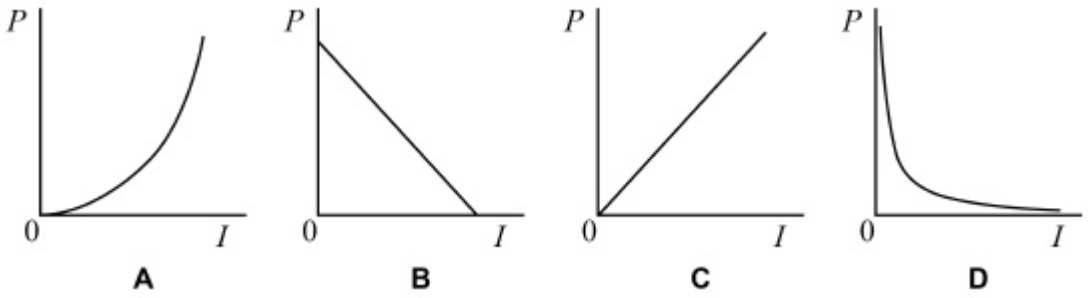
2 Which graph shows how power dissipated P varies with current I in a component that obeys Ohm's law?



A ⬭

B ⬭

C ⬭

D ⬭

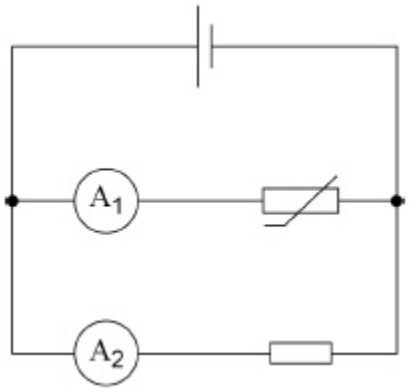
$P = VI$ $V = IR$

so $P = I^2 R$

so A

(Total 1 mark)

3 A circuit consists of a cell, a thermistor, a fixed resistor and two ammeters.



T ↓ R ↑ so I ↓

no effect

The cell has a constant electromotive force and negligible internal resistance. Readings from the two ammeters are taken.

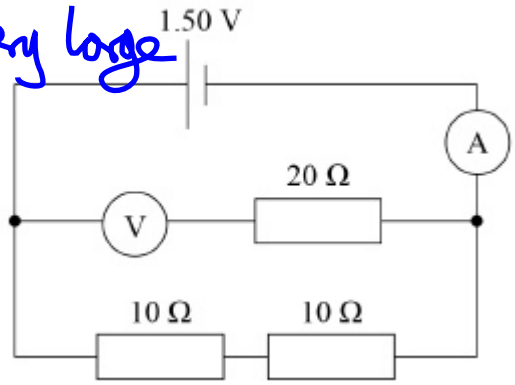
Which row describes what happens to the current in each ammeter when the temperature of the thermistor decreases?

	Current in ammeter A_1	Current in ammeter A_2	
A	Decreases	Unchanged	⬬
B	Decreases	Increases	⬭
C	Increases	Decreases	⬭
D	Increases	Unchanged	⬭

(Total 1 mark)

4 The circuit shows a cell with negligible internal resistance connected in a circuit with three resistors, an ammeter and a voltmeter.

Resistance of (V) very large so V drop over it is virtually 1.5 V & I is virtually zero so B or D



I in bottom loop:

$\frac{V}{R} = \frac{1.5}{20} = 0.075\,A$

Which row shows the readings on the ammeter and voltmeter?

	Current / A	Voltage / V	
A	0.075	0.75	○
B	0.075	1.50	○
C	0.150	0.75	○
D	0.150	1.50	○

(Total 1 mark)

5 A gas containing doubly-charged ions flows to give an electric current of 0.64 A

How many ions pass a point in 1.0 minute?

A 2.0×10^{18} ○

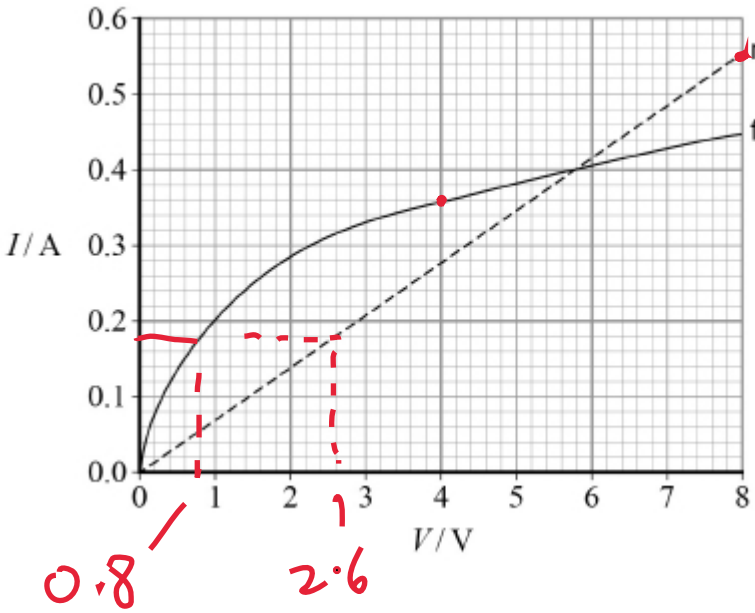
B 4.0×10^{18} ○

C 1.2×10^{20} ○

D 2.4×10^{20} ○

(Total 1 mark)

6 The graph below shows the current–voltage (I–V) characteristics for a resistor and a filament lamp.



(a) Explain, in terms of electron motion, why the I–V characteristic for the filament lamp is a curve.

increase in I (or v) leads to an increase in temperature
which increases the movement of lattice ions
which means more collisions between lattice ions and electrons meaning higher resistance
which means that the I does not go up as much as you'd expect (ie V and I no longer proportional)

(4)

(b) Determine the resistance of the resistor.

14.5

resistance = _____ Ω

(1)

(c) The resistor and the filament lamp are connected in series with a supply of variable emf and negligible internal resistance.

Determine the emf that produces a current of 0.18 A in the circuit.

3.4V

see graph which gives up the p.d across each component when I = 0.18

emf = _____ V

(3)

(d) The resistor and filament lamp are now connected in parallel.

Determine the resistance of the parallel combination when the emf of the supply is adjusted to be 4.0 V.

$R = 14.5\,\Omega$ Lamp : 4.0 & 0.36 A $\Rightarrow R = 11.1\,\Omega$

$\frac{1}{R_T} = \frac{1}{14.5} + \frac{1}{11.1}$

resistance = 6.3 Ω

(3)

(e) The resistance of the filament lamp at its working temperature is 14 Ω.

The filament has a length of 0.36 m and a diameter of 32 μm.

Calculate the resistivity of the metal that is used for the filament when the lamp is at its working temperature.

Give an appropriate unit for your answer.

$R = \rho \frac{L}{A} \Rightarrow \frac{RA}{L} = \rho$

$\rho = \frac{14 \times \pi \left(\frac{32 \times 10^{-6}}{2}\right)^2}{0.36}$

resistivity = 3.1×10^{-8} unit Ω m

(3)

(Total 14 marks)