TUTOR ZONE

Percentage	
Grade	

A Level Physics

Internal Resistance

Duration: 1 hour 30 min

Total Marks: 87

Information for Candidates:

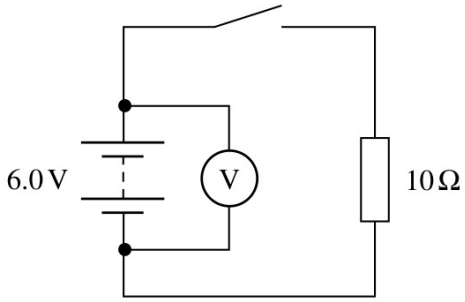
- Use black or blue ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional paper is used, the question number(s) must be clearly shown
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Do not write in this table	
Question	Mark
TOTAL	

box

7 A battery is connected to a 10 Ω resistor as shown in **Figure 2**. The emf (electromotive force) of the battery is 6.0 V.

Figure 2



7 (a) (i) Define the emf of a battery.

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(1 mark)

7 (a) (ii) When the switch is open the voltmeter reads 6.0 V and when it is closed it reads 5.8 V. Explain why the readings are different.

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(2 marks)

7 (b) Calculate the internal resistance of the battery.

answer = ... Ω
(3 marks)

7 (c) State and explain why it is important for car batteries to have a very low internal resistance.

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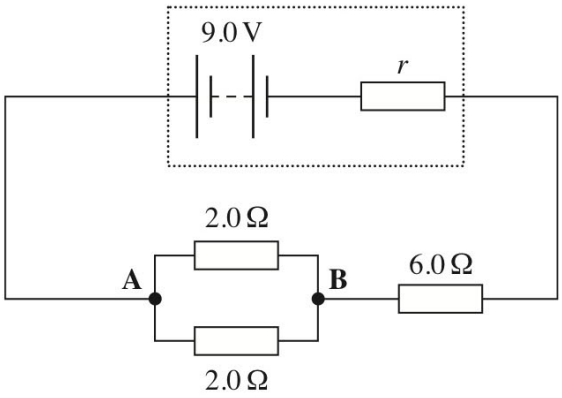
(2 marks)

8

END OF QUESTIONS

7 A battery of emf 9.0 V and internal resistance, r, is connected in the circuit shown in **Figure 2**.

Figure 2



7 (a) The current in the battery is 1.0 A.

7 (a) (i) Calculate the pd between points **A** and **B** in the circuit.

answer = ... V
(2 marks)

7 (a) (ii) Calculate the internal resistance, r.

answer = ... Ω
(2 marks)

7 (a) (iii) Calculate the **total** energy transformed by the battery in 5.0 minutes.

answer = ... J
(2 marks)

7 (a) (iv) Calculate the percentage of the energy calculated in part (iii) that is dissipated in the battery in 5.0 minutes.

answer..... %
(2 marks)

Question 7 continues on the next page

7 (b) State and explain **one** reason why it is an advantage for a rechargeable battery to have a low internal resistance.

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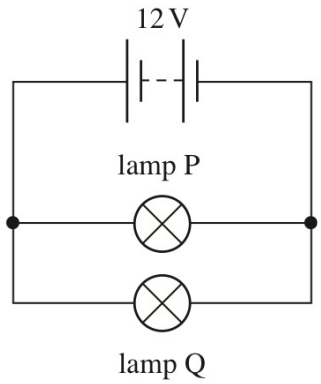
(2 marks)

10

END OF QUESTIONS

6 A battery of negligible internal resistance is connected to lamp P in parallel with lamp Q as shown in **Figure 2**. The emf of the battery is 12 V.

Figure 2



6 (a) Lamp P is rated at 12 V 36 W and lamp Q is rated at 12 V 6 W.

6 (a) (i) Calculate the current in the battery.

answer = ... A
(2 marks)

6 (a) (ii) Calculate the resistance of P.

answer = ... Ω
(1 mark)

6 (a) (iii) Calculate the resistance of Q.

answer = ... Ω
(1 mark)

6 (b) State and explain the effect on the brightness of the lamps in the circuit shown in **Figure 2** if the battery has a significant internal resistance.

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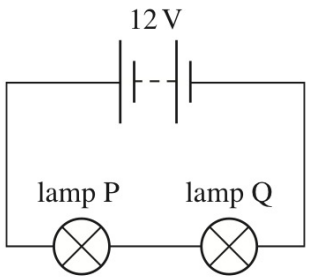
(3 marks)

Question 6 continues on the next page

6 (c) The lamps are now reconnected to the 12 V battery in series as shown in **Figure 3**.

Figure 3



6 (c) (i) Explain why the lamps will not be at their normal brightness in this circuit.

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(2 marks)

6 (c) (ii) State and explain which of the lamps will be brighter assuming that the resistance of the lamps does not change significantly with temperature.

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(3 marks)

12

Turn to page 14 for the next question

1 A student investigates how the power dissipated in a variable resistor, Y, varies as the resistance is altered.

Figure 1 shows the circuit the student uses. Y is connected to a battery of emf ε and internal resistance r.

Figure 1

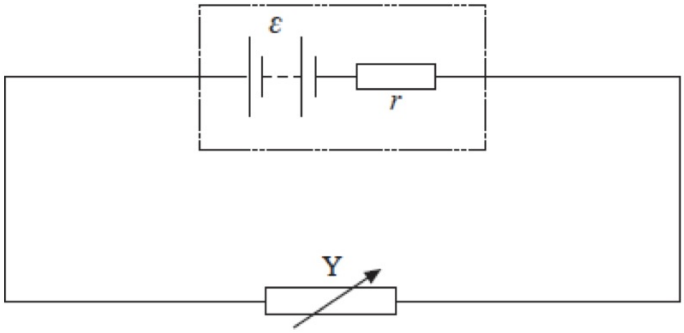
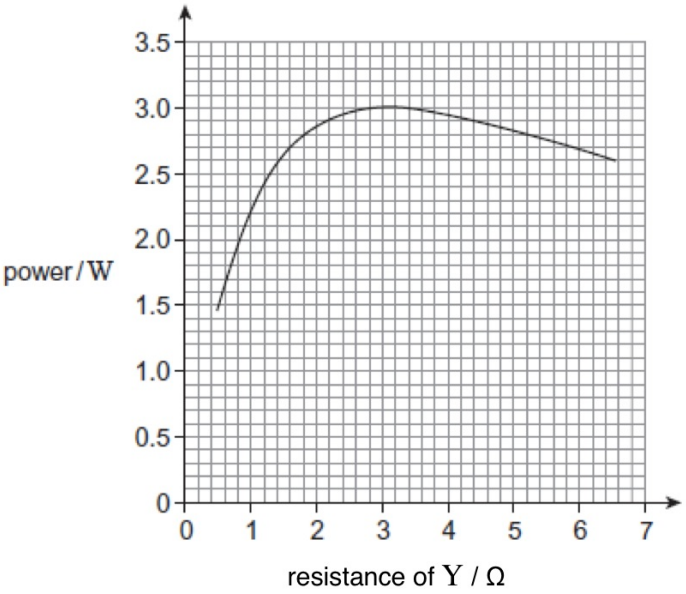


Figure 2 shows the results obtained by the student as the resistance of Y is varied from 0.5 Ω to 6.5 Ω.

Figure 2



(a) Describe how the power dissipated in Y varies as its resistance is increased from 0.5 Ω to 6.5 Ω.

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(2)

(b) The emf of the battery is 6.0 V and the resistance of Y is set at 0.80 Ω.

(i) Use data from **Figure 2** to calculate the current through the battery.

current ..... A

(3)

(ii) Calculate the voltage across Y.

voltage V

(2)

(iii) Calculate the internal resistance of the battery.

internal resistance ..... Ω

(2)

(c) The student repeats the experiment with a battery of the same emf but negligible internal resistance. State and explain how you would now expect the power dissipated in Y to vary as the resistance of Y is increased from 0.5 Ω to 6.5 Ω.

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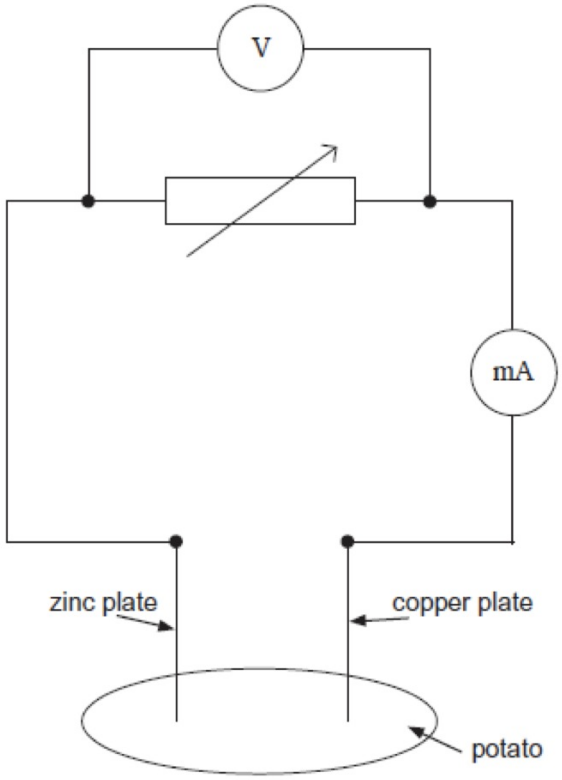
(3)
(Total 12 marks)

1 A 'potato cell' is formed by inserting a copper plate and a zinc plate into a potato. The circuit shown in **Figure 1** is used in an investigation to determine the electromotive force and internal resistance of the potato cell.

Figure 1



(a) State what is meant by electromotive force.

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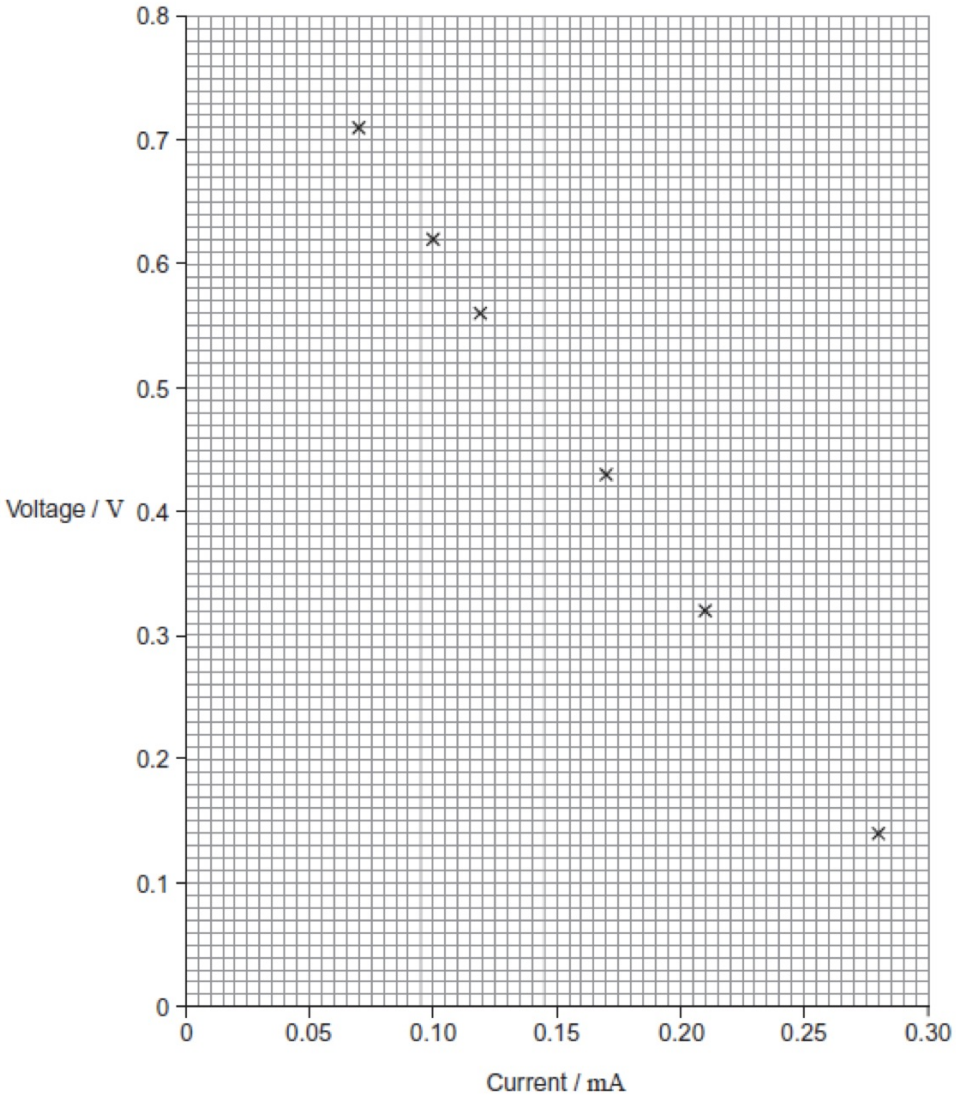
(2)

(b) The plotted points on **Figure 2** show the data for current and voltage that were obtained in the investigation.

Figure 2



(i) Suggest what was done to obtain the data for the plotted points.

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(1)

(ii) The electromotive force (emf) of the potato cell is 0.89 V. Explain why the voltages plotted on **Figure 2** are always less than this and why the difference between the emf and the plotted voltage becomes larger with increasing current.

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(3)

(iii) Use **Figure 2** to determine the internal resistance of the potato cell.

internal resistance = ... Ω

(3)

(c) A student decides to use two potato cells in series as a power supply for a light emitting diode (LED). In order for the LED to work as required, it needs a voltage of at least 1.6 V and a current of 20 mA.

Explain whether the LED will work as required.

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(2)
(Total 11 marks)

3 A cell is a source of e.m.f. When the cell is connected into a circuit the potential difference measured between its terminals, called the *terminal p.d.*, is less than its e.m.f.

(a) (i) Define the term *e.m.f.*

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..... **[2]**

(ii) Explain why the terminal p.d. is less than the e.m.f.

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..... **[2]**

(b) In the circuit of Fig. 3.1 the cell of e.m.f. 1.6 V and internal resistance *r* is delivering a current of 0.20 A to a resistor of resistance *R*. The voltmeter reads the terminal p.d. It is 1.2 V.

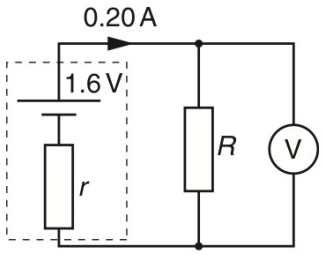

Fig. 3.1

Calculate the values of

(i) the resistance *R*

R = ... Ω **[2]**

(ii) the internal resistance *r*.

r = ... Ω **[2]**

(c) (i) The current in the resistor of Fig. 3.1 remains constant at 0.20 A for several hours. Calculate

1 the charge which passes through the resistor in 1.5 hours

charge = ... unit ..... **[3]**

2 the energy dissipated by the resistor in 1.5 hours.

energy = ... J **[2]**

(ii) The cell is left connected to the resistor for 12 hours. The graph of Fig. 3.2 shows the variation of current I with time t.

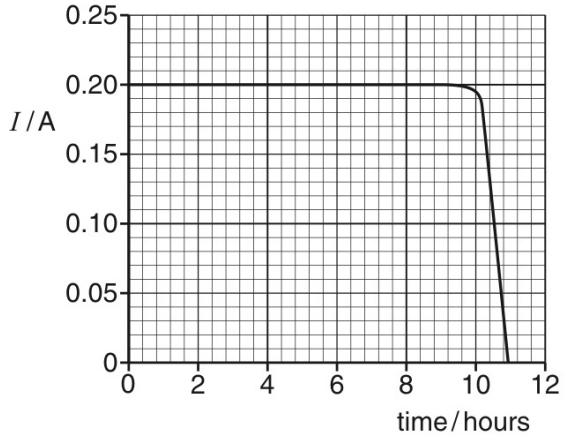

Fig. 3.2

Describe how the current varies with time. Suggest reasons why it varies in this way.

In your answer you should link each feature of the graph to the reason for it.

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..... **[4]**

[Total: 17]

4 Fig. 4.1 shows part of a circuit where three resistors are connected together.

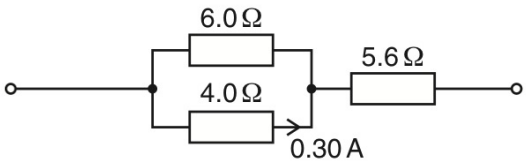

Fig. 4.1

The current in the 4.0 Ω resistor is 0.30 A.

(a) Explain why the current in the 6.0 Ω resistor is 0.20 A.

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..... **[2]**

(b) **(i)** State the law which enables you to calculate the current in the 5.6 Ω resistor.

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..... **[1]**

(ii) Calculate the current in the 5.6 Ω resistor.

current = ... A **[1]**

(c) Calculate the total resistance *R* of the combination of resistors.

R = ... Ω **[3]**

(d) To cause the current of 0.30 A in the 4.0 Ω resistor, the resistor combination is connected to a d.c. supply of electromotive force (e.m.f.) 5.0 V.

(i) Explain the term *e.m.f.*

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..... **[2]**

(ii) Show that the terminal potential difference across the supply is 4.0 V.

[1]

(iii) Calculate the internal resistance of the supply.

internal resistance = ... Ω **[2]**

[Total: 12]