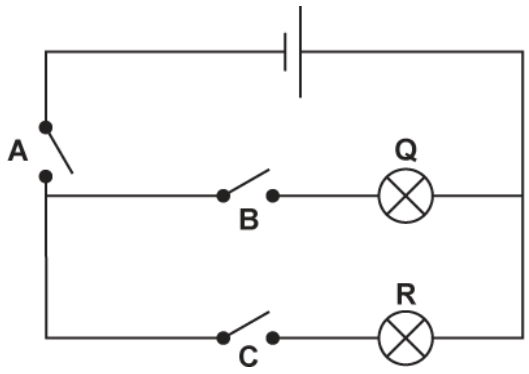
1(a). A student makes a circuit using a cell, three switches and two identical filament lamps.



Which switch or switches does the student close so that **only** lamp **Q** lights up?

_____ **[1]**

(b). Which switch or switches does the student close so that **only** lamp **R** lights up?

_____ **[1]**

(c). The switches are closed so that **both** lamp **Q** and lamp **R** light up.

Which sentence describes the brightness of lamp **Q** and lamp **R**?

Tick (✓) **one** box.

Both lamps are the same brightness.	☐
Lamp **Q** is brighter than lamp **R**.	☐
Lamp **R** is brighter than lamp **Q**.	☐

[1]

(d). Explain your answer to the previous question.

_____

_____ **[1]**

(e). Complete the sentences to explain what happens to the resistance of the metal wire inside the filament lamp when the current increases.

Use words or phrases from the list.

atoms	**decreases**	**elastic potential**	**electrons**
increases	**protons**	**stays the same**	**thermal**

As the current increases, the resistance of the metal wire ..... .

The ..... collide more often with the positive ions in the wire.

This increases the ..... energy of the wire.

[3]

2(a). This question is about static electricity.

Static electricity can build up in thunderclouds.

In one thundercloud the potential difference between the thundercloud and the ground is 5.0×10^8 V.

When lightning strikes the ground, 7.5×10^9 J of energy is transferred.

Calculate the amount of charge which flows when lightning strikes.

Use the equation: energy transferred = charge × potential difference

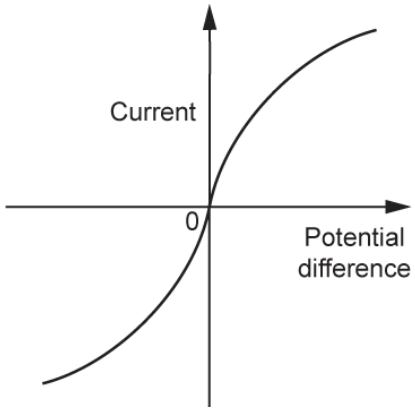
Charge = ... C **[3]**

(b). Calculate the charge flow in a circuit when there is a current of 15 A for 2 minutes.

Use the equation: charge flow = current × time

Charge flow = ... C **[3]**

3. A current-potential difference graph of an electrical component is shown.



Which row describes the type of graph and identifies the electrical component?

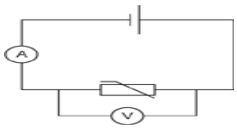
	Type of graph	Component
A	linear	diode
B	linear	filament lamp
C	non-linear	diode
D	non-linear	filament lamp

Your answer ☐ **[1]**

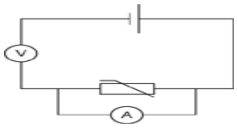
4. A student makes a circuit to measure the current in a thermistor and the potential difference across it.

Which circuit is correct?

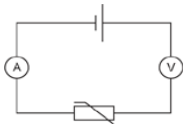
A



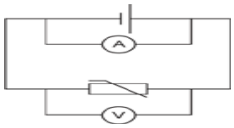
B



C



D



Your answer ☐ **[1]**

5. Hydrogen gas is placed in a glass tube in a laboratory.

Fig. 19.1 shows the emission spectrum of hydrogen.

Each line in the emission spectrum has a different colour

Fig. 19.1

i. Complete the sentences to explain the cause of the lines in the emission spectrum.

Use words from the list.

atoms	**electrons**	**light**	**protons**	**sound**

..... move from a higher energy level to a lower energy level and emit .....

[2]

ii. There is a potential difference of 3000 V across the tube.

A charge of 0.08 C flows in the tube.

Calculate the energy transferred.

Use the equation: energy transferred = charge × potential difference

Energy transferred = ... J **[2]**

iii. A special power supply is needed to provide the high potential difference of 3000 V.

Describe **one** risk of using this power supply

[1]

6. Since 2009, filament lamps in the home have often been replaced by other lamps, called LED lamps.

The table compares a filament lamp and an LED lamp which produce the **same** intensity of light.

	Filament lamp	**LED lamp**
Power	60 W	0.01 kW
Lifetime	2000 hours	26 000 hours
Cost to buy	£1.00	£5.00
Cost to run over 1 year	£22.00	£3.65
Dimmable	Yes	No
Structure	Glass	Plastic

Calculate the energy transferred by the LED lamp during its lifetime.

Use the equation: energy transferred = power × time

Give your answer in kW h.

Energy transferred = ... kW h **[2]**

7(a). A student investigates the resistance of a thermistor at different temperatures.

The student uses a Bunsen burner to heat the water in a beaker to three different temperatures.
The student uses an ohmmeter to measure the resistance of the thermistor at each temperature.

Fig. 20.1 shows how the student sets up their experiment and **Fig. 20.2** shows a graph of their results.

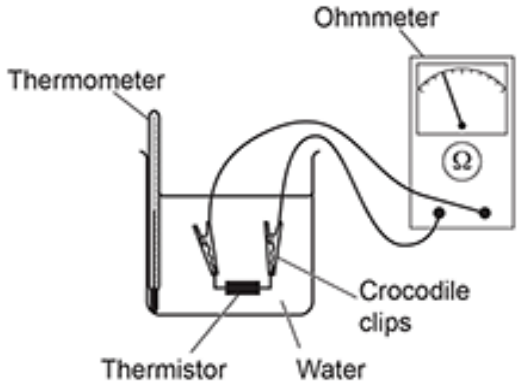


Fig. 20.1

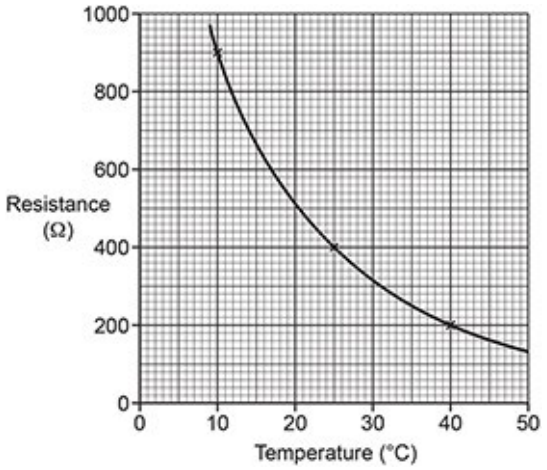


Fig. 20.2

Describe the trend shown by the graph.

Suggest how the student's method could be improved. Include ideas about accuracy and precision.

[6]

(b). The current in a thermistor is 300 mA.

Fig. 20.3 shows a choice of ammeters that the student can use to measure this current accurately.

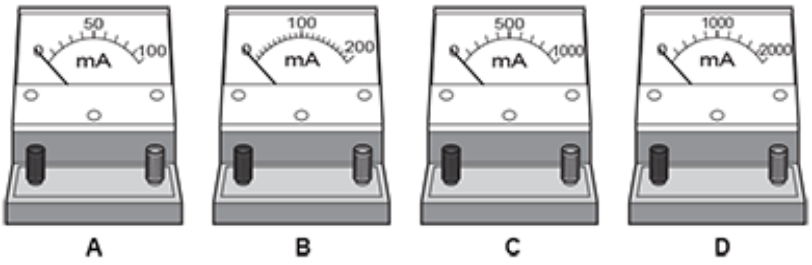


Fig. 20.3

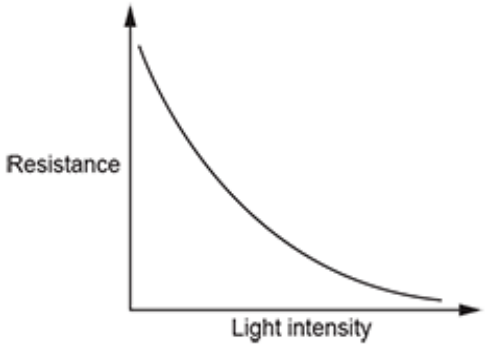
Which ammeter should the student use to measure a current of 300 mA?

Ammeter .....

Explain your answer.

[2]

(c). The graph shows how the resistance changes for a light dependent resistor (LDR).



State **one** use for a light dependent resistor and describe how it is used.

---**[2]**

8(a). A student draws current–potential difference (I-V) graphs for three different components.
These are shown in **Fig. 17.1**.

Draw one line from each **component** to its correct **current–potential difference graph**.

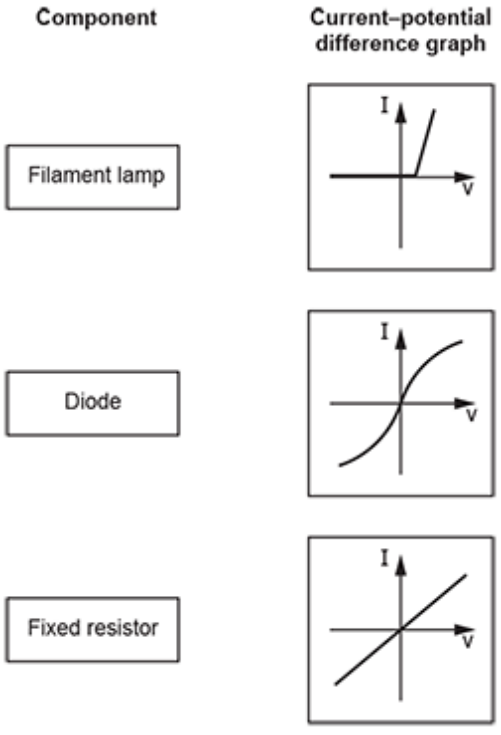


Fig. 17.1

[2]

(b). A student uses the circuit in **Fig. 17.2** to investigate the current in component **X** and the potential difference across it.

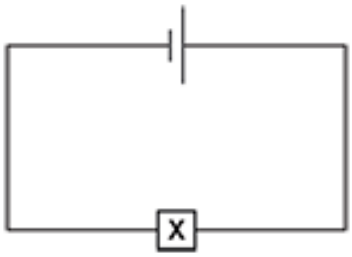


Fig. 17.2

i. State the name of the measuring instrument the student uses to measure the current in the circuit.

---

[1]

ii. Draw the circuit symbol for the measuring instrument in (b)(i) in a correct position in **Fig. 17.2**.

[2]

iii. State the name of the measuring instrument the student uses to measure the potential difference across component **X**.

---

[1]

iv. Draw the circuit symbol for the measuring instrument in (b)(iii) in a correct position in **Fig. 17.3**.

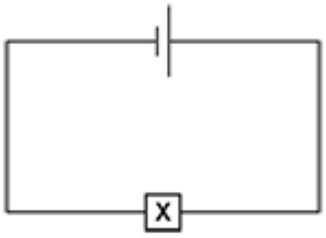


Fig. 17.3

[2]

(c). Component **X** has a resistance of 6.0 Ω.

A current of 4.0 A flows through component **X**.

Calculate the potential difference across component **X**.

Use the Equation Sheet June 23 J249-01-02-03-04.

Potential difference = ... V **[3]**

9. Which pair of resistors has the greatest total resistance?

A 

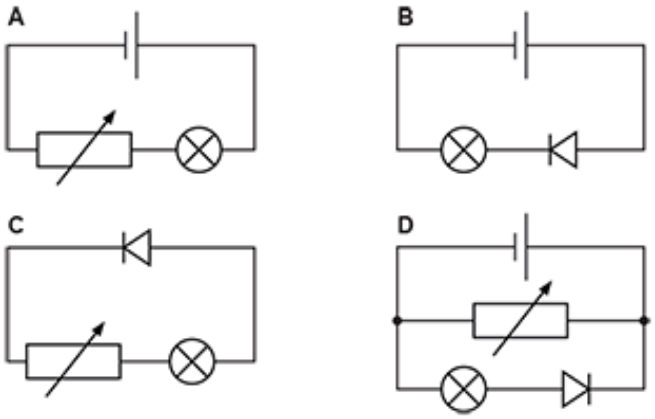
B 

C 

D 

Your answer ☐ **[1]**

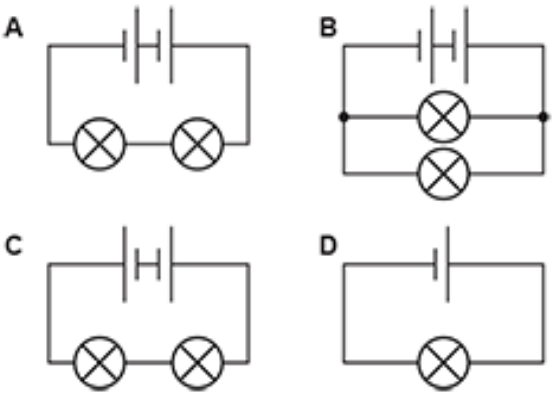
10. Which circuit diagram shows how the brightness of a lamp is changed using a variable resistor?



Your answer ☐ **[1]**

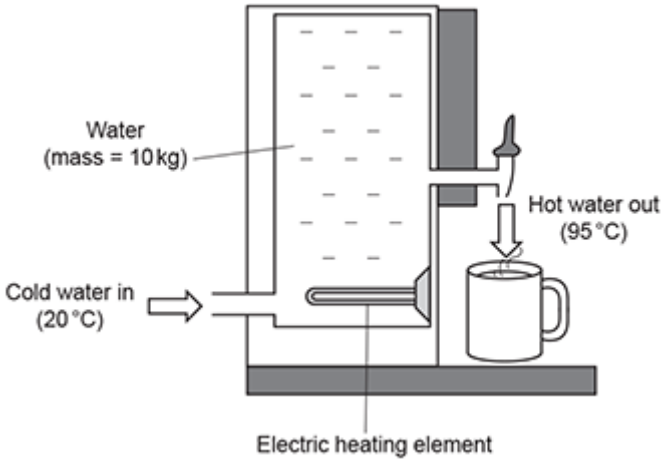
11. A student connects four circuits using identical cells and identical lamps.

Which circuit has the **brightest** lamps?



Your answer ☐ **[1]**

12. An electric water heater is used to make hot water for drinks.



i. The power of the water heater is 1840 W.
The p.d. of the mains supply is 230 V.

Calculate the current in the heating element.

Use the equation: power = potential difference × current

Current = ... A **[3]**

ii. An engineer says, 'You should use a water heater with a higher current.'

Suggest **two** reasons why this is a good idea.

1 _____

_____

2 _____

_____

[2]

13. A power station has an output power of 2×10^6 kW.

Calculate the energy produced by the power station in 3 hours.
Give your answer in kW h.

Use the equation: energy transferred = power × time

Energy = ... kW h **[2]**

14(a). A teacher investigates the resistance of a filament lamp.

Fig. 17.1 shows the circuit the teacher uses.

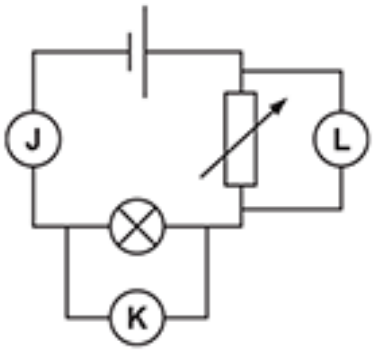


Fig. 17.1

The teacher takes measurements of the current through the filament lamp and the potential difference across it.

In which position, **J**, **K** or **L**, should the teacher place the ammeter and voltmeter?

Ammeter position: ..... Voltmeter position: ..... **[2]**

(b). The teacher takes measurements of the current through the filament lamp and the potential difference across it.

The teacher records their results in the table and plots the graph shown in **Fig. 17.2**.

Potential difference (V)	Current (A)
0.0	0.0
2.0	1.6
4.0	2.4
6.0	3.1
8.0	3.6
10.0	4.0

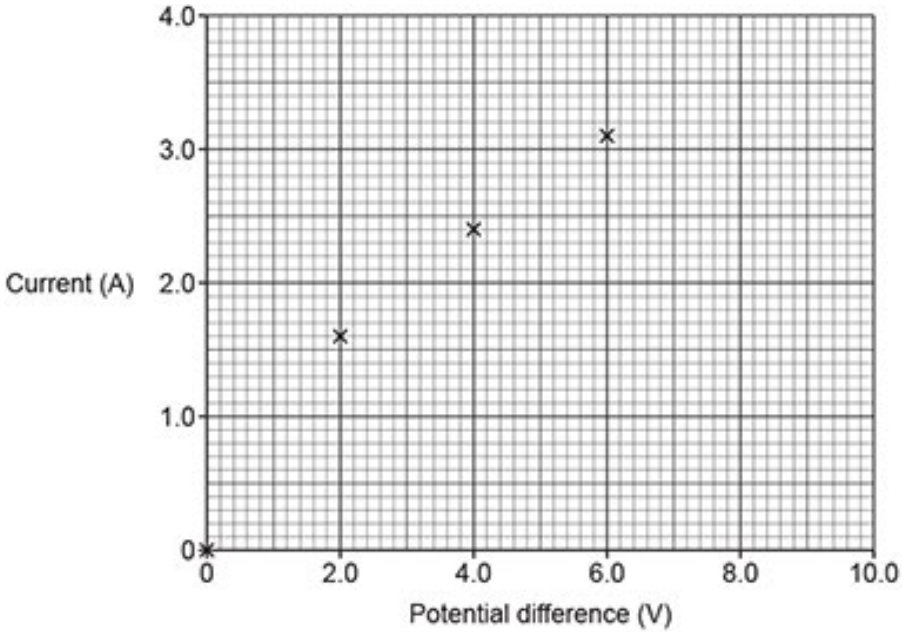


Fig. 17.2

i. Plot the **two** missing points on **Fig. 17.2** and draw a line of best fit.

[2]

ii. Calculate the power dissipated by the filament lamp when the potential difference is 5.0 V.

Use **Fig. 17.2** and the equation: power = potential difference × current

Power = ... W **[2]**

iii. Calculate the energy transferred if the filament lamp is used for 2 minutes.

Use your answer from **(ii)** and the equation: energy transferred = power × time

Energy = ... J **[3]**

15. A group of students investigate the resistance of an LDR.
The students change the distance between the LDR and the lamp and measure the resistance of the LDR.

The results are plotted on a graph.

Fig. 19.1 shows the experiment set-up and **Fig. 19.2** shows the graph of the students' results.

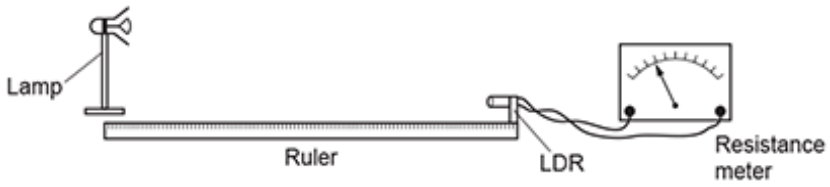


Fig. 19.1

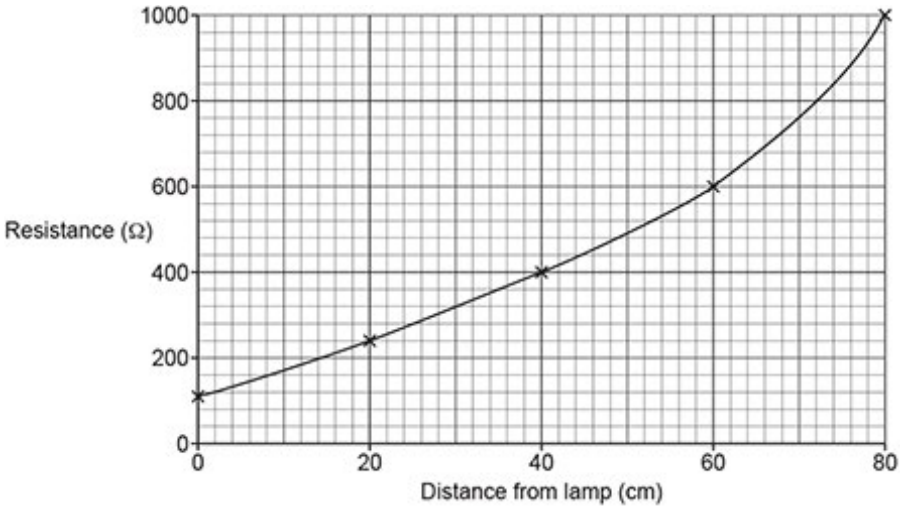
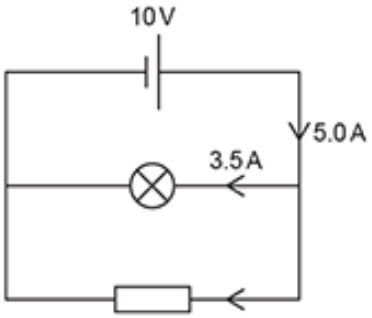


Fig. 19.2

Describe the trend shown by the graph in **Fig. 19.2**. Use data from the graph in your answer.
Suggest how the students could improve the accuracy and precision of their results.

[6]

16. A student sets up an electrical circuit as shown in the diagram.



What is the value of the current flowing through the fixed resistor?

A 1.5 A
B 3.5 A
C 5.0 A
D 8.5 A

Your answer ☐ **[1]**

17. A teacher investigates the resistance of a filament lamp.

Fig. 17.1 shows the circuit the teacher uses.

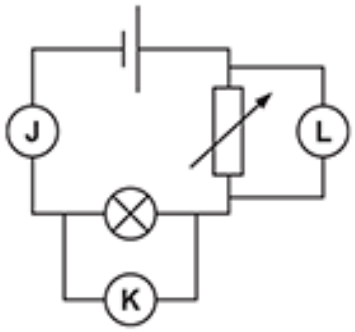


Fig. 17.1

Four students discuss the purpose of the component  in this circuit.

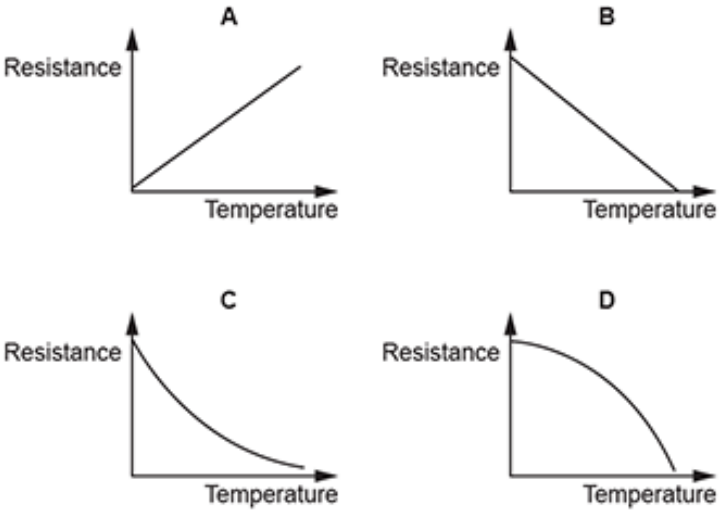
Student **A** says: “It is used to change the current flowing in the circuit.”
Student **B** says: “It is used to change the resistance of the cell.”
Student **C** says: “It is used to change the potential difference of the cell.”
Student **D** says: “It is used to change the total resistance of the circuit.”

Which **two** students have made a correct statement about the component?

Tick (✓) **two** boxes.

A ☐ B ☐ C ☐ D ☐ **[2]**

18. Which graph shows the relationship between temperature and resistance for a NTC thermistor?



Your answer ☐ **[1]**

END OF QUESTION PAPER