Neap

Trial Examination 2020

VCE Physics Unit 1

Written Examination

Question and Answer Booklet

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Student's Name: ______________________________

Teacher's Name: ______________________________

Structure of booklet

Section	*Number of questions*	*Number of questions to be answered*	*Number of marks*
A	10	10	10
B	16	16	80
			Total 90

Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, pre-written notes (one folded A3 sheet or two A4 sheets bound together by tape) and one scientific calculator.

Students are NOT permitted to bring into the examination room: blank sheets of paper and/or correction fluid/tape.

Materials supplied

Question and answer booklet of 20 pages

Formula sheet

Answer sheet for multiple-choice questions

Instructions

Please ensure that you write your **name** and your **teacher's name** in the space provided on this booklet and on the answer sheet for multiple-choice questions.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

All written responses must be in English.

At the end of the examination

Place the answer sheet for multiple-choice questions inside the front cover of this booklet.

You may keep the formula sheet.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

SECTION A – MULTIPLE-CHOICE QUESTIONS

Instructions for Section A

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

A correct answer scores 1; an incorrect answer scores 0.

Marks will **not** be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.

Take the value of g to be 9.8 m s^{-2}.

Question 1

Mia stirs her coffee with a metal spoon and notices that the spoon becomes warmer.

The method of heat transfer occurring is

A. evaporation.

B. conduction.

C. convection.

D. radiation.

Question 2

In an experiment, a 1.0 kg aluminium block is heated to 90°C. It is then dropped into 5.0 kg of water at 20°C. The specific heat capacity of water is 4200 J kg^{-1} K^{-1} and the specific heat capacity of aluminium is 880 J kg^{-1} K^{-1}.

Assuming no energy is transferred to the surrounding air or container, the final temperature of the aluminium block and water is closest to

A. 21°C

B. 23°C

C. 35°C

D. 55°C

Question 3

4.00 g of silver in liquid form solidifies at a constant temperature. The latent heat of fusion of silver is 1.05×10^5 J kg^{-1}.

How much energy is removed when this change is made?

A. 420 J

B. 2.60×10^4 J

C. 4.20×10^5 J

D. 2.60×10^7 J

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Question 4

According to Wien's Law, objects that have different temperatures emit spectra that peak at different wavelengths.

Which one of the following statements is correct?

A. Hotter objects emit most of their radiation at longer wavelengths; therefore, they appear more red than cooler objects.

B. Cooler objects emit most of their radiation at longer wavelengths; therefore, they appear more blue than hotter objects.

C. Hotter objects emit most of their radiation at shorter wavelengths; therefore, they appear more blue than cooler objects.

D. Cooler objects emit most of their radiation at shorter wavelengths; therefore, they appear more red than hotter objects.

Question 5

A battery supplies 4.5 J of energy to every 3.0 coulombs of charge that flow through it.

What is the voltage of the battery?

A. 0.7 V

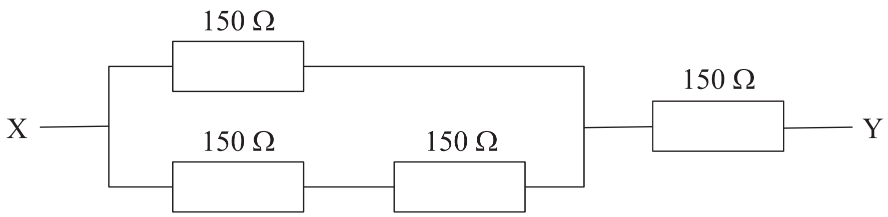
B. 1.5 V

C. 4.5 V

D. 13.5 V

Question 6

The diagram below shows an arrangement of four 150 Ω resistors.



The equivalent effective resistance between X and Y is

A. 150 Ω

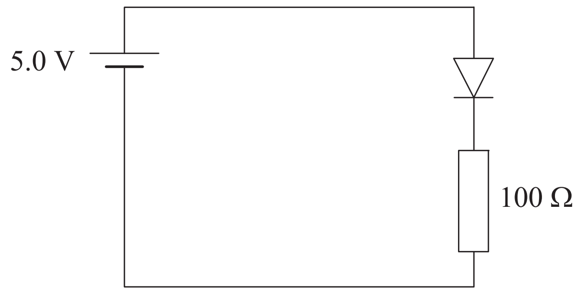
B. 200 Ω

C. 250 Ω

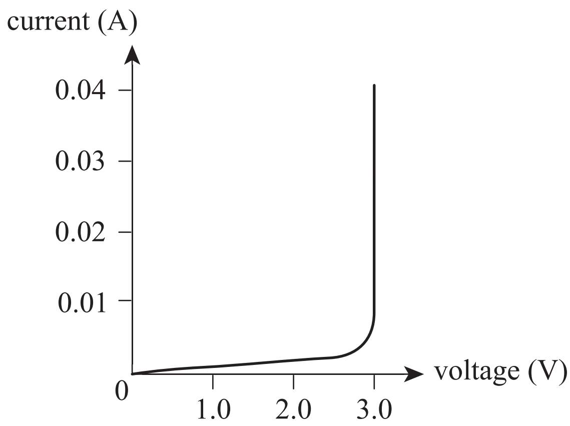
D. 300 Ω

Question 7

A light-emitting diode (LED) is connected in series with a 100 Ω resistor and a 5.0 V power supply, as shown in the diagram below.



The current versus voltage graph for the LED is shown below.



The current flowing through the 100 Ω resistor is

A. 10 mA

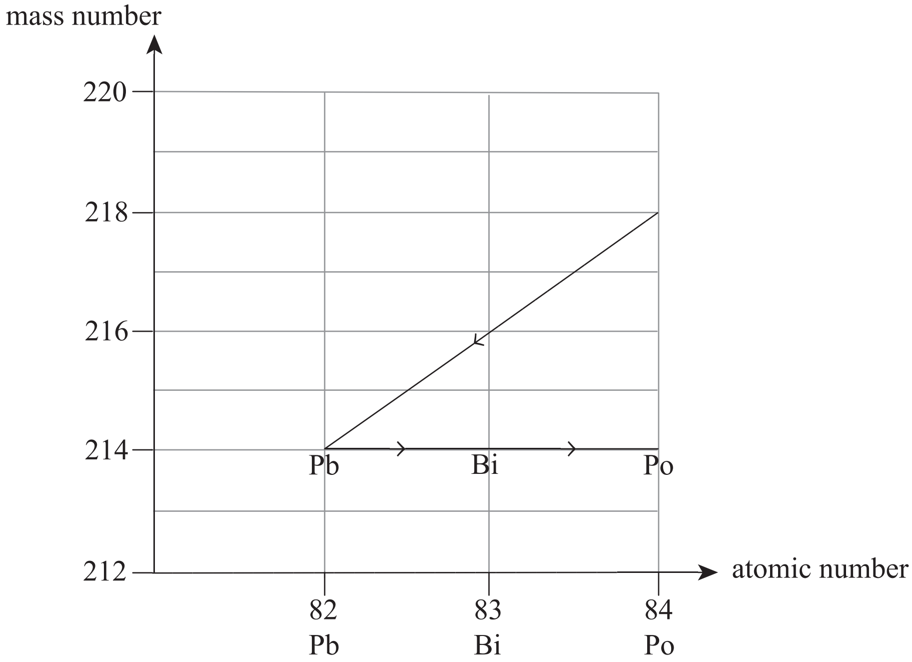
B. 20 mA

C. 30 mA

D. 50 mA

Question 8

The spontaneous nuclear decay of polonium-218 to polonium-214 that occurs during the decay series of uranium-238 into lead is shown in the graph below.



What is the order of the decay for polonium-218 to polonium-214?

A. α, α, β^-

B. α, β^-, β^-

C. β^-, β^-, α

D. $\beta^-, \beta^-, \beta^-$

Question 9

Consider the following nuclear transmutation.

$$^{27}_{13}\text{Al} + X \rightarrow ^{27}_{12}\text{Mg} + ^{1}_{1}\text{H}$$

What type of particle is X?

A. proton

B. beta particle

C. alpha particle

D. neutron

Question 10

Which one of the following is **not** considered to be one of the four observed fundamental forces?

A. weak nuclear force

B. strong nuclear force

C. dark matter force

D. electromagnetic force

END OF SECTION A

SECTION B

Instructions for Section B

Answer **all** questions in the spaces provided. Write using blue or black pen.
Where an answer box is provided, write your final answer in the box.
If an answer box has a unit printed in it, give your answer in that unit.
In questions where more than one mark is available, appropriate working **must** be shown.
Unless otherwise indicated, the diagrams in this booklet are **not** drawn to scale.
Take the value of *g* to be 9.8 m s^{-2}.

Question 1 (3 marks)

A 40g ice cube at –10°C is added to a 375ml glass of water initially at 19°C. Assuming no energy transfer to or from the surroundings, what will be the thermal equilibrium temperature of the combined substance at the end.

Specific Heat capacity of water = 4200 J/kg/K
Specific Heat capacity of ice = 2100 J/kg/K
Latent heat of fusion = 3.34 x 10^5 J/kg Latent Heat of Vaporisation= 2.25 x 10^6 J/kg

Question 2 (2 marks)

Rather than an open fireplace, some houses have a "wood heater". Wood heaters are more efficient than an open fireplace as they are typically made of a cast iron box with a glass door at the front so the fire can be seen. Explain the **main forms of heat transfer** that heat the room with reference to the importance of the cast iron box.

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Question 3 (5 marks)

Figure 1 shows a temperature (°C) versus energy removed (kJ) graph for 200 g of a substance that begins an experiment as a liquid and finishes as a solid. Energy is removed from the material at a constant rate.

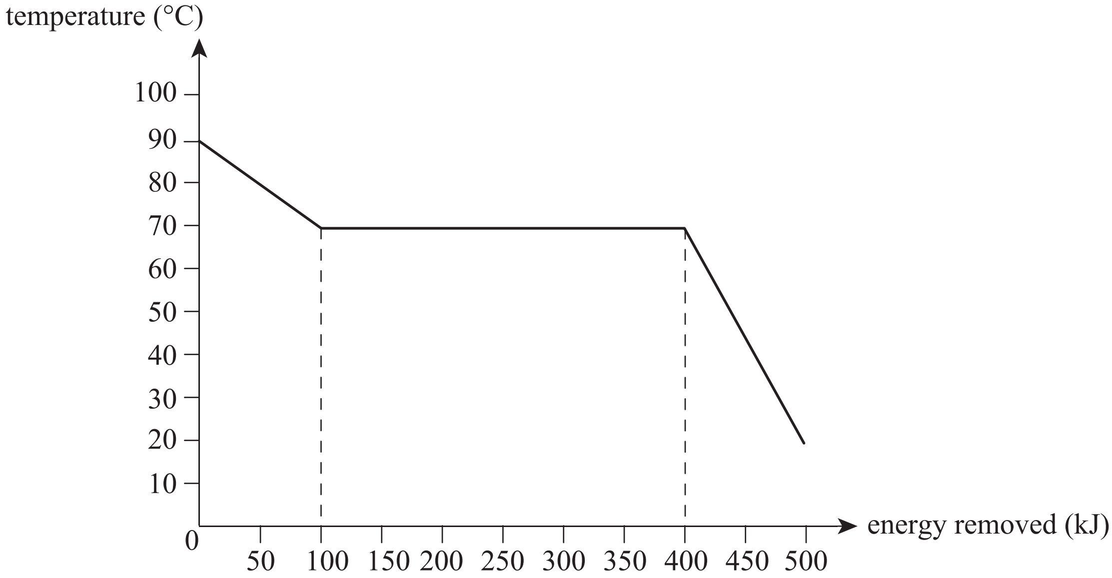

Figure 1

a. What happens to the substance when it reaches 70ºC? 1 mark

b. Calculate the latent heat of fusion of the substance. 2 marks

J kg^{-1}

c. Calculate the specific heat capacity of the substance when it is a liquid. 2 marks

J kg^{-1} K^{-1}

Question 4 (3 marks)

A system undergoes the following process:

Step 1: The system absorbs 70 J of heat while 35 J of work is done on it.

Step 2: The system absorbs 35 J of heat while performing 70 J of work.

a. Calculate the change in internal energy for the overall process. 2 marks

J

b. State whether there has been an increase, decrease or no change in the internal energy of the system. 1 mark

Question 5 (3 marks)

Aldebaran is a "red giant" star with a surface temperature of 3627° C.

Calculate Aldebaran's peak wavelength in **nanometers** and briefly explain if it would be ***visible*** by human eyes.

nm

Question 6 (4 marks)

a. Explain **how** greenhouse gases in the atmosphere **absorb** and **re-emit** infrared radiation, contributing to the natural greenhouse effect. 2 marks

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b. Explain how greenhouse gases produced by human activity, such as burning fossil fuels, contribute to the enhanced greenhouse effect. 2 marks

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Question 7 (4 marks)

Complete the table below with the properties of α, β^- and γ radiation using the following items.

heavy	~90% of *c*	high	none
−1	~10% of *c*	medium	+2

	α particle	**β^- particle**	**γ particle**
mass		light	
speed			speed of light
charge			no charge
penetration ability	low		

Question 8 (2 marks)

The Bismuth-211 nuclide indicated can undergo alpha OR beta $^{211}_{83}\text{Bi}$.

minus decay. Write the full decay equation for each of those.

Question 9 (3 marks)

a. Magnesium–23 decays via emission of a positron. Write the full decay equation for this.

b. Lead-210 emits a beta particle to become bismuth-210. Bismuth is an excited nucleus, denoted by an asterisk (*), and it goes on to emit a gamma ray.

Complete the decay equation below.

$$^{210}_{83}\text{Bi}^* \rightarrow \underline{\hspace{6cm}}$$

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Question 10 (11 marks)

Carbon-14 is a naturally occurring radioactive isotope of carbon. The half-life of carbon-14 is approximately 5700 (± 40) years. Carbon-14 undergoes beta decay to form the stable isotope nitrogen-14.

a. Write a decay equation for carbon-14 into nitrogen-14. 3 marks

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b. Complete the table below by filling in the missing values. Round the percentages to one decimal place. 3 marks

Years from present	0	5700	11 400					39 900
% ^{14}C	100.0							
% ^{14}N	0.0							

c. On Figure 2 below, sketch **one** curve showing the percentage of parent carbon-14 versus years, and **one** curve showing the percentage of daughter nitrogen-14 versus years. 4 marks

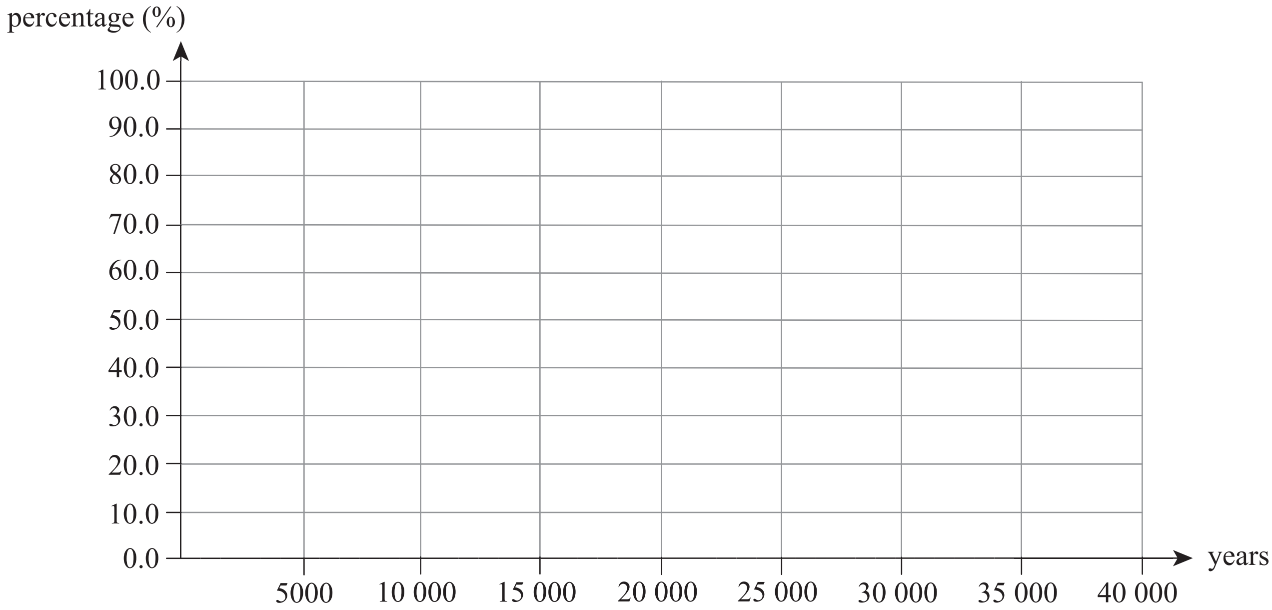

Figure 2

d. When the percentage for carbon-14 falls below 0.1%, it becomes very difficult to detect.

After approximately how many half-lives will the carbon-14 in an organic material become difficult to detect? 1 mark

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Question 11 (7 marks)

A lithium-7 nucleus consists of three protons and four neutrons. The table below shows the masses of a proton, neutron and lithium-7 nucleus.

Particle	**Mass**
proton	1.6726×10^{-27} kg
neutron	1.6749×10^{-27} kg
lithium-7 nucleus	1.1650×10^{-26} kg

a. Show that the lithium-7 nucleus is lighter than the sum of three protons and four neutrons by an amount of 6.7400×10^{-29} kg. 3 marks

b. State what happens to the difference of mass indicated in **part a.** 1 mark

c. Calculate the ***energy*** released due to the mass difference. 3 marks

MeV

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Question 12 (6 marks)

a. A student set up a circuit as shown in Figure 3.

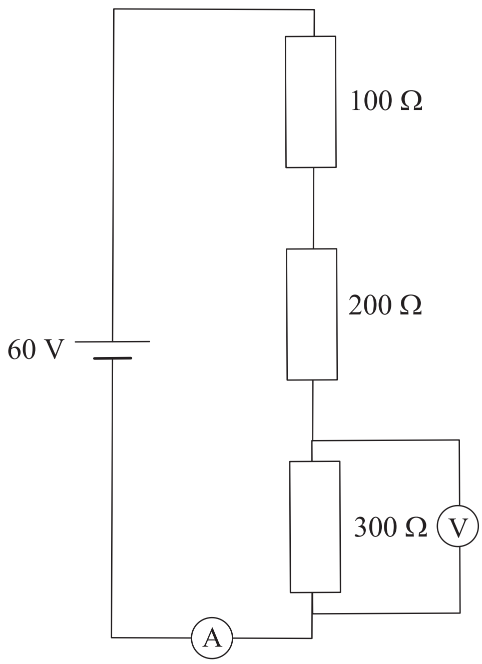

Figure 3

State the effective resistance, ammeter reading and voltmeter reading for the circuit shown above. 3 marks

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$R_T =$ Ω
$I_{ammeter} =$ mA
$V_{voltmeter} =$ V

b. The same student set up a circuit as shown in Figure 4.

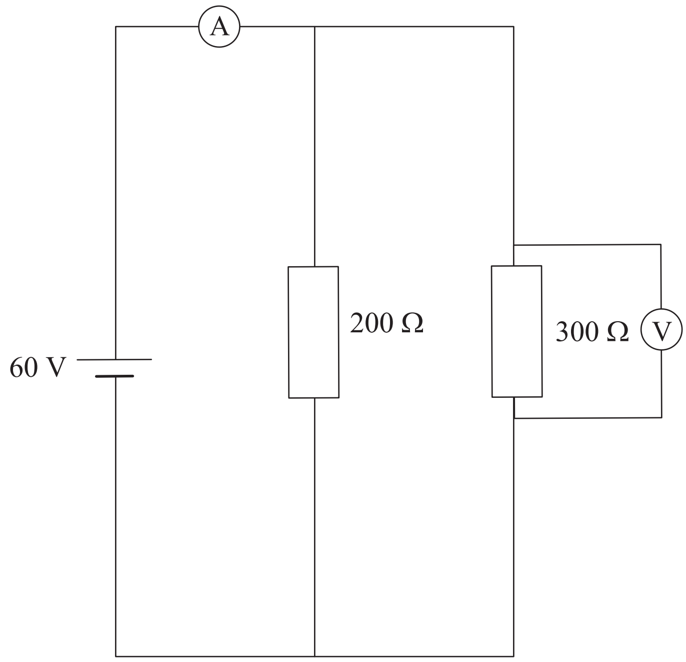

Figure 4

State the effective resistance, ammeter reading and voltmeter reading for the circuit shown above. 3 marks

R_T = Ω
$I_{ammeter}$ = mA
$V_{voltmeter}$ = V

Question 13 (11 marks)

Figure 5 shows a voltage divider circuit consisting of a 1000 Ω resistor and a variable resistor. The variable resistor can have any resistance from 0.0 Ω to 1000 Ω.

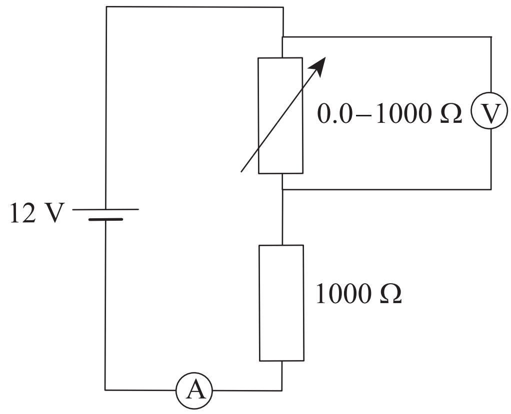

Figure 5

a. **i.** What is the minimum current possible, as measured by the ammeter? 2 marks

mA

ii. What is the maximum current possible, as measured by the ammeter? 2 marks

mA

b. **i.** What is the minimum voltage possible, as measured by the voltmeter? 1 mark

V

ii. What is the maximum voltage possible, as measured by the voltmeter? 2 marks

V

c. The voltmeter is removed, the variable resistor is set to 1000 Ω and a 1000 Ω resistor is placed across the variable resistor as shown in Figure 6 below.

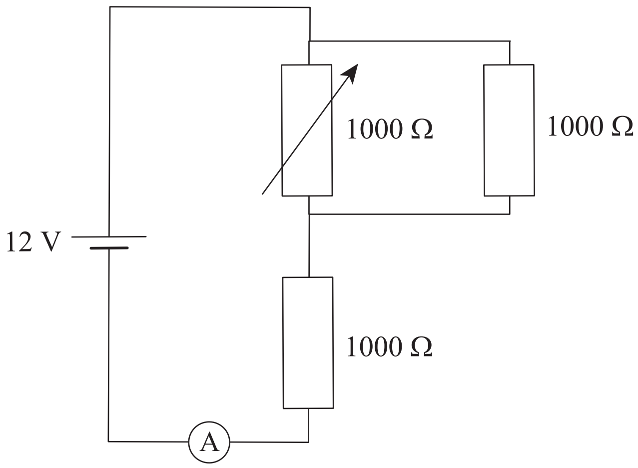

Figure 6

Calculate the current in the ammeter. 4 marks

mA

Question 14 (8 marks)

Amy is choosing between two new electrical components: component X and component Y. She has obtained a graph of their current–voltage (I–V) characteristics as shown in Figure 7.

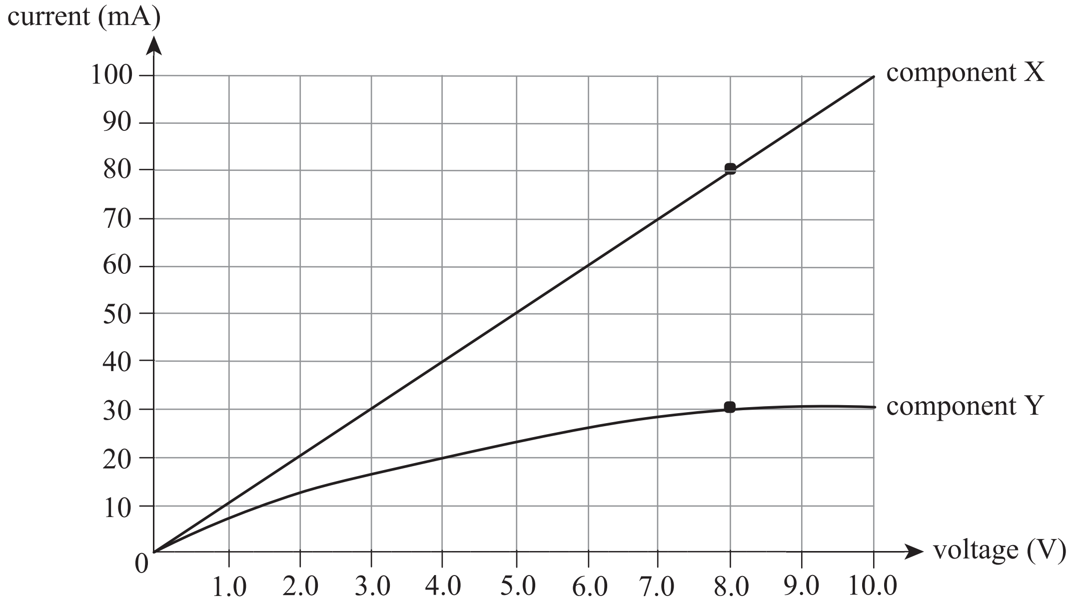

Figure 7

a . Components X and Y are connected in ***parallel*** with an **8 V DC power source**. State the current through EACH component . 2 marks

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b. Determine the e***ffective resistance*** of the circuit if components X and Y are connected in parallel as described. 2 mark

c. Later, components X and Y are connected **in series** with an **6 V DC** power source
.
i. Use the graph to determine the ***current*** and ***voltage*** through component Y with this circuit set up. (Do not calculate)

ii. Use the graph to determine the ***current*** and ***voltage*** through component X now.

4 marks

Question 15 (3 marks)

In Australia and New Zealand, metal toasters are required to have earth wires that are permanently connected to the metal case of the toaster.

a. State a hazard of a metal toaster that does not have an earth wire connected to the metal case. 1 mark

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b. **Explain** how your answer to **part a.** could result from the ***absence*** of an earth wire connected to the metal case. 2 marks

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Question 16 (5 marks)

At one point the cost of standard peak rate electricity in Victoria was 28 cents per kilowatt-hour (kWh).

a. How many joules does 1 kWh represent? 1 mark

J

b. A particular Victorian household used 3000 W of electric power during the two-hour peak rate period from 6.00 pm to 8.00 pm. Assume that the supply voltage was 240 V.

i. Calculate the total current flowing during that time period. 2 marks

A

ii. If the peak power rate use was consistent every night, what would the cost have been for a two-week period? Give your answer to the nearest cent. 2 marks

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END OF QUESTION AND ANSWER BOOKLET