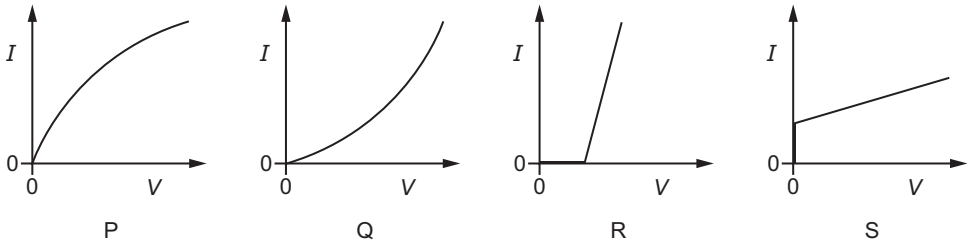
33 The graphs show possible current–voltage (I–V) characteristics for a filament lamp and for a semiconductor diode.



Which row identifies the I–V graphs for the lamp and for the diode?

	filament lamp	semiconductor diode
A	P	R
B	P	S
C	Q	R
D	Q	S

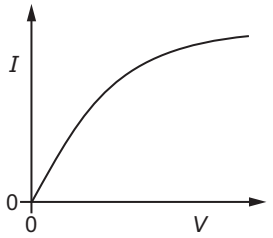
33 A piece of wire X has resistivity ρ, length L and cross-sectional area A. Wire X has a resistance R.

A second piece of wire Y is made of a different metal. It has the same resistance as X but has twice the length of X.

Which row gives possible values for the resistivity and the cross-sectional area of Y?

	resistivity	cross-sectional area
A	$\frac{1}{2}\rho$	$\frac{1}{2}A$
B	$\frac{1}{2}\rho$	A
C	ρ	$\frac{1}{2}A$
D	2ρ	A

32 Which component has the I–V graph shown?



A filament lamp

B metallic conductor at constant temperature

C resistor of fixed resistance

D semiconductor diode

34 A copper wire of length 2 m has a circular cross-section. There is a constant current in the wire when it is connected to a mobile phone in order to charge the battery.

The wire has a fault. A 1 m length of the wire has half the diameter of the other 1 m length.

The power dissipated in the thicker length of wire is P.

What is the power dissipated in the thinner length of wire?

A $\frac{1}{4}P$ **B** $\frac{1}{2}P$ **C** $2P$ **D** $4P$

5 A student uses a circuit containing an ammeter, a voltmeter and a cell to take measurements to determine the resistance of a length of nichrome wire.

(a) (i) Define resistance.

.....

..... [1]

(ii) Draw a circuit diagram to show how the components should be connected. Use the symbol for a resistor to represent the nichrome wire.

[2]

(b) The student also measures the length and the diameter of the wire. Table 5.1 shows the measurements recorded for each quantity.

Table 5.1

quantity	measurement
length	(0.864 ± 0.001) m
diameter	(0.496 ± 0.002) mm
voltmeter reading	(1.38 ± 0.02) V
ammeter reading	(0.276 ± 0.001) A

(i) Show that the resistance of the wire is 5.00 Ω.

[1]

(ii) Calculate, to three significant figures, the resistivity ρ of the nichrome.

ρ = ... Ω m [3]

(iii) Calculate the percentage uncertainty in ρ.

percentage uncertainty = ... % [2]

(iv) Determine the absolute uncertainty in ρ.

absolute uncertainty = ... Ω m [1]

[Total: 10]

32 Which expression gives the definition of resistance?

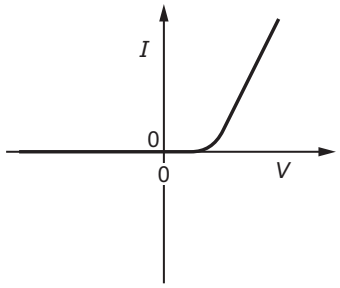
A current divided by potential difference

B current multiplied by potential difference

C potential difference divided by current

D resistivity multiplied by length

33 The graph shows the I–V characteristic of an electrical component.



What is the component?

A a filament lamp

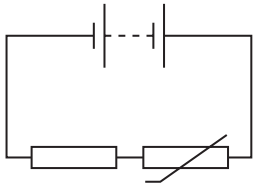
B a metallic conductor at constant temperature

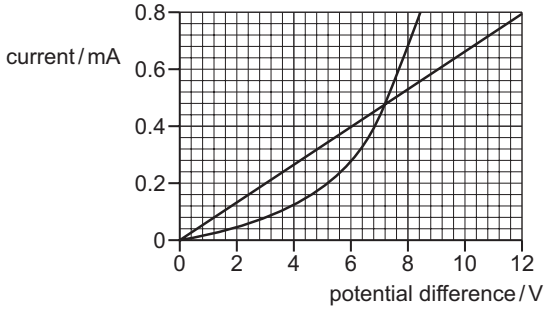
C a resistor

D a semiconductor diode

35 The diagram shows a circuit containing a thermistor, a fixed resistor and a battery.

The graph shows the I–V characteristics of both components.



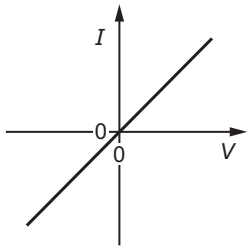


The battery has an e.m.f. of 12 V and negligible internal resistance.

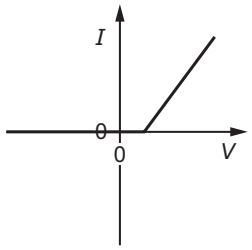
What is the current in the fixed resistor?

A 0.36 mA **B** 0.40 mA **C** 0.48 mA **D** 0.80 mA

33 The I–V characteristics for three electrical components are shown.



1



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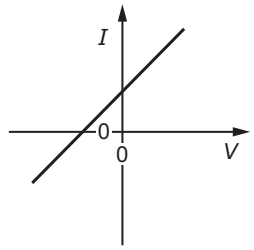
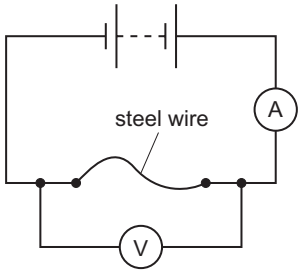


3

Which components obey Ohm's law?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 1 only

34 A steel wire with a length of 2.20 m is connected to a battery as shown.



The reading on the voltmeter is 1.50 V and the reading on the ammeter is 4.90 A.

The resistivity of steel is $6.90 \times 10^{-7}\,\Omega\,\text{m}$.

What is the diameter of the steel wire?

A $1.76 \times 10^{-4}\,\text{m}$ **B** $3.52 \times 10^{-4}\,\text{m}$ **C** $1.26 \times 10^{-3}\,\text{m}$ **D** $2.51 \times 10^{-3}\,\text{m}$

7 A nichrome resistance wire has length 150 cm, cross-sectional area $2.45 \times 10^{-7}\,m^2$ and resistivity $1.12 \times 10^{-6}\,\Omega m$.

(a) Calculate, to three significant figures, the resistance of the wire.

resistance = ... Ω [3]

(b) The nichrome wire forms part of a potentiometer circuit together with a cell of electromotive force (e.m.f.) 1.2 V and negligible internal resistance, as shown in Fig. 7.1.

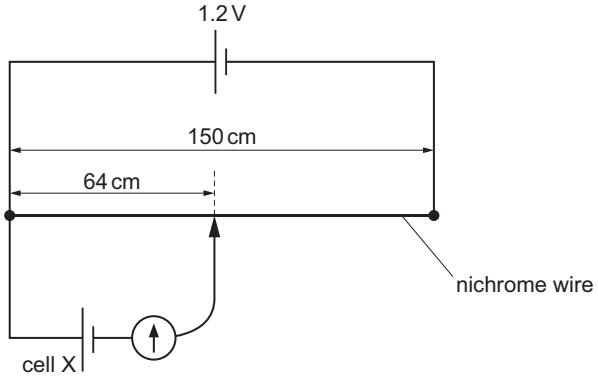


Fig. 7.1 (not to scale)

The circuit is used to determine the e.m.f. of cell X.

The galvanometer is used in a null method to find the null point 64 cm from the left-hand end of the nichrome wire.

(i) Explain what is meant by a null method.

.....

..... [1]

(ii) Calculate the e.m.f. of cell X.

e.m.f. = ... V [2]

(iii) The cell of e.m.f. 1.2 V is replaced by a new cell with the same e.m.f. but with an internal resistance that is **not** negligible.

State and explain the effect, if any, of the internal resistance of the new cell on the position of the null point.

.....

.....

.....

..... [2]

[Total: 8]

5 **(a)** **(i)** State and explain the effect, if any, on the resistance of a filament wire in a lamp as the current in the wire decreases.

.....

..... [1]

(ii) On Fig. 5.1, sketch the *I*–*V* characteristic of a filament lamp.

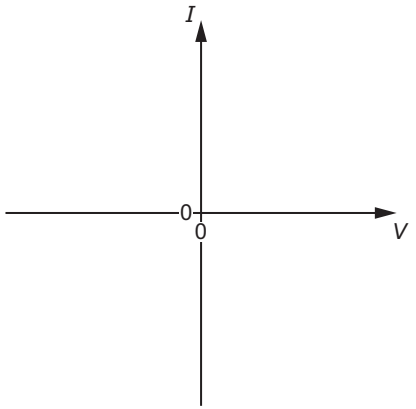


Fig. 5.1

[2]

(b) A battery of electromotive force (e.m.f.) *E* and negligible internal resistance is connected in parallel with two filament lamps A and B, as shown in Fig. 5.2.

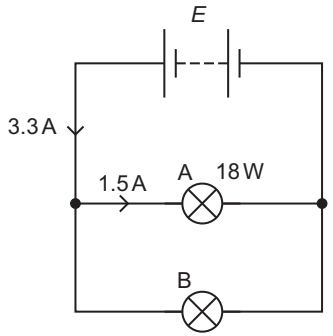


Fig. 5.2

The current in the battery is 3.3A and the current in lamp A is 1.5A. The power dissipated in lamp A is 18 W.

(i) Calculate the e.m.f. *E* of the battery.

E = ... V [2]

(ii) The filament wire of lamp B has a cross-sectional area of $1.4 \times 10^{-9}\,m^2$. The number of free (conduction) electrons per unit volume in the metal of the filament wire is $3.4 \times 10^{28}\,m^{-3}$.

Calculate the average drift speed of the free electrons in the filament wire of lamp B.

average drift speed = ... $m\,s^{-1}$ [3]

[Total: 8]