Class: XII

SESSION : 2022-2023

SAMPLE QUESTION PAPER (THEORY)

SUBJECT: PHYSICS

Maximum Marks: 70 Marks Time Allowed: 3 hours.

General Instructions:

(1) There are 35 questions in all. All questions are compulsory

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study-based questions of 4 marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.

5. Use of calculators is not allowed.

SECTION A

1. If the net electric flux through a closed surface is zero, then we can infer 1

(A) no net charge is enclosed by the surface.

(B) uniform electric field exists within the surface.

(C) electric potential varies from point to point inside the surface.

(D) charge is present inside the surface.

2. An electric dipole consisting of charges + q and – q separated by a distance L is in stable equilibrium in a uniform electric field $\vec{E}$. The electrostatic potential energy of the dipole is 1

(A) qLE

(B) zero

(C) – qLE

(D) – 2 qEL

3. A potentiometer can measure emf of a cell because 1

(A) the sensitivity of potentiometer is large.

(B) no current is drawn from the cell at balance.

(C) no current flows in the wire of potentiometer at balance.

(D) internal resistance of cell is neglected.

4. Two resistors R1 and R2 of 4 Ω and 6 Ω are connected in parallel across a battery. The ratio of power dissipated in them, P1 : P2 will be 1

(A) 4 : 9

(B) 3 : 2

(C) 9 : 4

(D) 2 : 3

5. The magnetic dipole moment of a current carrying coil does not depend upon 1

(A) number of turns of the coil.

(B) cross-sectional area of the coil.

(C) current flowing in the coil.

(D) material of the turns of the coil.

6. Larger aperture of objective lens in an astronomical telescope 1

(A) increases the resolving power of telescope.

(B) decreases the brightness of the image.

(C) increases the size of the image.

(D) decreases the length of the telescope.

7. A biconvex lens of glass having refractive index 1·47 is immersed in a liquid. It becomes invisible and behaves as a plane glass plate. The refractive index of the liquid is 1

(A) 1·47

(B) 1·62

(C) 1·33

(D) 1·51

8. For a glass prism, the angle of minimum deviation will be smallest for the light of 1

(A) red colour.

(B) blue colour.

(C) yellow colour.

(D) green colour.

9. Which of the following statements is not correct according to Rutherford model ? 1

(A) Most of the space inside an atom is empty.

(B) The electrons revolve around the nucleus under the influence of coulomb force acting on them.

(C) Most part of the mass of the atom and its positive charge are concentrated at its centre.

(D) The stability of atom was established by the model.

10.Photons of energies 1 eV and 2 eV are successively incident on a metallic surface of work function 0·5 eV. The ratio of kinetic energy of most energetic photoelectrons in the two cases will be 1

(A) 1 : 2

(B) 1 : 1

(C) 1 : 3

(D) 1 : 4

11. A bar magnet is cut into two equal halves by a plane parallel to the magnetic axis. Of the following physical quantities the one which remains unchanged is 1

a)pole strength

b)magnetic moment

c)intensity of magnetisation

d)None of these

12. The core of a transformer is laminated as 1

(A) it improves the ratio of voltage in the primary and secondary may be increased.

(B) it checks rusting of the core may be stopped.

(C) it reduces energy losses due to eddy currents.

(D) it increases flux linkage.

13. The number of turns of a solenoid are doubled without changing its length and area of cross-section. The self-inductance of the solenoid will become 1

a) 2 times

b). 3 times

c). 4 times

d). 5 times

14. According to Bohr's atomic model, the circumference of the electron orbit is always a multiple of de Broglie wavelength. 1

a) $2\pi/nh$

b) n

c) 2n

d) 3n

where n is an integer

15. A ray of light on passing through an equilateral glass prism, suffers a minimum deviation equal to the angle of the prism. The value of refractive index of the material of the prism is _____ 1

a) $\sqrt{2}$

b) $\sqrt{3}$

c) 1.5

d) 1.33

Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

a) Both A and R are true and R is the correct explanation of A
b) b Both A and R are true and R is NOT the correct explanation of A
c) c) A is true but R is false
d) d) A is false and R is also false

16. **Assertion (A):** Magnetic field interacts with a moving charge only. 1

Reason (R): Moving charge produces a magnetic field.

17. **Assertion (A):** The resistivity of a semiconductor decreases with temperature. 1

Reason (R): The atoms of a semiconductor vibrate with larger amplitude at higher temperature there by increasing it's resistivity.

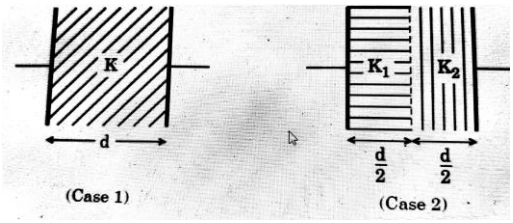
18. **Assertion (A):** de-Broglie equation is significant for microscopic particles. 1

Reason (R): de-Broglie wavelength is inversely proportional to the mass of a particle when velocity is kept constant.

SECTION B

19 . Explain the principle of working of a meter bridge. Draw the circuit diagram for determination of an unknown resistance using it. 2

20. The space between the plates of a parallel plate capacitor is completely filled in two ways. In the first case, it is filled with a slab of dielectric constant K. In the second case, it is filled with two slabs of equal thickness and dielectric constants K_1 and K_2 respectively as shown in the figure. The capacitance of the capacitor is same in the two cases. Obtain the relationship between K, K_1 and K_2 . 2



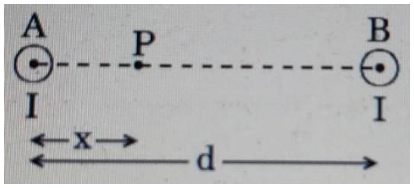
21. Define the term 'Half-life' of a radioactive substance. Two different radioactive substances have half-lives T_1 and T_2 and number of undecayed atoms at an instant, N_1 and N_2 , respectively. Find the ratio of their activities at that instant. 2

22. Define wavefront of a travelling wave. Using Huygens principle, obtain the law of refraction at a plane interface when light passes from a denser to rarer medium. 2

OR

Using lens maker's formula, derive the thin lens formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ for a biconvex lens. 2

23. Two long straight parallel wires A and B separated by a distance d, carry equal current I flowing in same direction as shown in the figure.



(a) Find the magnetic field at a point P situated between them at a distance x from one wire.

(b) Show graphically the variation of the magnetic field with distance x for $0 < x < d$. 2

24. Using Bohr's atomic model, derive the expression for the radius of n th orbit of the revolving electron in a hydrogen atom. 2

OR

(a) Write two main observations of photoelectric effect experiment which could only be explained by Einstein's photoelectric equation.

(b) Draw a graph showing variation of photocurrent with the anode potential of a photocell. 2

25. Explain the terms 'depletion layer' and 'potential barrier' in a p-n junction diode. How are the

(a) width of depletion layer, and

(b) value of potential barrier affected when the p-n junction is forward biased?

SECTION C

26. (a) Two cells of emf E_1 and E_2 have their internal resistances r_1 and r_2 , respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other.

(b) In case the two cells are identical, each of emf E = 5 V and internal resistance r = 2 Ω, calculate the voltage across the external resistance R = 10 Ω. 3

27. (a) Write an expression of magnetic moment associated with a current (I) carrying circular coil of radius r having N turns.

(b) Consider the above-mentioned coil placed in YZ plane with its centre at the origin. Derive expression for the value of magnetic field due to it at point (x, 0, 0). 3

OR

(a) Define current sensitivity of a galvanometer. Write its expression.

(b) A galvanometer has resistance G and shows full scale deflection for current Ig .

(i) How can it be converted into an ammeter to measure current up to I_0 (I_0 > Ig) ?

(ii) What is the effective resistance of this ammeter? 3

28. A resistance R and a capacitor C are connected in series to a source $V = V_0 \sin \omega t$. Find:

(a) The peak value of the voltage across the

(i) resistance and

(ii) capacitor.

(b) The phase difference between the applied voltage and current. Which of them is ahead? 3

29. What is the effect on the interference fringes in Young's double slit experiment due to each of the following operations? Justify your answers. 3

(a) The screen is moved away from the plane of the slits.

(b) The separation between slits is increased.

(c) The source slit is moved closer to the plane of double slit.

30. (a) Write the expression for the speed of light in a material medium of relative permittivity ε_r and relative magnetic permeability μ_r .

(b) Write the wavelength range and name of the electromagnetic waves which are used in

(i) radar systems for aircraft navigation, and

(ii) Earth satellites to observe the growth of the crops. 3

SECTION D

31. (a) Using Gauss law, derive expression for electric field due to a spherical shell of uniform charge distribution σ and radius R at a point lying at a distance x from the centre of shell, such that

(i) $0 < x < R$, and

(ii) $x > R$.

(b) An electric field is uniform and acts along + x direction in the region of positive x. It is also uniform with the same magnitude but acts in – x direction in the region of negative x. The value of the field is E = 200 N/C for $x > 0$ and E = – 200 N/C for $x < 0$. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one flat face is at x = + 10 cm and the other is at x = – 10 cm. Find :

(i) The net outward flux through the cylinder.

(ii) The net charge present inside the cylinder. 5

OR

(a) Find the expression for the potential energy of a system of two-point charges q_1 and q_2 located at $\overrightarrow{r1}$ and $\overrightarrow{r2}$, respectively in an external electric field $\vec{E}$.

(b) Draw equipotential surfaces due to an isolated point charge (– q) and depict the electric field lines.

(c) Three-point charges + 1 μC, – 1 μC and + 2 μC are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of an equilateral triangle of side 10 cm. 5

32. (a) Derive the expression for the torque acting on the rectangular current carrying coil of a galvanometer. Why is the magnetic field made radial?

(b) An α-particle is accelerated through a potential difference of 10 kV and moves along x-axis. It enters in a region of uniform magnetic field $B = 2 \times 10^{-3}$ T acting along y-axis. Find the radius of its path. (Take mass of α-particle = $6{\cdot}4 \times 10^{-27}$ kg) 5

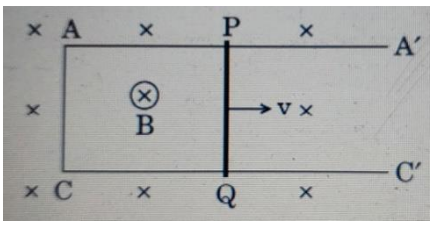
OR

(a) With the help of a labelled diagram, explain the working of a step-up transformer. Give reasons to explain the following :

(i) The core of the transformer is laminated.

(ii) Thick copper wire is used in windings.

(b) A conducting rod PQ of length 20 cm and resistance 0·1 Ω rests on two smooth parallel rails of negligible resistance AA′ and CC′. It can slide on the rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B = 0·4 T. The rails, the rod and the magnetic field are in three mutually perpendicular directions as shown in the figure. If the ends A and C of the rails are short circuited, find the (i) external force required to move the rod with uniform velocity v = 10 cm/s, and (ii) power required to do so.



33 a). Draw the ray diagram of an astronomical telescope when the final image is formed at infinity. Write the expression for the resolving power of the telescope.

(b) An astronomical telescope has an objective lens of focal length 20 m and eyepiece of focal length 1 cm. (i) Find the angular magnification of the telescope. (ii) If this telescope is used to view the Moon, find the diameter of the image formed by the objective lens. Given the diameter of the Moon is $3{\cdot}5 \times 10^6$ m and radius of lunar orbit is $3{\cdot}8 \times 10^8$ m.

OR

(a) An object is placed in front of a concave mirror. It is observed that a virtual image is formed. Draw the ray diagram to show the image formation and hence derive the mirror equation

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

b) An object is placed 30 cm in front of a plano-convex lens with its spherical surface of radius of curvature 20 cm. If the refractive index of the material of the lens is 1·5, find the position and nature of the image formed.

SECTION E

34. Read the following text and answer the following questions on the basis of the same:

Spectrum Analysis and Astronomy

Each element in the periodic table can appear in gaseous form and produce its own spectrum unique to that element. Hydrogen will not look like Helium, which will not look like carbon which will not look like iron... and soon.

Astrophysists can identify what kinds of materials are present in stars from the analysis of star 's spectra. This type of study is called astronomical spectroscopy.

The science of spectroscopy is quite sophisticated. From spectrum lines analysis astrophysists can determine not only the element, but the temperature and density of that element in the star. The spectral line also can tell us about any magnetic field of the star.

The width of the line can tell us how fast the material is moving. We can learn about winds in stars from this. The shifting of spectral lines shift back and forth indicates that the star may be orbiting another star.

The following table shows a rough guide for the relationship between the temperature of a star and the electromagnetic spectrum. If the spectrum of a star is red or blue shifted, then it can be used to infer its velocity along the line of sight. Edwin Hubble observed that more distant galaxies tended to have more red shifted spectra. This establishes the theory of expansion of the universe.

Temperature (Kelvin)	**Predominant radiation**	**Astronomical Examples**
600 K	Infrared	Planets, warm dust
6,000 K	Optical	The photosphere of Sun and other stars
60,000 K	UV	The photosphere of very hot stars
600,000 K	Soft X-rays	The corona of the Sun
6,000,000 K	X-rays	The coronae of active stars

a) What is astronomical spectroscopy?

b) From the spectrum analysis write down two points of information of a star can be obtained.

c). Which nature of spectrum establishes the theory of the expanding universe? Which nature of spectrum establishes the theory of the expanding universe?

35. Read the following text and answer the following questions on the basis of the same

Band theory of solid:

Consider that the Si or Ge crystal contains N atoms. Electrons of each atom will have discrete energies in different orbits. The electron energy will be same if all the atoms are isolated, i.e., separated from each other by a large distance. However, in a crystal, the atoms are close to each other (2 Å to 3 Å) and therefore the electrons interact with each other and also with the neighbouring atomic cores. The overlap (or interaction) will be more felt by the electrons in the outermost orbit while the inner orbit or core electron energies may remain unaffected. Therefore, for understanding electron energies in Si or Ge crystal, we need to consider the changes in the energies of the electrons in the outermost orbit only. For Si, the outermost orbit is the third orbit ($n = 3$), while for Ge it is the fourth orbit ($n = 4$). The number of electrons in the outermost orbit is 4 (2s and 2p electrons). Hence, the total number of outer electrons in the crystal is 4N. The maximum possible number of outer electrons in the orbit is 8 (2s + 6p electrons). So, out of the 4N electrons, 2N electrons are in the 2N s-states (orbital quantum number $l = 0$) and 2N electrons are in the available 6N *p*-states. Obviously, some *p*-electron states are empty. This is the case of well separated or isolated atoms.

A) Under what condition the energy of electrons of atoms of a substance will be same.
b) In which shell electrons should be so that it felt more overlap (or interaction).
c) In a crystal, what is the distance between two atoms ? For Silicon and Germanium name the outermost orbits