

Sample Question Paper

Class XII -Physics

(Applicable for March 2016 Examination)

Time Allowed: 3 Hours

Maximum Marks: 70

General Instructions

1. All questions are compulsory. There are 26 questions in all.
2. This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
3. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
4. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
5. You may use the following values of physical constants wherever necessary.

$$c = 3 \times 10^8 \text{ m/s}$$

$$h = 6.63 \times 10^{-34} \text{ Js}$$

$$e = 1.6 \times 10^{-19} \text{ C}$$

$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$

$$\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$$

$$\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$$

$$m_e = 9.1 \times 10^{-31} \text{ kg}$$

mass of neutron = 1.675×10^{-27} kg

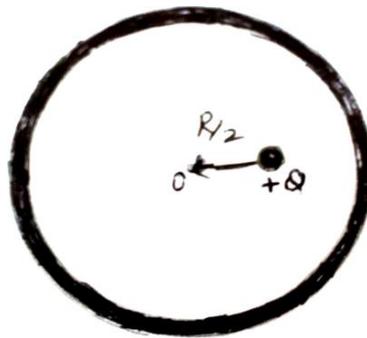
mass of proton = 1.673×10^{-27} kg

Avogadro's number = 6.023×10^{23} per gram mole

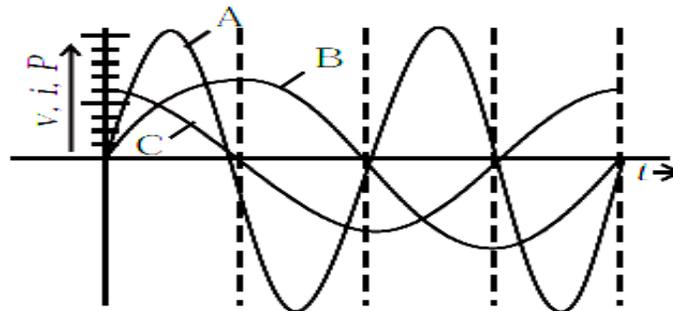
Boltzmann constant = 1.38×10^{-23} JK⁻¹

Section A

1. Figure shows a point charge +Q, located at a distance R/2 from the centre of a spherical metal shell. Draw the electric field lines for the given system. (1)



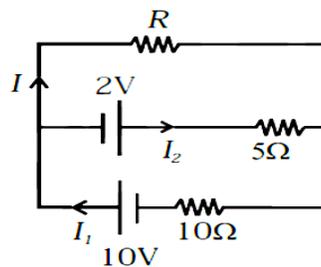
2. Give an example of a material each for which temperature coefficient of resistivity is (i) positive, (ii) negative. (1)
3. A device 'X' is connected to an a.c. source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one complete cycle is shown in the following figure. (1)
- (i) Which curve shows power consumption over a full cycle?
(ii) Identify the device 'X'.



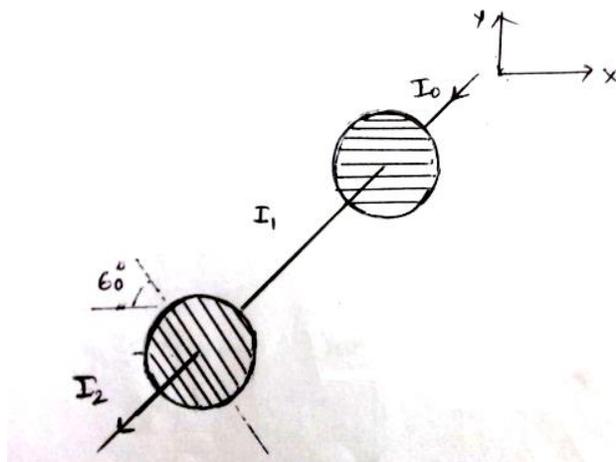
4. An object is placed in front of convex lens made of glass. How does the image distance vary if the refractive index of the medium is increased in such a way that still it remains less than the glass? (1)
5. Name the network within an institution, made by connecting all or some of their computers. (1)
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Section B

6. Two cells of E.M.F. 10 V and 2 V and internal resistances $10\ \Omega$ and $5\ \Omega$ respectively, are connected in parallel as shown. Find the effective voltage across R. (2)



7. Figure shows a system of two polarizing sheets in the path of initially unpolarized light. The polarizing direction of first sheet is parallel to x-axis and that of second sheet is 60° clockwise from x-axis. Calculate what fraction of intensity of light emerges from the system. (2)



OR

State Huygen's principle. Using it, construct a ray diagram for a plane wave front getting incident on a denser medium. (2)

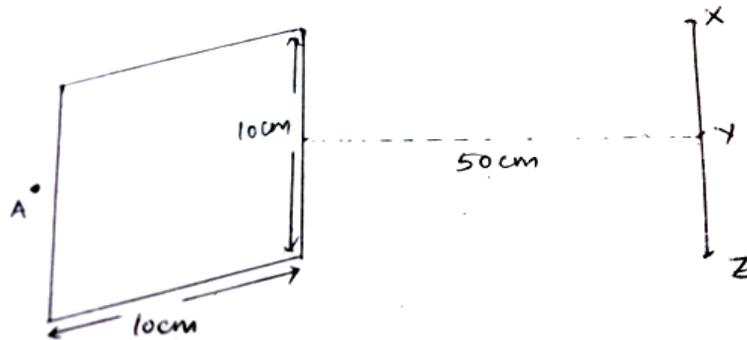
8. A monochromatic light source of power 5mW emits 8×10^{15} photons per second. This light ejects photoelectrons from a metal surface. The stopping potential for this set up is 2V. Calculate the work function of the metal. (2)
9. The following table shows some measurements of the decay rate of a radionuclide sample. Find the disintegration constant. (2)

Time (min)	lnR (Bq)
36	5.08
100	3.29
164	1.52
218	1.00

10. Distinguish between any two types of propagation of Electromagnetic waves with respect to (i) frequency range over which they are applicable (ii) communication systems in which they are used. (2)

Section C

11. Given a uniformly charged plane/ sheet of surface charge density $\sigma = 2 \times 10^{17}$ C/m². (3)
- (i) Find the electric field intensity at a point A, 5mm away from the sheet on the left side.
- (ii) Given a straight line with three points X, Y & Z placed 50 cm away from the charged sheet on the right side. At which of these points, the field due to the sheet remain the same as that of point A and why?



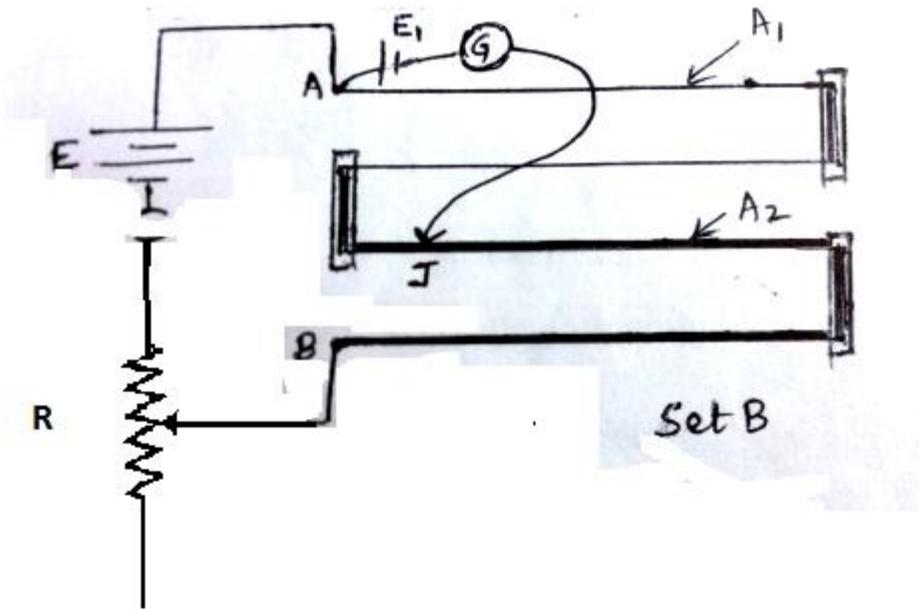
12. The potential difference across a resistor 'r' carrying current 'I' is Ir . (3)
- Now if the potential difference across 'r' is measured using a voltmeter of resistance ' R_v ', show that the reading of voltmeter is less than the true value.
 - Find the percentage error in measuring the potential difference by a voltmeter.
 - At what value of R_v , does the voltmeter measure the true potential difference?

OR

You are given two sets of potentiometer circuit to measure the emf E_1 of a cell.
 Set A: consists of a potentiometer wire of a material of resistivity ρ_1 , area of cross-section A_1 and length l .

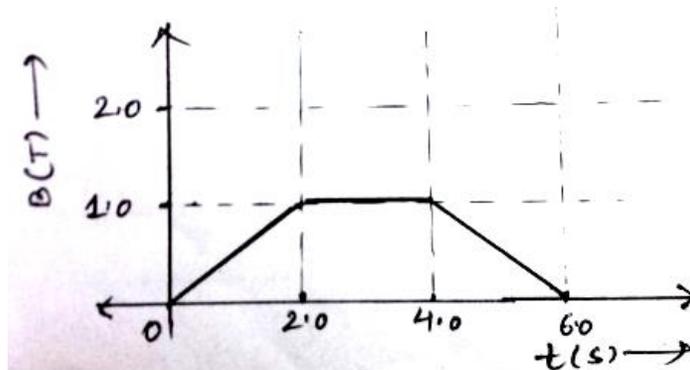
Set B: consists of a potentiometer of two composite wires of equal lengths $l/2$ each, of resistivity ρ_1, ρ_2 and area of cross-section A_1, A_2 respectively.

- Find the relation between resistivity of the two wires with respect to their area of cross section, if the current flowing in the two sets is same.
- Compare the balancing length obtained in the two sets. (3)



13. (i) Name the machine which uses crossed electric and magnetic fields to accelerate the ions to high energies. With the help of a diagram, explain the resonance condition. (2)
- (ii) What will happen to the motion of charged particle if the frequency of the alternating voltage is doubled? (1)

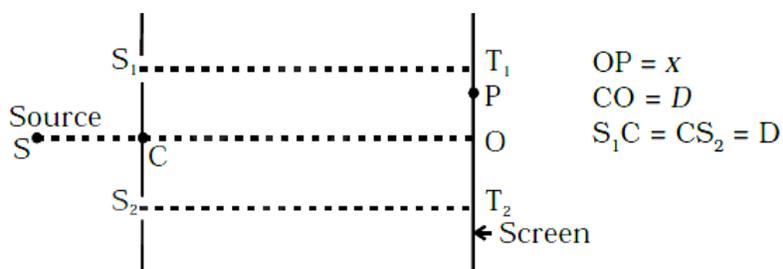
14. The magnetic field through a single loop of wire, 12cm in radius and 8.5Ω resistance, changes with time as shown in the figure. The magnetic field is perpendicular to the plane of the loop. Plot induced current as a function of time. (3)



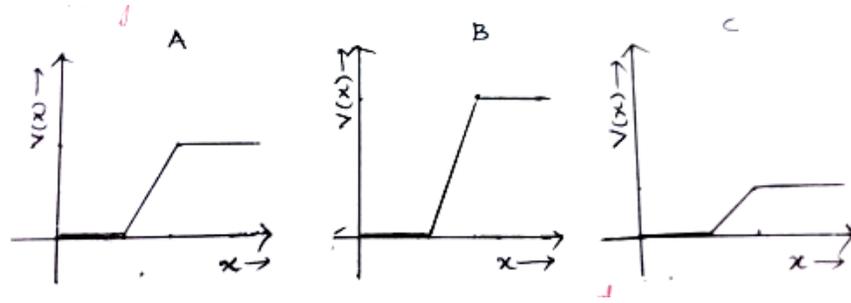
15. Identify the type of waves which are produced by the following way and write one application for each: (3)
- (i) Radioactive decay of the nucleus,
- (ii) Rapid acceleration and decelerations of electrons in aerials,

(iii) Bombarding a metal target by high energy electrons.

16. Consider a two slit interference arrangement (shown in figure) such that the distance of the screen from the slits is half the distance between the slits. Obtain the value of D in terms of λ such that the first minima on the screen fall at a distance D from the centre O. (3)



17. A compound microscope consists of an objective of focal length 1cm and eye piece of focal length 5cm separated by 12.2cm. (a) At what distance from the objective should an object be placed so that the final image is formed at least distance of distinct vision? (b) Calculate the angular magnification in this case. (3)
18. Compare the photoelectric effect on the basis of photon theory and wave theory of light and hence explain why the wave theory failed to explain it. (3)
19. Derive the expression for the magnetic field at the site of a point nucleus in a Hydrogen atom due to the circular motion of the electron. Assume that the atom is in its ground state and give the answer in terms of fundamental constants. (3)
20. The graph of potential barrier versus width of depletion region for an unbiased diode is shown in A. In comparison to A, graphs B and C are obtained after biasing the diode in different ways. Identify the type of biasing in B & C and justify your answer. (3)



21. Explain the following: (3)
- (i) In the active state of the transistor, the emitter base junction acts as a low resistance while base collector region acts as high resistance.
 - (ii) Output characteristics are controlled by the input characteristics in common emitter transistor amplifier.
 - (iii) LEDs are made of compound semiconductor and not by elemental semiconductors.
22. (i) Write the factors that prevent a baseband signal of low frequency to be transmitted over long distances.
- (ii) What is to be done to overcome these factors? Draw a block diagram to obtain the desired signal. (3)

Section D

23. Ria recently read about earth's magnetic field and its causes. She became so much fascinated by the topic that she further studied it in detail. She collected information as follows: (4)
- The magnitude of magnetic field at the Earth's surface ranges from 0.25 to 0.65 gauss.
 - The Earth's magnetic field varies with time. There are short term and long term variations.

- One the scale of million years, the Earth's magnetic field reverses its direction, and much more.

She made a power point presentation on the same and shared all this information with her classmates.

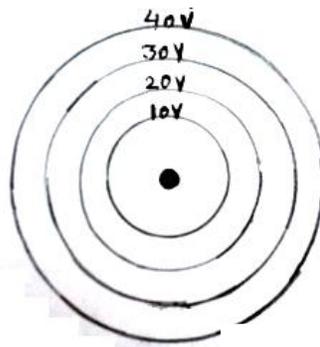
- Suggest another activity related to the same topic, which will help a student to internalize the same values gained by Ria.
- Draw a labelled diagram showing the three magnetic elements of earth.

Section E

24. (a) Two isolated metal spheres A and B have radii R and $2R$ respectively, and same charge q . Find which of the two spheres have greater : (i) Capacitance and (ii) energy density just outside the surface of the spheres. (2)

(b) (i) Show that the equipotential surfaces are closed together in the regions of strong field and far apart in the regions of weak field. Draw equipotential surfaces for an electric dipole. (1+1)

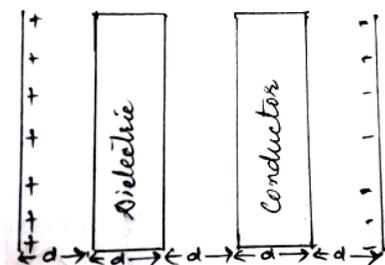
(ii) Concentric equipotential surfaces due to a charged body placed at the centre are shown. Identify the polarity of the charge and draw the electric field lines due to it. (1)



OR

(a) Compare the individual dipole moment and the specimen dipole moment for H_2O molecule and O_2 molecule when placed in

- (i) Absence of external electric field (2)
- (ii) Presence of external electric field. Justify your answer. (3)
- (b) Given two parallel conducting plates of area A and charge densities $+\sigma$ & $-\sigma$. A dielectric slab of constant K and a conducting slab of thickness d each are inserted in between them as shown.
- (i) Find the potential difference between the plates.
- (ii) Plot E versus x graph, taking $x=0$ at positive plate and $x=5d$ at negative plate. (2)

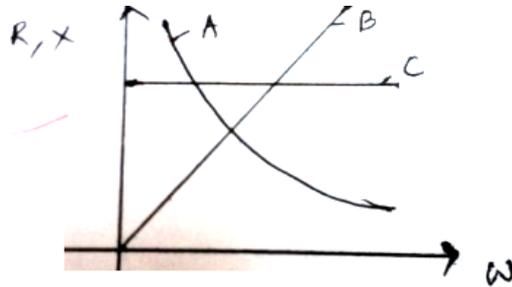


25. (a) With the help of a diagram, explain the principle and working of a device which produces current that reverses its direction after regular intervals of time. (3)
- (b) If a charged capacitor C is short circuited through an inductor L , the charge and current in the circuit oscillate simple harmonically.
- (i) In what form the capacitor and the inductor stores energy?
- (ii) Write two reasons due to which the oscillations become damped. (2)

OR

- (a) Figure shows the variation of resistance and reactance versus angular frequency. Identify the curve which corresponds to inductive reactance and

resistance.

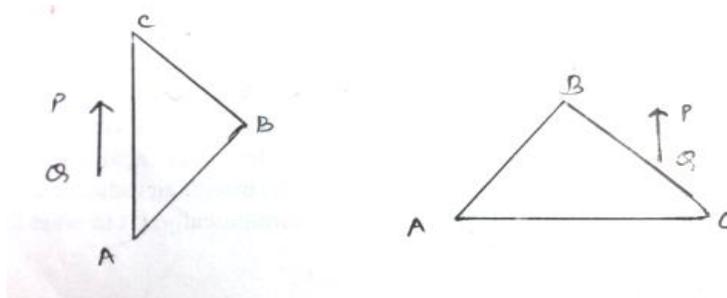


- (b) Show that series LCR circuit at resonance behaves as a purely resistive circuit. Compare the phase relation between current and voltage in series LCR circuit for (i) $X_L > X_C$ (ii) $X_L = X_C$ using phasor diagrams.

(c) What is an acceptor circuit and where it is used? (1+3+1)

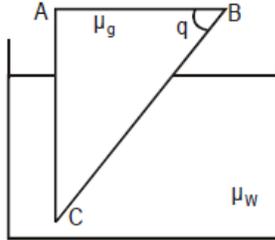
- 26 (a) Draw a ray diagram to show the formation of the real image of a point object due to a convex spherical refracting surface, when a ray of light is travelling from a rarer medium of refractive index μ_1 to a denser medium of refractive index μ_2 . Hence derive the relation between object distance, image distance and radius of curvature of the spherical surface. (3)

- (b) An object is placed in front of right angled prism ABC in two positions as shown. The prism is made of crown glass with critical angle of 41° . Trace the path of the two rays from P & Q. (2)



OR

- (a) Calculate the value of θ , for which light incident normally on face AB grazes along the face BC. $\mu_g = 3/2$ $\mu_w = 4/3$. (2)



- (b) Draw a graph showing the variation of angle of deviation ' δ ' with that of angle of incidence ' i ' for a monochromatic ray of light passing through a glass prism of refracting angle ' A '. What do you interpret from the graph? Write a relation showing the dependence of angle of deviation on angle of incidence and hence derive the expression for refractive index of the prism. (3)
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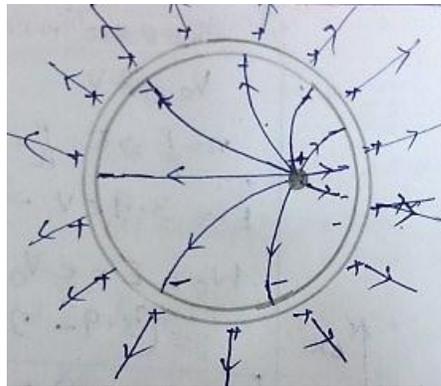
Class XII Physics
Sample Question Paper
(Applicable for March 2016 Examination)
(Marking Scheme)

Time Allowed: 3 Hours

Maximum Marks: 70

Section A

1.



Inside (1/2)

Outside (1/2)

2. (i) Cu (metals, alloys) (1/2)

(ii) Si (semiconductor) (1/2)

3. (i) A (1/2)

(ii) Capacitor (1/2)

4. $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$, $\frac{1}{f} = \left(\frac{\mu_l}{\mu_m} - 1\right) \left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ (1/2)

If μ_m increases, $1/f$ decreases, $\therefore v$ increases. (1/2)

5. LAN (1)

SECTION B

$$6. \epsilon_{\text{eq}} = \left(\frac{\epsilon_1}{r_1} + \frac{\epsilon_2}{r_2} \right) / \left(\frac{1}{r_1} + \frac{1}{r_2} \right) \quad (1/2)$$

$$\epsilon_{\text{eq}} = (10/10 - 2/5) / (1/10 + 1/5) \quad (1)$$

$$\epsilon_{\text{eq}} = 2V \quad (1/2)$$

$$7. I_1 = I_o/2 \quad (1/2)$$

$$I_2 = I_1 \cos^2 60^\circ \quad (1/2)$$

$$I_2 = I_o/8 \quad (1)$$

OR

7. Huygens' Principle (1)

Ray diagram using Huygen's construction (1)

$$8. P = 5 \times 10^{-3} \text{ W}$$

$$n = \frac{P}{E},$$

$$E = \frac{P}{n} = 6.25 \times 10^{-19} \text{ J} \quad (1/2)$$

$$E = 3.9 \text{ eV} \quad (1/2)$$

$$W_o = E - eV_o \quad (1/2)$$

$$= (3.9 - 2) eV_o$$

$$W_o = 1.9 \text{ eV} \quad (1/2)$$

$$9. R = R_o e^{-\lambda t} \quad (1/2)$$

$$\ln R = \ln R_o - \lambda t$$

$$\ln R = -\lambda t + \ln R_o \quad (1/2)$$

slope of $\ln R$ v/s t is $-\lambda$

$$-\lambda = \frac{0 - 1.52}{218 - 164} \quad (1/2)$$

$$\lambda = 0.028 \text{ minute}^{-1} \quad (1/2)$$

10.

	Frequency range	Use
Ground wave	500-1500KHz (1/2)	Standard AM broadcast (1/2)
Space wave	Above 40 MHz (1/2)	Television (1/2)

SECTION C

11. (i) at A, $E = \frac{\sigma}{2\epsilon_0}$ (1/2)

$E = 1.1 \times 10^{28} \text{ N/C}$ (1/2)

Directed away from the sheet (1/2)

(ii) Point Y (1/2)

Because at 50cm, the charge sheet acts as a finite sheet and thus the magnitude remains same towards the middle region of the planar sheet.

(1)

12. (i) $V = Ir$ (without voltmeter) R_v

$$V' = \frac{I r R_v}{r + R_v} = \frac{I r}{1 + \frac{r}{R_v}} \quad (1/2)$$

$$V' < V \quad (1/2)$$

(ii) Percentage error

$$\left(\frac{V - V'}{V} \right) \times 100 \quad (1/2)$$

$$= \left(\frac{r}{r + R_v} \right) \times 100 \quad (1)$$

(iii) $R_v \rightarrow \infty$, $V' = I r = V$ (1/2)

OR

12 (a) $I = \frac{\epsilon}{R + \frac{\rho_1 l}{A_1}}$ for Set A (1/2)

$$I = \frac{\epsilon}{R + \frac{\rho_1 l}{2A_1} + \frac{\rho_2 l}{2A_2}} \text{ for set B} \quad (1/2)$$

Equating the above two expressions and simplifying

$$\frac{\rho_1}{A_1} = \frac{\rho_2}{A_2} \quad (1/2)$$

(b) Potential gradient of the potentiometer wire for set A, $K = I \frac{\rho_1}{A_1}$

Potential drop across the potentiometer wire in set B

$$V = I \left(\frac{\rho_1 l}{2A_1} + \frac{\rho_2 l}{2A_2} \right)$$

$$V = \frac{I}{2} \left(\frac{\rho_1}{A_1} + \frac{\rho_2}{A_2} \right) l \quad (1/2)$$

$$K' = \frac{I}{2} \left(\frac{\rho_1}{A_1} + \frac{\rho_2}{A_2} \right), \text{ using the condition obtained in part (i)} \quad (1/2)$$

$$K' = I \frac{\rho_1}{A_1}, \text{ which is equal to } K.$$

Therefore, balancing length obtained in the two sets is same. (1/2)

13. (i) Machine : Cyclotron (1/2)

Diagram (1/2)

Resonance condition (1)

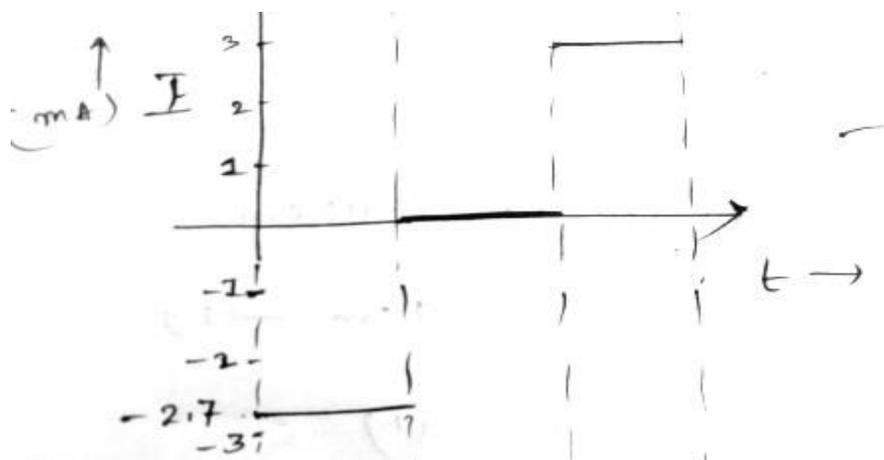
(ii) Particle will accelerate and decelerate alternately. However, the radius of the path will remain unchanged (1)

14. $\epsilon = - \frac{d\phi}{dt}$,

$$\epsilon = -0.023 \text{ V ,}$$

$$I = \epsilon/R = -2.7 \text{ mA for } 0 < t < 2\text{s.}$$

	$0 < t < 2\text{s}$	$2 < t < 4\text{s}$	$4 < t < 6\text{s}$
ϵ (V)	-0.023	0	+0.023
I (A)	-2.7	0	+2.7



(3)

15.

	Type of wave	Application
(a)	Gamma rays (1/2)	Treatment of tumors (1/2)
(b)	Radio waves (1/2)	Radio and television Communication systems (1/2)
(c)	X- rays (1/2)	Study of crystals (1/2)

$$16. \quad T_2P = D + x, \quad T_1P = D - x \quad (1/2)$$

$$S_1P = [(S_1T_1)^2 + (PT_1)^2]^{1/2} \quad (1/2)$$

$$= [D_2^2 + (D - x)^2]^{1/2} \quad (1/2)$$

$$S_2P = [D^2 + (D + x)^2]^{1/2} \quad (1/2)$$

$$\text{Minima will occur when } S_2P - S_1P = \lambda/2 \quad (1/2)$$

$$D = \frac{\lambda}{2(\sqrt{5}-1)} \quad (1/2)$$

$$17. \quad \frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e} \text{ solving } u_e = -4.2 \text{ cm} \quad (1)$$

$$\frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}, \text{ solving } u_o = -1.1 \text{ cm} \quad (1)$$

$$m = \frac{v}{u} \left(1 + \frac{D}{fe} \right) = -44 \quad (1)$$

18. Explanation of Photo electric effect (1)

Explanation of the effect using particle concept (1)

Explanation of the failure of wave theory in the explanation (1)

19. $mv^2/r = e^2/4\pi\epsilon_0 r^2$
 $v^2 = e^2/m4\pi\epsilon_0 r$ (1/2)

Bohr's quantisation condition

$$Mvr = nh/2\pi \quad (1/2)$$

$$\text{Solving, } v = e^2/2\epsilon_0 h, r = \epsilon_0 h^2/\pi m e^2 \quad (1/2)$$

Magnetic field at the centre

$$B = \mu_0 I/2r \quad (1/2)$$

$$I = ev/2\pi r \quad (1/2)$$

$$B = \mu_0 e^7 \pi m^2 / 8 \epsilon_0^3 h^5 \quad (1/2)$$

20. B : reverse biased (1/2)

C: forward biased (1/2)

Justification (2)

21.(i) Emitter base junction is forward biased whereas base collector junction is reverse biased. (1)

(ii) Small change in the current I_B in the base circuit controls the larger current I_C in the collector circuit. $I_C = \beta I_B$ (1)

(iii) Elemental semiconductor's band gap is such that the emitted wavelength lies in IR region. Hence cannot be used for making LED (1)

22. (i) size of the antenna (1/2)

Effective power radiated by the antenna (1/2)

Mixing up of signals from different transmitters (1/2)

(ii) modulation (1/2)

Block diagram of amplitude modulation (1)

SECTION D

23. (i) Any meaningful activity and values which could be inculcated (2)
 (ii) Diagram with labelling three magnetic elements of earth (1+1)

SECTION E

24. (a) (i) $C_A = 4\pi\epsilon_0 R$, $C_B = 4\pi\epsilon_0(2R)$ (1/2)

$C_B > C_A$ (1/2)

(ii) $u = \frac{1}{2} \epsilon_0 E^2$ (1/2)

$E = \frac{\sigma}{\epsilon_0} = \frac{Q}{A\epsilon_0}$, $u \propto 1/A^2$

$\therefore u_A > u_B$ (1/2)

(b) (i) $E = -\frac{dV}{dr}$ (1/2)

For same change in dV , $E \propto 1/dr$ (1/2)

where 'dr' represents the distance between equipotential surfaces.

Diagram of equipotential surface due to a dipole (1)

(ii) Polarity of charge – negative (1/2)

Direction of electric field – radially inward (1/2)

OR

24 (a)

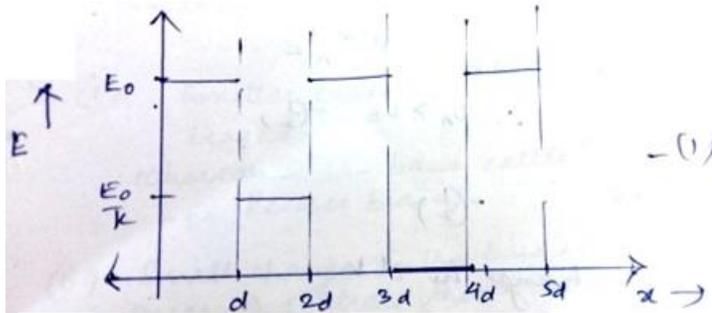
	Non-Polar (O ₂) –(1/2)	Polar (H ₂ O)- (1/2)
Absence of electric field (1)		
Individual	No dipole moment exists	Dipole moment exists
Specimen	No dipole moment exists	Dipoles are randomly oriented. Net P =0

Presence of electric field(1)		
Individual	Dipole moment exists (molecules become polarised)	Torque acts on the molecules to align them parallel to E
Specimen	Dipole moment exists	Net dipole moment exists parallel to Dipole moment exists E .

(b) (i) $V = E_0 d + \frac{E_0}{k} d + E_0 d + 0 + E_0 d$ (1/2)

$V = 3 E_0 d + \frac{E_0}{k} d$ (1/2)

(ii) Graph (1)



25. (a) AC generator

Diagram (1)

Principle (1)

Working (1)

(b) (i) Capacitor – electric field (1/2)

Inductor – magnetic field (1/2)

(ii) resistance of the circuit (1/2)

Radiation in the form of EM waves

(1/2)

OR

25 (a) B : inductive reactance

(1/2)

C: resistance

(1/2)

(b) At resonance $X_L = X_C$

(1/2)

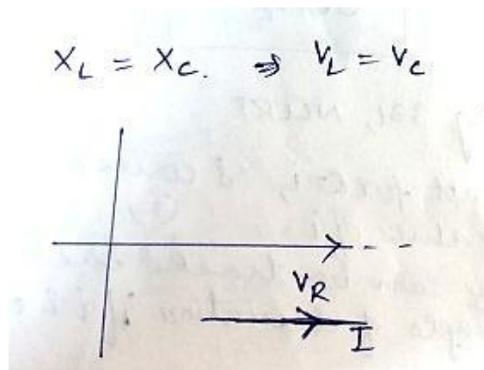
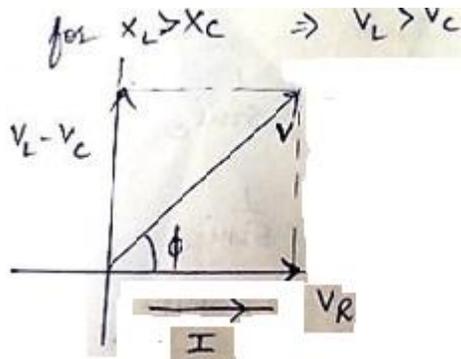
$$Z = [(X_L - X_C)^2 + R^2]^{1/2}, Z = R$$

(1/2)

Phasor diagrams

(1+1)

phase difference is ϕ



same phase

(c) Acceptor circuit: Series LCR circuit

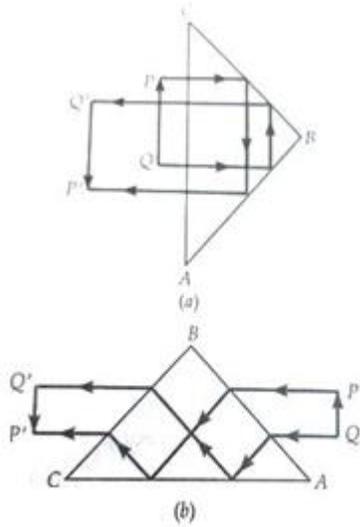
(1/2)

Radio tuning

(1/2)

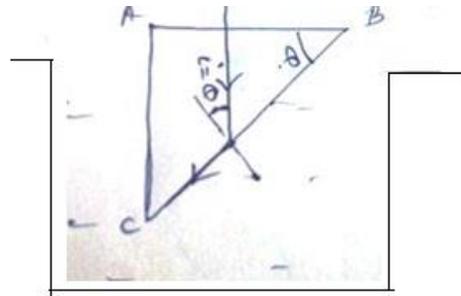
26. (a) To derive $\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$, (3)

(b) Diagram (2)



OR

26 (a) Diagram -



(1)

$$\mu_g/\mu_w = 1/\sin i_c$$

(1/2)

$$\sin i_c = 8/9 \quad (1/2)$$

(b) Graph (1)

Interpretation: Path of the ray can be traced back resulting in same angle of deviation if i & e are interchanged (1/2)

$$\delta + A = i + e \quad (1/2)$$

To derive $\mu = \frac{\sin(A + \delta m)/2}{\sin A/2}$ (1)

