Class: XII

2025-2026

POST MID -TERM EXAM

SUBJECT: PHYSICS (042)

Set-A1/A2(MS)

Maximum Marks: 70 Marks **Time Allowed: 3 hours.**

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. All the sections are compulsory.

(3) Section A contains sixteen questions of 1 mark each (12 MCQ and 4 Assertion Reason), Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of 4 marks each and section E contains three long questions of five marks each and Section.

(4) There is no overall choice. However, an internal choice has been provided.

(5). Use of calculators is not allowed.

(6) This Marking scheme contains 15 pages.

(7) You may use the following values of physical constants wherever necessary:

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

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

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

$1/4\pi\varepsilon_o = 9 \times 10^{9}Nm^2/C^2$

$\mu_0/4\pi = 10^{-7}$ T-m/A

$m_e = 9.1x10^{-31}$ Kg

$m_p = 1.7x10^{-27}$ Kg

Avogadro's number = $6.023x10^{23}$ per gm mole

SECTION-A

Q1. Which of the following statement is not correct.

(a) Equipotential surfaces around a point charge are concentric spherical surfaces.

(b) For a uniform spherical distribution of charges (like a spherical shell or a sphere), the equipotential outside the spheres are concentric spheres around the centre of distribution of charges.

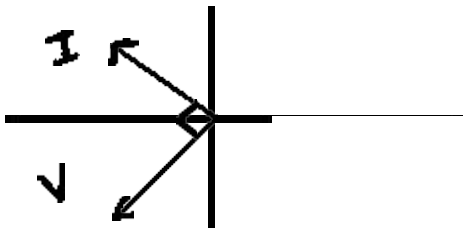
(c) Electric field lines are perpendicular to an equipotential surface and hence work done in moving a charge on an equipotential surface is non-zero.

(d) All the lines in a plane passing through the centre of a dipole and perpendicular to the axis of the dipole lie on an equipotential surface of zero potential. If the dipole lies along x-axis, the y-z plane (x = 0) is an equipotential surface with V = 0. If centre of dipole is at origin.

Q2. If a conducting wire of resistance 'R' ohm is bent in the form of a regular pentagon calculate the net resistance between two adjacent corners of this pentagon. consider that the wire is having uniform opposition of current.

(a) R
(b) R/2
(c) 2R/3
(d) 4R/25

Q3. If the phasor diagram for a device connected to AC supply is as shown in the figure then which of the following statement is true?



(a) when the frequency of ac source is increased than the opposition to the current of the device decreased.

(b) when the frequency of ac source is increased than the opposition to the current of the device increased.

(c) this device can not store energy

(d) for DC this device will have infinite opposition to the current.

Q4. When we arrange the following electromagnetic radiations in an ascending order of their frequencies : (i) Microwave(ii) Radio wave(iii) X-rays(iv) Gamma rays. The correct use of wave having minimum frequency is

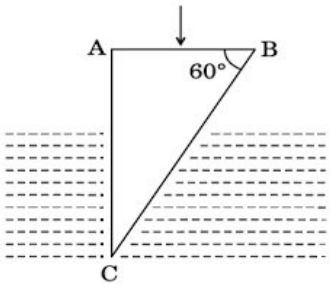
(a) in microwave oven

(b) for communication purposes

(c) for cancer treatment

(d) for medical diagnostic

Q5. A prism is kept in liquid and a Ray incident normally on face AB. If the refractive index of glass prism is 1.5 then refractive index of liquid (so that the ray grazes along the face BC in given figure) will be



(a) 1.3
(b) 1.4
(c) 1.1
(d) 1.2

Q6. If the ratio of intensities of two coherent sources is '4' then the value of

$(I_{max} - I_{min}) / (I_{max} + I_{min})$ is …

(a) 4

(b) 5

(c) 4/5

(d) 3/4

Q7. The ratio of the surface areas of the nuclei (assuming spherical shape) Zn^{64} and Al^{27} is ..

(a) 9 : 16

(b) 16 : 9

(c) 64 : 27

(d) 4 : 3

Q8. A charged particle is projected along the axis of a current carrying loop . which of the following statement is true?

(a) The acceleration of the charged particle will depend on the velocity with which it is projected .
(b) The acceleration of the charged particle will depend on the magnitude of the current passing through the coil .
(c) The acceleration of the charged particle will depend on the radius of the coil.

(d) The charge particle will move with constant velocity.

Q9. In a series LCR circuit the voltages across an inductor, capacitor and resistor are 60 V, 20 V and 40 V respectively. The phase difference between the applied voltage and the current in the circuit is…….
(a) 30°
(b) 45°
(c) 60°
(d) 0°

Q10. The emf generated by an ac source is given by $V = V_0 \sin\omega t$, where 'ω' is the angular frequency of the armature . what will be the emf if the angular frequency is 'n' times of 'ω'.

(a) $V = V_0 \sin n\omega t$

(b) $V = nV_0 \sin\omega t$

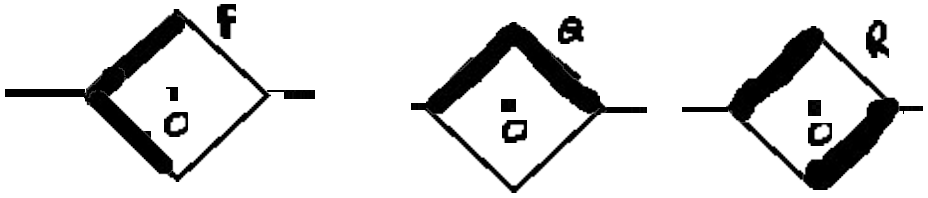
(c) $\mathbf{V = nV_0 \sin n\omega t}$

(d) $V = V_0 \sin\omega t$

Q11. An particle bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the particle will be proportional to

(a) m
(b) 1/m
(c) 1/Ze
(d) m^2

Q12. Two identical thick and two identical thin wires of same material and of same length form a square as shown in three different ways P,Q,R. The magnetic field at the centre 'o' of the square loop will be zero is case of…



(a) R only

(b) P and Q only

(c) P and R only

(d) Q and R only

For question number 13 to 16 , 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 and R is NOT the correct explanation of A 1

c) A is true but R is false

d) A is false and R is also false

Q13. ASSERTION – Nuclear density is higher for nuclei of big mass number.

REASON – Nuclear density is directly proportional to the (mass number)^2. (d)

Q14. ASSERTION- In an interference pattern observed in Young's double slit experiment, if the separation (d) between coherent sources as well as the distance (D) of the screen from the coherent sources both are reduced to half, then new fringe width remains the same.

REASON- Fringe width is proportional to (d/D) Ans- (c)

Q15. ASSERTION- Two light sources emitting waves of similar wavelengths are coherent.

REASON- Two independent light sources emitting are known as coherent sources.

Ans- d

Q16. ASSERTION- Dielectrics are the type of conductors.

REASON- When a piece of dielectric placed in external electric field, the net electric field is zero inside it.

Ans- d

SECTION-B

Q17. Name the part of electromagnetic spectrum which are

(i) Stopped by face mask worn by welders ans- (UV)
(ii) Used in detectors in earth satellites ans- (IR)
(iii) Used in short wave band in communication ans- **(Radio)**

Also arrange them in increasing order of wavelength.

Ans- ½ M for each

Q18. Two electric bulbs have the following specifications. (i) 100 W at 220 V (ii) 1000 W at 220 V. Which bulb has higher resistance? What is the ratio of the resistance of bulb '2' to bulb '1'?

Ans- The resistance of filament, 1 for formula 1 for Ans

$R=V/I= v^2 /P$

At constant voltage V, the resistance

$R\alpha 1/P$ (1)

That is the resistance of filament of 100 W bulb is greater than that of 1000 W bulb.

The ratio of resistances $=R2:::R1=P1:P2=100:1000=1:10$ (1)

Q19. The change in position of a charge 'q' coulomb in the electric field **E**=(A**i** + B**j** +C**k**)N/C is (a**i** + b**j**) m . calculate the work done.

Ans-

$$dW = q\,dV$$

$$= -q\int \vec{E}\cdot d\vec{r} = -q\,(A\hat{i}+B\hat{j}+C\hat{k})\cdot(a\hat{i}+b\hat{j})$$

$$= -q\,[aA+bB]\ J$$

Q20. Write the expression for the magnetic force per unit length between two parallel thin current carrying wires (current is in the same direction).

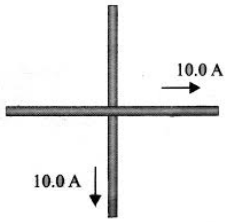
(i) Will they attract or repel

(ii) Hence define one apmere

Ans- ½ for expression . ½ M for (i) and 1m for def

OR

Q20. Figure shows two long straight insulated wires carrying currents i each and placed perpendicular to each other. Show that in quadrant '2' and '4' he resultant magnetic field can be zero



Ans- 2M for correct explanation

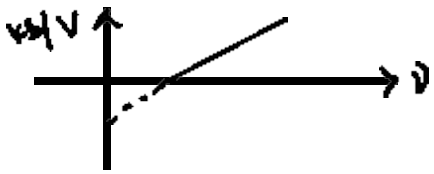
Q21. Find the relation between frequency of incident photon and KE_{max} of emitted electron and draw the graph. What does the slope of this graph represents.

Ans- 1M for relation , ½ M for graph and ½ M for slope.

OR

Q21. Find the relation between frequency of incident photon and stopping potential for emitted electron and draw the graph. What does the slope of this graph represents.

Ans- 1M for relation , ½ M for graph and ½ M for slope.



SECTION-C

Q22. (a) Draw a circuit diagram of a full wave rectifier.

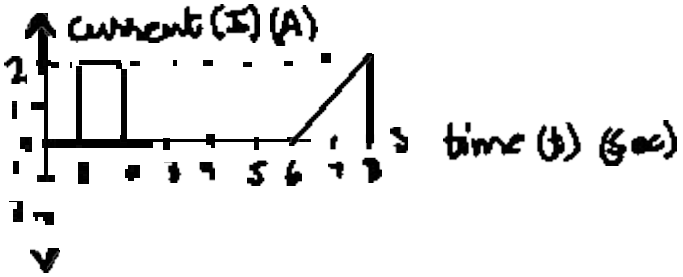
(b) Draw the input and output waveforms indicating clearly the functions of two diodes used.

(c) Draw energy band diagram for P type semiconductor.

Ans- 1M for each part

Q23. (a) State kirchoffs first law

(b) For the given graph calculate the ratio of charges flowing through the wire at time intervals 1 to 2sec and 6 to 8sec.



Ans- 1M for atatement

1:1 (2M)

Q24. (a) An electron in a given Bohr orbit has a total energy of -1.5eV, calculate its (i) kinetic energy (ii) potential energy.

Ans- KE = +1.5eV PE = −3eV (1M)

(a) The radius of innermost orbit of an electron in hydrogen atom is $0.53A^0$. Calculate its radius in n=3 orbit.

Ans- $\frac{\lambda_1}{\lambda_2} = \left(\frac{n_1}{n_2}\right)^2$ (½M) $\frac{.53}{\lambda_2} = \left(\frac{1}{3}\right)^2 \Rightarrow \frac{.53}{\lambda_2} = \frac{1}{9}$ (1½)

$\lambda_2 = 4.77\,A^\circ$

Q25. (a) The radii of curvature of both the surfaces of a convex lens of focal length 'f' are equal. if one of the surfaces is made plane, explicitly find the new focal length.

Draw a ray diagram to show the formation of image at 'D' for a simple microscope

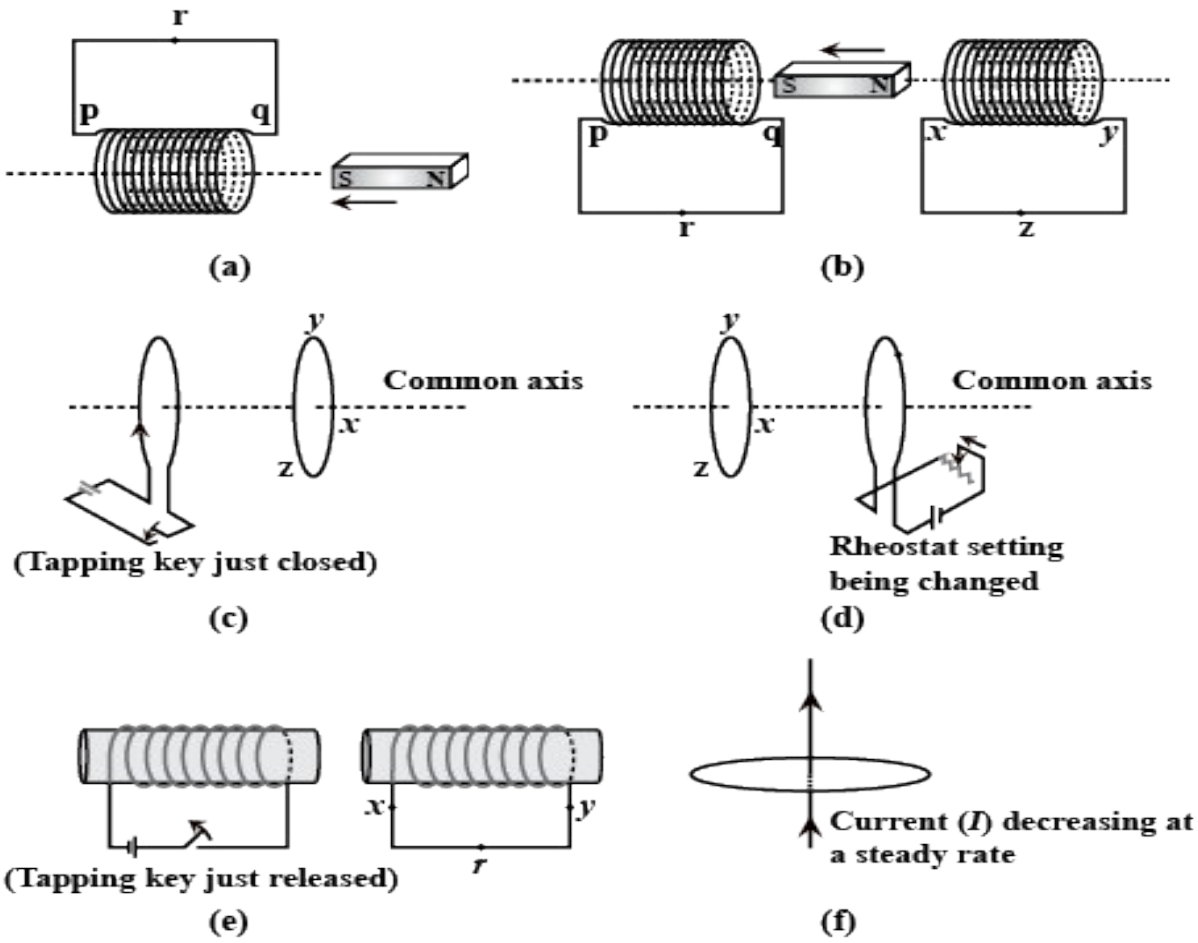
Ans- focal length will be doubled by using lens maker formula

Q26. What is the effect on the fringe width of interference fringes in a Young's double-slit experiment due to each of the following operations:

a) screen is moved closer to plane of slits?
b) separation between two slits is increased?
c) the source slit is moved closer to the double-slit plane
d) if the entire apparatus is immersed in a liquid of refractive index μ
e) the (monochromatic) source is replaced by another(monochromatic) source of shorter wavelength.
f) the monochromatic source is replaced by a source of white light

ans- dec, dec , no effect , dec ,dec , centre white

Q27. Predict the direction of induced current in the situations described by the following Figs. (a) to (f).



Ans- **(a)** The direction of the induced current is along **qrpq**.

(b) The direction of the induced current is along **prqp**.

(c) The direction of the induced current is along **yzxy**.

(d) The direction of the induced current is along **zyxz**.

(e) The direction of the induced current is along **xryx**.

(f) No current is induced since the field lines are lying in the plane of the closed loop.

OR

Q27. A long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region r < a and r > a.

Ans- $r < a$

$$I' = I.\frac{\pi r^2}{\pi a^2} = \frac{Ir^2}{a^2}$$

$$\therefore \quad B\oint \vec{dl} = \mu_o . I_e = \frac{\mu_o I r^2}{a^2}$$

$$\text{Or} \quad B = \frac{\mu_o I r^2}{a^2}\cdot\left(\frac{1}{2\pi r}\right) = \left(\frac{\mu_o}{2\pi}\frac{I}{a^2}\right)$$

(2)

(ii) For $r > a$

$$\oint \vec{B}.\vec{dl} = \mu_o I$$

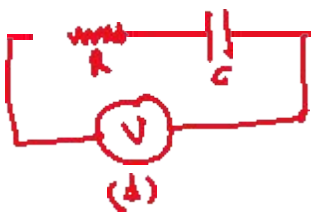
$$\therefore \quad B.2\pi r = \mu_o I$$

$$\text{or} \quad B = \frac{\mu_o I}{2\pi r}$$

(1)

Q28. A resistor of 'R' Ω and a capacitor of 'C'F are connected in series to a 'V' volt , 'f' Hz ac source. (a) Calculate the current in the circuit; (b) Calculate the voltage (rms) across the (i) Resistor (ii) Capacitor. (c) The algebraic sum of these voltages always more than the source voltage? resolve the paradox.

Ans-



(d)

$$Z = \sqrt{R^2 + \left(\frac{1}{2\pi f C}\right)^2}$$ (½m)

$$I = \frac{V}{Z} = \frac{V}{\sqrt{R^2 + \left(\frac{1}{2\pi f C}\right)^2}}$$ (1M) ½m for Formula

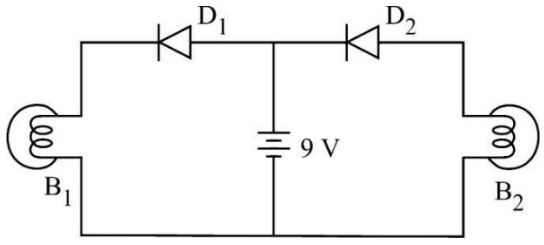
$$V_R = IR = \frac{V}{\sqrt{R^2 + \left(\frac{1}{2\pi f C}\right)^2}} \times R$$

$$V_C = I X_C \longrightarrow \frac{V}{\sqrt{R^2 + \left(\frac{1}{2\pi f C}\right)^2}} \times \frac{1}{(2\pi f C)}$$ (1)

SECTION-D

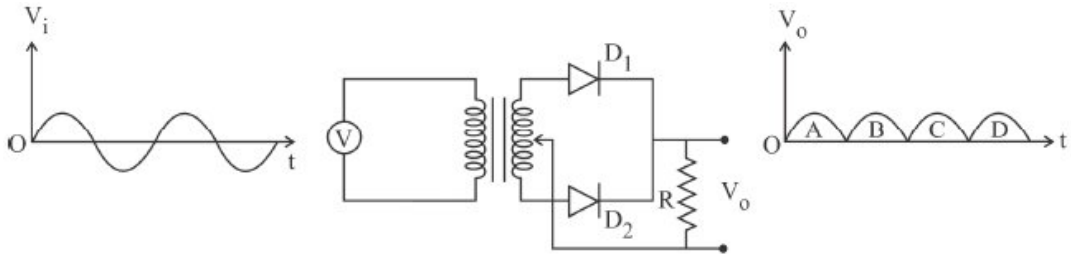
Q29. The process of converting ac into dc is called rectification and the device used is called a rectifier. When ac signal is fed to a junction diode during positive half cycle, the diode is forward biased and current flows through it. During the negative half cycle, the diode is reverse biased and it does not conduct. Thus the ac signal is rectified. The p-n junction diodes can be used as half-wave and full-wave rectifiers.

(i) Which bulb/bulbs will glow in the given circuit ?



ans- B1

(ii) A full-wave rectifier circuit is shown in the figure. The contribution in output waveform (out of A,B,C,D) from junction diode D_2 is …….



Ans- B , D

(iii) In a p-n junction diode, write the name of majority charge carriers on p-side and on n-side respectively.

ans-holes,electrons

(iv) If the input frequency is 'f' Hz . The output frequency of half-wave rectifier is ….. Hz, and the frequency of full-wave rectifier at output is …..?

Ans- f ,2f

1M for each part , ½ M for each for part iv

Q30. According to wave theory of light, the light of any frequency can emit electrons from metallic surface provided the intensity of light be sufficient to provide necessary energy for emission of electrons, but according to experimental observations, the light of frequency less than threshold frequency cannot emit electrons; whatever be the intensity of incident light. Einstein also proposed that electromagnetic radiation is quantized.

If photoelectrons are ejected from a surface when light of wavelength λ_1 = 520 nm is incident on it. The stopping potential for such electrons is V_s =0.20 V .

(i) Photoelectric effect supports quantum nature of light because
(A) there is a minimum frequency of light below which no photoelectrons are emitted.
(B) the maximum K.E. of photoelectric depends only on the frequency of light and not on its intensity.
(C) even when the metal surface is faintly illuminated, the photo electrons leave the surface immediately. (frequency of incident light is more then the threshold frequency)
(D) electric charge of the photoelectrons is quantized.

Which of the following is correct.

(a) A, B, C
(b) B, C
(c) C, D
(d) A, D, C

(ii) In photoelectric effect, electrons are ejected from metals, if the incident light has a certain minimum

(a) wavelength
(b) frequency

(c) amplitude
(d) angle of incidence

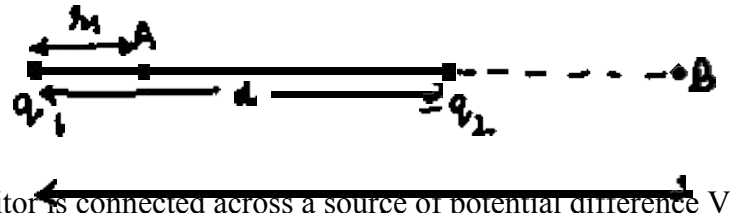
(iii) Suppose the radiation of wavelength λ_2 = 190 nm is incident on the surface. The stopping potential V_{s2} of surface in volt is…

(a) 5.47
(b) 3.16
(c) 2.76
(d) 4.34

(iv) The work function of the surface in eV.
(a) 3.75
(b) 2.19
(c) 4.20
(d) 3.60

SECTION-E

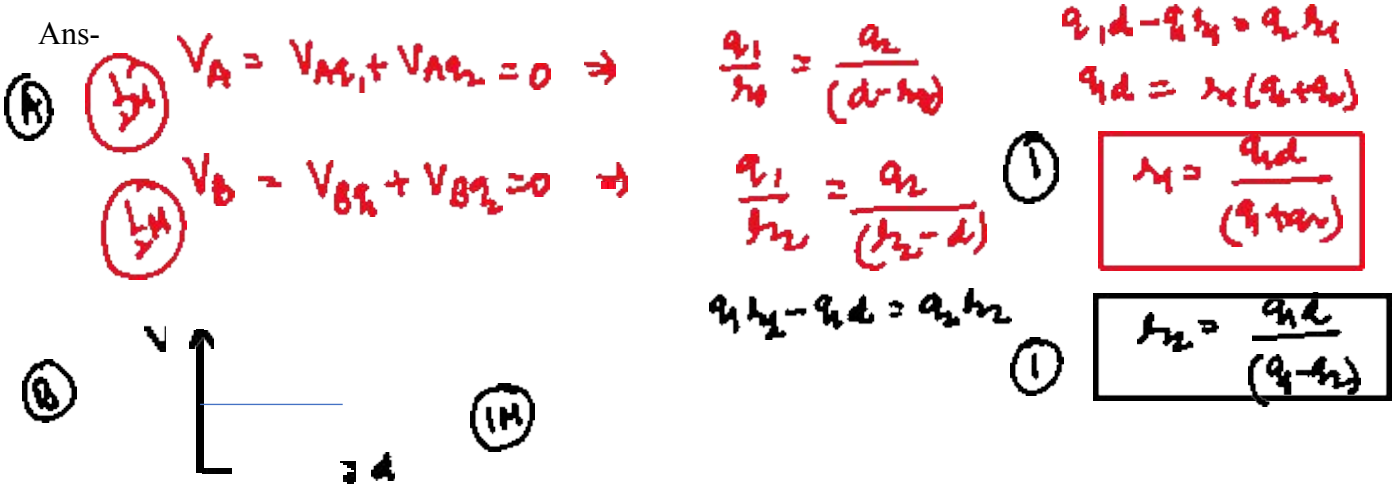
Q31. (a) Let q_1 and $-q_2$ are two charges separated by a distance 'd' apart. Let A and B be two points at distances r_1 and r_2 from the charge q_1 .The net electric potential at each point due to the two charges is zero as shown in the figure. Calculate the value of r_1 and r_2 in terms of q_1,q_2 and d.



(b) A capacitor is connected across a source of potential difference V and the separation 'd' between the plates is increased using insulating stick. Plot 'V' vs 'd' graph for the given capacitor.

(c) Find the expression for the capacity of a air filled parallel plate capacitor.

Ans-



(c) Proof (1M)

OR

Q31. (a) Two point charges 4q and 16q are placed at a distance r apart. Suppose a third charge -q is placed in between, on the line joining 4q and 16q, so that the electric potential energy of the system of charges is minimum. Calculate the position of the third charge. (2M)

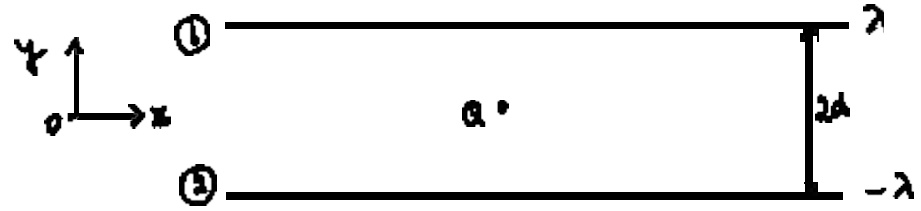
Ans- apply the formula for EPE

Do one time differentiation wrt to x

$$\frac{1}{x^2} = \frac{4}{(r-x)^2}$$

So ans is r/3 from 4q

(b) Consider two parallel thin long straight linearly charged wires of linear charge density λ, -λ as shown in figure calculate the force at 'Q' Coulomb of charge which is at the mid point of these parallel linearly charged wires. (all quantities are in SI system) (3M)



Ans- $\vec{E}_{Q1} = \frac{1}{4\pi\epsilon_0}\frac{2\lambda}{d}(-\hat{i})$, $\vec{E}_{Q2} = \frac{1}{4\pi\epsilon_0}\frac{2\lambda}{d}(-\hat{j})$

$$\vec{E}_{QN} = 2\frac{1}{4\pi\epsilon_0}\frac{2\lambda}{d}(\hat{r})$$

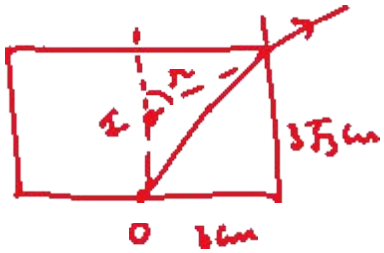
$$f = Q\vec{E}_{QN} = -2\frac{1}{4\pi\epsilon_0}\frac{2Q\lambda}{d}(\hat{j}) \text{ Newton}$$

Q32. (a) Draw a labelled ray diagram of astronomical refracting telescope for the final image formed during normal adjustment. Write the formula for magnifying power for the given case. Why we keep large aperture of Objective lens?

Ans- diagram 2M , ½ for formula and ½ M for reason

(b) A small object is placed at the centre of the bottom of a cylindrical vessel of radius 3cm and height 3√3 cm filled completely with a liquid. Consider a ray is leaving the vessel through a corner of water surface. Find the apparent depth of the image. Refractive index of liquid is √3.

Ans-



$r = 60$

$\sin r = \frac{AM}{AI}$

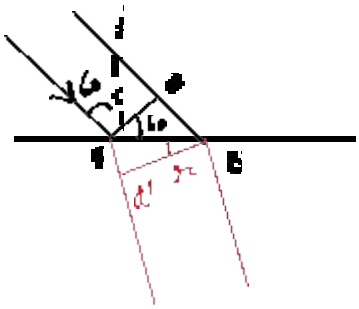
$AI = \sqrt{3}$ cm

(2M)

OR

Q32. (a) A beam of light of circular cross section of diameter 2cm falls on a plane surface of glass. The angle of incidence is 60^0 and refractive index of glass is 3/2 calculate the diameter of refractive beam.

Ans-



$\cos 60 = \frac{d}{PQ}$. $\cos r = \frac{d'}{PQ} \Rightarrow d' = 2d\cos r$ (1)

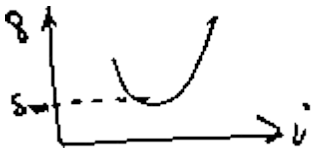
$\mu = \frac{\sin 60}{\sin r} \Rightarrow \frac{3}{2}\sin r = \frac{1}{\sqrt{3}}$ (1)

$\therefore \cos r = \sqrt{\frac{2}{3}}$

$\therefore d' = 2 \times 2 \times \sqrt{\frac{2}{3}}$ cm $= \frac{4\sqrt{2}}{\sqrt{6}}$ cm (1)

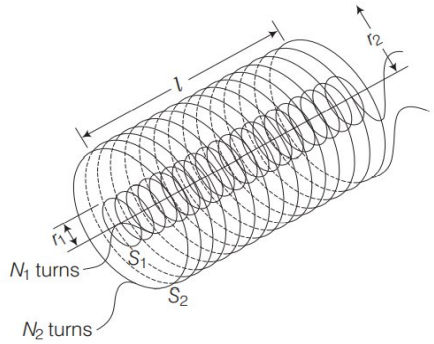
(b) Write two conditions for the angle of minimum deviation when a monochromatic light passing through a prism. Draw a graph showing variation of minimum angle of deviation with the angle of incidence . (1+1)

$\frac{1}{2}$ M for each Condition .



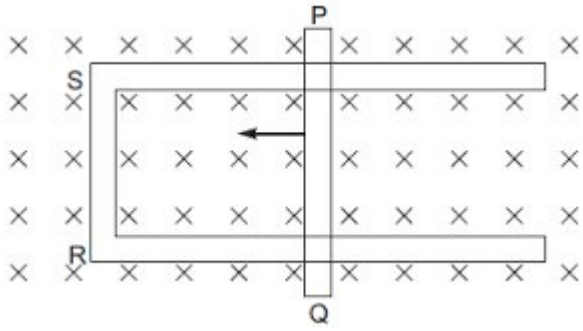
(1M)

Q33. (a) Calculate the Mutual inductance of two long co-axial solenoids of same length l. When a current I_2 is set up through S_2 as per the given diagram. (3M)



(b) The figure shows a rectangular conductor PQRS in which the arm PQ of length 10 cm and resistance 0.4 Ω is free to move. It is kept in a uniform magnetic field

B = 0.2 T acting perpendicular into the plane of PQRS. If arm PQ is moved with a velocity v of 5 cm/s as shown, find:



(a) The current induced in the loop, and
(b) The power required to move the arm.
(Resistance of arms PS, SR and RQ are negligible.)

Ans- e = 10^{-3} V (1/2)

I = 2.5mA (1/2)

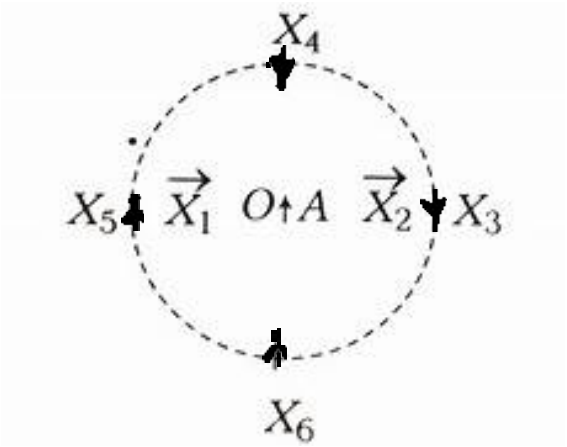
P = 25×10^{-7} watt (1)

OR

Q33. (a) The magnetic field inside a current carrying solenoid is B_0 .When the space inside solenoid is filled with a material of susceptibility 'δ' , the magnetic field along its core becomes B. show that the percentage increase in the magnetic field inside the solenoid is 100 times δ.

Ans- proof required 2M

(b) Figure shows a small magnetised needle 'A' placed at a point O. The arrow shows the direction of its magnetic moment. The other arrows show different positions (and orientations of the magnetic moment) of another identical magnetised needle 'X'. (a) In which configurations the system is not in equilibrium? (b) In which configuration is the system in (i) stable, and (ii) unstable equilibrium? (c) Which configuration corresponds to the lowest potential energy among all the configurations shown?



Ans-

(a) 1,2 ½ each
(b) (i)3,6 (ii) 4,5 ½ each
(c) 6 1M