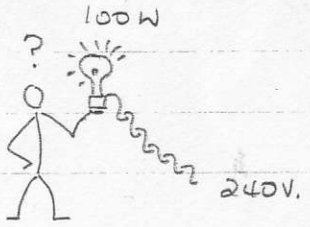
Basic Electricity (1)

AS Physics

.... charge, current, voltage, power, energy, resistance



formulas

$Q = It$

or work $E = QV = ItV$

$P = IV$

$V = IR$

1. a) How much energy does the bulb convert to heat and light in 2 min? (2)

b) What is the current in the bulb? (2)

c) How many electrons pass through the bulb in 1 second? (2)

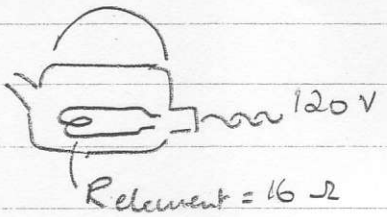
d) What is the bulb's resistance? (2)

Data

electron charge $e = -1.6 \times 10^{-19}$ C.

$C = 3 \times 10^8$ m/s = speed of light.

2. This kettle is to be used on the continent where the mains supply is 120V.



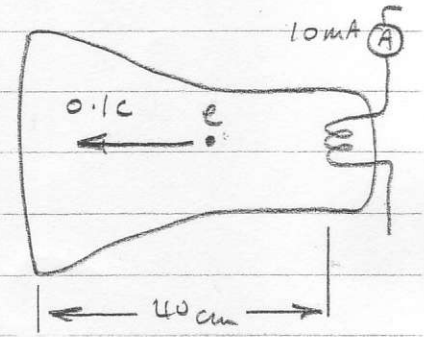
a) What is the current in the kettle? (2)

b) Show that power $P = V^2/R$, and use this to find the kettle power (2)

c) What charge flows through the kettle in 5 min.? (2)

d) How much heat energy does the kettle produce in 5 min? (2)

3 The diagram shows the latest widescreen digital TV (with Fastext and stereo sound.) A current of 10mA supplies electrons, which are fired at the screen at 10% of the speed of light.



a) Convert a 10 mA current into C/s. (2)

b) How many electrons are "used" to watch a 90 minute football match? (3)

c) How long does it take an electron to reach the screen? (2)

4 A 12V car battery has 2 headlamps connected in parallel, and 2 sidelamps, also connected in parallel. The battery sends a current of 5A through each headlamp, and 0.5A through each sidelamp.

a) draw the circuit diagram for this (3)

b) In 20 minutes how much charge passed through each headlamp, (c) each side lamp, (d) the battery? (5)

5 A cassette player needs a current of 0.4A, and a power of 0.4W. How many 1.5V cells are needed, and in series or parallel? (4)

Basic Electricity – Answers!

AS Physics

1a 1 W = 1 J/s ① so... 100 W = 100 J/s = 100 × (2×60) J in 2 mins = 12,000 J ①

b. $I = P/V$ ① $= 100/240 = 0.42$ ① A ← 0.4167 in Memory. !!

c. No. electrons = 0.42 A = 0.42 C/s = $0.42/1.6\times10^{-19} = 2.6\times10^{18}$ ① electrons/sec

d) $R = V/I$ ① $= 240/0.42 = 576$ ① Ω (or 571 Ω for I = 0.42)

[8]

2. a) $I = V/R$ ① $= 120/16 = 7.5$ ① A

b) $P = IV$ ① $= V/R \times V$ (Since $I = V/R$) ① $= V^2/R$ ① (or I^2R .... think about it!)

So $P_{kettle} = V^2/R = 120^2/16 = 900$ ① W

c) $Q = It$ ① $= 7.5 \times (5\times60) = 2250$ ① C

d) Energy $E = QV$ ① $= 2250 \times 120 = 270{,}000$ J $= 270$ kJ $= 2.7\times10^5$ J ①

└ or $E = I t V$.

3. a) 10 mA = 10 mC/s $= 10/1000$ C/s $= 0.01$ C/s ①

b) No. electrons "used" in 1 sec $= 0.01/1.6\times10^{-19} = 6.25\times10^{16}$ ①

So in 90 mins $= 90\times60$ ① s

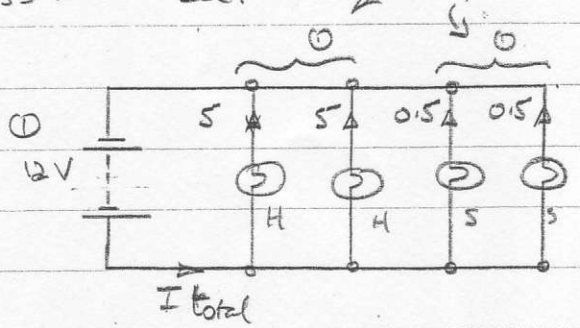
you use $6.25\times10^{16} \times (90\times60) = 3.38\times10^{20}$ ① electrons

c) use $D = V\times T \Rightarrow T = D/V$ ① $= \frac{0.4 \text{ m}}{3\times10^7}$ ← in m!

$= 1.33\times10^{-8}$ ① sec.

4. a) circuit diagram. ← in parallel

H = headlamp S = Sidelamp



/3

b) $Q_{headlamp} = It$ ① $= 5\times20\times60 = 6000$ ① C

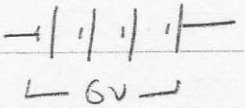
c) Q Sidelamp $= 0.5\times20\times60 = 600$ ① C

d) $Q_{battery} = Q_{total} = (2\times6000) + (2\times600) = 12000 + 1200$ ① $= 13200$ ① C

(or... $Q_{total} = I_{total} \times 20\times60 = 11$ ① $\times 20\times60 = 13{,}200$ ① C) /5

5. use $P = IV \rightarrow V = P/I$ ① $= 2.4/0.4 = 6$ ① volts needed

So you need 4 ① × 1.5 cells in series ①



TLN

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