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CLASS XII : SAMPLE QUESTION PAPER - 2
SUBJECT: PHYSICS (042)

Time Allowed: 3 Hours **Maximum Marks: 70**

General instructions:

(1) There are 33 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.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains fivequestions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study-based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

i. $c = 3 \times 10^8$ m/s ii. $m_e = 9.1 \times 10^{-31}$ kg

iii. $m_p = 1.7 \times 10^{-27}$ kg iv. $e = 1.6 \times 10^{-19}$ C

v. $\mu_0 = 4\pi \times 10^{-7}$ T mA^{-1} vi. $h = 6.63 \times 10^{-34}$ J s

vii. $\varepsilon_0 = 8.854 \times 10^{-12}$ C^{2}N^{-1} m^{-2} viii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION — A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. In the nuclear reaction, ${}_7N^{14} + {}_2He^4 \longrightarrow X + {}_1H^1$, X represents :

(a) ${}_7O^{16}$ (b) ${}_8N^{17}$

(c) ${}_8O^{17}$ (d) ${}_7N^{16}$

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

(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.

3. With increase in temperature the conductivity of

(a) metals increases and of semiconductor decreases.

(b) semiconductors increases and of metals decreases.

(c) in both metals and semiconductors increases.

(d) in both metal and semiconductor decreases.

4. Ampere's law is analogous to

(a) Kirchhoff's law in current electricity

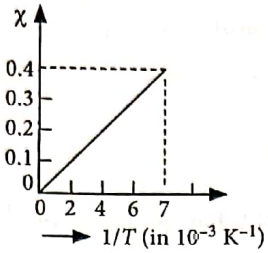
(b) Faraday's law in e.m.f.

(c) Lenz's law

(d) Gauss theorem in electrostatics

5. A strong magnetic field is applied on a stationary electron. Then the electron
   (a) moves in the direction of the field.
   (b) remains stationary.
   (c) moves perpendicular to the direction of the field.
   (d) moves opposite to the direction of the field.

6. The $\chi - 1/T$ graph for an alloy of paramagnetic nature is shown in figure. The curie constant is, then



   (a) 57 K (b) 2.8×10^{-3} K (c) 570 K (d) 17.5×10^{-3} K

7. To reduce the resonant frequency in an series *LCR* circuit with a generator
   (a) the generator frequency should be reduced.
   (b) another capacitor should be added in parallel to the first.
   (c) the iron core of the inductor should be removed.
   (d) dielectric in the capacitor should be removed.

8. Match column-I (Electromagnetic wave type) with column-II (its association / application) and select the correct option from the choices given.

Column-I		Column-II	
(A)	Infrared waves	(P)	To treat muscular strain
(B)	Radio waves	(Q)	For broadcasting
(C)	X-rays	(R)	To detect fracture of bones
(D)	Ultraviolet rays	(S)	Absorbed by the ozone layer of the atmosphere

   (a) (A) → (S); (B) → (Q); (C) → (Q); (D) → (P)
   (b) (A) → (P); (B) → (Q); (C) → (S); (D) → (R)
   (c) (A) → (R); (B) → (Q); (C) → (P); (D) → (S)
   (d) (A) → (P); (B) → (Q); (C) → (R); (D) → (S)

9. Which of the following statements is not correct ?
   (a) Whenever the amount of magnetic flux linked with a circuit changes, an emf is induced in the circuit.
   (b) The induced emf lasts so long as the change in magnetic flux continues.
   (c) The direction of induced emf is given by Lenz's law.
   (d) Lenz's law is a consequence of the law of conservation of momentum.

10. Two slits in Young's double slit experiment have widths in the ratio 81 : 1. The ratio of the amplitudes of light waves is
   (a) 3 : 1 (b) 3 : 2 (c) 9 : 1 (d) 6 : 1

11. An electron is moving with an initial velocity $\vec{v} = v_0\hat{i}$ and is in a magnetic field $\vec{B} = B_0\hat{j}$. Then its de-Broglie wavelength
   (a) remains constant
   (b) increases with time
   (c) decreases with time
   (d) increases and decreases periodically

12. The radius of a spherical nucleus as measured by electron scattering is 3.6 fm. What is the mass number of the nucleus most likely to be?

(a) 27 (b) 40

(c) 56 (d) 120

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

13. **Assertion (A) :** The positively charged nucleus of an atom has a radius of almost 10^{-15} m.

Reason (R) : In α-particle scattering experiment, the distance of closest approach for α-particles is 10^{-15} m.

14. **Assertion (A) :** An alternating current shows magnetic effect.

Reason (R) : Magnitude of alternating current varies with time.

15. **Assertion (A) :** In Young's double slit experiment, interference pattern disappears when one of the slits is closed.

Reason (R) : Interference occurs due to superposition of light waves from two coherent sources.

16. **Assertion (A) :** Photosensitivity of a metal is high if its work function is small.

Reason (R) : Work function = $h\upsilon_0$, where υ_0 is the threshold frequency.

SECTION B

17. Name the parts of the electromagnetic spectrum which is

(a) suitable for radar systems used in aircraft navigation.

(b) used to treat muscular strain.

(c) used as a diagnostic tool in medicine.

Write in brief, how these waves can be produced.

18. The magnetic needle has magnetic moment 6.7×10^{-2} A m^2 and moment of inertia $I = 7.5 \times 10^{-6}$ kg m^2. It performs 10 oscillations in 6.70 s. What is the magnitude of the magnetic field?

19. Draw the plot of the binding energy per nucleon as a function of mass number for different nuclei. The nuclei lying at the middle flat portion of the curve are more stable. Explain.

OR

In an experiment on α–particle scattering by a thin foil of gold, draw a graph showing, the number of particles scattered versus the scattering angle θ. Why is it that a very small fraction of the particles are scattered at $\theta > 90°$?

Write two important conclusions that can be drawn regarding the structure of the atom from the study of this experiment.

20. An object of 3 cm height is placed at a distance of 60 cm from a convex mirror of focal length 30 cm. Find the (i) nature, (ii) position and (iii) size of the image formed.

21. Light of wavelength 6×10^{-5} cm falls on a screen at a distance of 100 cm from a narrow slit. Find the width of the slit if the first minima lies 1 mm on either side of the central maximum.

SECTION C

22. Two identical circular coils of radius 0.1 m, each having 20 turns are mounted co-axially 0.1 m apart. A current of 0.5 A is passed through both of them (i) in the same direction, (ii) in the opposite directions. Find the magnetic field at the centre of each coil.

23. A rectangular wire loop of sides 8 cm and 2 cm with a small cut is moving out of a region of uniform magnetic field of magnitude 0.3 T directed normal to the loop. What is the emf developed across the cut if velocity of loop is 1 cm s^{-1} in a direction normal to the (i) longer side (ii) shorter side of the loop? For how long does the induced voltage last in each case?

24. (a) An *LCR* series circuit is connected to an ac source. If the angular resonant frequency of the circuit is ω_0, will the current lead or lag behind or be in phase with the voltage when $\omega < \omega_0$ and why ?
(b) We cannot step up a dc voltage using a transformer. Why ?
(c) On what principle does a metal detector work ?

OR

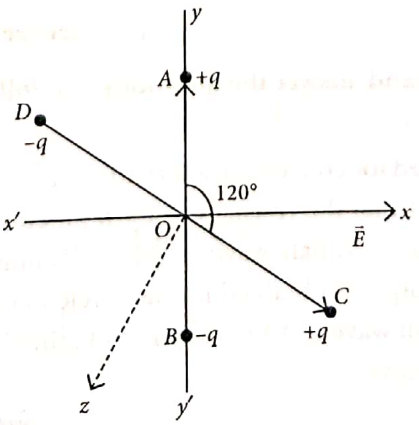
(a) For a given ac $i = i_0 \sin\omega t$, show that the average power dissipated in a resistor R over a complete cycle is $\frac{1}{2} i_0^2 R$.
(b) A light bulb is rated at 100 W for a 220 V ac supply. Calculate the resistance of the bulb.

25. (a) An electron and a proton are accelerated through the same potential. Which one of the two has
(i) greater value of de-Broglie wavelength associated with it, and
(ii) lesser momentum?
Justify your answer in each case.
(b) How is the momentum of a particle related with its de-Broglie wavelength? Show the variation on a graph.

26. The value of ground state energy of hydrogen atom is –13.6 eV.
(i) Find the energy required to move an electron from the ground state to the first excited state of the atom.
(ii) Determine (a) the kinetic energy and (b) orbital radius in the first excited state of the atom.
(Given the value of Bohr radius = 0.53 Å).

27. (i) Draw *V-I* characteristics of a *p-n* junction diode.
(ii) Write the property of a junction diode which makes it suitable for rectification of ac voltages.

28. Two small identical electric dipoles *AB* and *CD*, each of dipole moment $\vec{p}$ are kept at an angle of 120° to each other in an external electric field $\vec{E}$ pointing along the *x*-axis as shown in the figure. Find the
(a) dipole moment of the arrangement, and
(b) magnitude and direction of the net torque acting on it



SECTION D

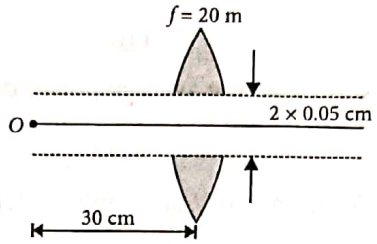
Case Study Based Questions

29. Read the following paragraph and answer the questions that follow.

Refraction of Lenses

A convex or converging lens is thicker at the centre than at the edges. It converges a parallel beam of light on refraction through it. It has a real focus. Convex lens is of three types : (i) Double convex lens (ii) Plano-convex lens (iii) Concavo-convex lens. Concave lens is thinner at the centre than at the edges. It diverges a parallel beam of light on refraction through it. It has a virtual focus.

(i) A point object O is placed at a distance of 0.3 m from a convex lens (focal length 0.2 m) cut into two halves each of which is displaced by 0.0005 m as shown in figure.
What will be the location of the image?



(a) 30 cm right of lens
(b) 60 cm right of lens
(c) 70 cm left of lens
(d) 40 cm left of lens

(ii) Two thin lenses are in contact and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, the focal length of the other would be.
(a) –26.7 cm (b) 60 cm (c) 80 cm (d) 20 cm

(iii) A spherical air bubble is embedded in a piece of glass. For a ray of light passing through the bubble, it behaves like a
(a) converging lens
(b) diverging lens
(c) plano-converging lens
(d) plano-diverging lens

(iv) Lens used in magnifying glass is
(a) Concave lens
(b) Convex lens
(c) Both (a) and (b)
(d) None of the above

OR

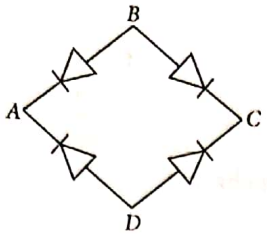
The magnification of an image by a convex lens is positive only when the object is placed
(a) at its focus F
(b) between F and $2F$
(c) at $2F$
(d) between F and optical centre

30. Read the following paragraph and answer the questions that follow.

Rectifier

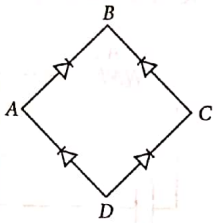
Rectifier is a device which is used for converting alternating current or voltage into direct current or voltage. Its working is based on the fact that the resistance of p-n junction becomes low when forward biased and becomes high when reverse biased. A half-wave rectifier uses only a single diode while a full wave rectifier uses two diodes only. Hence output is obtained for half cycle in case of half wave rectifier when diode is in forward bias while in case of full wave rectifier output is obtained for full ac cycle with one diode in foward bias in half of the ac cycle at a time.

(i) A bridge rectifier is shown in figure. Alternating input is given across A and C. What will be the output across BD ?



(a) 14 (b) < 1 (c) > 1 (d) Zero

(ii) In the diagram, the input ac is across the terminals A and C. On taking the output across B and D, the system will work as

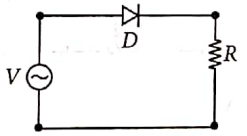


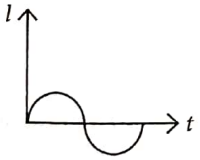
(a) half wave rectifier (b) full wave rectifier
(c) both half and full wave rectifier (d) none of these.

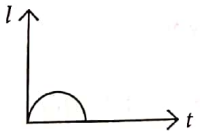
(iii) If the rms value of sinusoidal input to a full wave rectifier is $\frac{V_0}{\sqrt{2}}$ then, find the rms value of the rectifier's output.

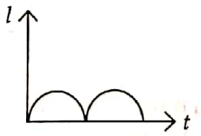
(a) $2\,V_0$ (b) $\frac{V_0}{2}$ (c) $\frac{V_0}{\sqrt{2}}$ (d) $\sqrt{2}\,V_0$

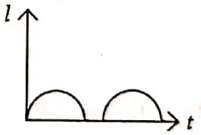
(iv) A p-n junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit. Which of the following graph showing best?



(a) 

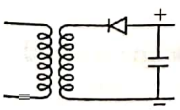
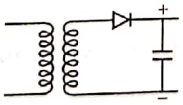
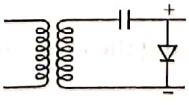
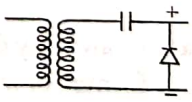
(b) 

(c) 

(d) 

OR

Which is the correct diagram of a half-wave rectifier ?

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

SECTION E

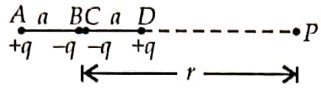
31. Consider a sphere of radius R with charge density distributed as

$$\rho(r) = kr \quad (\text{for} \quad r \le R)$$
$$= 0 \quad (\text{for} \quad r > R.)$$

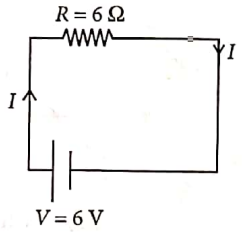
Suppose the total charge on the sphere is $2e$ where e is the electron charge. Where can two protons be embedded such that the force on each of them is zero ? Assume that the introduction of the proton does not alter the negative charge distribution.

OR

Figure shows a charge array known as an electric quadrupole. For a point on the axis of quadrupole, 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).



32. (a) Consider circuit shown in figure. How much energy is absorbed by electrons from the initial state of no current (ignore thermal motion) to the state of drift velocity?



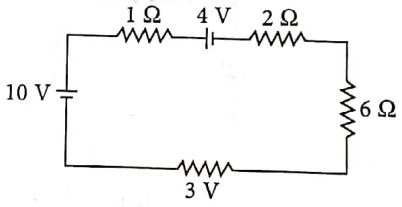
(b) Electrons give up energy at the rate of RI^2 per second to the thermal energy. What time scale would one associate with energy in problem (a)? Given, n = no. of electron/volume = $10^{29}/m^3$, length of circuit = 10 cm, cross-section, $A = 1\ mm^2$.

OR

(i) Define electrical conductivity of a wire. Give its SI unit.

(ii) High current is to be drawn safely from (1) a low-voltage battery, and (2) a high-voltage battery. What can you say about the internal resistance of the two batteries?

(iii) Calculate the total energy supplied by the batteries to the circuit shown in the figure, in one minute.



33. (a) Draw the intensity pattern for single slit diffraction and double slit interference. Hence, state differences between interference and diffraction patterns.

(b) What is the effect on the interference fringes in Young's double slit experiment when (i) the width of the source slit is increased ; (ii) the monochromatic source is replaced by a source of white light?

OR

(a) Draw a ray diagram showing the image formation by an astronomical telescope when the final image is formed at infinite.

(b) (i) A small telescope has an objective lens of focal length 140 cm and an eyepiece of focal length 5.0 cm. Find the magnifying power of the telescope for viewing distant objects when the telescope is in normal adjustment and the final image is formed at the least distance of distinct vision.

(ii) Also find the separation between the objective lens and the eyepiece in normal adjustment.