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Please check that this question paper contains 33 question and 12 printed pages.

D.A.V. INSTITUTIONS, CHHATTISGARH

SAMPLE QUESTION PAPER II -2023-24

Class - XII

SUBJECT: PHYSICS

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

General Instruction

1. All questions are compulsory. There are 33 questions in all.

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 one mark each, 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 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. You may use the following values of physical constants wherever necessary.

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

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

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

$\mu_0 = 4\pi \times 10^{-7} TmA^{-1}$

$\varepsilon_0 = 8.854 \times 10^{-12} C^2 N^{-1} m^{-2}$

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 Nm^2 C^{-2}$

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

$mass\ of\ neutron = 1.675 \times 10^{-27} kg$

$mass\ of\ proton = 1.673 \times 10^{-27} kg$

Avogadro's number = *6.023*$\times 10^{23} per\ gram\ mole$

$Boltzmann\ constant = 1.38 \times 10^{-23} JK^{-1}$

Section –A

Q.1. The electric field that can balance an electron of mass$3.2 \times 10^{-27} kg$ is

a) $19.6 \times 10^{-8} NC^{-1}$ b) $20 \times 10^{-6} NC^{-1}$

c) $19.6 \times 10^{8} NC^{-1}$ d) $2 \times 10^{6} NC^{-1}$

Q.2. If a conductor has a potential $V \neq 0$ and there are no charges anywhere else outside, then

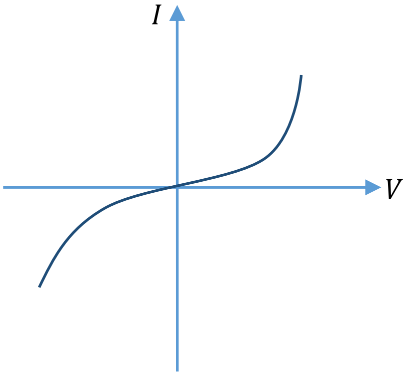
a) There must be charges on the surface or inside itself.

b) There cannot be any charge in the body of the conductor.

c) There must be charges only on the surface.

d) Both (a) and (b) are correct.

Q.3. The I- V characteristics shown in figure is represent for



a) Ohmic conductors

b) Non-ohmic conductors

c) Insulators

d) Superconductors

Q.4. If electron moving with velocity v produces a magnetic field B, then

a) The direction of field $\boldsymbol{B}$will be same in the direction of velocity $\boldsymbol{v}$.

b) The direction of field $\boldsymbol{B}$ will be opposite to the direction of velocity $\boldsymbol{v}$.

c) The direction of field $\boldsymbol{B}$ will be perpendicular to the direction of velocity $\boldsymbol{v}$.

d) The direction of field $\boldsymbol{B}$ does not depend upon the direction of velocity$\boldsymbol{v}$.

Q.5. Magnetic susceptibility of a diamagnetic substances

a) Increases with increase in temperature

b) Increases with decrease in temperature

c) Remains constant with change in temperature

d) None of these.

Q.6. An electromagnetic wave in vacuum has the electric and magnetic fields $\boldsymbol{E}$ and$\boldsymbol{B}$, which are always perpendicular to each other. The direction of wave propagation is given by kThen:

a) $\overrightarrow{K}||\overrightarrow{E}$ and $\overrightarrow{E} \perp \overrightarrow{B}$

b) $\overrightarrow{K}||\overrightarrow{E} \times \overrightarrow{B}$ and $\overrightarrow{E} \perp \overrightarrow{B}$

c) $\overrightarrow{K} \perp \overrightarrow{E}$ and $\overrightarrow{E}||\overrightarrow{B}$

d) $\overrightarrow{K}||\overrightarrow{E} \times \overrightarrow{B}$ and $\overrightarrow{E}||\overrightarrow{B}$

Q.7. In a double slit interference pattern, the first maxima for infrared light would be

a) At the same place as the first maxima for green light

b) Closer to the centre than the first maxima for green light

c) Farther from the centre than the first maxima for green light

d) Infrared light does not produce an interference pattern

Q.8. The de Broglie wavelength of a photon is twice the de Broglie wavelength of anelectron. The speed of the electron is$v_e = C/100$then

a) $E_e/E_P = 10^{-4}$ b) $E_e/E_P = 10^{-2}$

c) $^{P_e}/_{M_e C} = 10^{-1}$ d) $^{P_e}/_{M_e C} = 10^{-4}$

Q.9. If $13.6\ eV$ energy is required to separate a hydrogen atom into a proton and anelectron, then the orbital radius of electron in a hydrogen atom is

a) $5.3 \times 10^{-11} m$ b) $4.3 \times 10^{-11} m$

c) $6.3 \times 10^{-11} m$ d) $7.3 \times 10^{-11} m$

Q.10. The binding energy per nucleon of deuterium and helium nuclei are 1.1 MeV and7.0 MeV respectively. When two deuterium nuclei fuse to form a helium nucleus theenergy released in the fusion is

a) $23.6\ MeV$ b) $2.2\ MeV$

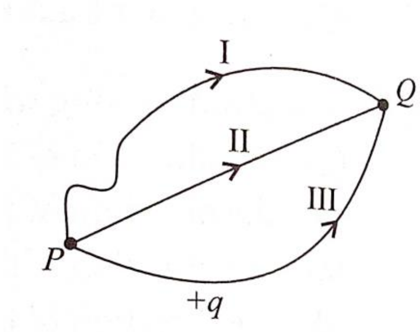
c) $28.0\ MeV$ d) $30.2\ MeV$.

Q.11. In which of the following circuits the maximum power dissipation is observed?

a) Pure capacitive circuit b) Pure inductive circuit

c) Pure resistive circuit d) None of these

Q.12. Which among the following statement is true about the work done in bringinga unit positive charge from point P to Q in an electrostatic field?



a) Minimum work is done in case of path II.

b) Maximum work is done in case of path I.

c) Work done is same in all the three paths.

d) Work done is zero in case of path II.

In Q.13. to Q.16., two statement are given one labeled Assertion (A) and other labeled Reason (R). Select the correct answer to these questions from the options as gives below.

(a) If both Assertion and reason are true and Reason is the 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.

Q.13. **Assertion (A):** Diamond behaves like an insulator.

Reason (R): There is a large energy gap between valence band and conduction band of diamond.

Q.14. **Assertion (A):** No interference pattern is detected when two coherent sources areinfinitely close to each other.

Reason (R): The fringe width is inversely proportional to the distance between thetwo slits.

Q.15. **Assertion (A):** In photoelectric effect, on increasing the intensity of light, both thenumber of electrons emitted and kinetic energy of each of them get increased butphotoelectric currentremains unchanged.

Reason (R): The photoelectric current depends only on wavelength of light.

Q.16. **Assertion (A):** Current sensitivity of a galvanometer is the deflection produced in the coil per unit current passed through it.

Reason (R): Current sensitivity of a galvanometer can be increased by increasing the magnetic field.

Section –B

Q.17. When an ideal capacitor is charged by a DC battery no current flows, however when an AC source is used, the current flows continuously. How does one explain this based on the concept of displacement current?

Q.18. i)What happens when a diamagnetic substance is placed in a varying magnetic field?

ii) Name the properties of a magnetic material that make it suitable for making

a) A permanent magnet and b) A core of an electromagnet.

Q.19. The fission properties of $_{94}\mathbf{Pu}^{239}$ are very similar to those of $_{92}\mathbf{U}^{235}$. The average energy released per fission is 180 MeV. How much energy, in MeV, is released if all the atoms in 1 kg of pure $_{94}\mathbf{Pu}^{239}$ under go fission?

OR

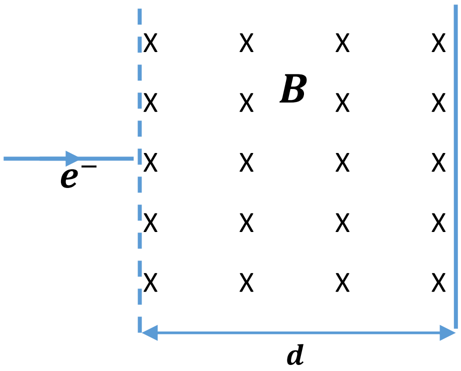
Calculate the ratio of energies of photons produced due to transition of electron ofhydrogen atom from its, second permitted energy level to the first level, and highest permitted energy level to the second permitted level.

Q.20. You are given two converging lenses of focal lengths 1.25cm and 5cm to design a compound microscope. If it is desired to have a magnification of 30, find out the separation between the objective and the eyepiece.

Q.21. For a single slit of width 'a' the first minimum of the interference pattern of a monochromatic light of wavelength λ occurs at an angle of **λ/a**. At the same angle of**λ /a,** we get a maximum for two narrow slits separated by a distance ' a'. Explain.

Section – C

Q.22. An electron moving horizontally with a velocity of $4 \times 10^4 ms^{-1}$ enters a region of uniform magnetic field of$10^{-5}T$acting vertically downward as shown in the figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.



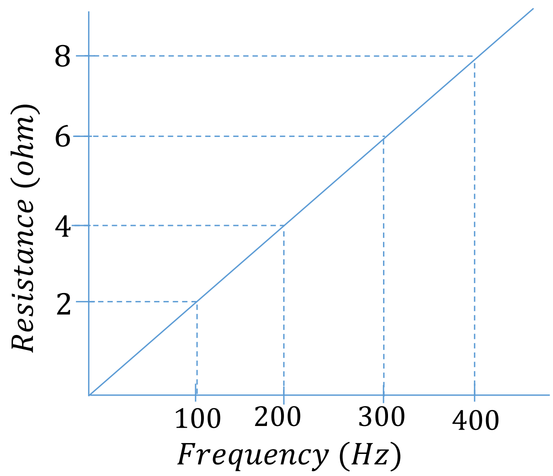
Q.23. A capacitor of capacitance $100\,\mu F$ and a coil of resistance 50Ω and inductance $0.5H$ are connected in series with a $110V, 50Hz$ source. Calculate the rms value of thecurrent in the circuit.

OR

Figure shows how the reactance of an inductor varies with frequency.

i) Calculate the value of the inductance of the inductor using the information given inthe graph.

ii) If this inductor is connected in series to a resistor of 8 ohm, find what would be theimpedance at 300 Hz.



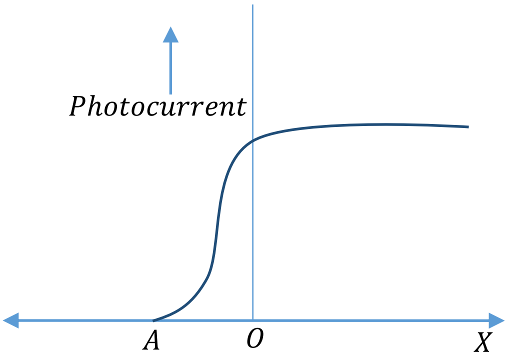
Q.24. Plot a graph showing the variation of photoelectric current with intensity of light.The work function for the following metals is given.

Na: **2.75 eV** and Mo: **4.175 eV**.

Which of these will not give photoelectron emission from a radiation of wavelength 3300 A^0 from a laser beam? What happens if the source of laser beam is brought closer?

OR

The following graph shows the variation of photocurrent for a photosensitive metal:



a) Identify the variable X on the horizontal axis.

b) What does the point A on the horizontal axis represent?

c) Draw this graph for three different values of frequencies of incident radiation $\boldsymbol{\nu_1}$, $\boldsymbol{\nu_2}$ and $\boldsymbol{\nu_3}$ $(\boldsymbol{\nu_1 > \nu_2 > \nu_3})$ for same intensity.

d) Draw this graph for three different values of intensities of incident radiation $\mathbf{1_1}$, $\mathbf{I_2}$ and $\mathbf{I_3}$ $(\mathbf{1_1 > 1_2 > 1_3})$ having same frequency.

Q.25. The kinetic energy of the electron orbiting in the first excited state of hydrogen atom is 3.4 eV. Determinethe de-Broglie wavelength associated with it.

Q.26. a) Define co-efficient of self-induction.

b) Calculate the self-inductance of a coil using the following data obtain when an AC source of frequency $(\frac{200}{\pi})Hz$ and a DC source is applied across the coil.

AC source		
S. No.	$V(Volt)$	$I(A)$
1	3.0	0.5
2	6.0	1.0
3	9.0	1.5

DC source		
S. No.	$V(Volt)$	$I(A)$
1	4.0	1.0
2	6.0	1.5
3	8.0	2.0

Q.27. a) Explain the formation of a p-n junction.

b) Can we take one slab of p-type semiconductor and physically join it to another n-type semiconductor to get a p-n junction? Explain.

Q.28. i) Two point charges $+Q_1$ and $-Q_2$ are placed r distance apart. Obtain the expression for the amount of work done to place a third charge Q_3 at the midpoint of the line joining the two charges.

ii) At what distance from the charge $+Q_1$ on the line joining the two charges (in terms of Q_1, Q_2 and r) will this work done be zero?

Section – D

Case Study Based Questions

Q.29. **Read the paragraph and answer the following questions.**

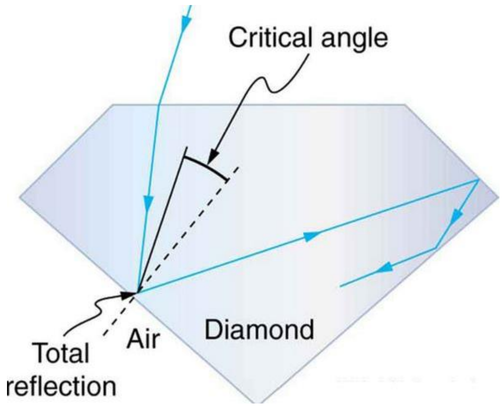
Total internal reflection (TIR) is the phenomenon in which waves arriving at the interface (boundary) from one medium to another (e.g., from water to air) are not refracted into the second ("external") medium, but completely reflected back into the first ("internal") medium. It occurs when the second medium has a higher wave speed (i.e., lower refractive index) than the first, and the waves are incident at a sufficiently oblique angle on the interface. For example, the water-to-air surface in a typical fish tank, when viewed obliquely from below, reflects the underwater scene like a mirror with no loss of brightness (Fig. 1).

Fig. 1: Underwater plants in a fish tank, and their inverted images (top) formed by total internal reflection in the water–air surface

TIR occurs not only with electromagnetic waves such as light and microwaves, but also with other types of waves, including sound and water waves.

As the angle of incidence approaches a certain threshold, called the critical angle, the angle of refraction approaches 90°, at which the refracted ray becomes parallel to the boundary surface. As the angle of incidence increases beyond the critical angle, the conditions of refraction can no longer be satisfied, so there is no refracted ray, and the partial reflection becomes total.

Diamond is popular because of its amazing shine and its glamorous look. The shine of the diamond is due to the phenomenon of total internal reflection. Another important application of total internal reflection is the concept of optical fibre. During such a phenomenon, when a beam of light strikes the cladding, the concept of total internal reflection takes place.



i) Critical angle for a given pair of media is satisfied when:

(a) Angle of refraction is greater than 90^0

(b) Angle of incidence corresponds to angle of refraction 90^0

(c) For $i > i_C$ no refraction is possible

(d) Ray refracts and move completely in rarer medium.

(ii) The diamond has sparkling brilliance because

(a) Light does not enterin diamond and reflects from its surface
(b) Light enters in diamond and gets dispersed
(c) Light gets internally reflected in it
(d) Light scatters in it.

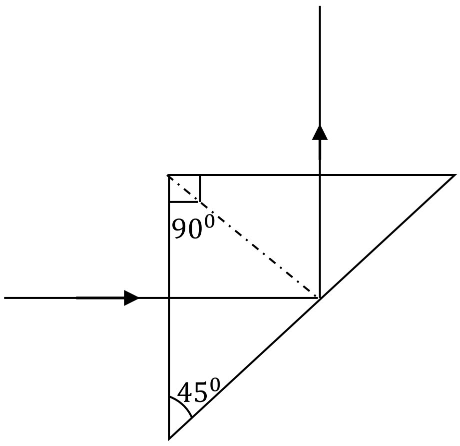
iii) On what principle do these optical fibres work?

(a) Laws of reflection (b) Laws of refraction

(c) Huygen's principle (d) Total internal reflection.

OR

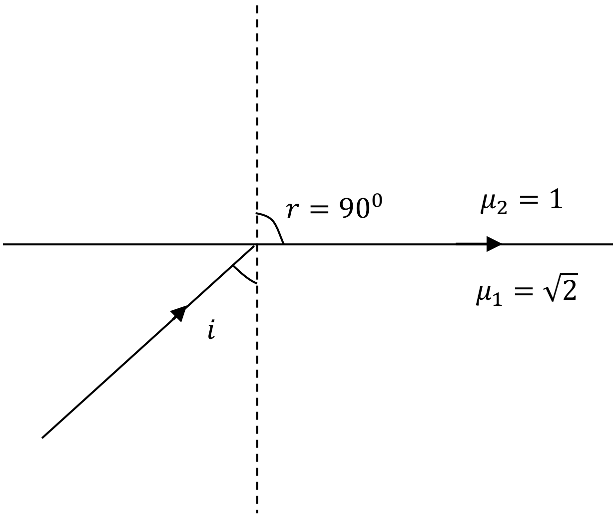
A ray of light incident normally on one face of a right isosceles prism is totally reflected as shown in figure.



The value of refractive index of glass will be

a) 2 b) $\sqrt{2}$ c) $\sqrt{3}$ d) 0

iv) Ray of light travelling from a medium of refractive index $\mu_1 = \sqrt{2}$ into the medium of refractive index $\mu_2 = 1$ so that it just grazes along the surface of separation.



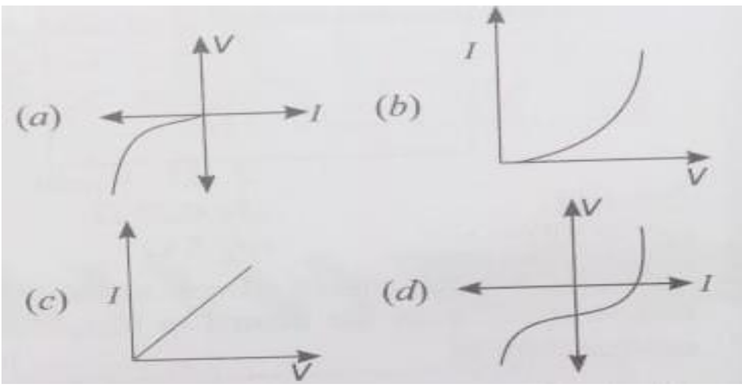
The angle of incidence will be

a) 30^0 b) 60^0 c) 45^0 d) 90^0

Q.30. **Read the following paragraph and answer the questions that follows:**

In Forward bias arrangement, the p side of a p-n junction is connected to the positive terminal of battery and n-side to negative terminal of battery the current first increases very slowly till a certain threshold voltage isreached. Beyond this value, the diode current increases exponentially even for a very small increment in diodebias voltage. In reverse bias, the current suddenly increases at very high reverse bias. This is called breakdown voltage.

(i) The characteristic curve for p-n junction in forward bias is



(ii) What is the approximate value of threshold voltage for a silicon diode?

a) $0.7V$ b) $0.14V$

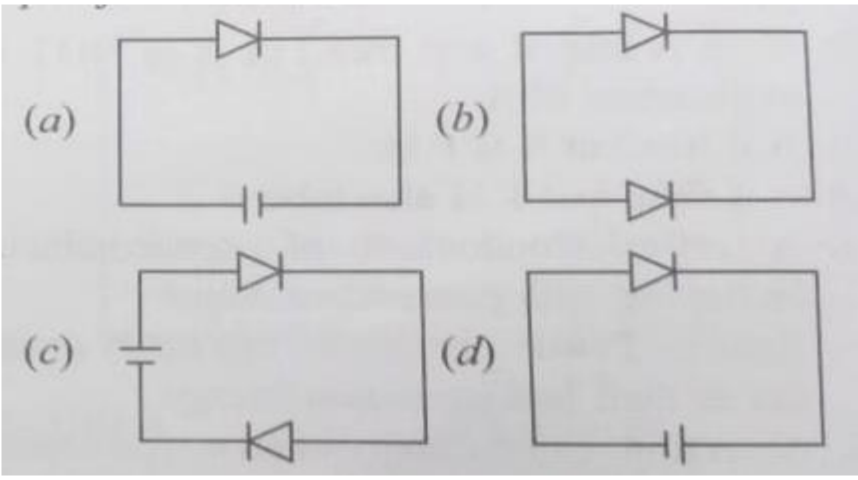
c) $0.7eV$ d) $0.14eV$

(iii) A p-n junction diode is connected to a battery of emf 5.5V and external resistance 5.1$k\Omega$. The barrier potential in the diode is 0.4V. The current in the circuit is

a) $1A$ b) $1mA$

c) $2mA$ d) $0.08mA$

(iv) Which diagram represents the reverse bias of a p-n junction diode?



OR

How does current under reverse bias depend onapplied voltage?

(a) It varies directly with potential.

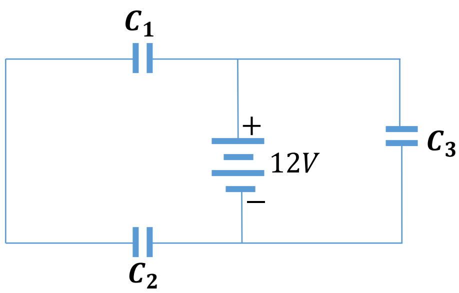
(b) It varies inversely with potential

(c) It is almost independent of applied potential upto critical voltage

(d) It remains unchanged after critical voltage is reached.

Section –E

Q.31. Three identical capacitors C_1, C_2 and C_3 of a capacitance $\boldsymbol{6\ \mu F}$ each are connectedto a 12 V battery as shown.



Find

i) Charge on each capacitor

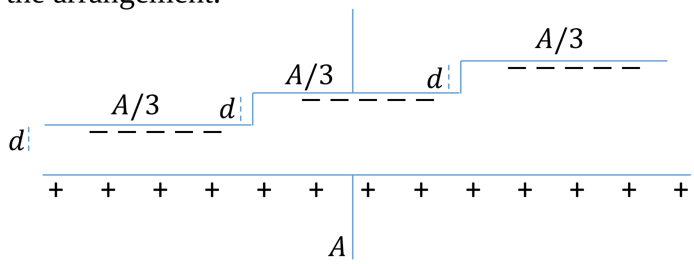
ii) Equivalent capacitance of the network

iii) Energy stored in the network of capacitors

OR

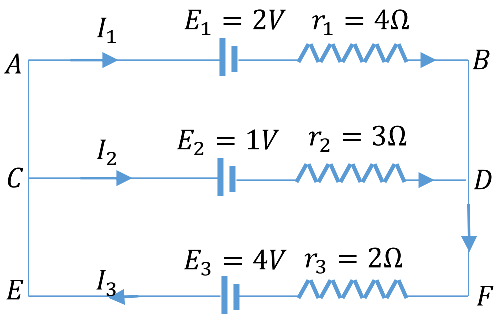
a) plot a graph comparing the variation of potential 'V' and electric field 'E' due to a point charge q as a function of distance r from the point charge.

b) A capacitor is made of a flat plate of area A and the second plate has a stair-like structure as shown in the figure below. If the width of each stair is A/3 and the height is 'd' find the capacitance of the arrangement.



Q.32. a) Write the condition for a balance Wheatstone bridge.

b) Use Kirchhoff's rule to find the current i_1, $i_2$and i_3 in the circuit diagram as shown.



OR

a) Deduce ohm's law using the concept of drift velocity.

b) Plot a graph showing variation of current density $\vec{J}$ versus the electric field $\vec{E}$ for two conductors of different materials.

c) What information from this plot regarding the properties of the conducting material can be obtained which can be used to select suitable material used for making i) standard resistance and ii)connecting wires in electric circuits?

Q.33. a) In Young's double slit experiment, the two slits are kept 2mm apart and the screen is positioned 140cm away from the plane of the slits. The slits are illuminated with light of wavelength 600nm. Findthe distance of the third bright fringe, from the central maximum, in the interference pattern obtained on the screen. If the wavelength of the incident light were changed to 480nm, find out the shift in theposition of third bright fringe from the central maximum.

b) Laser light of wavelength 630nm incident on a pair of slits produces an interference pattern in which the bright fringes are separated by 7.2mm. Calculate the wavelength of another source of laser light which produces interference fringes separated by 8.1mm using same pair of slits.

OR

a) Draw a ray diagram showing the formation of image by a reflecting telescope. Write two advantages of a reflecting telescope over a refracting telescope.

b) A small telescope has an objective lens of focal length $144cm$ and an eyepiece of focal length $6.0cm$. What is the magnifying power of the telescope. What is the separation between the objective and the eyepiece?