

Q1) $A = \pi r^2$ r_2 decrease

$A_1 = \pi r_1^2$ $r_2 = \frac{1}{2} r_1$

$A_2 = \pi r_2^2 = \frac{\pi r_1^2}{4} = \frac{A_1}{4}$

$I = ne v_d A$

$v_d = \frac{I}{ne A_1}$

$v_{2d} = \frac{I}{ne A_2} = \frac{I \cdot 4}{ne A_1}$

$v_{2d} = 4 v_d$ $\frac{P \propto v^2}{\text{if } v \propto 4, P \propto 16}$ $v_{2d} = \frac{1}{4} v_d$

Q2) $P = \frac{W}{t}$ $R = 3 \times 10^3 \Omega$
 $V = 20V$

$W = Pt = \frac{V^2}{R} t$ $t = 10 \text{ min}$

$W = \frac{20^2}{3 \times 10^3} \times 60 = 80J$

$W = 80J$

Q3) $\rho = 1.5 \times 10^{-6} \Omega m$
 $A = 3 \times 10^{-6} m^2$

$R = \rho \frac{l}{A}$

$\frac{R}{l} = \frac{\rho}{A} = \frac{1.5 \times 10^{-6}}{3 \times 10^{-6}} = 0.5 \Omega/m$

$\frac{R}{l} = 0.5 \Omega/m$

Q4) $A = 9 \times 10^{-4} m^2$ ($I = 3A$)
 $E = 120V/m$

$\rho = \frac{R A}{l} = \frac{V A}{I l}$

$\rho = \frac{V}{l} \frac{A}{I} = E \frac{A}{I} = 120 \frac{9 \times 10^{-4}}{3}$

$\rho = 0.036 \Omega m$

Q5) internal resistance

$\mathcal{E} = 12V$ $r = 1 \Omega$
 $R = 5 \Omega$

$\mathcal{E} = I R_{net}$ $R_{net} = 5 + 1$

$I = \frac{\mathcal{E}}{R_{net}} = \frac{12}{6} = 2A = 6 \Omega$

$V_R = 2 \times 5 = 10V$

$V_r = 2 \times 1 = 2V$
 $(12V)$

Q6) $\alpha = 3.9 \times 10^{-3}$

$\alpha = \frac{\Delta R}{R_0 \Delta T}$

$\Delta T = \frac{\Delta R}{R_0 \alpha} = \frac{27.3}{50 \times 3.9 \times 10^{-3}} = 140$

$T_2 = \Delta T + T_1 = 140 + 20 = 160^\circ C$

Q7) $I_5 + I_{10} = I_3$

$1 + I_{10} = I_3 \rightarrow \textcircled{1}$

$20 - 5 = 8I_3 + 5I_5$

$3 \cdot 18 = 8I_3 + 5I_5$

$I_3 = 3 - I_5 = 3 - 1 = 2A$

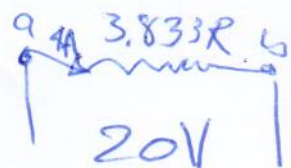
$I_{3 \Omega} = 2A$

Q8) \checkmark $0.333R$ $3R$ $0.5R$ 6

$V = I R_{net}$

$20 = 4 \times 3.833R$

$R = \frac{20}{15.333} = 1.3 \Omega$



Q9) $P = 1.6 \times 10^{-19}$ $m = 1.67 \times 10^{-27}$ kg

$$\frac{m v^2}{R} = q v B$$

$$\frac{v}{R} = \omega = \frac{q B}{m}$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi m}{q B}$$

$$B = \frac{2\pi m}{q T} = \frac{2\pi \times 1.67 \times 10^{-27}}{1.6 \times 10^{-19} \times 5 \times 10^{-6}}$$

$$B = 13.1 \text{ mT}$$

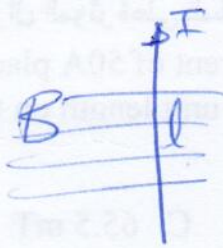
Q10) $R = \frac{m v}{q B}$

Q11) $F = l I B$

$$\frac{F}{l} = I B$$

$$B = \frac{F/l}{I} = \frac{4}{50}$$

$$B = 80 \text{ mT}$$



Q12) velocity selector

$$q E = q v B$$

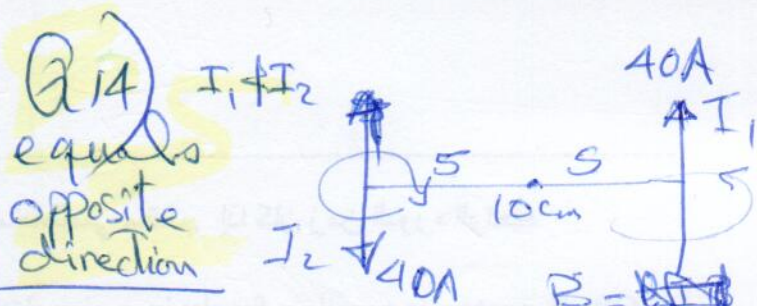
$$v = E/B$$

Q13) $l = 2 \text{ m}$ $n = 500/\text{m}$ $B_c = 31.4 \text{ mT}$

$$B_c = \mu_0 n I$$

$$I = \frac{B_c}{\mu_0 n} = \frac{31.4 \times 10^{-3}}{4\pi \times 10^{-7} \times 500}$$

$$I \approx 50 \text{ A}$$



$$B_{\text{center}} = B_1 + B_2$$

$$= 2 \frac{\mu_0 I}{2\pi a}$$

$$= 2 \frac{4\pi \times 10^{-7} \times 40}{2\pi \times 5 \times 10^{-2}}$$

$$B_c = 320 \text{ mT}$$

Q15)

$$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi a}$$

$$a = 10 \text{ cm}$$

$$= \frac{4\pi \times 10^{-7} \times 40^2}{2\pi \times 10 \times 10^{-2}} = 3.2 \text{ mN/m}$$

$$\frac{F}{l} = 3.2 \text{ mN/m}$$