Sample Paper 2

Physics (Unsolved)

(A Highly Simulated Practice Question Paper for CBSE Class XII Examination)

General Instructions

See Sample Question Paper 1.

Time : 3 hours

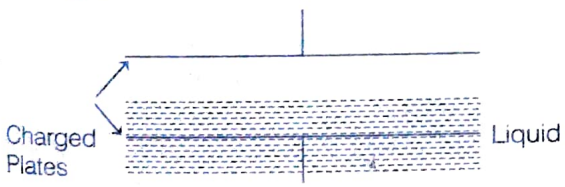
Max. Marks : 70

SECTION A

All questions are compulsory. In case of internal choices, attempt anyone of them.

1. Each of the two point charges are doubled and their distance is halved. Force of interaction becomes n times, then what is the value of n?

2. A parallel plate capacitor is located horizontally such that one of the plates is submerged in a liquid while the other is above the liquid surface. How is the level of liquid affected, when plates are charged?



3. Why do the electric field lines never cross each other?

Or How does a diamagnetic material behave when it is cooled at very low temperature?

4. Distinguish between a dielectric and a conductor.

5. Find the internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω.

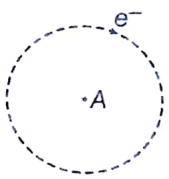
6. Can an inverted telescope works as microscope?

Or Under what condition, does the formation of rainbow occur?

7. de-Broglie postulated that the relation ship, $\lambda = h/p$ is valid for relativistic particles. Find out the de-Broglie wavelength for an (relativistic) electron whose kinetic energy is 3 MeV.

8. Calculate the energy equivalent of 2 g of substance.

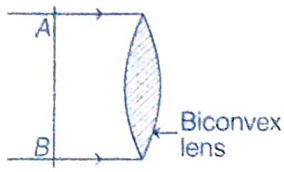
9. An electron is revolving around a circular loop as shown in the figure. What will be the direction of magnetic field at the point A?



Or Give reason why a galvanometer is not used in its real form, to measure current.

10. The ground state energy of hydrogen atom is −13.6 eV, then find the potential energy of the electron in this state.

Or If AB is incident wavefront (as shown in the figure below), then draw the refracted wavefront.



For question numbers 11, 12, 13 and 14, 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) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

11. Assertion The drift velocity of electrons in a metallic wire decreases, when temperature of the wire increases.

Reason On increasing temperature, conductivity of metallic wire decreases.

12. Assertion Electron moving perpendicular to **B** will perform circular motion.

Reason Force exerted by magnetic field on the electron is perpendicular to its velocity.

13. Assertion The magnetic field produced by a current carrying solenoid is independent of its length and cross-sectional area.

Reason The magnetic field inside the solenoid is uniform.

14. Assertion Ferromagnetic substances are those which gets strongly magnetised when placed in an external magnetic field.

Reason Ferromagnetic substances have strong tendency to move from a region of weak magnetic field to strong magnetic field, i.e. they get strongly attracted to a magnet.

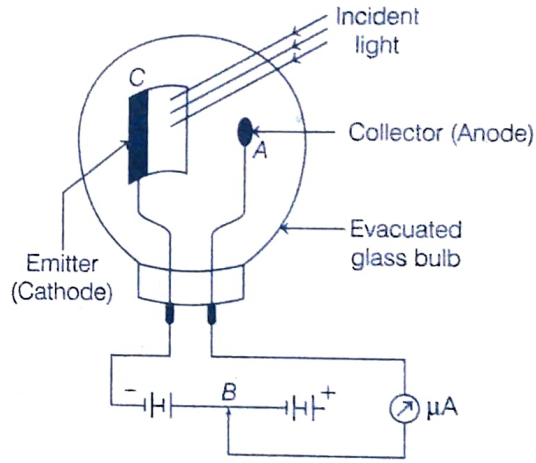
SECTION B

Questions 15 and 16 are case study based questions and are compulsory. Attempt any 4 sub-parts from each question. Each question carries 1 mark.

15. Photocell

Photocell is a device which converts light energy into electrical energy. It is also called an electric eye.

As, the photoelectric current sets up in the photoelectric cell corresponding to incident light, it provides the information about the objects as has been seen by our eye in the presence of light.



A photocell consists of a semi-cylindrical photosensitive metal plate *C* (emitter) and a wire loop *A* (collector) supported in an evacuated glass or quartz bulb. When light of suitable wavelength falls on the emitter *C*, photoelectrons are emitted.

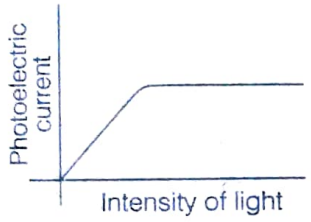
(i) A photocell cannot be used
(a) for reproduction of sound in motion pictures
(b) in burglar alarms
(c) as a fire alarm
(d) to illuminate a room

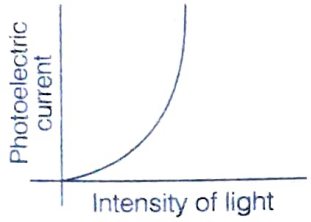
(ii) It is observed that no electrons are emitted when frequency of light is less than a certain minimum frequency.

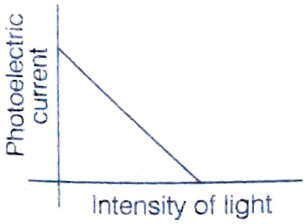
This minimum frequency depends on
(a) potential difference of emitter and collector plates
(b) distance between collector and the emitter plates
(c) size (area) of the emitter plate
(d) material of the emitter plate

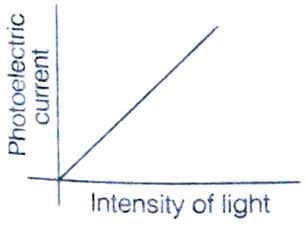
(iii) The work function of a metal used in photocell is hc/λ_0. If light of wavelength λ is incident on its surface, then the essential condition for the electron to come out from the metal surface is
(a) $\lambda \geq \lambda_0$ (b) $\lambda \geq 2\lambda_0$
(c) $\lambda \leq \lambda_0$ (d) $\lambda \leq \lambda_0/2$

(iv) Variation of photoelectric current with intensity of light for a photocell is

(a) 

(b) 

(c) 

(d) 

(v) A photon of energy 3.4 eV is incident on a metal surface of a photocell whose work function is 2 eV. Maximum kinetic energy of emitted photoelectrons will be
(a) 5.4 eV (b) 1.4 eV
(c) 3.7 eV (d) 3.4 eV

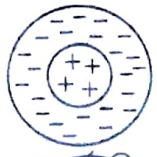
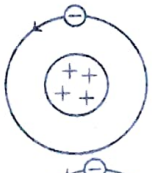
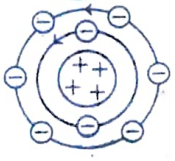
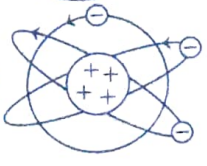
16. α-Particle Scattering Experiment

In this experiment, H. Geiger and E. Marsden took radioactive source ($^{214}_{83}Bi$) for α-particles. A collimated beam of α-particles of energy 5.5 MeV was allowed to fall on 2.1×10^{-7} m thick gold foil. The α-particles were observed through a rotatable detector consisting of a zinc sulphide screen & microscope and it was found that α-particles got scattered. These scattered α-particles produces scintillations on the zinc sulphide screen.

Observations of this experiment are as follows
I. Many of the α-particles pass through the foil without deflection.
II. Only about 0.14% of the incident α-particles scattered by more than 1°.
III. Only about one α-particle in every 8000 α-particles deflected by more than 90°.

Based on these observation, they were able to propose a nuclear model of atom, are called planetary model, in which entire positive charge and most of the mass of atom is concentrated in a small volume called the nucleus with electron revolving around the nucleus as planets revolve around the sun.

(i) Which of the following suggests the theory of Rutherford's atomic model?

(a) 
(b) 
(c) 
(d) 

(ii) Gold foil used in Geiger-Marsden experiment is about 10^{-8} m thick. This ensures
(a) gold foil's gravitational pull is small or possible
(b) gold foil is deflected when α-particle stream is not incident centrally over it
(c) gold foil provides no resistance to passage of α-particles
(d) most α-particle will not suffer more than 1° scattering during passage through gold foil

(iii) In Geiger-Marsden experiment, detection of α-particles scattered at a particular angle is done by
(a) counting flashes produced by α-particles on a ZnS coated screen
(b) counting spots produced on a photographic film
(c) using a galvanometer detector
(d) None of the above

(iv) Rutherford atomic model was unstable because
(a) nuclei will breakdown
(b) electrons do not remain in orbit
(c) electrons are attracted by nucleus
(d) orbiting electrons radiate energy

(v) The fact that only a small fraction of the number of incident particles rebound back in Rutherford scattering indicates that
(a) number of α-particles undergoing head-on-collision is small
(b) mass of the atom is concentrated in a small volume
(c) nucleus is positively charge
(d) All of the above

SECTION C

All questions are compulsory. In case of internal choices, attempt anyone.

17. The fission properties of $^{239}_{94}Pu$ are very similar to those of $^{235}_{92}U$. The average energy released per fission is 180 MeV. How much energy in MeV is released, if all the atoms in 1 kg of pure $^{239}_{94}Pu$ undergo fission?

Or

An atomic power nuclear reactor can deliver 300 MW. The energy released due to fission of each nucleus of uranium atoms U^{238} is 170 MeV. What will be the number of uranium atoms fissioned per hour?

18. Is photoelectric emission possible at all frequencies? Give reason for your answer.

Or

A Rowland ring of mean radius 15 cm has 3500 turns of wire wound on a magnetic material core of relative permeability 800. What is the magnetic field (B) in the core for a magnetising current of 1.2 A?

19. (i) A current is set up in a long copper pipe. Is there magnetic field (a) inside (b) outside the pipe?
(ii) A charged particle moves through a region of uniform magnetic field. Is the momentum of the particle affected?

20 Derive the expression for the resistivity of a good conductor in terms of the relaxation time of electrons.

Or

Write the expression for the resistivity of a metallic conductor showing its variation over a limited range of temperatures.

21. (i) Why there is no work done in moving a charge from one point to another on an equipotential surface?
(ii) Do electrons tend to go to regions of high potential or low potential?

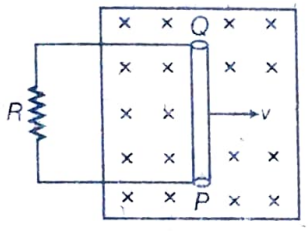
22. How does the angular separation between fringes in single slit diffraction experiment change when the distance of

separation between the slit and screen is doubled?

23. In a Young's double slit experiment, the angular width of the fringe is found to be 0.2° on a screen placed 1m away.

The wavelength of light used is 600 nm. What will be the angular width of the fringe, if the entire experimental apparatus is immersed in water? Take, refractive index of water to be 4/3.

24. A conducting rod PQ of length l, connected to a resistor R, is moved at a uniform speed v, normal to a uniform magnetic field B as shown in the figure.

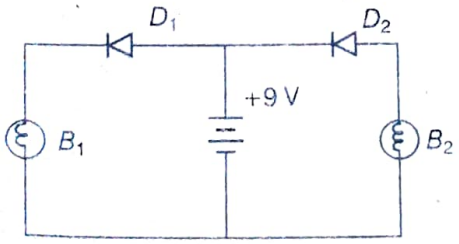


(i) Deduce the expression for the emf induced in the conductor.

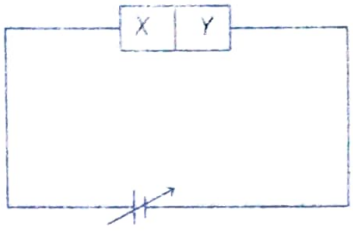
(ii) Find the force required to move the rod in the magnetic field.

(iii) Mark the direction of induced current in the conductor.

25. (i) In the following diagram, which bulb out of B_1 and B_2 will glow and why?



(ii) Two semiconductor materials X and Y shown in figure are made by doping a germanium crystal with indium and arsenic, respectively. These are joined end to end and connected to a battery as shown in figure below.



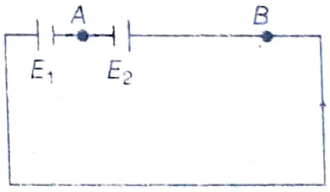
Will the junction be forward or reverse biased? Give reason for your answer.

SECTION D

All questions are compulsory. In case of internal choices, attempt anyone.

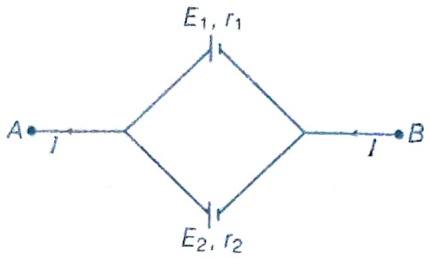
26. A current carrying loop consists of three identical quarter circles of radius R, lying in the positive quadrants of the X-Y, Y-Z and Z-X planes with their centres at the origin, joined together. Find the direction and magnitude of **B** at the origin.

27. The circuit in figure shows two cells connected in opposition to each other. Cell E_1 is of emf 6V & internal resistance 2 Ω and the cell E_2 is of emf 4V & internal resistance 8 Ω. Find (i) effective resistance of the circuit, (ii) effective emf of the two cells & current in the circuit (iii) and the potential difference between the points A & B.



Or

Two cells of emf E_1 & E_2 and internal resistances r_1 & r_2, respectively are connected in parallel as shown in the figure.



Deduce the expressions for

(i) the equivalent emf of the combination,

(ii) the equivalent resistance of the combination

(iii) and the potential difference between the points A & B.

28. (i) A particle moving with velocity 5×10^6 m/s has de-Broglie wavelength of 0.135 nm associated with it. Calculate its mass in kg and kinetic energy in eV.

(ii) In which region of the electromagnetic spectrum, does this wavelength lie?

29. (i) What is the apparent position of an object below a rectangular block of glass 6 cm thick, if a layer of water 4 cm thick is on the top of the glass? Given, $n_{ga} = 1.5$ and $n_{wa} = 1.33$.

(ii) What is the ratio of the velocities of two light waves travelling in vacuum and having wavelengths 4000 Å and 8000 Å?

30. In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence, obtain the expression for the fringe width.

Or

The impurity levels of dopped semiconductor are 30 MeV below the conduction band. At the room temperature, thermal collisions occur as a result of which, the extra electron loosely bound to the impurity ion gets an amount of energy kT and hence this electron can jump into conduction band. What is the value of T? (Take, k (Boltzmann constant) = 8.62×10^{-5} eV/K)

SECTION E

All questions are compulsory. In case of internal choices, attempt anyone.

31. Answer the following questions.

(i) Define power of a lens. Write its units. Deduce the relation $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ for two thin lenses kept in contact coaxially.

(ii) A virtual image, we always say, cannot be caught on a screen. Yet when we see a virtual image, we are obviously bringing it on to the screen (i.e. the retina) of our eye. Is there a contradiction?

(iii) A diver under water, looks obliquely at a fisherman standing on the bank of a lake. Would the fisherman look taller or shorter to the diver than what he actually is?

(iv) Does the apparent depth of a tank of water change, if viewed obliquely? If so, does the apparent depth increase or decrease?

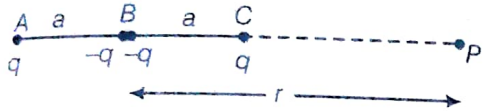
(v) The refractive index of diamond is much greater than that of ordinary glass. Is this fact of some use to a diamond cutter?

Or

(i) State Huygens' principle. Using this principle, draw a diagram to show how a plane wavefront incident at the interference of the two media gets refracted when it propagates from a rarer to a denser medium. Hence, verify Snell's law of refraction.

(ii) Is the frequency of reflected and refracted light same as the frequency of incident light ?

32. Given figure shows a charge array known as an electric quadruple. For a point on the axis of the quadruple, obtain the dependence of potential on r for $r/a >> 1$ and contrast your results with that due to an electric dipole and an electric monopole (i.e. a single charge).



Or

Describe schematically the equipotential surfaces corresponding to

(i) a constant electric field in the z-direction,

(ii) a field that uniformly increases in magnitude but remains in a constant (say z) direction

(iii) and a single positive charge at the origin.

33. A resistor of 400 Ω, an inductor of $(5/\pi)$ H and a capacitor of $(50/\pi)\mu$F are connected in series across a source of alternating voltage of $140 \sin 100\pi t$ V. Find the voltage (rms) across the resistor, the inductor and the capacitor. Is the algebraic sum of these voltage more than the source voltage? If yes, resolve the paradox.

Or

(i) Write some important properties of magnetic field lines.

(ii) A long solenoid of 10 turns/cm has a small loop of area 1 cm^2 placed inside with the normal of the loop parallel to the axis. Calculate the voltage across the small loop, if the current in the solenoid is changed from 1 A to 2 A in 0.1 s, during the duration of this charge.

Answers

1. 16
2. Rises
5. 0.5 Ω
7. 0.7×10^{-12} m
8. 1.8×10^{14} J
10. −27.2 eV
11. (b)
12. (a)
13. (b)
14. (b)
15. (i) (d) (ii) (d) (iii) (c) (iv) (d) (v) (b)
16. (i) (d) (ii) (d) (iii) (a) (iv) (d) (v) (d)
17. 4.53×10^{26} MeV *Or* 4×10^{22}
18. No *Or* 4.48 T
23. $\theta = 0.15°$
27. (i) 10 Ω (ii) 2V, 0.2 A (iii) 5.6 V
28. (i) 9.8×10^{-31} kg, 76.6 eV
29. (i) $d = 7$ cm (ii) $v_1 : v_2 = 1 : 1$
30. *Or* $T = 348.02$ K
33. $V_R = 80$ V, $V_L = 100$ V and $V_C = 40$ V

Or

(ii) 12.57×10^{-7} V