2009

PHYSICS - I (Optional)

100098

Standard : Degree

Total Marks : 200

Nature : Conventional

Duration : 3 Hours

Note :

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

(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/she 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)   State and explain the principle of conservation of linear and angular momentum.   **10**
Show that the linear momentum of a body of n-particles remain constant in absence of any external force acting on it. Also show that conservation of angular momentum applied to a planetary motion leads to law of constant areal velocity

(b)   Explain the phenomenon of reverberation. Discuss sabine law for reverberation.   **10**

(c)   Explain the phenomenon of double refraction in uniaxial crystal. Discuss the production of linearly and circularly polarised light.   **10**

How they are detected ?

(d)   Explain the structure of atmosphere. Discuss the variation of temperature in different layers of atmosphere.   **10**

(e)   Discuss the atmospheric pollution with green house effect. What would happen if green house effect did not exist ?   **10**

P.T.O.

Section - A

বিভাগ - A

2. Answer the following sub-question :

    Marks

(a) State and explain Newton's law of gravitation and gravitational potential. **15**
Calculate the gravitational potential due to sphere at any point.

    (i) Outside the sphere

    (ii) Inside the sphere

(b) Explain the terms : **10**

    (i) Young's modulus

    (ii) Poissons ratio

    (iii) Modulus of rigidity

    A rectangular bar of iron is supported on two knife edges and load is applied
at middle point. Obtain an expression for the depression at middle.

(c) Define coefficient of viscosity. What is the effect of temperature and pressure on **15**
viscosity ? Derive the Stock's formula for velocity of small sphere falling through
viscuss liquid. Define surface energy. Calculate the workdone in spraying a
spherical drop of water 1 mm radius in to million droplets of equal size.
(S.T. of water $= 72 \times 10^{-3} \, \text{N}/_\text{M}$)

3. Answer the following sub-question :

(a) State Kepler's laws of gravitation. Derive these laws from Newton's laws of **15**
gravitation. Calculate mean density of earth $[G = 6.6 \times 10^{-8}, \, g = 980 \, \text{cm}/_{\text{s}^2}$,
$R = 6400 \text{km})$

(b) Show that torsional couple per unit angular twist is $\dfrac{n \pi a^4}{2l}$ when a cylinder is **10**
twisted. In the equation symbol's have their usual meaning.

(c) State and prove the Bernoullis theorem. Explain any two application of this **15**
theorem.

Section - B

বিভাগ - B

4. Answer the following sub-questions :

(a) State the fundamental postulates of special theory of relativity. Obtain Lorentz **15**
transformation from them. Determine the time taken by the rocket (measured by
clock in rocket) to reach the distant star and return to earth with a constant
velocity 'v' equals to $\sqrt{0.99} \, C$, if distance of star is 4 light years.

(b) Explain the characterstics of SHM. Show how to find velocity at any phase of **15**
motion. The path of body executing SHM along a straight line is 4 cm and its
velocity when crossing the centre of path is 6 cm/sec. Calculate its time period.

(c) Explain the recording of sound on the film and how it is reproduced ? **10**

Marks

5.   Answer the following sub-question :

    (a)   On the basis of theory of relativity show that the mass of a particle varies with   **15** velocity. Hence prove that it is not possible for a material body to gain the velocity equal or greater than velocity of light

    (b)   What are beats ?

        Show that number of beats produced per second is equals to difference of   **15** frequencies of two sounding bodies.

    (c)   Explain, what do you mean by quality of sound ? On what factors does quality   **10** depend ?

Section - C
विभाग - C

6.   Answer the following sub-question :

    (a)   Explain the necessity of broad source to observe the interference in thin film.   **10** Show that the film appears bright in a reflected system and appears dark in a transmitted system.

    (b)   Describe the principle and construction of Michelson's interferometer. When the   **10** movable mirror of Michelson's interferometer is shifted by 0.0589 mm, a shift of 200 fringes are observed. Find the wavelength of light used

    (c)   Discuss the Fraunhofer's type diffraction due to straight edge and its intensity   **10** distribution curve.

    (d)   Discuss the construction and theory of plane transmission grating.   **10**

7.   Answer the following sub-question :

    (a)   Show that in 'Newton's ring' experiment the diameter of bright ring in reflected   **10** system are proportional to square root of odd natural number. In Newtons's ring experiment the diameter of nth bright ring changes from 0.3 cm to 0.26 cm when liquid is introduced between lens and glass plate. Calculate the refractive index of liquid.

    (b)   Write short note on Febry Perot interferometer.   **10**

    (c)   Explain Rayleigh criterion for resolution and discuss it in relation with the resolving   **10** power of telescope.

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

    (d)   Discuss the resolving power of plane transmission grating. What should be   **10** minimum number of lines in a grating which will just resolve in a second order lines whose wavelengths are 5890A° and 5896A° ?

P.T.O.

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Section - D

(বিভাগ - D)

Marks

8. Answer the following sub-questions

(a) Discuss the important assumptions of kinetic theory of gases. Explain the nature of Vander-Waal's forces   **10**

(b) Describe the Carnot's cycle and obtain expression for efficiency of an ideal gas heat engine in terms of temperature. An inventor claims to have developed an engine working between 500 k and 300 k capable of having efficiency of 52 %. Is the claim valid or invalid ?   **10**

(c) (i) Discuss the Maxwell's Boltzman's distribution for molecular speed. What are its limitations ? Show that internal energy of an ideal gas depends only on its temperature   **10**

     (ii) What is an electron gas ? Assuming the Fermi-Dirac statistics distribution law, derive an expression for energy distribution of free electron in metal   **10**

9. Answer the following sub-questions :

(a) What is Joule-Thomson effect ? Discuss the theory of JT effect. Hence explain why hydrogen shows the heating effect at ordinary temperature ?   **10**

(b) Define entropy. Derive an expression for entropy of an ideal gas interms of pressure, volume and specific heat. When gas undergoes the free expansion, then the change in entropy of one mole of ideal gas is positive, zero or negative   **10**

(c) (i) Define root mean square speed. Using Maxwell's distribution law of a molecular speed, show that rms speed is $\sqrt{\dfrac{3KT}{m}}$ **10**

     (ii) What is Bose-Einstein statistics. Derive an expression for $n_i = \dfrac{g_i}{e^{\alpha + BE_i} - 1}$ for most probable distribution in BE statistics.   **10**

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