Exampro A-level Physics (7407/7408)

PAL Prep

Xmas Break

Name:

Class:

Author:	Chella Nathan
Date:	
Time:	120
Marks:	90
Comments:	

Q1. Two resistors R_1 and R_2 are made of wires of the same material. The wire used for R_1 has half the diameter and is twice as long as the wire used for R_2.

What is the value of the ratio $\frac{\text{resistance of } R_1}{\text{resistance of } R_2}$?

A 8

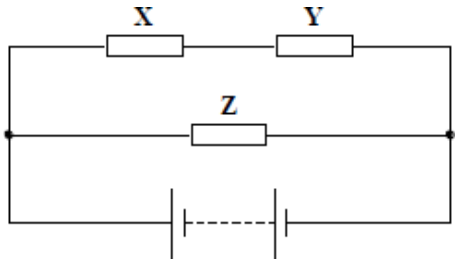
B 4

C 1

D 0.5

(Total 1 mark)

Q2. Three identical resistors **X**, **Y** and **Z** are connected across a battery as shown.



The ratio $\frac{\text{power developed in X}}{\text{power developed in Z}}$ is

A $\frac{1}{4}$

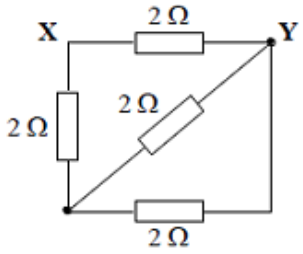
B $\frac{1}{2}$

C 1

D 2

(Total 1 mark)

Q3. The diagram shows a network of four 2 Ω resistors.



The effective resistance, in Ω, between **X** and **Y** is

A 0.5

B 1.2

C 1.7

D 2.0

(Total 1 mark)

Q4. The resistance of a metallic conductor increases with temperature because, at higher temperatures,

A more electrons become available for conduction

B the conductor becomes a superconductor

C the amplitude of vibration of lattice ions increases

D the length and cross-sectional area of the conductor both increase

(Total 1 mark)

Q5. In a cathode ray tube 7.5×10^{15} electrons strike the screen in 40 s. What current does this represent?

Charge of the electron is 1.6×10^{-19} C.

A 1.3×10^{-16} A ⬭

B 5.3×10^{-15} A ⬭

C 3.0×10^{-5} A ⬭

D 1.2×10^{-3} A ⬭

(Total 1 mark)

Q6. A 1.5 m length of wire has a cross-sectional area 5.0×10^{-8} m ^{2}. When the potential difference across its ends is 0.20 V, it carries a current of 0.40 A. The resistivity of the material from which the wire is made is

A 6.0×10^{7} Ω m

B 1.7×10^{-8} Ω m

C 1.1×10^{6} Ω m

D 9.4×10^{-7} Ω m

(Total 1 mark)

Q7. A cylindrical conductor of length l, diameter D, and resistivity ρ has a resistance R.

What is the resistance of another cylindrical conductor of length l, diameter $\frac{D}{2}$, and resistivity ρ?

A $8R$

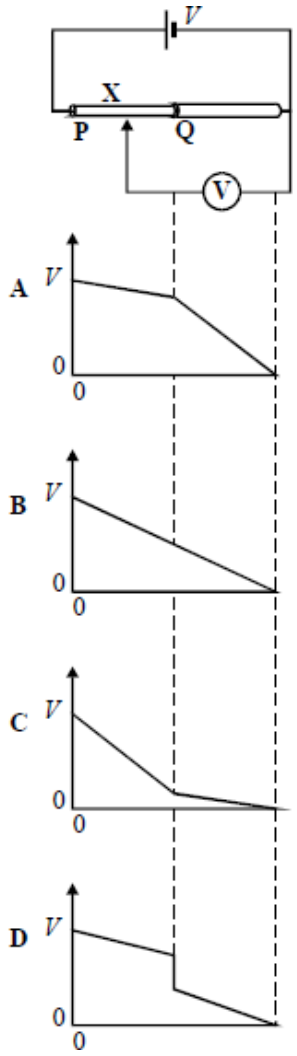
B $4R$

C $2R$

D R

(Total 1 mark)

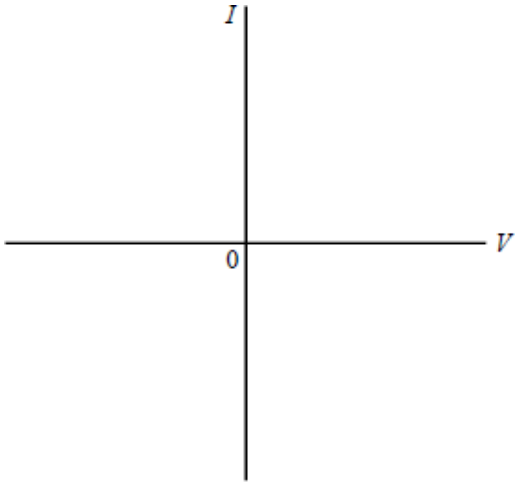
Q8. The diagram shows two wires, **P** and **Q**, of equal length, joined in series with a cell. A voltmeter is connected between the end of **Q** and a point **X** on the wires. The p.d. across the cell is V. Wire **Q** has twice the area of cross-section and twice the resistivity of wire **P**. The variation of the voltmeter reading as the point **X** is moved along the wires is best shown by



(Total 1 mark)

Q9. (a) Using the axes below, sketch the characteristic of a silicon semiconductor diode for forward bias and reverse bias.

Indicate approximate values on the voltage axis.



(4)

(b) Describe, with reference to the characteristic you have drawn, how the resistance of the diode changes with the voltage across the diode.

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(3)
(Total 7 marks)

Q10. (i) State what is meant by a superconductor.

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(2)

(ii) With reference to **two** uses for superconductors in today's world, explain the advantage of their use compared with conventional conductors such as copper.

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(3)
(Total 5 marks)

Q11. (a) The resistivity of a material in the form of a uniform resistance wire is to be measured. The area of cross-section of the wire is known.

The apparatus available includes a battery, a switch, a variable resistor, an ammeter and a voltmeter.

(i) Draw a circuit diagram using some or all of this apparatus, which would enable you to determine the resistivity of the material.

(ii) Describe how you would make the necessary measurements, ensuring that you have a range of values.

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(iii) Show how a value of the resistivity is determined from your measurements.

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(9)

(b) A sheet of carbon-reinforced plastic measuring 80 mm × 80 mm × 1.5 mm has its two large surfaces coated with highly conducting metal film. When a potential difference of 240 V is applied between the metal films, there is a current of 2.0 mA in the plastic. Calculate the resistivity of the plastic.

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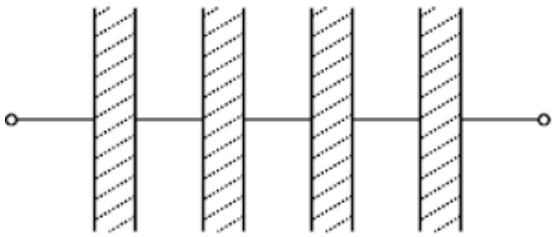
(3)

(c) If four of the units described in part (b) are connected as shown in the diagram, calculate the total resistance of the combination.



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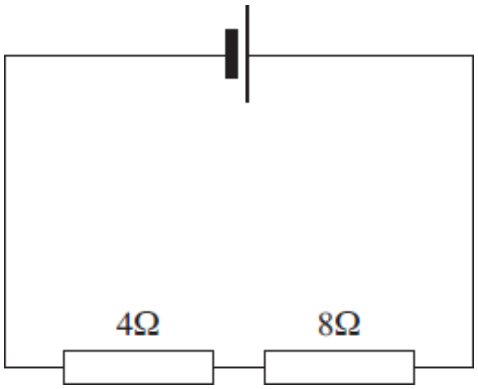
(2)

(Total 14 marks)

Q12. (a) The cell in **Figure 1** has an emf of 3.0 V and negligible internal resistance.

Figure 1



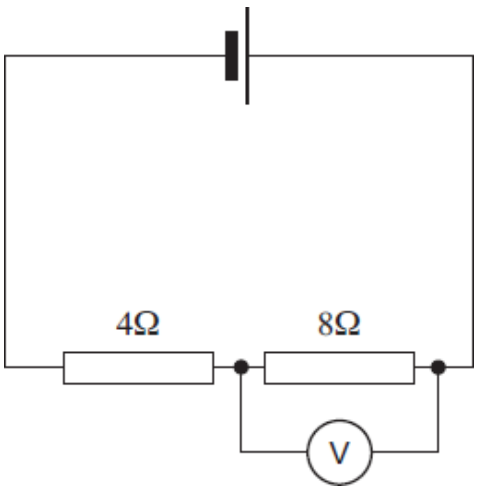
Calculate the potential difference across the 8 Ω resistor.

potential difference V

(2)

(b) **Figure 2** shows the same circuit with a voltmeter connected across the 8 Ω resistor.

Figure 2



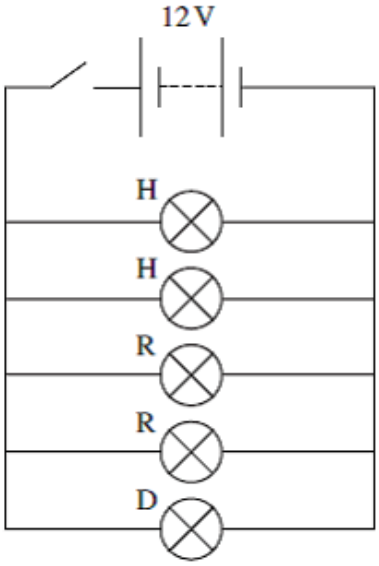
The voltmeter reads 1.8 V. Calculate the resistance of the voltmeter.

resistance .....Ω

(3)

(Total 5 marks)

Q13. The Figure below shows a simplified circuit for the main lights on a car. The battery has an emf of 12 V and no internal resistance.



The table below gives data about the lamps being used in the circuit. The resistances given are correct when the lamp is operating at its normal operating voltage.

LAMP	OPERATING VOLTAGE V	RESISTANCE Ω
H, headlight lamp	12	3.8
R, rear lamp	12	5.6
D, dashboard lamp	12	72

(a) (i) Calculate the power of a single headlight lamp when operating at 12 V.

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power ..... W

(2)

(ii) Calculate the resistance of the combination of lamps when operating at 12 V.

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resistance ..... Ω

(3)

(iii) Calculate the total power of the combination of lamps when operating at 12 V.

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power ..... W

(2)

(b) The battery is replaced with one of a lower emf. State and explain how the resistance of the lamps would have to change in order to achieve the same brightness.

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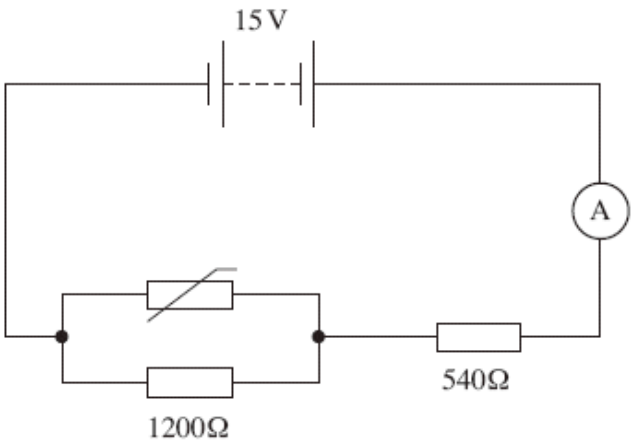
(2)
(Total 9 marks)

Q14. The circuit shown below shows a thermistor connected in a circuit with two resistors, an ammeter and a battery of emf 15V and negligible internal resistance.



(a) When the thermistor is at a certain temperature the current through the ammeter is 10.0 mA.

(i) Calculate the pd across the 540 Ω resistor.

answer = ... V

(1)

(ii) Calculate the pd across the 1200 Ω resistor.

answer = ... V

(1)

(iii) Calculate the resistance of the parallel combination of the resistor and the thermistor.

answer = ... Ω

(2)

(iv) Calculate the resistance of the thermistor.

answer = ... Ω

(2)

(b) The temperature of the thermistor is increased so that its resistance decreases. State and explain what happens to the pd across the 1200 Ω resistor.

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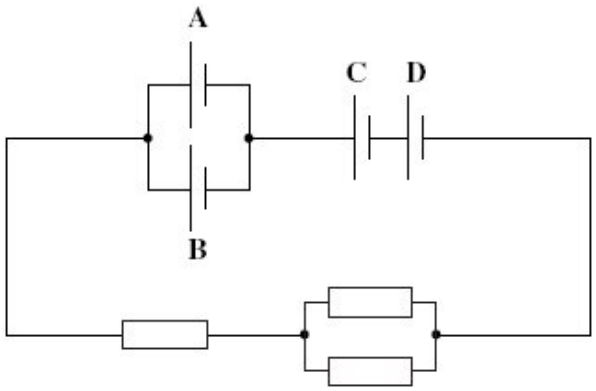
(3)
(Total 9 marks)

Q15. The circuit in the diagram below contains four identical new cells, **A**, **B**, **C** and **D**, each of emf 1.5V and negligible internal resistance.



(a) The resistance of each resistor is 4.0 Ω.

(i) Calculate the total resistance of the circuit.

answer = ... Ω

(1)

(ii) Calculate the total emf of the combination of cells.

answer = ... V

(1)

(iii) Calculate the current passing through cell **A**.

answer = ... A

(2)

(iv) Calculate the charge passing through cell **A** in five minutes, stating an appropriate unit.

answer = ...

(2)

(b) Each of the cells can provide the same amount of electrical energy before going flat. State and explain which two cells in this circuit you would expect to go flat first.

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(3)

(Total 9 marks)

Q16. (a) A set of decorative lights consists of a string of lamps. Each lamp is rated at 5.0 V, 0.40 W and is connected in series to a 230 V supply.

Calculate

(i) the number of lamps in the set, so that each lamp operates at the correct rating,

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(ii) the current in the circuit,

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(iii) the resistance of each lamp,

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(iv) the total electrical energy transferred by the set of lights in 2 hours.

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(5)

(b) When assembled at the factory, one set of lights inadvertently contains 10 lamps too many. All are connected in series. Assume that the resistance of each lamp is the same as that calculated in part (a) (iii).

(i) Calculate the current in this set of lights when connected to a 230 V supply.

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(ii) How would the brightness of each lamp in this set compare with the brightness of each lamp in the correct set?

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(3)
(Total 8 marks)

Q17. In each of the following circuits the battery has negligible internal resistance and the bulbs are identical.

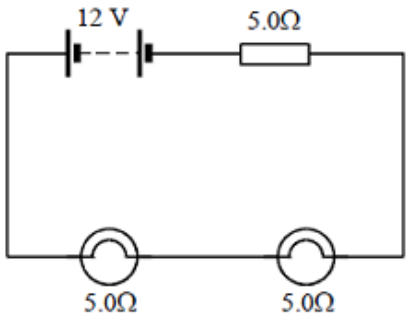

Figure 1

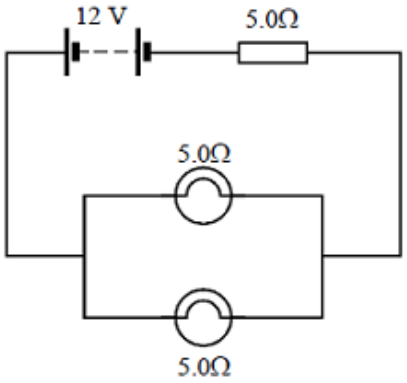

Figure 2

(a) For the circuit shown in **Figure 1** calculate

(i) the current flowing through each bulb,

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(ii) the power dissipated in each bulb.

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(2)

(b) In the circuit shown in **Figure 2** calculate the current flowing through each bulb.

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(3)

(c) Explain how the brightness of the bulbs in **Figure 1** compares with the brightness of the bulbs in **Figure 2**.

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(2)
(Total 7 marks)

Q18. (a) A student is given three resistors of resistance 3.0 Ω, 4.0 Ω and 6.0 Ω respectively.

(i) Draw the arrangement, using all three resistors, which will give the largest resistance.

(ii) Calculate the resistance of the arrangement you have drawn.

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(iii) Draw the arrangement, using all three resistors, which will give the smallest resistance.

(iv) Calculate the resistance of the arrangement you have drawn.

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(5)

(b) The three resistors are now connected to a battery of emf 12 V and negligible internal resistance, as shown in **Figure 1**.

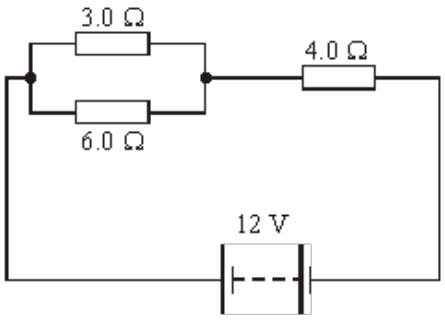

Figure 1

(i) Calculate the total resistance in the circuit.

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(ii) Calculate the voltage across the 6.0 Ω resistor.

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(4)
(Total 9 marks)