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Sol (1) length of Solenoid $l = 0.5\,m$.

$\therefore$ no. of turns per unit length $n = \frac{500}{0.5} = 1000$

The magnetic field Intensity $B = 2.52 \times 10^{-3}\,T$

let the current $= I$.

using formula $B = \mu_0 n I$

$$\therefore I = \frac{B}{\mu_0 n} = \frac{2.52 \times 10^{-3}}{(10^{-7} \times 4\pi) \times 100}$$

$$\therefore I = \frac{2.52 \times 10^{-3}}{10^{-7} \times 4 \times 3.14 \times 1000} = \frac{2.52 \times 10^{-3+7}}{4 \times \frac{314}{100} \times 10\cancel{00}}$$

$$= \frac{2.52 \times 10^{4}}{12560} = 0.0002006 \times 10^{4}$$

$$= 2.006\,A.$$

Sol (2) length of solenoid $l = 50\,cm = 0.5\,m$.

no. of turns per unit length $n = \frac{100}{0.5} = 200$

current $I = 2.5\,A$

(a) magnetic Inside the solenoid $B = \mu_0 n I$

$$\therefore B = (10^{-7} \times 4\pi) \times 200 \times 2.5$$

$$= 10^{-7} \times 4 \times 3.14 \times 200 \times 2.5$$

$$= 10^{-7} \times 4 \times \frac{314}{1\cancel{00}} \times 2\cancel{00} \times 2.5$$

$$= 6280 \times 10^{-7}\,T$$

$$= 6.280 \times 10^{-4}\,T$$

(b) magnetic field at end point of solenoid

$$B_{end} = \frac{\mu_0 n I}{2} = \frac{\cancel{6.280}^{\,3.140} \times 10^{-4}}{\cancel{2}}$$

$$= 3.140 \times 10^{-4}\,T.$$

Sol (3) magnetic flux $\phi = 5 \mu wb = 5 \times 10^{-6} wb.$
current $I = 1 mA = 10^{-3} A$
Let self Inductance $= L$
Using formula $\phi = LI$

$$\therefore L = \frac{\phi}{I} = \frac{5 \times 10^{-6}}{10^{-3}} = 5 \times 10^{-6+3}$$

$$= 5 \times 10^{-3} H \quad \text{Ans.}$$

Sol (4) Same as question no. 3

Sol. (5) Here $\phi_1 = 12 \times 10^{-3}$ wb.
$\phi_2 = 6 \times 10^{-3}$ wb.

$t = 0.015$ s

According to Faraday's laws

$$e = \frac{-(\phi_2 - \phi_1)}{t} = \frac{-[(6 \times 10^{-3}) - (12 \times 10^{-3})]}{0.015}$$

$$= \frac{-[-6 \times 10^{-3}]}{0.015} = \left(\frac{6}{0.015}\right) \times 10^{-3}$$

$$= 400 \times 10^{-3} = 0.4 \text{ Volt.}$$

Sol. (6) Same as question no. 5

Sol. (7) Here $d\phi = 0.2 \times 10^{-2}$ wb
and $dt = 0.12$ s

Since $e = \frac{-d\phi}{dt} = \frac{-(0.2 \times 10^{-2})}{0.12}$

$$= -1.666 \times 10^{-2} = -0.01666$$
$$= -0.0167 \text{ Volt}$$

Sol (8) Resistance in left gap of metre bridge is
$R = 20\,\Omega$.
The balance point i.e. $l = 40$ cm
Let the unknown resistance $= X$.

Using formula $X = \dfrac{R(100 - l)}{l} = \dfrac{\cancel{20}^{1}(100-40)}{\cancel{40}_{2}}$

$= \dfrac{1(\cancel{60}^{30})}{\cancel{2}} = 30\,\Omega$ Ans.

Sol (9) Same as in question no (8)

Sol (10) Let radius of small drop $= r$
and radius of bigger drop $= R$.
The charge on bigger drop $= Q$
the charge ~~of~~ on small drop $= q$

$\therefore \quad Q = (\text{no. of drops})\, q \Rightarrow \boxed{Q = 125q}$

The Volume of bigger drop $= 125$ (Volume of small drop)

$\therefore \quad \frac{4}{3}\pi R^3 = 125\left(\frac{4}{3}\pi r^3\right)$

$\therefore \quad R^3 = 125 r^3 \Rightarrow \boxed{R = 5r}$

Now Potential on Bigger drop $= \left(\dfrac{1}{4\pi\epsilon_0}\right)\dfrac{Q}{R}$

i.e. $V = \left(\dfrac{1}{4\pi\epsilon_0}\right)\dfrac{\cancel{125}^{25}q}{\cancel{5}r} = 25\left[\dfrac{1}{4\pi\epsilon_0}\dfrac{q}{r}\right]$

$= 25$ (Potential of small drop)

$= 25(10) = 250$ volt Ans

Sol (11) Same as in question no. (10)

Sol. (12) Here $G = 15\,\Omega$

$I_g = 4\,mA = \frac{4}{1000} = 0.004\,A$

and $I = 6\,A$

To convert galvanometer into ammeter, a low resistance shunt is connected in parallel.

$$\therefore S = \frac{I_g G}{I - I_g} = \frac{0.004 \times 15}{6 - 0.004} = \frac{0.06}{5.996}$$

$$= 0.01\,\Omega \text{ in parallel}$$

Sol. (13) Same as in question no. (12)

Sol. (14) Here $\lambda_0 = 6000\,Å = 6 \times 10^{-7}\,m$

(a) let threshold frequency $= \nu_0$

$$\therefore \nu_0 = \frac{c}{\lambda_0} = \frac{3 \times 10^8}{6 \times 10^{-7}} = 0.5 \times 10^{8+7}$$

$$\boxed{\nu_0 = 0.5 \times 10^{15}\,Hz}$$

(b) Work function $W = h\nu_0$

$$= (6.626 \times 10^{-34})(0.5 \times 10^{15})$$

$$= 3.313 \times 10^{-34+15}$$

$$= 3.313 \times 10^{-19}\,J$$

$$= \frac{3.313 \times \cancel{10^{-19}}}{1.6 \times \cancel{10^{-19}}} = 2.07\,eV.$$

Sol. 15 Work function of Na is $W = 2.75\,eV$

Wavelength $\lambda = 6800\,Å = 68 \times 10^{-8}\,m$

$\therefore$ Energy of Incident light $E = \frac{hc}{\lambda}$

$$\therefore E = \frac{(6.626 \times 10^{-34})(3 \times 10^{8})}{68 \times 10^{-8}}$$

$$= \left(\frac{6.626 \times 3}{68}\right) \times 10^{-34+8+8}$$

$$= 0.292 \times 10^{-18}\,J.$$

$$= \frac{0.292 \times 10^{-18}}{1.6 \times 10^{-19}} = 0.1825 \times 10^{1}$$

$$= 1.825\,eV$$

Here $E < W$

Thus photoelectric emission does not takes place.

Sol. 16 Same as in question 15

Sol. 17 In Air

$$\frac{1}{f_{air}} = ({}_{g}^{a}\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{10} = (1.5 - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{10} = (0.5)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{10} = \frac{\frac{1}{5}}{\frac{10}{2}}\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{10_5} \times 2 = \left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\boxed{\frac{1}{5} = \left[\frac{1}{R_1} - \frac{1}{R_2}\right]} \quad -(1)$$

In Water:

$$\frac{1}{f_{water}} = \left(\frac{{}_{g}^{a}\mu}{{}_{g}^{w}\mu} - 1\right)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

$$\frac{1}{f_{water}} = \left(\frac{1.5}{1.3} - 1\right)\left(\frac{1}{5}\right)$$

$$\therefore \frac{1}{f_{water}} = \left(\frac{1.5 - 1.3}{1.3}\right)\left(\frac{1}{5}\right)$$

$$\frac{1}{f_{water}} = \left(\frac{0.2}{1.3}\right)\left(\frac{1}{5}\right)$$

$$\frac{1}{f_{water}} = \frac{0.2}{6.5}$$

$$f_{water} = \frac{6.5}{0.2}$$

$$\boxed{f_{water} = 32.5 \text{ cm}}$$

Sol (19) Here $P_1 = +15D$
$P_2 = -5D$

Let power of combination $= P$

$\therefore P = P_1 + P_2 = +15 - 5 = +10D$

But $P = \frac{1}{f}$

$\therefore f = \frac{1}{P} = \frac{1}{10} = 0.1m$

$= 10\ cm$

Sol (20) Here $\frac{a}{b} = \frac{2}{5}$

$5a = 2b \Rightarrow \boxed{a = \frac{2b}{5}}$

Now $\frac{I_{max}}{I_{min}} = \frac{(a+b)^2}{(a-b)^2} = \frac{\left(\frac{2b}{5} + b\right)^2}{\left(\frac{2b}{5} - b\right)^2}$

$= \frac{\left(\frac{2b+5b}{5}\right)^2}{\left(\frac{2b-5b}{5}\right)^2} = \left(\frac{7b}{5}\right)^2 \times \left(\frac{5}{-3b}\right)^2$

$= \frac{49b^2}{9b^2} = \frac{49}{9}$

Thus required ratio is $49 : 9$