Electricity – 2021/20 GCSE Gateway Physics A

1. Nov/2021/Paper_J249/01/No.1

Which of the following would you find in the nucleus of an atom?

A Neutrons and electrons

B Neutrons, electrons and protons

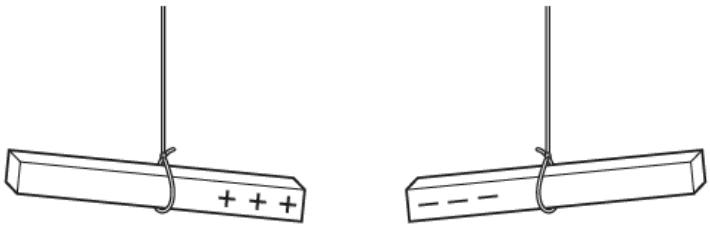
C Protons and electrons

D Protons and neutrons

Your answer ☐ **[1]**

2. Nov/2021/Paper_J249/01/No.2

Two charged rods are brought close together.



Which of the following explains what happens to the rods?

A Like charges attract so the rods move towards each other.

B Like charges repel so the rods move away from each other.

C Opposite charges attract so the rods move towards each other.

D Opposite charges repel so the rods move away from each other.

Your answer ☐ **[1]**

3. Nov/2021/Paper_J249/01/No.6

A current of 8A flows in a circuit for 32 seconds.

Calculate the charge which flows in the circuit.

Use the equation: charge flow = current × time

A 0.25 C

B 4.0 C

C 24.0 C

D 256 C

Your answer ☐ **[1]**

4. Nov/2021/Paper_J249/01/No.17

A student sets up a circuit using a diode, a lamp and a variable resistor, as shown in **Fig. 17.1**.

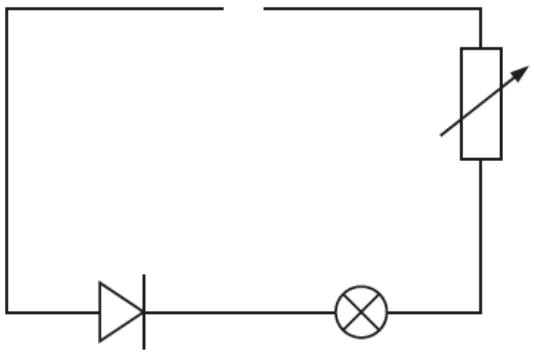


Fig. 17.1

Draw a cell in the circuit on **Fig. 17.1** so that the lamp would light up. **[2]**

5. Nov/2021/Paper_J249/01/No.24

A student does an experiment to calculate the resistance of an unknown component, **Y**.

The student sets up the circuit in **Fig. 24.1**.

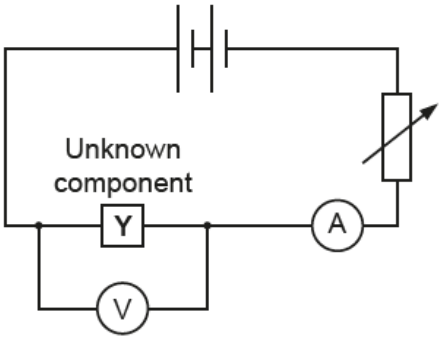
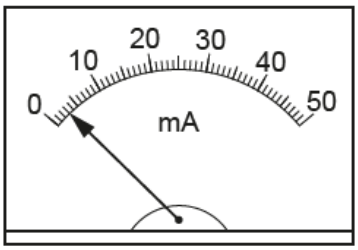


Fig. 24.1

(a) The student needs to be able to measure a current of up to 1A.

The student has a choice of two different ammeters to use, ammeter **A** and ammeter **B**.

Fig. 24.2 shows the initial readings on the ammeters **before** they are connected to the circuit.



Ammeter **A**

Ammeter **B**

Fig. 24.2

Which ammeter is best for the student to use? Give **two** reasons.

Ammeter .....

Reason 1 .....

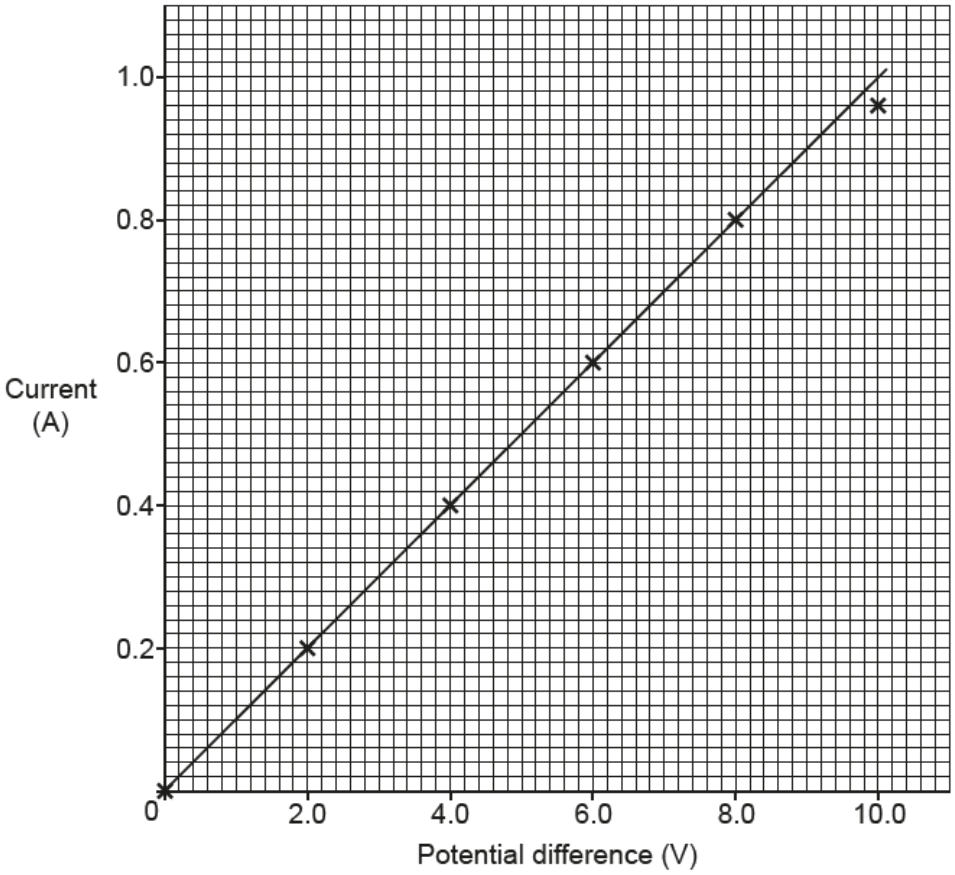
.....

Reason 2 .....

.....

[2]

(b) The student takes readings of potential difference and current for component **Y** and plots them on a graph.



(i) Explain why the student thinks that component **Y** is a fixed resistor.

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..... **[2]**

(ii) The student has correctly plotted the point at 10.0 V on the graph.

Suggest **one** reason why the point is not on the line of best-fit.

.....

..... **[1]**

(iii) Suggest **two** ways the student can check if their results are reproducible.

1 .....

.....

2 .....

.....

[2]

(c) The resistor has a resistance of 10.0 Ω.

Calculate the power of the resistor when the current is 0.5A.

Use the equation: power = (current)^2 × resistance

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

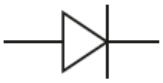
6. Nov/2021/Paper_J249/01/No.17

A teacher sets up a circuit to turn on a heater when the temperature decreases.

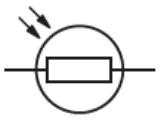
Which component does the teacher need to use in their circuit?

A

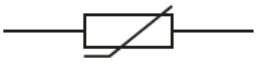
B



C



D

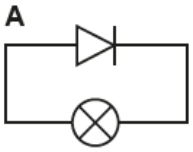


Your answer ☐ **[1]**

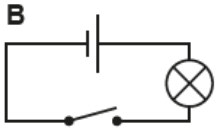
7. Nov/2020/Paper_J249/01/No.5

A student sets up four electrical circuits.

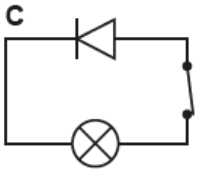
A



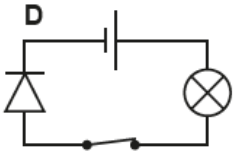
B



C



D



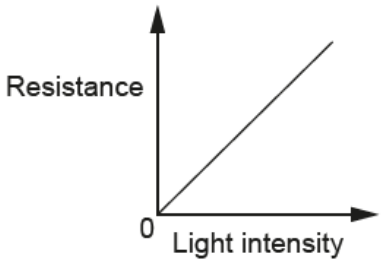
Identify in which circuit the lamp will light up.

Your answer ☐ **[1]**

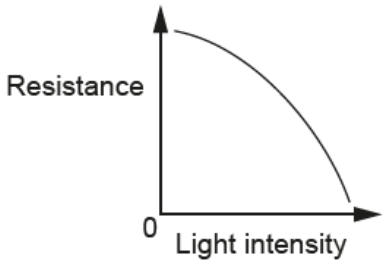
8. Nov/2020/Paper_J249/01/No.10

A student investigates how the resistance of a light dependent resistor (LDR) changes with light intensity.

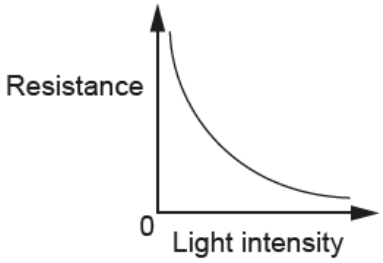
A



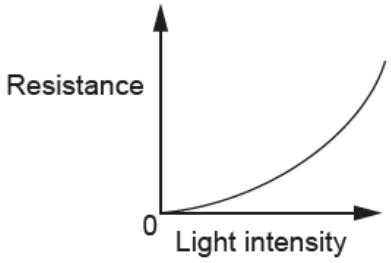
B



C



D



Which graph shows the correct relationship between the resistance of an LDR and light intensity?

Your answer ☐ **[1]**

9. Nov/2020/Paper_J249/01/No.12

Calculate the charge flow when a current of 20 mA flows for 2000 s.

Use the equation: charge flow = current × time

A 40 C

B 100 C

C 40 000 C

D 100 000 C

Your answer ☐ **[1]**

10. Nov/2020/Paper_J249/01/No.14

Which item uses the most power?

Use the equation: power = potential difference × current

	Item	Current (A)	Potential difference (V)
A	Calculator	0.1	3
B	Mobile Phone	1.0	5
C	Radio	0.5	12
D	Torch	1.2	6

Your answer ☐ **[1]**

11. Nov/2020/Paper_J249/01/No.17

A student sets up the circuit in **Fig. 17.1** to investigate the resistance of a lamp.

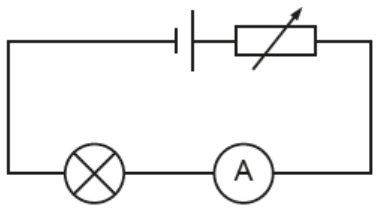


Fig. 17.1

(a) (i) The student also needs to add a voltmeter to the circuit.

On **Fig. 17.1 draw** where the voltmeter should be connected. **[2]**

(ii) The student takes readings of potential difference and current and records them in **Table 17.1**.

Potential difference (V)	Current
1.0	1.000
2.0	1.9
3.0	2.7
4.0	3.2
5.0	3.5

Table 17.1

There are **two** mistakes in the results table.

Write down the **two** mistakes and suggest how they could be corrected.

Mistake 1: .....

Correction 1: .....

Mistake 2: .....

Correction 2: .....

[4]

(iii) Calculate the resistance of the lamp when the potential difference is 4.0 V in **Table 17.1**.

Use the equation: potential difference = current × resistance

Resistance = ... Ω **[3]**

(b) The student plots the results from **Table 17.1** on the graph in **Fig. 17.2**.

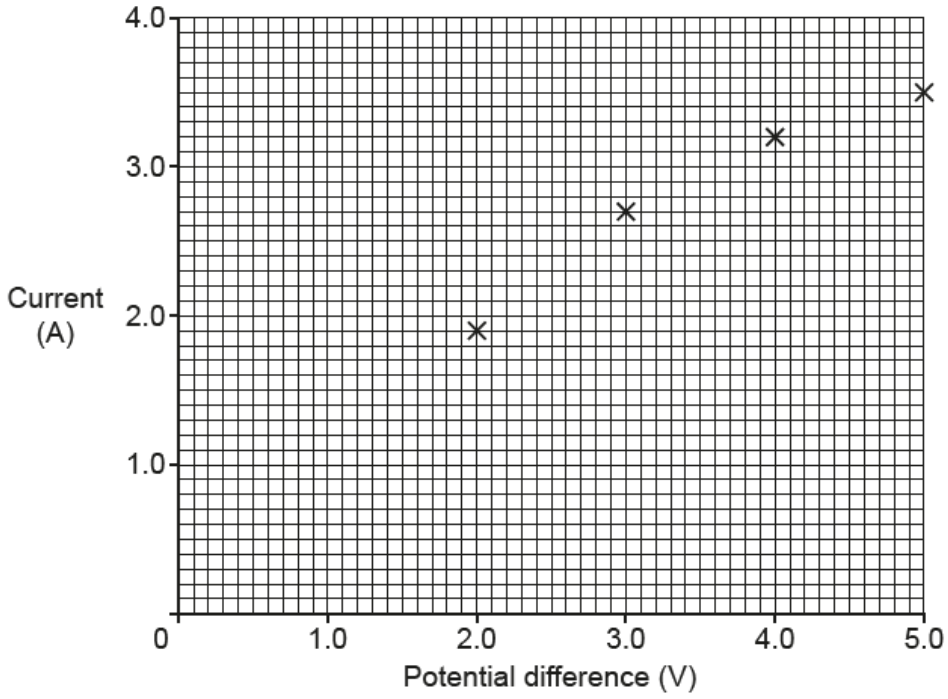


Fig. 17.2

(i) Plot the missing point at 1.0 V on the graph **and** draw a line of best fit. **[2]**

(ii) Describe the relationship between potential difference and current.

Use data from the graph to support your answer.

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..... **[2]**

(iii) Explain how you could use the circuit in **Fig. 17.1** to investigate the resistance of a fixed resistor instead of a lamp.

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..... **[2]**

(iv) Explain how and why the graph in **Fig. 17.2** would look different for a fixed resistor at a constant temperature.

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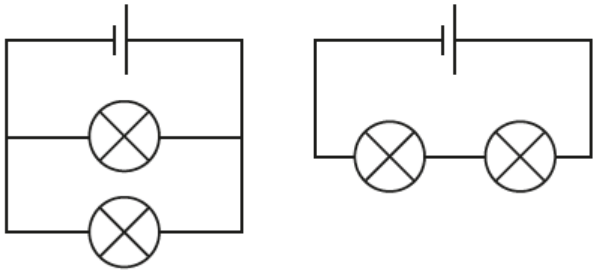
..... **[2]**

12. Nov/2020/Paper_J249/01/No.20

A student investigates if lamps are brighter in a series circuit or a parallel circuit. He sets up two different circuits, **A** and **B**.



A **B**

State which circuit will have the brightest lamps and explain why.

In your answer, include the variables that the student will need to control in this experiment.

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..... **[6]**

13. Nov/2020/Paper_J249/01/No.22

A student investigates static electricity using a plastic ruler.

(a) **(i)** Explain in terms of electrons why the plastic ruler is not normally charged.

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..... **[2]**

(ii) Explain in terms of electrons why the ruler becomes charged when the student rubs it with a cloth.

.....

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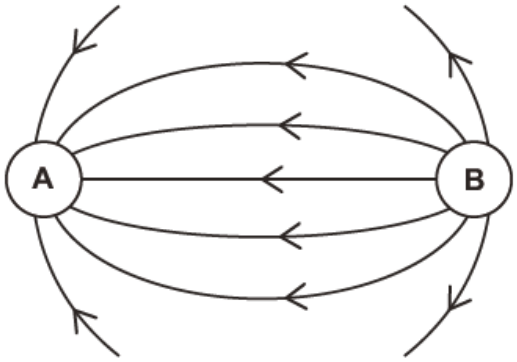
..... **[2]**

(b) The diagram shows the electric field between two charges, **A** and **B**.



(i) State the charges of **A** and **B**.

Use the diagram to explain your answer.

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.....

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..... **[3]**

(ii) Describe **one** similarity between the electric field line diagram and a magnetic field line diagram.

.....

..... **[1]**

(c) Calculate the charge when 200 J of energy is transferred with a potential difference of 40 V.

Use the equation: energy transferred = charge × potential difference

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

14. Nov/2020/Paper_J249/02/No.11

The table shows the current and potential difference for four different lamps.

Which lamp has the highest **power**?

Use the equation: power = potential difference × current

	Current (A)	Potential difference (V)
A	2	5
B	3	4
C	4	2
D	5	1

Your answer ☐ **[1]**

15. Nov/2021/Paper_J249/03/No.4

Two balloons, A and B, repel each other when placed close together.

Which row in the table explains why?

	Balloon A	Balloon B
A	Equal numbers of protons and electrons	More protons than electrons
B	Equal numbers of protons and electrons	Equal numbers of protons and electrons
C	More electrons than protons	More electrons than protons
D	More electrons than protons	More protons than electrons

Your answer ☐ **[1]**

16. Nov/2021/Paper_J249/03/No.6

In a series circuit a current of 50 μA flows.

Which current is the same size as 50 μA?

A 50×10^{-6} A

B 50×10^{-3} A

C 50×10^{3} A

D 50×10^{6} A

Your answer ☐ **[1]**

17. Nov/2021/Paper_J249/03/No.12

A transformer has 100 turns in the primary coil and 200 turns in the secondary coil. The potential difference across the primary coil is 30 V.

What is the potential difference across the secondary coil?

Use an equation from the data sheet to help you.

A 15 V

B 30 V

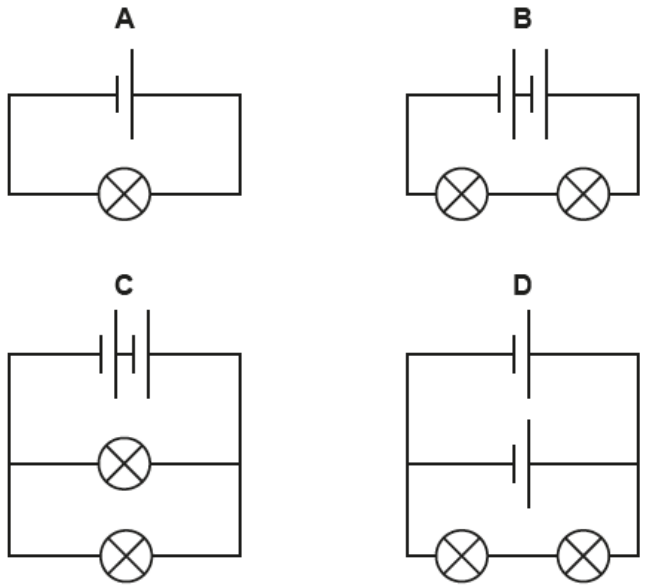
C 60 V

D 6000 V

Your answer ☐ **[1]**

18. Nov/2021/Paper_J249/03/No.13

The diagrams show four different circuits using identical cells and identical lamps.



Which circuit will have the brightest lamps?

Your answer ☐ [1]

19. Nov/2021/Paper_J249/03/No.17

A hamster has a mass of 100 g. When the hamster moves it has a momentum of 0.50 kg m/s.

Calculate the velocity of the hamster.

Use the equation: momentum = mass × velocity

A 0.0050 m/s

B 0.20 m/s

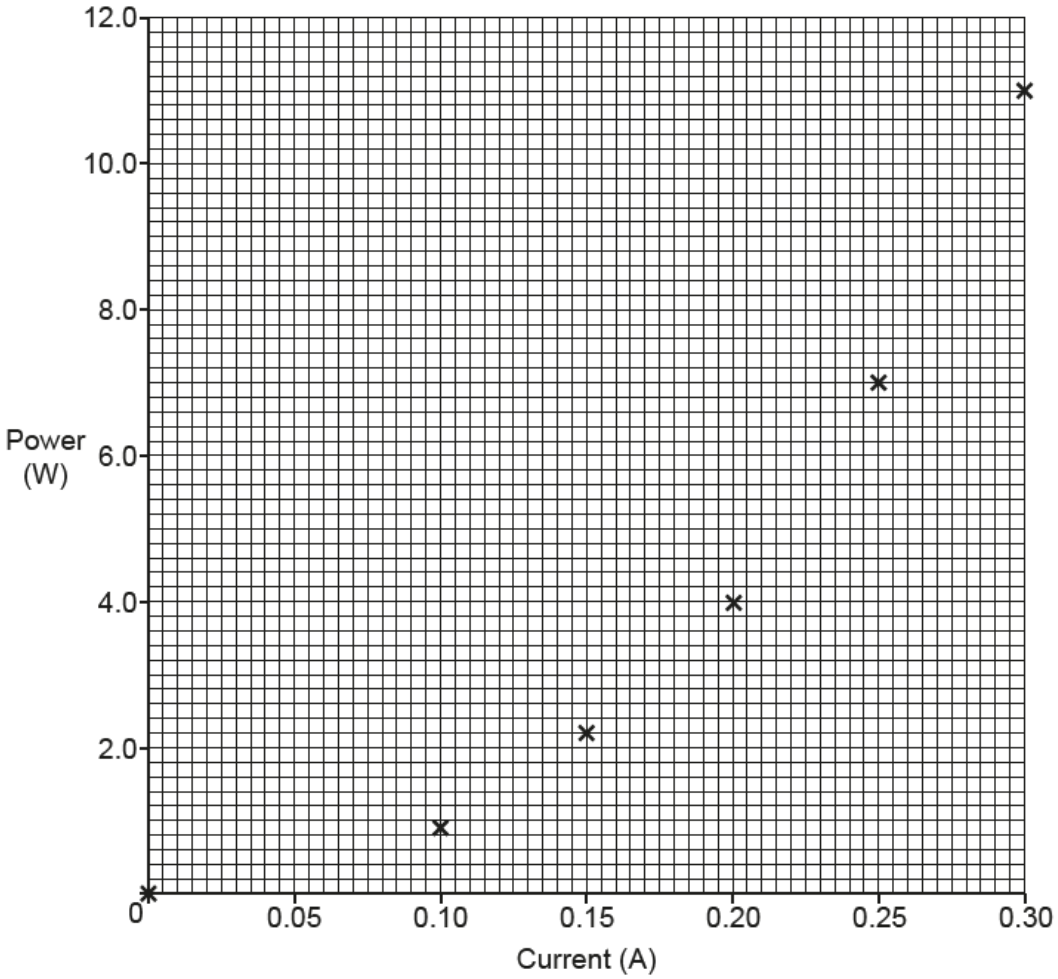
C 5.0 m/s

D 200 m/s

Your answer ☐ [1]

20. Nov/2021/Paper_J249/03/No.24

A student investigates how the electrical power of a component changes with current. They plot a graph of their results.



(a) Draw a line of best fit on the graph. **[1]**

(b) Use the graph to describe the relationship between current and power for the component.

.....

.....

..... **[2]**

(c) Use the graph to estimate the current when the power is 3.0 W.

Current = ... A **[1]**

(d) The student thinks that the resistance of the component increases as the current increases.

Use data from the graph to explain if the student is correct.

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.....

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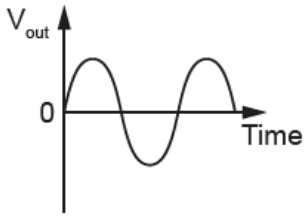
..... **[3]**

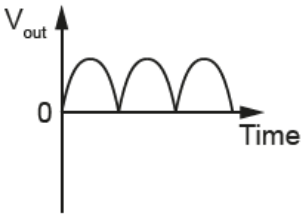
21. Nov/2020/Paper_J249/03/No.9

Which of the following graphs shows the typical output potential difference, V_{out}, for a dynamo?

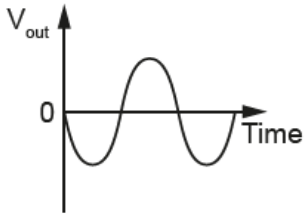
A



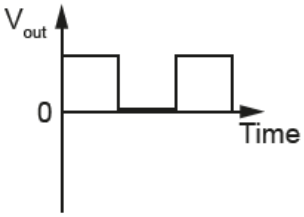
B



C



D



Your answer ☐ **[1]**

22. Nov/2020/Paper_J249/03/No.16

A student investigates static electricity using a plastic ruler.

(a) **(i)** Explain in terms of electrons why the plastic ruler is not normally charged.

.....

.....

..... **[2]**

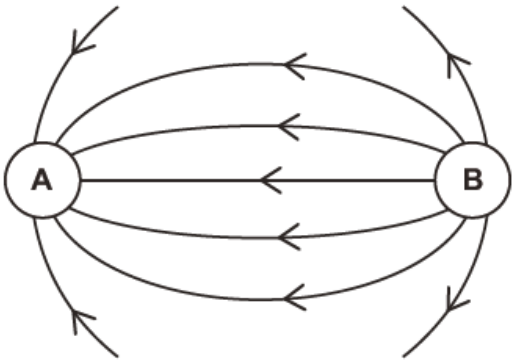
(ii) Explain in terms of electrons why the ruler becomes charged when the student rubs it with a cloth.

.....

.....

..... **[2]**

(b) The diagram shows the electric field between two charges, **A** and **B**.



(i) State the charges of **A** and **B**.

Use the diagram to explain your answer.

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.....

.....

..... **[3]**

(ii) Describe **one** similarity between the electric field line diagram and a magnetic field line diagram.

.....

..... **[1]**

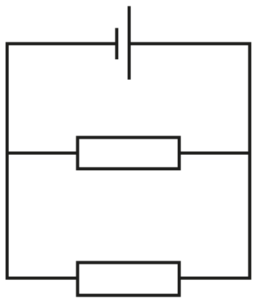
(c) Calculate the charge when 200 J of energy is transferred with a potential difference of 40 V.

Use the equation: energy transferred = charge × potential difference

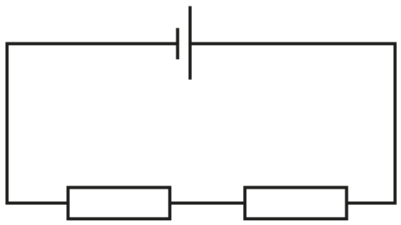
Charge = ... C **[3]**

23. Nov/2020/Paper_J249/03/No.19

A student builds two electrical circuits. Each circuit uses identical cells and identical fixed resistors.



A



B

(a) Explain why circuit **A** has a lower total resistance than circuit **B**.

.....

.....

..... **[2]**

(b) Another student investigates the resistance of a filament lamp.

(i) Explain why the resistance of a filament lamp increases when current increases.

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.....

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..... **[2]**

(ii) Design a circuit diagram which could be used to investigate how the resistance of a filament lamp changes with current.

Use the circuit symbols below. Each symbol can be used once, more than once, or not at all.

[2]

(iii) Describe how the student would use the circuit you have drawn in **19(b)(ii)** to investigate how the resistance of a filament lamp changes with current.

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..... **[3]**

24. Nov/2020/Paper_J249/04/No.21

(a) This question is about an electric kettle.

(i) An electric kettle is filled with water, connected to the mains and switched on.

The electricity for the kettle is generated in a coal-fired power station.

Describe the energy transfer that occurs when the kettle is switched on.

Include ideas about energy stores in your answer.

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..... **[2]**

(ii) The mains supply has a potential difference of 230 V.

The kettle has a current of 5.0 A. The kettle is switched on for 2.0 minutes.

Calculate the total energy transferred to the kettle in 2.0 minutes.

Total energy transferred = ... J **[4]**

(b) (i) **Table 21.1** gives some information about a different kettle.

Energy transferred to the kettle	525 000 J
Mass of water	1.2 kg
Starting temperature of water	25 °C
Final temperature of water	100 °C
Specific heat capacity of water	4200 J / kg °C

Table 21.1

Calculate the efficiency of the kettle described in **Table 21.1**.

Give your answer as a percentage.

Use an equation from the data sheet.

Efficiency = ... % **[5]**

(ii) Explain why the efficiency of the kettle is less than 100%.

.....

..... **[1]**

(c) The water can also be heated using a 12 V heater.

A transformer is used to change a 120 V supply into 12 V.
The current in the secondary coil is 9.0 A.

Calculate the current in the primary coil.

Use an equation from the data sheet.

Current = ... A **[2]**