Physics

Question	Maximum Mark	Mark Awarded
#1	9	
#2	10	
#3	10	
#4	11	
#5	12	
#6	12	
#7	11	
#8	13	
#9	13	
#10	13	
#11	14	
#12	14	
#13	14	
#14	17	
#15	16	
Total	189	

created with

Question Bank

#1

4. *(a)* **Describe** how the resistance of a metal varies between 0K and 1000K.
[Assume that the metal is superconducting below a certain temperature.]
Account for this variation in resistance at higher temperatures. [6 QER]

(b) Superconductors are used in MRI scanners and particle accelerators. Consider which of these two applications has been of greater benefit to society. [3]

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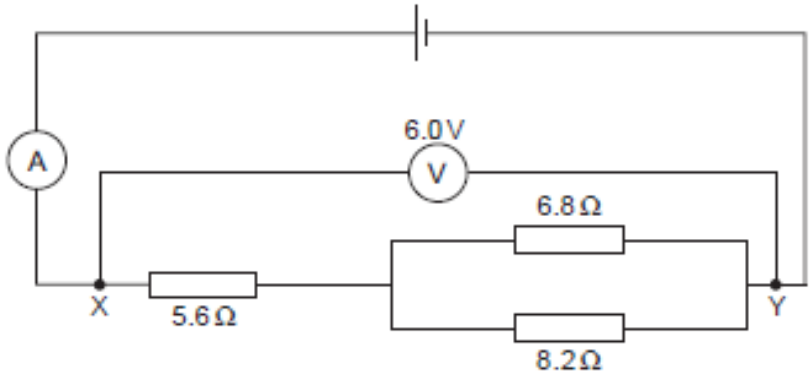
Question taken from Eduqas examination paper 842102, June 2019

#2

2. A circuit is set up as shown.



(a) In the circuit shown, the potential difference between X and Y is 6.0 V. Explain what this statement means. [2]

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(b) (i) Determine the reading on the ammeter if it has an instrument resolution of ± 0.01 A. [4]

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(ii) Calculate the potential difference across the 8.2 Ω resistor. [2]

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(iii) Calculate the power dissipated in the parallel resistor combination. [2]

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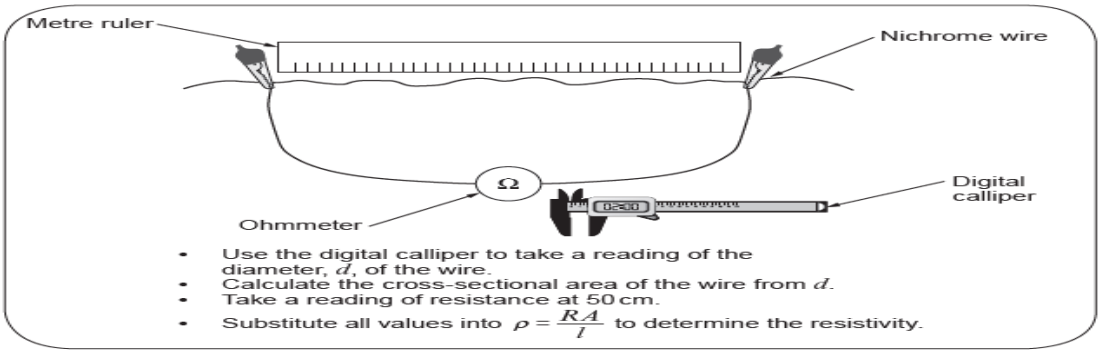
Question taken from Eduqas examination paper 842002, June 2018

#3

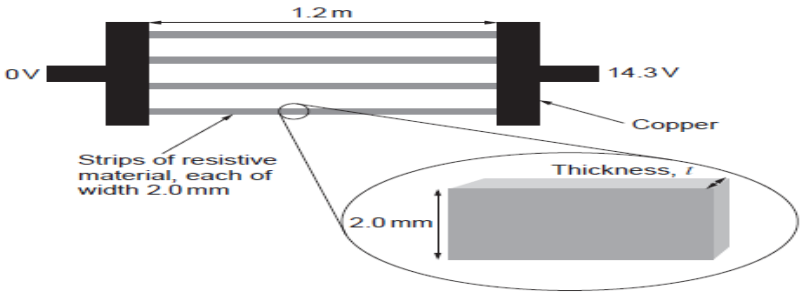
(a) Sally writes a plan for an experiment to determine the resistivity, ρ, of nichrome in a wire. Her outline plan, which includes a diagram of the apparatus is given below.



- Use the digital calliper to take a reading of the diameter, d, of the wire.
- Calculate the cross-sectional area of the wire from d.
- Take a reading of resistance at 50 cm.
- Substitute all values into $\rho = \frac{RA}{l}$ to determine the resistivity.

Sally's teacher believes the plan lacks detail, which might lead to an inaccurate value for ρ. Using the same apparatus, suggest improvements to the plan. You should include details of how to reduce the uncertainty in ρ using a graphical method. [6 QER]

(b) A heating unit proposed for the rear window of a car is to consist of four rectangular strips of resistive material, each of length 1.2 m and width 2.0 mm, joined at their ends by strips of copper of negligible resistance as shown. The unit must generate 45 W of heat when connected to a supply of 14.3 V.
Determine whether or not this can be done using a thickness, t, of approximately 0.2 mm for the metal strips.
[Resistivity of resistive material = $6.0 \times 10^{-6}\,\Omega\,m$] [4]



Question taken from Eduqas examination paper 842102, November 2020

#4

10. A silver ring on a light rod swings as a pendulum with damped simple harmonic motion. The damping is caused by a stationary magnet as shown in the diagram.

(a) Explain why the motion of the pendulum is damped. [4]

(b) Explain what, if anything, would happen to the motion of the pendulum if the bar magnet were reversed. [2]

(c) The resistivity of silver is $1.59 \times 10^{-8}\,\Omega\text{m}$, the radius of the silver ring is 2.5 cm and the cross-sectional area of the silver wire of the ring is $2.4 \times 10^{-5}\,\text{m}^2$. Show clearly that the resistance of the silver ring is approximately $0.1 \times 10^{-3}\,\Omega$. [2]

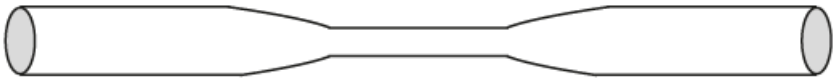
(d) The maximum current induced in the silver ring is 5.5 A. Calculate the maximum rate at which the magnetic flux density inside the ring changes. [3]

Question taken from Eduqas examination paper 842103, June 2018

#5

(a) Calculate the mean drift velocity of the free electrons in a wire, which has a diameter of 0.50 mm and carries a current of 2.8 A. Assume each aluminium atom contributes 3 free electrons, and there are 6.0×10^{28} atoms per m^3 of aluminium. [4]

(b) The wire is thinner in a small section as shown below.



Paula claims that within the thinner section the mean drift velocity of the free electrons will be greater. Evaluate whether she is correct. [3]

(c) (i) State what is meant by a superconductor. [1]

(ii) State and explain **one** advantage and **one** disadvantage of using superconductors to carry large currents. [4]

Advantage:

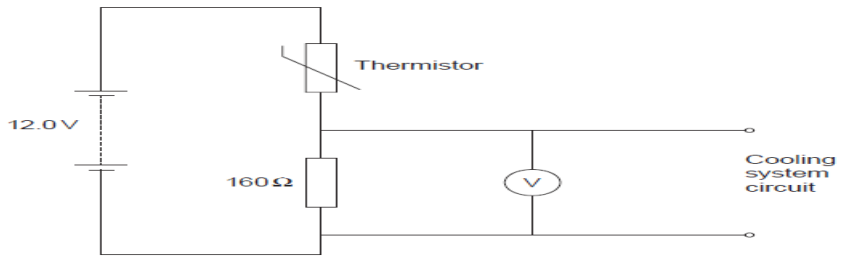
Disadvantage:

Question taken from Eduqas examination paper 842002, June 2017

#6

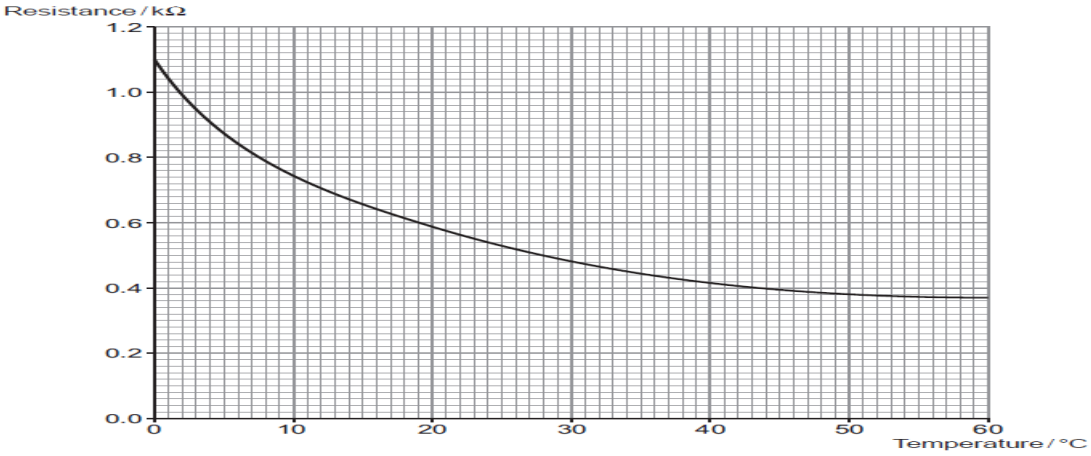
(a) Define the *potential difference* across two points in an electric circuit. [1]

(b) The diagram shows a possible control circuit for a cooling system. It consists of a battery of emf 12.0 V and negligible internal resistance connected in series with a thermistor and a 160 Ω fixed resistor. The voltmeter and cooling system circuit have very high resistances.



Calculate the resistance of the thermistor when the voltmeter reads 2.4 V. [3]

(c) The graph shows how resistance varies with temperature for this thermistor.



(i) The reading on the voltmeter increases when the temperature of the thermistor increases. Explain why this is the case. [2]

(ii) The cooling system can only be activated when the voltage across the 160 Ω resistor rises above 2.8 V. An engineer suggests that this thermistor and resistor combination is suitable to use in a car cooling system and should activate when the temperature reaches 30 °C. Check this claim. [4]

(d) The arrangement can also be used as a basis for a thermometer. By considering the shape of the graph on page 3 discuss whether this thermistor arrangement would be more effective at measuring changes in temperature between 0 °C and 10 °C or between 50 °C and 60 °C. [2]

Question taken from Eduqas examination paper 842102, June 2017

#7

An insulated wire is made into a long solenoid of length 4.00 m by winding it around a pipe of diameter 3.00 cm. The wire is 0.25 mm thick and is wound so that each loop just touches the next.

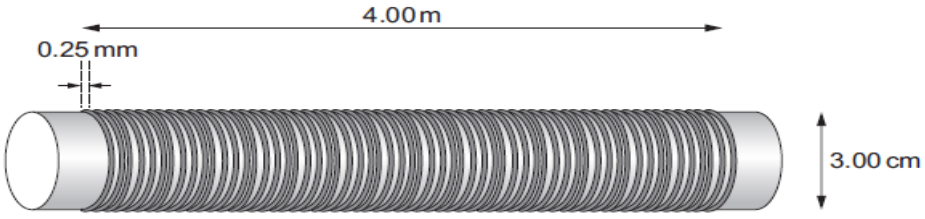


Diagram not to scale

(a) Show that the length of the wire is approximately 1.5 km. *You may assume that the insulation thickness is negligible.* [3]

(b) Show that a steady current of approximately 25 mA is carried in the wire when a pd of 12.0 V is applied across its ends. The resistivity of the wire is $1.59 \times 10^{-8}\ \Omega$ m. [3]

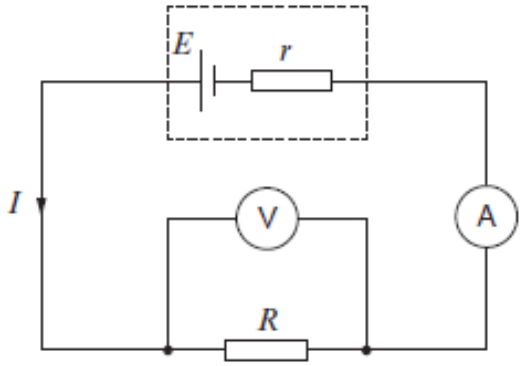
(c) Calculate the magnetic field strength, B, inside the solenoid. [2]

(d) Explain whether or not the solenoid could produce a magnetic field of 2 T. You should include a calculation to reinforce your answer. [3]

Question taken from Eduqas examination paper 842103, June 2017

#8

1. The following circuit shows a cell of emf, E, and internal resistance, r, connected to a resistor of resistance, R.



(a) An equation which can be applied to the above circuit is:

$$V = E - Ir$$

Explain this equation in terms of energy. [4]

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(b) Two students, Kiera and Tom, set up a circuit using two identical cells in series, each with an emf of 1.5V, to power a small heating coil. The heating coil dissipates power at the rate of 1050mW and the pd across the coil is 2.5V.

Calculate:

(i) the internal resistance of each cell; [3]

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(ii) the energy dissipated in each cell in **one minute**. [2]

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(c) The students note that the cells get hot when the heater is switched on for long periods. Tom believes that adding an identical heating coil in parallel with the original would halve the energy dissipated in each cell. Kiera disagrees. She believes that the energy dissipated would increase by a factor of 3 if a coil is added in parallel. Investigate whether Kiera or Tom or neither of them is correct. [4]

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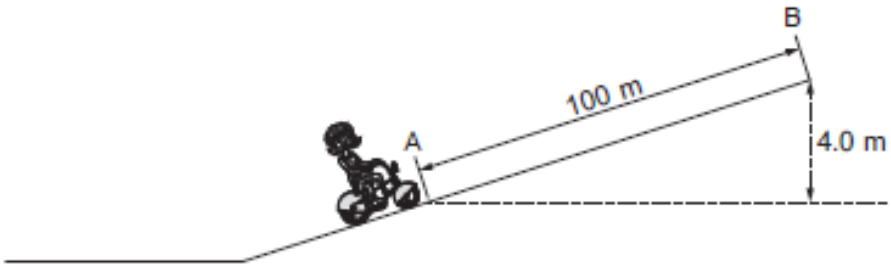
Question taken from Eduqas examination paper 842102, June 2019

#9

3. Helen is riding an electric bike (a bike that is assisted by an electric motor) up a hill at a speed of 4.5 m s^{-1}. At point A she starts the electric motor and accelerates uniformly reaching a speed of 9.2 m s^{-1} at B. Whilst accelerating she also gains a height of 4.0 m as shown in the diagram below.



(a) Show that the time taken for Helen's journey between A and B is approximately 15 s. [2]

(b) Helen and the bike have a combined mass of 95 kg. Determine the gain in total energy between A and B. [3]

(c) (i) If the bike's electric motor operates at 36 V and 7.0 A calculate the electrical energy used by the motor between A and B. [2]

(ii) Helen, by pedalling, also provides 5500 J of work between A and B. Determine the efficiency of the electric motor. *Ignore all resistive forces on Helen and the bike.* [2]

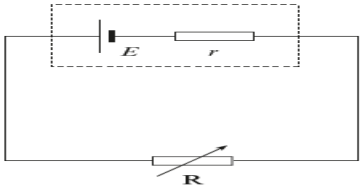
(iii) In practice resistive forces will act. Identify these forces and where they act. [2]

(d) Helen believes that by riding an electrically powered bike to the shops rather than using her car she is benefiting the environment. Explain whether or not Helen is correct. [2]

Question taken from Eduqas examination paper 842001, June 2018

#10

Abigail investigates how the power dissipated in a variable resistor varies as its resistance is altered. The diagram shows the circuit that Abigail uses (meters not shown). The variable resistor is connected to a battery of emf, E, and internal resistance, r.



Abigail obtains the following data as the resistance is varied from 0.5 Ω to 6.0 Ω.

Resistance, R / Ω	Power dissipated in R / W
0.5	2.5
1.0	3.3
2.0	3.8
3.0	3.8
4.0	3.7
5.0	3.6
6.0	3.5

(a) Plot a graph of power dissipated in R (on the y-axis) against resistance (on the x-axis) and draw a smooth curve through the data. [3]

(b) The emf of the battery is 6.0 V and the resistance, R, is now set at **4.5** Ω.

(i) State what is meant by an *emf* of 6.0 V. [2]

(ii) Calculate the current through the battery using data from your graph. [3]

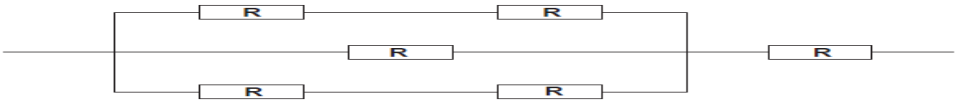
(iii) Calculate the internal resistance, r, of the battery. [3]

(c) Abigail repeats the experiment but with a battery of the same emf but smaller internal resistance. Explain how the graph would change. [2]

Question taken from Eduqas examination paper 842002, June 2017

#11

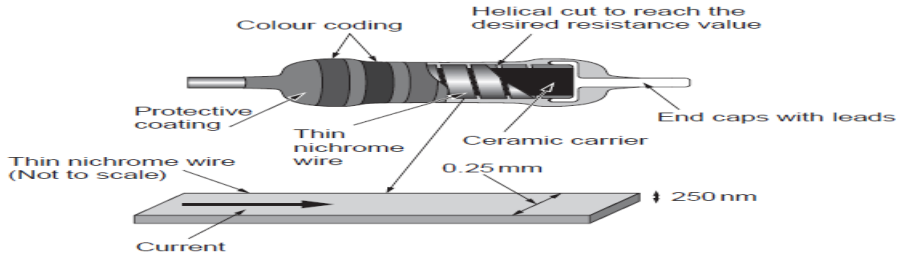
(a) The resistor network shown consists of six identical resistors, each of value **R Ω**.



(i) Determine, **in terms of R**, the total resistance of the network. [3]

(ii) **Draw a circle** around the resistor which dissipates the greatest power when a pd is applied across the arrangement. Explain your answer. [2]

(b) The alloy nichrome is commonly used to make 'Metal Film Resistors'. A cross-section through such a resistor is shown. The value of the resistor is determined by the length of the nichrome wire used in it.



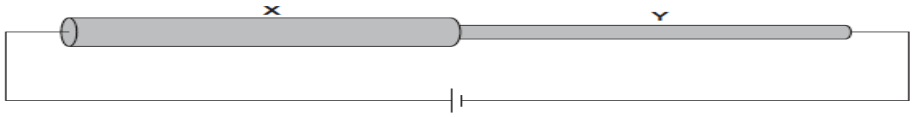
The wire used in such a resistor has a rectangular cross-section as shown. Determine the length of nichrome wire required to make a 2.0 kΩ resistor.
[Resistivity of nichrome = 1.20×10^{-6} Ω m] [2]

(c) The current I through a wire is related to the drift velocity, v, of free electrons through the wire by the equation:

$$I = nAve$$

(i) State the meaning of n. [1]

(ii) Two pieces of nichrome wire, **X** and **Y**, are joined end to end and connected to a battery as shown. The wires are of the same length but the diameter of **X** is **double** that of **Y**.



The table below shows the ratios of the values of n, I and v in the two wires. Write in the table the value of each ratio, giving an explanation for each of your answers.
Space is provided for calculations. [3]

Ratio	Value	Explanation
$\frac{n_X}{n_Y}$		
$\frac{I_X}{I_Y}$		
$\frac{v_X}{v_Y}$		

(iii) Wire **Y** is replaced with another wire **Z** of the same cross-sectional area as **Y** but double the length and made of a material with resistivity half that of **X**. Calculate the ratio:

$$\frac{\text{Power dissipated in wire Z}}{\text{Power dissipated in wire X}}$$

[3]

Question taken from Eduqas examination paper 842102, June 2017

#12

2. *(a)* (i) State what is meant by *electric current*. [1]

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(ii) Show that the unit of resistance, the ohm (Ω), can be expressed as: [2]

$$J\,s\,C^{-2}$$

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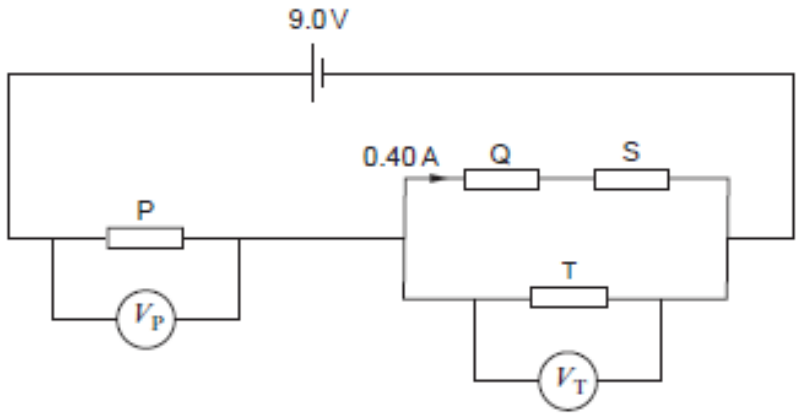
(b) The following circuit shows an arrangement of **identical resistors** labelled P, Q, S and T connected to a fixed pd of 9.0 V. V_P and V_T are the pds across P and T respectively. There is a current of 0.40 A in Q and S.



(i) Show that $V_P = 1.5\ V_T$. [2]

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(ii) Hence or otherwise show that the values given in the diagram are consistent with the resistance of each resistor being 4.5 Ω. [3]

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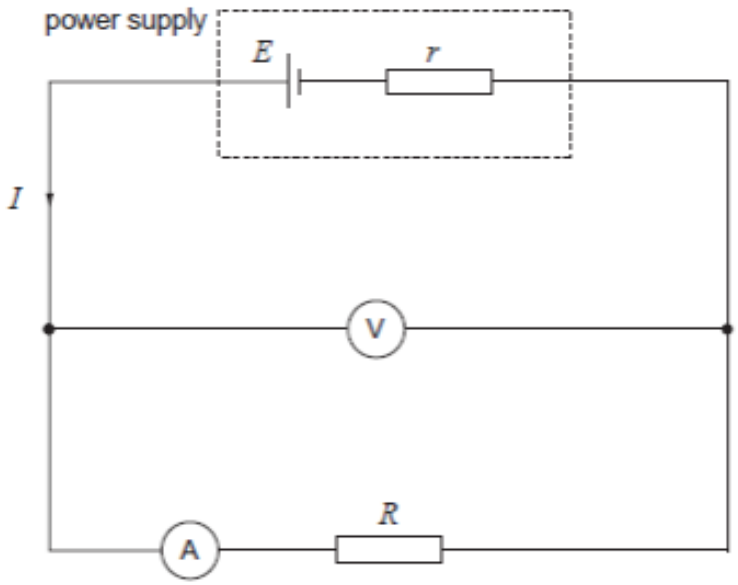
(c) Show that the total energy dissipated per second in the whole circuit is 15 times more than the energy dissipated per second in resistor Q. [3]

(d) Resistor T is now removed from the circuit. Explain the effect this will have on the ratio calculated in part *(c)*. [3]

Question taken from Eduqas examination paper 842102, June 2018

#13

5. Zhang Li sets up the following circuit and uses a spreadsheet to analyse her data as the load resistance, R, is varied.



	A	C	D	E	F
1					
2	Emf, E	Load resistance, R	Current, I	pd across R, V	Internal resistance, r
3	V	Ω	A	V	Ω
4	1.5	1.4	0.94	1.32	0.19
5	1.5	3.3	0.43	1.42	0.19
6	1.5	4.7	0.31	1.46	0.13
7	1.5	5.6	0.26	1.46	.....
8	1.5	8.0	0.19	1.49	0.17

(a) Zhang Li uses 3 resistors of values 3.3Ω, 4.7Ω and 5.6Ω, to create various load resistance values. Show clearly how the value in cell C4 (column C and row 4) is obtained. [3]

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(b) (i) Zhang Li uses the spreadsheet formula = $\frac{A4 - E4}{D4}$ to determine the internal resistance in cell F4. Explain in terms of energy why this is a valid method. [6]

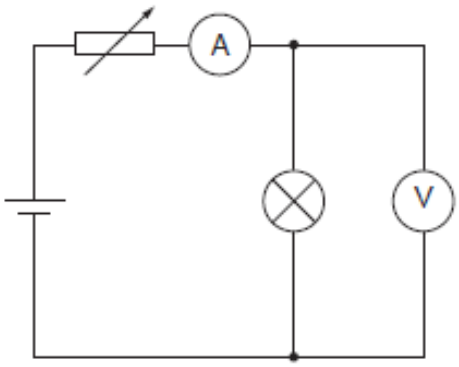
(ii) Determine the internal resistance value for cell F7. [2]

(iii) Zhang Li can choose between 4.7 Ω resistors with power ratings of 0.25 W or 0.50 W. Justify, numerically, which resistor power rating she should use in the circuit. [3]

Question taken from Eduqas examination paper 842002, June 2019

#14

2. Jasmine uses the following circuit to investigate how the resistance, R, of a filament lamp varies with the potential difference, V, across it.



(a) Jasmine obtains a range of values for V and I. Describe **briefly** how she does this. [1]

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(b) The relationship between R and V can be expressed as:

$$R = kV^n$$

where k and n are unknown constants. By taking logs of both sides of the equation, show how it can be written in the form $y = mx + c$. [2]

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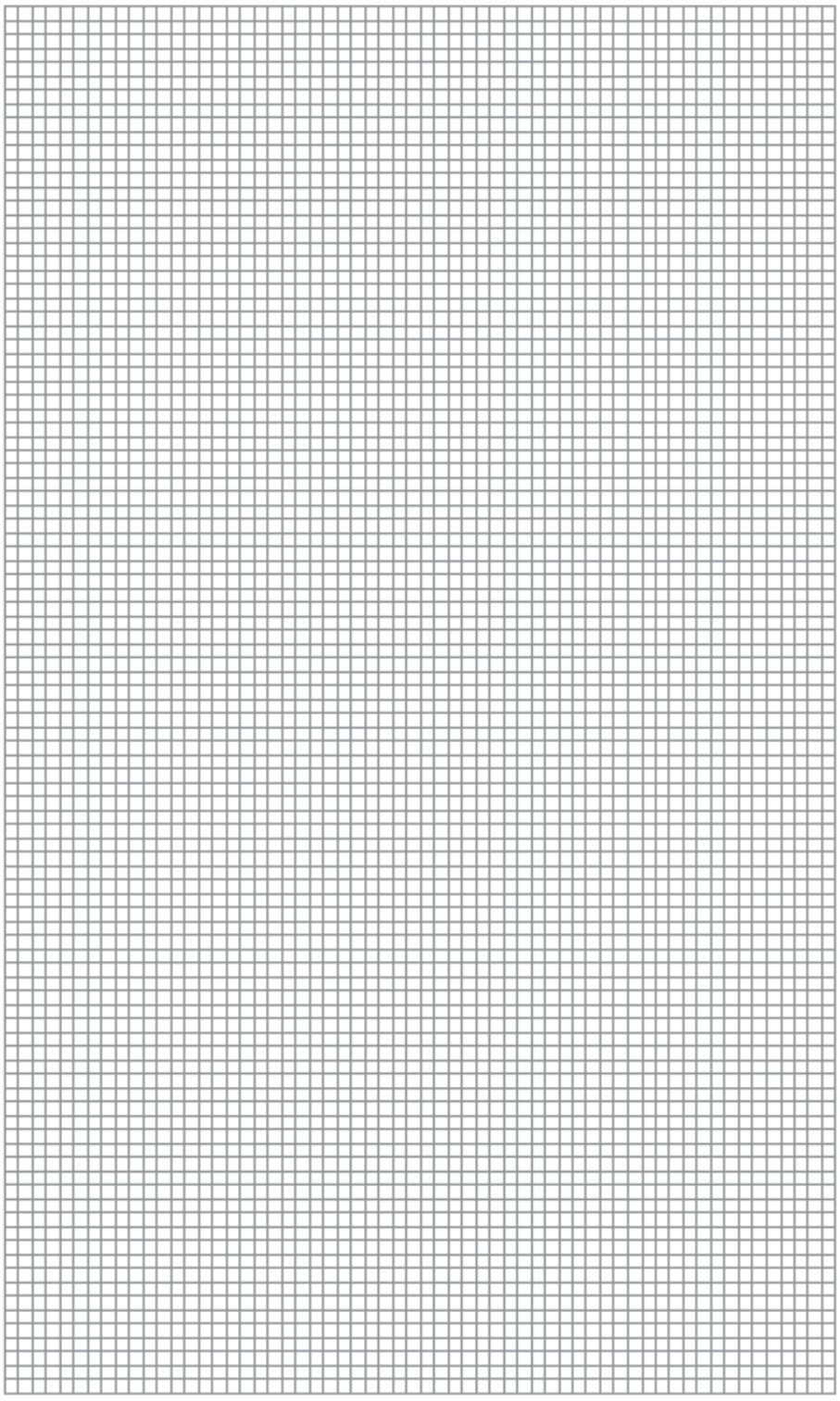
(c) Jasmine records the following data. Complete the table using an appropriate number of significant figures. [3]

V / V	I / A	R / Ω	log(V / V)	log(R / Ω)
1.00	0.52			
2.00	0.72			
4.00	0.98			
6.00	1.20			
8.00	1.40			
10.00	1.54			

(d) Draw a graph of log R (vertical axis) against log V (horizontal axis) and draw a line of best fit. Error bars are **not** required. [5]



(e) (i) Use your graph to determine suitable values for k and n. [4]

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(ii) Hence, write down an equation showing the relationship between R and V for this filament lamp. [1]

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(f) Comment on the quality of Jasmine's results. [1]

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Question taken from Eduqas examination paper 842102, June 2019

#15

4. A length of wire of an unknown material is found at a crime scene. The diameter of the wire is measured as 0.28 ± 0.01 mm and its length 32.4 ± 0.1 cm. The resistance of the wire is measured as 0.085 Ω ± 5 %.

(a) (i) Calculate the resistivity of the material of the wire. [3]

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(ii) Calculate the **absolute** uncertainty in the resistivity. [4]

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(iii) Evaluate whether it is possible to identify the unknown material from the table below. [2]

Material	Resistivity (10^{-8} Ωm)
Aluminium	2.65
Copper	1.68
Silver	1.59
Iron	9.71
Tungsten	5.60

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(b) Anika applies a fixed potential difference of 6.0 V across a different piece of metal wire. At a temperature of 0 °C the current is found to be 0.30 A. At 50 °C the current is 0.24 A.

(i) Explain in terms of electrons why the current is **smaller** at 50 °C than at 0 °C. [4]

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(ii) Anika states that the resistance of the wire can be considered to be directly proportional to temperature in °C. Use the following table of data to determine whether Anika is correct. [3]

Temperature (°C)	Current (A)
10	0.29
30	0.26
50	0.24

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Question taken from Eduqas examination paper 842002, June 2019