

- 5 The photograph shows a statue of Buddha in Sri Lanka, which is protected by a lightning conductor.



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- (a) During a storm, a potential difference of 2.7 MV was generated between a cloud and the top of the lightning conductor on the statue. A flash of lightning passed between the cloud and the lightning conductor, producing a current of 25 kA for a time of 7.5 ms .

Calculate the energy transferred by the lightning strike.

(3)

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Energy transferred =

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(b) The lightning conductor is a length of copper wire with a diameter of 1.2×10^{-2} m and a resistance of $4.3 \times 10^{-3} \Omega$. It runs along the back of the statue from the base to a height of 1.5 m above the top of the statue.

A guidebook claims that the statue is over 30 m high.

Assess the validity of this claim.

resistivity of copper = $1.7 \times 10^{-8} \Omega\text{m}$

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(c) Give a reason why the lightning conductor should be taller than the statue.

(1)

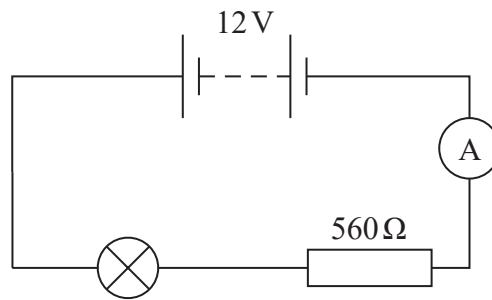
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(Total for Question 5 = 8 marks)



- (b) The student sets up the following circuit with the filament lamp. The battery has negligible internal resistance.



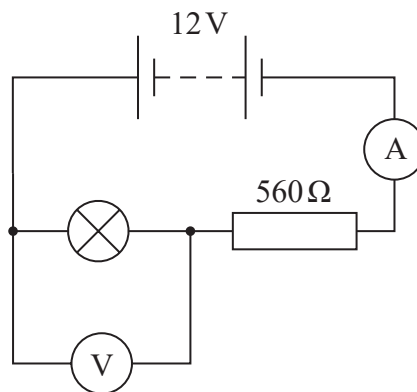
- (i) The reading on the ammeter is 17.5 mA.

Calculate the value of the potential difference (p.d.) across the filament lamp.

(2)

p.d. across filament lamp =

- (ii) When a voltmeter with a resistance of 1.5 k Ω is connected as shown, the p.d. across the filament lamp decreases.



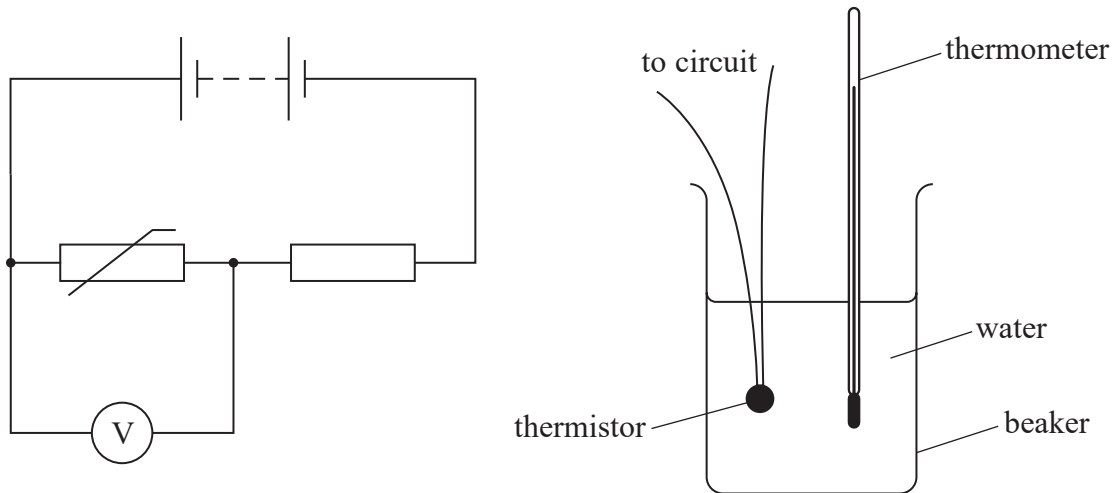
Explain why the p.d. across the filament lamp decreases.

(3)

(Total for Question 9 = 11 marks)



- 11 A student carried out an experiment to calibrate a thermistor. She connected the thermistor in series with a resistor and a power supply as shown. Then she placed the thermistor in a beaker of hot water and used a thermometer to record the temperature θ of the water.



The student recorded θ and corresponding values of the reading V on the voltmeter as the water cooled.

- (a) Explain, making reference to charge carriers, why V increased as the water cooled.

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(b) Over a limited temperature range V varies with θ according to the expression

$$V = V_0 e^{-b\theta}$$

where b and V_0 are constants.

(i) Explain why a graph of $\ln V$ against θ would give a straight line.

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P 6 9 4 4 4 A 0 2 1 3 6

(ii) The student's data is shown in the table below.

$\theta/^\circ\text{C}$	V/V	
89.0	1.9	
74.0	2.9	
53.5	4.9	
32.5	9.1	
18.5	12.6	
3.5	18.7	

Plot a graph of $\ln V$ against θ on the grid opposite. Use the column provided to show any processed data.

(5)

(iii) Determine values for b and V_0 .

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$$b = \dots\dots\dots$$

$$V_0 = \dots\dots\dots$$

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