Science Department

Science curriculum booklet

2023-24

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Plymouth High School for Girls aims to be an outstanding grammar school for the 21st century, remaining true to the philosophy of the school's motto: 'for life, not school, we learn'.

A school which:

Promotes a culture of high aspiration enabling personal and academic success

Prepares students to think confidently and independently

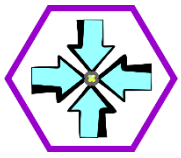
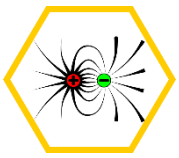
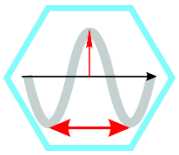
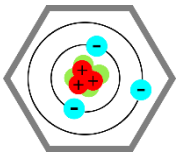
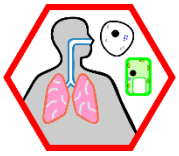
Provides an outstanding education for all, the key to this being high quality teaching

Provides enjoyment, excitement and challenge for all, stimulating an enthusiasm for lifelong learning

Prepares students to become active citizens, equipped to succeed in a world of rapid change

The Curriculum

a. Intent: *mastering the 10 big ideas*

 Forces	 Electromagnetism
 Energy	 Waves
 Matter	 Reactions
 Earth	 Organisms
 Ecosystems	 Genes

Our curriculum is an ambitious seven-year program focused on mastering ten big scientific ideas.

These ideas, along with essential skills in English literature, English language, and mathematics, have been thoughtfully selected to empower our students as global citizens capable of independent thinking.

Lessons in science adhere to PHSG's 'RESPECT' agenda:

Retrieval practice, **E**xpectations of learning, **S**alient slides, **P**ace, **E**xpectations of behaviour, **C**hallenge and **T**hinking tools.

Science teaching also considers seven key principles of effective teaching: 'SEFMMMQ'

Subject knowledge, **E**xplanations, **F**eedback, **M**etacognition, **M**emory, **M**odelling and **Q**uestioning

Scientific thinking lies at the core of innovation and technology, enabling disease cures, designing flying planes, and predicting properties of elements. It relies on evidence and readily embraces new information while dismissing unsupported notions. However, it also raises moral and ethical dilemmas, questioning whether we should pursue certain advancements just because we can.

In our teaching approach, we prioritize critical thinking and set high expectations for our students. Science teachers employ retrieval practice and various thinking tools to ensure an engaging learning experience, followed by thorough reviews of key points.

We value our students' perspectives, and our sixth form Science Captains organize activities to inspire younger students while seeking their feedback to shape future curricula.

In an age of abundant information, often with questionable scientific accuracy, we aim to equip our students with not only scientific knowledge but also an evidence-based mindset to discern fact from fiction in their daily lives.

Our hope is that this adaptable and sceptical outlook will enable them to thrive in an ever-changing world, meeting its demands with confidence.

What do we mean by 'mastery'?

We believe that there are three aspects to the mastery of scientific ideas:

- ✓ **Learning a body of core knowledge**
- ✓ **Demonstrating understanding of that knowledge**
- ✓ **Practising a set of skills that support that knowledge**

These three aspects of mastery are of equal importance and we believe that their consideration and development will lead to a successful experience for our students. We also believe that these big scientific ideas are worth mastering for their own sake.

What do we mean by 'knowledge'?

Our curriculum sees 'knowledge' as the crucial details of an idea or concept, which must be committed to memory for convenience, and serve as a bridge to acquire even more knowledge. Core scientific knowledge will likely include:

- **Statements of fact, definitions and important numerical constants**
- **General rules that show patterns**
- **Agreed laws, principles and explanations that are well-tested and predictive**
- **Processes that have a particular sequence**
- **Models and metaphors to help explain concepts**
- **Key language and terminology so students can share their knowledge with others**

What do we mean by 'understanding'?

Students demonstrate understanding when they move beyond simply recalling knowledge that has been rehearsed and memorised. To understand concepts and ideas means that students can use their knowledge ways that are not indicated in the programme of study or specification. Understanding can be demonstrated by:

- **Recognising previously learned concepts within unfamiliar contexts**
- **Applying learned concepts to provide explanations for unfamiliar phenomena**
- **Making links between discrete scientific contexts**
- **Suggesting solutions to problems that are unfamiliar using existing knowledge**
- **Making judgements of new ideas based on existing understanding**
- **Using data from unfamiliar investigations to draw conclusions**

What do we mean by 'skills'?

We have defined skills as certain capabilities that rest upon a student's knowledge which are bettered with practice. Some skills are transferrable to other subjects and activities, others are uniquely science-specific. We have distilled six key skills of importance:

- **Scientific thinking, to include how theories change over time**
- **Scientific enquiry, including how to devise a valid experiment**
- **Scientific analysis, including using maths and statistics to interpret collected data**
- **Scientific communication, including usage of standard rules and conventions, such as units**
- **Practical competencies, including appropriate techniques for measuring mass or pH**
- **Mathematical skills, such as changing the subject of an equation**

b. Implementation: *organising our curriculum in order to master the 10 big ideas*

Unifying our various curricula around these ten big ideas serves to remind both teachers and students that scientific knowledge is not just a long list of discrete facts and theories, but a series of interconnected explanations for our world.

In periodically revisiting these ideas, the level of challenge increases:

- **Newer, more complex processes and ideas are added – sometimes appearing to contradict previous simpler explanations**
- **The skillset changes from a 'describe and explain' approach to one of analysis and scrutiny**
- **The mathematical demands increase, from simple arithmetic to the use of natural logarithms and statistical analysis**
- **The apparatus and techniques become more expert, from acquiring their first Bunsen burner licence to distillation and heating under reflux.**

As each idea is revisited, the big idea is strengthened and reinforced. Their knowledge and skills becoming 'baked in'.

The charts below show the sequencing of knowledge and skills from Year 7 to Year 13.

Implementation: development of knowledge and understanding of the 10 big ideas from Year 7 to 13

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Forces	Speed and gravity	Contact forces and pressure			Forces in balance Motion Force and motion Force and pressure	Mechanics	Further mechanics Gravitational fields
"By the end of the year…"	*…students will have gained an introductory working knowledge of **forces**, building on basic ideas from KS2. This will have included how forces arise, and how they change the motion of objects. They should have also started to understand speed, and how to tell the story of a journey with a graph.*	*…students will have started to secure their knowledge of **forces** to have included pressure in fluids and should be able to relate it to floating and sinking. They should also have developed their understanding of solid objects exerting pressure on one another.*			*…students will have begun mastering the big idea of **forces** by having revisited gravity, motion, friction and pressure at a higher level. They should have deepened their understanding of how forces through Newton's Three Laws of Motion*	*…students will have developed a more advanced mastery of **forces** by significantly increasing their existing knowledge and understanding of motion beyond KS4. Better known as mechanics, their understanding should now include use of a number of additional kinematics equations.*	*…students will have further mastered **forces** with the introduction of circular motion, the concept of 'impulse' as part of Newton's second law and angular momentum. Their understanding of gravity should now include a number of new equations including that for V_{grav} for a radial gravitational field.*
Sequencing rationale:	Simple physical principles → complex interactions			Simple physical principles → complex interactions		Simple physical principles → complex interactions	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Electro-magnetism	Voltage and resistance Current	Electromagnets Magnetism		Electric circuits Electricity in the home	Electromagnetism	Electric circuits	Electric and magnetic fields
"By the end of the year…"	*…students will have gained an introductory working knowledge of* ***electromagnetism****, building on basic ideas from KS2. This will have included the concepts of current, resistance, charge and potential difference. They should have also appreciate everyday uses of electricity in household appliances.*	*… students will have developed their knowledge of* ***electromagnetism*** *to include electromagnets, how to change their strength and some of their uses. They should also have developed their understanding of magnetic fields, both as a model and in real contexts, like the Earth.*		*…students will have further developed their knowledge of* ***electromagnetism*** *by revisiting electricity at a greater depth. A more quantitative approach has resulted in them committing the following formulae to memory: $V = I R$, $Q = I t$, $P = V I$, $P = I^2 V$, $E = P t$, and $E = Q V$ and the efficiency rating of household appliances.*	*…students will have begun mastering the big idea of* ***electromagnetism*** *by having revisited the construction of electromagnets. They should have deepened their understanding of the 3D magnetic field and the motor effect. The should also be able to use the equation $F = B I l$.*	*…students will have developed a more advanced mastery of* ***electromagnetism*** *by significantly increasing their existing knowledge beyond KS4. Their understanding should now include the ability to derive equations, to sketch, recognise and interpret I-V graphs for a range of components and understand new quantities like emf and resistivity.*	*…students will have developed a more advanced mastery of* ***electromagnetism*** *by significantly increasing their existing knowledge beyond KS4. Their understanding should now include the measurement of electric field strength using $E = F/Q$ as well as a range of additional new equations, including $F = B q v \sin\theta$ using existing knowledge of Fleming's left-hand rule from KS4.*
Sequencing rationale:	Simple physical principles → complex interactions			Simple physical principles → complex interactions		Simple physical principles → complex interactions	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Energy	Energy costs Energy transfer	Work Heating and cooling	Energy transfer and resources			Enthalpy changes Reaction rates and equilibrium (qualitative)	Rates of reaction and equilibrium (quantitative) pH and buffers Enthalpy, entropy and free energy Thermodynamics
"By the end of this year…"	*…students will have gained an introductory working knowledge of **energy**, building on basic ideas from KS2. This will have included how energy is costed and the introduction of the kilowatt hour . They should have also started to understand different energy pathways, including useful and wasted energy .*	*…, students should have developed their knowledge of **energy** to include 'work done' and transferring energy between stores. Students will have also developed their understanding of different ways to stop energy transfer through friction and conduction.*	*…students will have developed their knowledge of **energy** by revisiting energy use. They should have deepened their understanding to include efficiency calculations, and complex ways of generating electricity.*			*…students will have developed a more advanced mastery of **energy** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include a more advanced understanding of internal heat content, or enthalpy.*	*…students will have developed a more advanced mastery of **energy** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include a highly quantitative approach to thermodynamics, including pV = NkT, pV = 1/3 Nm<c>, L = σAT^4*
Sequencing rationale:	Simple physical principles → complex interactions			Simple physical principles → complex interactions		Simple physical principles → complex interactions	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Waves ***"By the end of this year…"***	Sound Light	Wave effects Wave properties			Wave properties EM waves Light	Waves and the particle nature of light	Oscillations
	*…students will have gained an introductory working knowledge of **waves**, building on basic ideas from KS2. This will have included distinguishing between transverse and longitudinal waves, in the context of light and sound respectively. They should have also started to understand ideas like transmission, refraction and reflection .*	*… students will have developed their knowledge of **waves**, including a greater number of contexts, the energy they transfer and their interactions with surfaces and materials. Students will have also developed their ability to model waves, to predict their behaviour, uses and dangers.*			*…students will have begun mastering the big idea of **waves** by having revisited the transverse and longitudinal wave. They should have deepened their understanding by learning about EM waves and the EM spectrum, recognising light as an example.*	*…students will have developed a more advanced mastery of **waves** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include the evaluation of wave and photon models of EM radiations.*	*…students will develop an advanced mastery of **waves** by studying and analysing oscillations. Their understanding should now include simple harmonics and the use of key equations, including $\omega = 2\pi f$ a and $T = 2\pi\sqrt{\frac{l}{g}}$*
Sequencing rationale:	Simple physical principles → complex interactions			Simple physical principles → complex interactions		Simple physical principles → complex interactions	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Matter	Particle model Separating mixtures	Elements The periodic table	Atomic structure The periodic table	Structure and bonding Molecules and matter Radioactivity	Polymers Chemical analysis	Atoms, compounds, molecules and equations Amount of substance Electrons, bonding and structure The periodic table and periodicity Group 2 and the halogens Basic concepts Materials	Nuclear and particle physics Nuclear radiation
"By the end of this year…"	*…students will have gained an introductory working knowledge of **matter**, building on basic ideas from KS2. This will have included a simple look at particles. They should have also started to understand basic separation of mixtures.*	*…students will have started to secure their knowledge of **matter** by classifying particles into different groups and periods. They should also have developed their understanding compounds that are not easily separable.*	*…students will have started to secure their knowledge of **matter** to have included isotopes of elements.*	*…students will have further developed their knowledge of **matter** by revisiting pressure and energy transfer, developed in Big Ideas 1 and 3. They should have deepened their understanding of isotopes to include radioactivity. They should also have deepened their understanding of different bonding types .*	*…students will have begun mastering the big idea of **matter** by having revisited covalent bonding. Here, they apply this to more complex contexts like polymerisation.*	*…students will have developed a more advanced mastery of **matter** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include complicated contexts, but also a more quantitative approach, using n=v/24 and PV=nRT. Students should also be able to describe the electronic configuration of matter.*	*…students will develop an advanced mastery of **matter** by significantly increasing their existing knowledge and understanding of radioactivity from KS4. Their understanding should now include analysis of daughter elements and readily use the unit, Sievert.*
Sequencing rationale	Fundamentals → materials → the Earth			Fundamentals → materials → the Earth		Fundamentals → materials → the Earth	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Reactions	Metals and non-metals Acids and alkalis	Chemical energy Types of reaction		Chemical calculations Chemical changes Energy changes	Rates and equilibrium Organic reactions	Acid-base and redox reactions Alcohols and haloalkanes Organic synthesis	Redox and electrode potentials Aromatic compounds Carbonyl compounds Carboxylic acids and esters Nitrogen compounds Polymers Organic synthesis
"By the end of this year…"	*…students will have gained an introductory working knowledge of **reactions**, building on basic ideas from KS2. This will have included simple behaviours and properties of metals and non-metals. They should have also started to recognise the presence of acids and alkalis in our lives.*	*…students will have started to secure their knowledge of **reactions** by classifying reactions into groups, such as decomposition or combustion. They should also have developed their understanding of conserving energy.*		*…students will have further developed their knowledge of **reactions** by revisiting previous ideas but with a quantitative perspective. They should have deepened their understanding to include concepts like the mole and bond enthalpy.*	*…students will have begun mastering the big idea of **reactions** by having revisited reaction rates, or 'chemical kinetics' as they will now call it. They should have deepened their understanding of carbon compounds to include organic chemistry.*	*…students will have developed a more advanced mastery of **reactions** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include new, more complicated contexts and new calculations like the equilibrium constant (K_c) and Hess's Law. They will consider combinations of previously understood groups of molecules, such as haloalkanes.*	*…students will develop an advanced mastery of **reactions** by significantly increasing their existing knowledge and understanding from KS4 and Year 12. Their understanding should now include multi-stage calculations, novel molecules and groups. More advanced calculations are introduced, such as K_a and pK_a*
Sequencing rationale	Fundamentals → materials → the Earth			Fundamentals → materials → the Earth		Fundamentals → materials → the Earth	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Earth	Earth structure and the Universe	Climate and Earth's resources	The Earth's atmosphere and the Earth's resources	Electrolysis	Crude oil and fuels Using our resources Space	Hydrocarbons Analytical techniques	Transition elements Chromatography and spectroscopy (NMR) Space
"By the end of this year…"	*…students will have gained an introductory working knowledge of **Earth**, building on basic ideas from KS2. This will have included the different layers of the Earth . They should have also started to understand Earth's location within the Solar System and Universe .*	*…students will have started to secure their knowledge of **Earth** to have included the ways we exploit materials from the Earth . They should also have developed their understanding of the resulting anthropological environmental effects like climate change.*	*…students will have started to secure their knowledge of **Earth** to have included a timeline of the evolution of Earth's atmosphere and the evidence for this.*	*…students will have further developed their knowledge of **Earth** by revisiting our need for resources. They should have deepened their understanding to include more complex means of extraction, including the use of electricity.*	*…students will have begun mastering **Earth** as a big idea by having revisited resource use once more through the context of man-made composite materials, lifecycle assessments, as well as new technologies. Students also examine the evolution of Earth's atmosphere.*	*…students will have developed a more advanced mastery of **Earth** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include the carbon chemistry of hydrocarbons, including standard nomenclature. Students will have evaluated anthropogenic impacts on the chemistry of the atmosphere*	*…students will develop an advanced mastery of **Earth** by significantly increasing their existing knowledge and understanding to include the introduction of complex metal ions and ligands. Also students will become familiar with methods for identifying unknown materials.*
Sequencing rationale	Fundamentals → materials → the Earth			Fundamentals → materials → the Earth		Fundamentals → materials → the Earth	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Organisms	Movement and Cells	Breathing Digestion	Disease	Cell structure and transport Cell division Organisation and the digestive system Organising animals and plants The nervous system Hormones Homeostasis		Cell structure Biological molecules Nucleic acids Enzymes Membranes Cell division Gas exchange Animal transport Plant transport Communicable diseases	Communication and homeostasis Excretion Neuronal communication Hormonal communication Plant and animal responses
"By the end of this year…"	*…students will have gained an introductory working knowledge of **organisms**, building on basic ideas from KS2. This will have included looking inside organisms at how their skeleton and muscles work together. They should have also started to examine the building blocks of living things: cells*	*…students will have started to secure their knowledge of **organisms** to have included how cells work together to form tissues, organs and organ systems. They should also have developed their understanding of nutrition and health in order to keep the body functioning.*	*…students will have developed their knowledge of **organisms** by revisiting health and disease. Students will have learned about the differences between communicable and non-communicable diseases, as well as the function of the immune system. Students will also examine in depth the various risk factors for NCDs*	*…students will have significantly broadened and deepened their knowledge of **organisms** by revisiting. They will have also learned how the body coordinates its internal environment. Revisiting cells to include more key features, tissues and organ systems in greater depth, to include both animal and plant examples. They should have deepened their understanding to include the biological molecules found in food and how cell specialisation occurs.*		*…students will have developed a more advanced mastery of **organisms** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include complex biochemistry and detailed processes of exchange and transport. Immunity is discussed at far greater depth.*	*…students will develop an advanced mastery of **organisms** by significantly increasing their existing knowledge and understanding of… from KS4. Their understanding should now include complex processes that explain how coordination of the body's systems is carried out. The relationships between cells is examined at an expert level.*
Sequencing rationale	Us → populations/global Visible/tangible → abstract/counterintuitive			Small → Big Fundamental → Complex Single cells → multi → populations		Small → Big Fundamental → Complex Single cells → multi → populations	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Ecosystems	Interdependence and plant reproduction	Respiration and photosynthesis		Photosynthesis and respiration	Adaptation, interdependence and competition Organising an ecosystem Biodiversity and interdependence	Biodiversity	Photosynthesis Respiration Ecosystems Populations and sustainability
	*…students will have gained an introductory working knowledge of **ecosystems**, building on basic ideas from KS2. This will have included a basic idea about how different organisms interact with each other in different ways, predators and prey, mating and competition. They should have also started to understand how plant species reproduce.*	*…students will have started to secure their knowledge of **ecosystems** to have included how energy is transferred between organisms and the environment. They should also have developed their understanding of two major energy pathways: photosynthesis and respiration.*		*…students will have further developed their knowledge of **ecosystems** by revisiting the transfer of energy during photosynthesis and respiration. They should have deepened their understanding to include symbol chemical equations, and more complex cell biology. They will also examine quantitative factors that affect the rates of these reactions.*	*…students will have begun mastering the big idea of **ecosystems** by having revisited the concept of interdependence. They should have deepened their understanding inter- and intraspecific forms of competition. The predator-prey relationship is also examined as well as the importance of biodiversity and conservation.*	*…students will have developed a more advanced mastery of **ecosystems** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include complex quantitative measures of biodiversity, such as the Simpson's Index of Diversity, and also statistical tools like standard deviation, t-testing, and correlation coefficients. Conservation efforts are classified as in situ and ex situ*	*…students will develop an advanced mastery of **ecosystems** by significantly increasing their existing knowledge and understanding of photosynthesis and respiration from KS4. Their understanding should now include highly complex biochemistry and advanced intra-cellular structural detail. Students will have studied specific examples of global conservation efforts*
Sequencing rationale	Us → populations/global Visible/tangible → abstract/counterintuitive			Small → Big Fundamental → Complex Single cells → multi → populations		Small → Big Fundamental → Complex Single cells → multi → populations	

	Key Stage 3			Key Stage 4		Key Stage 5	
Big idea	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**
Genes	Variation and reproduction	Evolution and inheritance			Reproduction Variation and evolution Genetics and evolution	Classification and taxonomy	Cellular control Patterns of inheritance Manipulating genomes Cloning and biotechnology
"By the end of this year…"	*…students will have gained an introductory working knowledge of **genes**, building on basic ideas from KS2. This will have included identifying the ways in which people and organisms are different. They are also introduced to human reproduction.*	*…students will have started to secure their knowledge of **genes** including how gradual changes in DNA can lead to evolution. They should also have developed their understanding of how features are passed to offspring.*			*…students will have begun mastering the big idea of **genes** by having revisited evolution and inheritance. They should have deepened their understanding by examining how natural selection can select for particular adaptations and using quantitative analysis to predict the characteristics of offspring. They will have also explored different systems of classification*	*…students will have developed a more advanced mastery of **genes** by significantly increasing their existing knowledge beyond KS4. Their understanding should now include a detailed genetic and molecular analysis of the two differing classification systems used.*	*…students will develop an advanced mastery of **genes** by significantly increasing their existing knowledge and understanding of inheritance from KS3 or 4. Their understanding should now include a variety of different genetic processes that activate genes as well as changing the pattern of inheritance, such as epistasis, codominance and linkage.*
Sequencing rationale	Us → populations/global Visible/tangible → abstract/counterintuitive			Small → Big Fundamental → Complex Single cells → multi → populations		Small → Big Fundamental → Complex Single cells → multi → populations	

Implementation: development of skills

<table>
<tr><th>Skill</th><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th><th>Year 11</th><th>Year 12</th><th>Year 13</th></tr>
<tr><td rowspan="2">Scientific thinking

By the end of the year…</td><td colspan="3">2.13 Estimate risks
2.14 Examine consequences
2.15 Review theories
2.16 Interrogate sources</td><td colspan="2">WS1.1 How theories change over time
WS1.2 Use models
WS1.3 Appreciate the power and limitations of science, including arising ethics
WS1.4 Applications and implications of scientific ideas
WS1.5 Evaluate risks and consider how risk is perceived
WS1.6 Recognise the importance of peer review</td><td colspan="2">HSW1 Use theories, models and ideas to develop scientific explanations
HSW2 Use knowledge and understanding to pose scientific questions, define scientific problems, present arguments and scientific ideas
HSW7 Know that scientific knowledge and understanding develops over time
HSW9 Consider applications and implications of science and evaluate their associated benefits and risks
HSW10 Consider ethical issues in the treatment of humans, other organisms and the environment
HSW11 Evaluate the role of the scientific community in validating new knowledge and ensuring integrity</td></tr>
<tr><td>…students will be able to use key words like risk and hazard, identify groups that can be positively or negatively harmed by an action, can explain what is meant by a theory and know what bias means</td><td>…students will be able to identify risks and hazards, can consider environmental implications of actions, will appreciate how ideas have changed and can check information for bias</td><td>…students will be able to suggest how investigations can be made safe, can evaluate choices in terms of benefit and harm, can explain why theories take time to change and can articulate the benefit of peer review</td><td>…students will have revisted ideas about scientific thinking, but will also increasingly evaluate models for scientific ideas and consider ethical dilemmas that arise. Contexts will have included: cost effectiveness of additions to greenhouses, modelling giant covalent structures and the development of atomic structure,</td><td>…students will be able to consider scientific thinking in a variety of more complex biological, chemical and physical contexts, including: evaluating different brain procedures, considering the properties of thermosetting and thermosoftening polymers and advancing astrophysics ideas like dark matter and dark energy.</td><td>…students will master scientific thinking in a variety of highly technical and advanced biological, chemical and physical contexts, including the impacts of international conservation legislation</td><td>…students will master scientific thinking in a variety of highly technical and advanced biological, chemical and physical contexts, including acceptance of the delocalised benzene model by the scientific community in light of supporting experimental evidence.</td></tr>
</table>

Skill	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Scientific enquiry	2.9 Collect data 2.10 Devise questions 2.11 Plan variables 2.12 Test hypotheses			WS2.1 Use scientific theories and explanations to develop hypotheses WS2.2 Plan experiments WS2.3 Use of appropriate techniques for an experiment WS2.4 Appropriate and safe use of apparatus WS2.5 Collection of representative samples WS2.6 Make and record observations		HSW3 Use appropriate methods, including ICT to answer scientific questions and solve scientific problems HSW4 Carry out experimental and investigative activities, including appropriate risk management	
By the end of the year…	*…students will be able to use key words like control group, independent variable, hypothesis and prediction.*	*…students will be able to choose ranges and intervals for data collection, ask questions in the form: "how does.. change over time?" , identify control variables and conclude whether a hypothesis was correct.*	*…students will be able to explain why having a large range or many readings leads to accurate data, whether a given question can be investigated, why some variables are uncontrollable, and what to do if conclusions do not agree with predictions.*	*…students will have revisited ideas about **scientific enquiry**, but will also increasingly evaluate the appropriateness of selected techniques. Students will also have taken greater control over method planning. Contexts in Year 10 will have included investigating antibiotics, preparation of a pure, dry salt from an insoluble oxide, and determining the specific heat capacity of a material.*	*…students will be able to consider **scientific enquiry** in a variety of more complex biological, chemical and physical contexts, including: investigating factors affecting reaction times, the analysis and purification of water samples, and determining the suitability of apparatus used to measure frequency, wavelength and wave speed in a ripple tank.*	*…students will master **scientific enquiry** in a variety of highly technical and advanced biological, chemical and physical contexts, the use of appropriate sampling techniques, or using Quickfit apparatus for reflux.*	*…students will further master **scientific enquiry** in a variety of highly technical and advanced biological, chemical and physical contexts, including investigating photosynthetic pigments with thin layer chromatography or using qualitative analysis to distinguish aldehydes and ketones.*
Scientific analysis	2.1 Analysing patterns 2.2 Discuss limitations 2.3 Draw conclusions 2.4 Present data			WS2.7 Evaluate methods and suggest improvements WS3.1 Presenting observations and other data using appropriate methods WS3.2 Translating data from one form to another WS3.3 Using maths and statistics to analyse WS3.4 Estimating uncertainty WS3.5 Identifying trends and patterns and drawing conclusions WS3.6 Presenting reasoned explanations based on hypotheses WS3.7 Being objective, and evaluating data		HSW5 Analyse and interpret data to provide evidence, recognising correlations and causal relationships HSW6 Evaluate methodology, evidence and data, and resolve conflicting evidence	
By the end of the year…	*…students will be able to use key words like outlier, experimental error, primary data, and be able to perform simple calculation and read from a variety of charts and graphs.*	*…students will be able to select relevant data and process it, suggest improvements to experiments, draw simple conclusions from data, and construct line graphs.*	*…students will be able to appreciate how anomalous data can obscure patterns, identify potential sources of random and systematic error, identify further questions for investigation, and explain choices of graph.*	*…students will have revisited ideas about **scientific analysis**, but will have also explored simple ideas of uncertainty and objectivity. This will have been in a range of contexts including: investigating osmosis in plant tissue, determining of reacting volumes of strong acids, and measuring reaction times.*	*…students will be able to consider **scientific analysis** in a variety of more complex biological, chemical and physical contexts, including: investigating phototropism in plants, and investigating factors affecting acceleration.*	*…students will include a focus on resolving apparent conflicting evidence in their mastery of **scientific analysis** in a variety of highly technical and advanced biological, chemical and physical contexts, such as factors affecting permeability of phospholipid bilayers and balancing safety, rate and economics in the Haber process.*	*…students will further master **scientific analysis** in a variety of highly technical and advanced biological, chemical and physical contexts, including evolutionary concepts and an understanding of when K_a approximations break down.*

<table>
<tr><th>Skill</th><th>Year 7</th><th>Year 8</th><th>Year 9</th><th>Year 10</th><th>Year 11</th><th>Year 12</th><th>Year 13</th></tr>
<tr><td>Scientific communication</td><td colspan="3">2.5 Communicate ideas
2.6 Construct explanations
2.7 Critique claims
2.8 Justify opinions</td><td colspan="2">WS3.8 Communicating investigations in paper-based and electronic reports
WS4.1 Use scientific terminology
WS4.2 Recognise the importance of scientific quantities and their origin
WS4.3 Use SI units and IUPAC nomenclature
WS4.4 Use standard prefixes and powers of ten for orders of magnitude
WS4.5 Interconvert units
WS4.6 Use appropriate numbers of significant figures</td><td colspan="2">HSW8 Communicate information and ideas in appropriate ways using appropriate terminology
HSW12 Evaluate the ways in which society uses science to inform decision making.</td></tr>
<tr><td>By the end of the year…</td><td>…students will be able to use writing styles that suit a particular audience, make clear distinctions between facts and opinion, and use key words like evidence, claim, reasoning.</td><td>…students will be able write about ideas clearly and correctly, develop explanations, and can check evidence for accuracy.</td><td>…students will be able to suggest ideas for better communication, explain why explanations are more believable when supported with data, can evaluate a claim with evidence, and identify ways in which different opinions could both be valid.</td><td>…students will have revisited ideas about scientific communication, but will have also explored standardised rules and procedures like SI units, table and graph conventions and IUPAC nomenclature for chemicals and the required physics equations.</td><td>…students will be able to consider scientific communication in a variety of more complex biological, chemical and physical contexts, including the required practical investigations.</td><td>…students will include a focus on how society is influenced by scientific innovations in their mastery of scientific communication in a variety of highly technical and advanced biological, chemical and physical contexts, such as vaccination programmes and use of spectroscopy for drug monitoring</td><td>…students will further master scientific communication in a variety of highly technical and advanced biological, chemical and physical contexts, such as evaluating the potential impacts of interrupting ecological succession or the correct use of rate equations in chemistry.</td></tr>
</table>

Skill	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Practical competency	1. heat a measured volume of water until almost boiling, having selected and used appropriate equipment 2. obtain and record a clearly focused image of a microscopic object 3. find out at regular intervals the temperature of water being heated and tabulate observations to reveal the pattern 4. separate ingredients from mixtures using appropriate techniques such as evaporation, filtration, chromatography and magnets 5. measure the speed of a moving object using appropriate equipment 6. measure changes in the pH of solutions using indicators 7. carry out practical procedures using instructions without guidance and in a calm fashion with due regard to the safety of others 8. observe and investigate a range of chemical reactions using equipment appropriately 9. build electrical circuits using various components and measure current and voltage using an ammeter and voltmeter 10. build an electrical circuit based upon a range of circuit diagrams			1. Use of appropriate apparatus to make and record a range of measurements accurately, including length, area, mass, time, temperature, volume of liquids and gases, and pH 2. Safe use of appropriate heating devices and techniques including use of a Bunsen burner and a water bath or electric heater 3. Use of appropriate apparatus and techniques for the observation and measurement of biological changes and/or processes. 4. Safe and ethical use of living organisms (plants or animals) to measure physiological functions and responses to the environment 5. Measurement of rates of reaction by a variety of methods including production of gas, uptake of water and colour change of indicator. 6. Application of appropriate sampling techniques to investigate the distribution and abundance of organisms in an ecosystem via direct use in the field 7. Use of appropriate apparatus, techniques and magnification, including microscopes, to make observations of biological specimens and produce labelled scientific drawings 8. Use of appropriate techniques and qualitative reagents to identify biological molecules and processes in more complex and problem-solving contexts including continuous sampling in an investigation		See individual documentation.	

Skill	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13
Mathematical skills	7.1 Arithmetic and number • Recognise and use decimal numbers • Use ratios, fractions and percentages • Make estimates from simple calculations 7.2 Handling data • Calculating means, modes and medians • Construct and interpret bar charts • Use a scatter diagram to identify correlations between two variables • Understand sampling • Make order of magnitude calculations 7.3 Algebra • Understand and use the symbols: =, <, > • Substitute numerical values into simple algebraic equations using appropriate units for physical quantities • Solve simple algebraic equations 7.4 Graphs • Translate information between graphical and numeric form • Plot two variables from data • Determine the slope and intercept of a linear graph 7.5 Geometry and trigonometry • Use angular measures in degrees • Calculate areas of triangles and rectangles, surface areas and volumes of cubes			Additionally: 7.1 Arithmetic and number • Recognise standard form numbers 7.2 Handling data • Appropriateness with significant figures • Construct and interpret frequency diagrams and histograms • Understand simple probability 7.3 Algebra • Understand and use the symbols: <<, >>, $\propto$ and ~ • Change the subject of an equation 7.4 Graphs • Understand that y = mx + c represents a linear relationship • Determine the slope and intercept of a linear graph • Draw and use the slope of a tangent to a curve as a measure of the rate of change • Understand the physical significance of the area between a curve and the x-axis and measure it by counting the squares 7.5 Geometry and trigonometry • Visualise and represent 2D and 3D forms including 2D representations of 3D objects		Additionally: M0 Arithmetic and number • Recognise and make use of appropriate units in calculations • Use calculators to find and use power, exponential and logarithmic function M1 Handling data • Select and use a statistical test • Understand measures of dispersion, including standard deviation and range • Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined M2 Algebra • Use logarithms in relation to quantities that range over several orders of magnitude M4 Geometry and trigonometry • Calculate circumferences, surface areas and volumes of all regular shapes	
Sequencing rationale	Decimals → standard form and indices → logarithms Formatting of charts/graphs → appropriateness of graphs → statistical analysis						

c. Impact: how do we know that our students are progressing on this journey?

Feedback and assessment: attempting to measure impact and allowing students to reflect

Curricular impact is difficult to fully quantify. We must look to a range of student attributes and abilities, some of which are easily measured, others less so.

Examples of indications that our curriculum has successfully impacted our students' progress include:

- **Students who can discuss big scientific ideas with a fluency that is appropriate for their curriculum level. Core pieces of knowledge are easily recalled.**
- **Students who can recognise knowledge in complicated contexts or scenarios they are unacquainted with.**
- **Students who are shrewd, judgemental sceptics who possess an evidence-based approach to scientific ideas.**
- **Students who can successfully transfer mathematical skills into scientific contexts and use them to solve problems.**
- **Students who are at ease in the laboratory environment and can use standard apparatus and techniques appropriately.**

Day-to-day informal assessment is one way to review impact and comes in many forms, including: questioning, discussion, as well as looking at class work and homework.

Written assessments in the form of tests are an easy way to quantify our curriculum's impact. We accept that exams are an important reality for both students and our school, however, we are conscious of not making them the sole purpose of our work, nor do we believe that excessive exam coaching is a good use of curriculum time. With this in mind, we limit formal assessment to just six activities per subject per year. Examples and timings are noted in the *Assessment Overview*.

All of our assessments have a formative nature to them and are used as opportunities to evaluate current understanding. Guided by teacher comments throughout, students are invited to reflect upon what went well and where improvements could be made. Institutional 'end of year' assessments which are inherently summative are still used as a formative exercise.

The simple template below features on the front of all assessments:

Student reflection **www**
Ebi

Up to six times per year, students' notes in their exercise books are reviewed and acknowledged for completeness and effectiveness, see the example below:

Book review (GCSE)

Most recent assessment:

U	4	5	6	7	8	9

What went well:	✓	Even better if:	✓
Your last assessment went really well. *You are applying your science knowledge correctly.*		**Your last assessment was not your best work.** *Look at how you review your knowledge and ask for help.*	
You have acted upon my previous advice/targets. *Now your work better helps you recall core knowledge and study for assessments.*		**You must act on my previous advice/targets** *and do this by your next homework deadline.*	
You have spelled scientific keywords correctly. *This means your written work on scientific ideas is clear to read.*		**Your spellings of scientific keywords need to improve**. *Always double-check them, especially if they are similar to other science words.*	
You are using units correctly. *Just as scientists do.*		**Ensure correct use of units.** *They make your answers clearer.*	
Your written/drawn work is organised sensibly. *This will help you remember past work and prepare for assessments*		**Ensure your written work is well-organised** *so that it will be helpful when preparing for assessments. Think: will your work still make sense in one month?*	
Your worksheets/tests are stuck in the correct place. *This will help you remember past work and prepare for assessments*		**Stick worksheets and tests in the correct place.** *Lost materials cannot help you prep for assessments. Organise them by your next homework deadline.*	
All of your class work is present. *This means your core knowledge is complete and can help with your studies.*		**Catch up on missed work urgently.** *Core knowledge is missing and cannot help you study. Get this completed by your next homework deadline.*	
Your tables/graphs follow scientific rules. *This is exactly how real scientists present their data.*		**Your tables/graphs are not correctly drawn.** Follow the advice given and re-draw them by your next homework deadline.	

*** highlight one of your teacher's EBI targets that you will make your first priority**

Impact beyond the curriculum

Though inherently extra-curricular, our enrichment activities also contribute to our intentions and have valued impact. The sciences offer a number of opportunities, not limited to the following:

- **Membership of Team Hummingbird is highly inclusive and allows for the development of:**
  - **Knowledge and understanding of big ideas like Energy, Electromagnetism and Forces**
  - **Subject-specific skills, such as trial and error and the scientific method.**
  - **Cultural capital, such as inter-personal skills and teamwork, making friends with shared interests, an interest in protecting our environment.**

- **Trips, visits and events, including:**
  - **We The Curious (Bristol), where students can handle and work with scientific innovations that improve our lives**
  - **Science Live, where students listen to leading scientists and their research**
  - **Operating Theatres Live, where students can engage with the healthcare sciences and decide whether it is a future or career for them**
  - **Medicine Day, a linked event with partner schools where medical professionals discuss careers in medicine**
  - **International visits, including the Azores where sustainability, environmental protection and biodiversity are discussed and seen *in situ*.**

Reviewing the impact of our curriculum

Annually we review our curriculum to ensure that our intentions continue to be realised. In the summer term, the sequencing of knowledge and our assessment scheme are both discussed and where necessary modified to more closely align to our intent.

Quality assurance is also used to measure the visibility of our intentions and ensure that they are being implemented in the way we hoped. Quality assurance includes:

- **Annual lesson observations**
- **Review of students class work**
- **Drop-ins**
- **Student surveys**
- **Student focus groups**

Where we find our intentions are not being implemented, we will seek to refine our practice, or where necessary look again to our intentions and assess their suitability.

Assessment overview

CURRICULUM & ASSESSMENT OVERVIEW: *SCIENCES (BIOLOGY, CHEMISTRY, PHYSICS)*						
	Autumn 1	**Autumn 2**	**Spring 1**	**Spring 2**	**Summer 1**	**Summer 2**
Year 7 (KS3)	*Topic(s):* *Lab safety* *Forces* • *Gravity* • *Speed* *Electromagnetism* • *Voltage and resistance* • *Current* *Assessment 1* *See Example 1*	*Topic(s):* *Energy* • *Energy costs* • *Energy transfer* *Waves* • *Sound* • *Light* *Matter* • *The Particle model* *Assessment 2*	*Topic(s):* *Matter* • *Separating mixtures* *Reactions* • *Metals and non-metals* • *Acids and alkalis* *Assessment 3*	*Topic(s):* *Earth* • *Earth structure* • *The Universe* *Organisms* • *Movement* *Assessment 4*	*Topic(s):* *Organisms* • *Cells* *Ecosystems* • *Interdependence* • *Plant reproduction* *Assessment 5* *End of Year 7 exam*	*Topic(s):* *Genes* • *Variation* • *Reproduction* *Assessment 6*

Year 8 (KS3)	*Topics:* *Forces* • *Contact forces* • *Pressure* *Assessment 1*	*Topics:* *Waves* • *Wave effects* • *Wave properties* *Matter* • *Elements* • *The periodic table* *Assessment 2*	*Topics:* *Reactions* • *Chemical energy* • *Types of reaction* *Earth* • *Climate* • *Earth resources* *Assessment 3* *See Example 2*	*Topics:* *Organisms* • *Breathing* • *Digestion* *Assessment 4*	*Topics* *Ecosystems* • *Photosynthesis* • *Respiration* *Assessment 5*	*Topics* *Genes* • *Evolution* • *Inheritance* *Assessment 6*
Year 9 (KS3)	*Topics:* *Biology* • *9B1 Cell structure and transport* • *9B2 Cell division* *Assessment 1*	*Topics:* *Biology:* • *Organisation and the digestive system* *Assessment 2*	*Topics* *Chemistry:* • *9C1 Atomic structure* • *9C2 The periodic table* *Assessment 3*	*Topics* *Chemistry:* • *9C3 Structure and bonding* *Assessment 4*	*Topics* *Physics* • *9P1 Conservation and dissipation of energy* *Assessment 5* *End of Year 9 test*	*Topics* *Physics* • *9P2 Energy transfer by heating* • *9P3 Energy resources* *Assessment 6*

Year 10 (GCSE)	***Topics*** ***Biology*** • ***B4 Organisation in animals and plants*** ***Assessment 1*** ***Chemistry*** • ***Review C1, C2, C3*** • ***C4 Chemical calculations*** ***Assessment 1*** ***Physics*** • ***P4 Electric circuits*** • ***P5 Electricity in the home*** ***Assessment 1***	***Topics*** ***Biology*** • ***B5 Communicable diseases*** • ***B6 Preventing and treating disease*** ***Assessment 2*** ***Chemistry*** • ***C4 Chemical calculations*** • ***C5 Chemical changes*** ***Assessment 2*** ***Physics*** • ***P6 Molecules and matter*** • ***P7 Radioactivity*** ***Assessment 2***	***Topics*** ***Biology*** • ***B7 Non-communicable diseaes*** • ***B8 Photosynthesis*** ***Assessment 3*** ***Chemistry*** • ***C6 Electrolysis*** • ***C7 Energy changes*** ***Assessment 3*** ***Physics*** • ***P8 Forces in balance*** • ***P9 Motion*** ***Assessment 3***	***Topics*** ***Biology*** • ***B9 Respiration*** • ***B10 Human nervous system*** ***Assessment 4*** ***Chemistry*** • ***C7 Energy changes*** • ***C8 Rates and equilibrium*** ***Assessment 4*** ***Physics*** • ***P9 Motion*** • ***P10 Force and motion*** ***Assessment 4***	***Topics*** ***Biology*** • ***B11 Hormonal coordination*** • ***B12 Homeostasis in action*** ***Assessment 5*** ***Chemistry*** • ***C8 Rates and equilibrium*** • ***C9 Crude oil and fuels*** ***Assessment 5*** ***Physics*** • ***P10 Force and motion*** • ***P11 Force and pressure*** ***Assessment 5***	***Topics*** ***Biology*** • ***B12 Homeostasis in action*** ***Assessment 6*** ***End of Year 10 exam*** ***Chemistry*** • ***C9 Crude oil and fuels*** ***Assessment 6*** ***End of Year 10 exam*** ***Physics*** • ***P11 Force and pressure*** • ***P12 Wave properties*** ***Assessment 6*** ***End of Year 10 exam***

Year 11 (GCSE)	***Topics*** ***Biology*** • ***B13 Reproduction*** • ***B14 Variation and evolution*** ***Assessment 1*** ***See Example 3*** ***Chemistry*** • ***Review of C9*** • ***C10 Organic reactions*** • ***C11 Polymers*** ***Assessment 1*** ***Physics*** • ***P13 Electromagnetic waves*** • ***P14 Light*** ***Assessment 1***	***Topics*** ***Biology*** • ***B15 Genetics and evolution*** • ***B16 Adaptation and interdependence*** ***Assessment 2*** ***Chemistry*** • ***C11 Polymers*** • ***C12 Chemical analysis*** • ***Assessment 2*** ***Physics*** • ***P14 Light*** • ***P15 Electromagnetism*** ***Assessment 2***	***Topics*** ***Biology*** • ***B17 Organisation of an ecosystem*** • ***B18 The effects of human interactions on ecosystems*** ***Assessment 3*** ***Chemistry*** • ***C13 Our atmosphere*** ***Assessment 3*** ***Physics*** • ***P15 Electromagnetism*** • ***P16 Space*** ***Assessment 3***	***Topics*** ***Biology*** • ***Revision of B1-B9*** ***Assessment 4 (mock)*** ***Chemistry*** • ***C14 The Earth's resources*** • ***C15 Using our resources*** ***Assessment 4 (mock)*** ***Physics*** • ***P16 Space*** ***Assessment 4 (mock)***	***Topics*** ***Biology*** • ***B9-B18*** ***Assessment 5 (optional)*** ***Chemistry*** • ***Revision (C1-C15)*** ***Assessment 5 (optional)*** ***Physics*** • ***Revision*** ***Assessment 5 (optional)***	

Year 12 Biology	***Topic(s):*** ***Module 2 - Cell structure and cell membranes*** ***Module 2 Biological molecules*** ***Assessment:*** ***Initial maths skills test*** ***Cell structure test*** ***Biological molecules test***	***Topic(s):*** ***Module 2 Cell Division*** ***Module 2 Nucleic acids and Enzymes*** ***Assessment:*** ***Cell membranes test*** **Cell Division test** **Nucleic acids test**	***Topic(s):*** ***Module 3 - Exchange surfaces and breathing*** ***Module 4 - Communicable diseases*** ***Assessment:*** **Enzymes test** **Exchange surfaces and breathing test**	***Topic(s):*** ***Module 3 Transport in animals*** ***Module 4 - Biodiversity*** ***Assessment:*** **Communicable diseases & Transport in animals tests**	***Topic(s):*** ***Module 3 - Transport in plants*** ***Module 4 - Classification and evolution*** ***Assessment:*** **Biodiversity test** **Classification test** **Transport in plants test**	***Topic(s):*** ***Biodiversity Fieldwork (Module 6 Ecosystems)*** ***MOCK EXAM (OR Exemplar Assessments)*** ***AS Breadth and Depth papers***
Year 12 Chem	***Topic(s):*** ***Chapters 2.1 and 2.2*** ***Assessment(s):*** ***Progress test and progress test resit (if needed).*** ***2.1 and 2.2 assessed Homework tasks***	***Topic(s):*** ***Chapters 2.1 and 2.2*** ***Assessment(s):*** ***Chapters 2.1 and 2.2 Module tests. (Resits available if needed)*** ***2.1 and 2.2 assessed Homework tasks***	***Topic(s):*** ***Chapters 3.1 and 4.1*** ***Assessment(s):*** ***Chapters 3.1 and 4.1 Module tests. (Resits available if needed)*** ***3.1 and 3.2 assessed Homework tasks***	***Topic(s):*** ***Chapter 3.2 and 4.2*** ***Assessment(s):*** ***Chapter 4.2 Module test. (Resits available if needed)*** ***3.2 and 4.2 assessed Homework tasks***	***Topic(s):*** ***Continue and complete Chapter 3.2*** ***Preparation for mock exams after half term*** ***Mock exam revision over half term*** ***Assessment(s):*** ***C3.2 Module test. (Resit available if needed)***	***Topic(s):*** ***Go through Mock exams*** ***Start Module 6.1 (Introduction to Benzene)*** ***Set Benzene essay as Summer holiday homework)*** ***MOCK EXAM (OR Exemplar Assessments).***

Year 12 Physics	*Topic(s):* ***Rectilinear motion*** ***Momentum*** ***Charge and current*** ***Potential difference, electromotive force and power*** ***Current – pd. Relationships*** ***Assessment:*** ***Rectilinear motion test – teacher marked, with comments*** ***Basic electricity test – peer marked, with teacher comments*** ***CP1: Determine the acceleration of a freely-falling object. – self-assessment, teacher comments***	*Topic(s):* ***Forces*** ***Work, energy and Power*** ***Resistance and resistivity*** ***Internal resistance, series and parallel circuits and the potential divider*** ***Assessment:*** ***Mechanics test – peer assessment, with teacher comments*** ***Yr 12 electricty test – teacher marked, with comments*** ***CP2: Determine the electrical resistivity of a material. – self-assessment, teacher comments*** ***CP3: Determine the e.m.f. and internal resistance of an electrical cell. – self-assessment, teacher comments***	*Topic(s):* ***Fluids*** ***Nature of waves*** ***Transmission and reflection of waves*** ***Assessment:*** ***Fluids test – self-assessment, with teacher comments*** ***CP4: Use a falling-ball method to determine the viscosity of a liquid. – self-assessment, teacher comments*** ***CP6: Determine the speed of sound in air using a 2-beam oscilloscope, signal generator, speaker and microphone. – self-assessment, teacher comments***	*Topic(s):* ***Solid materials*** ***Superposition of waves*** ***Particle nature of light*** ***Assessment:*** ***Materials Test – teacher marked, with comments*** ***Waves and Light test – teacher marked, with comments*** ***CP5: Determine the Young modulus of a material– self-assessment, teacher comments*** ***CP7: Investigate the effects of length, tension and mass per unit length on the frequency of a vibrating string or wire – self-assessment, teacher comments*** ***CP8: Determine the wavelength of light from a laser or other light source using a diffraction grating. – self-assessment, teacher comments***	*Topic(s):* ***Specific Heat Capacity*** ***Internal energy, absolute zero and change of state*** ***Gas laws and kinetic theory*** ***Electric fields*** ***Capacitance*** ***Magnetic fields*** ***Assessment:*** ***CP11: Use an oscilloscope or data logger to display and analyse the potential difference (p.d.) across a capacitor as it charges and discharges through a resistor. – self-assessment, teacher comments*** ***CP12: Calibrate a thermistor in a potential divider circuit as a thermostat. – self-assessment, teacher comments*** ***CP13: Determine the specific latent heat of a phase change. – self-assessment, teacher comments*** ***CP14: Investigate the relationship between pressure and volume of a gas at fixed temperature. – self-assessment, teacher comments***	*Topic(s):* ***Revision and review*** ***MOCK EXAM (AS past paper)***

Year 13 Biology	***Topic(s):*** ***Module 5 - Communication and Homeostasis, Excretion*** ***Module 6 - Cellular Control and Patterns of Inheritance*** ***Assessment: Breadth AS paper if necessary Homeostasis test Cellular control test***	***Topic(s):*** ***Module 5 - Neuronal communication, Hormonal communication*** ***Module 6 - Manipulating genomes*** ***Assessment: Excretion test Patterns of inheritance test Neuronal communication test***	***Topic(s):*** ***Module 5 - Plant and animal responses*** ***Module 6 - Cloning and Biotechnology*** ***Assessment: Hormonal communication test Plant and animal responses test Cloning and Biotechnology test***	***Topic(s):*** ***Module 5 - Photosynthesis and Respiration*** ***Module 6 - Ecosystems. Populations and sustainability*** ***Assessment: Photosynthesis test Respiration test Ecosystems test Populations and sustainability test***	***Topic(s):*** ***Review of Year 1, Review of practical work.*** ***Assessment: Biological Processes past paper Biological Diversity past paper Unified Biology past paper***	***AL***
Year 13 Chemistry	***Topic(s):*** ***Chapters 5.1 and 6.1***	***Topic(s):*** ***Chapters 6.1 and 6.2 and 5.1***	***Topic(s):*** ***Chapters 6.2 and 5.2 and 5.3***	***Topic(s):*** ***Chapters 6.3 and 5.3***	***Topic(s):*** ***Revision***	***ALEVEL***

	Assessment(s): ***Review of AS content test.*** ***5.1 and 6.1 assessed Homework tasks.***	***Assessment(s):*** ***Chapters 6.1 and 5.1 Module tests. (Resits available if needed)*** ***6.2 assessed Homework tasks.***	***Assessment(s):*** ***Chapters 6.2 and 5.2 Module Tests. (Resits available if needed)*** ***5.2 assessed Homework task.***	***Assessment(s):*** ***Chapters 5.3 and 6.3 Module tests. (Resits available if needed)*** ***PAPER 3 MOCK*** ***5.3 and 6.3 assessed Homework tasks.***	***Assessment(s):*** ***Mock exams (PAPERS 1 & 2).*** ***Access given to all end of chapter tests from the last 2 years.***	
Year 13 Physics	***Topic(s):*** ***Electrons and nuclei*** ***Momentum and energy*** ***Assessment:*** ***Thermodynamics test – teacher marked, with comments*** ***CP9: Investigate the relationship between the force exerted on an object and its change of momentum – self-assessment, teacher comments.*** ***CP10: Use ICT to analyse collisions between small spheres, e.g. ball bearings on a table top. – self-assessment, teacher comments***	***Topic(s):*** ***Particle Physics*** ***Motion in a circle*** ***Assessment:*** ***Peer assessment of particle physics presentation, with teacher comments*** ***Further mechanics test – teacher marked, with comments***	***Topic(s):*** ***Universal Gravitation*** ***Nuclear decay*** ***Assessment:*** ***CP15: Investigate the absorption of gamma radiation by lead. – self-assessment, teacher comments*** ***MOCK EXAM (A2 past papers)***	***Topic(s):*** ***Astrophysics*** ***Cosmology*** ***Oscillations*** ***Assessment:*** ***CP16: Determine the value of an unknown mass using the resonant frequencies of the oscillation of known masses. – self-assessment, teacher comments***	***Topic(s):*** ***Assessment:***	***AL***

Example 1: Year 7 Physics Assessment

Example 2: Year 8 Chemistry Assessment

Example 3: Year 11 Biology Assessment

Physics Department

Year 8
Topics 1 and 2

Big Ideas: Forces and Electromagnetism
(45 MINUTES)

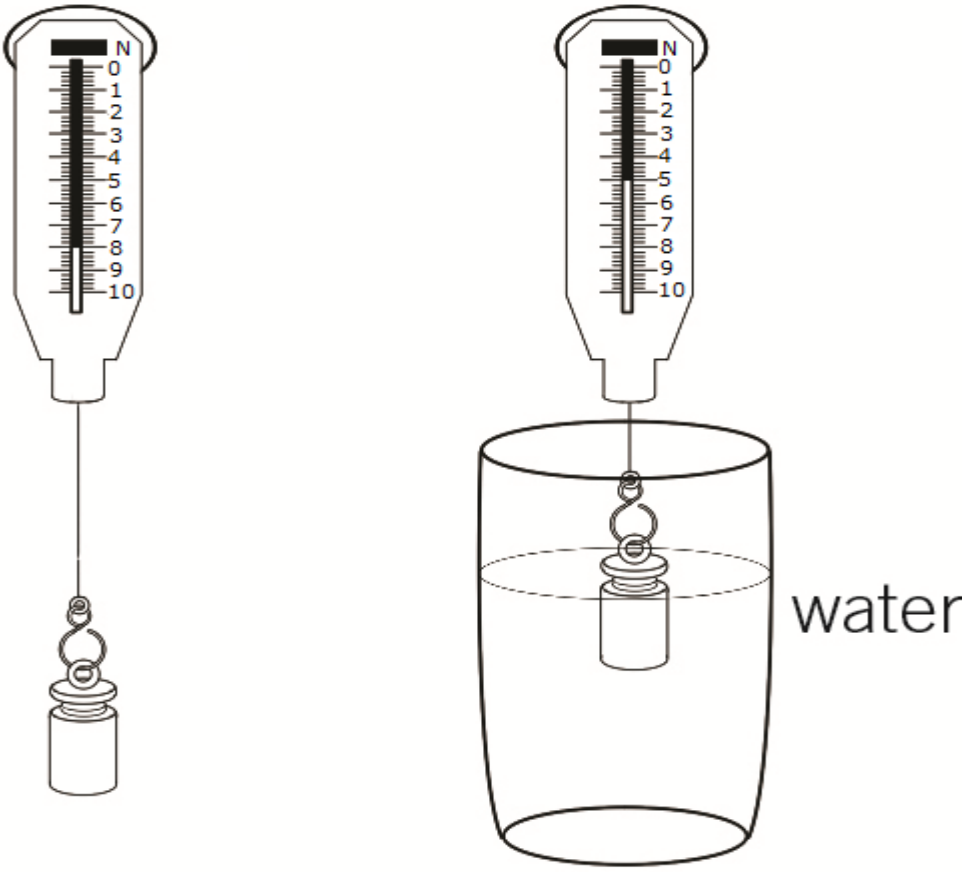
Name: .....
Teacher: .....
Score: ..... / 46

Grade									
Marks									

Teacher evaluation	Student evaluation
www	www

ebi	ebi

1. The diagram shows a newton meter weighing an object in air and then suspended in water.



a State the weight of the object in the air.

.....

(1 mark)

b Calculate the upthrust acting on the weight when it is in the water.

.....

.....

.....

(2 marks)

2. A student investigated how the area of a parachute affected how fast it fell. Their results are shown in the table.

Area of parachute (cm^2)	Time to fall (s)
100	1.3
200	1.5
400	1.8
600	2.1

a State the independent variable.

.....

(1 mark)

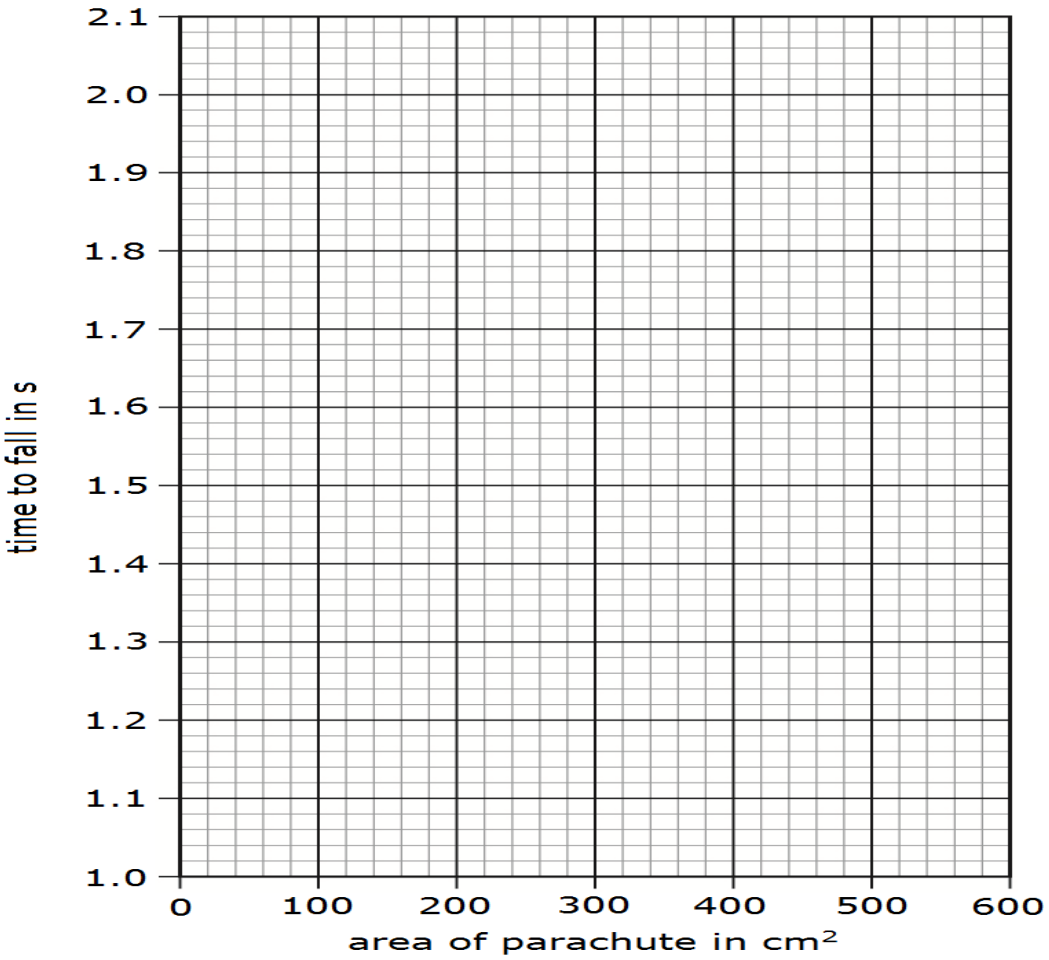
b State the dependent variable.

.....

(1 mark)

c Plot a graph of the results.

(3 marks)



3. **A snowboarder and her snowboard have a weight of 600 N. The snowboard is 140 cm long and 20 cm wide.**

a **Calculate the area of the snowboard**

.....

.....

= ..... cm^2

(1 mark)

b **Calculate the stress on the snow when the snowboarder stands on the board.**

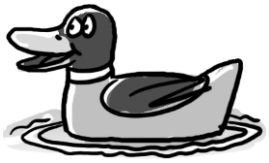
.....

.....

.....

(2 marks)

4. **The picture shows a duck in a bath.**



A student says there is no force acting on the duck because it is not moving. Is the student correct? Explain your answer.

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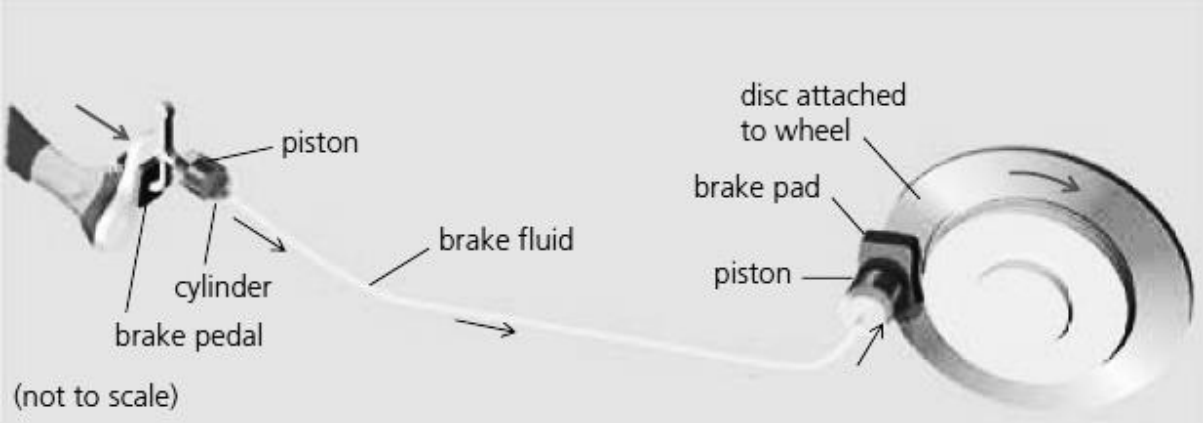
(3 marks)

5. **The diagram shows the hydraulic braking system in a car.**



Explain how the hydraulic braking system in a car acts as a force multiplier and why if the system leaked fluid it would not work.

Start by considering the pressure on the liquid caused by the car driver pressing their foot on the brake pedal. You should include calculations in your answer.

Brake pedal piston	**Brake pad piston**
Force on pedal = 20 N	**Area = 500 cm^2**
Area = 10 cm^2	

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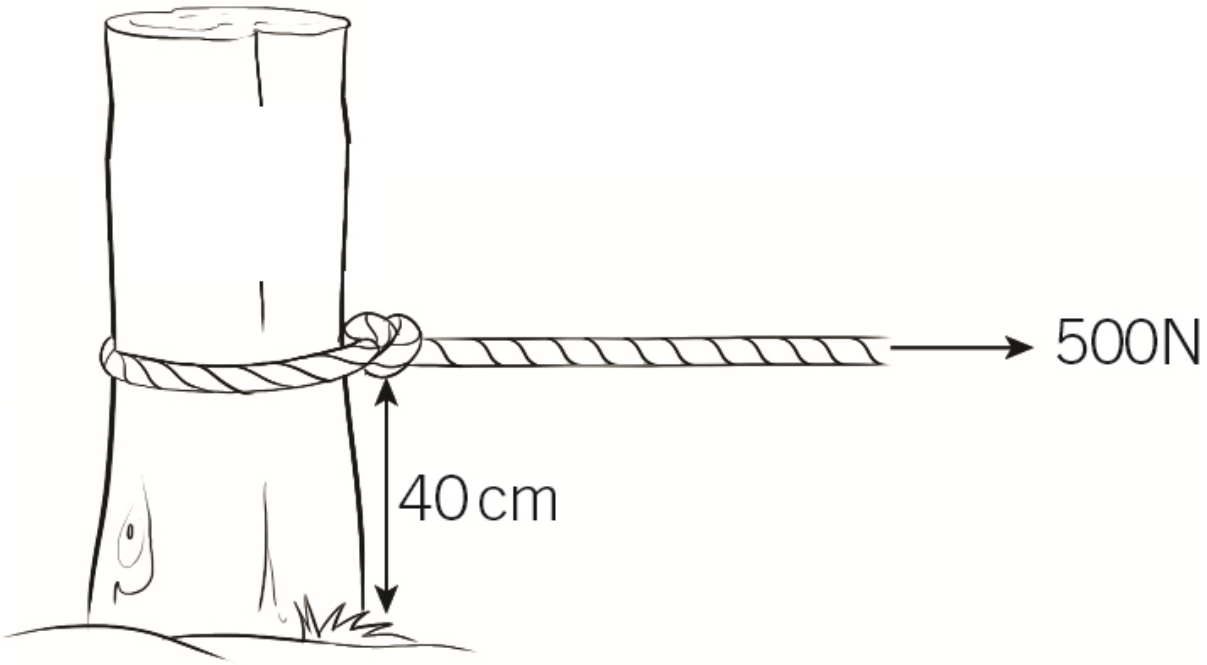
(6 marks)

6. A gardener is trying to remove a tree stump.



The gardener ties a rope around the tree stump 40 cm above the ground and pulls with a force of 500 N.

a Calculate the moment in Nm.

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(2 marks)

The tree is just starting to move but the gardener is struggling to keep pulling with this force. She moves the rope to 80 cm above the ground and keeps the same moment.

b Calculate the new pulling force.

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(2 marks)

7. An electromagnet consists of a solenoid and an iron core.

a Draw the magnetic field around a solenoid when a current flows through it.

(1 mark)

b Label the diagram to show where the field is strongest.

(1 mark)

c Describe and explain how the force on a magnetic material changes with distance from the solenoid.

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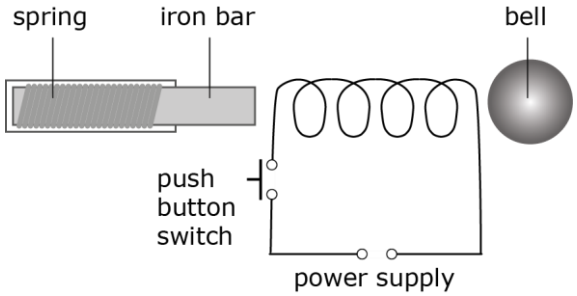
.....

(2 marks)

8. The diagram shows the design of a doorbell.

The homeowner feels the doorbell is too quiet.



a Describe how the bell works.

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(4 marks)

b Describe two changes that could be made to make the doorbell louder.

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.....

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..... *(2 marks)*

9. Describe how you would investigate how the number of coils affects the strength of an electromagnet, using this equipment:

iron core; wire; power supply; paper clips (small, medium, or large)

Your answer should include:

- **a method**
- **how you control the variables**
- **whether you should repeat**
- **whether you should use small, medium, or large paper clips**
- **safety advice.**

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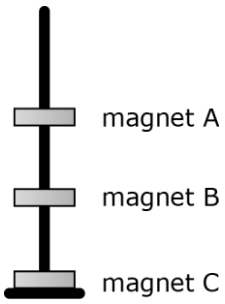
(6 marks)

10 **The diagram shows a toy called *floating magnets*. Magnet B is pushed down and then released.**



a **Describe the motion of magnet B after it is released.**

.....
.....

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.....

(2 marks)

b **Describe the motion of magnet A when:**

i **magnet B is pressed down**

.....
...

(1 mark)

ii **magnet B is released.**

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...

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...

(2 marks)

c **Suggest what would happen if a fourth repelling magnet was added on top.**

.....
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(1 mark)

Chemistry Department

YEAR 8 CHEMISTRY

5.3 and 5.4

(Big Idea: Matter)

(45 minutes)

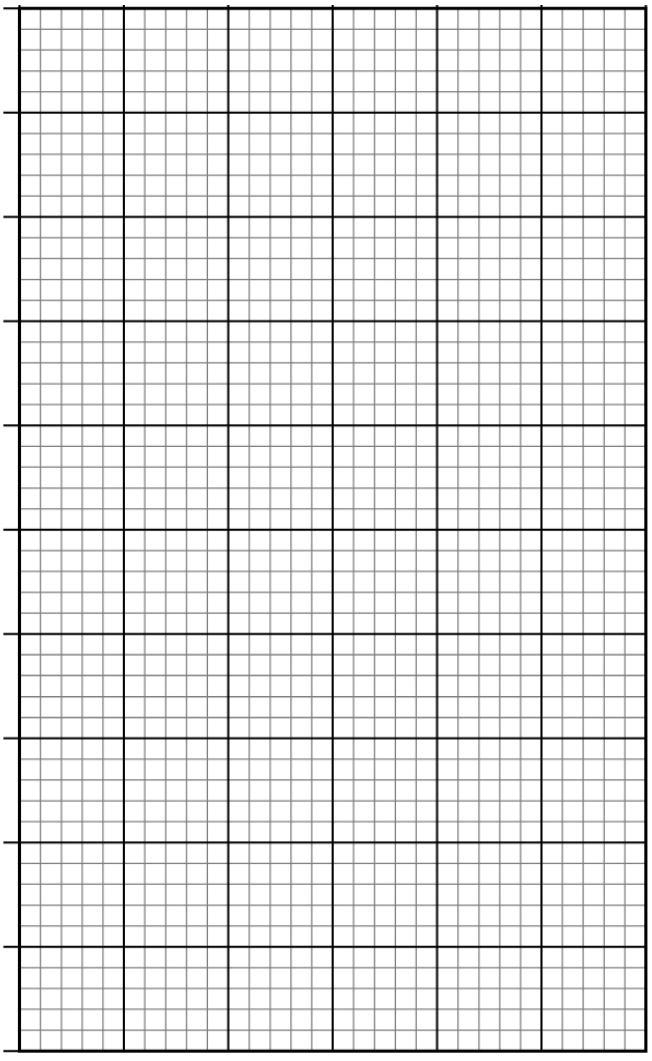
Name:	
Teacher:	
Score:	/ 40

Grade	4-	4	4+	5-	5	5+	6-	6	6+	7-	7	7+
Marks	14	16	18	20	22	24	26	28	30	32	34	36

Teacher evaluation	Student evaluation
www:	**www:**
ebi:	**ebi:**

1a Plot the data from the table on the graph below.
Remember to add labels for the axes and choose a sensible scale. *(4 marks)*

Element	Melting point (°C)
Lithium	180
Sodium	98
Potassium	
Rubidium	39



b Describe the trend shown by the graph by completing the sentence below.

As you move down Group 1 the melting point .....

(1 mark)

c Use the graph to estimate the melting point of potassium.

.....

(1 mark)

2 Complete the names and proportions of each of the elements in the table.

Chemical formula	Elements and their relative proportions
$ZnCO_3$	
MgO	
CO_2	
$Al(NO_3)_3$	

(4 marks)

3 a Describe the chemical reactions of Group 1 and Group 7 elements.

Your answer should include:

- examples of word equations for a specific Group 1 element
- the reaction between a Group 7 element and iron
- word equations for any reactions you describe. *(6 marks)*

In this question you get marks for how well your answer is written.

You will get marks for:

- spelling
- grammar
- organising your ideas and information clearly
- using key scientific words.

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b Compare the trends in reactivity between Group 1 and Group 7.

.....
.....
.....

(2 marks)

c i State what is meant by the term "displacement reaction".

.....

.....

(2 marks)

ii Select the reactions where a displacement reaction will take place.

☐ **fluorine + potassium chloride**

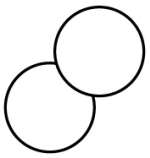
☐ **bromine + sodium iodide**

☐ **chlorine + sodium fluoride**

☐ **iodine + potassium chloride**

(2 marks)

4a Determine the name for each chemical formula and then draw a particle diagram to represent it. The first one has been completed for you.

Chemical formula	Name	Particle diagram
O_2	Oxygen	
NO_2		
SO_3		
CO		
H_2O		

(8 marks)

b Identify which of the substances from the table is an element.

.....

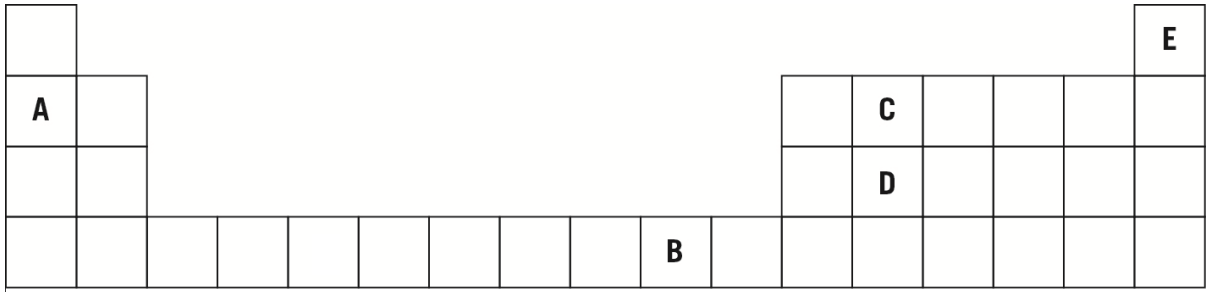
(1 mark)

c Explain why a poly(ethene) has a much higher melting point than any of the substances in the table.

.....

(1 mark)

5 Use the diagram below to answer the questions that follow. The letters may be used one, more than once or not at all.



a Element C has a very high melting point and is a solid at room temperature.

Give the letters of the other element(s) that are likely to have these properties and explain your answer.

.....

.....

(2 marks)

b Give the letter of the element you would you use if you needed an electrical conductor to use in wiring.

.....

(1 mark)

c Give the letter of the element you would use to fill a hot air balloon.

.....

(1 mark)

6 This table shows the boiling points of the Group 0 elements.

Element	Boiling point (°C)
helium	–269
neon	–246
argon	
krypton	–152
xenon	–108

a Predict the position of an unreactive element with a boiling point of –109°C.

.....

(2 marks)

b Estimate the boiling point for argon

.....

(2 marks)

Biology Department

GCSE BIOLOGY

B13: Reproduction

(Big Idea: Organisms)

(50 minutes)

Name:	.....
Teacher:	.....
Score:	..... / 43

Grade	9	8	7	6	5	4	U
Marks	33	31	26	22	20	16	<15

Teacher evaluation	Student evaluation
www	www
ebi	ebi

Q1. In sexual reproduction, an egg fuses with a sperm.

(a) (i) Draw a ring around the correct answer to complete the sentence.

An egg and a sperm fuse together in the process of

cloning.
fertilisation.
mitosis.

(1)

(ii) Egg cells and sperm cells each contain the structures given in the box.

chromosome	**gene**	**nucleus**

List these three structures in size order, starting with the smallest.

1 ..... (smallest)

2 .....

3 ..... (largest)

(2)

(iii) The egg and the sperm contain genetic material.

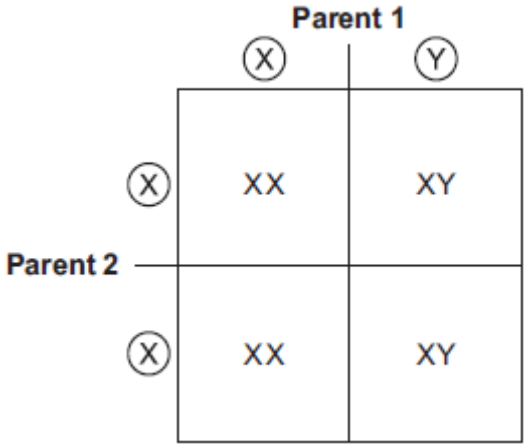
Draw a ring around the correct answer to complete the sentence.

The genetic material is made of

carbohydrate.
DNA.
protein.

(1)

(b) The diagram below shows the inheritance of **X** and **Y** chromosomes.



(i) Draw a tick (✓) on the part of the diagram that shows a sperm cell.

(1)

(ii) What is the chance of having a female child?

Give the reason for your answer.

.....

.....

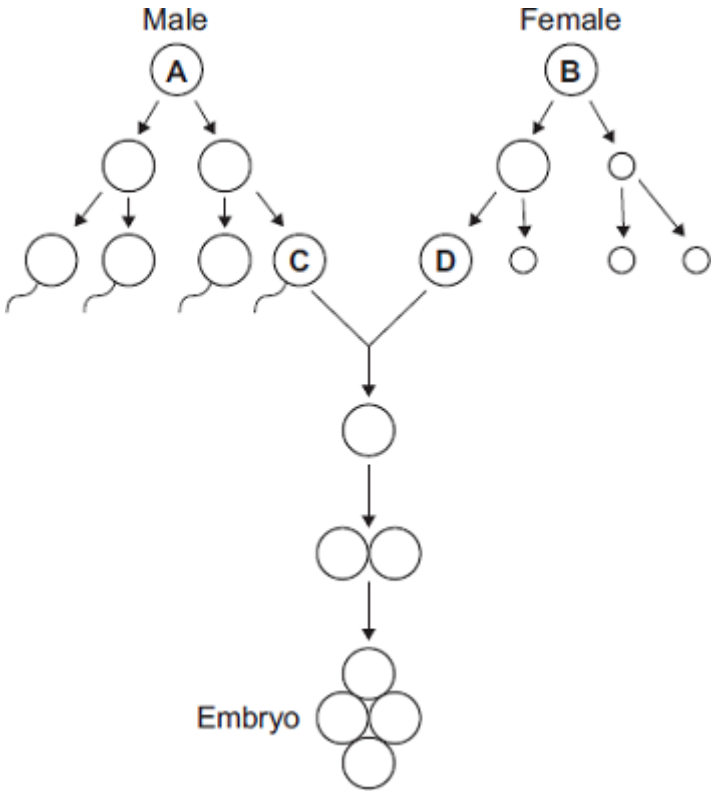
.....

.....

(2)

(Total 7 marks)

Q2. The diagram shows some of the cell divisions that occur during human reproduction.



(a) (i) Name the type of cell division that produces cell **D** from cell **B**.

.....

(1)

(ii) Which organ in the male body produces cell **C** from cell **A**?

.....

(1)

(b) (i) Cells **A** and **B** each contain 46 chromosomes.

How many chromosomes would there be in the nucleus of cell **C**? ☐

(1)

(ii) Why is it important that cell **C** has this number of chromosomes?

.....

.....

.....

.....

(2)
(Total 5 marks)

Q3. A child saved apple seeds from an apple she ate. She planted the seeds in the garden. A few years later the apple trees she had grown produced apples.

(a) The apples from the new trees did **not** taste like the original apple.

Explain why.

.....

.....

.....

.....

.....

(2)

(b) (i) Apple trees can be reproduced so that the apples from the new trees will taste the same as the apples from the parent trees.

Give **one** method used to reproduce apple trees in this way.

.....

.....

(1)

(ii) Explain why the method you have suggested in part **(b)(i)** will produce apples that taste the same as the apples from the parent trees.

.....

.....

.....

.....**(2)**
(Total 5 marks)

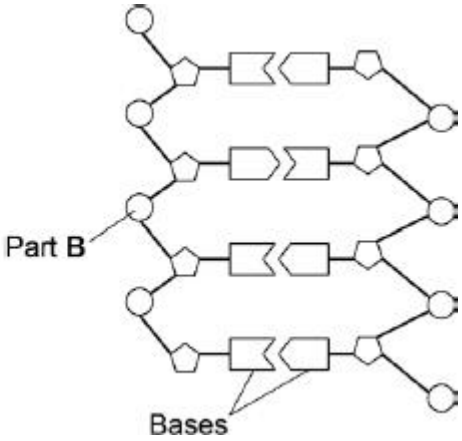
Q4.Figure 1 shows an image of a small section of DNA.

Figure 2 shows the structure of a small section of DNA.

Figure 1

© Svisio/iStock/Thinkstock

Figure 2



(a) What is Part **B**?

.....

.....

(1)

(b) In **Figure 1** the structure of DNA shows four different bases.

There are four different bases and they always pair up in the same pairs.

Which bases pair up together?

.....

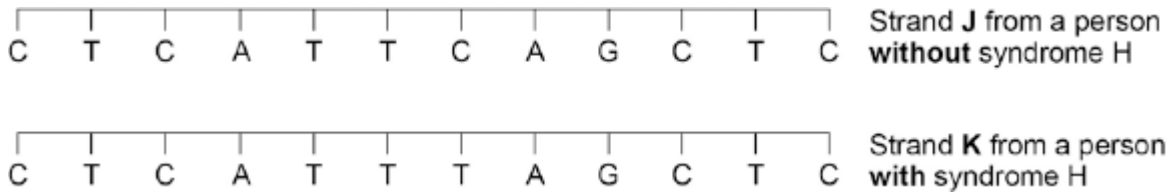
(1)

(c) **Syndrome H is an inherited condition.**

People with syndrome H do not produce the enzyme IDUA.

Figure 3 shows part of the gene coding for the enzyme IDUA.

Figure 3



Strand K shows a mutation in the DNA which has caused syndrome H.

The enzyme IDUA helps to break down a carbohydrate in the human body.

The enzyme IDUA produced from Strand K will not work.

Explain how the mutation could cause the enzyme not to work.

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(5)

(d) A recessive allele causes syndrome H.

A heterozygous woman and a homozygous recessive man want to have a child.

Draw a Punnett square diagram to determine the probability of the child having syndrome H.

Identify any children with syndrome H.

Use the following symbols:

A = dominant allele

a = recessive allele

Probability = ... %

(5)

(Total 12 marks)

Q5. DNA is the genetic material of human cells.

Figure 1 shows the structure of part of a DNA molecule.

Figure 1

(a) (i) Describe where DNA is found in a human cell.

.....

.....

.....

(2)

(ii) When a cell divides by mitosis the new cells are genetically identical.

What causes the cells to be genetically identical?

.....

.....**(1)**

(b) Many genes have different forms called alleles.

(i) A person has polydactyly (extra fingers or toes). Polydactyly is caused by a dominant allele.
What is the smallest number of copies of the dominant allele for polydactyly that could be found in a body cell of this person?

.....

(1)

(ii) Another person has cystic fibrosis. Cystic fibrosis (CF) is caused by a recessive allele.
How many copies of the recessive CF allele are there in a body cell of this person?

.....

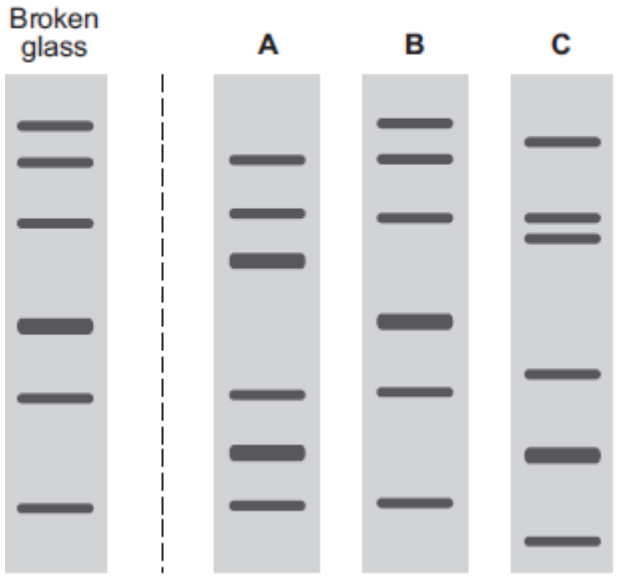
(1)

(c) A burglar broke into a house. The burglar cut his hand on some broken glass. Scientists extracted DNA from the blood on the broken glass.

The scientists analysed the DNA from the glass and DNA from three suspects, **A**, **B** and **C**. The scientists used a method called DNA fingerprinting.

Figure 2 shows the scientists' results.

Figure 2



Which suspect, **A**, **B** or **C**, is most likely to have been the burglar?

Tick (✓) **one** box.

A ☐

B ☐

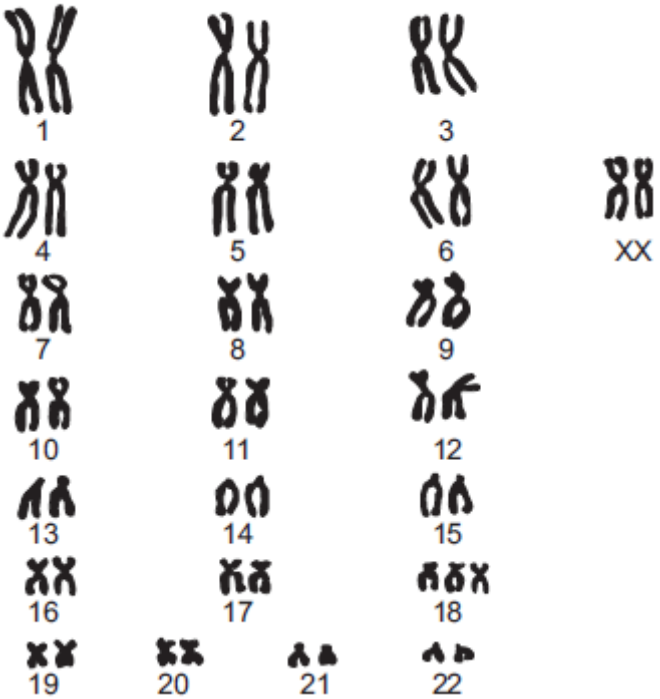
C ☐

(1)
(Total 6 marks)

Q6. Genetic disorder **E** is a condition caused by a change in the chromosomes.

(a) **Figure 1** shows the chromosomes from one cell of a person with genetic disorder **E**.

Figure 1



(i) How do you know this person is female?

Use information from **Figure 1**.

.....

.....

(1)

(ii) Describe how the chromosomes shown in **Figure 1** are different from the chromosomes from a person who does not have genetic disorder **E**.

.....

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.....

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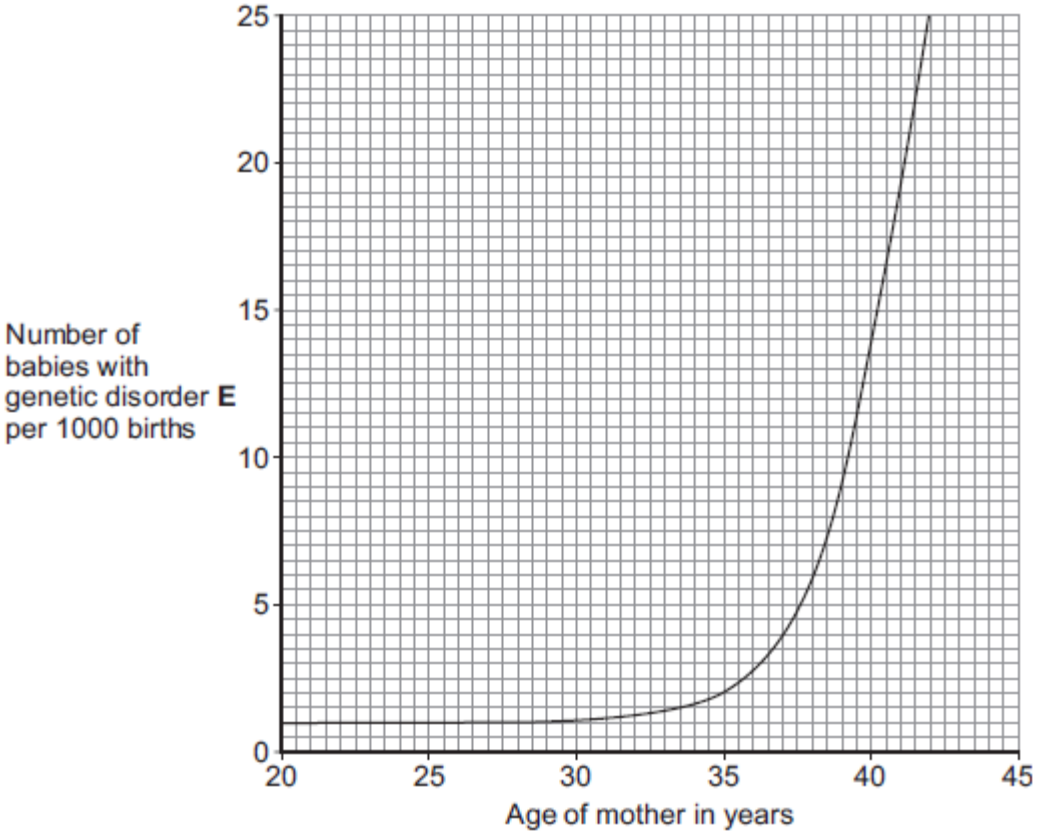
(2)

(b) As a woman gets older, the chance of her having a baby with genetic disorder **E** increases.

Figure 2 shows this.

Figure 2



(i) The chance of a 35-year-old woman having a baby with genetic disorder **E** is 2 per 1000 births.

What is the chance of a 40-year-old woman having a baby with genetic disorder **E**?

..... per 1000 births

(1)

(ii) A 40-year-old woman is more likely than a 35-year-old woman to have a baby with genetic disorder **E**.

How many times more likely?

..... times

(1)

(c) A 41-year-old woman wants to have a baby. A 41-year-old woman has an increased chance of having a baby with genetic disorder **E**.

Doctors can screen embryos for genetic disorder **E**.

The table gives some information about two methods of embryo screening.

Method 1	Method 2
1. The woman is given hormones to cause the release of a few eggs. The eggs are taken from her body in a minor operation. The eggs are fertilised in a glass dish.	1. The woman gets pregnant in the normal way.
2. One cell is taken from each embryo when the embryo is 3 days old.	2. Cells are taken when the embryo is 10 weeks old.
3. Cells are screened for genetic disorder **E**.	3. Cells are screened for genetic disorder **E**.
4. An unaffected embryo is placed in the woman's uterus. Embryos that are not used are destroyed or used in medical research.	4. An unaffected fetus is allowed to develop. If the fetus has genetic disorder **E**, the woman can choose to have an abortion.
5. This method costs about £6000.	5. This method costs about £600.

Use information from the table to give **two** advantages and **one** disadvantage of **Method 1** compared with **Method 2** for detecting genetic disorder **E**.

Advantages of **Method 1**:

1.....

.....

2.....

.....

Disadvantage of **Method 1**:

.....

.....

(3)
(Total 8 marks)