Neap:

PHYSICS VCE UNITS 1&2
DIAGNOSTIC TOPIC TESTS 2016

TEST 4: HOW DO ELECTRIC CIRCUITS WORK? (II)

TOTAL 45 MARKS (45 MINUTES)

Student's Name: _____ Teacher's Name: _____

Directions to students

Write your name and your teacher's name in the spaces provided above.
Answer all questions in the spaces provided.

Question 1 (16 marks)

Figure 1 shows the voltage versus current graph for two electrical components, P and Q.

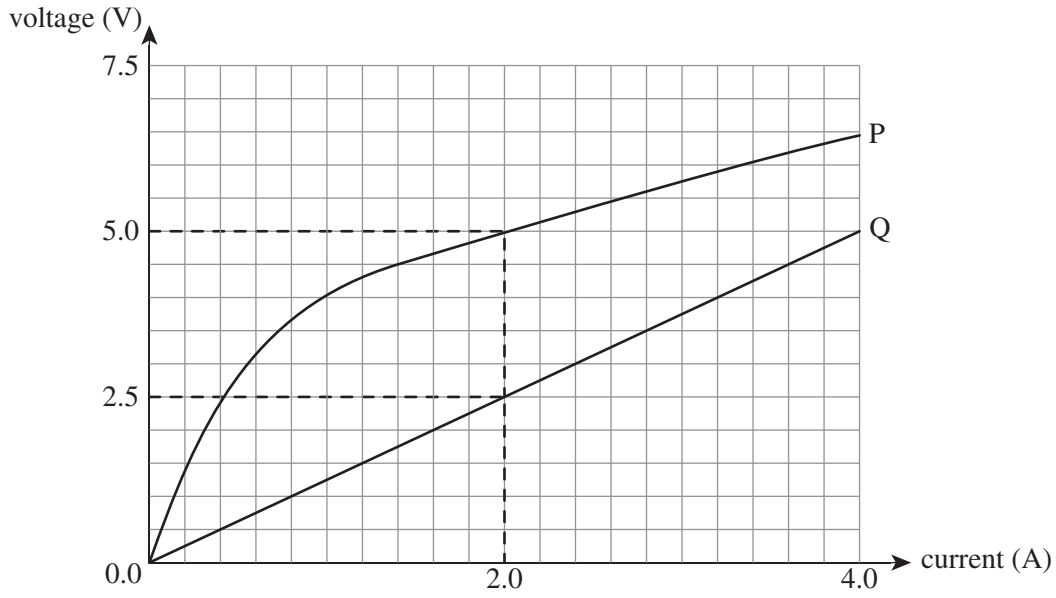

Figure 1

a. By examining the voltage versus current graph, determine which of the two electrical components, P or Q, demonstrates ohmic behaviour. Explain your answer. 2 marks

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The two electrical components P and Q are now placed in a series circuit powered by a variable DC voltage supply, as shown in Figure 2.

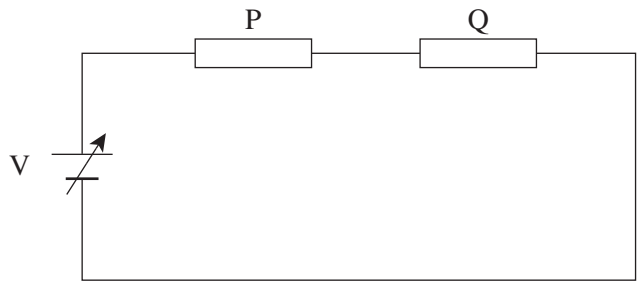

Figure 2

The current through component *P* is measured as 2.0 A.

b. Determine the current through component Q. 1 mark

A

c. Determine the potential difference across component P. 2 marks

V

d. Determine the potential difference across component Q. 2 marks

V

e. Determine the voltage supplied by the variable DC voltage source. 1 mark

V

f. Calculate the electrical power supplied by the variable DC voltage source. 2 marks

W

The electrical components P and Q are now placed in a parallel circuit and the variable DC voltage source is set to 5.0 V

g. Determine the current through component P. 2 marks

A

h. Determine the current through component Q. 2 marks

A

i. Calculate the electrical power supplied by the variable DC voltage source. 2 marks

W

Question 2 (2 marks)

A voltage divider circuit can be used to control electrical equipment. The general diagram for a voltage divider circuit is shown in Figure 3.

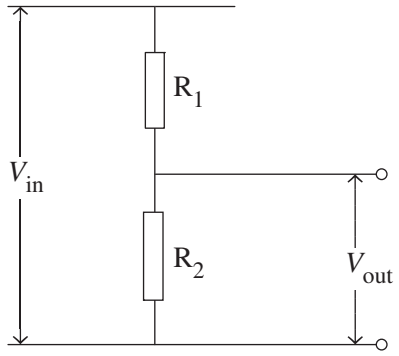

Figure 3

In a notebook computer the input voltage (V_{in}) to the voltage divider circuit is 18.0 V DC. An output voltage (V_{out}) of 5.0 V DC is required for the microprocessor. The value of R_1 is 26.0 kΩ.

Determine the value of R_2 in the voltage divider circuit.

kΩ

Question 3 (2 marks)

The following table shows the effect of the mains electricity (240 V AC, 50 Hz) acting for 0.5 s on the human body.

Current (mA)	Effect on the body
1.0	able to be felt
10	painful
20	muscles are paralysed – cannot let go
200	death likely

Explain why a current of 20 mA is so dangerous for yourself and other members of your family who are in the room and can see that you are being electrocuted.

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Question 4 (2 marks)

Figure 4 shows the graph of resistance (kΩ) versus illumination (lux) for an LDR used in security lighting.

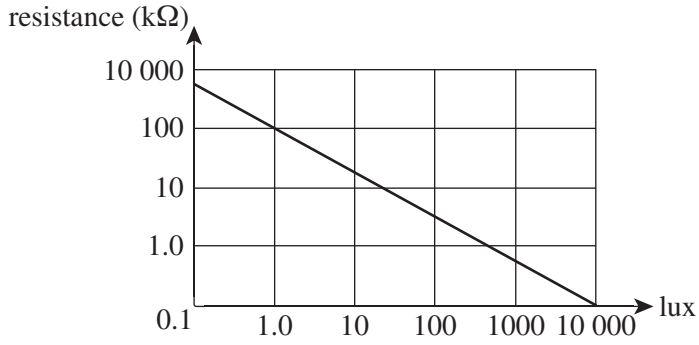

Figure 4

The LDR is placed in a circuit with a resistor as shown in Figure 5. If the voltage across DE ≥ 8.0 V, the security lights will turn on. The voltage across DF = 12.0 V.

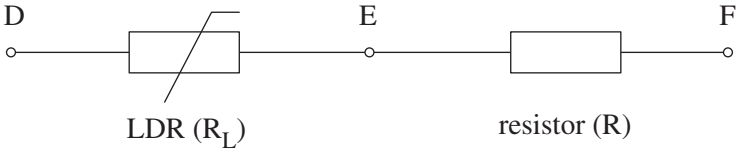

Figure 5

Calculate the value of the resistor R so that when the external light goes down to a value of 1 lux, the security lights turn on.

kΩ

Question 5 (2 marks)

Describe the energy transformations that occur in LEDs and photodiodes.

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Question 6 (6 marks)

Figure 6 shows two possible combinations of light globes and a 12 V battery. Each globe is identical and has a rated power of 24 W.

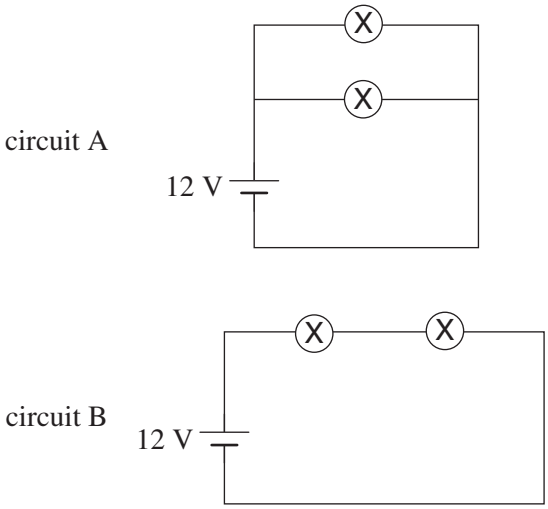

Figure 6

a. Calculate the resistance of one light globe in circuit A. 2 marks

Ω

b. Calculate the total resistance of the two light globes in circuit A. 2 marks

Ω

It is decided that one of these light combination circuits would be a useful circuit to have for car headlights.

c. Which circuit, A or B, would be useful circuit to have for car headlights? Explain your answer. 2 marks

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Question 7 (10 marks)

Figure 7 below shows a schematic circuit of a typical Australian 240 V household lighting circuit.

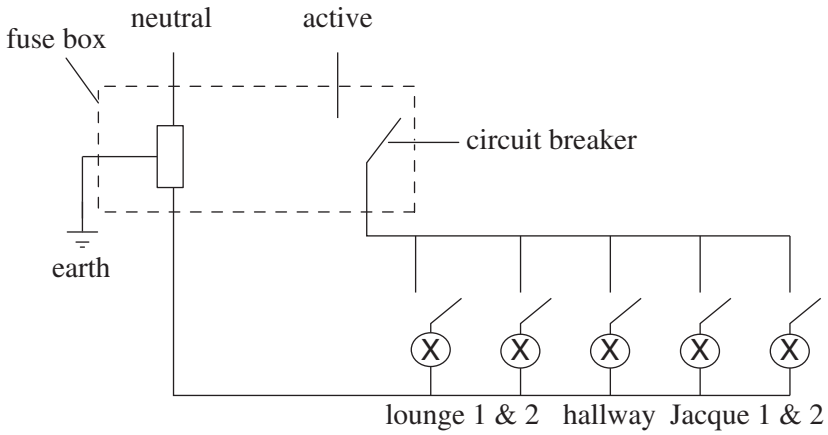

Figure 7

a. Explain why the circuit beaker is placed in the active side of the lighting circuit. 2 marks

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b. Explain the function of the circuit breaker found inside the fuse box. 2 marks

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c. Explain why the five lights are wired in parallel and not wired in series in the household circuit shown in Figure 7. 2 marks

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d. Do the light globes in this circuit have to be the same wattage? Explain your answer. 2 marks

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The circuit breaker is designed to trip when the current exceeds 10.0 A. Initially there are five light globes, each of a 120 W power rating.

e. Calculate the total current drawn by the light globes when they are all on. 2 marks

A

Question 8 (5 marks)

Jacque has two lights in his bedroom and a single general purpose power outlet (a single GPO) into which he has plugged his television. He decides, unwisely and illegally, to create an electrical connection between his metal-cased electric kettle and one of the light sockets. His electric kettle is rated at 2400 W. When he turns the kettle on to boil some water, both the light and the kettle stop working.

a. Explain, using calculations, why both the light and the kettle stop working. 2 marks

Jacque's father is extremely upset when he sees what Jacque has done by creating an electrical connection between the metal-cased electric kettle and the light socket, and says that Jacque was lucky he was not killed.

b. With reference to earthing, the metal-cased electric kettle and the illegal connection to the light socket, explain why Jacque's father was extremely upset. 3 marks