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Q3.
A.

→

(i) To increase the amount of light transmitted, many lens have coatings (thin films) that will allow a certain wavelength of light to be less reflected and thus being transmitted by a larger amount.

These coatings often look purple because they do reflect some red and violet light.

These coatings are called non reflective coatings and are used widely in the optical sector for making spectacles and sunglasses.

(ii) Given: $\mu = 1.4$, $\alpha = 20 \text{ sec} = \frac{20}{60 \times 60} = 0.0055°$

$\beta = 0.25 \text{ cm} = 25 \times 10^{-4} \text{ m}$.

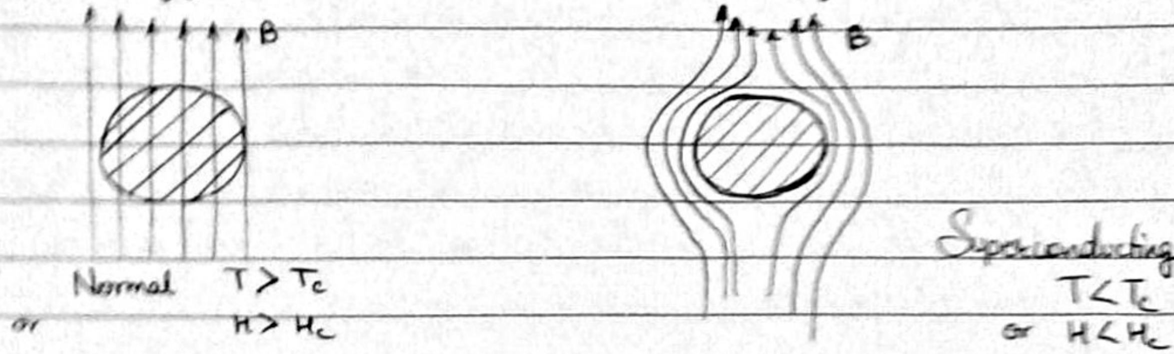
Formula: $\beta = \frac{\lambda}{2\mu\alpha}$

Solution: $\lambda = 2\mu\alpha\beta = 2 \times 1.4 \times 25 \times 10^{-4} \times 0.0055$.

$\therefore \lambda = 3888 \text{Å}$

Conclusion: The wavelength of light is 3888Å.

Q3.
c.
→ (i) " When superconductors are cooled below its critical temperature in magnetic field, then in superconducting state, material ~~kept~~ repels the magnetic lines of force."
This effect is known as Meissner effect.



Explanation - 1) Consider superconductor in the form of cylinder is kept in a magnetic field of induction B.

2) Above the critical temperature, when the material is in the state of normal conductor then magnetic lines of force penetrates through the material.

3) When the material is in superconducting state, the magnetic lines of force repels outwards the material and material acts as perfectly diamagnetic.

4) Above critical temperature T_c, the material is normal conductor. Therefore, total flux density in the material becomes infinity.

5) Below critical temperature T_c, the material becomes superconductor and total flux density in the material becomes zero.

(ii) for normal state ($T > T_c$) the magnetic induction inside specimen is
$B = \mu_0 (H+M)$ where $\mu_0 \rightarrow$ permeability in free space.
$H \rightarrow$ external magnetic field applied.
$M \rightarrow$ magnetisation produced within specimen.

As $T_0 < T_c$, $B = 0$ $\therefore \mu_0(H+M) = 0$. $H = -M$.
$\therefore$ The susceptibility of the material is $\chi = \frac{M}{H}$

$\therefore \chi = -1$.

The negative value of magnetic susceptibility shows that the specimen is a perfect diamagnet.

Q3.
B.
→ (i) The boundary conditions for an electron moving in one ~~directional~~ dimensional potential box with infinite walls at $x=0$ and $x=a$ are :-

$V(x) = 0$; for $0 \leq x \leq a$.
$V(x) = \infty$; for $x < 0$; $x > 0$.

(ii) Given : Width of potential well $= 2.5 \mathring{A}$
$a = 2.5 \times 10^{-10}$ m.

Solution : Energy of electron at ground state, $n=1$

$$E_1 = \frac{1^2 \times (6.63 \times 10^{-34})^2}{8 \times (9.1 \times 10^{-31}) \times (2.5 \times 10^{-10})^2}$$

$$= 0.97 \times 10^{-18} \text{ J}$$

$$\therefore E_1 = 6.06 \text{ eV}$$

Energy of electron in first excited state, $n=2$

$$E_2 = \frac{2^2 \times (6.63\times10^{-34})^2}{8\times 9.1\times10^{-31}\times(2.5\times10^{-10})^2}$$

$$= 3.86\times10^{-18}\,J$$

$$\therefore E_2 = 24.15\,eV.$$

Energy of electron in second excited state, $n=3$.

$$E_3 = \frac{3^2\times(6.63\times10^{-34})^2}{8\times 9.1\times10^{-31}\times(2.5\times10^{-10})^2}$$

$$= 8.69\times10^{-16}\,J.$$

$$\therefore E_3 = 54.34\,eV.$$

Conclusion: The energy values in the ground state E_1 and the first two excited states E_2 and E_3 are

$E_1 = 6.06\,eV$,
$E_2 = 24.15\,eV$,
$E_3 = 54.34\,eV$, respectively

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