17/1

2008

PHYSICS

Paper 1

Time : 3 Hours] *[Maximum Marks : 300*

INSTRUCTIONS

Candidates should attempt ***all*** *the questions in Parts A, B & C. However, they have to choose only* ***three*** *questions in Part D.*

Answers must be written in the medium opted (i.e. English or Kannada).

SEAL

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
D	90 marks

Marks allotted to each question are indicated in each part.

PART A

4×5=20

Answer each question in about 50 words. Each question carries 5 marks.

1. (a) Define torque and angular momentum. Obtain the relation between them.

   (b) State and explain Planck's law for black body radiation.

   (c) What are forced oscillations ? Explain resonance and the condition for the same.

   (d) Give a brief description of one technique for the production of linearly polarized light.

PART B

10×10=100

Answer each question in about 100 words. Each question carries 10 marks.

2. Explain Kepler's laws of planetary motion. Derive the third law from the basic laws of motion and gravity.

3. Explain gyroscope and precessional motion.

4. Discuss Bernoulli's equation and one application.

5. Explain Carnot's cycle with reference to a PV plot. What is the relevance of the area enclosed by the plot ?

6. Explain pressure exerted by a gas based on kinetic theory. Obtain an expression for the same.

7. Discuss thermal ionization. Give an explanation for stellar spectra in terms of this process.

8. What is meant by superposition of waves ? Distinguish between phase velocity and group velocity and give the relation between them.

9. Explain damping. Show how this is taken into consideration in the equation of motion of a single harmonic oscillator. What is its effect on the amplitude and the frequency ?

10. Give the important features of Fresnel and Fraunhofer diffraction by a circular aperture.

11. Explain resolving power of an optical instrument and the Rayleigh criterion for the same.

PART C

6×15=90

Answer each question in about 150 words. Each question carries 15 marks.

12. (a) Explain the two basic conservation laws operating in the collision between two bodies.

(b) What is collision impact parameter ? Explain its significance.

13. (a) What are the postulates of the special theory of relativity ? Explain.

(b) Derive the Lorentz transformation equations for space and time co-ordinates.

14. (a) Explain Maxwell's distribution law of velocities of gas molecules at a temperature T.

(b) Describe the principle of the Joule – Kelvin effect.

15. (a) What are the basic assumptions of Einstein's theory of specific heats of solids ?

(b) Develop the theory.

16. (a) Write down the wave equation and obtain the harmonic solutions.

(b) Hence explain plane and spherical waves.

17. (a) Describe the principle and operation of a He-Ne laser.

(b) Distinguish between spatial and temporal coherence.

PART D

3×30=90

*Answer any **three** of the following questions, each in about 300 words. Each question carries 30 marks.*

18. (a) What is meant by central forces ? What are their characteristics ?

(b) Show that for a particle moving under the influence of a central force obeying inverse square law, the angular momentum is conserved.

(c) What are geostationary orbits ? Obtain an expression for the radius of a geostationary orbit.

19. (a) Describe the set-up and experimental procedure of the Michelson – Morley experiment. Discuss its outcome.

(b) Derive an expression for the relativistic variation of mass with velocity.

(c) Prove the relativistic invariance of the quantity

$$(ds)^2 = (dx)^2 - (c\,dt)^2.$$

20. (a) Explain adiabatic and isothermal processes.

(b) Define entropy. Discuss how it varies in the above two processes.

(c) Two blocks of copper, each of mass 850 gm, are put in thermal contact in an insulated box. The initial temperatures of the two blocks are 325 K and 285 K. Given that the specific heat of copper is 0·386 J/g.K, calculate the final temperature of the two blocks. What is the change in entropy of the two blocks ?

21. (a) Describe Huygens' principle and apply it to the propagation of plane waves.

(b) Explain the phenomenon of interference. Enlist the conditions necessary for observing a stable interference pattern.

(c) In a double slit experiment, the slits are 0·5 cm apart at 1 m from the screen. These are illuminated by a light source emitting two light waves with λ_1 = 480 nm and λ_2 = 600 nm. What is the separation on the screen between the third order bright fringes for the two wavelengths ? Also, calculate the shortest distance from the centre of the screen where the bright fringe of λ_1 overlaps the dark fringe of the other.

22. (a) Explain the phenomenon of polarization of light. Which property of light waves does this process illustrate ? Explain.

(b) Describe how circularly polarized light can be produced and detected.

(c) A beam of partially polarized light is passed through a polarizing filter and then the filter is rotated through 360° while keeping it perpendicular to the beam. The transmitted intensity is found to vary by a factor of 5 during the rotation. What fraction of the intensity of the original beam is associated with the polarized component of the beam ?

17/2

2008

PHYSICS

Paper 2

Time : 3 Hours] *[Maximum Marks : 300*

INSTRUCTIONS

Candidates should attempt ***all*** *the questions in Parts A, B & C. However, they have to choose only* ***three*** *questions in Part D.*

Answers must be written in the medium opted (i.e. English or Kannada).

This paper has four parts :

A	20 marks
B	100 marks
C	90 marks
D	90 marks

Marks allotted to each question are indicated in each part.

SEAL

PART A

$4 \times 5 = 20$

Answer each question in about 50 words. Each question carries 5 marks.

1. (a) Derive the equation for Coulomb's second law of electrostatics and define a unit charge.

(b) Discuss the dual nature of matter and wave.

(c) What is radioactivity ? Compare the properties of α, β and γ rays.

(d) Explain why NAND and NOR gates are called universal gates.

PART B

10×10=100

Answer each question in about 100 words. Each question carries 10 marks.

2. State and prove Gauss theorem in electrostatics.

3. State and explain Faraday's and Lenz's law of electromagnetic induction.

4. Explain the concept of displacement current density in the time varying electric and magnetic fields. Prove that the displacement current density, $\vec{J}_d = \frac{\partial \vec{D}}{\partial t}$.

5. State Bohr's fundamental postulates for hydrogen atom. Mention its limitations (any two). Obtain expressions for its energy levels.

6. State and explain the significance of four quantum numbers n, l, s and m_l.

7. What is light scattering ? Explain why intensity of Stokes lines are more than Antistokes lines in Raman effect.

8. What is nuclear binding energy ? Draw a binding energy curve.

9. Write a note on intrinsic and extrinsic semiconductors.

10. What is a zener diode ? Describe its working principle.

11. Describe with a circuit diagram transistor emitter follower.

PART C

6×15=90

Answer each question in about 150 words. Each question carries 15 marks.

12. (a) What is Biot – Savart's law ?

(b) Show that magnetic field due to a current, I, carrying circular loop of radius r is given by $B = \frac{\mu_0 I}{2r}$.

13. (a) Express Maxwell's equations in differential and integral form, and use them to obtain the equation of continuity.

(b) Show that speed of electromagnetic wave in vacuum is $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$.

14. (a) Explain Classical theory of Raman effect.

(b) Irradiation of carbon tetrachloride by 4358 Å radiation gives Raman lines at 4400, 4419 and 4447 Å. Calculate the Raman shift for each of these lines.

15. (a) Explain Nuclear fission.

(b) Describe the release of energy during nuclear fission.

16. (a) Describe in short the formation of energy bands in solids. Mention how materials are classified based on the energy bands.

(b) Obtain expression for conductivity in semiconductor material.

17. (a) Explain the working of diode half wave rectifier briefly, with circuit diagram.

(b) Explain :

(i) Positive logic

(ii) Negative logic

PART D

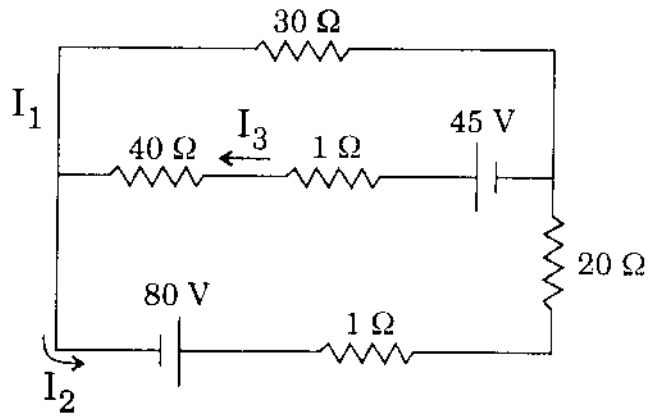
3×30=90

*Answer any **three** of the following questions, each in about 300 words. Each question carries 30 marks.*

18. (a) State and explain Kirchhoff's laws of electrical network.

(b) Obtain the condition of balance of Wheatstone's bridge using Kirchhoff's laws.

(c) In the given electrical circuit, calculate the values of I_1, I_2 and I_3. The internal resistance of the cells is negligible.



19. (a) Explain the transverse nature of plane electromagnetic waves in vacuum.

(b) Define Poynting's vector and write down its expression.

(c) Distinguish briefly between para, dia and ferromagnetic substances.

20. (a) What is photoelectric effect ? Explain a simple experimental arrangement to study the same.

(b) Prove that the Compton shift $\Delta\lambda = \frac{h}{m_e c}(1 - \cos\theta)$ where symbols have their usual meaning.

(c) In Compton scattering the incident photons have wavelength $3{\cdot}0 \times 10^{-10}$ m. Calculate the wavelength of scattered radiation if they are viewed at an angle 60° to the direction of incidence.

21. (a) Describe construction and working of cyclotron.

(b) Describe briefly the theory on which a cyclotron works.

(c) Calculate the magnetic field in which the cyclotron dees should be placed to accelerate protons, the frequency applied being 8×10^6 c/s. ($e = 4{\cdot}8 \times 10^{-10}$ esu. Mass of proton $= 1{\cdot}67 \times 10^{-34}$ gm)

22. (a) What is an oscillator ? Obtain an expression for the Barkhausen criterion for oscillations.

(b) Input to an oscillator is not provided. Then where will it get the starting voltage ?

(c) A phase shift oscillator uses three identical RC sections. The values of the components are R = 100 kΩ and C = 0·01 μF. Determine its frequency of oscillation.