Techior Solutions Pvt. Ltd.

HSC Physics Sample Paper

Total Time: 3 Hr | Total Marks: 70.0

Physics

Section A

Q. 1. Select the correct alternatives and write the answers :

1) Two bodies with moments of inertia I_1 and I_2 ($I_1 > I_2$) rotate with the same angular momentum. If E_1 and E_2 are their rotational kinetic energies, then **1.0**

A) $E_2 > E_1$
B) $E_2 = E_1$
C) $E_2 < E_1$
D) $E_2 \leq E_1$

2) The momentum of a photon with $\lambda = 3315$ Å is **1.0**

A) 2×10^{-27} kg·m/s
B) 5×10^{-27} kg·m/s
C) 2×10^{-41} kg·m/s
D) 5×10^{-41} kg·m/s

3) The amount of energy radiated per unit time by a body does not depend upon the **1.0**

A) nature of its surface
B) area of its surface
C) mass of the body
D) temperature difference of the surface and surroundings

4) A vertical spring-and-block system has a block of mass 10 g and oscillates with a period 1 s. The period of SHM of a block of mass 90 g, suspended from the same spring, is **1.0**

A) 1/9 s
B) 1/3 s
C) 3 s
D) 9 s

5) When light of wavelength 5000 Å falls on a metal surface whose photoelectric work function is 1.9 eV, the kinetic energy of the most energetic photoelectrons is **1.0**

A) 0.59 eV
B) 1.39 eV
C) 1.59eV
D) 2.59eV.

6) A rectangular bar magnet-with sides l. b and w - h.is mass n and magnetic moment M. It is free to rotate about a vertical axis through its centre of mass such that its faces of area l × b are horizontal The period T of angular oscillations of this magnet in a uniform magnetic field B is given by **1.0**

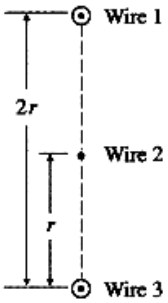
A) $\frac{1}{2\pi}\sqrt{\frac{12MB}{m(I^2+b^2)}}$

B) $\sqrt{\frac{\pi^2 m(I^2+b^2)}{3MB}}$

C) $\sqrt{\frac{\pi^2 M(I^2+b^2)}{3mB}}$

D) $\sqrt{\frac{m(I^2+b^2)}{3MB}}$

7) Three straight, parallel wires are coplanar and perpendicular to the plane of the page. The currents I_1 and I_3 are directed out of the page. If the wire 3 experiences no force due to the currents I_1 and I_2, then the current in the wire 2 is **1.0**



A) $I_2 = 2I_1$ and directed into the page

B) $I_2 = 0.5I_1$ and directed into the page

C) $I_2 = 2I_1$ and directed out of the page

D) $I_2 = 0.5I_1$ and directed out of the page

8) A simple generator has a 300 loop square coil of side 20 cm turning in a field of 0.7 T. How fast must it turn to produce a peak output of 210 V ? **1.0**

A) 25 rps

B) 4 rps

C) 2.5 rps

D) 0.4 rps

9) The dimensions of magnetic dipole moment are **1.0**

A) $[L^2I]$

B) $[LI]$

C) $[L^{-1}I]$

D) $[L^{-2}I]$

10) Which of the following is diamagnetic? **1.0**

A) Dysprosium
B) Gadolinium
C) Magnesium
D) Silver

Q. 2. Answer the following questions :

11) What is an AC generator? **1.0**

12) What are common properties of waves? **1.0**

13) Complete the following equation describing nuclear decay. **1.0**

$^{12}_{7}\mathrm{N} \rightarrow ^{12}_{6}\mathrm{C} + \_\_\_\_\_$

14) What will happen to the angular speed of a conical pendulum if its length is increased from 0.5 m to 2 m, keeping other conditions the same? **1.0**

15) What is absolute zero temperature? **1.0**

16) What is motional emf? **1.0**

17) What are sound waves? **1.0**

18) A water pipe with a diameter of 5.0 cm is connected to another pipe of diameter 2.5 cm. How would the speeds of the water flow compare? **1.0**

Section B

Attempt any EIGHT of the following questions :

19) State the expression for the self inductance of a solenoid. Hence show that the SI unit of magnetic permeability is the henry per metre. **2.0**

20) A string 1m long is fixed at one end. The other end is moved up and down with frequency of 15 Hz. Due to this, a stationary wave with four complete loops gets produced on the string. Find the speed of the progressive wave which produces the stationary wave.
[Hint: Remember that the moving end is an antinode.] **2.0**

21) Define electric polarization in dielectrics. **2.0**

22) Show graphically how the number of nuclei (N) of a radioactive element varies with time (t). **2.0**

23) What is the emissive power of a perfect black-body at 1000 K? ($\sigma = 5.67 \times 10^{-8}$ W/m^2.K^4) **2.0**

24) If the frequency of certain light is 6×10^{14} Hz, what is its wavelength in free space ? **2.0**

[$c = 3 \times 10^8$ m/s]

25) A solenoid of length Lm and 5 cm in diameter has winding of 1000 turns and carries a current of 5 A. Calculate the magnetic field at its center along the axis. **2.0**

26) Why cold wash is recommended for new cotton fabrics while hot wash for removing stains? **2.0**

27) Find the thermal efficiency of a heat engine if in one cycle the work output is 3000 J and the heat input is 10000 J. **2.0**

28) What is the photoelectric effect? **2.0**

29) The speed of transverse waves on a vibrating string is 50 m/s. If the length of the string is 0.25 m, what is the fundamental frequency of vibration? **2.0**

30) A Zener diode has a Zener voltage of 2.4 V and a 500 mW power rating. What should be the maxi-mum current through the diode if you design conservatively with a safety factor of 2? **2.0**

Section C

Attempt any EIGHT of the following questions :

31) What is a PN-junction diode? What is a depletion region? What is barrier potential in a PN-junction? **3.0**

32) Obtain the ratio of the wavelength of the H_α line to the wavelength of the H_γ. line in the Balmer series. **3.0**

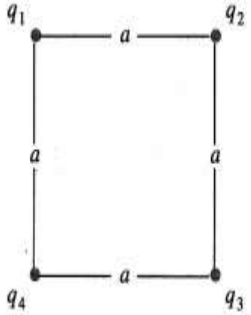
33) Why should not the jockey be slided along the potentiometer wire? **3.0**

34) A metal plate is introduced between the plates of a charged parallel plate capacitor. What is its effect on the capacitance of the capacitor? **3.0**

35) Define : **3.0**
(1) retentivity
(2) coercivity.

36) What is the electric potential energy of the following charge configuration? **3.0**

Take $q_1 = +1 \times 10^{-8}$ C, $q_2 = -2 \times 10^{-8}$ C, $q_3 = +3 \times 10^{-8}$ C, $q_4 = 2 \times 10^{-8}$ C and a = 1 m. Assume the charges to be in vacuum.



37) What are isotones? Give an example. **3.0**

38) A toroid (Rowland ring) of mean radius 16 cm has 1000 turns of wire closely wound on a ferromagnetic core of relative permeability 400. What is the magnetic induction B within the core for a magnetizing current of 1 A? **3.0**

39) State the expression for the energy stored in the magnetic field of an inductor. Hence, define its self inductance. **3.0**

40) Calculate the angular momentum of the electron in the third Bohr orbit of hydrogen atom. **3.0**

[Data: $e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg, $h = 6.63 \times 10^{-34}$ J·s, $c = 3 \times 10^8$ m/s. I eV = 1.6×10^{-19} J, $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m, $R = 1.097 \times 10^7$ m 1, $1/4\pi\varepsilon_0 = 9 \times 10^9$ N·m^2/C^2]

41) Find the de Broglie wavelength of a dust particle of radius 1 μm and density 2.5 g/cm^3 drifting at 2.2 m/s. (Take $\pi = 3.14$) **3.0**

42) A proton is to be suspended in vacuum between two parallel plates separated by 1 mm. Find (i) the electric field required (ii) the potential difference between the plates corresponding to the desired field. [$m_p = 1.67 \times 10^{-27}$ kg] **3.0**

Section D

Attempt any THREE of the following questions :

43) State any two sources of errors in the meter-bridge experiment. Explain how they can be minimized. **4.0**

44) Effective magneton numbers for iron group ions (No. of Bohr magnetons) **4.0**

Ion	Electron configuration	Magnetic moment (in terms of /i_B)
Fe^{3+}	[Ar] $3s^2 3p^6 3d^5$	5.9
Fe^{2+}	[Ar] $3s^2 3p^6 3d^6$	5.4
Co^{2+}	[Ar] $3s^2 3p^6 3d^7$	4.8
n^{2+}	[Ar] $3s^2 3p^6 3d^8$	3.2

(Courtsey : Introduction to solid state physics by Charles Kittel, pg. 306)
These magnetic moments are calculated from the experimental value of magnetic susceptibility. In several ions the magnetic moment is due to both orbital and spin angular momenta.

45) How are oscillations produced using an inductor and a capacitor? **4.0**

46) Explain one application of electromagnet. **4.0**