Half Unit Test

AS Physics – Unit 1 – Electricity 1/of 2

AS Physics

1. A current of 60 μA flows for 12 ms, driven by a p.d. of 25 V.

a) How much charge has flowed? (2)

b) How many electrons is this? (2)

c) How much energy has been produced as heat? (2)

d) What power is produced while the current flows? (2)

2. a) Is a filament bulb an Ohmic or a non-Ohmic device? Explain your answers. (3)

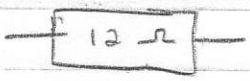
Sketch V/I graphs for

(b) an ldr in the light and dark states (3)

(c) a diode (3)

3. How does a solution of copper sulphate conduct current, compared to a metal? (4)

4. A 240 V mains shower has a 12 Ohm heating element in it.



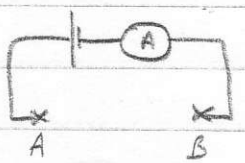
(a) What is the power of the shower? (2)

(b) What resistance would you need for a power of 3 kW? (2)

(c) The 12 Ohm element is made of resistance wire of 0.5 mm diameter. How long is the wire? (4)

d) What is the drift velocity of electrons in this wire when it is connected to 240 V? The metal has 5×10^{28} free electrons/m^3) (4)

5. a) A student connected a metal wire between A and B. and noted the current reading. She then heated the wire in a Bunsen flame, State and explain the change in current reading. (3)



(b) The student replaced the metal wire with a thermistor. (3)

State and explain the change in current on heating the thermistor.

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6. a) A Science Teacher puts a new 1.5 V cell in his minidisc player, circuit resistance 20 Ω. He plays his favourite garage and trance music for 2 hours, during which time the external cell p.d. drops steadily to 1.2 V. Sketch a graph to show how the current varies with time, and calculate the total charge passed. (6)

b) The teacher puts in a new type of cell, with an emf of 1.6 V and internal resistance 0.8 Ω. What is the terminal p.d. of this cell when it runs the minidisc player? (3)

c) How much thermal energy is dissipated in the cell in the first 5 minutes? (assume the internal resistance stays constant. (3)

Q... 1. /8 2. /9 3. /4 4. /12 5. /6 6. /12 Total /51

TLN 03.11

AS Physics – Unit – Unit 2 Test Answers 1/2

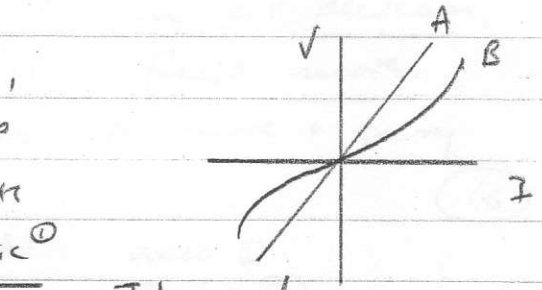
1. (a) $Q = It$ ① $= 60\times10^{-6} \times 12\times10^{-3} = 7.2\times10^{-7}$ ① C (b) $Q = \frac{7.2\times10^{-7}}{1.6\times10^{-19}}$ ① $= 4.5\times10^{12}$ ① electrons

(c) $E = QV$ ① $= It V = 7.2\times10^{-7} \times 25 = 1.8\times10^{-5}$ J

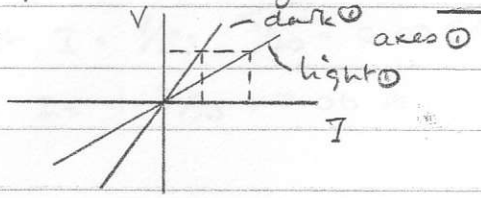
(d) $P = IV$ ① $= 60\times10^{-6} \times 25 = 1.5\times10^{-3}$ watts ①

/8

2. (a) An ohmic device has a constant R, so the V/I graph is linear ① A bulb does not have a constant R because its temperature changes – so it's non-ohmic ①

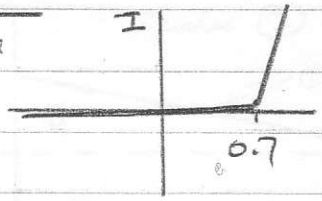


b) ldr



axes ①

(c) diode



- axes ①
- graph ①
- switch on pd = 0.7 ①

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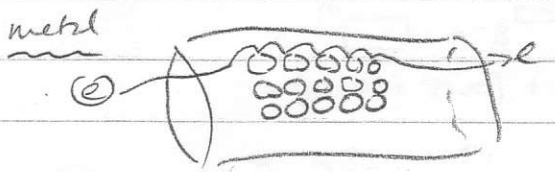
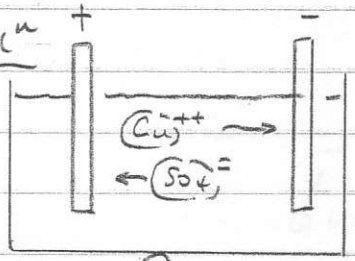
3. metal



each atom releases 1 "free" electron.

... electrons drift from atom (or ion) ① atom ... slowed down by atomic collisions.

$CuSO_4$ soln



+ and − charged ions ① move through solution to the oppositely charged electrode

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4. a) $P = IV = \frac{V}{R} \times V = \frac{V^2}{R}$ ① $= 4800$ ① W (or $I = V/R = 20$ A .... $P = IV = 4800$ W)

b) for 3 kW power ... $R = V^2/P$ ① $= 240^2/3000 = 19.2\ \Omega$ ①

(or $I = P/V = 3000/240 = 12.5$ A .... $R = V/I = 240/12.5 = 19.2\ \Omega$)

c) Use $R = \rho l/A$ ① Area $A = \pi r^2 = \pi \times (0.25\times10^{-3})^2$ ① $= 1.96\times10^{-7}$ ① m^2

So $l = RA/\rho = 12 \times 1.96\times10^{-7} / 1.2\times10^{-6} = 1.96$ m ①

d) drift velocity ... $I = nAve$ ① $\Rightarrow v = I/nAe$

see part (a) $= 20$ ① $/ 5\times10^{28} \times 1.96\times10^{-7} \times 1.6\times10^{-19}$ ① $= 0.013$ ① m/s

or 1.3×10^{-2} ms^{-1}

/12

Unit 1 Test – ½ Unit Test } Answers } 2/0f2

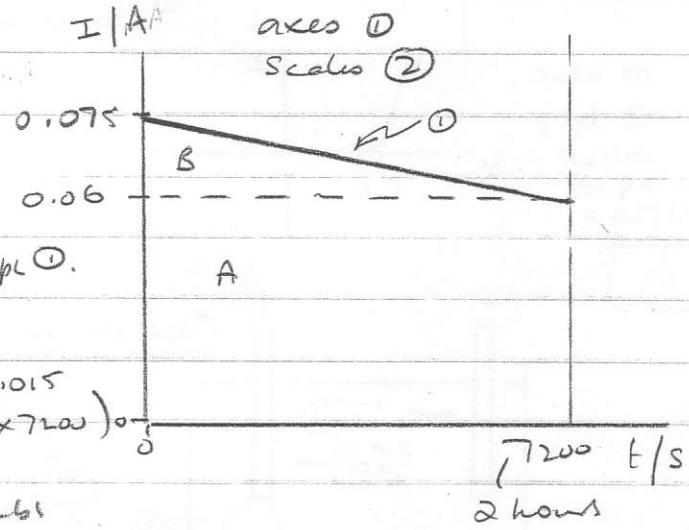
5. (a) The Current reading will decrease ①, because the resistance will increase ① because the metal atoms are vibrating more violently ①

(b) The current will increase ①, because Resistance will decrease ①, because the extra thermal energy has freed more electrons ① from their atoms to be able to move + carry current

(6)

6. a) Start $I = V/R = 1.5/20 = 0.075$ A

and $I = 1.2/20 = 0.06$ A



Charge passed = area under graph ①.

$= A + B$

$= (0.06 \times 7200) + \frac{1}{2}(0.015 \times 7200)$

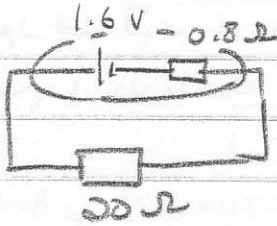
$= 432 + 54$

$= 486$ ① Coulombs

b) A "real" cell ... $E = IR + Ir$ ①

$1.6 = I(20 + 0.8)$

so $I = 0.0769$ ① A



So "lost" p.d. inside cell $= Ir = 0.0769 \times 0.8$

$= 0.0615$ V

So new cell terminal p.d. $= 1.6 - 0.0615$

$= 1.54$ V ①

c) Internal heat produced = power × t

$= IV \times t$ ①

$= 0.0769 \times 0.0615 \times 300$ ① (secs in 5 mins)

(p.d. across r internal)

$= 1.42$ ① Joules

TJN 03.11.