Assignment 5 Solutions

1. $i = 45\ \mu A$

$= 45 \times 10^{-6}\ C/s = \frac{\Delta Q}{\Delta t}$

$\therefore \Delta Q = i \Delta t$

$= 45 \times 10^{-6}\ C/s \cdot 35\ s$

$= 1.575 \times 10^{-3}\ C$

$\#\ electrons = \frac{\Delta Q}{|q_e|} = \frac{1.575 \times 10^{-3}}{1.6 \times 10^{-19}}$

$= 9.84 \times 10^{15}$

2. $q = 4t^3 + 5t + 6$

a) $i = \frac{dq}{dt} = 12t^2 + 5$

$i(1.00\ s) = 12(1.00)^2 + 5$

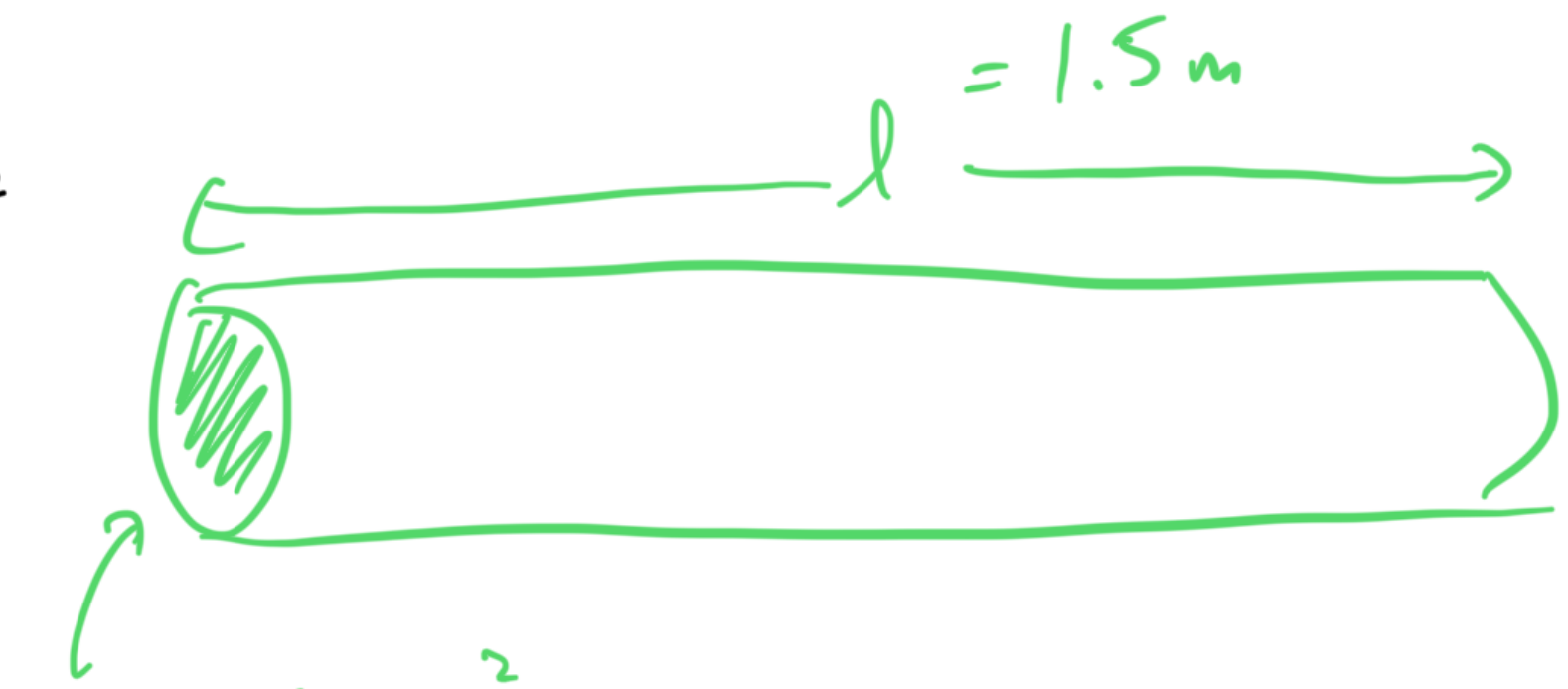
$= 17\ A$

b) $j = \frac{i}{A} = \frac{17\ A}{2.06 \times 10^{-4}\ m^2}$

$= 8.25 \times 10^4\ A/m^2$

$= 82.5\ kA/m^2$

3.



$A = 0.6\ mm^2$

$= (0.6)(.001\ m \times 0.001\ m)$

$= 6 \times 10^{-7}\ m^2$

for tungsten

$R = \rho \frac{l}{A} = \frac{(5.6 \times 10^{-8}\ \Omega \cdot m)(1.5)}{6.0 \times 10^{-7} m^2}$

$= 0.14\ \Omega$

$\Delta V = iR \qquad i = \frac{\Delta V}{R} = \frac{0.5\ V}{.14\ \Omega}$

$= 3.57\ A$

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4. Toaster

800 W @ 240 V

a) $P = i\,\Delta V$

$\therefore i = P/\Delta V = \frac{800\ W}{240\ V}$

$= 3.33\ A$

b) $P = \frac{\Delta V^2}{R} = i\,\Delta V = i^2 R$

$P = i^2 R$

$R = P/i^2 = \frac{800}{(3.33)^2}$

$= 72\ \Omega$

or

$P = (\Delta V)^2/R$

$R = \frac{(\Delta V)^2}{} = \frac{(240)^2}{}$

$$\frac{\quad}{P} \qquad 800$$

$$= \underline{\underline{72\,\Omega}}$$

5.

Situation 1

$\Delta V = 120V$

$P = 100W$

$$P = \frac{\Delta V^2}{R} \rightarrow R = \frac{\Delta V^2}{P}$$

$$= \frac{(120)^2}{100}$$

$$\boxed{R = 144\,\Omega}$$

This will not change!!

Situation 2

$\Delta V = 140V$

$$P = \frac{\Delta V^2}{R} = \frac{(140)^2}{144}$$

$$P = 136.1\,W$$

136.1 W

$\therefore$ 100 W → 136.1 W

$\therefore$ 36.1 % increase.

Alternate clever method:

$P = \frac{\Delta V^2}{R}$ $\therefore$ $P \sim \Delta V^2$

$\therefore \quad \frac{P_2}{P_1} = \frac{(\Delta V_2)^2}{(\Delta V_1)^2} = \left(\frac{140}{120}\right)^2$

$= 1.361$

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6. a) 12 V battery

53.0 A·hr.

Consider 1 hour:

$i = 53.0$ A will exhaust the battery.

$P = iV = (53.0)(12)$

$= 636$ W

1 hr. ↓

$P = E/t \quad \therefore \quad E = P \cdot t$

$(\quad)(3600\,s)$

$= (636)(\ldots)$

$= \underline{\underline{2.29 \times 10^6 \text{ J}}}$

What is 1 kW.hr.

$1 \underbrace{\text{kW}}_{1000\ \frac{J}{s}} . \overbrace{\text{hr}}^{3600\,s} = 3.6 \times 10^6 \text{ J}$

$\therefore E = \dfrac{2.29 \times 10^6 \text{ J}}{3.6 \times 10^6 \text{ J}/\text{kWhr}}$

$= 0.636 \text{ kW.hr.}$