PRE BOARD 1

Physics 12th (Code 042)

Time : 3 Hrs.

Max. Marks : 70

General Instructions

1. This question paper contains 33 questions. All questions are compulsory.
2. Question paper is divided into FIVE sections - Section A, B, C, D and E.
3. In **Section A**, Question number 1 to 16 are **Multiple Choice Questions (MCQ)** type. Each question carries 1 mark.
4. In **Section B**, Question number 17 to 21 are **Very Short Answer (VSA) type questions**. Each question carries 2 marks.
5. In **Section C**, Question number 22 to 28 are **Short Answer (SA) type questions**. Each question carries 3 marks.
6. In **Section D**, Question number 29 and 30 are **Case Based questions**. Each question carries 4 marks.
7. In **Section E**, Question number 31 to 33 are **Long Answer Type questions**. Each question carries 5 marks.
8. There is no overall choice. However, an internal choice has been provided in few questions in all the sections except Section A.
9. Use of calculator is NOT allowed.

Section A Multiple Choice Questions *(Each Que. carries 1 M)*

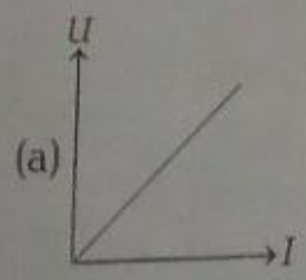
Direction *(Q.Nos. 1-16) Select the correct option out of the four given options.*

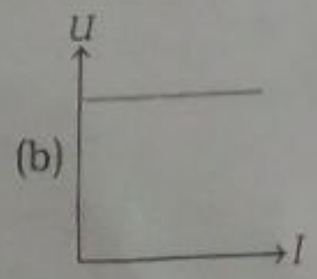
1. In a uniform magnetic field, an electron enters perpendicular to the field. The path of electron will be [1]

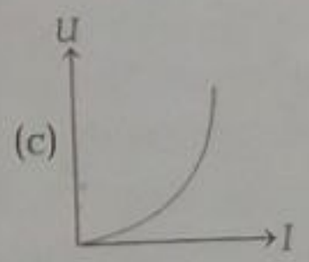
(a) ellipse (b) circular

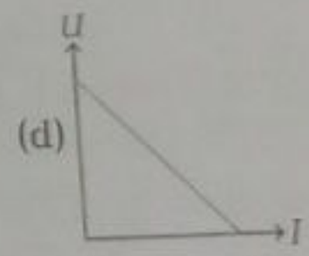
(c) parabolic (d) linear

2. The current flowing through an inductor of self-inductance *L* is continuously increasing. The graph depicting the variation of magnetic potential energy stored with the current is [1]

(a) 

(b) 

(c) 

(d) 

3. Two equal and opposite charges each of 2 C are placed at a distance of 0.04 m. Dipole moment of the system will be [1]

(a) 6×10^{-8} C-m (b) 8×10^{-2} C-m

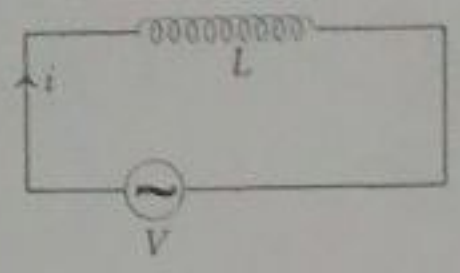
(c) 15×10^{-2} C-m (d) 8×10^{-6} C-m

4. The de-Broglie wavelength of a particle is λ. What will be the wavelength of the particle, if its kinetic energy is $\frac{K}{9}$? [1]

(a) λ (b) 2λ (c) 3λ (d) 4λ

P1

5. Which of the following statement is correct about an inductive circuit? [1]



(a) In an inductive circuit, using Kirchhoff's loop rule, we get $V - L\frac{di}{dt} = 0$, where the second term is the mutual induced emf in the inductor.

(b) The quantity ωL is analogous to the conductance.

(c) The current phasor **I** is $\frac{\pi}{2}$ ahead of the voltage phasor **V**.

(d) The average power supplied to an inductor over one complete cycle is zero.

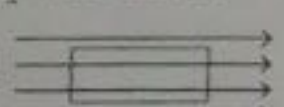
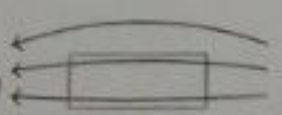
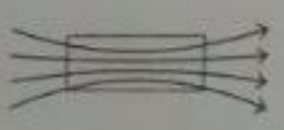
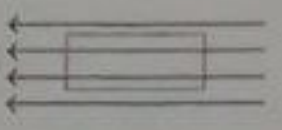
6. Charge through a conductor is given as function of time t as $q = (4t^2 + 4t + 4)$ C. At 2s, what is the current flowing? [1]

(a) 15 A (b) 10 A (c) 20 A (d) 25 A

7. In Rutherford's nuclear model of the atom, if F_e indicates electrostatic force between electron and nucleus and F_c indicates the centripetal force on revolving electron, then [1]

(a) $F_e = F_c$ (b) $F_e > F_c$
(c) $F_e < F_c$ (d) $F_e = \infty$ and $F_c = 0$

8. A uniform magnetic field parallel to the plane of paper exists in space, initially directed from left to right. When a bar of soft iron is placed in the field parallelly, the lines of force passing through it will appears as in [1]

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

9. An electromagnetic wave of frequency 3 MHz passes from vacuum into a dielectric medium with permittivity $\varepsilon = 4.0$, then [1]

(a) wavelength doubled and frequency remains unchanged
(b) wavelength doubled and frequency becomes half
(c) wavelength and frequency both remain unchanged
(d) wavelength is halved and frequency remains unchanged

10. Match the Column I with Column II.

	Column I	Column II
A.	Magnetic field induction at a point due to straight carrying conductor	1. $\frac{\mu_0}{4\pi}\frac{4\pi NI}{l}$
B.	Magnetic field induction at the centre of circular coil carrying current	2. $\frac{\mu_0}{4\pi}\frac{2\pi NI}{r}$
C.	Magnetic field induction at a point on the axis of the circular coil carrying current at a distance equal to the radius of the coil	3. $\frac{\mu_0}{4\pi}\frac{2I}{r}$
D.	Magnetic field induction at a point well inside the solenoid carrying current	4. $\frac{\mu_0}{4\pi}\frac{\pi NI}{\sqrt{2}r}$

Codes

	A	B	C	D
(a)	1	2	4	3
(b)	1	2	3	4
(c)	3	2	4	1
(d)	3	2	4	1

11. Pure silicon at 300 K has equal electron (n_e) and hole (n_h) concentration of $1.5 \times 10^{16}\ m^{-3}$. Doping by indium increases n_h to $4.5 \times 10^{22}\ m^{-3}$. The n_e in doped silicon (in m^{-3}) is [1]

(a) 9×10^5 (b) 5×10^9
(c) 2.25×10^{11} (d) 3×10^{19}

12. In double-slit experiment using light of wavelength 600 nm, the angular width of a fringe formed on a distant screen is 0.1°. What is the spacing between the two slits? [1]

(a) 3.4×10^{-4} m (b) 5.6×10^{-4} m
(c) 6.6×10^{-4} m (d) 4.5×10^{-4} m

Directions For question number 13 to 16, two statements are given-one labelled Assertion (A) and other labelled Reason (R). Select the correct answer of these questions from the codes (a), (b), (c) and (d) as given below.

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

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

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

(d) If both Assertion (A) and Reason (R) are false.

13. **Assertion** (A) The goggle have zero power.

Reason (R) Radius of curvature of both sides of lens of goggle is same. [1]

14. **Assertion** (A) The graph of de-Broglie wavelength *versus* stopping potential is a rectangular hyperbola.

Reason (R) de-Broglie wavelength of a particle is inversely proportional to square root of the stopping potential. [1]

15. **Assertion** (A) An electron on *p*-side of a *p*-*n* junction moves to *n*-side just after diffusion of charge carriers across junction.

Reason (R) Drifting of charge carriers reduces the concentration gradient across junction. [1]

16. **Assertion** (A) Changing magnetic flux can produce induced emf.

Reason (R) Faraday established induced emf experimentally. [1]

Section B Very Short Answer Type Questions *(Each Que. carries 2 M)*

17. Derive the expression for the resistivity of a good conductor in terms of the relaxation time of electrons. [2]

18. When monochromatic light travels from a rarer to a denser medium, explain the following giving reasons.

(i) Is the frequency of reflected and refracted light same as the frequency of incident light? [1]

(ii) Does the decrease in speed imply a reduction in the energy carried by light wave. [1]

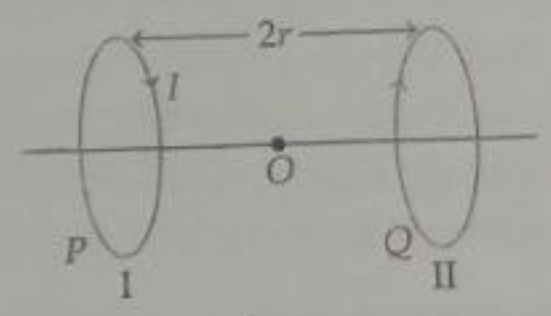
Or (i) Show analytically from the lens equation that when the object is at the principal focus, the image is formed at infinity. [1]

(ii) A magician during a show makes a glass lens $n = 1.47$ disappear in a trough of liquid. What is the refractive index of the liquid? Could liquid be water? [1]

↳ Same ↳ No ↳ 1.33

19. Draw the energy band diagrams of conductors and insulators. [2]

20. Two identical circular loops *P* and *Q*, each of radius *r* and carrying equal currents are kept in the parallel planes having a common axis passing through *O*. The direction of current in *P* is clockwise and in *Q* is anti-clockwise as seen from *O* which is equidistant from the loops *P* and *Q*. Find the magnitude of the net magnetic field at *O*. [2]



21. Work function of a certain metal is 2eV. When light of frequency 5×10^{15} Hz is incident on the metal surface, emission of electrons take place. Find

(i) maximum kinetic energy of emitted electrons and [1]

(ii) stopping potential. [1]

Section C Short Answer Type Questions *(Each Que. carries 3 M)*

22. (i) Mention two characteristic properties of isotopes. [2]

(ii) Obtain approximately the ratio of the nuclear radii of the gold isotope $^{197}_{79}Au$ and the silver isotope $^{107}_{47}Ag$ [1]

23. Answer the following questions.

(i) Name the electromagnetic waves which are used for the treatment of certain forms of cancer. Write their frequency range. [1]

↳ MRI

(17) Conductor ——— Insulator ———

(ii) Thin ozone layer on top of stratosphere is crucial for human survival. Why? [1]

(iii) Why is the amount of the momentum transferred by the electromagnetic waves incident on the surface so small? [1]

24. A wire of length L is bent round in the form of a coil having N turns of same radius. If a steady current I flows through it in clockwise direction, then find the magnitude and direction of the magnetic field produced at its centre. [3]

25. (i) Define self-inductance. Write its SI units. [1]

(ii) Derive the expression for self-inductance of a long solenoid of length l, cross- sectional area A having N number of turns. [2]

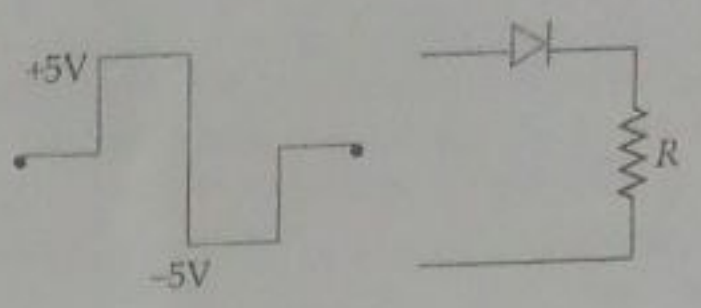
Or The current through two inductors of self-inductance 12 mH and 30 mH is increasing with time at the same rate. Draw graphs showing the variation of the

(i) emf induced with the rate of change of current in each inductor.

(ii) energy stored in each inductor with the current flowing through it.

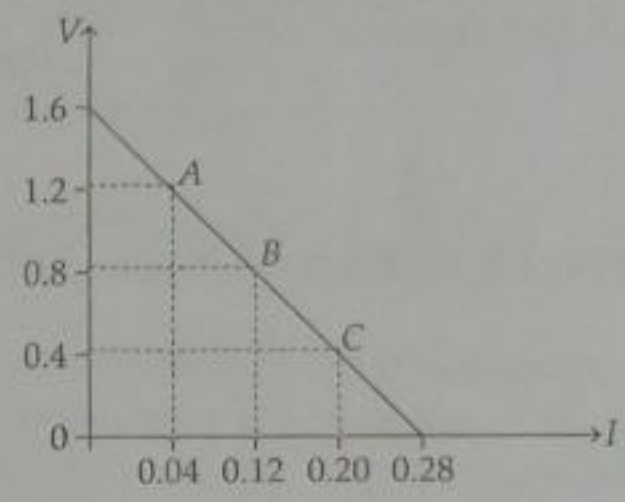
Compare the energy stored in the coils, if the power dissipated in the coils is the same. [3]

26. (i) Draw and explain the output waveform across the load resistor R, if the input waveform is as shown below



(ii) Why is a semiconductor damaged by strong current? [3]

27. The potential difference across terminal of a cell were measured (in volt) against different current (in ampere) flowing through the cell. A graph is drawn which is a straight line ABC as shown below.



Determine from the graph [3]

(i) Emf of the cell

(ii) Maximum current obtained from the cell and

(iii) internal resistance of the cell.

28. (i) State Gauss's law for electrostatics. [1]

(ii) Prove Gauss's law for spherically symmetric surface. [2]

Section D Case Based Questions *(Each Que. carries 4 M)*

Direction *Question number 29 and 30 are case study based questions: Read the following paragraph and answer the questions that follows.*

29. Atomic masses and the concentration of the atomic nucleus are fundamental concepts in the field of atomic and nuclear physics. The atomic mass of an atom is primarily determined by the mass of its protons, neutrons and electrons. The number of protons in the nucleus determines the element's identity, while the number of neutrons can vary, leading to different isotopes of the same element.

Atomic masses are not whole numbers because they are calculated based on the weighted average of the masses of all naturally occurring isotops of an element.

(i) If an element X has three isotopes with atomic masses 10 amu, 11 amu and 12 amu, and their relative abundances are 20%, 70% and 10%. The average atomic mass of element X is [1]

(a) 11 amu (b) 12 amu

(c) 10 amu (d) 10.9 amu

(ii) The element which has highest number of isotopes is [1]

(a) Carbon

(b) Uranium

(c) Gold

(d) Sodium

(iii) The total number of protons and neutrons in an atom with atomic number 20 and mass number 40 is [1]

(a) 20 (b) 40

(c) 60 (d) 80

Or

(iii) The atomic mass of an element X is 12.01 amu. the most abundant isotop of this element is [1]

(a) X-12 (mass = 12.00 amu)

(b) X-13 (mass = 13.00 amu)

(c) X-14 (mass = 14.00 amu)

(d) X-15 (mass = 15.00 amu)

(iv) The statement which is correct about atomic mass unit is [1]

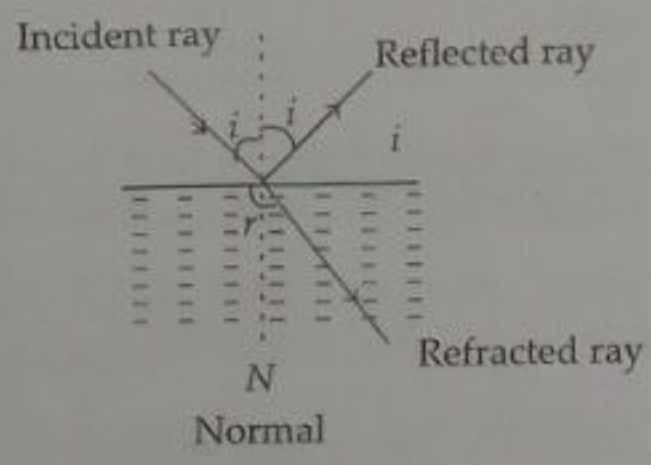
(a)1 amu is the mass of a neutron

(b)1 amu is the mass of an electron

(c)1 amu is defined as $\frac{1}{12}$ th the mass of a carbon-12 atom

(d)1 amu is equivalent to 1 gram.

30. Refraction involves change in the path of light due to change in the medium.



When a beam of light encounters another transparent medium, a part of light gets reflected back into the first medium, while the rest enters the other. The direction of propagation of an obliquely incident ray of light, that enters the other medium, changes at the interface of two media . The phenomenon is called refraction of light.

(i) Which quantity remains unchanged after refraction? [1]

(a) Wavelength

(b) Frequency

(c) Intensity

(d) Amplitude

(ii) A ray of light strikes an air-glass interface at an angle of incidence *i* and get refracted at an angle of refraction *r*. Then, on increasing the value of *i*, the value of *r* will [1]

(a) also increase

(b) also decrease

(c) remain unchanged

(d) None of the above

(iii) For the same angle of incidence, the angles of refraction in media *P*, *Q* and *R* the are 35°, 25° and 15°, respectively.
If v_P, v_Q and v_R are velocity of light in medium *P*, *Q* and *R*, then [1]

(a) $v_P = v_Q = v_R$

(b) $v_P > v_Q > v_R$

(c) $v_P = v_Q > v_R$

(d) $v_P < v_Q < v_R$

Or

(iii) The image formed by an objective of a compound microscope is [1]

(a) virtual and diminished

(b) real and diminished

(c) real and enlarged

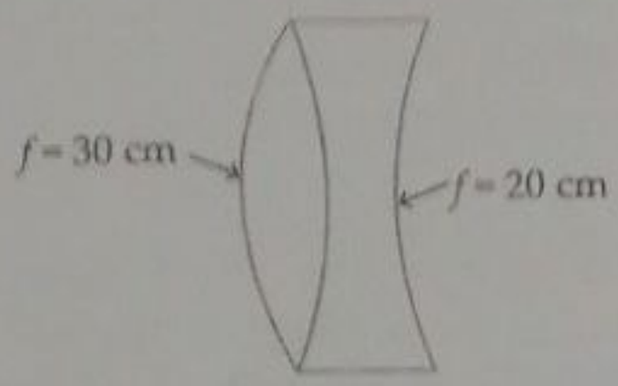
(d) virtual and enlarged

(iv) Velocity of light in glass is 2×10^8 m/s and that in air is 3×10^8 m/s. By how much would an ink dot appear to be raised when covered by a glass plate 6 cm thick? [1]

(a) 2 cm (b) 4 cm (c) 8 cm (d) 2.6 cm

Section E Long Answer Type Questions *(Each Que. carries 5M)*

31. (i) (a) What is the focal length of a lens combination as shown below? [1]



(b) Is the system a converging or a diverging lens? Ignore thickness of the lenses. [1]

(ii) At what angle should a ray of light be incident on the face of a prism of refracting angle 60°, so that it just suffers total internal reflection at the other face? The refractive index of the material of the prism is 1.524. [3]

Or (i) Define the power of lens. [2]

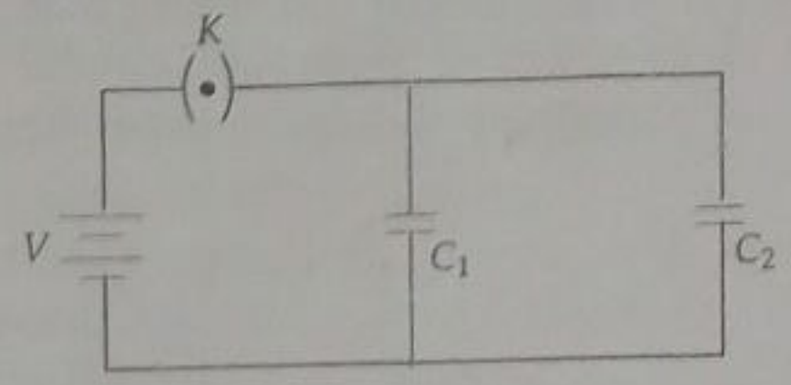
(ii) An angular magnification (magnifying power) of 24 is desired using an objective of focal length 1.25 cm and an eyepiece of focal length 5 cm. How will you set-up the compound microscope? [3]

32. (i) Derive the expression for the capacitance of a parallel plate capacitor having plate area A and plate separation d. [3]

(ii) Two parallel plate capacitors of capacitances C_1 and C_2 such that $C_1 = 2C_2$ are connected across a battery of V volt as shown in the figure. Initially, the key (K) is kept closed to fully charge the capacitors. The key is now thrown open and a dielectric slab of dielectric constant K is inserted in the two capacitors to completely fill the gap between the plates. Find the ratio of

(a) the net capacitance and

(b) the energies stored in the combination before and after the introduction of the dielectric slab. [2]



Or

(i) Derive an expression for the potential energy of an electric dipole placed in a uniform electric field. [3]

(ii) Discuss the conditions of stable and unstable equilibrium for above case. [2]

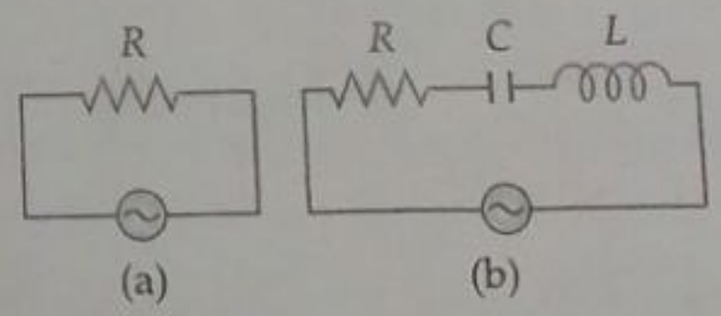
33. A series L-C-R circuit with $L = 0.12$ H, $C = 480$ nF, $R = 23\Omega$ is connected to a 230 V variable frequency supply.

(i) What is the source frequency for which current amplitude is maximum? Obtain this maximum value. [2]

(ii) What is the source frequency for which average power absorbed by the circuit is maximum? Obtain the value of maximum power. [2]

(iii) What is the impedance of the cirucit at $\omega = \frac{1}{12}$ rad/s? [1]

Or Study the circuits (a) and (b) shown in the figure and answer the following questions.



(i) Under which conditions would the rms currents in the two circuits be the same? [3]

(ii) Can the rms current in circuit (b) be larger than that in (a)? [2]