and intensity.

Calculate the change in intensity level when the intensity increases by 10^5 times its original value.

Marks

9. (a) Distinguish between two specific heats of a gas. **10**

Find out the relation between them.

The molar heat capacity of a gas (Cυ) is found to be 5 cal/mol. Find the ratio (r) for the gas. ($R = 2cal/mol - k$)

(b) Explain the terms 'Reversible cycle and Entrophy'. **10**

Describe Carnot engine principle and find its efficiency.

A sample of 100 gm water is slowly heated from 27°C to 87°C, calculate the change in entropy of water (sp. heat capacity for water = 4200J/kg − k)

(c) (i) Give precise explanation of the following concepts : **10**

Generalised coordinates, phase space, microstate, macrostate.

Define thermodynamic probability. How it does differ from mathematical probability ?

Establish the relation between entrophy and thermodynamic probability.

(ii) In what way F.D. distributions do differ from B.E. ones ? **10**

Give the physical significance of fermi function and fermi temperature.

Analyse the behaviour of fermi function and fermi energy with respect to temperature.

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Marks

SECTION - C

6. (a) Explain the formation of Newton's rings. **10**

Give the necessary theory.

How you would employ this phenomenon for measuring the wavelength of light used.

In Newton's rings experiment, diameter of the 5th ring is 0.336 cm and that of the 15th ring is 0.590 cm. Find the radius of curvature of plane convex lens used. ($\lambda = 5880A°$)

(b) Describe the principle and use of Fabry - Perot interferometer analytically. **10**

Discuss the visibility of fringes.

(c) What is Rayleigh's criterion for just resolution of two objects ? **10**

Find an expression for R.P. of a telescope.

Calculate the aperture of the objective of a telescope which may be used to resolve stars separated by 4.88×10^{-6} radians for light of wavelength 6000A°.

(d) Describe the action of a plane transmission grating in producing a spectrum. **10**

How the wavelength of light is determined using plane grating.

In a plane transmission grating, angle of diffraction for the second order maxima is 30°, Calculate the number of lines per cm. of the grating surface.

($\lambda = 5 \times 10^{-5}$ cm)

7. (a) What are coherent sources ? **10**

Describe Young's double slit experiment, develop the theory of bright fringes.

Two straight and narrow parallel slits 1mm apart are illuminated by monochromatic light. Fringes formed on the screen held at 100 cm from the slits are 0.50 mm apart. Guess the wavelength of light.

(b) Discuss the theory of interference for thin films due to reflected light. **10**

Find the necessary formula for fringe width of fringes produced by wedge-shaped thin film.

(c) Explain the action of a zone plate and compare it with a lens. **10**

Find the radius of first half period zone on a zone plate behaving like a convex lens of focal length 60 cm.

(d) Discuss the points of distinction between the spectra obtained with a grating and prism. **10**

Compare the Paschen and Rowland in outings.

P.T.O.

Marks

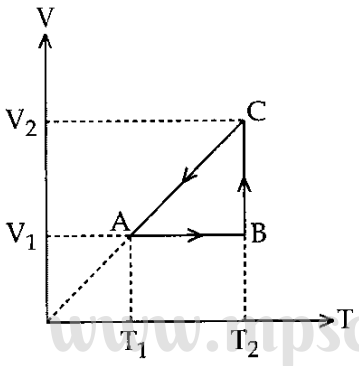
SECTION - D

8. (a) State the assumptions of Kinetic theory of gases and on this basis find out the expression for pressure of an ideal gas. **10**

(b) Comment on 'First Law of Thermodynamics leads to the statement of law of conservation of energy. **10**

Find out the workdone on ideal gas in isothermal process.

The figure shows the process ABCA performed on an ideal gas. Find the net heat given to the system during process.



(c) (I) Maxwellian distribution of speed is given by **10**

$f(\upsilon) = 4\pi n\,(m/2\pi kT)^{3/2}\,\upsilon^2 \exp(-mv^2/2kT)$ where symbols carry their usual meanings.

(i) Give a plot of $f(\upsilon)$ against υ and explain why the curve shows a peak.

(ii) Derive expressions for mean speed, r.m.s. speed and most probable speed.

(iii) Find the most probable speed when $m = 3 \times 10^{-23}$gm at a temperature of 27°C

(II) Discuss the limitations of M.B. statistics. **10**

Explain the criterion for applicability of B.E. statistics.

Obtain Planck radiation formula on the basis of BE distribution.

P.T.O.