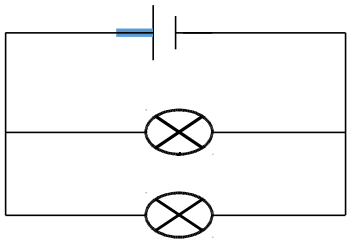
Lesson 8 – Parallel Circuits and Current

Do now:

1. Is this circuit series or parallel? (1)



2. Describe how current flows in a parallel circuit.(1)

3. Describe the difference between a cell and a battery. (1)

4. Name the piece of equipment used to measure current. (1)

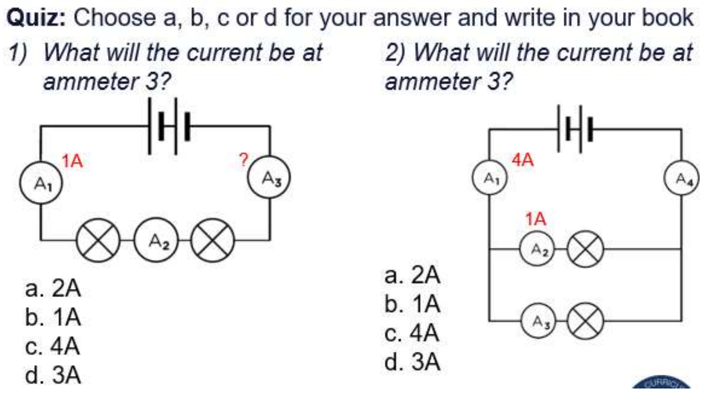
5. Give the units for charge flow. (1)

Challenge: Compare series and parallel circuits**.**

Key Knowledge:

Describe current in a series circuit.	The current is the same across all components.
If you add another bulb to a series circuit, how will the affect the brightness of the bulbs in the circuit?	The brightness will decrease.
Describe current in a parallel circuit.	The current is shared across all components.
If you add another bulb to a parallel circuit, how will the affect the brightness of the bulbs in the circuit?	The brightness will stay the same.

Quiz:


Quiz: Choose a, b, c or d for your answer and write in your book

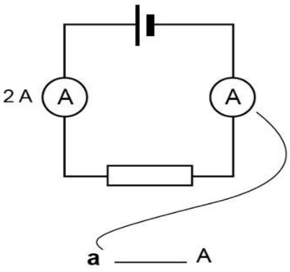
1) *What will the current be at ammeter 3?*

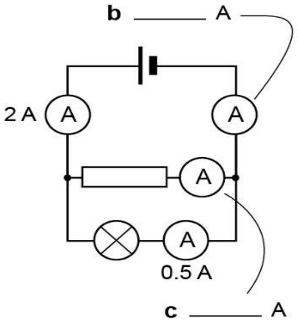
a. 2A
b. 1A
c. 4A
d. 3A

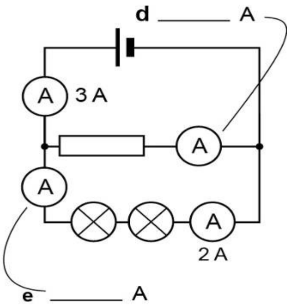
2) *What will the current be at ammeter 3?*

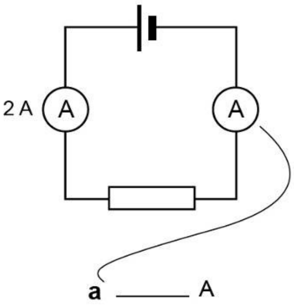
a. 2A
b. 1A
c. 4A
d. 3A

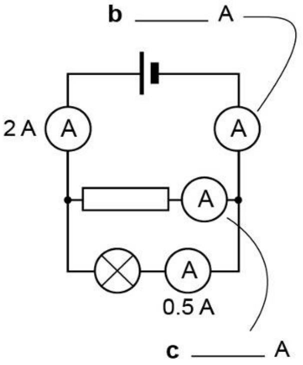
Application Task: Fill in the blanks

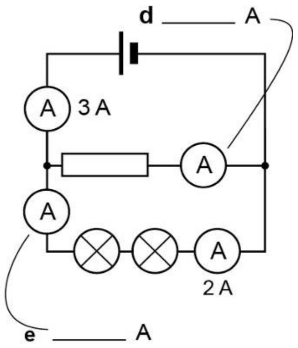


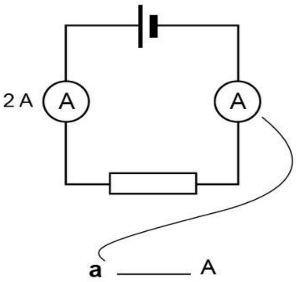


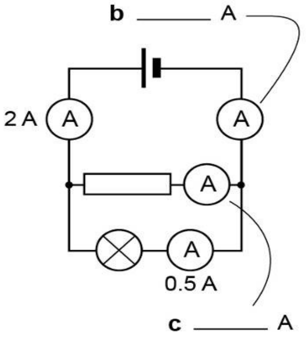


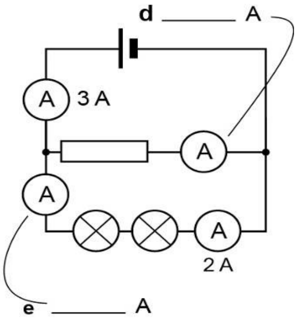












Lesson 9: Potential Difference

Do now:

1. Describe current in a series circuit. (1)

2. Describe how the brightness of a bulb would be affected if another bulb was added in series. (1)

3. Which subatomic particles has a negative charge? (1)

4. Explain why we use control variables. (1)

5. Calculate the charge flow through a component if a current of 5A flows for 10 seconds. (1)

Challenge: Explain why a parallel circuit would be better to use if you were linking 8 bulbs in a circuit together to light up a classroom.

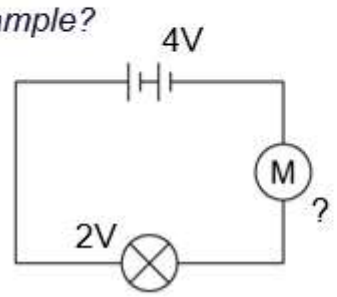
Key knowledge:

What is potential difference (V)?	Potential difference is the amount of energy supplied, per unit of charge, to move an electron around a circuit.
What happens to the energy carried by charges when those charges move through a component?	The energy is transferred to the components.
What is potential energy measured in?	Volts (V)
What are the two rules for potential difference in a series circuit?	1. Potential difference is shared between components in a series circuit 2. The sum of the voltages across components in series is equal to the voltage of the supply.

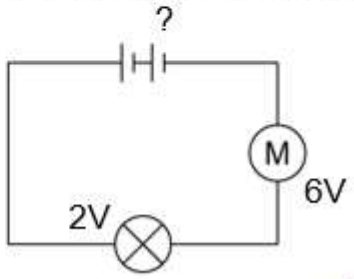
Quiz:

1) *Define potential difference.*
2) *Give the units for measuring potential difference.*

3) *What potential difference is transferred to the motor in this example?*



4) *What is the potential difference of the battery in this example?*



Application task:

Explain how potential difference across a component in a circuit is determined by the cell and number of components in a circuit (5 marks)

Success Criteria

- ❑ State what component contains an energy store.
- ❑ Describe how energy is transferred from the store through the wires, to a component.
- ❑ Describe what happens to potential difference across the bulb in the circuit to the left when another cell is added to circuit.
- ❑ Describe what happens to the potential difference across the component when a second component is added to the circuit.

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Lesson 10: Measuring Potential Difference

Do now:

1. Define potential difference. (1)

2. Give the units for potential difference. (1)

3. Explain why electrical current can flow through a conductor. (1)

4. Name the piece of equipment used to measure the current in a circuit. (1)

5. Calculate the range of these numbers: (1) 13 17 2 8 22 19 24 1

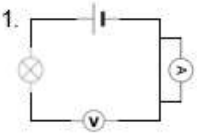
Challenge: Compare current and potential difference in series circuits.

Key Knowledge:

What piece of apparatus is used to measure potential difference across a component?	Voltmeter
How should a voltmeter be arranged in a circuit?	In parallel with the component.
Why must a voltmeter be set up in parallel to a particular component?	Voltage is a measure of the change in energy across a component, therefore, two readings are needed to work out the difference.
Describe potential difference in a series circuit.	Potential difference is shared between components in a series circuit
Describe potential difference in a parallel circuit.	The potential difference across each component is equal to the potential difference from the battery.

Quiz:

Which of these shows an ammeter and voltmeter correctly placed?

1.


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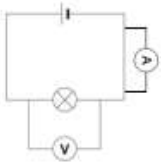
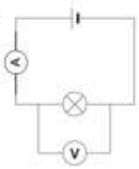
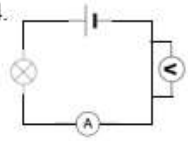
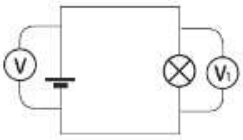


3.


4.


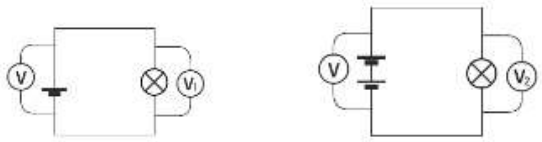
In this circuit, the voltage across the cell is 2V.



What is the reading on voltmeter V1?

1) 4V
2) 2V
3) 1V
4) 0V

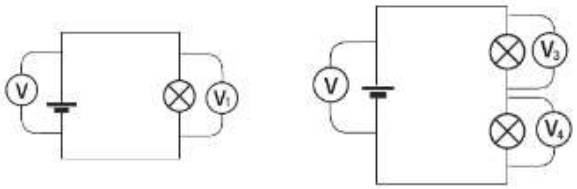
Another cell is added to the circuit. $V_1 = 2V$.



What is the reading on voltmeter V_2?

1) 4V
2) 2V
3) 1V
4) 0V

Instead of adding another cell, another bulb is added.
$V_1 = 2V$.



What is the reading on voltmeter V3?

1) 4V
2) 2V
3) 1V
4) 0V

Application task: Draw the circuits described in the table

Circuit	Description	Drawing
1	One cell, one bulb. Voltmeter connected in parallel across the lamp.	
2	One cell, one bulb. Voltmeter connected in parallel across the cell.	
3	Two cells, one bulb. Voltmeter connected across the bulb.	

4	Two cells, two bulbs. Voltmeter connected across one of the lamps (Doesn't matter which one)	
5	Two cells, two bulbs. Voltmeter connected across both lamps.	
6	Two cells, two bulbs. Voltmeter connected across the cell.	

Lesson 11: Parallel Circuits and Voltage

Do now:

1. Potential difference is the difference in _____ from one point in a circuit to another. (1)

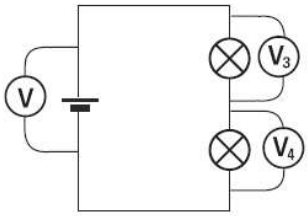
2. How do we connect a voltmeter to measure the voltage across a component? (1)

3. Describe the main energy transfer involved in a circuit. (1)

4. Name the piece of equipment used to measure potential difference in a circuit. (1)

5. Give the rearranged equation to find time from current and charge flow. (1)

Challenge: The potential difference across at V3 is 4.5V, what is the p.d. at V4 and across the cell?

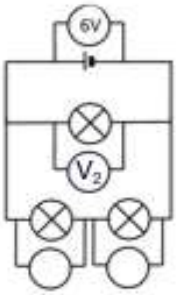


Key knowledge:

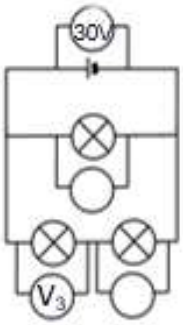
Define potential difference.	The difference in energy from one point in a circuit to another. This provides the push for the charges to flow.
What is the rule for potential difference in a parallel circuit?	The potential difference across each branch of the circuit is the same as the potential difference across the power supply.
What is the rule for potential difference in a branch of a parallel circuit with more than one component?	The potential difference is shared between components within a branch of a parallel circuit.

Quiz:

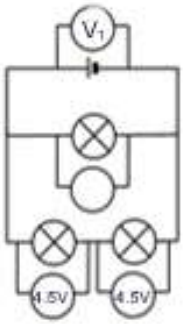
A) What is the reading on voltmeter V_2?
1. 8V
2. 6V
3. 12V



B) What is the reading on voltmeter V_3?
1. 30V
2. 60V
3. 15V

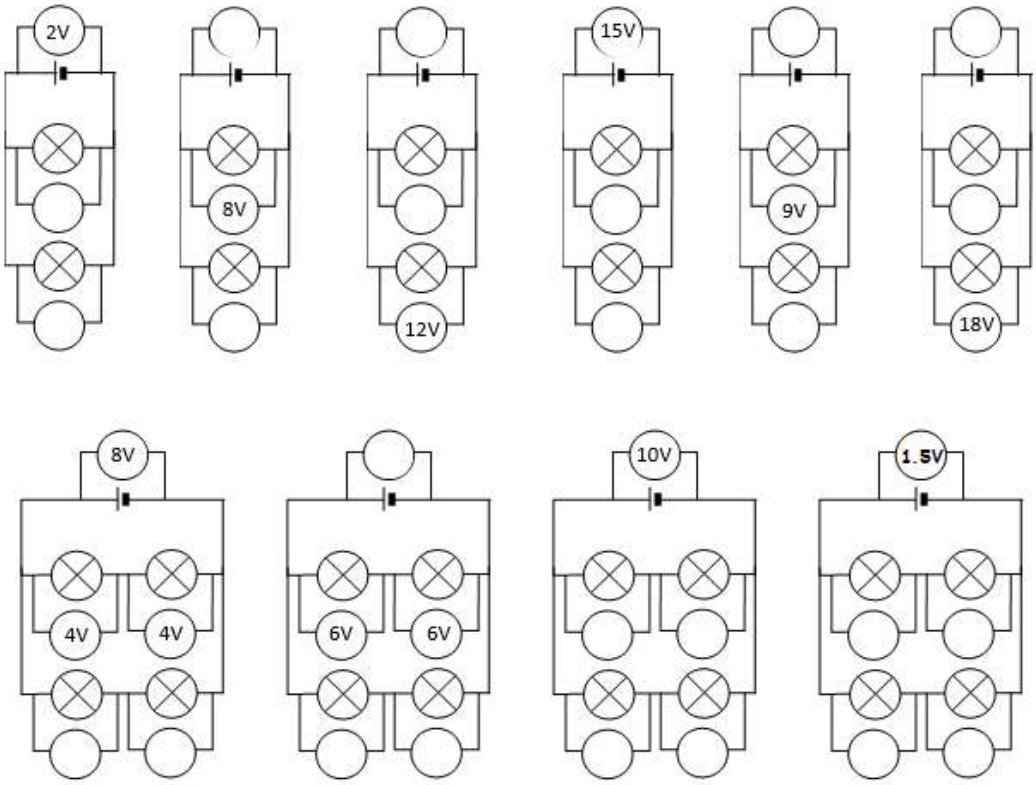


C) What is the reading on voltmeter V_1?
1. 9V
2. 4.5V
3. 18V



Application task: Fill in the blank readings

Potential Difference in Parallel Circuits

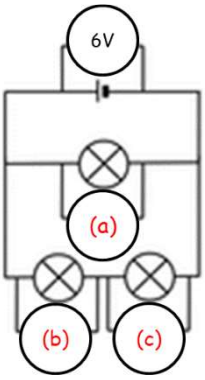


Lesson 12: Resistance in a Circuit

Do now:

1. In a series circuit, potential difference is _____ between components. (1)

2. In a parallel circuit, the potential difference of each branch is equal to… (1)



3. State the reading on the voltmeters at points (a), (b) and (c). (3)

4. Name the variables which we keep the same in an experiment. (1)

5. State the units for current. (1)

Challenge: Calculate the time taken for 5C of charge to pass through a 10A bulb.

Key Knowledge:

Define resistance.	A measure of how hard it is for current to flow through a particular part of a circuit.
How much resistance do components, such as light bulbs, have?	Components have high resistance.
How much resistance do copper wires have?	Copper wires have almost no resistance.
What is the equation that links potential difference, current and resistance?	potential difference (V) = current (A) x resistance (Ω - Ohms) V = I R
What is the rule for resistance in circuits?	The resistance in a circuit is the sum of the resistance of all components.

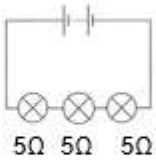
Quiz:

A) Define resistance.

1. A measure of how hard it is for current to flow through a part of a circuit.
2. A measure of how easy it is for current to flow through a part of a circuit.
3. A measure of how hard it is for resistance to flow through a part of a circuit.

B) What is the total resistance of the circuit to the right?

1. 5Ω
2. 10Ω
3. 15Ω



C) What is the equation that links resistance, current and potential difference? on voltmeter V_1?

1. Resistance (Ω) = current (A) x potential difference (V)
2. Current (A) = resistance (Ω) x potential difference (V)
3. Potential difference (V) = current (A) x resistance (Ω)

Application task:

1. What is the formula linking potential difference, current and resistance?	5. Calculate the resistance through a device which has a potential difference output of 230V and a current of 100A.	9. If the resistance of a kettle is 20Ω, with a potential difference of 2.5V, what is the current flowing through it?
2. Rearrange this formula to find	6. Calculate the resistance of a	10. If the resistance of a TV is

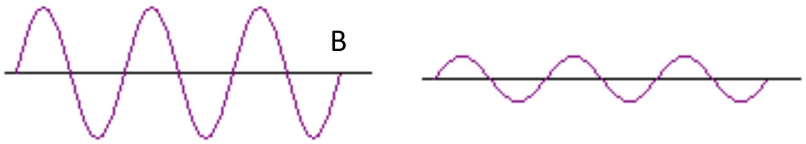
current.	device with a potential difference of 640V when a 12.8A current is running through it.	60Ω, with a potential difference of 150V, what is the current flowing through it?
3. Rearrange this formula to find resistance.	7. Calculate the resistance of a device with a potential difference of 230V and a current of 46A.	11. If the resistance of a toaster is 20Ω, with a current flowing through it of 20A, what is the potential difference?
4. A circuit contains two 1.5 volt batteries and a bulb with a resistance of 3 ohms. Calculate the current.	8. What is the voltage of a circuit with 15 amps of current and toaster with 8 ohms of resistance?	12. A light bulb has a resistance of 4 ohms and a current of 2 A. What is the potential difference across the bulb?

Lesson 13: Power in a Circuit

Do now:

1. What are the 3 sub-atomic particles that make up an atom?
2. What is the unit for resistance?
3. What is the unit for wave speed?
4. Which wave, A or B has a high amplitude?

A



5. A solution has a pH of 6.5. Is this an acid, alkali or neutral?

Challenge: Find the resistance in a component with 6V of p.d. and a current of 1.5A flowing through.

Key knowledge:

Define power.	Power is the amount of energy transferred each second.
What is the equation to calculate Power from potential difference and current?	Power (W) = Potential difference (V) x Current (A) P = V x I
What happens to the power if we increase the current?	Power is increased.
What happens to the power if we increase the potential difference?	Power is increased.
What does 1 Watt (W) of power tell us?	1 Watt (W) tells us that 1J of energy was transferred per second

Quiz:

A. Which letter represents power?
1) W
2) P
3) V

B. What unit do we use for power?
1) Amps
2) Volts
3) Watts

C. What is the formula for calculating power from current and the potential difference?
1) Power (P) = potential difference (V) x current (I)
2) Power (P) = current (I) ÷ potential difference (V)
3) Power (P) = potential difference (V) x current (C)

D. What happens to power if we decrease the current?
1) Power decreases
2) Power increases
3) Power stays the same

Application task:

30%	50%	70%
5. What is the formula linking power, current and voltage?	4. A kettle has a current of 10A and a p.d. of 230V. Calculate the power output.	7. The heating element in a kettle produces an output of 1200W with a p.d. of 230V. Calculate the current flowing through it.

6. Rearrange this formula to calculate current.	5. A TV has a current of 80A and a p.d. of 230V. Calculate the power output.	8. A TV produces an output of 5kW with a p.d. of 230V. Calculate the current flowing through it.
7. Rearrange this formula to calculate voltage.	6. A toaster has a current of 20A and a p.d. of 230V. Calculate the power output.	9. A toaster produces an output of 2.5kW with a p.d. of 230V. Calculate the current flowing through it.

Lesson 14: Mini Quiz

Do now:

1. Define power. (1)
2. What happens to power of a component if the potential difference is increased across the component? (1)
3. Explain why adding a bulb to a series circuit with a bulb and battery will decrease the brightness of the bulb. (1)
4. Define repeatable. (1)
5. Calculate the power of a bulb if 20A of current is flowing with a potential difference across the bulb 230V. (1)

Challenge: A pair of hair straighteners has a power output of 2.2kW and a potential difference of 110V. Calculate the current flowing through them.

Mini quiz:

Current

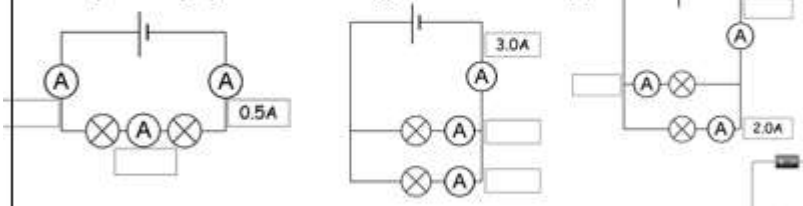
1. Write the definition of 'current' (1)

/7

Current is the _____ of _____ of charge in a circuit.

2. Draw the symbol and write the name for the component used to measure current (1)

3. Complete the gaps with the readings in these circuits (3)



4. The middle bulb is broken in the circuit to the **right**. Does bulb 2 stay on or go out?. Explain your answer. (2)

Conductivity and circuits

1.) What is the name for a material which does not allow electricity to pass through? (1)

2): List two properties that make copper a good material for electric wires? (2)

3) What do these two symbols represent? (2)

4) Draw a circuit with 1 cell, 1 switch and 1 bulb (2)

/7

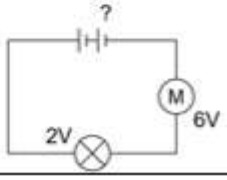
Potential difference

1. Write the definition of 'potential difference' (1)

Potential difference is the difference in _____ from one point in a circuit to another that provides the _____ for the charges to flow.

2. Draw the symbol and write the name for the component used to measure potential difference (2)

3. Calculate the potential difference of the battery in this circuit. (1)



4. Name the unit for potential difference. (1)

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Resistance and Power

1. What is power measured in? (1)

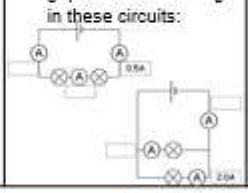
2. Power = ... x ..... (1)

3. Calculate the power of a bulb if 10A of current flows with a potential difference of 10 V across the bulb. (1)

4. The equation for resistance is: Resistance = Voltage ÷ Current
If the current in a circuit is 12A and the voltage is 24V what is the resistance? Include the units. (2)

/5

MAD Time task: choose based on which section you scored lowest

MAD Time Task 1	MAD Time Task 2	MAD Time Task 3	MAD Time Task 4
Use your book to answer the following questions: 1. Define a conductor 2. Name 2 materials that are good conductors 3. Define an insulator 4. Name 2 insulating materials 5. Draw a complete circuit including the following components: Cell, bulb, switch	Use your book to answer the following questions: 1. Draw the symbols for: Cell, bulb, switch, wire, ammeter, voltmeter, buzzer 2. Draw a series circuit with 2 cells, an open switch and a bulb 3. Will the bulb light up? Explain your answer. 4. Draw a circuit with 2 bulbs in parallel, a cell and a voltmeter measuring the potential difference across one bulb. b) If the voltage of one bulb is 2V what is the voltage of bulb 2?	Use the book to answer the following questions: 1. Define current 2. What are the unit for current? 3. What is the rule for current in a series circuit? 4. What is the rule for current in a parallel circuit? 5. Now complete the gaps with the readings in these circuits: 	Use the book to answer the following questions: 1. Define voltage 2. What are the units for voltage? 3. In the diagram, the voltage across the battery is 3V. What is the voltage across the voltmeter? Explain your answer.  4. Calculate the power of a kettle that is plugged into a mains electricity (220V) and has a current of 10A .

EXTENSION TASKS

Calculate the power of bulb if it has resistance of 12.5Ω and a potential difference across the bulb of 150V. (5 marks)

Lesson 15: Magnetic Fields

Do now:

1. Define a permanent magnet.
2. State the magnetic materials
3. Explain why electrical circuits for lighting in buildings are typically parallel circuits.
4. Name a piece of equipment to use for accurately measuring pH.
5. State the equation for power.

Challenge: Explain how you could test to see if a magnet is permanent (2).

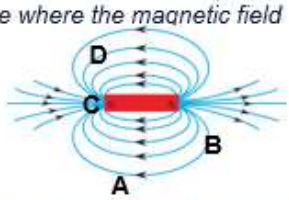
Key knowledge:

What is the region around a magnet where magnetic force has an effect called?	Magnetic field
State one factor that effects the strength of the force of a magnetic field	Distance from magnet
What direction do the magnetic field lines go when drawn around a magnet?	North (seeking) pole to south (seeking) pole
How do you plot magnetic field lines around a magnet?	Use a compass to identify north and join dot to dot
How does a compass work for navigation?	The core of the Earth is magnetic!

Quiz:

A. The magnetic field of a magnet is…
1) the region around a magnet where magnets attract
2) the region around a magnet where magnetic force has an effect
3) the region around a magnet where magnets repel

B. Which letter in the diagram represents the place where the magnetic field force is strongest?
1) A
2) B
3) C
4) D

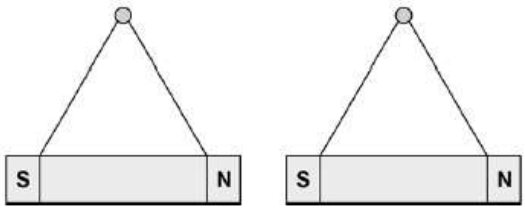


C. What direction do the magnetic field lines go when drawn around a magnet?
1) North (seeking) pole to south (seeking) pole
2) South (seeking) pole to north (seeking) pole

Application task:

Q1.

Figure 1 shows two bar magnets suspended close to each other.



(a) Explain what is meant by the following statement.

'A non-contact force acts on each magnet'.

_____

_____

_____

_____

(2)

(b) Describe how to plot the magnetic field pattern of a bar magnet.

_____

_____

_____

_____

_____

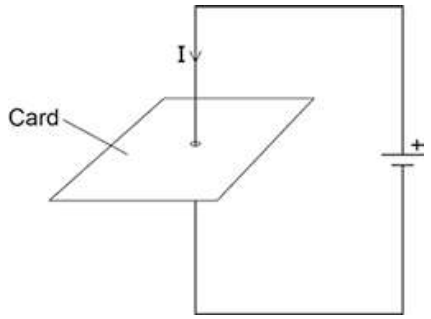
_____

(3)

Q2.

Figure 1 shows a straight wire passing through a piece of card.

A current (I) is passing down through the wire.



(a) Describe how you could show that a magnetic field has been produced around the wire.

_____

_____

_____

_____

(2)

Q3.

(a) **Diagram 1** shows a magnetic closure box when open and shut. It is a box that stays shut, when it is closed, due to the force between two small magnets.

These boxes are often used for jewellery.

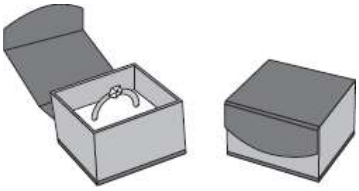
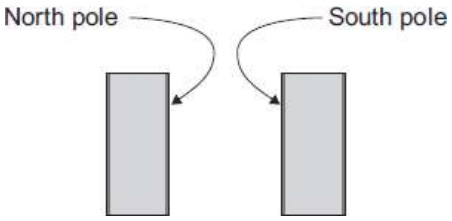


Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

Diagram 2



(i) Draw, on **Diagram 2**, the magnetic field pattern between the two facing poles.

(2)

(ii) The magnets in the magnetic closure box must **not** have two North poles facing each other.

Explain why.

_____

_____

_____

_____

(2)

Lesson 16: Magnets

Do now:

1. State the equation for calculating power. (1)
2. What is the power of a phone if the current flowing through it is 5A and the potential difference is 200V? (1)
3. I want to find out if a substance is an acid or an alkali, how could I do this? (1)
4. I have got the following results for an acidic solution: 2.8, 3, 3.2, 3.1 and 6. State the anomaly in my results and explain why you chose it. (2)
5. Rearrange the power equation to find current. (1)

Challenge: Explain the difference between potential difference and current in a parallel circuit.

Key knowledge:

Define "poles" on a magnet	The place where the magnetic force is the strongest
What is the effect of two like poles on each other? (e.g. N-N)	Repel
What is the effect of two different poles on each other? (e.g. N-S)	Attract
What type of force are attraction and repulsion?	Non-contact
Define "permanent" magnet	Produces it's own magnetic field
Define "induced" magnet	A material that becomes a magnet when placed in a magnetic field
Name 4 magnetic materials	Iron, steel, cobalt, nickel
Describe the force between a magnet and a magnetic material	Attraction

Quiz:

A. Which statement describes the forces in the diagram to the right?
1) Magnetic force of repulsion between like poles
2) Magnetic force of attraction between like poles
3) Magnetic force of repulsion between opposite poles

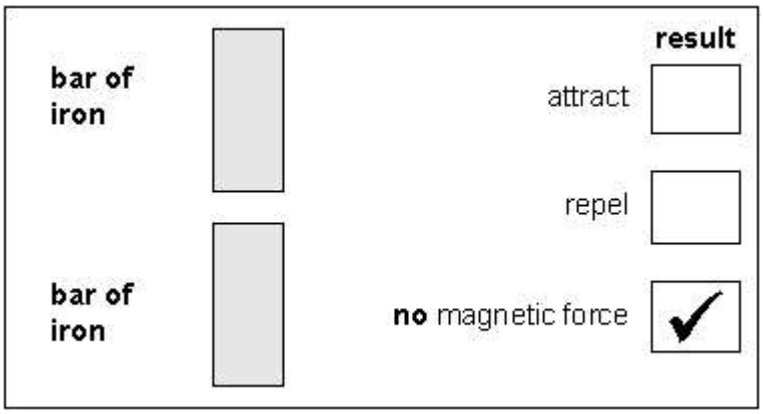
B. Which statement is true of induced magnets?
1) Produce their magnetic field – always attracts
2) Becomes a magnetic when placed in a magnetic field – always attracts
3) Produce their magnetic field – always repels

C. Name four magnetic materials.

Application task:

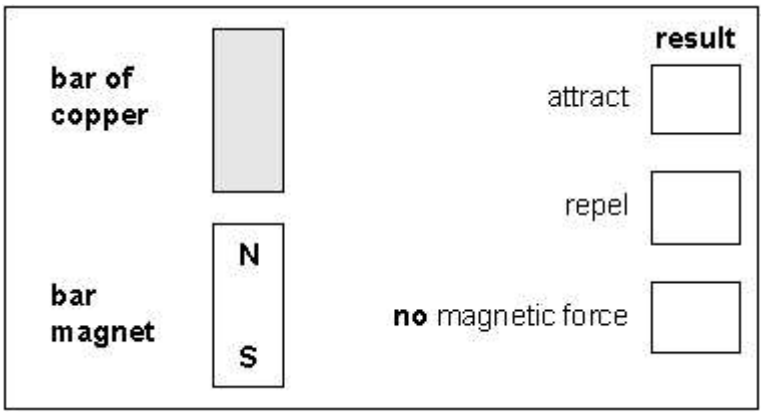
Q1.

David put two bars of iron close to each other.
There was **no** magnetic force between them.
David recorded the result as shown below.



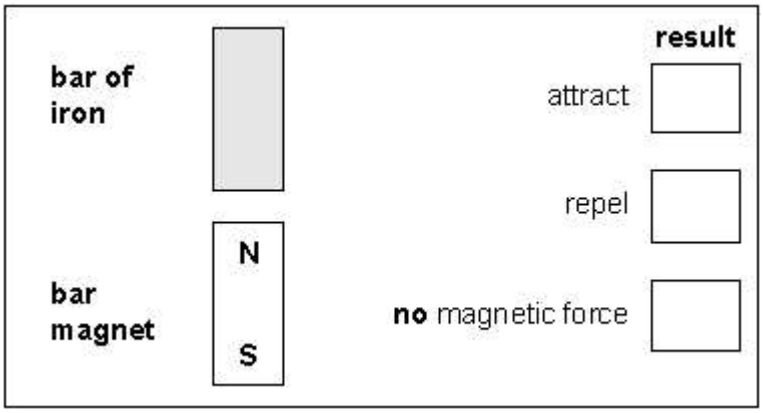
(a) David did three other tests.
Tick the correct box to show the result for each test.

(i)



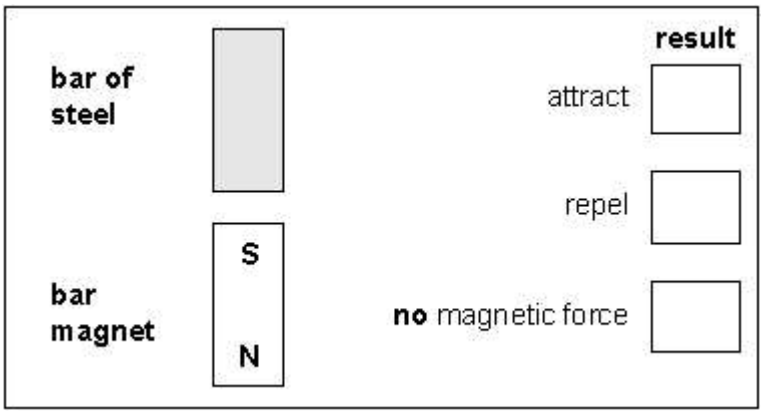
1 mark

(ii)



1 mark

(iii)



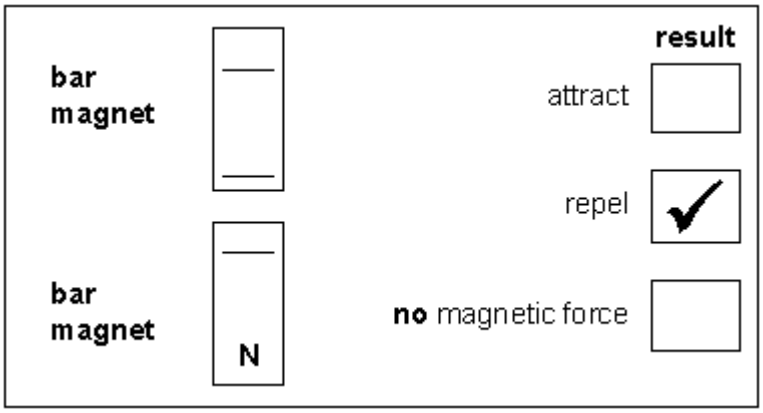
1 mark

(b) David then did two experiments with magnets.

The tick in each box shows David's results in each experiment.

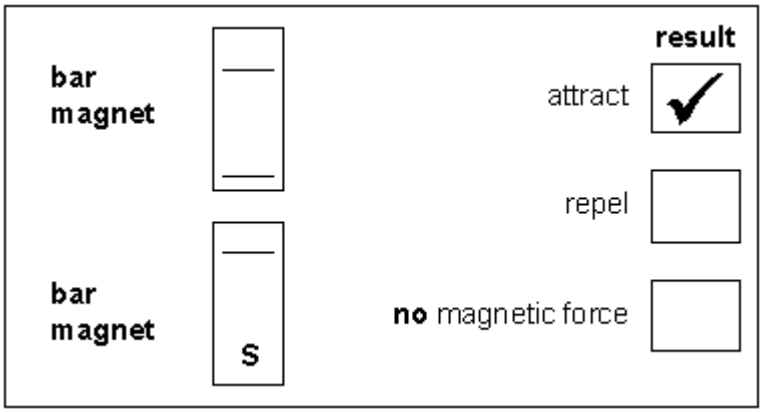
Label the missing poles on **each** magnet to match David's results.

(i)



1 mark

(ii)



1 mark

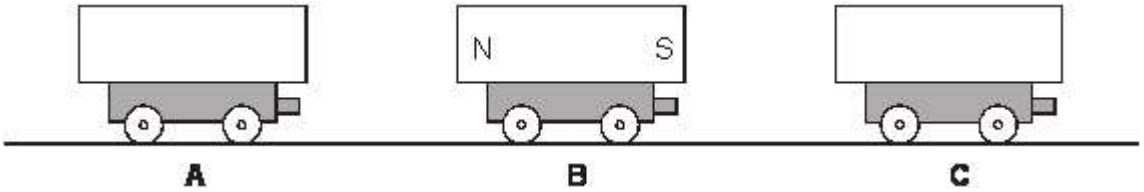
maximum 5 marks

Q2.

The diagram below shows three trolleys.
Peter put a bar magnet on each trolley.

(a) He pushed trolleys A, B and C together.

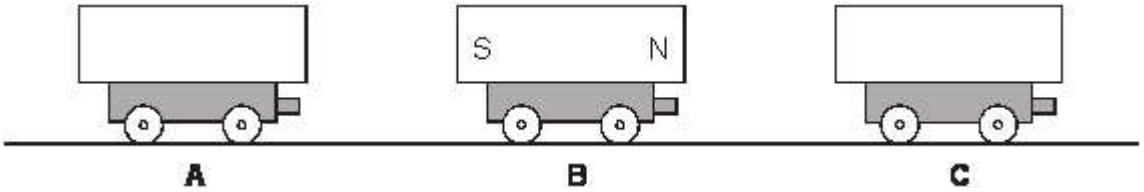
- Magnet B **attracted** magnet A.
- Magnet B **repelled** magnet C.



On the diagram above, label the north and south poles of magnets A and C.
Use the letters N and S.

2 marks

(b) Peter turned trolley B around. Trolleys A and C were **not** turned around.



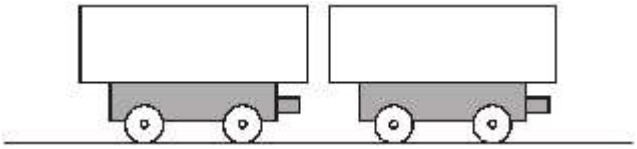
What would happen now when Peter pushed them all together?
Use either **attract** or **repel** to complete each sentence below.

Magnet B would ..... magnet A.

Magnet B would ..... magnet C.

1 mark

(c) Peter held two trolleys close together and then let go.



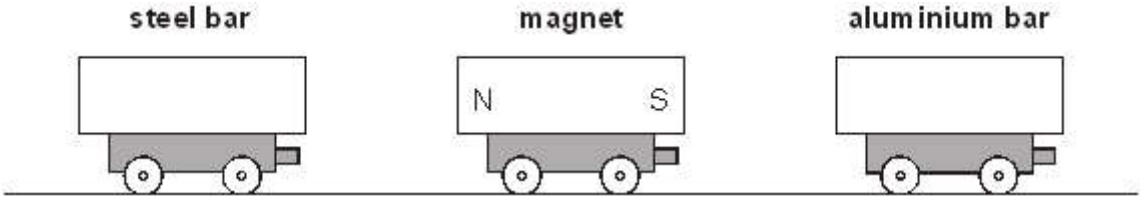
The magnets repelled each other.

Draw an arrow on both magnets to show which way they would move.

1 mark

(d) Peter took a magnet, a steel bar and an aluminium bar.

He put them on three trolleys as shown below.



(i) What happens to the steel bar as he moves it closer to the magnet?

.....
.

1 mark

(ii) What happens to the aluminium bar as he moves it closer to the magnet?

.....
.

1 mark
maximum 6 marks

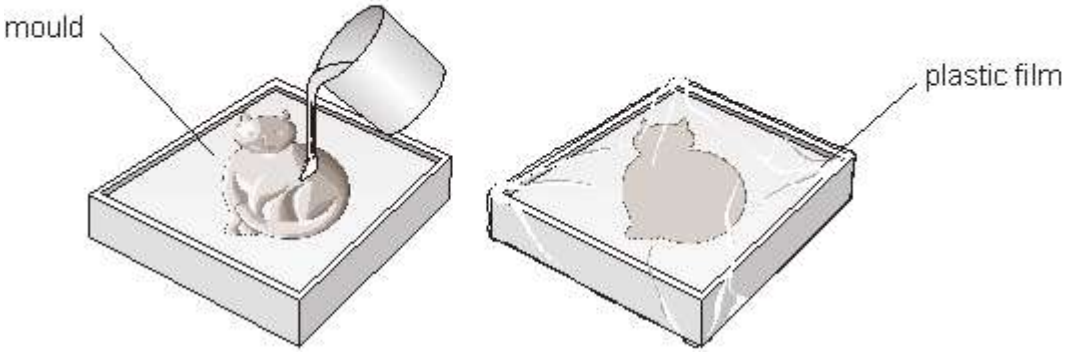
Q3.

Sam made a model cat.

He mixed modelling powder with water.

He poured all of the mixture into a mould.

He covered the mould with plastic film so that water could **not** evaporate.



(a) (i) After 10 minutes, Sam removed the model cat from the mould.

Sam had mixed 40 g of modelling powder with 12 g of water.
What was the mass of the model cat?

..... g

(ii) Complete the sentence below using words from the list.

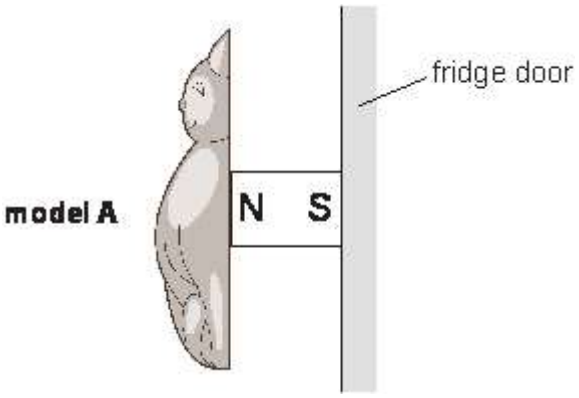
gas **liquid** **solid** **vapour**

After 10 minutes, the mixture in the mould changed from a

..... into a .....

2 marks

(b) Sam attached a small magnet to the model cat.
The magnet was attracted to the fridge door.



What metal are magnets made from?

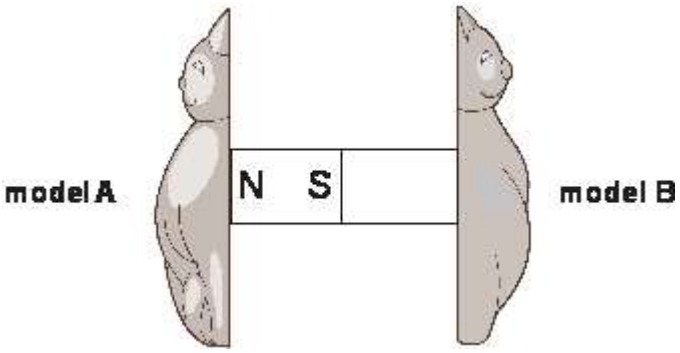
.....

1 mark

(c) Sam made another model, B. He attached a small magnet to model B.

(i) Sam placed model A next to model B. The magnets attracted each other.

Label the poles on the magnet on model B
Use the letters N and S.



(ii) Sam then turned the magnet on model A around.
What would happen to model B?

.....

2 marks
maximum 5 marks

Lesson 17: Electromagnets

Do now:

1. How does a compass work for navigation?
2. What direction do the magnetic field lines go when drawn around a magnet?
3. Define a permanent magnet.
4. Describe a method for plotting the magnetic field lines around a magnet.
5. State the equation for calculating current for charge flow and time.

Challenge: What is the rule for potential difference in a branch of a parallel circuit with more than one component?

Key knowledge:

What happens when a current flows in a conducting wire?	A magnetic field is created around the wire
What is a solenoid?	A wire looped into coils
What is an electromagnet?	A solenoid with an iron core in the centre
How can we increase the strength of an electromagnet?	Increase the Current Increase number of Coils Add an iron Core
How can we investigate the strength of an electromagnet?	By testing how many paperclips an electromagnet can pick up when one of the above variables is changed.

Quiz:

Choose the electromagnet that will pick up the most paper clips:

What is a solenoid?

1. **A coil of wire with no current flowing through it and an iron core**

2. **A coil of wire with current flowing through it and no iron core**

3. **A coil of wire with current flowing through it and an iron core**

I can increase the strength the magnetic field of a solenoid by...

1. **Increasing the current, increasing the number of coils and removing the iron core**

2. **Increasing the current, adding an iron core and reducing the number of coils**

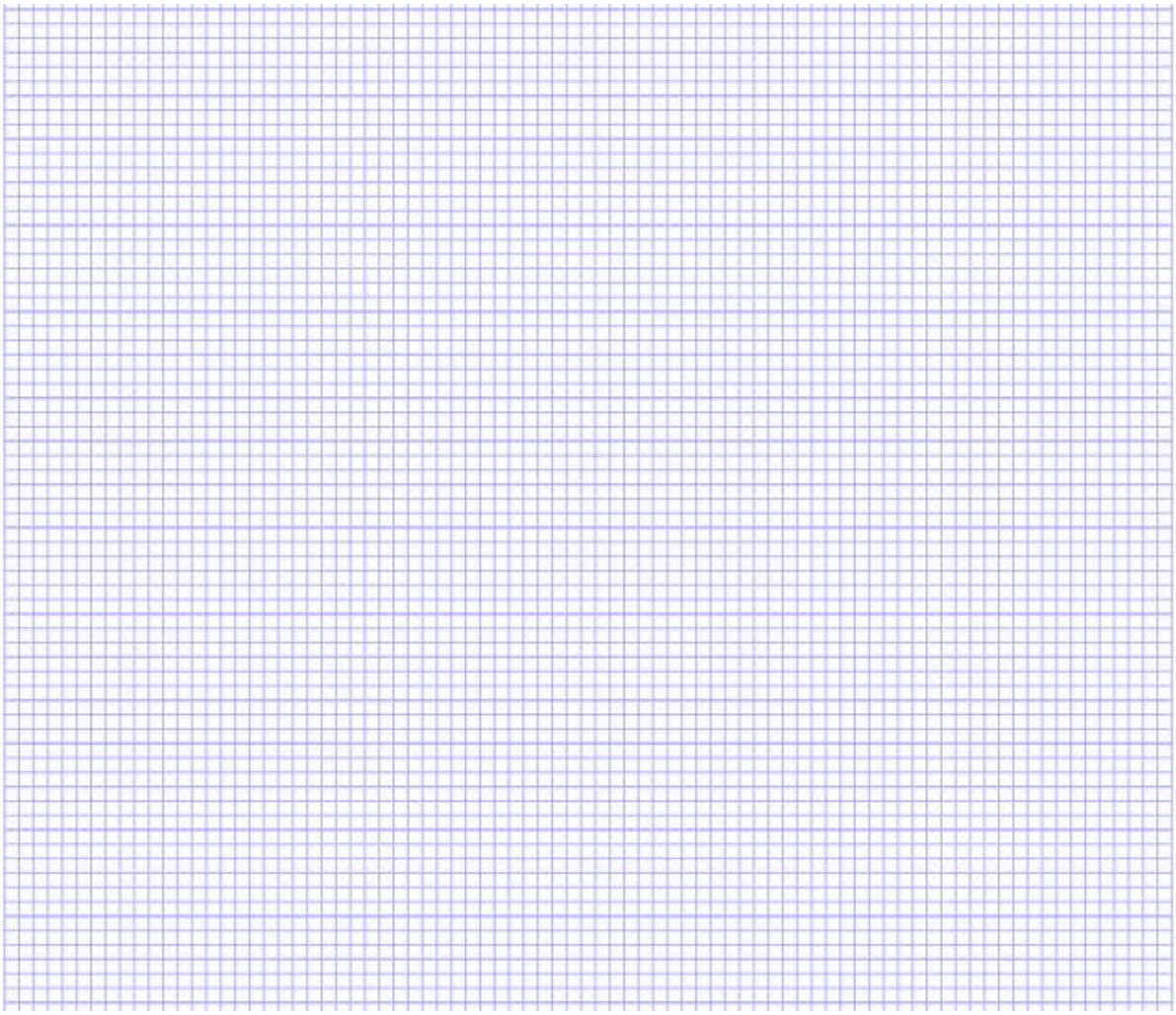
3. **Increasing the current, adding an iron core and increasing the number of coils.**

Application task:

Plot a graph to show how the number of coils affects how many paperclips an electromagnet picks up. (8 mins)

- ✓ Scale
- ✓ Choice of graph
- ✓ Units
- ✓ Labels
- ✓ Title
- ✓ Smooth line of best fit

Number of turns of wire	Mean number of paper clips picked up
10	6
20	10
30	14
40	18
50	22
60	26
70	30



Lesson 18: Making Magnets

Do now:

1. How does a compass work for navigation?
2. The direction of magnetic field lines is from _____ to _____.
3. Define an induced magnet.
4. Describe a method for plotting the magnetic field lines around a magnet.

Challenge: Calculate the time taken for 300C of charge to pass through a 30A bulb.

Key knowledge:

Define "induced" magnet	A material that becomes a magnet when placed in a magnetic field
What happens when a current flows in a conducting wire?	A magnetic field is created around the wire
How can we increase the strength of an electromagnet?	Increase the Current Increase number of Coils Add an iron Core
How can we investigate the strength of an electromagnet?	By testing how many paperclips an electromagnet can pick up when one of the above variables is changed.
What happens when we stroke a magnetic material in one direction with same end of a bar magnet?	The domains align in the direction of the stroke.

Recall quiz:

Choose the electromagnet that will pick up the fewest paper clips:

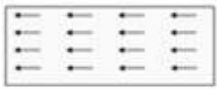
What happens when we stroke a magnetic material in one direction with same end of a bar magnet?

1. **The domains align in the direction of the stroke.**
2. **The magnets align in the direction of the stroke.**
3. **The domains are misaligned in different directions.**

I can increase the strength the magnetic field of an electromagnet by...

1. **Increasing the current, increasing the number of coils and removing the iron core**
2. **Increasing the current, adding an iron core and reducing the number of coils**
3. **Increasing the current, adding an iron core and increasing the number of coils.**

Which picture represents the domains inside an induced magnet?

1. 
2. 
3. 

Application task:

Compare permanent and induced magnets and describe how to make an induced magnet

(5 marks)

Success Criteria

- ❑ Define a permanent magnet
- ❑ Define an induced magnet
- ❑ Name the two methods for inducing magnetism are.
- ❑ Describe both methods for inducing magnetism.

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Lesson 19: Uses of Electromagnets

Do now:

1. Name the two methods for inducing magnetism.
2. Describe how to increase the strength of an electromagnet.
3. State where the magnetic force is the strongest around a bar magnet.
4. Give two types of error that can occur in an investigation
5. Give this number to 2 decimal places: 927.49162

Challenge: Explain why hitting an induced magnet against a hard object can cause it to lose it's magnetism

Key knowledge:

What are 3 uses of electromagnets?	• loudspeakers • circuit breakers • door locks
How does a circuit breaker work?	The circuit breaks when the current is too high to prevent a fire.
How does a loudspeaker work?	The changing sizes and current creates vibrations.
How does a door lock work?	When a switch is closed the electromagnet attracts the iron bar. and unlocks the door.
Why are electromagnets useful?	They can be switched on and off, meaning we can control when the electromagnet is magnetised.

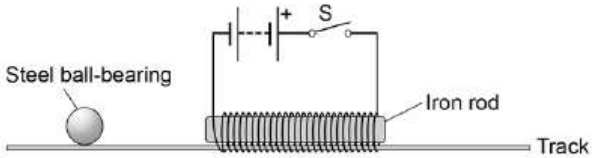
Quiz:

1. What are 3 uses of electromagnets?
2. How does a circuit breaker work?
3. How does a loudspeaker work?
4. How does a door lock work?

Application task:

1. A student has set up the apparatus shown in **Figure 2**.The iron rod is fixed to the track and cannot move.

Figure 2



The student gives the steel ball bearing a gentle push in the direction of the iron rod.

At the same time the student closes the switch **S**.

Explain the effect on the motion of the ball bearing when the switch **S** is closed.

_____

_____

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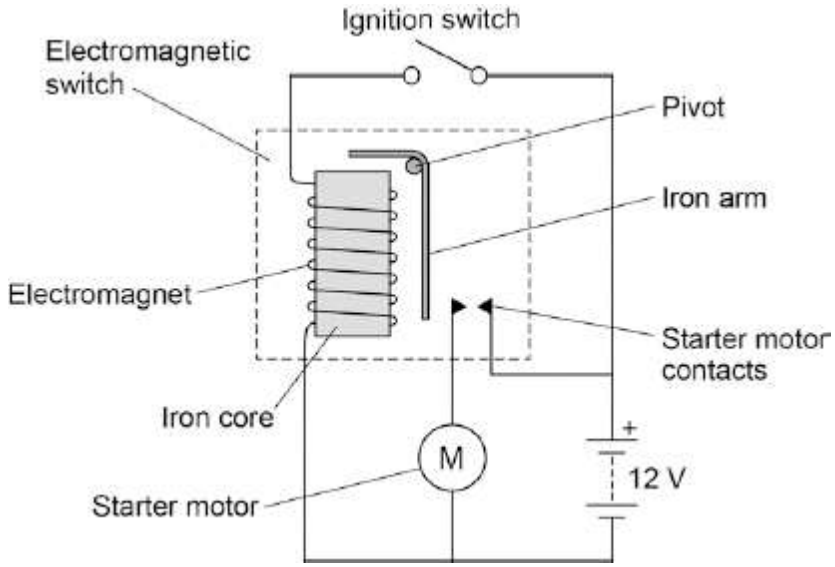
_____

(4)

Q2. Figure 2 shows the ignition circuit used to switch the starter motor in a car on.

The circuit includes an electromagnetic switch.

Figure 2



Explain how the ignition circuit works.

_____

_____

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_____

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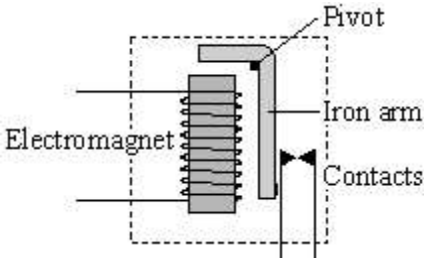
_____

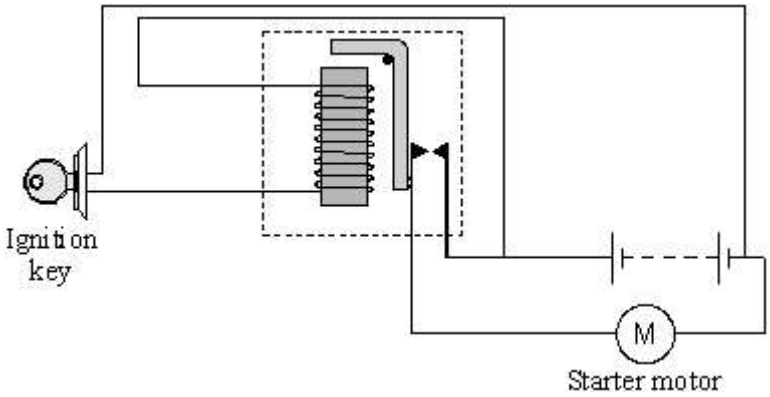
(6)

Q3.

The diagram shows a switch that is operated by an electromagnet.



The switch is used in a car starter motor circuit.



Explain how turning the ignition key makes a current flow in the starter motor.

_____

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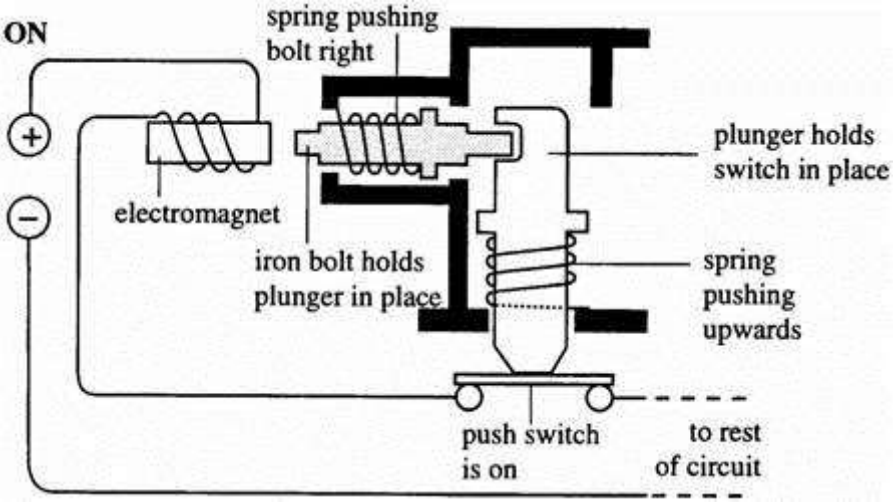
(4)

Q5. Challenge Example

A fault in an electrical circuit can cause too great a current to flow.
Some circuits are switched off by a circuit breaker.



One type of circuit breaker is shown above. A normal current is flowing.
Explain, in full detail, what happens when a current which is bigger than normal flows.

_____

_____

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(Total 4 marks)