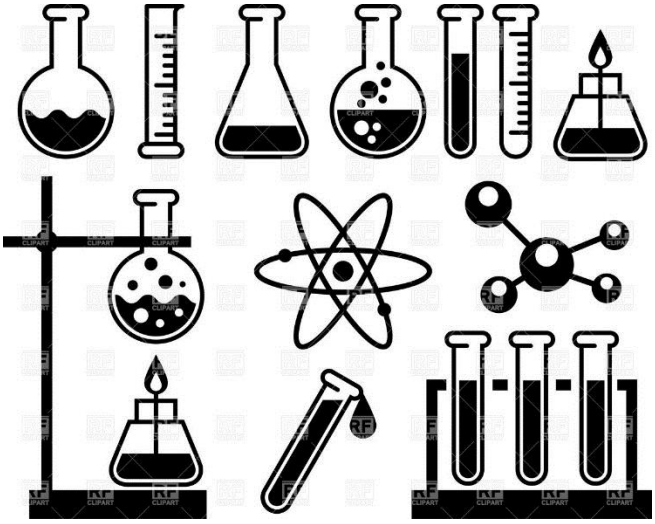
AQA

# GCSE Combined Science

Grades 9-1



Chace Community School

Combined Science Grade 9-1 GCSE

- This course will give you two GCSE Science qualifications.
- You will cover Biology, Chemistry and Physics.
- During this course and you will sit two exam papers for each science, six papers in total.
- The breakdown of what each exam will cover is included in this pack.
- During this course you will also complete 21 required practicals. These are practicals that you will complete in lesson with your science teacher.
- You **will** be asked questions about the required practicals in your GCSE Science exams.

The checklists show you exactly what you need to know for each topic.

| ***Exam Paper*** | ***How it is accessed*** |
|---|---|
| **Biology Paper 1**<br>Biology topics B1-B10:<br>Cell Biology; Organisation; Infection and response; and Bioenergetics. | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |
| **Biology Paper 2**<br>Biology topics B11-B17:<br>Homeostasis and response; Inheritance, variation and evolution; and Ecology. | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |
| **Chemistry Paper 1**<br>Chemistry topics C1-C7:<br>Atomic structure and the periodic table; Bonding, structure, and the properties of matter; Quantitative chemistry; Chemical changes; and Energy changes. | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |
| **Chemistry Paper 2**<br>Chemistry topics C8-C12:<br>The rate and extent of chemical change; Organic chemistry; Chemical analysis; Chemistry of the atmosphere; and Using resources. | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |
| **Physics Paper 1**<br>Physics topics: P1-P7<br>Energy; Electricity; Particle model of matter; and Atomic structure. | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |
| **Physics Paper 2**<br>Physics topics: P8-P13<br>Forces; Waves; and Magnetism and electromagnetism | Written exam: 1 hour 15 minutes<br>Foundation and Higher Tier<br>70 marks<br>16.7% of GCSE<br>Questions are multiple choice, structured, closed short answer, and open response. |

# What you can do to 'be the best that you can be' in Science

1. Know your specification! This tells you everything that will be on each exam!

http://www.aqa.org.uk/subjects/science/gcse/combined-science-trilogy-8464

2. Regularly use websites to help with your homework and your revision.

http://www.bbc.co.uk/schools/gcsebitesize/science/aqa/

3. Watch YouTube videos to reinforce what you have learnt in lesson.

https://www.youtube.com/user/myGCSEscience

4. Log on to Kerboodle and use the electronic book, interactive activities and progress tests to strengthen your revision. Remember the institution code is VE0.

www.kerboodle.com

User name:

Password:

Institution Code: VE0

5. Make sure you take your GCSE Combined Science (Grade 9-1) Revision guide and workbook to every lesson and revision session to that you can use it. You can order these on Parentpay and collect them from science prep room.

Revision techniques

- Make a timetable! You can even get an app for it! (Type revision into the app store and search).
- Don't waste time making your notes pretty, just get on with doing practise questions!
- Make mind maps.
- Draw images to represent key concepts.
- Take regular breaks and reward yourself for working hard!

## Exam Dates

15th May 2018 Biology Paper 1
17th May 2018 Chemistry Paper 1
23rd May 2018 Physics Paper 1

11th June 2018 Biology Paper 2
13th June 2018 Biology Paper 2
15th June 2018 Physics Paper 2

GCSE Grade Breakdown

My science target grade is _____

| 9-1 Grade | A* - G Equivalent |
|---|---|
| 9 | A** |
| 8 | A* |
| 7 | A |
| 6+ | B1 |
| 6- | B2 |
| 5+ | B3 |
| 5- | C1 |
| 4+ | C2 |
| 4- | C3 |
| 3+ | D1 |
| 3- | D2/D3 |
| 2 | E |
| 1 | F/G |
| U | U |

Topic Breakdown

| **Biology** | **Chemistry** | **Physics** |
|---|---|---|
| **B1** Cell Structure and Transport | **C1** Atomic Structure | **P1** Conservation and Dissipation of Energy |
| **B2** Cell Division | **C2** The Periodic Table | **P2** Energy Transfer by Heating |
| **B3** Organisation and the Digestive System | **C3** Structure and Bonding | **P3** Energy Resources |
| **B4** Organising Animals and Plants | **C4** Chemical Calculations | **P4** Electric Circuits |
| **B5** Communicable Diseases | **C5** Chemical Changes | **P5** Electricity in the Home |
| **B6** Preventing and Treating Disease | **C6** Electrolysis | **P6** Molecules and Matter |
| **B7** Non-communicable diseases. | **C7** Energy Changes | **P7** Radioactivity |
| **B8** Photosynthesis | **C8** Rates and Equilibrium | **P8** Forces and Balance |
| **B9** Respiration | **C9** Crude Oil and Fuels | **P9** Motion |
| **B10** The Human Nervous System | **C10** Chemical Analysis | **P10** Force and Motion |
| **B11** Hormonal Control in Humans and Plants | **C11** The Earth's Atmosphere | **P11** Wave Properties |
| **B12** Reproduction | **C12** The Earth's Resources | **P12** Electromagnetic Waves |
| **B13** Variation and Evolution | | **P13** Electromagnetism |
| **B14** Genetics and Evolution | | |
| **B15** Adaptations and Competition | | |
| **B16** Organising an Ecosystem | | |
| **B17** Biodiversity and Ecosystems | | |

| Cell Structure and transport | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B1.1 The world of the microscope | I can use a light microscope. | I can describe the difference between magnification and resolution. | I can compare and contrast the magnification and resolution obtained by using light and electron microscopes. |
| | I can state why microscopes are useful in the study of cell biology. | I can describe the advantages and disadvantages of using a light and electron microscope. | I can justify the use of an electron microscope. |
| | I can calculate total magnification. | I can use the formula: magnification = size of image/size of real object. | I can re-arrange the magnification equation and measure the size of cells. |
| B1.2 Animal and plant cells | I can identify a plant and animal cell from a diagram. | I can describe the functions of the parts of cells. | I can explain how the main structures of cells are related to their functions. |
| | I can name the main parts of cells. | I can compare plant and animal cells. | I can suggest reasons why some cells do not contain all cell structures. |
| | I can prepare a microscope slide. | I can use a microscope to study plant and algal cells. | I can compare sizes of cells using units of length and standard form. |
| B1.3 Eukaryotic cells and prokaryotic cells | I can identify structures in prokaryotic cells. | I can compare prokaryotic and eukaryotic cells. | I can explain how the main structures of prokaryotic cells are related to their functions. |
| | I can state that bacterial (prokaryotic) cells do not contain a nucleus and eukaryotic cells do. | I can describe the functions of the parts of a prokaryotic cell. | I can perform calculations to work out orders of magnitude. |
| | I can use orders of magnitude to correctly order objects according to size. | I can use orders of magnitude to compare sizes of organisms. | |
| B1.4 Specialisation in animal cells | I can identify specialised animals cells from diagrams. | I can explain why animals have specialised cells. | I can discuss how the structure of specialised animal cells are related to their function within the organ and whole organism. |
| | I can describe the function of specialised animal cells. | I can compare the structure of a specialised and generalised animal cell. | I can suggest the function of an unknown specialised cell based on its structure. |
| | I can write a basic explanation of how animal cells are adapted. | I can write a coherent explanation of how animal cells are adapted. | I can write an effectively structured explanation of how animal cells are adapted. |
| B1.5 Specialisation in plant cells | I can identify specialised plant cells from diagrams. | I can compare the structure of a specialised and generalised plant cell. | I can discuss how the structure of specialised plant cells is related to their function within the organ and whole organism. |
| | I can describe the function of specialised plant cells. | I can describe the adaptations of specialised plant cells. | I can design a cell, tissue or organ to perform a certain function. |
| | I can use a light microscope to view a root hair cell. | I can draw a scientific drawing of a root hair cell observed using a light microscope. | I can measure a root hair cell observed using a light microscope. |

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|---|---|---|---|
| B1.6 Diffusion | I can state that diffusion is the spreading of the particles of any substance in solution, or particles of a gas. | I can predict which way substances will move across a cell membrane. | I can explain how temperature and concentration gradient affects rate of diffusion. |
| | I can list the factors that affect the rate of diffusion. | I can explain why surface area affects the rate of diffusion. | I can write a hypothesis using detailed scientific knowledge and explain how it could be tested. |
| | I can write a simple hypothesis. | I can write a hypothesis using scientific knowledge. | |
| B1.7 Osmosis | I can describe what osmosis is. | I can state the differences between osmosis and diffusion. | I can explain how a model shows osmosis in a cell. |
| | I can state that if animal cells lose or gain too much water by osmosis they can stop working properly. | I can use ideas about osmosis to explain why maintaining constant internal conditions in living organisms is important. | I can use the terms isotonic, hypotonic or hypertonic to explain the movement of water across a cell membrane. |
| | | I can write a prediction using scientific knowledge of osmosis. | |
| B1.8 Osmosis in plants | I can state that if a plant loses too much water from its cells they become soft. | I can use use osmosis to explain the effect of placing plant tissue in salt or sugar solutions. | I can explain the mechanisms that lead to turgid or flaccid plant cells and plasmolysis. |
| | I can write a simple method with support. | I can write a suitable plan to investigate into the effect of salt or sugar solutions on plant tissue. | I can write a detailed plan independently. |
| | I can use given data to plot a suitable graph with some support. | I can calculate percentage change and use this to plot a line graph with negative numbers and draw a line of best fit. | I can use a line graph to estimate the concentration of solution inside a plant cell. |
| B1.9 Active transport | I can define active transport as the movement of a substance against a concentration gradient using energy. | I can explain why active transport is important for living organisms. | I can describe how active transport takes place. |
| | I can identify where active transport takes place. | I can explain the differences between diffusion, osmosis, and active transport. | I can suggest how a cell that carries out active transport is adapted to this function. |
| | I can use a representational model to show active transport. | I can suggest some improvements/ limitations to a representational model that shows active transport. | I can design and evaluate a representational model to show active transport. |
| B1.10 Exchanging materials | I can state the function of exchange surfaces in plants and animals. | I can describe how the effectiveness of exchange surfaces is increased. | I can link ideas about diffusion to explain how the adaptations of exchange surfaces increases their effectiveness. |
| | I can state that a single-celled organism has a relatively large surface area to volume ratio. | I can use ideas about surface area to volume ratio to describe why multicellular organisms need exchange surfaces. | I can use ideas about surface area to explain the shape of a leaf. |
| | I can calculate the surface area to volume ratio of a cube. | I can calculate the surface area to volume ratio of a cylinder. | I can calculate the surface area to volume ratio of a sphere. |

| **Cell division** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| B2.1 Cell division | I can state that human body cells have 46 chromosomes and gametes have 23. | I can explain why chromosomes in body cells are normally found in pairs. | I can explain why genetic material must be doubled during mitosis. |
| | I can state that mitosis is a stage in cell division. | I can describe situations where mitosis is occurring. | I can explain in detail what happens at each stage of the cell cycle. |
| | I can state the meaning of most of the keywords – mitosis, chromosomes, gene, gametes. | I can use the keywords to describe the process of mitosis. | I can use the keywords to write detailed explanations on why mitosis is an important process in living things and how characteristics are inherited. |
| B2.2 Growth and differentiation | I can define the terms growth and differentiation. | I can describe the importance of cell differentiation in multicellular organisms. | I can compare and contrast differentiation in plants and animals. |
| | I can state why plant clones are genetically identical to each other. | I can explain how using tissue culture creates a clone of a plant. | I can explain why it is easier to clone a plant compared to an animal. |
| | I can attempt to clone a plant by using apparatus correctly. | I can attempt to clone a plant by using the apparatus correctly and following safety rules. | I can explain and carry out a practical accurately and safely in order to successfully clone a plant. |
| B2.3 Stem cells | I can state that a stem cell is a cell that is not differentiated. | I can describe differences between embryonic and adult stem cells. | I can explain why embryonic stem cells are more useful for helping medical conditions. |
| | I can state that plant stem cells can be used to create clones. | I can explain why plant clones are produced in the agriculture industry. | I can write a well-structured article about stem cells which has impact by the use of precise vocabulary and real-life examples. |
| | I can write a simple article which states ways that stem cells can be used to help medical conditions. | I can write an well-structured article which communicates effectively how stem cells can be used to help medical conditions. | |
| B2.4 Stem cell dilemmas | I can list some arguments for and against the use of stem cells. | I can describe what therapeutic cloning can be used for. | I can explain the process of therapeutic cloning organism. |
| | I can verbally communicate simple ideas during a group discussion. | I can explain the reasons for ethical and religious objections against stem cells. | I can evaluate the use of stem cells. |
| | | I can verbally communicate well-constructed arguments. | I can clearly communicate strong, well-researched arguments in a persuasive manner. |

| Organisation and the digestive system | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B3.1 Tissues and organs in animals | I can state examples of cells, tissues, organs, and organ systems. | I can define the terms tissue, organ, and organ system. | I can relate levels of organisation to familiar organ systems in order to give examples of cells, tissues, and organs. |
| | I can name organs found in a given organ systems. | I can describe the function of certain organs and organ systems. | I can explain why the cells of multicellular organisms are organised into tissues, organs, and organ systems. |
| | I can order cells, tissues, organs, and organ systems according to their relative sizes. | I can identify tissues that make up organs. | I can suggest the function of glandular, epithelial, and muscular tissue in organs. |
| B3.2 The human digestive system | I can identify some of the organs of the digestive system. | I can name all of the organs of the digestive system. | I can link the process of digestion to other processes in the body in order to explain its function. |
| | I can state the function of some of the organs of the digestive system. | I can state the functions of the organs. | I can explain in detail how the small intestine is adapted to its function. |
| | I can state simply what happens to food during digestion. | I can summarise the process of digestion. | I can explain in detail what happens to food during digestion. |
| B3.3 The chemistry of food | I can recall that food contains the molecules carbohydrates, lipids (fats), and protein. | I can describe the structure of simple sugars, starch, lipids, and proteins. | I can explain which food molecules are polymers. |
| | I can state the function of each food molecule in the diet. | I can carry out multiple food tests in an organised manner. | I can apply knowledge of the function of food molecules in the body to give diet advice. |
| | I can carry out a food test and record results in a table. | I can design a results table to clearly record results from food tests. | I can use scientific knowledge to make predictions of what nutrients a food contains. |
| B3.4 Catalysts and enzymes | I can recall that enzymes are proteins which are biological catalysts – they speed up reactions. | I can describe how enzymes are used in digestion. | I can explain how enzymes speed up reactions. |
| | I can state one function of enzymes inside the body. | I can use the 'lock and key theory' to explain why the shape of the enzyme is vital for it to function. | I can explain how enzymes control metabolism. |
| | I can state the independent variable in an investigation. | I can state the variables in an investigation. | I can plan an experiment to investigate how different catalysts affect the rate of a reaction. |

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| B3.5 Factors affecting enzyme action | I can state that temperature and pH affects how well an enzyme works. | I can explain why high temperatures and changes in pH prevent enzymes from catalysing reactions. | I can explain in detail how a change in temperature or pH affects the rate of an enzyme-catalysed reaction. |
| | I can plan a simple method to carry out an investigation. | I can plan and carry out an investigation in order to gather accurate results. | I can plot a line graph with error bars. |
| | I can state simply what a line graph shows about how temperature or pH affects the rate of an enzyme catalysed reaction. | I can plot a line graph and use it to draw conclusions about how temperature and pH affects the rate of an enzyme catalysed reaction. | I can analyse results in order to evaluate a method and the validity of conclusions, explaining suggestions for possible improvements. |
| B3.6 How the digestive system works | I can recall that enzymes are used in digestion to break down food molecules. | I can explain why enzymes are needed for digestion. | I can suggest how to test for substrates and products in the model gut. |
| | I can identify that carbohydrases break down carbohydrates, proteases break down proteins, and lipases break down lipids. | I can for each food molecule, name the enzyme that acts on it, where it is produced, and which products are formed. | I can make a prediction with a scientific explanation. |
| | I can follow a method to set up and test for substances in a model gut. | I can make a prediction on the results from the model gut. | I can evaluate a model by discussing its limitations. |
| B3.7 Making digestion efficient | I can state that the stomach contains acid. | I can describe the functions of bile. | I can explain how acid in the stomach increases the efficiency of pepsin. |
| | I can state that the liver produces bile. | I can calculate the mean rate of an enzyme-catalysed reaction. | I can explain how bile increases the efficiency of fat digestion. |
| | I can write a simple hypothesis and prediction. | I can analyse data in order to determine if a hypothesis is correct. | I can explain how the rate of an enzyme catalysed reaction shows how efficient the reaction is. |

| Organising animals and plants Lesson | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B4.1 The blood | I can state the main components in blood. | I can summarise the process of blood clotting. | I can suggest how white blood cells are adapted |
| | I can recognise the components of blood from photomicrographs. | I can view blood under a light microscope and recognise components. | I can estimate the diameter of a red blood cell and comment on its uncertainty. |
| | I can describe the function of each component in blood. | I can explain how red blood cells are adapted to their function. | I can evaluate in detail a model of the blood. |
| B4.2 The blood vessels | I can state the three main types of blood vessel and recognise them from diagrams. | I can explain how the structure relates to the functions of blood vessels. | I can explain in detail the importance of a double circulatory system. |
| | I can estimate heart rate. | I can comment on how accurate estimations are. | I can explain how to make estimates more accurate in terms of precision of data. |
| B4.3 The heart | I can state the function of the heart. | I can describe the function of the main structures of the human heart. | I can explain in detail how the structure of the different parts of the human heart is related to their function. |
| | I can state the main structures of the human heart. | I can describe the problems that can develop with blood vessels in the heart and their treatments. | I can recognise the main structures of the heart when carrying out a heart dissection. |
| | I can state examples of problems that can develop in blood vessels in the human heart. | I can suggest advantages and disadvantages of using stents and statins. | I can evaluate the use of stents and statins in treating problems with blood vessels. |
| B4.4 Helping the heart | I can state that heartbeat is maintained by a group of cells that act as a pacemaker. | I can explain why an irregular heartbeat is detrimental to health. | I can explain how a natural pacemaker maintains the heartbeat. |
| | I can state some ways in which the heart can stop functioning efficiently. | I can describe why people may have objections to heart transplants. | I can suggest how an artificial pacemaker regulates an irregular heartbeat. |
| | I can describe why a person may need an artificial pacemaker or an artificial heart. | I can summarise the advantages and disadvantages different treatments of heart problems. | I can evaluate in detail the different methods used in the treatment of heart problems. |
| B4.5 Breathing and gas exchange | I can list the main structures of the gas exchange system. | I can describe the function of the main structures of the gas exchange system. | I can evaluate in detail a model of the lungs. |
| | I can state that gas exchange happens in the alveoli. | I can describe how alveoli are adapted. | I can explain in detail how adaptations of alveoli result in efficient gas exchange. |
| | I can use data in the form of percentages to describe the differences in the composition of inhaled and exhaled air. | I can describe the processes of ventilation and gas exchange. | I can explain the differences between the composition of inhaled and exhaled air. |

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|---|---|---|---|
| B4.6 Tissues and organs in plants | I can recognise examples of plant organs and state their functions. | I can describe how plant organs are involved in the transport system. | I can suggest what type of plant organs unfamiliar structures are. |
| | I can use a light microscope to view a cross-section of a leaf. | I can use a microscope to identify the different tissues in a cross-section of a leaf. | I can use a light microscope to draw a leaf cross-section and calculate scale. |
| | I can state the functions of different plant tissues. | I can explain how the structures of tissues in the leaf are related to their functions. | I can suggest functions for unknown plant tissues. |
| B4.7 Transport systems in plants | I can state the function of xylem and phloem tissue. | I can describe why transport in plants is important. | I can apply knowledge of the plant transport system to explain how systemic pesticides work and evaluate their use. |
| | I can collect evidence for movement of water through xylem. | I can explain how the structure of xylem and phloem are adapted to their functions. | I can explain in detail how the rate of transport through a plant can be measured. |
| B4.8 Evaporation and transpiration | I can state that transpiration is the evaporation of water vapour from the leaves. | I can describe how transpiration maintains the movement of water from roots to leaves. | I can evaluate drinking from a straw as a model for transpiration. |
| | I can state the function of stomata. | I can describe how the opening and closing of stomata is controlled by guard cells. | I can explain in detail how stomata control transpiration. |
| | I can calculate the mean number of stomata on a given area of leaf. | I can use sampling to estimate the number of stomata on a leaf. | I can suggest reasons for differences in the number and distribution of stomata, as well as their adaptations. |
| B4.9 Factors affecting transpiration | I can recognise the factors that affect transpiration. | I can explain why temperature, humidity, light intensity and the amount of air flow affect the rate of transpiration. | I can apply particle model to explain in detail why temperature, humidity, light intensity and the amount of air flow affect the rate of transpiration. |
| | I can describe how a potometer can be used to estimate the volume of water lost by a plant. | I can describe the differences between a moving bubble potometer and a mass photometer. | I can summarise adaptations to control water loss and explain how they work. |
| | I can identify variables when investigating rate of transpiration. | I can make a prediction using scientific knowledge when investigating rate of transpiration. | I can evaluate in detail the use of a potometer to measure the rate of transpiration. |

| **Communicable diseases** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| B5.1 Health and disease | I can describe health as a state of physical and mental wellbeing. | I can describe the difference between communicable and non-communicable diseases. | I can suggest how communicable diseases are spread. |
| | I can state some causes of ill health. | I can use a scatter diagram to identify a correlation between two variables. | I can suggest links between lifestyle and health. |
| | I can state a simple conclusion from data on health. | I can construct and interpret bar charts, frequency tables, frequency diagrams and histograms. | I can discuss the validity of a statement based on evidence in the form of data. |
| B5.2 Pathogens and disease | I can state that pathogens are microorganisms that cause disease. | I can describe how bacteria and viruses cause disease. | I can explain why viruses are always pathogens but not all bacteria are. |
| | I can describe ways that pathogens can be spread. | I can explain why communicable diseases spread rapidly following a natural disaster. | I can explain how pathogens are passed from one organism to another and use this to suggest ways of preventing the spread. |
| B5.3 Growing bacteria in the lab | I can state that bacteria reproduce by cell division and this is called binary fission. | I can explain why numbers of bacteria on an agar plate will eventually stop growing. | I can explain what is meant by exponential growth and analyse a graph showing it. |
| | I can prepare a bacterial culture on agar gel. | I can explain why it is important to use an uncontaminated culture to investigate bacterial growth. | I can suggest how to measure the growth of bacteria and discuss uncertainty. |
| | I can follow the rules needed to prepare an uncontaminated culture. | I can describe and explain why each rule is needed in order to safely prepare, incubate and dispose of a culture. | I can plan a detailed investigation to find out how a variable affects the growth of bacteria. |
| B5.4 Preventing bacterial growth | I can describe the difference between an antiseptic, disinfectants and antibiotic. | I can explain when an antiseptic, disinfectant, and antibiotic would be used | I can write a prediction using detailed scientific knowledge. |
| | I can write a prediction. | I can calculate the number of bacteria in a population after a certain time if given the mean division time. | I can calculate the number of bacteria in a sample when using a counting chamber. |
| | I can measure the diameter of clear areas around colonies. | I can calculate the area of the clear circle around colonies using $r^2$. | I can apply knowledge of sampling techniques to ensure samples are representative. |
| B5.5 Preventing infections | I can state some ways that communicable diseases are spread. | I can describe how the spread of diseases can be reduced or prevented. | I can use scientific knowledge to explain in detail how methods reduce or prevent the spread of disease. |
| | I can take a role in designing a form of communication to inform the public about how to prevent the spread of a disease. | I can communicate to the public about how to stop the spread of a disease. | I can use an example to explain how the scientific method has been applied to help prevent the spread of disease. |
| | I can name some diseases that are caused by viruses. | I can describe how measles, HIV and tobacco mosaic virus affect the infected organism. | I can explain how measles, HIV and tobacco mosaic virus affect the infected organism. |

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|---|---|---|---|
| B5.6 Viral diseases | I can state how measles and HIV are spread. | I can use a microscope to identify the different tissues in a cross-section of a leaf the UK has changed over time. | I can explain why viral infections are often more difficult to prevent and treat than bacterial infections. |
| | I can summarise information in a table. | I can design a table and use it to summarise information. | I can write a persuasive letter to parents urging them to vaccinate their children against measles. |
| B5.7 Bacterial diseases | I can name some diseases that are caused by bacteria. | I can describe similarities and differences between salmonella and gonorrhoea. | I can suggest why more people die from viral diseases compared to bacterial diseases. |
| | I can state how salmonella and gonorrhoea are spread. | I can describe how the spread of salmonella and gonorrhoea is controlled. | I can explain in detail how methods to control the spread of salmonella and gonorrhoea work. |

| Preventing and treating diseases | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B6.1 Vaccination | I can describe why people are vaccinated. | I can explain how vaccination works. | I can explain why, if a large proportion of the population is vaccinated, the spread of the pathogen is reduced. |
| | I can state that vaccines contain dead or inactive forms of a pathogen. | I can describe what an antibody and antigen are. | I can apply ideas about specificity of antibodies. |
| B6.2 Antibiotics and painkillers | I can describe what an antibiotic is. | I can describe how antibiotics work. | I can suggest a reasoned explanation for a pattern in data. |
| | I can state that viral infections cannot be treated with antibiotics. | I can describe what is meant by antibiotic resistant bacteria. | I can explain in detail how antibiotic resistant bacteria arise. |
| | I can decide when a painkiller or antibiotic should be used to treat an illness. | I can explain why it is difficult to develop drugs to treat viral infections. | I can explain why scientists are constantly developing new antibiotics. |
| B6.3 Discovering drugs | I can name some drugs based on extracts from plants or microorganisms. | I can describe how new antibiotics are tested for effectiveness. | I can suggest why mould naturally produces antibiotics. |
| | I can order the events that led to the production of penicillin. | I can discuss the advantages and disadvantages of looking for new drugs from living organisms. | I can discuss how effective herbal remedies are. |
| | I can state a simple conclusion using data. | I can analyse data to draw conclusions on the effectiveness of new antibiotics. | I can analyse data to evaluate the effectiveness of new antibiotics and make a reasoned decision which one to develop further. |
| B6.4 Developing drugs | I can state that new medical drugs have to be tested to check that they are safe and effective. | I can explain why each procedure in drugs testing and trialling is used. | I can describe in some detail how new medical drugs are tested and trialled for safety, effectiveness, toxicity, efficacy, and dose. |
| | I can state the procedures used to trial a new drug in the correct order. | I can describe how a double blind trial is carried out. | I can critically analyse the results from a double blind trial. |
| | I can state what is meant by a placebo. | I can explain why a placebo is used during drug trialling. | I can explain why the results of drug trials are published in journals. |
| B6.5 Producing monoclonal antibodies (H) | | I can describe what a monoclonal antibody is. | I can explain why hybridoma cells are used to produce monoclonal antibodies. |
| | | I can outline the procedure used to produce monoclonal antibodies. | I can explain in detail how pregnancy tests work. |
| | | I can state some uses of monoclonal antibodies. | I can describe how monoclonal antibodies are used to produce ELISA tests and outline how they are used. |
| B6.6 Using monoclonal | | I can describe the ways that monoclonal antibodies can be used to treat cancer. | I can explain in detail how the methods of using monoclonal antibodies to treat cancer work. |

(H)

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| antibodies | | I can outline the advantages and disadvantages of using monoclonal antibodies. | I can evaluate the use of monoclonal antibodies in treating cancer compared to other treatments. |

| **Non-Communicable Diseases** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| B7.1 Non-communicable diseases | I can name some non-communicable diseases. | I can classify diseases as communicable and non-communicable. | I can describe some impacts of non-communicable diseases. |
| | I can list some risk factors that are linked to an increased rate of disease. | I can draw conclusions from data on risk factors. | I can identify risk factors from data. |
| | I can identify correlations in data. | I can decide whether a link is causal. | I can explain why a correlation does not prove a causal mechanism. |
| B7.2 Cancer | I can define a tumour as a mass of abnormally growing cells. | I can describe the difference between benign and malignant tumours. | I can explain how benign and malignant tumours can be life-threatening. |
| | I can state some causes of cancer. | I can describe why carcinogens and ionising radiation increase the risk of tumours. | I can link a lack of control in the cell cycle to tumour formation. |
| | I can list some of the benefits and risks of chemotherapy. | I can analyse data to assess the risks and benefits of chemotherapy. | I can evaluate the risks of chemotherapy in relation to data, drug testing, and consequences in order to come to an |
| B7.3 Smoking and the risk of disease | I can name the harmful substances found in tobacco smoke. | I can describe the effects of the harmful substances found in tobacco smoke. | I can explain in detail the effects of the harmful substances found in tobacco smoke. |
| | I can state that smoking increases your risk of developing lung diseases. | I can analyse data to describe evidence for the link between smoking and lung disease. | I can suggest possible causal mechanisms to explain trends shown in data, and explain how the causal link between smoking and |
| B7.4 Diet, exercise, and disease | I can describe some health problems caused by a poor diet and lack of exercise. | I can describe causal mechanisms for the link between exercise and health. | I can suggest reasons for the correlation between exercise and health, and decide which are causal. |
| | I can list some ways in which people can avoid becoming overweight. | I can suggest measures to prevent a further rise in the number of people with type 2 diabetes. | I can explain in detail why eating a poor diet can lead to health problems. |
| B7.5 Alcohol and other carcinogens | I can state that drinking too much alcohol can affect liver and brain function. | I can describe the short- and long-term effects of drinking alcohol. | I can explain in detail how drinking alcohol affects the nervous system. |
| | I can state that alcohol can affect unborn babies. | I can describe the effects of alcohol on unborn babies. | I can evaluate the evidence on the effects of alcohol on a developing baby. |
| | I can define the term carcinogen. | I can describe the link between ionising radiation and cancer. | I can explain the link between radiation and cancer. |

| Photosynthesis | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B8.1 Photosynthesis | I can describe how plants get the materials they need for growth. | I can describe how the leaf is adapted for photosynthesis. | I can explain how adaptations of the leaf make photosynthesis efficient. |
| | I can state the word equation for photosynthesis. | I can write the balanced symbol equations for photosynthesis. | I can explain how adaptations of the leaf make photosynthesis efficient. |
| | I can describe why plants need light to carry out photosynthesis. | I can describe an experiment to prove that plants carry out photosynthesis when exposed to light. | I can explain why chlorophyll is needed for photosynthesis. |
| B8.2 The rate of photosynthesis | I can list the factors that affect the rate of photosynthesis (temperature, carbon dioxide concentration, light intensity, amount of chlorophyll). | I can describe why low temperature, shortage of carbon dioxide, shortage of light and shortage of chlorophyll limit the rate of photosynthesis. | I can apply knowledge of enzymes to explain why a high temperature affects the rate of photosynthesis. |
| | I can state simply the relationship between these factors and the rate of photosynthesis. | I can suggest which factor limits the rate of photosynthesis in a given situation. | I can predict how the rate of photosynthesis will be affected with more than one limiting factor. |
| | I can plot a line graph and write a simple conclusion. | I can interpret and explain graphs of photosynthesis rate involving one limiting factor. | I understand and can use the inverse square law and light intensity in the context of photosynthesis. |
| B8.3 How plants use glucose | I can list some ways in which plants use glucose. | I can describe all the ways in which plants use glucose, including how they make proteins. | I can explain how carnivorous plants are adapted to their environment. |
| | I can test a leaf for starch and state some safety rules. | I can evaluate risks involved in the starch test. | I can explain how and why plants convert glucose to starch for storage. |
| B8.4 Making the most of photosynthesis | | I can describe why greenhouse increase plant growth. | I can explain in detail how using greenhouses can help control limiting factors and increase the rate of photosynthesis. |
| | | I can comment on the cost-effectiveness of adding heat, light, or carbon dioxide to greenhouses. | I can use data to comment on the cost-effectiveness of greenhouses. |
| | | I can discuss the benefits of using greenhouses and hydroponics. | I can evaluate the use of greenhouses and hydroponics in terms of economics. |

| **Respiration** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| B9.1 Aerobic respiration | I can state the word equation for aerobic respiration. | I can write the balanced symbol equation for respiration. | I can apply understanding of respiration in new contexts. |
| | I can list ways in which living organisms use energy. | I can describe respiration as an exothermic reaction. | I can explain why respiration is an exothermic reaction. |
| | I can identify a control. | I can plan an investigation to include a control. | I can explain why a control is necessary in some scientific investigations. |
| B9.2 The response to exercise | I can describe how heart rate, breathing rate, and breath volume change with exercise. | I can explain why heart rate, breathing rate, and breath volume change with exercise. | I can explain why stores of glycogen change with exercise. |
| | I can draw a suitable chart/graph to display data with some support. | I can choose the best way to display data and calculate percentage changes. | I can justify he choice of chart/graph used to display data. |
| B9.3 Anaerobic respiration | I can state the word equation for anaerobic respiration in animals, plants, and microorganisms. | I can write the balanced symbol equation for anaerobic respiration in plants and microorganisms. | I can compare and contrast anaerobic respiration in animals, plants, and microorganisms. |
| | I can describe the reason why cells respire anaerobically. | I can compare and contrast aerobic and anaerobic respiration. | I can explain in detail why heart and breathing rate continue to be high for a period of time after exercise. |
| | I can give some uses of fermentation. | I can explain why muscles get tired during exercise. | I can write a prediction based on scientific knowledge. |
| B9.4 Metabolism and the liver | I can define metabolism as the sum of all reactions on a cell or the body. | I can describe the role of the liver in repaying the oxygen debt. | I can explain the link between protein consumption and concentration of urea in urine. |
| | I can list some metabolic reactions. | I can discuss whether it is possible to increase metabolism. | I can evaluate information to assess credibility. |

| The Human Nervous System | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B10.1 Principles of homeostasis | I can name some human internal conditions that are controlled. | I can define homeostasis. | I can apply knowledge of enzymes and osmosis to explain in detail why internal conditions need to be maintained. |
| | I can state the pathway of a control system as receptor, coordination centre, effector. | I can explain why internal conditions need to be maintained. | I can explain how drugs affect homeostasis. |
| | | I can identify stimuli, receptors, coordination centres and effectors in examples of nervous and chemical responses. | I can explain how nervous and chemical responses differ. |
| B10.2 The structure and function of the human nervous system | I can identify the stimuli that sense organs detect. | I can describe the pathway of impulses from receptor to effector. | I can explain in detail how the nervous system coordinates a response. |
| | I can state what a neurone and nerve are. | I can describe how information is passed along neurones. | I can evaluate results in detail in order to discuss precision and accuracy. |
| | I can measure reaction times using repeats to increase accuracy. | I can evaluate a method and describe how accuracy could be increased. | |
| B10.3 Reflex actions | I can identify reflex reactions. | I can describe how reflex actions are fast and automatic. | I can explain in detail how impulses travel across a synapse. |
| | I can state why reflex actions are important. | I can describe the events involved in a reflex action. | I can apply knowledge of synapses to explain the effects of drugs. |
| | I can order the events involved in a reflex action. | I can describe the function of synapses. | |

| Hormone control in humans and plants | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B11.1 Principles of hormonal control | I can match the pituitary gland, pancreas, thyroid, adrenal gland, ovary and testes to their position on a diagram of the human body. | I can explain why the pituitary gland is known as a 'master gland'. | I can compare and contrast nervous and hormonal action. |
| | I can state that hormones are chemicals secreted into the bloodstream by glands and have an effect on a target organ. | I can describe the role of hormones released by endocrine glands. | I can apply knowledge to suggest and explain how changes in hormone production could affect the body. |
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| B11.2 The control of blood glucose levels | I can state that blood glucose concentration is controlled by the pancreas. | I can describe what happens when blood glucose levels become too high or too low. | I can explain how glucagon interacts with insulin to control blood glucose levels. |
| | I can state that there are two types of diabetes. | I can describe the difference in the causes of Type 1 and Type 2 diabetes. | I can explain why it is important to control the level of glucose in the blood. |
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| B11.3 Treating diabetes | I can state that Type 1 diabetes is normally treated with insulin injections. | I can explain why Type 1 diabetes is treated with insulin injections. | I can evaluate different treatments for Type 1 diabetes. |
| | I can state that Type 2 diabetes can be treated by changes to diet and exercise. | I can explain how Type 2 diabetes can be treated by changes to diet and exercise. | I can explain in detail how lifestyle choices affect the risk of developing Type 2 diabetes. |
| | I can describe data that shows a link between obesity and Type 2 diabetes. | I can describe how the production of insulin for people with diabetes has developed over time. | I can summarise how scientists are working to find a cure for diabetes. |
| B11.4 The role of negative feedback | | I can describe the function of adrenaline and thyroxine. | I can explain how adrenaline prepares the body for 'fight or flight'. |
| | | I can interpret and explain diagrams of negative feedback control. | I can design labelled flow diagrams of negative feedback control. |
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| B11.5 Human | I can identify oestrogen and testosterone as reproductive hormones in women and men respectively. | I can compare and contrast the changes to boys and girls during puberty. | I can explain why fertility changes with age in men and women. |

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| reproduction | I can describe what happens during the menstrual cycle. | I can name the hormones involved in the menstrual cycle. | I can explain the role of each hormone in the menstrual cycle. |
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| B11.6 Hormones and the menstrual cycle | | I can name the glands that produce the hormones oestrogen, progesterone, LH and FSH. | I can explain the interactions of hormones in the control of the menstrual cycle. |
| | | I can describe the function of the hormones that control the menstrual cycle. | I can interpret in detail a graph showing how the levels of hormones change. |
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| B11.7 Artificial control of fertility | I can state what contraception is and list examples. | I can explain how contraceptives work. | I can apply knowledge of hormones in the menstrual cycle to suggest how hormonal contraceptives work. |
| | I can categorise contraceptives as hormonal and non-hormonal. | I can list the advantage and disadvantage of different contraceptives. | I can evaluate different methods of contraception in detail. |
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| B11.8 Infertility treatments | | I can describe what is meant by infertility and suggest reasons for it. | I can describe FSH and IVF can be used to help treat infertility. |
| | | I can describe the steps used in IVF. | I can evaluate the advantages and disadvantages of IVF. |
| | | I can outline the issues surrounding IVF. | I can use different viewpoints to make an informed decision on unused IVF embryos. |

| **Reproduction** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| B12.1 Types of reproduction | I can define asexual and sexual reproduction. | I can describe the differences between asexual and sexual reproduction. | I can compare and contrast sexual and asexual reproduction. |
| | I can name some organisms that use either asexual or sexual reproduction. | I can describe the advantages and disadvantages of sexual and asexual reproduction. | I can explain in detail why meiosis is important for sexual reproduction. |
| | I can use a model to show why variation is produced in offspring from sexual reproduction but not in asexual reproduction. | I can design a model to show why variation is produced in offspring from sexual reproduction but not in asexual reproduction. | I can evaluate a model to show that variation is produced in offspring from sexual reproduction but not in asexual reproduction. |
| B12.2 Cell division in sexual reproduction | I can state that gametes (sex cells) are formed by meiosis. | I can describe the processes of mitosis and meiosis. | I can compare and contrast mitosis and meiosis. |
| | I can state that meiosis halves the number of chromosomes in gametes and fertilisation restores the full number. | I can explain how meiosis halves the number of chromosomes in gametes and fertilisation restores the full number. | I can explain in detail why gametes are all genetically different to each other. |
| | I can solve simple probability questions with guidance. | I can solve simple probability questions. | I can solve a complex calculation to determine the number of possible gametes formed during meiosis. |
| B12.3 DNA and the genome | I can state that DNA contains a code to build proteins. | I can describe the relationship between DNA, genes, and chromosomes. | I can explain why the cost of genome sequencing has reduced since it started. |
| | I can describe what the Human Genome Project was. | I can describe some of the benefits of studying the human genome. | I can explain why knowledge of the genomes of other species is useful. |
| | I can give one goal of the Human Genome Project. | I can explain why genome projects are costly and take a long time. | I can discuss the possible issues surrounding genome sequencing. |
| B12.4 Inheritance in action | I can recognise examples of inherited traits. | I can use the terms allele, dominant, recessive, homozygous and heterozygous correctly. | |
| | I can recognise a genotype and a phenotype. | I can describe a phenotype when given the genotype. | |
| | I can use a simple diagram to state how offspring have inherited traits. | I can use a Punnett square diagram to predict the outcome of a monohybrid cross using the theory of probability. | |
| B12.5 More about | I can state that in females the sex chromosomes are XX and in males they are XY. | I can carry out a genetic cross to show sex inheritance. | I can explain why we only get the expected ratios in a genetic cross if there are large numbers of offspring. |

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| genetics | I can use a family tree to describe how people are related. | I can use direct proportion and simple ratios to express the outcome of a genetic cross. | I can use a family tree to work out where an individual is likely to be homozygous or heterozygous for particular alleles. |
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| B12.6 Inherited disorders | I can state what is meant by an inherited disorder and recognise examples. | I can name examples of inherited disorders, such as cystic fibrosis and polydactyly. | I can evaluate in to detail the use of using genetic engineering to cure inherited disorders. |
| | I can use secondary sources of information to describe symptoms of an inherited disorder. | I can use a genetic cross to explain how inherited disorders are passed on. | I can use a genetic cross to predict the probability of a child inheriting an genetic disorder. |
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| B12.7 Screening for genetic disorders | I state a reason why embryos might be screened. | I can outline the methods used to screen embryos. | I can explain how screening shows if the embryo has a genetic disorder. |
| | I can state one concern about embryo screening. | I can state advantages and disadvantages of embryo screening. | I can make an informed judgement about embryo screening by evaluating in detail the economic, social and ethical issues. |
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| **Variation and evolution** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| B13.1 Variation | I can list some examples of human variation. | I can list some examples of variation in plants and categorise as being due to genetic, environmental causes or both. | I can explain why some traits are only due to genetic causes. |
| | I can categorise some human traits as being due to genetic, environmental causes or both. | I can suggest reasons why identical twins will start to show variation as they get older. | I can explain why it is so hard to get valid results form identical-twin studies. |
| | I can describe why identical twins share the same genes. | I can use data to explain why studying identical twins helps scientists investigate which traits have genetic causes. | I can discuss some of the issues scientists face when conducting twin studies. |
| B13.2 Evolution by natural selection | I can state that a mutation is a change in the DNA code. | I can explain how a mutation may lead to a new phenotype. | I can explain why it is rare that a mutation leads to a new phenotype. |
| | I can describe the theory of evolution by natural selection as a process by which living things have evolved from simple life forms. | I can describe the steps that take place during evolution by natural selection. | I can apply the theory of evolution by natural selection to suggest how a specific organism evolved. |
| | I can state some useful adaptations. | I can analyse data from an activity modelling natural selection. | I can explain how a change in a model can make it useful for explaining something else. |
| B13.3 Selective breeding | I can describe selective breeding as a process where humans choose which plants or animals to breed together. | I can explain the process of selective breeding. | I can compare and contrast natural and artificial selection. |
| | I can give one examples where selective breeding has been used. | I can explain why humans have used selective breeding. | I can explain in detail how the variation of alleles in a population is reduced through selective breeding. |
| | I can choose organisms to breed together to result in desired traits in the offspring. | I can explain what inbreeding is and why it is a problem in dog breeding. | I can explain in detail why the reduction of variation is a problem. |
| B13.4 Genetic engineering | I can describe GM organisms as containing a gene from another organism and order the stages of genetic engineering. | I can describe the steps used in genetic engineering to produce GM organisms. | I can explain the process of genetic engineering using technical vocabulary, e.g. plasmid, vector, restriction enzymes, marker genes, recombinant DNA. |
| | I can give examples of GM organisms and describe why they are useful to humans. | I can analyse data to describe why growing GM crops maybe be beneficial to a farmer. | I can explain how genetic engineering could be used to cure people with inherited disorders and discuss the limitations. |
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| B13.5 Ethics of genetic technologies | I can give one concern people may have about growing GM crops. | I can outline the potential benefits and risks of genetic engineering. | I can evaluate the potential benefits and risks of genetic engineering. |
| | I can describe why some people are against the cloning of animals. | I can describe economic and ethical concerns that people may have about cloning animals. | I can explain in detail the significance of events in the field of genetics. |
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| Genetics and evolution | Aiming for 4 | Aiming for 6 | Aiming for 8 |
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| B14.1 Evidence for evolution | I can describe what a fossil is and give an example. | I can describe how fossils are formed. | I can evaluate the use of fossils as evidence for evolution by natural selection and how life first formed. |
| | I can recognise that fossils are evidence for evolution by natural selection. | I can describe how fossils are evidence for evolution by natural selection. | I can use standard form to discuss the large time scales that we use when considering the evolution of life. |
| | I can order geological events. | I can explain why the fossil record is not complete. | I can create a geological timeline to scale. |
| B14.2 Fossils and extinction | I can state what is meant by extinction. | I can describe how other organisms can cause an animal or plant to become extinct. | I can suggest alternative hypotheses for why an organism became extinct. |
| | I can describe one way that an animal could become extinct. | I can suggest a hypothesis for why an organism became extinct. | I can evaluate in detail the need to conserve endangered plants. |
| | I can order fossil diagrams to show the evolution of the horse. | I can explain how fossil diagrams show how the horse has evolved. | I can apply knowledge of speciation to explain why dodos were only found on one island. |
| B14.3 More about extinction | I can describe what a mass extinction is. | I can suggest the effects of an asteroid, comet or meteorite strike on Earth. | I can link ideas to give a scientific explanation why an asteroid could have caused the dinosaurs to become extinct. |
| | I can state that environmental change and a catastrophic event are two possible causes of mass extinction. | I can explain how environmental change can cause mass extinctions. | I can suggest why mass extinctions are important for the evolution of life on Earth. |
| | I can describe one theory that explains why the dinosaurs became extinct. | I can identify strengths and weaknesses in two different theories of mass extinction. | I can evaluate two theories to come to a conclusion about which is more believable and explain why scientists are not sure what caused the extinction of dinosaurs or mammoths. |
| B14.4 Antibiotic resistant bacteria | I can state what is meant by an antibiotic resistant bacteria. | I can describe how antibiotic resistant bacteria evolve. | I can explain how a fast reproduction rate is linked to the development of antibiotic resistance strains. |
| | I can describe why scientists want to slow down the rate of development of new strains of antibiotic resistant bacteria. | I can explain why scientists need to develop new antibiotics. | I can explain how antibiotic resistant bacteria are evidence for evolution. |
| | I can list some ways scientists can slow down the development of new strains of antibiotic resistant bacteria. | I can create an information sheet outlining important facts about antibiotic resistant bacteria to the public. | I can summarise the reasons why the development of new antibiotics is unlikely to keep up with the emergence of new strains of antibiotic resistant bacteria. |

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| B14.5 Classification | I can state what classification is. | I can describe the classification system developed by Carl Linnaeus, to include the order of the taxonomic groups. | I can use the Linnaean system to name the groups that given organisms belong to. |
| | I can classify animals into groups based on their shared characteristics. | I can identify genus and species from a scientific name. | I can suggest why hybrids are not assigned scientific names using the binomial system. |
| | I can write an organism's name correctly using the binomial system. | I can explain why a binomial naming system is useful. | |
| B14.6 New systems of classification | I can name the three domains. | I can describe how organisms are divided in the three domain system. | I can compare and contrast the Linnaean system with the three domain system. |
| | I cab state that ideas about classification have changed over time. | I can describe why the three domain system was proposed. | I can outline how ideas about classification have developed over time. |
| | I can draw a conclusion from a simple evolutionary tree. | I can draw several conclusions from a simple evolutionary tree. | I can draw conclusions from a more complex evolutionary tree. |

| Adaptations, independence, & competition | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B15.1 The importance of communities | I can state what is meant by ecosystem, population and community. | I can define the terms community, population, habitat, ecosystem, abiotic factor, biotic factor. | I can link keywords to explain why a community is stable and important. |
| | I can list some resources that living things need. | I can describe what a stable community is and give an example. | I can use evidence to write hypotheses about why populations have changed in a community. |
| | I can use a given example to describe why one species relies on another. | I can suggest how one species relies on another. | I can explain why interdependence is important in maintaining a stable community. |
| B15.2 Organisms in their environment | I can identify factors as biotic or abiotic. | I can describe how a factor influences the distribution of organisms. | I can describe in detail how to measure the pH and water content of soil. |
| | I can use an instrument to measure an abiotic factor. | I can record measurements of abiotic factors. | I can analyse data in detail and draw appropriate conclusions. |
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| B15.3 Distribution an abundance | I can state the function of a quadrat and transect. | I can explain how to use a quadrat and transect to estimate population size. | I can discuss what factors determine the size of the quadrat used. |
| | I can follow a method to estimate a population using a sampling technique. | I can design a method to estimate a population using a sampling technique. | I can design independently an investigation based around a question or hypothesis. |
| | I can calculate the mean of a set of results. | I can calculate range, mean, median and mode in order to analyse results. | I can evaluate in detail the use of sampling to estimate population size. |
| B15.4 Competition in animals | I can recognise that animals compete with each other for resources. | I can use information to suggest factors that animals are competing for in a given habitat. | I can evaluate a model of competition between organisms. |
| | I can list resources that animals compete with each other for. | I can explain tactics that help an animal compete for a resource. | I can use the terms inter-specific and intra-specific competition and give examples of each. |
| | I can describe what will happen to an animal if it cannot compete for resources. | I can describe how the distribution of a species has changed because of competition. | I can suggest and explain how animals are adapted to compete for resources. |
| | I can list resources that plants compete with each other for. | I can suggest factors that plants are competing for in a given habitat. | I can plan a method to investigate competition between cress seeds. |

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| B15.5 Competition in plants | I can state what seed dispersal is and give some ways plants carry it out. | I can explain why plants use seed dispersal. | I can analyse data to explain the effects of overcrowding. |
| | I can make measurements of seedlings. | I can describe the methods plants use to outcompete others of avoid competition. | I can suggest the problems caused by plants that can easily outcompete others. |
| B15.6 Adapt and survive | I can state one example of how an organism is adapted. | I can suggest features that an organism may have in order to survive in a given habitat. | I can suggest and explain in detail how an organism in an extreme location might evolve to become better adapted to its habitat. |
| | I can define an extremophile. | I can explain how adaptations allow an organism to survive in its habitat. | I can apply knowledge of extremophiles to discuss why scientists believe there could be life on other planets (or moons). |
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| B15.7 Adaptations in animals | I can state one example of an animal adaptation. | I can classify adaptations as structural, behavioural or functional. | I can suggest structural, behavioural or functional adaptations. |
| | I can describe why it is important that most animals maintain the correct body temperature. | I can calculate surface area to volume ratio. | I can explain and illustrate how surface area to volume ratio is linked to maintaining the correct body temperature. |
| | I can describe why fur or feathers can be used to maintain a warm body temperature. | I can describe how animals are adapted to live in hot, dry and cold habitats. | I can discuss how and why climate change is affecting the distribution of animals. |
| B15.8 Adaptations in plants | I can state one example of a plant adaptation. | I can explain how a plant adaptation allows it to survive in its habitat. | I can explain how an unfamiliar plant is adapted and give reasons for its adaptations. |
| | I can describe why plants need a constant supply of water. | I can explain why plants need to reduce water loss by transpiration. | I can link and explain rate of transpiration to leaf surface. |
| | I can draw a graph to display data, with guidance. | I can display data using a graph and describe what it shows. | I can suggest and explain why a cactus would not survive in a cold climate. |

| Organising an ecosystem | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| B16.1 Feeding relationships | I can state the meaning of producer, consumer, predator, prey and give examples of each. | I can identify producers, primary consumers, secondary consumers, tertiary consumers, predators and prey in a food web. | I can explain in detail why all living things depend on producers. |
| | I can identify producers, consumers, predators and prey in a food chain. | I can describe what happens to a population in a food web when another changes. | I can evaluate in detail food chains/webs as models to show feeding relationships. |
| | I can describe what a graph shows about how the numbers of predator and prey change over time. | I can plot data as a line graph and explain the pattern of predator and prey populations. | I can make predictions based on data of a predator prey relationship. |
| B16.2 Materials cycling | I can state what a decomposer is and give examples. | I can explain why decomposers are important to a stable ecosystem. | I can explain how detritivores increase the rate if decay using ideas about surface area. |
| | I can name some substances that are recycled in the living world. | I can explain the importance of recycling substances. | I can explain how substances change as they decay. |
| | I can describe the events in the water cycle. | I can describe the events in the decay cycle. | I can comment on the limitations of a simple model of decay. |
| B16.3 The carbon cycle | I can state that carbon atoms are moved around the Earth (recycled). | I can describe the events in the carbon cycle. | I can explain in detail why the concentration of carbon dioxide I the atmosphere is rising and why this is an |
| | I can give one reason why we need to recycle carbon. | I can explain why the carbon cycle is vital to life on Earth. | I can explain the links between photosynthesis, respiration and combustion in the carbon cycle. |
| | I can use a diagram of the carbon cycle to describe the main processes involved. | I can write word equations for photosynthesis, respiration and combustion. | I can write balanced symbol equations for photosynthesis, respiration and combustion. |

| Biodiversity and ecosystems | Aiming for 4 | Aiming for 6 | Aiming for 8 |
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| B17.1 The human population explosion | I can state what biodiversity means. | I can describe why a good level of biodiversity is important to the future of the human species. | I can explain in detail why a high level of biodiversity is important to the stability of ecosystems. |
| | I can list some resources that humans are using up. | I can describe some effects of human population growth. | I can explain why human population change differs from population change of other animals. |
| | I can state some ways that air, water and land is polluted. | I can analyse and interpret data and information concerning human population growth. | I can suggest and evaluate solutions to the problems caused by human population growth. |
| B17.2 Land and water pollution | I can state some substances that pollute the water and land. | I can describe how sewage, fertilisers, pesticides and herbicides pollute the land and water. | I can explain in detail how pollution affects biodiversity. |
| | I can state some effects of rubbish, pesticides and sewage on land and water. | I can describe the process of eutrophication and bioaccumulation. | I can explain how pesticides in water can kill top predators in food chains. |
| | I can display data appropriately with guidance. | I can draw conclusions from data. | I can consider a land or water-based pollution issue, stating opinions with reasoning. |
| B17.3 Air pollution | I can state that acid rain is caused as a result of burning some fuels. | I can describe how acid rain is formed. | I can use word and symbol equations to show how burning some fuels produces acidic gases. |
| | I can list some effects of acid rain on plants and animals. | I can plan an investigation to find out how acid rain affects the germination of seeds. | I can explain what causes global dimming and smog and describe their effects. |
| | I can analyse observations and data with guidance. | I can choose a suitable method for analysing data. | I can analyse in detail data showing sulphur emissions over the last 3 years and suggest reasons for the trend. |
| B17.4 Deforestation and peat destruction | I can define deforestation. | I can explain the effects of deforestation and peat removal. | I can explain in detail how deforestation and peat removal increases the amount of carbon dioxide in the air. |
| | I can state at least one reason for deforestation and one effect. | I can categorise reasons for and effects of deforestation as environmental, social, economic and/or political. | I can analyse data to describe a trend in deforestation rate and give an explanation. |
| | I can give a use for peat. | I can describe why there is a conflict between using peat to increase food production and the need to conserve peat bogs. | I can explain the conflict between using peat to increase food production and the need to conserve peat bogs. |
| B17.5 Global warming | I can state that global warming is caused by increased levels of carbon dioxide and methane in the atmosphere. | I can use the terms greenhouse effect, global warming and climate change correctly. | I can produce scale diagrams showing some of the contributors to the greenhouse effect. |

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| | I can give one biological consequence of global warming. | I can describe in detail the biological consequences of global warming. | I can explain in detail the causes and effects of rising carbon dioxide and methane levels in the atmosphere. |
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| B17.6 Maintaining biodiversity | I can list some ways in which people can help maintain biodiversity. | I can describe programmes to reduce negative effects on ecosystems and explain how they work. | I can evaluate the conflicting pressures on maintaining biodiversity in some habitats. |
| | I can state reasons why some habits are at risk. | I can use information to explain the conflicting pressures on maintaining biodiversity. | I can link ideas to suggest why recycling can help protect habitats. |
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| **Atomic structure** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| C1.1 Atoms | I can define the word element. | I can describe the basic structure of an atom. | I can use chemical symbols of atoms to produce the chemical formulae of a range of elements and compounds. |
| | I can classify familiar substances as elements or compounds. | I can explain in detail, including diagrams, the difference between a pure element, mixture and compound. | I can explain the significance of chemical symbols used in formulae and equations. |
| | I can use the periodic table to find the symbols or names of given elements. | I can name and give the chemical symbol of the first 20 elements in the periodic table. | |
| C1.2 Chemical equations | I can describe familiar chemical reactions in word equations. | I can explain why mass is conserved in a chemical reaction. | I can justify in detail how mass may appear to change in a chemical reaction. |
| | I can state that mass is conserved in a chemical reaction. | I can describe familiar chemical reactions with balanced symbol equations including state symbols. | I can describe unfamiliar chemical reactions with more complex balanced symbol equations, including state symbols. |
| | | I can balance given symbol equations. | I can write balanced symbol equations. |
| C1.3 Separating mixtures | I can define the word 'mixture'. | I can explain the difference between a compound and a mixture. | I can use experimental data to explain the classification of a substance as a compound or a mixture. |
| | I can identify a mixture and a compound. | I can explain how the chemical properties of a mixture relate to the chemical it is made from. | I can suggest an appropriate separation or purification technique for an unfamiliar mixture. |
| | I can list different separation techniques. | I can describe different separation techniques. | I can explain in detail how multi-step separation techniques work. |
| C1.4 Fractional distillation and paper chromatography | I can state when fractional distillation would be used. | I can describe the process of fractional distillation. | I can explain in detail how fractional distillation can separate miscible liquids with similar boiling points. |
| | I can safely make a paper chromatogram. | I can explain the main processes occurring in paper chromatography. | I can evaluate separation or purification techniques for a given mixture. |
| | I can list the significant models proposed for atoms. | I can describe the differences between the plum-pudding and the nuclear model of the atom. | I can justify why the model of the atom has changed over time. |

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| C1.5 History of the atom | I can identify the key parts of the plum-pudding model and the nuclear model of the atom. | I can explain how evidence from scattering experiments changed the model of the atom. | I can evaluate the current model of an atom. |
| C1.6 Structure of the atom | I can state the relative charges and masses of subatomic particles. | I can describe atoms using the atomic model. | I can use the periodic table to find atomic number and mass number data and use it to determine the number of each subatomic particle in any given atom. |
| | I can state that atoms have no overall charge (are neutral). | I can explain why atoms have no overall charge. | I can recognise and describe patterns in subatomic particles of elements listed in the periodic table. |
| | I can label the subatomic particles on a diagram of a helium atom. | I can use atomic number and mass numbers of familiar atoms to determine the number of each subatomic particle. | I can explain why we can be confident that there are no missing elements in the first 10 elements of the periodic table. |
| C1.7 Ions, atoms, and isotopes | I can state what an ion is. | I can describe isotopes using the atomic model. | I can use the periodic table to find atomic number and mass number data and use it to determine the number of each subatomic particle in an ion. |
| | I can define an isotope. | I can explain why ions have a charge. | I can use SI units and prefixes to describe the size of an atom and its nucleus in standard form. |
| | I can state the relative sizes of an atom and its nucleus. | I can use atomic number and mass numbers of familiar ions to determine the number of each subatomic particle. | I can explain why chlorine does not have a whole mass number. |
| C1.8 Electronic structures | I can state that electrons are found in energy levels of an atom. | I can write the standard electronic configuration notation from a diagram for the first 20 elements. | I can use the periodic table to find atomic number and determine the electronic structure for the first 20 elements . |
| | I can state the maximum number of electrons in the first three energy levels. | I can explain why elements in the same group react in a similar way . | I can make predictions for how an element will react when given information on another element in the same group. |

| **The Periodic Table** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| C2.1 Development of the periodic table | I can list the significant models for ordering the elements. | I can describe how the elements are arranged in groups and periods in the periodic table. | I can explain how and why the ordering of the elements has changed over time. |
| | I can state how the elements are ordered in the periodic table. | I can explain why the periodic table was a breakthrough in how to order elements. | |
| C2.2 Electronic structures and the periodic table | I can define a group and period in the periodic table. | I can describe how the electronic structure of metals and non-metals are different. | I can explain how the electronic structure of metals and non-metals affects their reactivity. |
| | I can describe how electronic structure is linked to the periodic table. | I can explain in terms of electronic structure how the elements are arranged in the periodic table. | I can use the periodic table to make predictions about the electronic structure and reactions of elements. |
| | I can state that noble gases are unreactive. | I can explain why the noble gases are unreactive and the trend in their boiling points. | I can predict the electronic structure of stable ions for the first 20 elements. |
| C2.3 Group 1- the alkali metals | I can name the first three elements in Group 1. | I can recognise trends in supplied data. | I can illustrate the reactions of Group 1 metals with balanced symbol equations. |
| | I can describe the Group 1 metals as having low densities. | I can explain why the elements in Group 1 react similarly and why the first three elements float on water. | I can explain how Group 1 metals form ions with a +1 charge when they react with non-metals. |
| | I can write word equations from descriptions of how Group 1 metals react with water. | I can Describe how you can show that hydrogen and metal hydroxides are made when Group 1 metals react with water. | I can justify how Group 1 metals are stored and the safety precautions used when dealing with them. |
| C2.4 Group 7- the halogens | I can name the first four elements in Group 7. | I can recognise trends in supplied data. | I can illustrate the reactions of Group 7 metals with balanced symbol equations. |
| | I can recognise a halogen displacement reaction. | I can explain why the elements in Group 7 react similarly. | I can explain how Group 7 non-metals form ions with a −1 charge when they react with metals. |
| | I can describe the main properties of halogens. | I can explain how to complete a halogen displacement reaction and explain what happens in the reaction. | I can explain in detail how to compare the reactivity of the Group elements. |
| C2.5 Explaining trends | I can state the trend in reactivity in Group 1. | I can explain how electronic structure affects the trend in reactivity of Group 1 and Group 7 elements. | I can use electronic structure to explain the trends in physical and chemical properties of Group 1 and Group 7 elements. |
| | I can state the trend in reactivity in Group 7. | I can use the nuclear model to explain how the outer electrons experience different levels of attraction to the nucleus. | I can apply knowledge of reactivity of Groups 1 and 7 to suggest and explain the trend in reactivity of Group 2 and 6. |
| C2.6 The transition elements | I can list the typical properties of transition metals and their compounds. | I can describe how the properties of Group 1 metals compare with transition metals. | I can justify the use of a transition metal or its compound in terms of its chemical properties. |
| | I can explain why mercury is not a typical transition element. | I can interpret the formula and names of familiar transition metal compounds. | I can suggest why Group 1 metals have different properties compared to transition metals. |

| Structure & Bonding | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| C3.1 States of matter | I can identify the three states of matter and their state symbols. | I can use data to determine the state of a substance at a given temperature. | I can use the particle model to describe how energy, movement, and attraction between particles changes as a substance is heated or cooled. |
| | I can describe the process of melting, freezing, boiling, and condensing. | I can explain, in terms of particles, energy and temperature of a substance when it is at the melting point or boiling point. | I can suggest why substances have different melting and boiling points from each other. |
| | I can use the particle model to draw a representation of how particles are arranged in the three states of matter. | I can describe the factors that affect rate of evaporation. | I can evaluate a model, explaining its limitations. H |
| C3.2 Atoms in ions | I can state the particles involved in ionic and covalent bonding. | I can draw dot and cross diagrams of compounds formed between Group 1 and Group 7 elements. | I can draw dot and cross diagrams of unfamiliar ionic compounds. |
| | I can describe, with an example, how a Group 1 metal atom becomes a positive ion. | I can explain how electron transfer allows ionic bonding to occur in the compound formed when a Group 1 metal reacts with a Group 7 non-metal. | I can suggest and explain the charge of a monatomic ion based on its position in the periodic table. |
| | I can describe, with an example, how a Group 7 non-metal atom becomes a negative ion. | | |
| C3.3 Ionic bonding | I can state that opposite charges attract. | I can explain how the position of an element on the periodic table relates to the charge on its most stable monatomic ion. | I can suggest the charge on unfamiliar ions using the position of the element in the periodic table. |
| | I can write the charges of ions of Group 1, Group 2, Group 6, and Group 7 elements. | I can explain, in terms of electronic structure, how unfamiliar elements become ions. | I can explain the ratio of metal and non-metal ions in compounds. |
| | I can describe an ionic lattice. | I can interpret formula of familiar ionic compounds to determine the number and type of each ion present. | I can generate formula of a wide range of ionic compounds when the charges of the ions are given. |
| C3.4 Giant ionic structures | I can state that ionic compounds have high melting points and can dissolve in water. | I can explain why ionic compounds have a high melting point. | I can explain in detail why ionic compounds cannot conduct electricity when they are solid but can when molten or in solution. |
| | I can state that ionic compounds can conduct electricity when molten or dissolved in water. | I can describe, in terms of ions, how an ionic compound can conduct electricity. | I can justify in terms of properties that a compound has ionic bonding. |
| | I can describe an ionic lattice. | I can explain the movement of ions in solutions or when molten. | I can apply the ionic model to make predictions of the physical properties of ionic |
| C3.5 Covalent bonding | I can describe a covalent bond. | I can explain how a covalent bond forms in terms of | I can draw dot and cross diagrams and ball |

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| | | electronic structure. | and stick diagrams for unfamiliar small molecules. |
| | I can recognise a covalent compound from its formula, name, or diagram showing bonds. | I can draw dot and cross diagrams and ball and stick diagrams for $H_2$, $Cl_2$, $O_2$, $N_2$, HCl, $H_2O$, $NH_3$, and $CH_4$ | I can suggest how double and triple covalent bonds can be formed. |
| | I can name familiar examples of small molecules which contain covalent bonds. | I can describe a double bond in a diatomic molecule. | I can suggest how the properties of a double bond could be different to the properties of a single covalent bond. |

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| C3.6 Simple molecules | I can state that small molecules have low melting and boiling points. | I can explain how the size of molecules affects melting and boiling points | I can predict the physical properties of unfamiliar covalently bonded substances. |
| | I can state that small molecules do not conduct electricity. | I can explain why small molecules and polymers do not conduct electricity. | I can compare and contrast the properties of substances with different bonding. |
| | I can describe an intermolecular force. | I can identify substances that would have weak intermolecular forces. | I can justify the use of a model to explain the physical properties of a small molecule and discuss the limitations of various molecular models. |
| C3.7 Giant covalent structures | I can list the main physical properties of diamond and graphite. | I can recognise the structure of diamond and graphite from information provided in written or diagrammatic form. | I can use a molecular model of an unfamiliar giant covalent structure to predict and explain is physical properties. |
| | I can state that giant covalent structures have high melting points. | I can explain the properties of diamond in terms of its bonding. | I can justify in detail a use for graphite based on its properties. |
| | I can describe the structure of graphite in terms of layers of carbon atoms. | I can explain the properties of graphite in terms of its bonding. | I can justify in detail a use for diamond based on its properties. |
| C3.8 Fullerenes & graphene | I can describe the relationship between graphite and graphene. | I can recognise the structure of a fullerene or nanotube in diagrams and prose. | I can describe and explain the applications of fullerenes. |
| | I can list the main physical properties of fullerenes. | I can explain the structure of fullerenes. | I can use molecular models of graphene, nanotubes, and fullerenes to explain their |
| | I can state the molecular formula of buckminsterfullerene. | I can list the properties and consequent uses of fullerenes and carbon nanotubes. | I can justify in detail a use for graphene, nanotubes and fullerenes, based on their |
| C3.9 Bonding in metals | I can state that metals form a giant structure. | I can describe metallic bonding. | I can explain how metal atoms form giant structures. |
| | I can recognise metallic bonding in diagrams. | I can recognise and represent metallic bonding diagrammatically. | I can evaluate different models of metallic bonding. |
| C3.10 Bonding in metals | I can list the physical properties of metals. | I can explain key physical properties of metals using the model of metallic bonding. | I can explain in detail, including labelled diagrams, how alloying affects the structure and bonding in metals and its effect on properties. |
| | I can describe the structure of a pure metal. | I can describe why metals are alloyed. | I can justify in detail why alloys are more often used than pure metals. |
| C3.11 Nanoparticles | I can state a definition of nanoscience. | I can describe the size of nanoparticles. | I can classify a particle as coarse, fine, or nanoparticles based on their size. |
| | I can describe how surface area to volume increases as particle size reduces. | I can explain why surface area to volume ratio increases as particle size decrease. | I can quantitatively explain the relationship between surface area to volume ratio and particle size and its effect on properties. |

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| | I can recognise that the negative indices in standard form used in nanoscience are very small numbers. | I can convert lengths into standard form. | I can convert standard form into a variety of length units. |
| C3.12 Applications of nanoscience | I can state that nanoparticles can be used in sun cream. | I can list the advantages and disadvantages of using nanoparticles. | I can evaluate the use of nanoparticles in their applications, including sun cream. |
| | I can list a variety of uses of nanoparticles. | I can explain why nanoparticles can have new applications. | I can decide and justify in detail why nanotechnology research should continue. |

| Chemical Calculations | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| C4.1 Relative masses and moles | I can use the periodic table to identify the relative atomic mass for the first 20 elements. | I can use the periodic table to find the relative atomic mass of all elements. | I can explain why some elements have the same relative atomic mass as each other and why relative atomic masses may not be a whole number. |
| | I can calculate the relative formula mass for familiar compounds when the formula is supplied and is without brackets. | I can calculate the relative formula mass for unfamiliar compounds when the formula is given. | I can calculate the number of moles or mass of a substance from data supplied. |
| | | I can state the units for the amount of substance. | I can convert between units in calculations. |
| C4.2 Equations and calculations (H) | | I can explain why chemical equations must be balanced. | I can interpret balanced symbol equations in terms of mole ratios. |
| | | I can calculate the relative formula mass for one substance when the relative formula masses are given for all the other substances in a balanced symbol equation. | I can use balanced symbol equations to calculate reacting masses. |
| C4.3 From masses to balanced equations (H) | | I can explain why chemical equations must be balanced. | I can explain the effect of a limiting reactant on the amount of product made. |
| | | I can identify the limiting reactant in a chemical reaction. | I can use balanced symbol equations to calculate reacting masses when there is a limiting reactant. |
| C4.4 Yield of a chemical reaction | I can state the definition of theoretical yield, actual yield, and percentage yield. | I can calculate percentage yield when the actual yield is given and the mass of the limiting reactant is given. | I can calculate the percentage yield using a variety of units and conversions. |
| | I can calculate percentage yield when actual yield and theoretical yield are given. | I can list reasons why actual yield is often lower than theoretical yield. | I can justify why percentage yield can never be above 100%. |

| Chemical changes | Aiming for 4 | Aiming for 6 | Aiming for 8 |
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| C5.1 The reactivity series | I can list the order of common metals in the reactivity series. | I can describe oxidation and reduction in terms of gain or loss of oxygen. | I can justify uses of metals in the reactivity series based on their chemical reactivity. |
| | I can use general equations to write specific word equations for metals listed in the reactivity series reacting with oxygen, water, and acid. | I can write word equations for the metals listed in the reactivity series reacting with oxygen, water, and acid and balance given symbol equations. | I can write balanced symbol equations, with state symbols, for the metals listed in the reactivity series reacting with oxygen, water, and acid. |
| | I can safely make and record observations. | I can predict observations for the metals listed in the reactivity series reacting with oxygen, water, and acid. | I can evaluate in detail the investigation of metals plus acid, assessing the control of variables and the validity of conclusions drawn from the data collected. |
| C5.2 Displacement reactions | I can recall a definition of a displacement reaction. | I can explain why a displacement reaction occurs. | I can describe displacement reactions using an ionic equation. H |
| | I can use the reactivity series to determine whether a reaction between a metal and a different metal salt would happen or not. | I can write word equations and straightforward balanced symbol equations for displacement reactions. | I can write balanced symbol equations, with state symbols, for displacement reactions. |
| | I can safely make and record observations. | I can predict observations for the metals listed in the reactivity series reacting with a different metal salt. | I can determine and explain which species is oxidised and which species (metal atom or ion) is reduced in a displacement reaction in terms of electron transfer. H |
| C5.3 Extracting metals | I can define oxidation and reduction in terms of oxygen. | I can identify species that are being oxidised and reduced in a chemical reaction. | I can explain how carbon or hydrogen can be used to reduce an ore. |
| | I can describe how metals can be extracted. | I can explain why some metals are found uncombined in the Earth's crust. | I can evaluate the extraction process to obtain a metal from its ore. |
| C5.4 Salts from metals | I can recall a definition of a salt. | I can describe how to make a salt by reacting a metal with an acid. | I can explain the reaction between a metal and an acid. H |
| | I can name a salt formed between a metal and sulfuric acid or hydrochloric acid. | I can write a balanced symbol equation to describe a reaction between a metal and sulfuric acid or hydrochloric acid. | I can write ionic and half equations, including state symbols, to describe a reaction between a metal and sulfuric acid or hydrochloric acid. H |

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| | I can recall a general equation for a metal reacting with an acid and use it to write specific word equations. | I can identify the formula of the salt produced from the reaction between an acid and a metal. | I can identify and explain in detail which species is oxidised and which is reduced in a reaction. (H) |
| C5.5 Salts from insoluble bases | I can safely prepare a pure, dry sample of a soluble salt from an insoluble base and a dilute acid. | I can describe a method to prepare a pure, dry sample of a soluble salt from an insoluble substance and a dilute acid. | I can explain the reaction between a metal oxide or metal hydroxide and an acid, including an ionic equation. (H) |
| | I can name a salt formed between a metal hydroxide or metal oxide and sulfuric acid or hydrochloric acid. | I can write a balanced symbol equation to describe a reaction between a metal hydroxide or oxide and sulfuric acid or hydrochloric acid. | I can generate the formulae of salts given the names of the metal or base and the acid. |
| | I can recall a general equation for a base reacting with an acid and use it to write specific word equations. | I can explain why the reaction between a base and a dilute acid is a neutralisation reaction. | I can explain how alkalis are a subgroup of bases. |
| C5.6 Making more salts | I can safely make a salt by reacting a metal carbonate with a dilute acid. | I can describe how to make a dry sample of a salt from reacting a metal carbonate or an alkali with a dilute acid. | I can explain the reaction between ammonia and dilute acids to produce salts and the agricultural importance of the salts. |
| | I can write a general word equation for metal carbonates and alkalis reacting with dilute acids and use this to make specific word equations. | I can write balanced symbol equations for neutralisation reactions. | I can describe neutralisation using ionic equations, including the ionic equation for a carbonate plus an acid. |
| C5.7 Neutralisation and the pH scale | I can safely use universal indicator to classify as acidic or alkaline. | I can describe how universal indicator can be used to classify a chemical as acidic or alkaline. | I can evaluate how universal indicator or a data logger can be used to determine the approximate pH of a solution. |
| | I can describe the pH scale. | I can describe how solutions can be acidic or alkali. | I can use ionic equations to explain how solutions can be acidic or alkali. |
| | I can recall an example of an alkali, neutral, base, and acidic chemical. | I can describe the relationship between alkalis and bases. | I can explain how the pH of a solution changes as acid or alkali is added. |
| C5.8 Electronic structures (H) | | I can recall examples of strong and weak acids. | I can explain the difference between concentration and strong or weak in terms of acids and alkalis. |
| | | I can describe how an acid or alkali can be concentrated or dilute. | I can use ionic equations to explain how acids can be strong or weak. |
| | | I can describe how an acid or alkali can be weak or strong. | I can quantatively explain how the concentration of hydrogen ions relates to the pH number. |

| Electrolysis | Aiming for 4 | Aiming for 6 | Aiming for 8 |
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| C6.1 Introduction to electrolysis | I can define electrolysis. | I can describe electrolysis in terms of movement of ions. | I can explain why electrolysis can only occur when an ionic compound is molten or in aqueous solution. |
| | I can write a word equation to describe the electrolysis of a molten ionic compound. | I can write a balanced symbol equation including state symbols for the overall electrolysis of a molten ionic compound. | I can describe electrolysis with half equations at the electrodes. |
| | | I can predict the products at each electrode for the electrolysis of a molten ionic compound. | I can explain the classification of the reactions at each electrode as oxidation or reduction. |
| C6.2 Changes at the electrodes | I can state that oxygen can be produced at the anode when some solutions are electrolysed. | I can describe electrolysis of solutions in terms of movement of ions. | I can explain how hydrogen ions and hydroxide ions can be present in solutions, including a balanced symbol equation with state symbols, for the reversible reaction in which water ionises. |
| | I can state that hydrogen can be produced at the cathode when some solutions are electrolysed. | I can write a balanced symbol equation including state symbols for the overall electrolysis of a solution. | I can describe electrolysis with half equations at the electrodes. |
| | I can write a word equation to describe electrolysis of a solution. | I can predict the products at each electrode for the electrolysis of a molten ionic compound or its solution. | I can explain the classification of reactions at the electrodes as oxidation or reduction. |
| C6.3 Extraction of aluminium | I can state that aluminium can be extracted from aluminium oxide using electrolysis. | I can describe the electrolysis of aluminium oxide. | I can explain why electrolysis is used to extract aluminium from compounds. |
| | I can write a word equation to describe the electrolysis of aluminium oxide. | I can explain why electrolysis is an expensive metal extraction method and illustrate this with the extraction of aluminium. | I can describe electrolysis with half equations at the electrodes. |
| | | I can explain why cryolite is added to aluminium oxide in the industrial extraction of aluminium. | I can explain the classification of the reactions at each electrode as oxidation or reduction. |
| C6.4 Electrolysis of aqueous solutions | I can state the products of the electrolysis of brine and a use for each. | I can describe how to electrolyse brine in terms of ions moving. | I can explain the electrolysis of brine using half equations, classifying reactions at the electrode as oxidation or reduction. |
| | I can safely electrolyse a solution, with guidance provided. | I can predict the products of electrolysis of a solution. | I can evaluate in detail an investigation we have planned and carried out, commenting on our methodology and quality of the data |
| | | I can plan and carry out an electrolysis investigation. | I can explain the classification of the reactions at each electrode as oxidation or reduction. |

| Energy changes | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| C7.1 Exothermic and endothermic reactions | I can define exothermic and endothermic reactions. | I can describe examples of exothermic and endothermic reactions. | I can explain a chemical reaction in terms of energy transfer. |
| | I can state that energy is conserved in a chemical reaction. | I can explain, using observations from calorimetry, how to classify a reaction as exothermic or endothermic. | I can plan, carry out, and evaluate the errors in a calorimetry investigation. |
| | I can safely complete a calorimetry experiment for a reaction that takes place in solution. | I can explain in detail how to carry out a calorimetry experiment. | |
| C7.2 Using energy transfers from reactions | I can state a use of an exothermic reaction and an endothermic reaction. | I can explain how an energy change from a chemical reaction can be used. | I can suggest a chemical reaction for a specific purpose based on the energy change for the |
| | I can write word equations for familiar reactions. | I can write balanced symbol equations for familiar reactions. | I can evaluate in detail the uses of exothermic and endothermic reactions. |
| C7.3 Reaction profiles | I can define activation energy. | I can label activation energy on a reaction profile diagram. | I can explain why chemical reactions need activation energy to start them. |
| | I can sketch a generic reaction profile diagram for an exothermic or endothermic reaction. | I can generate a specific reaction profile diagram for a given chemical reaction when its energy change is also supplied. | I can use the particle model to explain how a chemical reaction occurs. |
| | | I can identify bonds broken in reactants and new bonds made in products of a reaction. | I can explain energy change in terms of the balance between bond making and bond breaking. |
| C7.4 Bond energy calculations | | I can explain, using the particle model, how reactants become products in a chemical reaction. | I can calculate the energy needed to break the reactant bonds and the energy released when the product bonds are made. |
| | | I can explain why bond breaking is endothermic and bond making is exothermic. | I can calculate the energy change for a reaction, including the correct unit. |
| | | I can define bond energy and identify all the bonds that break and are made in a chemical reaction. | I can explain in terms of bond energies how a reaction is either exothermic or endothermic. |

| Rates and equilibrium | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| 8.1 Rate of reaction | I can recall a definition for rate of reaction. | I can explain how there can be different units for measuring rate of reaction. | I can plot and use a graph to calculate the gradient to measure the initial rate of reaction. |
| | I can safely describe and follow a method to monitor rate of reaction. | I can calculate the mean rate of reaction. | I can justify a chosen method for a given reaction to monitor the rate of reaction. |
| | I can state the units for rate of reaction. | I can calculate the rate of reaction at a specific time. | I can explain why there is more than one unit for rate of reaction. |
| C8.2 Collision theory and surface area | I can describe how surface area of a solid can be increased. | I can describe how changing the surface area changes the rate of reaction. | I can use collision theory to explain in detail how increasing surface area increases the rate of reaction. |
| | I can state that chemical reactions can only occur when a collision occurs with enough energy. | I can describe what the activation energy of a reaction is. | I can use a graph to calculate the rate of reaction at specific times in a chemical reaction. |
| | I can list the factors that can affect the rate of a chemical reaction. | I can calculate the surface area to volume ratio. | I can explain why many collisions do not lead to a chemical reaction. |
| C8.3 The effect of temperature | I can describe how temperature affects the rate of reaction. | I can use collision theory to explain how changing temperature alters the rate of reaction. | I can use a graph to calculate the rate of reaction at specific times in a chemical reaction. |
| | I can safely an experiment on how temperature affects the rate of a reaction. | I can calculate mean rates of reaction. | I can calculate (1/t) and plot a graph with a more meaningful line of best fit. |
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| C8.4 The effect of concentration or pressure | I can describe how changing concentration affects the rate of reaction. | I can use collision theory to explain how changing concentration or pressure alters the rate of reaction. | I can interpret a rate of reaction graph, including calculating the rate of reaction at specific times in a chemical reaction. |
| | I can describe how changing pressure affects the rate of gas phase reactions. | I can calculate mean rates of reaction. | I can explain why changing pressure has no effect on the rate of reaction for some reactions. |
| | | I can explain how to change gas pressure. | I can justify quantitative predictions and evaluate in detail their investigation into the effect of concentration on rate of reaction. |
| | I can define a catalyst. | I can use collision theory to explain how adding a catalyst alters the rate of reaction. | I can use a reaction profile diagram to explain in detail the effect of adding a catalyst. |

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| C8.5 The effect of catalysts | I can describe how adding a catalyst affects the rate of reaction. | I can explain, with an example, the industrial use of a catalyst. | I can justify the use of catalysts in industry and in household products. |
| | I can describe and carry out a method to safely investigate which catalyst is best for a reaction. | I can calculate the mean rate of reaction. | I can explain what an enzyme is and how it works. |
| C8.6 Reversible reactions | I can define a reversible reaction. | I can explain, using a familiar reaction, how a reaction can be reversible. | I can describe an unfamiliar reversible reaction, using a balanced symbol equation with state symbols. |
| | I can write a word equation for a familiar reversible reaction. | I can describe a familiar reversible reaction using a balanced symbol equation. | I can justify the use of reversible reactions in the lab and items available in the home. |
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| C8.7 Energy and reversible reactions | I can state whether a reversible reaction is exothermic or endothermic in the reverse direction if the forward direction is stated. | I can explain why the energy change in a reversible reaction is exothermic in one direction and endothermic in the reverse direction. | I can explain in detail the energy changes in an equilibrium system. |
| | I can write the word equation for the reversible reaction of dehydration/hydration of copper sulfate. | I can generate balanced symbol equations for reversible reactions from information provided. | I can suggest and explain a simple laboratory test which could be completed using a reversible reaction. |
| | | I can make predictive observations of familiar reversible reactions when information is supplied. | I can make predictive observations of unfamiliar reversible reactions when information is supplied. |
| C8.8 Dynamic equilibrium | I can define a dynamic equilibrium. | I can describe how to achieve dynamic equilibrium. | I can explain dynamic equilibrium. |
| | I can describe a closed system. | I can describe how the rate of the forward reaction compares to the rate of the backward reaction in dynamic equilibrium. | I can explain why the concentration of chemicals in a dynamic equilibrium remains constant. |
| | | I can describe Le Chatelier's Principle. | I can predict the effect on the rate forward and reverse reactions by applying the Le Chatelier's Principle when the conditions of a dynamic equilibrium are changed. |
| C8.9 Altering conditions | | I can explain how changing conditions for a system at dynamic equilibrium affects the rate of the forward and reverse reactions. | I can explain why changing pressure has no effect on some systems. |
| | | I can predict the effect on yield of changing temperature, concentration, or pressure in a given equilibrium system. | I can justify, in detail, the compromise conditions chosen in given industrial processes. |
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| Crude oil and fuels | Aiming for 4 | Aiming for 6 | Aiming for 8 |
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| C9.1 Hydrocarbons | I can describe the composition of a crude oil. | I can describe how to separate crude oil into fractions in a school laboratory. | I can explain why fractional distillation is used to separate crude oil into fractions. |
| | I can state a definition of a hydrocarbon. | I can classify a hydrocarbon as an alkane. | I can apply a general formula to generate a molecular formula and a displayed formula for a straight-chain alkane. |
| | I can state a definition of an alkane. | I can state the names and describe the first four alkanes. | I can classify and justify the classification of a chemical as an alkane. |
| C9.2 Fractional distillation of oil | I can name the different fractions from crude oil. | I can describe how the trend in colour, viscosity, flammability, and boiling point changes as the length of the hydrocarbon chain changes. | I can explain in detail how fractional distillation is used to separate crude oil into fractions. |
| | I can state a use for each fraction from crude oil. | I can describe how the properties of a fraction of crude oil make it appropriate for its use. | I can explain how chain length affects the properties of crude oil fractions. |
| | | | I can make predictions about the properties of crude oil fractions from the fraction's hydrocarbon chain length. |
| C9.3 Burning hydrocarbon fuels | I can define complete and incomplete combustion. | I can explain the differences between complete and incomplete combustion. | I can justify the use of a given fuel over another. |
| | I can write a word equation to describe the complete combustion of a hydrocarbon. | I can write balanced symbol equations for the complete and incomplete combustion of hydrocarbons. | I can explain in detail how the production of carbon monoxide in incomplete combustion can be lethal. |
| | I can write a word equation to describe the incomplete combustion of a hydrocarbon. | I can explain how to test for the products of complete combustion. | I can use balanced symbol equations to calculate amounts of reactants or products in a combustion reaction. |
| C9.4 Cracking hydrocarbons | I can define the process of cracking. | I can describe the process of cracking, including conditions. | I can use examples to explain the process of cracking and why it is so important to the petrochemical industry. |
| | I can generate a word equation to describe cracking. | I can generate a balanced symbol equation to describe cracking. | I can explain the similarities and differences between alkanes and alkenes. |
| | I can recognise and give examples of alkenes. | I can describe a chemical test to show an alkene is present. | I can explain, using balanced symbol equations, the reaction between bromine water and an alkene. |

| Chemical analysis | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| C10.1 Pure substances and mixtures | I can state what a pure substance is. | I can describe the difference between pure substances, impure substances, and formulations. | I can justify the classification of pure substances, impure substances, and formulations when data is supplied. |
| | I can describe how melting point and boiling point data can be used to identify pure substances. | I can explain how melting point and boiling point data can be used to determine the purity of a substance. | I can explain in detail the use of formulations. |
| | I can state what a formulation is. | I can state uses of formulations. | I can calculate percentage compositions of components in a range of formulations. |
| C10.2 Analysing chromatograms | I can describe and safely carry out a method to make a paper chromatogram. | I can explain how chromatography separates solutes. | I can explain why different substances and different conditions will have different $R_f$ |
| | I can describe how to calculate $R_f$ values. | I can calculate $R_f$ values from given data. | I can calculate $R_f$ values from a chromatogram, using an appropriate number of significant figures. |
| | I can describe a use of chromatography. | I can use a chromatogram to determine if a sample is pure or impure. | I can interpret a chromatogram to identify unknown substances. |
| C10.3 Testing for gases | I can safely carry out the laboratory test for hydrogen, oxygen, carbon dioxide, and chlorine. | I can explain why limewater turns milky when it reacts with carbon dioxide. | I can write balanced symbol equations, including state symbols, for the reactions of limewater with carbon dioxide and hydrogen with oxygen. |
| | I can describe how to safely carry out the laboratory test for chlorine gas. | I can interpret results to identify a gas that is present. | I can explain why a glowing splint re-ignites in oxygen. |
| | I can identify hydrogen, carbon dioxide, and oxygen from a laboratory test. | I can explain why hydrogen ‘pops’ near a naked flame. | I can explain why chlorine gas turns damp indicator paper colourless. |

| **The Earths Atmosphere** | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| C11.1 History of our atmosphere | I can describe the Earth's early atmosphere. | I can state the composition, including formulae, of the Earth's early atmosphere. | I can use a theory to explain in detail how the atmosphere developed. |
| | I can describe how oxygen was formed in the development of the atmosphere. | I can describe a theory for the development of the Earth's atmosphere. | I can explain the limits of the theory for the development of the Earth's atmosphere and why it has changed. |
| | | I can explain, using word equations, how gases were formed in the atmosphere and oceans were formed. | I can use balanced symbol equations to explain how gases were formed in the |
| C11.2 Our evolving atmosphere | I can state that the levels of carbon dioxide have decreased in the atmosphere. | I can describe how the proportion of carbon dioxide in the early atmosphere was reduced. | I can use a theory to explain in detail how the early atmosphere developed to form the |
| | I can list the names and symbols of the gases in dry air. | I can state the composition of dry air. | I can explain why the compositions of the Earth's atmosphere has not changed much for 200 million years. |
| | I can state where methane and ammonia in the atmosphere may have come from. | I can use word equations to show how carbon dioxide can form sedimentary rocks. | I can use balanced symbol equations to explain how carbon dioxide forms sedimentary rock and how methane and ammonia were removed from the atmosphere. |
| C11.3 Greenhouse gases | I can describe the greenhouse effect. | I can explain the greenhouse effect. | I can justify why scientists, as well as the public, disagree about the cause of climate change. |
| | I can name three greenhouse gases. | I can explain how greenhouse gases increase the temperature of the atmosphere. | I can explain the difference between global warming and the greenhouse effect. |
| | I can state some human activities that affect the proportion of greenhouse gases. | I can explain how human activity can change the proportion of greenhouse gases in the atmosphere. | I can evaluate evidence to suggest if global warming is man-made or natural. |
| C11.4 Global climate change | I can list some of the possible outcomes of climate change. | I can explain the possible effects of global climate change and why they are difficult to predict. | I can evaluate the scale, risk, and environmental impact of global climate change. |
| | I can state a definition for carbon footprint. | I can explain possible methods to reduce greenhouse gas emissions. | I can justify why reducing greenhouse gas emissions can be difficult to achieve. |
| | I can list some ways to reduce a carbon footprint. | I can explain some of the problems in trying to reduce greenhouse gas emissions. | I can evaluate the use of products, services, or events in terms of their carbon footprint. |
| | I can list some atmospheric pollutants. | I can explain how sulphur dioxide and nitrogen oxides are made when fossil fuels are combusted. | I can predict the products of combustion of a fuel given appropriate information about the composition of the fuel and the conditions in which it is used. |

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| C11.5 Atmospheric pollutants | I can describe how carbon monoxide and soot (carbon) can be made from the incomplete combustion of fossil fuels. | I can describe the health impacts of atmospheric pollutants. | I can evaluate the negative social, economic, and environmental consequences of atmospheric pollution. |
| | I can complete word equations to describe how atmospheric pollutants can be made. | I can use balanced symbol equations to show how atmospheric pollutants are formed. | I can suggest and explain methods to reduce atmospheric pollution. |

| The Earth's Resources | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| C12.1 Finite and renewable resources | I can list some human uses of the Earth's resources. | I can describe and classify a resource as finite or renewable when information is given. | I can understand data and interpret information using orders of magnitude to compare. |
| | I can give examples of a finite and a renewable resource. | I can explain the use of natural, sustainable, and finite resources. | I can explain the role of chemistry in improving agricultural and industrial processes. |
| | I can state an example of a natural product that is supplemented or replaced by agricultural or | I can interpret information from different formats including graphs, charts, tables, and prose. | I can draw conclusions consistent with information provided from graphs, charts, tables, |
| C12.2 Water safe to drink | I can describe why potable water is important. | I can explain the method of obtaining potable water depends on the local conditions. | I can explain the difference between pure water and potable water. |
| | I can list the key processes to make drinking water. | I can explain reasons for filtration and sterilisation in water treatment. | I can justify the choice of potable water supply in a given scenario. |
| | I can safely distil salty water. | I can describe and explain in detail how to safely distil salty water. | I can explain in detail why desalination is not often used to generate safe clean drinking water and justify when it is used. |
| C12.3 Treating waste water | I can list what is removed from waste water before it can be released. | I can explain why waste water should be treated before it is released into the environment. | I can evaluate the ease of obtaining potable water from waste, ground, or salt water. |
| | I can state the main processes in sewage treatment. | I can describe the main processes in sewage treatment. | I can explain in detail how and why waste water is processed before it is released into the environment. |
| | I can state uses of sewage slurry. | I can explain the uses of sewage slurry. | I can evaluate the use of sewage slurry. |
| C12.4 Extracting metals from ores | | I can describe the processes of phytomining and bioleaching. | I can explain in detail how phytomining and bioleaching extract metals. |
| | | I can write balanced symbol equations to explain metal extraction techniques. | I can write ionic equations to explain metal extraction techniques and identify the species being oxidised or reduced. |
| | | I can explain the need for new ways of extracting metals (in particular copper). | I can evaluate biological methods of metal extraction. |
| C12.5 Life Cycle | I can state the different stages of an LCA in the correct order. | I can explain the importance of LCA and how it can be misused. | I can explain the limits of LCAs. |
| | I can carry out an LCA for shopping bags made from plastic or paper with support. | I can carry out LCAs for different products when data is supplied. | I can evaluate products in detail using LCAs. |
| | I can list some products that can be reused or recycled. | I can explain the importance of reusing and recycling products. | I can evaluate the environmental, economic, and social impacts of reusing and recycling products. |

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| Assessments | | | |
| C12.6 Reduce, reuse, and recycle | I can describe how metal can be reused and recycled. | I can explain why some recycling can be difficult. | I can evaluate ways of reducing the use of limited resources. |
| | I can describe how glass can be reused and recycled. | I can evaluate ways of reducing the use of limited resources when information is given. | I can suggest ways of minimising the environmental impact of exploiting raw materials. |

| P1 Atomic structure | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| P 1.1 Changes in energy stores | I can state some examples of energy stores. | I can describe a wide range of energy stores in different contexts. | I can describe the nature of energy stores in detail including the relationship between objects. |
| | I can state the processes that can transfer energy from one store to another. | I can describe changes in energy stores in terms of the process that causes the change. | I can explain factors that affect the size of changes in energy stores. |
| | I can identify changes in some energy stores using simple systems. | I can use quantitative descriptions of changes in energy stores. | I can represent energy changes graphically, accounting for changes in all stores. |
| P1.2 Conservation of energy | I can state that energy is conserved in any transfer. | I can apply the law of conservation of energy in straightforward situations. | I can apply the law of conservation of energy to explain why forces cause heating effects. |
| | I can state that energy is dissipated (is no longer useful) when it heats the environment. | I can describe changes in energy stores explaining why energy ceases to be useful. | I can describe closed systems and the changes to energy stores within them using the principle of conservation of energy. |
| | I can investigate the energy transfers in a pendulum and bungee. | I can describe the energy changes in a range of experiments and account for energy dissipation to the surroundings. | I can evaluate in detail experiments to investigate energy changes. |
| P1.3 Energy and work | I can state that energy is measured in joules (J). | I can describe the action of frictional forces on objects and the associated heating effect. | I can use the principle of conservation of energy and forces to explain why objects become heated by frictional forces. |
| | I can calculate the work done by a force. | I can use the equation for work done to calculate distances or size of forces. | I can apply the equation for work done in a wide range of contexts. |
| | I can measure the work done by a force experimentally. | I can use repeat values to measure the work done by a force experimentally. | I can evaluate in detail an experiment to measure work done, explaining why there is variation in the measurements. |
| P1.4 Gravitational potential stores | I can state the factors that affect the change in the gravitational potential energy store of a system. | I can describe the effect of different gravitational field strength on the gravitational potential energy store changes | I can perform calculations using rearrangements of the gravitational potential energy store equations. |
| | I can calculate the gravitational potential energy store of a system using the weight of an object and its height. | I can calculate the gravitational potential energy store of a system using the mass gravitational field strength, and height. | I can apply gravitational potential energy store equations in a wide range of contexts. |
| | I can measure the gravitational potential energy store changes in a system with a simple practical activity. | I can describe energy changes that involve a heating effect as opposed to movement of an object. | I can account for all changes of energy during falls or increases in height, including health effects. |
| P1.5 | I can state the factors that affect the size of a kinetic energy store of an object. | I can calculate the kinetic energy store of an object. | I can perform calculations involving the rearrangement of the kinetic energy equation. |

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| Kinetic energy and elastic energy stores | I can state the factors that affect the elastic potential energy store of a spring. | I can calculate the elastic potential energy store of a stretched spring. | I can perform calculations involving the rearrangement of the elastic potential energy equation. |
| | I can describe energy transfers involving elastic potential energy and kinetic energy stores. | I can investigate the relationship between the energy stored in a spring and the kinetic energy store of an object launched from | I can perform a wide range of calculations involving transfer of energy. |
| P1.6 Energy dissipation | I can identify useful and wasted energy in simple scenarios. | I can analyse energy transfers to identify useful and less useful energy transfers. | I can use a wide range of energy stores and physical processes to decide on wasted and useful energy transfers. |
| | I can describe energy dissipation in terms of heating the surroundings. | I can describe energy dissipation and how this reduces the capacity of a system. | I can apply the concept of energy dissipation in a wide range of scenarios. |
| | I can measure the frictional force acting on an object. | I can investigate the factors that affect frictional forces. | I can evaluate in detail an experiment to measure the frictional forces acting on an abject. |
| P1.7 Energy and efficiency | I can identify useful and wasted energy in simple scenarios. | I can analyse energy transfers to identify useful and less useful energy transfers. | I can use a wide range of energy stores and physical processes to decide on wasted and useful energy transfers. |
| | I can describe energy dissipation in terms of heating the surroundings. | I can describe energy dissipation and how this reduces the capacity of a system. | I can apply the concept of energy dissipation in a wide range of scenarios. |
| | I can measure the frictional force acting on an object. | I can investigate the factors that affect frictional forces. | I can evaluate in detail an experiment to measure the frictional forces acting on an abject. |
| P1.8 Electrical appliances | I can list some electrical appliances. | I can rank electrical devices in terms of their power. | I can compare electrical devices in terms of efficiency. |
| | I can survey a range of electrical devices and their operation. | I can compare mains-powered and battery-powered devices. | I can calculate the efficiency of an electrical device. |
| | I can calculate the efficiency of a simple energy transfer. | I can investigate the efficiency of a motor. | I can evaluate in detail an efficiency investigation to justify conclusions. |
| P1.9 Energy and power | I can state the unit of power as the watt and kilowatt. | I can calculate the energy transferred by an electrical device. | I can compare the power ratings of devices using standard form. |
| | I can, with support, rank electrical appliances in order of power. | I can calculate the efficiency of a device from power ratings. | I can apply the efficiency equation in a range of situations, including rearrangement of the equation. |
| | I can identify ‘wasted’ and ‘useful’ energy transfers in electrical devices. | I can find the wasted power of a device. | I can combine the electrical power equation with other equations to solve complex problems. |

| P2 Energy Transfer by Heating | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| P2.1 Energy transfer by conduction | I can describe materials as good or poor thermal conductors. | I can analyse temperature change data to compare the thermal conductivity of materials. | I can explain the different thermal conductivities of materials using the free electron and lattice vibration explanations of conduction. |
| | I can compare the thermal conductivities of materials in simple terms. | I can describe the changes in the behaviour of the particles in a material as the temperature of the material increases. | I can evaluate the results of an experiment into thermal conductivity in terms of repeatability and reproducibility of data, and the validity of conclusions drawn from the data. |
| | I can relate the thermal conductivities of a material to the uses of that material in familiar contexts. | I can apply understanding of thermal conductivity in reducing energy dissipation through the choice of appropriate insulating materials. | I can justify the choices of material involved in insulation or conduction using the concept of thermal conductivity and other data. |
| P2.2 Specific heat capacity | I can describe materials in terms of being difficult or easy to heat up (increase the temperature of). | I can describe the effects of changing the factors involved in the equation. | I can evaluate materials used for transferring energy in terms of their specific heat capacity. |
| | I can state the factors that affect the amount of energy required to increase the temperature of an object. | I can calculate the energy required to change the temperature of an object. | I can use the specific heat capacity equation to perform a wide range of calculations in unfamiliar contexts. |
| | I can, with some support, measure the specific heat capacity of a material. | I can measure the specific heat capacity of a material and find a mean value. | I can evaluate in detail the results of an experiment to measure specific heat capacity. |
| P2.3 Heating and insulating buildings | I can state some design features used to prevent energy transfer to the surroundings in the home. | I can describe how some design features used to reduce energy dissipation from a home work. | I can evaluate in detail design features used to reduce the rate of energy loss from the home. |
| | I can calculate the payback time of a simple home improvement feature. | I can compare home improvement features in terms of payback time. | I can decide on home improvement features using payback time and savings beyond the payback time. |
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| P3 Energy Resources | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| P3.1Energy demands | I can identify which fuels are renewable and which are non-renewable. | I can outline the operation of a fossil fuel burning power station. | I can compare energy use from different sources and different societies from available data. |
| | I can identify activities that require large energy transfers. | I can outline the operation of a nuclear power station. | I can compare fossil fuels and nuclear fuels in terms of energy provided, waste, and pollution. |
| | I can state that biofuels are carbon neutral whereas fossil fuels are not. | I can explain why biofuels are considered carbon neutral. | I can discuss some of the problems associated with biofuel use and production. |
| P3.2 Energy from wind and water | I can state that wind turbines, wave generators, hydroelectric systems, and tidal systems are renewable energy resources. | I can describe the operation of a wind farm. | I can compare the operation of hydroelectric, wave, and tidal systems in terms of reliability, potential power output, and costs. |
| | I can state some simple advantages or disadvantages of renewable energy systems. | I can describe the operation of a hydroelectric system. | I can explain in detail the purpose, operation, and advantages of a pumped storage system. |
| | I can outline the operation of a renewable energy source. | I can suggest the most appropriate energy resource to use in a range of scenarios. | I can justify the choice of an energy resource by using numerical and other appropriate data. |
| P3.3 Power from the Sun and the Earth | I can explore the operation of a solar cell. | I can compare and contrast the operation of solar cells (photovoltaic cells) with solar heating panels. | I can analyse the power output of a variety of energy resources. |
| | I can state one difference between solar cells and solar heating systems. | I can describe the operation of a solar power tower. | I can calculate the energy provided by a solar heating system by using the increase in water temperature. |
| | I can state that radioactive decay is source of heating in geothermal systems. | I can describe the operation of a geothermal power plant. | I can plan in detail an investigation into the factors that affect the power output of a solar cell. |
| P3.4 Energy and the environment | I can list some environmental problems associated with burning fossil fuels. | I can describe the effects of acid rain and climate change. | I can evaluate methods of reducing damage caused by waste products of fossil fuels and nuclear fuels. |
| | I can identify the waste products of fossil fuels and nuclear fuel. | I can describe techniques to reduce the harmful products of burning fossil fuels. | I can discuss in detail the problems associated with nuclear accidents and the public perception of nuclear safety. |
| | I can state simple advantages and disadvantages of a variety of renewable energy resources. | I can compare a wide range of energy resources in terms of advantages and disadvantages. | I can evaluate the suitability of an energy resource for a range of scenarios, taking into account a wide range of factors. |

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| P3.5 Big energy issues | I can rank the start-up times of various power stations. | I can use base load and start-up time data to explain why some power stations are in constant operation whereas others may be switched on and off. | I can use capital and operational costs of energy resources to evaluate their usefulness. |
| | I can compare some of the advantages and disadvantages of various energy resources. | I can compare energy resources in terms of capital and operational costs. | I can form persuasive arguments for or against a variety of energy resources. |
| | I can discuss the construction of a power plant in the local area in simple terms by using information provided. | I can debate the construction of a power plant in the local area by using a wide range of information, much of which is provided. | I can debate the construction of a power plant in local area by using a wide range of information, much of which is independently researched. |

| P4 Electric Circuits | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
|---|---|---|---|
| P4.1 Current and charge | I can identify circuit components from their symbols. | I can describe the operation of a variable resistor and a diode and their effects on current. | I can explain the nature of an electric current in wires in terms of electron behaviour. |
| | I can draw and interpret simple circuit diagrams. | I can calculate the charge transferred by a steady current in a given time. | I can perform a range of calculations, including rearrangement of the equation $Q=It$. |
| | I can construct a simple electrical circuit. | I can construct an electrical circuit and accurately measure the current. | I can measure the current in a circuit accurately and use it to calculate the rate of flow of electrons. |
| P4.2 Potential difference and resistance | I can state that resistance restricts the size of a current in a circuit. | I can calculate the potential difference. | I can describe potential difference in terms of work done per unit charge. |
| | I can state Ohm's law and describe its conditions. | I can calculate the resistance of a component. | I can rearrange equations for resistance and potential difference. |
| | I can measure the current and potential difference in a circuit to determined the resistance. | I can measure the effect of changing the length of a wire on its resistance in a controlled experiment. | I can investigate a variety of factors that may affect the resistance of a metal wire, such as the current through it, length, cross-sectional area, and metal used. |
| P4.3 Component characteristics | I can identify the key characteristics of electrical devices. | I can describe the resistance characteristics of a filament lamp. | I can explain the resistance characteristics of a filament lamp in terms of electrons and ion collisions. |
| | I can identify components from simple *I*–*V* graphs. | I can describe the characteristics of diode and light-emitting diode. | I can determine the resistance of a component based on information extracted from an *I*–*V* graph. |
| | I can state the operation of a diode in simple terms. | I can investigate the resistance characteristics of a thermistor and a LDR. | I can compare the characteristics of a variety of electrical components, describing how the components can be used. |
| P4.4 Series circuits | I can state that the current in any part of a series circuit is the same. | I can find the potential difference across a component in a circuit by using the p.d. rule. | I can explain, in detail, why the current in a series circuit is the same at all points by using the concept of conservation of charge (electrons). |
| | I can calculate the potential difference provided by cell combinations. | I can calculate the current in a series circuit containing more than one resistor. | I can analyse a variety of series circuit to determine the current through, p.d. across, and resistance of combinations of components. |

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| | I can calculate the total resistance of two resistors placed in series. | I can investigate the resistance of series circuits with several components. | I can evaluate in detail the investigation of series circuits and explain discrepancies. |
| P4.5 Parallel circuits | I can identify parallel sections in circuit diagrams. | I can measure the p.d. across parallel circuits and explain any discrepancies. | I can analyse parallel circuits in terms of current loops. |
| | I can state the effect of adding resistors in parallel on the size of the current in a circuit. | I can describe the effect on the resistance in a circuit of adding a resistor in parallel. | I can calculate the current at any point in a circuit. |
| | I can state that the p.d. across parallel sections of a circuit is the same. | I can investigate the effect of adding resistors in parallel on the size of the current in a circuit. | I can evaluate in detail an investigation into the effect of adding resistors in parallel on a circuit. |

| P5 Electricity in the Home | Aiming for 4 | Aiming for 6 | Aiming for 8 |
|---|---|---|---|
| P5.1 Alternating current | I can state that the UK mains supply is a high-voltage alternating current supply. | I can describe the characteristics of the UK mains supply. | I can explain the process of half-wave rectification of an a.c. source. |
| | I can state simple differences between a.c. and d.c. sources. | I can compare a.c. traces in terms of period and amplitude (voltage). | I can analyse a.c. traces with an oscilloscope to determine the voltage and frequency. |
| | I can describe how the trace on an oscilloscope changes when the frequency or amplitude of the signal is changed. | I can operate a cathode ray oscilloscope to display an a.c. trace. | I can compare and contrast the behaviour of electrons in a wire connected to d.c. and a.c. supplies. |
| P5.2 Cables and plugs | I can identify the live, neutral, and earth wires in a three-pin plug. | I can discuss the choices of materials used in cables and plugs in terms of their physical and electrical properties. | I can explain why it is not necessary for some appliances to be earthed. |
| | I can identify the key components of a typical three-pin plug and socket. | I can describe why a short circuit inside a device presents a hazard. | I can explain when there will be a current in the live, neutral, and earth wires of an appliance. |
| | I can identify simple and obvious hazards in electrical wiring. | I can identify a variety of electrical hazards associated with plugs and sockets. | I can discuss in detail the hazards associated with poor electrical wiring. |
| P5.3 Electrical power and potential difference | I can state that the power of a device is the amount of energy transferred by it each second. | I can calculate the power of systems. | I can measure and compare the power of electrical devices and explain variations in readings. |
| | I can describe the factors that affect the rate of energy transfer by a current in a circuit. | I can calculate the power of electrical devices. | I can calculate the electrical heating caused by resistance. |
| | I can explain why different fuses are required electrical devices in simple terms. | I can select an appropriate fuse for a device. | I can combine a variety of calculations to analyse electrical systems. |
| P5.4 Electrical currents and energy transfer | I can state that an electric current consists of a flow of charge (electrons in a wire). | I can calculate the charge transferred by a current in a given time. | I can perform calculations involving rearrangement of the equations $Q = It$ and $E = VQ$. |
| | I can identify the factors that affect the energy transfers in a circuit. | I can calculate the energy transferred by a charge passing through a potential difference. | I can explain how energy is conserved in terms of current and p.d. during energy transfers by an electric current. |
| | I can state that a battery or power supply provides energy to a current whereas a resistor causes a transfer of energy to the surroundings. | I can apply the law of conservation of energy in a circuit. | I can use algebra to combine the equations $Q = It$ and $E = VQ$ to form the relationships $E = VIt$ and $P = IV$. |
| P5.5 Appliances and efficiency | I can describe the factors that affect the cost of using various electrical devices. | I can calculate energy transfer in kilowatt-hours. | I can convert between relevant units during calculations of energy transfer. |
| | I can calculate energy transfer in joule. | I can convert between efficiencies stated in percentages and those stated in decimal forms. | I can analyse the use of a variety of electrical devices to determine their costs of operation. |
| | I can state that energy transfer can be measured in kilowatt-hours. | I can calculate the power rating of a device from the energy transferred and the time of operation. | I can compare a range of electrical devices in terms of efficiency using calculations to support any conclusions. |

| P6 Molecules and Matter | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P6.1 Density | I can describe density as a property of a material and not a particular object. | I can explain why some materials will float on water. | I can use the density equation in a wide variety of calculations. |
| | I can state that the density of a material is the mass per unit volume. | I can calculate the density of materials. | I can use appropriate significant figures in final answers when measuring density. |
| | I can calculate the volume of some regular shapes and the density of materials, with support. | I can measure the density of a solid and a liquid. | I can evaluate in detail the experimental measurement of density, accounting for errors in measurements. |
| P6.2 States of matter | I can describe the simple properties of solids, liquids and gases. | I can describe the arrangement of the particles in a solid, liquid, and gas. | I can describe the forces acting between particles in a solid, liquid, and gas. |
| | I can name the changes of state. | I can explain the behaviour of a material in terms of the arrangement of particles within it. | I can describe the changes in the energy of individual particles during changes of state. |
| | I can state that there are changes in stores of energy associated with a material when its temperature is increased. | I can describe the changes in behaviour of the particles in a material during changes of state. | I can explain in detail why the density of a material changes during a change of state, using a particle model. |
| P6.3 Changes of state | I can state that the melting point of a substance is a temperature at which it changes from a solid to a liquid and vice versa. | I can state that the melting and boiling points of a pure substance are fixed. | I can describe how the melting and boiling points of a substance can be changed. |
| | I can state that the boiling point of a substance is the temperature at which it changes from a liquid to a gas and vice versa. | I can use the term ‘latent heat’ to describe the energy gained by a substance during heating for which there is no change in temperature. | I can describe in detail the behaviour of the particles during changes of state. |
| | I can describe the process of melting and boiling. | I can find the melting or boiling point of a substance by using a graphical technique. | I can evaluate data produced by a heating experiment to discuss the reproducibility of the measurement of a melting point. |
| P6.4 Internal energy | I can state that the internal energy of a system increases as it is heated. | I can describe how the internal energy of an object can be increased by heating. | I can use the concepts of kinetic and potential energy to explain changes in internal energy. |

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| | I can identify which changes of state are related to increases in internal energy and which are related to decreases. | I can describe how the behaviour of particles changes as the energy of a system increases. | I can describe the changes in the size of intermolecular forces during changes of state. |
| | I can outline the behaviour of particles in solids, liquids, and gases. | I can describe the energy changes by heating between objects within the same system. | I can explain in detail why the pressure of a gas increases as it is heated. |
| P6.5 Specific latent heat | I can state that heating a material will increase its internal energy. | I can describe the changes in particle bonding during changes of state. | I can perform a variety of calculations based on the latent heat equation. |
| | I can describe energy changes during melting and vaporisation. | I can calculate the latent heat of fusion and latent heat of vaporisation for a substance. | I can combine variety of equations to solve problems involving heating. |
| | I can measure the latent heat of vaporisation for water. | I can measure the latent heat of fusion for water. | I can evaluate the reproducibility of a measurement of latent heat based on collated data. |
| P6.6 Gas pressure and temperature | I can state that as the temperature of a gas in a sealed container increases, the pressure of the gas increases. | I can describe the behaviour of particles in a gas as the gas is heated. | I can describe the linear relationship between changes in temperatures and pressure for a gas. |
| | I can describe a gas as consisting of a large number of rapidly moving particles. | I can outline Brownian motion and how this provides evidence for the particle nature of matter. | I can explain Brownian motion in terms of particle behaviour and collisions, relating the speeds of smoke particles and air molecules. |
| | I can describe pressure as being caused by collisions of gas particles with the walls of its container. | I can describe the relationship between an increase in the temperature of a fixed volume of a gas and the increase in pressure of the gas. | I can describe in detail how the relationship between the pressure of a gas and its temperature can be investigated. |

| P7 Radioactivity | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P7.1 Atoms and radiation | I can name the three types of nuclear radiation. | I can describe some safety precautions used when dealing with radioactive materials. | I can describe in detail the decay of an unstable nucleus. |
| | I can name the three sub-atomic particles found in an atom (proton, neutron, and electron). | I can describe how a Geiger counter can be used to detect radiation. | I can explain the similarities and differences between nuclear radiation and visible light. |
| | I can identify some sources of background radiation. | I can identify natural and man-made sources of background radiation. | I can describe the relative penetrating powers of the three types of nuclear radiation. |
| P7.2 The discovery of the nucleus | I can identify the Rutherford (nuclear) model of an atom. | I can describe he plum pudding model of the atom. | I can compare the plum pudding model, Rutherford model, and Bohr model of the atom in terms of the evidence for each model. |
| | I can identify the locations of protons, neutrons, and electrons in the nuclear model. | I can describe the evidence provided by the Rutherford scattering experiment. | I can explain how Rutherford and Marsden's experiment caused a rejection of the plum pudding model. |
| | I can state that electrons can move between fixed energy levels within an atom. | I can describe the properties of protons, neutrons, and electrons. | I can describe how the initial evidence for the nuclear model was processed and how the model came to be accepted. |
| P7.3 Changes in the nucleus | I can identify the mass and atomic number by using nuclear notation. | I can calculate the number of neutrons in an isotope by using nuclear notation. | I can explain why particles are ejected from the nucleus during nuclear decay. |
| | I can identify the type of decay taking place from a nuclear equation. | I can describe the differences between isotopes. | I can describe the changes in the nucleus that occur during nuclear decay. |
| | I can describe how isotopes are atoms of the same element with different mass numbers. | I can complete decay equations for alpha and beta decay. | I can write full decay equations for example nuclear decays. |
| P7.4 More about alpha, beta, and gamma radiation | I can rank the three types of nuclear radiation in order of their penetrating power. | I can describe how the penetrating powers of radiation can be measured. | I can describe in detail how the thickness of a material being manufactured can be monitored by using a beta source. |
| | I can rank the three types of nuclear radiation in order of their range through air. | I can describe the path of radiation types through a magnetic field. | I can compare the ionisation caused by different types of nuclear radiation. |

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| | I can state that all three types of nuclear radiation are ionising. | I can describe the process of ionisation. | I can evaluate in some detail the risks caused by alpha radiation inside and outside the human body. |
| P7.5 Activity and half-life | I can state that the activity of a radioactive sample will fall over time. | I can find the ratio of a sample remaining after a given number of half-lives. | I can compare a physical model of decay with the decay of nuclei, noting the limitations of the model. |
| | I can define half-life in simple terms such as ‘the time it takes for half of the material to decay’. | I can state that all atoms of a particular isotope have an identical chance to decay in a fixed time. | I can outline how the age of organic material can be determined by using radioactive dating. |
| | I can find the half-life of a substance from a graph of count rate (or nuclei remaining) against time with support. | I can plot a graph showing the decay of a sample and use it to determine half-life. | I can calculate the changes in count rate or nuclei remaining by using an exponential decay function. |

| P8 Forces and Balance | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P8.1 Vectors and Scalars | I can state that scalars have size (magnitude) without direction. | I can draw a scale diagram to represent a single vector. | I can interpret a scale diagram to determine the magnitude and direction of a vector. |
| | I can state that vectors have both size (magnitude) and direction. | I can categorise a wide range of quantities as either a vector or a scalar. | I can translate between vector descriptions and vector diagrams and vice versa using a range of appropriate scales. |
| | I can list some common scalars and vectors. | I can compare a scalar and a similar vector and explain how these quantities are different. | I can use a scale diagram to add two or more vectors. |
| P8.2 Forces between objects | I can use arrows to represent the directions of forces. | I can use scale diagrams to represent the sizes of forces acting on an object. | I can use appropriate SI prefixes and standard form to describe a wide range of forces. |
| | I can give examples of contact and non-contact forces. | I can describe the action of pairs of forces in a limited range of scenarios. | I can explain the pairs of forces acting in a wide range of unfamiliar scenarios, including the nature (contact or non-contact), direction, and magnitude of the forces. |
| | I can compare the sizes of forces using the unit newton (N). | I can investigate the effect of different lubricants on the size of frictional forces. | I can evaluate force measurement techniques in terms of precision and accuracy. |
| P8.3 Resultant forces | I can label a diagram showing several forces acting on an object. | I can draw a scaled diagram of the forces acting in a range of situations using arrows to represent the forces. | I can draw a scaled free-body force diagram showing forces as vectors and find the resultant force vector. |
| | I can calculate a resultant force from two parallel forces acting in opposite directions. | I can calculate resultant force produced by several forces acting on an object in coplanar directions. | I can calculate resultant forces from several forces acting in coplanar directions using a range of SI prefixes. |
| | I can state that a non-zero resultant force will cause a change in motion and a zero resultant force will not. | I can describe the effect of zero and non-zero resultant forces on the motion of moving and stationary objects. | I can create a detailed plan to investigate the factors that affect the acceleration of objects acted on by non-zero resultant force. |
| P8.4 Centre of mass | I can identify the approximate centre of mass of a range of simple shapes. | I can describe an experimental technique to determine the centre of mass of an object. | I can evaluate an experimental technique to determine the centre of mass of an object, identifying the likely sources of error leading to inaccuracy. |

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| | I can state that a suspended object will come to rest so that the centre of mass lies below the point of suspension. | I can explain why a suspended object comes to rest with the centre of mass directly below the point of suspension in terms of balanced forces. | I can apply understanding of the particle model and moments to explain why objects have a point at which the mass seems to act. |
| | I can use lines of symmetry to identify the location of the centre of mass. | I can compare the stability of objects to the position of their centre of mass of an object, identifying the likely sources of error leading to inaccuracy. | I can plan a detailed investigation into the stability of three-dimensional objects. |
| P8.5 The parallelogram of forces | | I can find the resultant of two forces at an acute angle by drawing a scale diagram. | I can find the resultant of two forces at an obtuse angle by drawing a scale diagram. |
| | | I can describe a system in equilibrium in which non-parallel forces are acting. | I can investigate non-parallel forces acting on a system in equilibrium to verify the parallelogram of forces. |
| | | I can calculate the component of a force using scale diagrams and ratios. | I can analyse a wide range of systems of non-parallel forces using a parallelogram technique. |
| P8.6 Resolution of forces | | I can resolve a single force into wo perpendicular components. | I can resolve a pair of forces into the overall perpendicular components. |
| | | I can determine if an object is in equilibrium by considering the horizontal and vertical forces. | I can determine if an object is in equilibrium by considering the horizontal and vertical components of forces. |
| | | I can investigate the effect of increasing the weight of an object on a slope on the component of the weight acting along the slope. | I can plan a detailed investigation into the effect of increasing the gradient of a slope on the component of the weight acting along the slope. |

| P9 Motion | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P9.1 Speed and distance-time graphs | I can state that the gradient of a distance-time graph represents the speed. | I can use the gradients of distance-time graphs to compare the speeds of objects. | I can calculate the speed of an object by extracting data from a distance-time graph. |
| | I can estimate typical speeds for walking, running, and cycling. | I can describe the motion of an object by interpreting distance-time graphs. | I can extract data from a distance-time graph to calculate the speed of an object at various points in its motion. |
| | I can calculate the distance an object at constant speed will travel in a given time. | I can calculate the speed of an object and the time taken to travel a given distance, | I can perform calculations of speed, distance, and time which involve conversion to and from SI base units. |
| P9.2 Velocity and acceleration | I can describe the difference between speed and velocity using an appropriate example. | I can identify the features of a velocity-time graph. | I can compare and contrast the features of a distance-time, displacement-time, and velocity-time graph. |
| | I can recall he equation relating velocity, acceleration, and time. | I can rearrange the acceleration equations in calculations. | I can combine equations relating to velocity and acceleration in multi-step calculations. |
| | I can calculate the acceleration of an object using the change in velocity and time. | I can calculate the change in velocity for an object under constant acceleration for a given period of time. | I can calculate a new velocity for a moving object that has accelerated for a given period of time. |
| P9.3 More about velocity-time graphs | I can identify the feature of a velocity-time graph which represents the acceleration (the gradient), and compare these values. | I can describe sections of velocity-time graphs, and compare the acceleration in these sections. | I can calculate the acceleration of an object from values taken from a velocity-time graph. |
| | I can identify the feature of a velocity-time graph which represents the distance travelled (the area beneath the line), and compare these values. | I can calculate the distance travelled using information taken from a velocity-time graph for one section of motion. | I can calculate the total distance travelled from a multi-phase velocity-time graph. |
| | I can measure the acceleration of an object as it moves down a ramp. | I can use a series of repeat measurements to find an accurate measurement of the acceleration of a moving object. | I can evaluate an experiment into the acceleration of an object in term of precision based on the spread of repeat measurements. |
| P9.4 Analysing motion graphs | I can identify speed on a distance-time graph using change in gradient. | I can calculate the speed of an object by extracting data from a distance-time graph. | I can calculate the acceleration of an object by extracting data from a velocity-time graph. |
| | I can identify acceleration on a velocity-time graph using change in gradient. | I can use a tangent to determine the speed of an object from a distance-time graph. | I can use the gradient of a velocity-time graph to determine the acceleration of an object. |

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| | I can calculate the distance travelled by an object at constant velocity using data extracted from a graph. | I can use the equation $v^2 - u^2 = 2as$ in calculations where the initial or final velocity is zero. | I can apply transformations of the equation $v^2 - u^2 = 2as$ in calculations involving change in velocity and acceleration where both velocities are non-zero. |

| P10 Forces and Motion | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P10.1 Force and acceleration | I can state the factors that will affect the acceleration of an object acted on by a resultant force. | I can describe the effect of changing the mass or the force acting on an object on the acceleration of that object. | I can define the inertial mass of an object in terms of force and acceleration. |
| | I can calculate the force required to cause a specified acceleration on a given mass. | I can perform calculations involving the rearrangement of the $F = ma$ equation. | I can calculate the acceleration of an object acted on by several forces. |
| | I can investigate a factor that affects the acceleration of a mass. | I can combine separate experimental conclusions to form an overall conclusion. | I can evaluate an experiment by identifying sources of error and determining uncertainty in the resulting data. |
| P10.2 Weight and terminal velocity | I can state the difference between the mass of an object and its weight. | I can calculate the weight of objects using their mass and the gravitational field strength. | I can apply the mathematical relationship between mass, weight, and gravitational field strength in a range of situations. |
| | I can describe the forces acting on an object falling through a fluid. | I can apply the concept of balanced forces to explain why an object falling through a fluid will reach a terminal velocity. | I can explain the motion of an object falling through a fluid by considering the forces acting through all phases of motions. |
| | I can investigate the motion of an object when it falls. | I can investigate the relationship between the mass of an object and the terminal velocity. | I can evaluate the repeatability of an experiment by considering the spread of the results. |
| P10.3 Forces and braking | I can state factors which affect the stopping distance of a car. | I can categorise factors which affect thinking distance, braking distance and both. | I can calculate acceleration, mass, and braking force of vehicles. |
| | I can calculate the thinking distance for a car from the initial speed and reaction time. | I can calculate the braking distance of a car. | I can calculate total stopping distance, initial speed, reaction time, and acceleration. |
| | I can estimate the relative effects of changing factors which affect the stopping distance of cars. | I can describe the relationship between speed and both thinking and braking distance. | I can explain the relative effects of changes of speed on thinking and stopping distance. |
| | | I can apply the equation $p = mv$ to find the momentum, velocity or mass of an object. | I can fully describe the motion of objects after an explosion accounting for any frictional effects. |

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| P10.4 Momentum | | I can describe how the principle of conservation of momentum can be used to find the velocities of objects. | I can apply principle of conservation of momentum to a range of calculations involving the velocities of objects. |
| | | I can investigate the behaviour of objects during explosions to verify the conservation of momentum. | I can evaluate the data produced from an investigation and compare this to a theoretical framework. |
| P10.5 Forces and elasticity | I can state Hooke's law. | I can explain the limitations of Hooke's law including the limit of proportionally. | I can find the spring constant of a spring using a graphical technique. |
| | I can calculate the extension of a material using its length and original length. | I can calculate the force required to cause a given extension in a spring using the spring constant. | I can Hooke's law equation in a wide of situations. |
| | I can compare materials in terms of elastic and non-elastic behaviour. | I can compare the behaviour of different materials under loads in terms of proportional and non-proportional behaviour. | I can evaluate an investigation into the extension of materials in terms of the precision of the data. |

| P11 Wave Properties | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P11.1 The nature of waves | I can state that waves can transfer energy and information without the transfer of matter. | I can investigate wave motion through a spring model. | I can explain the features of a longitudinal wave in terms of compressions and rarefactions by using a particle model. |
| | I can identify waves as either transverse or longitudinal. | I can compare transverse and longitudinal waves in terms of direction of vibration and propagation. | I can discuss the features of a transverse wave in terms of particle or field behaviour. |
| | I can identify waves as either mechanical or electromagnetic. | I can compare electromagnetic and mechanical waves in terms of the need for a medium. | I can compare mechanical waves and their particulate nature with electromagnetic waves and their field oscillations. |
| P11.2 The properties of waves | I can outline the derivation of the wave speed equation. | I can outline the derivation of the wave speed equation. | I can explain how the wave speed equation can be derived from fundamental principles. |
| | I can calculate the period of a wave from its frequency. | I can calculate the period of a wave from its frequency. | I can perform calculations involving rearrangements of the period equation and the wave speed equation. |
| | I can measure the speed of a water wave. | I can calculate the wave speed from the frequency and wavelength. | I can perform multi-stage calculations linking period, frequency, wave speed, and wavelength. |
| P11.3 Reflection and refraction | | I can describe refraction at a boundary in terms of wavefronts. | I can use a wavefront model to explain refraction and reflection. |
| | | I can describe refraction including the reflected rays. | I can describe the relationship between the angle of incidence and angle of refraction. |
| | | I can explain partial absorption as a decrease in the amplitude of a wave and therefore the energy carried. | I can explain refraction in terms of changes in the speed of waves when they move between one medium and another. |
| | I can measure the speed of a wave in water. | I can measure the speed of a wave in a solid (string).. | I can evaluate the sustainability of apparatus for measuring the frequency, wavelength and speed of waves. |

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| P11.4 More about waves | I can describe how sound waves travel more quickly in solids than they do in gases. | I can describe the effect that changing the frequency of a wave has on its wavelength in a medium. | I can explain why the wavelength of a wave in a particular medium changes as the frequency changes with reference to the wave equation. |
| | I can describe how the sound waves require a medium to travel in. | I can calculate the speed of waves using the wave speed equation. | I can evaluate data from speed of sound experiments to discuss the range of uncertainty. |

| P12 Electromagnetic waves | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P12.1 The electromagnetic spectrum | I can state that electromagnetic waves transfer energy without transferring matter. | I can describe the relationship between the energy being transferred by an electromagnetic wave and the frequency of the wave. | I can apply the wave model of electromagnetic radiation as a pair of electric and magnetic disturbances that do not require a medium for travel. |
| | I can identify the position of EM waves in the spectrum in order of wavelength and frequency. | I can calculate the frequency and the wavelength of an electromagnetic wave. | I can use standard form in calculations of wavelength, frequency, and wave speed. |
| | I can state that all EM waves travel at the same speed in a vacuum. | I can explain why the range of wavelengths detected by the human eye is limited. | I can explain the interactions between an electromagnetic wave and matter. |
| P12.2 Light, infrared, microwaves, and radio waves | I can state that white light is a part of the EM spectrum and composed of a range of frequencies. | I can describe how a range of electromagnetic waves are used in a variety of scenarios. | I can determine the wavelength of radio waves in air. |
| | I can list some simple examples of the uses of light, microwaves, and radio waves. | I can explain why a particular wave is suited to its application. | I can describe the interactions between a range of waves and matter, including the effect of absorption. |
| | I can carry out a practical task to determine the penetrating power of an electromagnetic signal. | I can determine whether the law of reflection applies to a microwave signal. | I can plan, carry out, and evaluate in detail an investigation into the penetrating power of microwaves. |
| P12.3 Communications | I can state that radio waves and microwaves are used in communications through the atmosphere. | I can compare the rate of information transfer through optical fibres and radio signals. | I can describe in detail how carrier waves are used in the transfer of information. |
| | I can state that the higher the frequency of a wave, the greater the rate of data transfer possible. | I can outline the operation of a mobile phone network and the waves used. | I can describe the structure of a radio communication system, including the effect of a radio wave on the current in the receiver. |
| | I can describe the sub-regions of the radio spectrum. | I can discuss the evidence for mobile phone signals causing damage to humans. | I can discuss the relationship between wavelength data transmission and range to explain to explain why particular frequencies are chosen for particular transmissions. |
| P12.4 Ultraviolet | I can state that high-frequency EM radiation is ionising. | I can describe the penetrating powers of gamma rays, X-rays, and ultraviolet rays. | I can describe in detail the interaction between ionising radiation and inorganic materials. |

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| waves, X-rays, and gamma rays | I can describe the uses and dangers of UV radiation. | I can compare X-rays and gamma radiation in terms of their origin. | I can compare different regions of the electromagnetic spectrum in terms of their potential harmfulness. |
| | I can describe the uses and dangers of X-rays and gamma radiation. | I can describe the ionisation of atoms in simple terms. | I can explain how the process of ionisation can lead to cell death or cancer through damage to DNA. |
| P12.5 X-rays in medicine | I can state some safety procedures that take place during the operation of devices that produce ionising radiation. | I can describe the operation of an X-ray machine. | I can compare the operation of a CT-scanner and that of a simple X-ray device. |
| | I can describe the formation of an X-ray photograph in terms of absorption or transmission. | I can explain why contrast media can be used during X-rays. | I can evaluate the doses of ionising radiation received in a variety of occupations or medical treatments. |
| | I can state that X-ray therapy can be used to kill cancerous cells in the body. | I can describe the factors that affect the radiation doses received by people. | I can explain in detail how various safety features reduce exposure to ionising radiation. |

| P13 Electromagnetism | **Aiming for 4** | **Aiming for 6** | **Aiming for 8** |
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| P13.1 Magnetic fields | I can state the names of the poles of a magnet. | I can sketch the shape of a magnetic field around a bar magnet. | I can describe the regions in a magnetic field where magnetic forces are greatest using the idea of field lines. |
| | I can describe the interaction of magnetic poles (attraction and repulsion). | I can describe how the shape of a magnetic field can be investigated. | I can explain in detail how a magnetism can be induced in some materials. |
| | I can list some magnetic and non-magnetic metals. | I can compare the Earth's magnetic field to that of a bar magnet. | I can plan in detail how the strength of a magnetic field can be investigated. |
| P13.2 Magnetic fields of electric current | I can state that the magnetic field produced by a current carrying wire is circular. | I can use the corkscrew rule to determine the direction of the field around a current carrying wire. | I can determine the polarity of the ends of a solenoid from the direction of the current. |
| | I can describe the effect of increasing the current on the magnetic field around a wire. | I can describe the shape of the field produced by a solenoid. | I can sketch the shape of the field surrounding a solenoid relating this to the direction of the current through the coil. |
| | I can describe the effect of reversing the direction of the current in the wire. | | I can plan a detailed investigation into the factors that affect the strength of the magnetic field around a solenoid. |
| P13.3 The motor effect | | I can describe the operation of a moving-coil loudspeaker. | I can describe and explain in detail the operation of a d.c. motor. |
| | | I can apply Fleming's left-hand rule to determine the direction of the force acting on a conductor. | I can perform calculations involving rearrangements of the equation $F = BIl$. |
| | | I can calculate the force acting on a conductor when it is placed in a magnetic field. | I can investigate the factors that affect the rotation of an electric motor. |