

DAY — **06**

SEAT NUMBER

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2024 II 27

1100

**J-837**

(E)

## **PHYSICS (54)**

Time : 3 Hrs.

( 8 Pages )

Max. Marks : 70

### **General Instructions :**

*The question paper is divided into four sections :*

- (1) **Section A :** *Q. No. 1 contains Ten multiple choice type of questions carrying One mark each.*  
*Q. No. 2 contains Eight very short answer type of questions carrying One mark each.*
- (2) **Section B :** *Q. No. 3 to Q. No. 14 contain Twelve short answer type of questions carrying Two marks each.*  
*(Attempt any Eight).*
- (3) **Section C :** *Q. No. 15 to Q. No. 26 contain Twelve short answer type of questions carrying Three marks each.*  
*(Attempt any Eight).*
- (4) **Section D :** *Q. No. 27 to Q. No. 31 contain Five long answer type of questions carrying Four marks each.*  
*(Attempt any Three).*
- (5) *Use of the log table is allowed. Use of calculator is not allowed.*
- (6) *Figures to the right indicate full marks.*
- (7) *For multiple choice type questions, only the first attempt will be considered for evaluation.*

(8) *Physical Constants :*

- (i) Mass of electron  $m = 9.1 \times 10^{-31}$  kg
- (ii)  $\epsilon_0 = 8.85 \times 10^{-12}$  C $^2$  / Nm $^2$
- (iii)  $\pi = 3.142$
- (iv) Charge on electron  $e = 1.6 \times 10^{-19}$  C
- (v)  $\mu_0 = 4\pi \times 10^{-7}$  Wb / Am
- (vi) Planck's constant  $h = 6.63 \times 10^{-34}$  J.s.
- (vii) Speed of light  $c = 3 \times 10^8$  m/s
- (viii)  $g = 9.8$  m/s $^2$
- (ix) Rydberg's constant  $R_H = 1.097 \times 10^7$  m $^{-1}$
- (x) Stefan's constant  $\sigma = 5.67 \times 10^{-8}$  J m $^{-2}$  s $^{-1}$  K $^{-4}$

## SECTION – A

**Q. 1. Select and write the correct answer for the following [10]  
multiple choice type of questions :**

- (i) The moment of inertia (MI) of a disc of radius R and mass M about its central axis is \_\_\_\_\_.
  - (a)  $\frac{MR^2}{4}$
  - (b)  $\frac{MR^2}{2}$
  - (c)  $MR^2$
  - (d)  $\frac{3MR^2}{2}$
- (ii) The dimensional formula of surface tension is \_\_\_\_\_.
  - (a)  $[L^{-1}M^1T^{-2}]$
  - (b)  $[L^2M^1T^{-2}]$
  - (c)  $[L^1M^1T^{-1}]$
  - (d)  $[L^0M^1T^{-2}]$



(viii) The current in a coil changes from 50A to 10A in 0.1 second. The self inductance of the coil is 20H. The induced e.m.f. in the coil is \_\_\_\_\_.  
(a) 800V (b) 6000V  
(c) 7000V (d) 8000V

(ix) The velocity of bob of a second's pendulum when it is 6 cm from its mean position and amplitude of 10 cm, is \_\_\_\_\_.  
(a)  $8\pi$  cm/s (b)  $6\pi$  cm/s  
(c)  $4\pi$  cm/s (d)  $2\pi$  cm/s

(x) In biprism experiment, the distance of 20<sup>th</sup> bright band from the central bright band is 1.2 cm. Without changing the experimental set-up, the distance of 30<sup>th</sup> bright band from the central bright band will be \_\_\_\_\_.  
(a) 0.6 cm (b) 0.8 cm  
(c) 1.2 cm (d) 1.8 cm

**Q. 2. Answer the following questions :**

[8]

- (i) Define centripetal force.
- (ii) Why a detergent powder is mixed with water to wash clothes?
- (iii) What is the resistance of an ideal voltmeter?
- (iv) Write the formula for torque acting on rotating current carrying coil in terms of magnetic dipole moment, in vector form.

(v) What is binding energy of a hydrogen atom?

(vi) What is surroundings in thermodynamics?

(vii) In a photoelectric experiment, the stopping potential is 1.5V. What is the maximum kinetic energy of a photoelectron?

(viii) Two capacitors of capacities  $5\mu\text{F}$  and  $10\mu\text{F}$  respectively are connected in series. Calculate the resultant capacity of the combination.

## SECTION – B

**Attempt any EIGHT questions of the following :**

**[16]**

**Q. 3.** Explain the change in internal energy of a thermodynamic system (the gas) by heating it.

**Q. 4.** Explain the construction of a spherical wavefront by using Huygens' principle.

**Q. 5.** Define magnetization. State its SI unit and dimensions.

**Q. 6.** Obtain the differential equation of linear simple harmonic motion.

**Q. 7.** A galvanometer has a resistance of  $30\Omega$  and its full scale deflection current is 20 microampere ( $\mu\text{A}$ ). What resistance should be added to it to have a range 0-10 volt?

**Q. 8.** Explain Biot-Savart law.

**Q. 9.** What is a Light Emitting Diode? Draw its circuit symbol.

**Q. 10.** An aircraft of wing span of 60 m flies horizontally in earth's magnetic field of  $6 \times 10^{-5}$  T at a speed of 500 m/s. Calculate the e.m.f. induced between the tips of wings of aircraft.

**Q. 11.** Derive an expression for maximum speed of a vehicle moving along a horizontal circular track.

**Q. 12.** A horizontal force of 0.5N is required to move a metal plate of area  $10^{-2}$  m<sup>2</sup> with a velocity of  $3 \times 10^{-2}$  m/s, when it rests on  $0.5 \times 10^{-3}$  m thick layer of glycerin. Find the coefficient of viscosity of glycerin.

**Q. 13.** Two tuning forks having frequencies 320 Hz and 340 Hz are sounded together to produce sound waves. The velocity of sound in air is 340 m/s. Find the difference in wavelength of these waves.

**Q. 14.** Calculate the change in angular momentum of electron when it jumps from third orbit to first orbit in hydrogen atom.

## SECTION – C

**Attempt any EIGHT questions of the following :** [24]

**Q. 15.** A circular coil of wire is made up of 200 turns, each of radius 10 cm. If a current of 0.5A passes through it, what will be the magnetic field at the centre of the coil?

**Q. 16.** Define photoelectric effect and explain the experimental set-up of photoelectric effect.

**Q. 17.** Define the current gain  $\alpha_{DC}$  and  $\beta_{DC}$  for a transistor. Obtain the relation between them.

**Q. 18.** Define surface energy of the liquid. Obtain the relation between the surface energy and surface tension.

**Q. 19.** What is an isothermal process? Obtain an expression for work done by a gas in an isothermal process.

**Q. 20.** Derive an expression for equation of stationary wave on a stretched string. Show that the distance between two successive nodes or antinodes is  $\lambda/2$ .

**Q. 21.** Derive an expression for the impedance of an LCR circuit connected to an AC power supply. Draw phasor diagram.

**Q. 22.** Calculate the wavelength of the first two lines in Balmer series of hydrogen atom.

**Q. 23.** A current carrying toroid winding is internally filled with lithium having susceptibility  $\chi = 2.1 \times 10^{-5}$ . What is the percentage increase in the magnetic field in the presence of lithium over that without it?

**Q. 24.** The radius of a circular track is 200 m. Find the angle of banking of the track, if the maximum speed at which a car can be driven safely along it is 25 m/sec.

**Q. 25.** Prove the Mayer's relation :  $C_p - C_v = \frac{R}{J}$

**Q. 26.** An alternating voltage is given by  $e = 8 \sin 628.4t$ . Find

- (i) peak value of e.m.f.
- (ii) frequency of e.m.f.
- (iii) instantaneous value of e.m.f. at time  $t = 10$  ms.

## SECTION – D

Attempt any THREE questions of the following :

[12]

**Q. 27.** What is a transformer? Explain construction and working of a transformer. Derive the equation for a transformer.

**Q. 28.** Using the geometry of the double slit experiment, derive the expression for fringe width of interference bands.

**Q. 29.** Distinguish between an ammeter and a voltmeter. (Two points each).

The displacement of a particle performing simple harmonic motion is  $\frac{1}{3}$ rd of its amplitude. What fraction of total energy will be its kinetic energy?

**Q. 30.** Draw a neat labelled diagram of Ferry's perfectly black body. Compare the rms speed of hydrogen molecules at 227°C with rms speed of oxygen molecule at 127°C. Given that molecular masses of hydrogen and oxygen are 2 and 32 respectively.

**Q. 31.** Derive an expression for energy stored in a charged capacitor. A spherical metal ball of radius 15 cm carries a charge of  $2\mu\text{C}$ . Calculate the electric field at a distance of 20 cm from the center of the sphere.

