



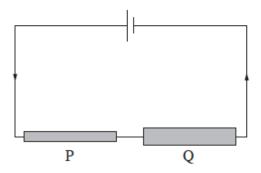
GCE PHYSICS

S21-A420QS

Assessment Resource number 16 Electricity and the Universe Resource G

1.	(a)	Compare the movement of free electrons in a metal before and after a pd is applied to the metal. [3]		
	(b)	(i) The current, I , in a wire of cross-sectional area, A , is given by the formula:		
		I = nAve		
		where n is the number of free electrons per unit volume and v is the drift velocity of these electrons. Derive the formula. Include a clearly labelled diagram. [4]		
••••				
••••				
••••				

(ii) Wires P and Q are connected to a fixed voltage source. Wire Q is made of a different metal from wire P and has fewer free electrons per unit volume.
[n_P = 6.4 × 10²⁸ m⁻³ and n_Q = 2.0 × 10²⁸ m⁻³]. The diameter of wire Q is twice the diameter of wire P.



Determine the ratio	$\frac{v_{\mathbf{Q}}}{v_{\mathbf{p}}}$.	[3]

2. Zack investigates how the energy stored in a capacitor depends on the value of the capacitor, for a fixed potential difference, V.

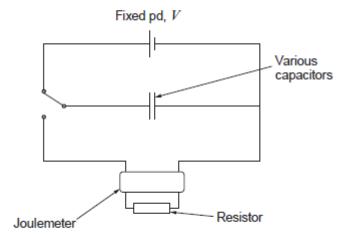
He is provided with 5 capacitors of differing values.

He uses the following circuit to fully charge each of the capacitors from the fixed pd, V, and then

discharges them in turn through a resistor.

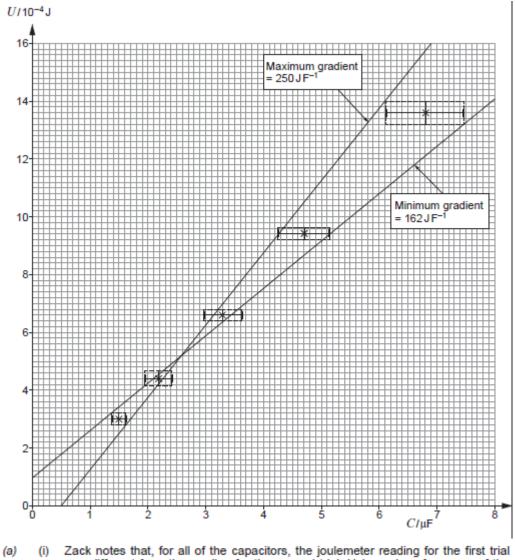
The energy transferred is measured using a joulemeter.

He carries out this procedure twice for each capacitor.



Zack plots a graph of mean energy stored, U, against capacitance C. The graph (on page 6) displays the uncertainties in the mean values of U and C. Zack uses the percentage tolerance (uncertainty) information displayed on each capacitor to draw the error bars on the capacitance axis.

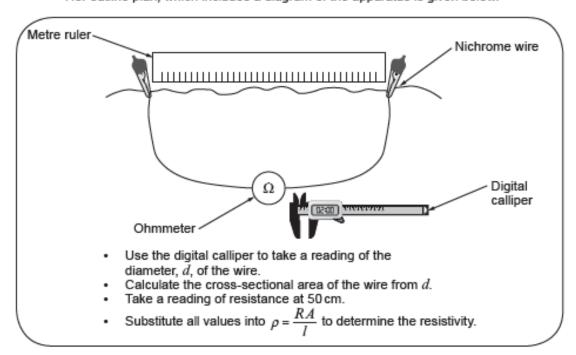
He notes that the percentage tolerance is the same for each capacitor.



from one of the	(i) Zack notes that, for all of the capacitors, the joulemeter reading was different from the reading for the second trial. Using values data points, explain how the length of the error bars on the y-axis readings.
[2]	(ii) Determine the percentage tolerance of the capacitors.
propriate equation, [3]	(b) (i) Using the values of the gradients given on the grid and an appr determine the maximum and minimum values for V.

	(ii) Hence determine the pd, \it{V} , along with its absolute uncertainty. [3]
(c)	Zack's teacher suggests that he should carry out another experiment. Zack decides to discharge the $6.8\mu F$ capacitor through a $5.6M\Omega$ resistor. He notes that it took 35 seconds for the pd across the capacitor to drop to $8.0V$. Determine whether or not these results are consistent with an initial value of $V=20.0V$.

(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.



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]

