① (111)

② ~~whether~~ Volt-meter (Vm) ~~or Nm~~ OR Nm^2/c

③ magnetic dipoles only
(Non-existence of monopole)

④ electric field

⑤ Red, orange Blue, Gold

⑥ $R/2$

⑦ (111)

⑧ ⓐ Statement / $\phi = q/\varepsilon_0$

ⓑ $\phi = \dfrac{q_{inside}}{\varepsilon_0}$

$= \dfrac{q_1 + q_2 + q_4}{\varepsilon_0}$

$= \dfrac{(5 + ^-3 + 5) \times 10^{-9}}{8.85 \times 10^{-12}}$

$= 0.79 \times 10^{3} \text{ V/m}$

⑨ Ni — Std. resistance coil

Current density — Vector

Semi conductor — Ge
— Si

Resistivity

⑩ ⓐ $\oint \vec{E} \cdot \vec{dl} = \mu_0 \Sigma I$

ⓑ $I_{enclosed} = I + ^-I = 0$

∴ $\int \vec{E} \cdot \vec{dl} = 0$

⑪ ⓐ Nature and conc^n of electrolyte
surface area of rod
distance between rod

⑪ⓑ (11b) $\dfrac{E}{\gamma}$

⑫ ⓐ para

ⓑ Two properties

⑬ ⓐ $\vec{F} = q(\vec{v} \times \vec{B})$

ⓑ True. (only direction of $\vec{p}$ changes)

⑭ ⓐ It is the heat energy dissipated in one second

ⓑ when p.d is applied, charges are moving through the conductor under the action of electric field, kinetic energy also increases. The charge particles moves with a steady drift velocity due to collision. During collisions, the energy will be shared with atoms and they vibrate vigorously. Thus conductor heats up.

⑮
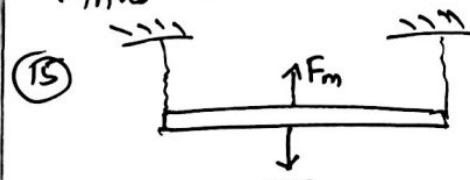
For No tension,
$mg = F_m$

$mg = I\,lB$

$B = \dfrac{mg}{Il} = \dfrac{60 \times 10^{-3} \times 9.8}{5 \times 0.45} = 0.261\,T$

(16) (a)
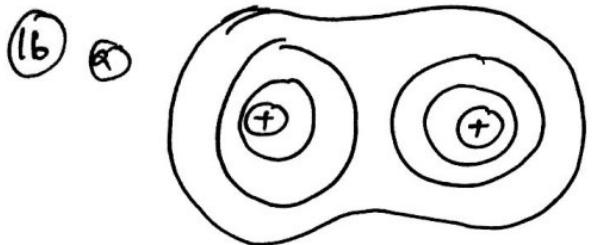
(b) W = 0

potential inside is the same everywhere.

(17) (a) $U = -MB\cos\theta$

(b) $\theta = 0$

(18) (a)(i) $j = \sigma E$

(b)

$$R = \frac{AB}{BC}$$

$$= \frac{0.6 - 0.4}{0.3 - 0.2}$$

$$= \frac{0.2}{0.1} = 2\Omega$$

(19)
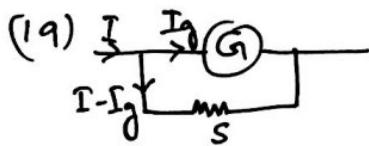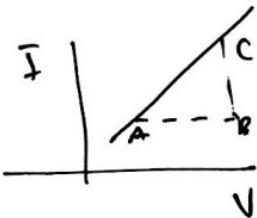
By connecting a low resistance in parallel to Galvanometer, we can convert Galvanometer to Ammeter

$$I_g R_G = (I - I_g)S$$

$$\boxed{S = \frac{I_g R_G}{I - I_g}}$$

(20) (a) $\vec{F}_{12} = \frac{1}{4\pi\varepsilon} \frac{q_1 q_2}{r_{12}^2} \hat{r}_{12}$

$\vec{F}_{21} = \frac{1}{4\pi\varepsilon} \frac{q_1 q_2}{r_{21}^2} \hat{r}_{21}$

(b) For equilibrium

$$\frac{q_1}{r_1^2} = \frac{q_2}{r_2^2}$$

$$\frac{q_1}{x^2} = \frac{q_2}{(r-x)^2}$$

$$8\times10^{-9}(40-x)^2 = 2\times10^{-9} \times x^2$$

$$4(40-x)^2 = x^2$$

$$2(40-x) = x$$

$$80 - 2x = x$$

$$3x = 80$$

$$x = 80/3 = 26.67 \text{ cm from } q_1$$

(21) (a) Derivation $C = \frac{\varepsilon A}{d}$

(b) decreases

$E = \frac{\sigma - \sigma_p}{\varepsilon_0} = \frac{\sigma}{\varepsilon \varepsilon_r}$

(22) (a) dip, declination, B_H

(b) $\tan\theta = \frac{B_V}{B_H} = 1 \Rightarrow \theta = 45°$

(23) (a) Derivation $E = \frac{\sigma}{2\varepsilon_0}$

(b) $E_A = 0$

$$E_B = \frac{\sigma_1}{2\varepsilon} - \frac{\sigma_2}{2\varepsilon}$$

$$= \frac{\sigma}{2\varepsilon} - \frac{-\sigma}{2\varepsilon}$$

$$= \frac{\sigma}{\varepsilon_0}$$

$$= \frac{17\times10^{-22}}{8.85\times10^{-12}} = 1.92\times10^{-10} \text{ V/m}$$

(24) (a) proof of Wheatstone's principle

(b) $R_3 = \frac{R_1}{R_2} \times R_4 = \frac{3}{2} \times 6 = 9\Omega$

(25) (a) Derivation, $\tau = MB\sin\alpha$

$= NIAB\sin\theta$

(b) $F = 0$

(c) parallel (plane of coil)

26) (a) Derivation, $V = \dfrac{1}{4\pi\varepsilon} \dfrac{q}{r}$

b) $V = 50x^2 + 36y^2$

$E_x = -\dfrac{\Delta V}{\Delta x}$ $= -50 \times 2x$

$= -100x$

$= -100 x^{-1}$

$= 100 \, V/m$

$E_y = \dfrac{-\Delta V}{\Delta y} = -36 \times 2y$

$= -72 \times 3$

$= -216 \, V/m$

$E_z = 0$

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(27) (a) circuit diagram

(b) $I = \dfrac{E}{R_1 + R_2} = \dfrac{6}{10 + R}$.

for wire, $V = IR_1$

$= \dfrac{6}{10+R} \times R = \dfrac{60}{10+R}$

potential gradient, $\phi = \dfrac{V}{l}$

$= \dfrac{60}{(10+R) \times 500}$

p.d across $l_1 = 250$ is,

$V_1 = \phi l_1$

$= \dfrac{60}{(10+R)500} \times 250$

$= \dfrac{30}{10+R}$

Since 1V is balanced at 250

$1 = \dfrac{30}{10+R}$

$10 + R = 30$

$R = 20\,\Omega$

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(28) (a) Series Combination.

(b) $\dfrac{1}{C} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + \dfrac{1}{C_3}$

(c) $C = \dfrac{\varepsilon_0 A}{d} = 8 \times 10^{-12} \, F$

$d' = d/2$

$k = 6$

$C' = \dfrac{\varepsilon_0 A \times K}{d'}$

$= \dfrac{\varepsilon_0 A}{d/2} k$

$= 2k \times C$

$= 2 \times 6 \times 8 \, pF$

$= 96 \, pF$

(29) (a)
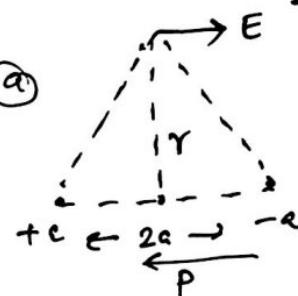
(b) Derivation $E_{eq} = \dfrac{1}{4\pi\varepsilon} \dfrac{P}{r^3}$.

(c) $180°$

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