Neap:

PHYSICS VCE UNITS 1&2
DIAGNOSTIC TOPIC TESTS 2016

TEST 3: HOW DO ELECTRIC CIRCUITS WORK? (I)

SUGGESTED SOLUTIONS AND MARKING SCHEME

Question 1 (4 marks)

a. $Q = It$

$= (2.0 \text{ A})(2 \times 60 \text{ s})$

$= 240 \text{ C}$ 1 mark

b. $V = IR$

$R = \frac{12}{2}$

$= 6.0 \ \Omega$ 1 mark

c. $P = IV$

$= 2 \times 12$ 1 mark

$= 24 \text{ W}$ 1 mark

Question 2 (12 marks)

a. $2.0 \times 10^5 \text{ C s}^{-1}$ 2 marks

The current in amperes is actually the number of coulombs per second, which in this case is 200 kA, or $2.0 \times 10^5 \text{ C s}^{-1}$.

b. $Q = It$

$= (2.0 \times 10^5)(10 \times 10^{-3})$ 1 mark

$= 2000 \text{ C}$ 1 mark

Note: Consequential on answer to ***Question 2a.***

c. $1.2 \times 10^6 \text{ J C}^{-1}$ 2 marks

The voltage in volts is actually the number of joules per coulomb, which is 1.2 MJ (or 1.2 megajoule per coulomb).

d. $U = VQ$

$= (1.2 \times 10^6)(2000)$ 1 mark

$= 2.4 \times 10^9$ J 1 mark

Note: Consequential on answer to ***Question 2b.***

e. $P = IV$

$= (2.0 \times 10^5)(1.2 \times 10^6)$ 1 mark

$= 2.4 \times 10^{11}$ W

$= 2.4 \times 10^8$ kW 1 mark

f. Although there is a tremendous amount of electrical energy available in this lightning bolt (see part **e.**), there is no predicting when or where it will strike. 1 mark

Also, we do not have any method of harnessing all this energy, which is discharged in such a small time burst (10 milliseconds). 1 mark

Question 3 (13 marks)

a. circuit B 1 mark

The light globes are placed in series with each other and the battery.

b. 12 V 2 marks

Circuit A shows a parallel arrangement of the light globes, hence each light globe has the potential difference of the battery supply; that is, 12 V.

c. 4 V 2 marks

Circuit B is a series circuit. As each light globe is identical this is equivalent to three identical resistors placed in series with the battery. This means that the potential difference across each resistor will be 4 V.

d. $I = \dfrac{V}{R}$

$= \dfrac{12}{4}$ 1 mark

$= 3$ A 1 mark

e. The total resistance of the three light globes in series is 12 Ω.

$V = IR$

$I = \dfrac{12}{12}$ 1 mark

$= 1$ A 1 mark

f. $P = IV$

$= 1 \times 4$ 1 mark

$= 4$ W 1 mark

g. circuit A 1 mark

For each light globe in circuit A, the power is given by $P = IV = 3 \times 12 = 36$ W, whereas for each light globe in circuit B, the power is 4 W (see part **e.**). The amount of light is proportional to the output power of each globe. 1 mark

Question 4 (6 marks)

a. non-ohmic 1 mark

The graph of the electrical device does not follow a straight-line graph (straight-line graphs characterise ohmic devices). 1 mark

b. **C** 2 marks

The electrical device's resistance decreases as the current increases.

c. $I = 1.0$ A, $V = 10$ V

$P = IV$

$= 10 \times 1$ 1 mark

$= 10$ W 1 mark

Question 5 (10 marks)

a. series 1 mark

Each solar cell produces 1.2 V; by putting ten solar cells in series, a total potential difference of 12 V is obtained. 1 mark

b. $I = \frac{P}{V}$

$= \frac{960}{12}$ 1 mark

$= 80$ A 1 mark

c. 40 2 marks

Each module produces 2 A of current. Therefore, 40 modules will produce 80 A.

Note: Consequential on answer to ***Question 5b.***

d. total power in = total power out

$P = IV$

$I = \frac{960}{240}$ 1 mark

$= 4$ A 1 mark

e. energy produced in kW h = Pt

$= 0.96$ kW $\times$ 4 h 1 mark

$= 3.84$ kW h 1 mark