Science KS4: Blended Learning Booklet

Stewards Academy

P7 Electromagnets

Name:

Form:

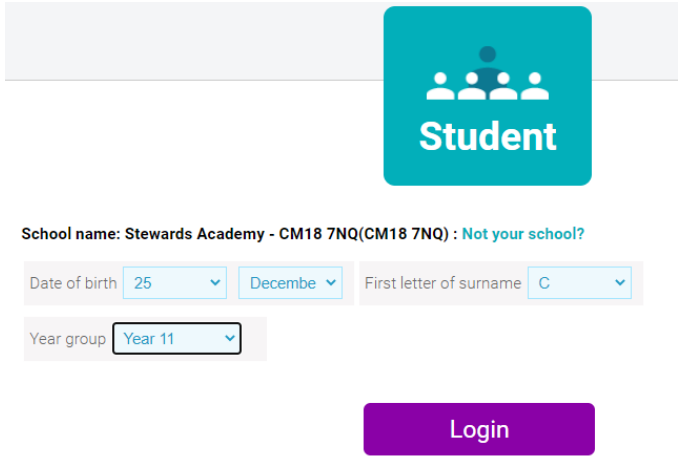
Aim to complete four lessons each week. Watch the videos and follow the four part lesson plan

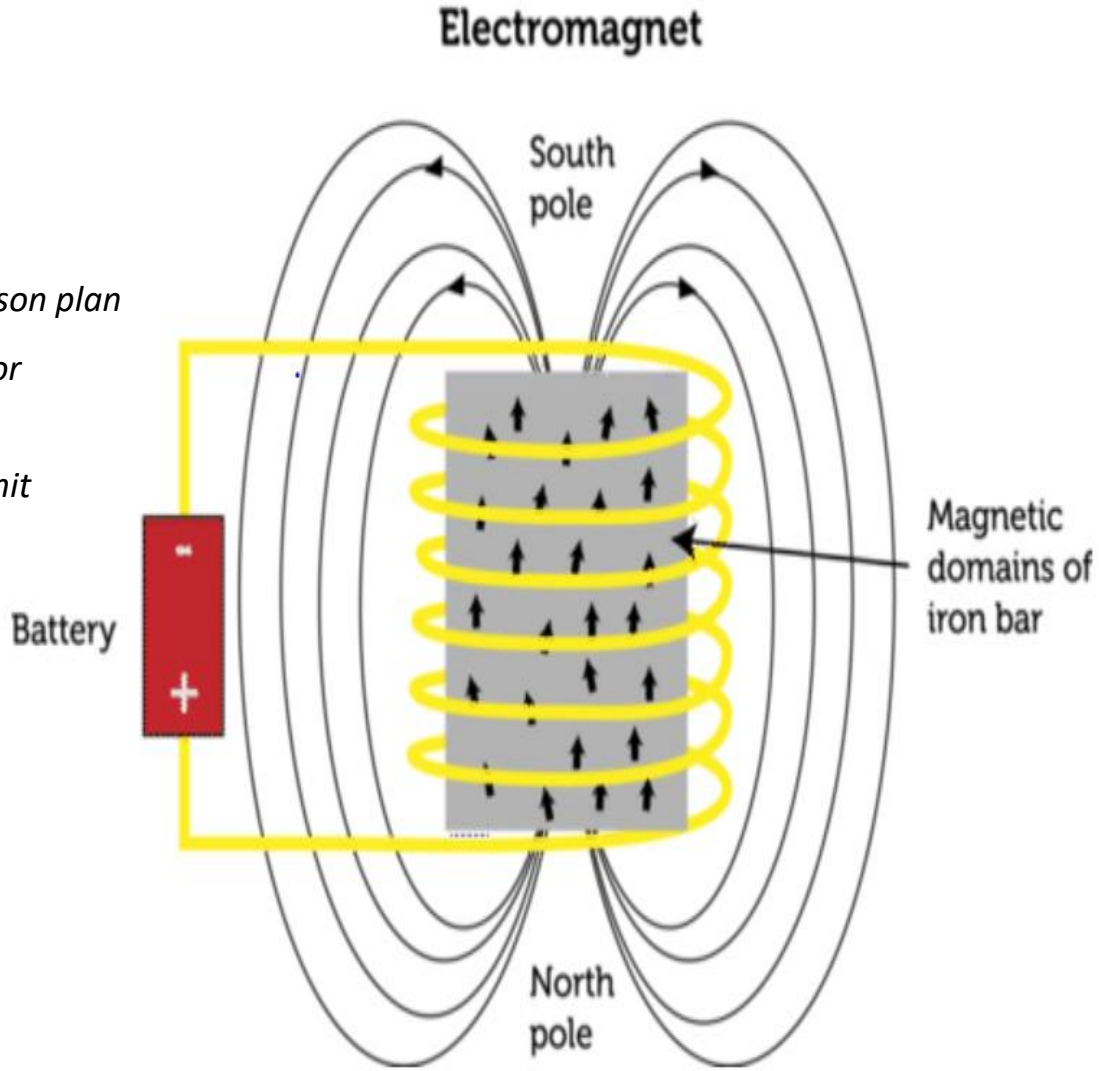
All video clips are online using the ClassCharts link. Upload all work onto ClassCharts for feedback.

The online textbook has all the key information and vocabulary to help you with this unit

To log on to the online textbook:

- https://connect.collins.co.uk/school/portal.aspx
- Type in “stewards” and select Stewards Academy
- Login using your date of birth, initial of your surname and your academic year





Strength of an Electromagnet

Contents

Contents

(T) = Triple scientists only

Big Picture – Year 11 Overview

Science

Next step...

GCSE's Good Luck

End of Unit Test

Gravity (T)

Red-shift (T)

How elements were formed (T)

Life cycle of stars (T)

Moons, planets and artificial satellites (T)

The solar system (T)

Space

***I will** be able to explain how our solar system is organized and how its existence is affected by the lifecycle of a star (T). **I will** be able to explain how objects move in space and how space itself is ever increasing in size (T). **I will** be able to explain the importance of red-shift as evidence for the Big Bang theory (T). I will be able to describe the importance of the role of gravity in space (T).*

UNIT P8 (T)

End of Unit Test

Production and use of fertilisers (T)

Ceramics, polymers and composites (T)

Preventing corrosion and using alloys (T)

Alternative methods of metal extraction

LCA 's and recycling

Sustainability

I will be able to explain how we can sustain resources for future generations. **I will** be able to describe the processes required to make water potable and also process required to treat sewage and waste water. **I will** be able to describe methods for reducing resource waste and lessening the environmental impact of removing resources from the Earth. **I will** be able to describe alternative methods of extracting metals. *Finally, **I will** be able to describe the importance of fertilisers in maintaining food security (T)*

Potable and waste water

Sustainable use of the Earth resources

UNIT C10

End of Unit Test

Food security and biotechnology (T)

Maintaining biodiversity

Waste management and pollution

Land use *and changing environments (T)*

Ecology

I will be able to describe the factors that affect living organisms within a habitat. **I will** be able to explain how plants and animals interact within a habitat. **I will** be able to explain how human activities impact biodiversity. **I will** be able to explain how carbon and water are recycled *and also which factors affect the rate of decay (T)*

Transformers (T)

End of Unit Test

UNIT B8

Investigating ecosystems

Predator prey relationships

Trophic levels and transferring biomass (T)

Water cycle, carbon cycle *and decay (T)*

The generator effect (T)

I will be able to describe the shape of the magnetic field that surrounds a magnet. **I will** be able to explain how an electric current can be used to generate a magnetic field *and give some example of the uses of electromagnets (T)*. **I will** be able to explain how a motor works. ***I will** be able to explain how a transformer works and how this links to supplying electrical energy efficiently.*

Electromagnetism

Loudspeakers (T)

Force on a conductor and electric motors

Electromagnets *and their uses (T)*

Magnetic forces and fields

UNIT P7

End of Unit Test

Atmospheric pollutants and their effects

The Atmosphere

I will be able to describe what the early atmosphere was like and how and why it changed. **I will** be able to explain the consequences of the green house effect, how humans add to the impact of the green house effect and what we can do to reduce this. **I will** be able to describe how various atmospheric pollutants are formed and the effects that they have on the environment.

Carbon footprints

End of Unit Test

UNIT C9

The early atmosphere

Evolution of the atmosphere

Human impact on Greenhouse gases

Global climate change

Survival or extinction

I will be able to explain what causes variation and its effects on the individual. **I will** be able to explain how variation contributes to natural selection *and the evolution of new species.* **I will** be able to describe the causes of extinction.

Variation & Evolution

Classification - The tree of life

Genetic engineering *and cloning (T)*

Natural selection and selective breeding

Darwin and Wallace (T)

Variation and evolution

UNIT B7

Year 11

ZOOM IN...

MY LEARNING JOURNEY:

Subject: Electromagnetism: Year: 11 Unit: P7

AIMS

Students will learn how a magnetic field can be used to create an electric current and the application of this effect. This includes studying solenoids, motors, generators, speakers, microphones and transformers.

DEVELOPING COURAGE

C Understanding how a compass works

O Build a basic motor

U Work together describe the magnetic effect of a solenoid

R Make the link between magnetism and electricity (two abstract ideas)

A The significance of the electric motor

G Share expertise to carry out practicals

E Creating a functional motor

UP NEXT

Cource complete (Combined)

Space (Triple only)

- Solar system
- Orbits
- Stars
- Red shift
- Gravity

CAREERS

- Mechanic
- Robotic engineers,
- MRI technicians
- National Grid workers.

PREVIOUS LEARNING

Students will have met the idea of magnetic materials, how magnets work, and how the Earth itself possesses a magnetic field which can be used for navigation. They will have been introduced to the idea that a current flowing through a wire produces a magnetic field and the use of electromagnets.

WHAT WE KNOW/ REMEMBER

- .....
- .....
- .....
- .....
- .....

RECOMMENDED READING

1. Electromagnetism for Babies by Chris Ferrie.
2. 40 Attractive (and Repulsive) Devices and Demonstrations by Fred Jeffers
3. The Life and Science of James Clerk Maxwell by Brian Clegg.

PERSONAL OBJECTIVES

- .....
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Lesson 1: P7.1 - Magnetism and magnetic forces.

Connection

Have a look at the topic overview and the P7 zoom in.

Populate what you know and your personal objectives.

Activation

LI: Describe magnetic materials and induced magnetism.

https://www.youtube.com/watch?v=hFAOXdXZ5TM

1. Make a note of the title and the LI
2. Read pages 244-245
3. Define “attract”, “repel”, “induced magnet”, and “permanent magnet”
4. Draw and label figures 7.2 and 7.3
5. State the direction of the magnetic field
6. Name 4 magnetic materials. Highlight which are elements.

Demonstration

Attempt questions 1-6.
In 10 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P7.1 – Magnetism and Magnetic forces

Connection

1 NA
2 NA
3 NA

Demonstration

1 They repel each other.
2 You need to see which way the compass points at different places so that you can plot the field lines.
3 When the pins and tacks are inside a magnetic field they become magnets themselves. When they are removed from the magnetic field, the tacks lose their magnetism straight away because they are made of iron, but the pins remain magnetised because they are made from steel.
4 The iron tacks become magnetised, so they are magnetic materials whereas the pins remain permanently magnetised. Therefore, the tacks will have no effect on other tacks; the tacks and pins will always attract each other; the pins will either attract or repel other pins depending on which way round they are.
5 A magnet will be repelled by another magnet. A material like iron can only be attracted by another magnet.
6 The magnetic compass experiences forces of attraction and repulsion from the Earth which would suggest that the core of the Earth is magnetic

Lesson 2 P7.2 – Compasses and Magnetic Fields

Connection

Q1. Which poles attract and which poles repel ?

Q2. Draw a sketch diagram of a magnetic field around a bar magnet.

Q3. What is the difference between a Permanent magnet and an Induced magnet?

Activation

LI: Describe the Earth's magnetic field and explain the link between current and magnetic field.

https://www.youtube.com/watch?v=aVqN1tW1k7w
https://www.youtube.com/watch?v=caHXwJbkbQU

1. Make a note of the title and the LI
2. Read pages 246 - 247
3. Draw and label figures 7.5
4. Draw and label figure 7.6 and 7.7

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Demonstration

Attempt questions 1-6.
In 10 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

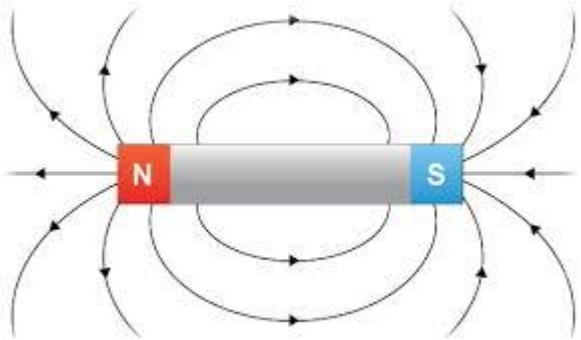
Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P7.2 – Compasses and Magnetic Fields

Connection

1 Attract = NS; Repel = NN or SS

2



3 A permanent magnet produces its own magnetic field; an induced magnet becomes magnetic when placed in a magnetic field.

Demonstration

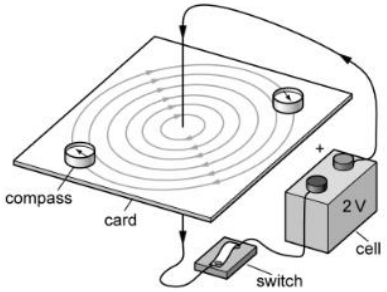
1a 

1b 

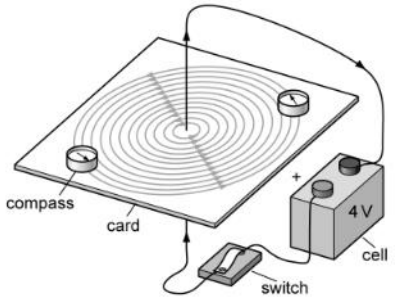
2 A magnetic compasses point away from the geographic south pole so the polarity of the geographic south pole is actually north.

3 It seeks out (i.e. points towards) the Earth's North Pole.

4



5



6 The magnetic field produced by the current is very weak and it is even weaker the further you are from the wire. Therefore, a compass towards the edge of the card will be affected by the Earth's magnetic field as much as the wire's.

Lesson 3: P7.3 – The magnetic effect of a solenoid

Connection

Q1. What is the difference between Earth's geographic poles and magnetic poles?

Q2. What do the fingers and thumb represent when using the right hand rule?

Q3. How can you increase the strength of the magnetic field around a wire?

Activation

LI: Draw the magnetic field around a conducting wire

https://www.youtube.com/watch?v=BbmocfETTFo

1. Make a note of the title and the LI
2. Read pages 248
3. Define "solenoid" using the glossary
4. Draw and label Figures 7.8, 7.9 and 7.10
5. Simulation to show a solenoid https://phet.colorado.edu/sims/cheerpj/faraday/latest/faraday.html?simulation=magnets-and-electromagnets

Demonstration

Attempt questions 1-3.
In 10 mins answer as many questions as you can.
Self mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self assess the relevant past paper question for this topic - From the P7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P7.3 - The magnetic effect of a solenoid

Connection

1 They are opposites; eg the geographic north pole is the magnetic south pole.

2 Fingers represent the direction of the magnetic field. The thumb represents the direction of the current.

3 You can increase the current

Demonstration

1 The magnetic field is in the opposite direction.

2 The south pole.

3 All of these will make the magnetic field stronger: Increase the number of turns of wire; increase the current; place iron inside the coil.

Lesson 4: P7.3H – The force on a wire (Higher)

Connection

Q1. The magnetic field of a solenoid is similar to a _____

Q2. How can you change the direction of the magnetic field of a solenoid?

Q3. What does A.C stand for?

Activation

LI: describe the force on a wire in a magnetic field, apply the left-hand rule to work out the direction of a magnetic field.

https://www.youtube.com/watch?v=ltpPhpi-CC4&t=8s

1. Make a note of the title and the LI
2. Read pages 249
3. Draw and label figure 7.11 and 7.12
4. Describe three ways to increase the force on a wire
5. Describe two ways to change the direction of the force on a wire
6. Simulation to show how the direction of force changes
   https://javalab.org/en/lorentzs_force_3d_en/

Demonstration

Attempt questions 4-6.
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P7.3H – The force on a wire (Higher)

Connection

1 The magnetic field of a solenoid is similar to a bar magnet

2 Change the direction of the current

3 A.C stands for alternating current.

Demonstration

4a To the right

4b Assuming the current is in the original direction, the wire moves to the right. If the current remains reversed, then the wire would move to the left.

5 You could reduce the current or reduce the strength of the magnetic field by using a weaker magnet.

6 Applying Fleming's left hand rule: the first finger needs to point from N to S; the second finger needs to point down along the wire. This means that the thumb is pointing out of the magnet towards the switch. So the vertical wire will move to the right towards the switch (whilst remaining vertical).

Lesson 5: P7.4 – Electromagnets in action

Connection

Q1. What does the thumb, first finger and second finger represent using the left hand rule?

Q2. How can you change the direction of the force on a wire?

Q3. How can you change the magnitude of the force on a wire?

Activation

LI: describe simple uses of electromagnets, explain how an electric bell works

https://www.youtube.com/watch?v=OqLi6lrOCzs

1. Make a note of the title and the LI
2. Read pages 250-251
3. Define “electromagnet” using the glossary
4. Draw and label figure 7.13
5. Draw and label figure 7.14
6. In six bullet points describe how an electric bell works.

Demonstration

Attempt questions 1-7.
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Answers: P7.4 – Electromagnets in action

Connection

1 Thumb: force/motion
First finger: field
Second finger: current

2 Change the direction of the field
Change the direction of the current

3 Increase the number of length of a wire
Increase the current in the wire
Increase the strength of the magnetic field

Demonstration

1 Iron is a magnetic material and so becomes magnetised in the coil's magnetic field. This makes the magnetic field stronger.
2 Once steel has been magnetised it remains permanently magnetised. So once the electromagnet is switched on it will be permanently magnetised even when it is switched off.
3 The iron contact strips alternately makes contact and breaks contact.
4 The electromagnet attracts the iron contact strip when a current flows through it.
5 When the hammer strikes the gong the contact is broken so no current flows. The electromagnet no longer attracts the iron contact strip and the spring is able to move the hammer back.
6 A large current needs to pass through the starter motor. If this current passed through the switch (that is operated by the driver) then this could be dangerous.
7 You would have to rewire the bell so that the electromagnet is a complete circuit. So disconnect the wire at x, disconnect the wire from the top end of the hammer and join these two wires together. Now we can make the hammer and the gong act as the switch that controls the circuit with the large current. So connect up a high p.d. power supply to the hammer and the rest of the circuit to the gong – so the gap between the hammer and the gong is like an open switch. Pressing the push button switch will magnetise the electromagnet using a small current. This makes the hammer touch the gong, which completes the circuit that has the large current. When the push button is released, the electromagnet switches off and the spring pulls the hammer/gong switch open which switches off the circuit with the large current.

Lesson 6: P7.5 - Calculating the force on a conductor (Higher)

Connection

Q1. Name four magnetic materials?

Q2. Why is steel not used for electromagnets?

Q3. Name three uses of electromagnets

Activation

LI: Explain the meaning of magnetic flux density, B, calculate the force on a current-carrying conductor in a magnetic field

https://www.youtube.com/watch?v=CdJKKuvQeBo

1. Make a note of the title and the LI
2. Read pages 252-253
3. Define "magnetic flux density" using the glossary
4. Write down the equation that links force, length, current and magnetic flux density. Include the units for each.
5. Rearrange the equation to length, current and magnetic flux density the subject.
6. Complete the following table:

Force (N)	Current (A)	Length of wire (m)	Magnetic flux density (T)
	2	0.25	0.20
	5	0.50	0.10
0.15		0.10	0.15
0.05	10		0.02
0.02	2	0.20	
0.03		0.50	0.01

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher

Demonstration

Attempt questions 1-7.
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Answers: P7.5 - Calculating the force on a conductor

Connection

1 Steel, Iron, Nickel, Cobalt
2 Steel does not lose its magnetism as quickly
3 magnetic locks, electric bell, scrap yard crane

Demonstration

1 The magnetic field inside the solenoid is uniform (the same everywhere). This can be seen by the field lines that are parallel and equally spaced. The strength of the field is indicated by how close the lines are together and they remain the same distance apart throughout.
2a The force doubles.
2b The force is four times bigger.
3a $F = BIl = 0.05 \times 0.5 \times 2 = 0.05$ N
3b $F = BIl = 0.1 \times 2 \times 0.5 = 0.1$ N
4 $I = F / Bl = 0.03 / (0.02 \times 0.3) = 5$ A along the wire.
5 $B = F / Il = 0.05 / (3 \times 0.25) = 0.067$ T
6 No. When the length of wire is parallel to the magnetic field then no force acts; a maximum force acts when they are at right angles to each other.
7a Force needed to lift wire = 0.30 N $F = Bil$ So $0.30 = 0.00003 \times I \times 2.0$ $I = 0.30 / (0.00003 \times 2.0) = 5000$ A.
7b No, it wouldn't be possible. The magnetic field lines near a pole would be vertical. The force needs to be at right angles to the field lines (from Fleming's left hand rule) so there is no orientation of the wire that can produce a force upwards.

Lesson 7: P7.6 – Electric motors (Higher)

Connection

Q1. Write down the equation that links force, length, current and magnetic flux density.

Q2. What is the unit of magnetic flux density?

Q3. If a 1m length of wire with 2 amps running through it, experiences a force of 5N, what is the strength of the magnetic field it was placed in?

Activation

LI: describe how motors work, describe how to change the speed and direction of rotation of a motor.

https://www.youtube.com/watch?v=CWulQ1ZSE3c&t=490s

1. Make a note of the title and the LI
2. Read pages 254-255
3. Draw and label figure 7.19
4. Use the text in section 2 How motors work and this simulation to describe how a DC motor works - https://javalab.org/en/dc_motor_en/
5. Draw and label figure 7.21
6. State two ways a motor can have its direction reversed

Consolidation

Complete and self-assess the relevant past paper question for this topic - From the P7 DIP file

Demonstration

Attempt questions 1-8.
In 15 mins answer as many questions as you can.
Self-mark the questions you have done making any necessary corrections in blue pen

Challenge yourself to answer as many as you can:
Green questions to GCSE Level 3
Blue questions to GCSE Level 6
Purple questions to GCSE Level 9

Extension

Make a note of one thing you think you understand well and one thing that you would like to ask your teacher