Sample Paper 3

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. Which part of the spectrum of electromagnetic radiation used to cook food?

Or

In Young's double slit experiment, distance between slits in kept 1 mm and a screen is kept 1 m apart from slits. If wavelength of light used is 500 nm, then find the fringe spacing.

2. When a ray of light enters from one medium to another, then its velocity in second medium becomes double. What will be the maximum value of angle of incidence, so that total internal reflection may not take place?

3. If the capacity of a condenser is 1 F, then what will be its resistance in a DC circuit?

4. A parallel plate capacitor has a uniform electric field E in the space between the plates. If the distance between the plates is d and area of each plate is A, calculate the energy stored in the capacitor.

5. 2J of work is done in taking a charge of 20C from one point to the other at a distance of 0.2 m. What is the potential difference between the points?

6. Sn, C, Si and Ge are all group XIV elements. Yet, Sn is a conductor, C is an insulator while Si and Ge are semiconductors. Why?

7. Draw suitable graphs to show the variation of photoelectric current with collector plate potential for a fixed frequency but different intensities $I_1 > I_2 > I_3$ of radiation.

8. Draw a labelled diagram of full wave rectifier.

Or

When temperature of a junction diode increases, then how its resistivity changes ?

9. The electron in a given Bohr orbit has a total energy – 1.5 eV. Find

(i) its kinetic energy

(ii) and potential energy.

Or

The charging current for a capacitor is 0.25 A. What is the displacement current across its plates?

10. Two nuclei have mass number in the ratio of 2 : 5. What is the ratio of their nuclear densities?

Or

Name an experiment which shows wave nature of the electron. Which phenomenon was observed in this experiment using an electron beam?

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** If a loop is placed in a non-uniform (with respect to position) magnetic field, then induced emf is produced in the loop.

Reason In a non-uniform magnetic field, magnetic flux passing through the loop will change. Therefore, induced emf is produced.

12. **Assertion** If $X_C > X_L$, ϕ is positive and the circuit is predominantly capacitive. The current in the circuit leads the source voltage.

Reason If $X_C < X_L$, ϕ is negative and the circuit is predominantly inductive. The current in the circuit lags the source voltage.

13. **Assertion** UV-radiations are used in LASIK eye surgery.

Reason Due to shorter wavelengths, UV-radiations can be focussed into very narrow beams.

14. **Assertion** Secondary rainbow is fainter than primary rainbow.

Reason Secondary rainbow is formed by a four step process and hence, the intensity of light is reduced at the second reflection inside the rain drop.

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. Doppler Effect

According to Doppler effect, whenever there is a relative motion between a source of light and observer, the apparent frequency of light received by observer is different from the true frequency of light emitted actually from the source of light. Astronomers call the increase in wavelength due to Doppler effect as **red shift**, since a wavelength in the middle of the visible region of spectrum moves towards the red end of the spectrum.

When waves are received from a source moving towards the observer, there is an apparent decrease in wavelength, this is referred to as **blue shift.**

(i) In the context of Doppler effect in light, the term blue shift signifies
(a) decrease in frequency
(b) increase in frequency
(c) decrease in intensity
(d) increase in intensity

(ii) The Doppler effect in light, find applications in measurement of
(a) speed of stars and galaxies
(b) speed of rotation of sun
(c) velocity of aeroplanes, rockets, etc
(d) All of the above

(iii) If source and observer are moving towards each other with a velocity v_{radial} and c indicates velocity of light, then fractional change in frequency of light due to Doppler's effect will be

(a) $\frac{\Delta\nu}{\nu}=\frac{v_{radial}}{c}$ (b) $\frac{\Delta\nu}{\nu}=\frac{-v_{radial}}{c}$

(c) $\frac{\Delta\nu}{\nu}=\frac{c}{v_{radial}}$ (d) $\frac{\Delta\nu}{\nu}=\frac{-c}{v_{radial}}$

(iv) The source of light is moving towards observer with relative velocity of 6 kms^{-1}. The fractional change in frequency of light observed is

(a) 2×10^{-3} (b) 2×10^{-5}

(c) 3×10^{-5} (d) None of these

(v) The wavelength of spectral line coming from a distant star shift from 300 nm to 300.1 nm. The velocity of the star relative to earth is

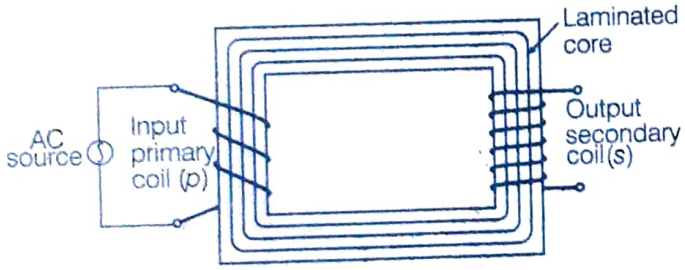
(a) 75 kms^{-1} (b) 100 kms^{-1}

(c) 50 kms^{-1} (d) 200 kms^{-1}

16. The Transformer

Transformer is a device, which is used to increase or decrease the alternating voltage. The transformers are of the following types

1. Step-up transformer
2. Step-down transformer



Transformer is based upon the principle of mutual induction. It consists of two coils, primary coil (p) and secondary coil (s), insulated from each other wounded on soft iron core. Often, the primary coil is the input coil and secondary coil is the output coil. These soft iron cores are laminated to minimise eddy current loss.

(i) Which of the following is not associated with a transformer?

(a) Eddy current

(b) Direct current

(c) Alternating current

(d) Induced current

(ii) Which quantity remains same during transformer operation?

(a) Energy (b) Frequency

(c) Voltage (d) Both (a) and (b)

(iii) A transformer has 200 turns in its primary and 500 in secondary. If the primary is connected to 220 V DC supply, what will be the induced voltage in the secondary side?

(a) 10 V (b) 3 V (c) 5 V (d) Zero

(iv) The ratio of secondary to primary turns in an ideal transformer is 9 : 7. If power input is P, then the ratio of power output to power input is

(a) 7 : 9 (b) 9 : 7

(c) 81 : 49 (d) 1 : 1

(v) A power transmission line feeds input power at 2000 V to a step-down transformer with its primary windings having 4000 turns. What should be the number of turns in the secondary in order to get output power at 200 V?

(a) 600 (b) 450 (c) 400 (d) 375

SECTION C

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

17. A parallel plate capacitor is charged by a battery. When the battery remains connected, a dielectric material is inserted between the plates. Explain what changes, if any, occur in the values of charge on the plates and energy stored in the capacitor?

18. The relaxation time τ is nearly independent of applied E whereas it changes significantly with temperature T. First fact is responsible for Ohm's law whereas second fact leads to variation of ρ with temperature. Elaborate why?

19. Define drift velocity. Write the expression for the current in a conductor of cross-sectional area A in terms of drift velocity.

20. A 100 Ω resistor is connected to a 220V, 50Hz supply.

(i) What is the rms value of current in the circuit?

(ii) What is the net power consumed over a full cycle?

Or Two identical loops, one of copper and other of aluminium are rotated with the same angular speed in the same magnetic field. Compare

(i) the induced emf and

(ii) the current produced in the two coils. Justify your answer.

21. Derive the expression for the wavelength of the H-atom for different spectral series.

Or Derive the Bohr's quantisation condition for angular momentum of the orbiting of electron in hydrogen atom, using de-Broglie's hypothesis.

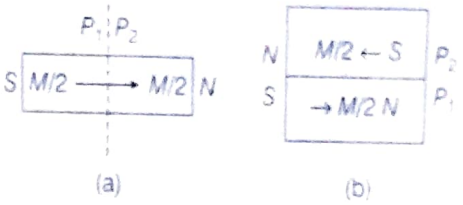
22. In a region of uniform magnetic induction $B = 10^{-2}$ T, a circular coil of radius 30 cm and resistance $\pi^2 \Omega$ is rotated about an axis which is perpendicular to the direction of B and which forms a diameter of the coil. If the coil rotates at 200 rpm, find the amplitude of the alternating current induced in the coil.

23. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the plates is now reduced by its half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of the capacitance of the capacitor in the second case.

Or

A bar magnet is cut into two equal parts as shown in the Fig. (a). One part is now kept over the other such that, the P_2 is above P_1 as shown in the Fig. (b).

If M is the magnetic moment of the original magnet, what would be the magnetic moment of new combination of magnets, so formed?



24. (i) In reflecting type telescope, objective lens is replaced by convex parabolic mirror. Is this statement true? Justify.

(ii) You can see that when it starts becoming dark in the evening streetlights are ON. Yellow light is used instead of white light for streetlighting, why?

25. Name the constituent radiation of electromagnetic spectrum which

(i) is used for studying crystal structure.

(ii) is absorbed from sunlight by ozone layer.

(iii) produces intense heating effect.

(iv) is used in cellular phones to transmit voice communication.

(v) is used for sterilizing surgical instruments.

(vi) is used for taking photograph in foggy season.

SECTION D

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

26. A bar magnet M is dropped, so that it falls vertically through the coil C. Obtain the graph for voltage produced across the coil *versus* time.

(i) Explain which quantity is depicted by the area of graph.

(ii) Why is the negative peak longer than the positive peak?

Or

What is the self-inductance of a solenoid of length 40 cm, area of cross-section 20 cm^2 and total number of turns is 800?

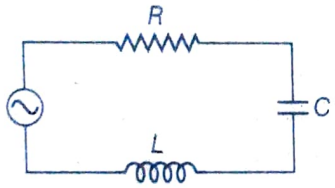
27. In a single slit diffraction pattern, how is the angular width of central bright maximum changed when

(i) the slit-width is decreased,

(ii) the distance between the slit and the screen is increased

(iii) and light of smaller wavelength is used. Justify your answer.

28. The figure shows a series L-C-R circuit with $L = 10.0$ H, $C = 40\ \mu$F, $R = 60\ \Omega$ connected to variable frequency 240 V source. Calculate



(i) the angular frequency of the source which drives the circuit at resonance,

(ii) the current at the resonating frequency

(iii) and the rms potential drop across the inductor at resonance.

29. It is desired to supply a current of 2A through a resistance of 10Ω. 20 cells are provided, each of them has 2V emf and internal resistance of 0.5Ω. Two students of class XIIth, Shikha and Shahana try their hands on the requirement. Shahana succeeds but Shikha not.

(i) Justify the set-up of Shahana.

(ii) What might have gone wrong with Shikha, when she gets 1.2 A current in the load?

(iii) What is the maximum current that can be drawn from the given cell?

30. A horizontal straight wire 10 m long extending from east to west is falling with a speed of 5m/s, at right angles to the magnetic field 0.30×10^{-4} Wb/m^2.

(i) What is the instantaneous value of the emf induced in the wire?

(ii) What is the direction of the emf ?

(iii) Which end of the wire is at higher electrical potential?

SECTION E

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

31. (i) Explain with the help of suitable diagram, the two processes which occur during the formations of a p-n junction diode. Hence, define the terms

(a) depletion region

(b) and potential barrier.

(ii) Draw a circuit diagram of a p-n junction diode under forward bias and explain its working.

Or

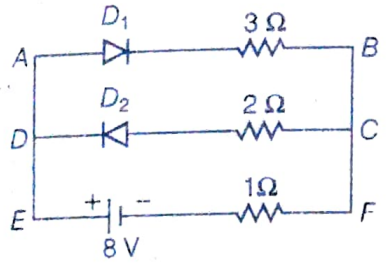
(a) The resistivity of pure silicon is 3000 Ω-m and the electron & hole mobilities are 0.12 $m^2V^{-1}s^{-1}$ and 0.045 $m^2V^{-1}s^{-1}$ respectively, determine

(i) the resistivity of a specimen of the material when 10^{19} atoms of phosphorous are added per m^3.

(ii) the resistivity of the specimen, if further 2×10^{19} boron atoms per m^3 are also added.

(b) Assuming that the two diodes D_1 and D_2 used in the electric circuit as shown in the figure are ideal, find out the

value of the current flowing through 1 Ω resistor.



32. (i) The coil area of a galvanometer is $25 \times 10^{-4}\,m^2$. It consists of 150 turns of a wire and is in a magnetic field of 0.15 T. The restoring torque constant of the suspension fibre is 10^{-6} N-m per degree. Assuming the magnetic field to be radial, calculate the maximum current that can be measured by the galvanometer, if the scale can accomodate 30° deflection.

(ii) Show that the electron revolving around the nucleus in a radius r with orbital speed v has magnetic moment $evr/2$.

Or An electron and a positron are released from (0,0,0) and (0,0,1.5R) respectively, in a uniform magnetic field $\mathbf{B} = B_0\hat{\mathbf{i}}$, each with an equal momentum of magnitude $p = eBR$. Under what conditions on the direction of momentum will the orbits be non-intersecting circles?

33. (i) Show that the refractive index of the material of a prism is given by

$$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

where, the symbols have their usual meanings.

(ii) A lens of focal length of forms the image of an object on a screen m times larger. Prove that the distance of the screen from the lens is $(m + 1)f$.

Or

What is the shape of the wavefront in each of the following cases?

(i) Light diverging from point source.

(ii) Light emerging out of a convex lens when a point source is placed at its focus.

(iii) The portion of the wavefront of light from a distant star intercepted by the earth.

Draw diagrams for cases (ii) and (iii).

Answers

1. Microwaves *Or* 0.5 mm

2. 30° **3.** Infinity

4. $\frac{1}{2}\varepsilon_0 E^2 Ad$ **5.** 10^{-1} V

9. (i) 1.5 eV (ii) −3 eV *Or* 0.25 A

10. 1 : 1 *Or* Davisson-Germer experiment

11. (d) **12.** (b)

13. (a) **14.** (a)

15. (i) (b) (ii) (d) (iii) (b) (iv) (b) (v) (b)

16. (i) (b) (ii) (b) (iii) (d) (iv) (d) (v) (c)

20. (i) 2.2 A (ii) 484 W **22.** 6mA

23. 80 pF *Or* zero

26. *Or* 4.02×10^5 H

28. (i) 50 rad/s (ii) 4 A (iii) 2000 V

29. (iii) 40 A

30. (i) 1.5 mV

31. *Or* (a) (i) 5.2 Ω-m (ii) 13.9 Ω-m (b) 2A

32. (i) 5.4×10^{-4} A