Yr 10 Summary

These are the topics that you have covered this year:

Biology:

- CB1 Key Concepts
- CB2 Cells and Control
- CB3 Genetics
- CB4 Natural Selection
- CB5 Health and Disease
- CB9 Ecosystems and Material Cycles

Chemistry:

- CC1 States of Matter
- CC2 Separating & Purifying
- CC3 Atomic Structure
- CC4 The Periodic Table
- CC5, 6 & 7 Bonding
- CC8 Acids and Alkalis
- CC9 Calculations
- CC10 Electrolysis
- CC11 Extracting Metals

Physics:

- CP1 Motion
- CP2 Forces and Motion
- CP3 Conservation of Energy
- CP4 Waves
- CP5 Light and EM Spectrum
- CP6 Radioactivity
- CP7 & 8 Energy and Forces

CB1 – What should you know?

- Draw plant cells, animal cells and bacteria cells
- Name the structures in these cells and their functions
- Explain how sperm egg and ciliated epithelial cells are specialised
- Describe how to use a microscope to view cells
- Explain the advantages of electron microscopy
- Convert between the units milli, micro, nano and pico
- Be able to write numbers using standard form
- Describe how enzymes catalyse reactions using the lock and key hypothesis
- Explain how the active site of enzymes leads to specificity to substrates
- Explain how denaturation of enzymes is related to the active site
- Explain the effects of temperature, substrate concentration and pH on enzyme activity
- Calculate enzyme activity using a rate calculation
- Explain the importance of enzymes as catalysts in digestion
- Describe transport in cells by the processes of diffusion, osmosis and active transport

CB1 – Practise Question

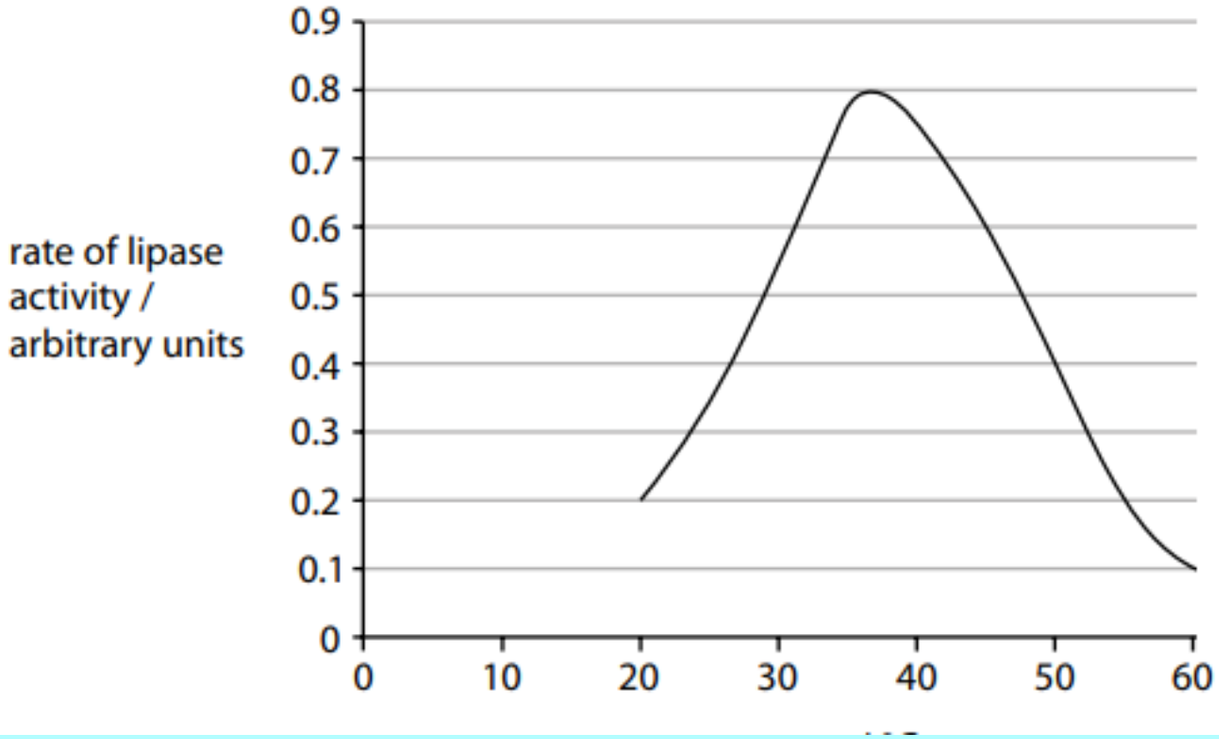
Phenolphthalein is an indicator. It is pink in alkaline solutions and turns colourless as the pH decreases.

It can be used to measure the activity of the enzyme lipase on the breakdown of lipids.

Samples of milk containing phenolphthalein were incubated with lipase at different temperatures.

The time taken for the phenolphthalein to turn colourless was recorded and used to calculate the rate of enzyme activity.

Figure 10 shows these results.



Questions:

1. Explain why phenolphthalein turns colourless when lipase breaks down the lipids in milk.

2. Describe the effect of temperature on the activity of lipase

3. Explain why the activity of lipase changes above a temperature of 40°C.

CB1 – Practise Question - Answer

Answer	Mark
An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • fatty acids are formed when the lipids are broken down by lipase (1) • and fatty acids are acidic (so the pH decreases) (1)	**(2)**

Answer	Mark
An answer that combines up to a maximum of **two** points to provide a logical description: • as the temperature increases from 20 °C to 37 °C the rate of lipase activity increases (from 0.2 to 0.8) (1) • the rate of lipase activity is optimal at 37 °C (1) • above 37 °C the rate of lipase activity decreases (from 0.8 to 0.1) (1)	**(2)**

Answer	Mark
An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • an increase in temperature above 40 °C causes changes in the shape of the active site of the enzyme (1) • therefore the enzyme becomes denatured and no longer functions (1)	**(2)**

CB2 – What should you know?

- Describe the cell cycle, including the stages of mitosis
- Describe how mitosis is used for growth, repair and asexual reproduction
- Define diploid and haploid
- Understand how mitosis produces two genetically identical diploid cells
- Describe how uncontrolled cell division can result in cancer
- Describe how stem cells and meristem cells in plants are undifferentiated
- Describe uses of stem cells in medicine (including embryonic stem cells)
- Describe how cell differentiation produces specialised cells
- Describe growth in animals, involving cell division and differentiation
- Describe growth in plants, involving cell division, elongation and differentiation
- Understand how to use percentile charts to monitor growth
- Describe the structure and function of the nervous system
- Draw and label a sensory, motor and relay neurones
- Describe what is meant by a stimulus and response and how the nervous system transmits electrical impulses
- Describe what is meant by a reflex and explain the reflex arc

CB2 – Practise Question

Mitosis and meiosis are types of cell division.

Compare these two types of cell division.

(6)

CB2 – Practise Question - Answer

Question Number		Indicative Content	Mark
QWC	**1(d)**	A comparison between mitosis and meiosis including **Mitosis** • (genetically) identical cells produced • two daughter cells • one division • diploid daughter cells • identical set of chromosomes • occurs in the formation of body cells • for growth and repair (of body tissues) **Meiosis** • (genetically) non-identical cells • four daughter cells • 2 divisions • haploid daughter cells • half the number of chromosomes • occurs in the formation of gametes • for sexual reproduction • results in genetic variation	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited description including two points on either meiosis or mitosis there maybe confusion between the two but this does not negate the level • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description including one comparison of meiosis and mitosis or a detailed description of either mitosis or meiosis • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed comparison of both meiosis and mitosis – at least two correct comparisons made • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

CB3 – What should you know?

- Know that meiosis produces gametes (sex cells)
- Understand how meiosis produces four genetically different haploid cells
- Describe the structure of DNA as a double helix, made of two strands with a sugar and phosphate backbone and joined by nucleotide bases
- Know that the nucleus of cells contains genetic information in the form of chromosomes, which are called DNA
- Know that a gene is a section of DNA that codes for a particular protein
- Describe what is meant by ‘phenotype’ and ‘characteristic’
- Describe the difference between inherited and genetic variation
- Explain how alleles result in genetic variation, using the terms dominant and recessive.
- Draw Punnett squares to show inherited variation, using percentages
- Understand that most phenotypes are the result of multiples genes
- Describe how sex of offspring is determined at fertilisation
- Understand how mutation results in variation in a species.

CB3 – Practise Question

The earlobes of an individual are detached or attached. This is determined by the alleles inherited from their parents.

detached earlobe

attached earlobe

An individual with attached earlobes must have inherited two recessive alleles from each of their parents and will have the genotype **ee**.

Questions:

1. State the genetic term used to describe an individual with the genotype ee for attached earlobes.
2. A female with the genotype ee has attached earlobes and a male with the genotype Ee has detached earlobes. Draw a Punnett square to show the gametes and genotypes of the offspring for this female and male.
3. State the probability of the offspring having detached earlobes

CB3 – Practise Question - Answer

Answer	Acceptable answers	Mark
homozygous recessive	Accept in any order: homozygous recessive (alleles)	**(1)**
female gametes male gametes **e** **e** **E** Ee Ee **e** ee ee correct gametes in male/female gametes headings (1) correct offspring genotypes (1)		**(2)**
Any **one** of the following • 1/2 • 0.50 • 2/4 • 50 % • 1:1 / 2:2	Accept if 2 correct answers are given e.g. ½, 50% evens chance	**(1)**

CB4 – What should you know?

- Describe how organisms are classified by Kingdom, Phylum, Class, Order, Family, Genus and Species
- Describe how genetic analysis has lead to the suggestion of 3 domains rather than 5 kingdoms
- Describe the difference between eukaryotes and prokaryotes
- Describe the process of selective breeding and its use in farming and on domesticated animals
- Explain Darwin's theory of evolution by natural selection
- Describe the evidence that stone tools and fossils provide for evolution
- Explain how natural selection can result in antibiotic resistance in bacteria
- Describe genetic engineering as a process to produce organisms with desirable characteristics
- Describe the stages of genetic engineering, including use of restriction enzymes, ligase, sticky ends and vectors
- Evaluate the benefits and risks of genetic engineering and selective breeding

CB4 – Practise Question

A cloned animal contains genetic information that is identical to its parent.

Describe the stages in the production of a cloned mammal.

(6)

CB4 – Practise Question - Answer

Question Number		Indicative Content	Mark
QWC	***1 (a (ii)**	A description including • use of body cell • nucleus removed from body / parent cell • use of egg cell • nucleus removed from egg cell/enucleated egg • nucleus (from body cell) transferred to enucleated egg • electric shock; • to stimulate cell division • mitosis • formation of embryo; • embryo implanted • into surrogate	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• Limited description of 2 of the stages involved in cloning and the sequence of events is confused • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple description of 3 or more of the stages involved in cloning but some of the steps may be missing or out of sequence • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed description of 5 or more of the stages involved in cloning but the sequence is largely in order and complete • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

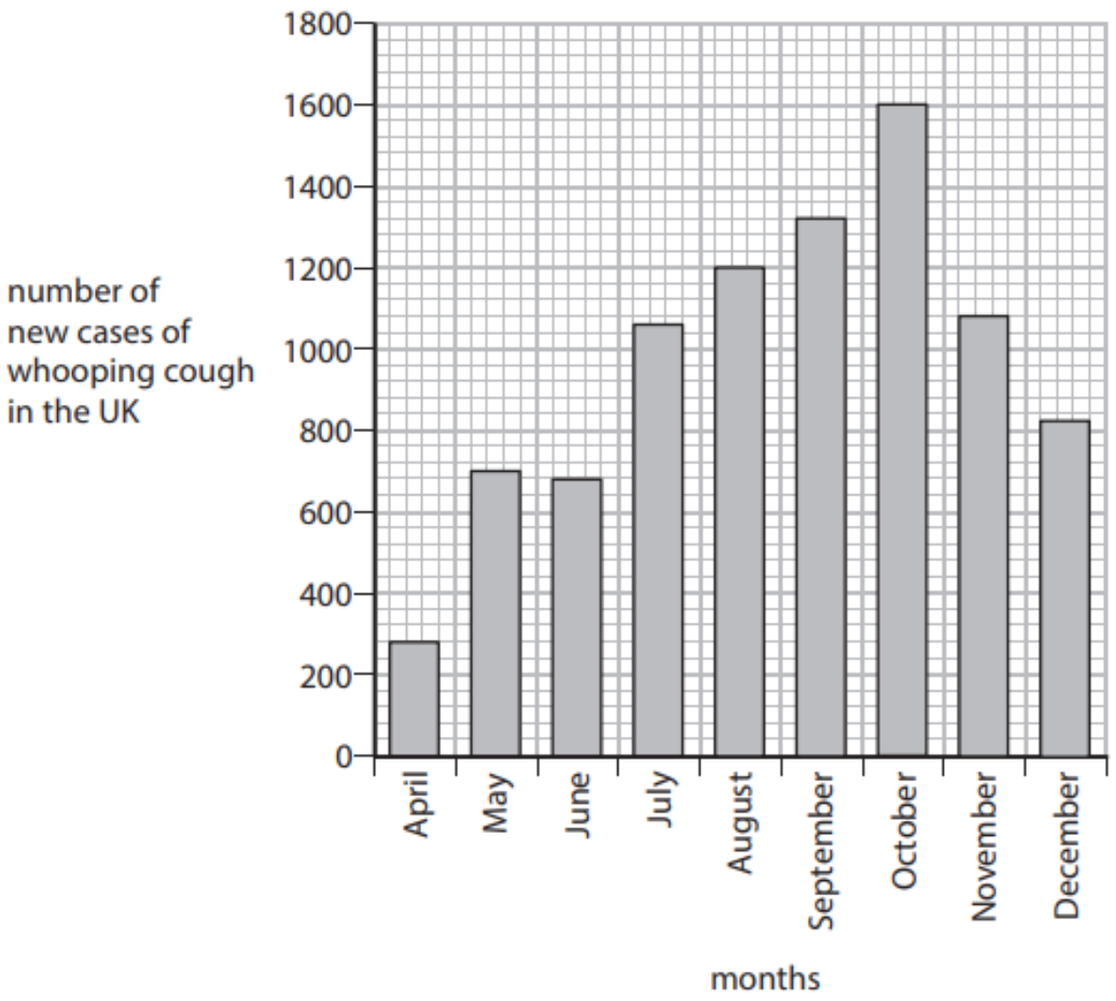
CB5 – What should you know?

- Describe health as a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity
- Describe the difference between communicable and non-communicable disease
- Explain why the presence of one disease can lead to a higher susceptibility to other diseases
- Know what a pathogen is (including viruses, bacteria, fungi and protisists)
- Describe some communicable diseases, including cholera, tuberculosis, chalara ash dieback, malaria and HIV
- Describe how pathogens are transmitted and how to reduce the spread
- Describe how sexually transmitted infections (STIs) are spread, and how to reduce or prevent the spread. Including Chlamydia and HIV
- Describe the physical and chemical barriers of the human body against pathogens
- Explain the immune response of the human body, including antigens, antibodies and memory lymphocytes
- Explain how vaccination leads to immunisation
- Explain how antibiotics can be used to treat bacterial infections
- Describe the process of developing new medicines
- Describe some non-communicable disease, including cardiovascular disease, lung disease and some forms of cancer
- Explain how lifestyle factors affect non-communicable disease, including diet and exercise, weight, alcohol use and smoking
- Evaluate some different treatments for cardiovascular disease, including life-long medication, surgical procedures and lifestyle changes.

CB5 – Practise Question

In 2012 there was an outbreak of whooping cough in the UK.

The graph shows the number of new cases of whooping cough in the UK from April to December 2012.



Questions:

1. Describe the trend shown in the graph from April to December
2. In September 2011 there were 168 cases of whooping cough in the UK. Calculate the difference in the number of cases of whooping cough in September 2011 and September 2012
3. Children in the UK can be immunised against whooping cough. Suggest why outbreaks of whooping cough still occur in the UK
4. Describe the response of the human body to immunisation

CB5 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	an increase in cases until **October** and then a decrease (in the number of cases) (1)	accept an increase in cases till **November** when it decreases	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	1320 (1) 1320 – 168 = 1152	**2 marks for correct answer**	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)	**A suggestion including two of the following** not everyone has been immunised (1) immigration introduces people who are not immunised (1) immunisation not fully effective (1) immunity can decrease with age (1)	 accept no herd immunity accept bacteria mutates (making immunisation ineffective) accept immunity requires boosters/loss of memory lymphocytes	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(d)	**A description including the following** (immunisation) introduces an antigen/(immunisation) causes an immune response (1) (B) lymphocytes (1) production of antibodies (1) (the production of) <u>memory lymphocytes</u> (1)	 accept immune system recognises an antigen (in the immunisation) ignore white blood cells	**(3)**

CB9 – What should you know?

- Describe the different levels of organisation from individual organisms, populations, communities, to the whole ecosystem
- Explain how communities can be affected by abiotic and biotic factors, including: temperature, light, water, pollutants, competition, predation
- Describe the importance of interdependence in a community
- Describe how the survival of some organisms is dependent on other species, including parasitism and mutualism
- Explain how to determine the number of organisms in a given area using raw data from field-work techniques, including quadrats and belt transects
- Explain the positive and negative human interactions within ecosystems and their impacts on biodiversity, including: fish farming, introduction of non-indigenous species, eutrophication
- Explain the benefits of maintaining local and global biodiversity, including the conservation of animal species and the impact of reforestation
- Describe how different materials cycle through the abiotic and biotic components of an ecosystem
- Explain the importance of the carbon cycle, including the processes involved and the role of microorganisms as decomposers
- Explain the importance of the water cycle, including the processes involved and the production of potable water in areas of drought including desalination
- Explain how nitrates are made available for plant uptake, including the use of fertilisers, crop rotation and the role of bacteria in the nitrogen cycle

CB9 – Practise Question

The photograph shows a lake which has been polluted by excess nutrients.

(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The build-up of nutrients in an aquatic environment is known as

- ☒ **A** decomposing
- ☒ **B** eutrophication
- ☒ **C** mutualism
- ☒ **D** parasitism

Questions:

1. Suggest how farming can lead to a build-up of nutrients in the lake.

2. State the effects of nitrates on plant growth.

3. Nitrates can be produced by soil bacteria. Explain how soil bacteria produce nitrates.

4. Name one type of bacteria that reduce the nitrate content of soil.

CB9 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	B - eutrophication		**(1)**

Question Number	Answer	Acceptable answers	Mark
3a(ii)	Any **two** from the following: • (over use of) nitrates / phosphates fertilisers (1) • leaching into the lake(1) • sewage leakage into the lake (1)	flowing into lakes / washing into lakes (accept streams, rivers for lakes)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3a(iii)	(plant growth) is increased / protein is made(1)	excessive/overgrowth of algae/plants on the surface	**(1)**

Question Number	Answer	Acceptable answers	Mark
3b(i)	An explanation linking **three** of the following points: • decomposers /decomposer bacteria (1) • bacteria /they break down dead animal and plant matter in the soil (1) • into ammonia (1) • {ammonia / nitrites} is/are converted into nitrates (1) • by nitrifying bacteria (1)	ref to nitrogen fixing bacteria (fixing nitrogen) (1)	**(3)**

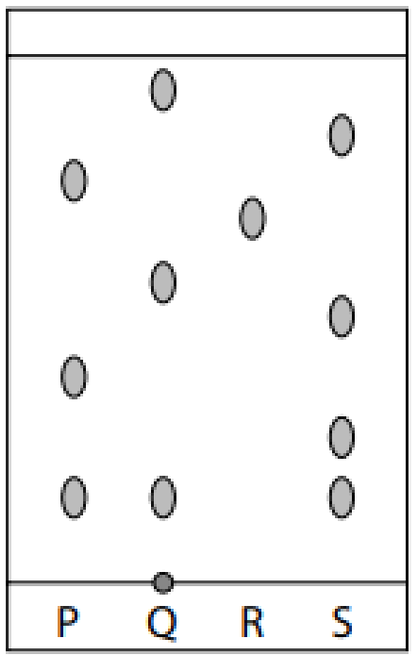
Question Number	Answer	Acceptable answers	Mark
3b(ii)	denitrifying (bacteria) (1)	named bacteria e.g ***Thiobacillus denitrificans, Micrococcus denitrificans, Serratia, Pseudomonas,*** and ***Achromobacter***	**(1)**

CC1 & 2 – What should you know?

- Describe the arrangement, movement and the relative energy of particles in each of the three states of matter: solid, liquid and gas
- Recall the names of the changes of state and understand that these are physical, not chemical, changes
- Explain the changes in arrangement, movement and energy of particles during a state change
- Predict the physical state of a substance under specified conditions, given suitable data
- Explain the difference between the use of ‘pure’ in chemistry compared with its everyday use and the differences in chemistry between a pure substance and a mixture
- Interpret melting point data to distinguish between pure substances which have a sharp melting point and mixtures which melt over a range of temperatures
- Explain the types of mixtures that can be separated by using the following experimental techniques: simple distillation, fractional distillation, filtration, crystallisation, paper chromatography
- Describe an appropriate experimental technique to separate a mixture, knowing the properties of the components of the mixture
- Explain how paper chromatography separates a mixture
- Interpret a paper chromatogram: to distinguish between pure and impure substances, to identify substances by comparison with known substances, to identify substances by calculation and use of Rf values
- Describe how waste and ground water can be made potable, including the need for sedimentation, filtration and chlorination
- Describe how sea water can be made potable by using distillation
- Describe how water used in analysis must not contain any dissolved salts

CC1 & 2 – Practise Question

P, **Q**, **R** and **S** are mixtures of food colourings.
They are investigated using paper chromatography.
Figure 4 shows the chromatogram at the end of the experiment.



Questions:

1. Which mixture contains an insoluble food colouring?

2. Give a change that could be made to the experiment to obtain an Rf value for the insoluble colouring.

3. Explain, by referring to Figure 4, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment.

CC1 & 2 – Practise Question - Answer

	Answer	Mark
	Q	(1)

	Answer	Mark
	use a different solvent.	(1)

	Answer	Mark
	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • mixture S (1) • because it gives the greatest number of spots/gives four spots (1)	(2)

CC3 – What should you know?

- Describe how the Dalton model of an atom has changed over time because of the discovery of subatomic particles
- Describe the structure of an atom as a nucleus containing protons and neutrons, surrounded by electrons in shells
- Recall the relative charge and relative mass of: a proton, neutron and electron
- Explain why atoms contain equal numbers of protons and electrons
- Describe the nucleus of an atom as very small compared to the overall size of the atom
- Recall that most of the mass of an atom is concentrated in the nucleus
- Recall the meaning of the term mass number of an atom
- Describe atoms of a given element as having the same number of protons in the nucleus and that this number is unique to that element
- Describe isotopes as different atoms of the same element containing the same number of protons but different numbers of neutrons in their nuclei
- Calculate the numbers of protons, neutrons and electrons in atoms given the atomic number and mass number
- Explain how the existence of isotopes results in relative atomic masses of some elements not being whole numbers
- Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes

CC3 – Practise Question

(a) Chlorine has an atomic number of 17.

Chlorine-35 and chlorine-37 are two isotopes of chlorine.

(i) Complete the table to show the numbers of protons, neutrons and electrons in each of the isotopes.

(2)

	chlorine-35	**chlorine-37**
number of protons		
number of neutrons		
number of electrons		

(ii) A normal sample of chlorine contains only chlorine-35 and chlorine-37 atoms.

Explain why the relative atomic mass of chlorine is 35.5

(2)

CC3 – Practise Question - Answer

Question Number	Answers	Acceptable Answers	Mark
3 (a)(i)	<table><tr><td></td><td>chlorine-35</td><td>chlorine-37</td></tr><tr><td>number of protons</td><td>**17**</td><td>**17**</td></tr><tr><td>number of neutrons</td><td>**18**</td><td>**20**</td></tr><tr><td>number of electrons</td><td>**17**</td><td>**17**</td></tr></table> the four 17s (1) the 18 and 20 (1)		**(2)**

Question Number	Answers	Acceptable Answers	Mark
3 (a)(ii)	An explanation linking M1 average (mass of atoms/isotopes present) (1) M2 more chlorine-35 than chlorine-37 / higher {percentage / abundance} of Cl-35 / lower {percentage / abundance} of Cl-37 / (1)	mean ignore weight 75% chlorine-35 / 25% chlorine-37/ chlorine-35 and chlorine-37 in ratio 3:1 / correct calculation to obtain 35.5 (2) eg[(75x35) + (25x37)]/100	**(2)**

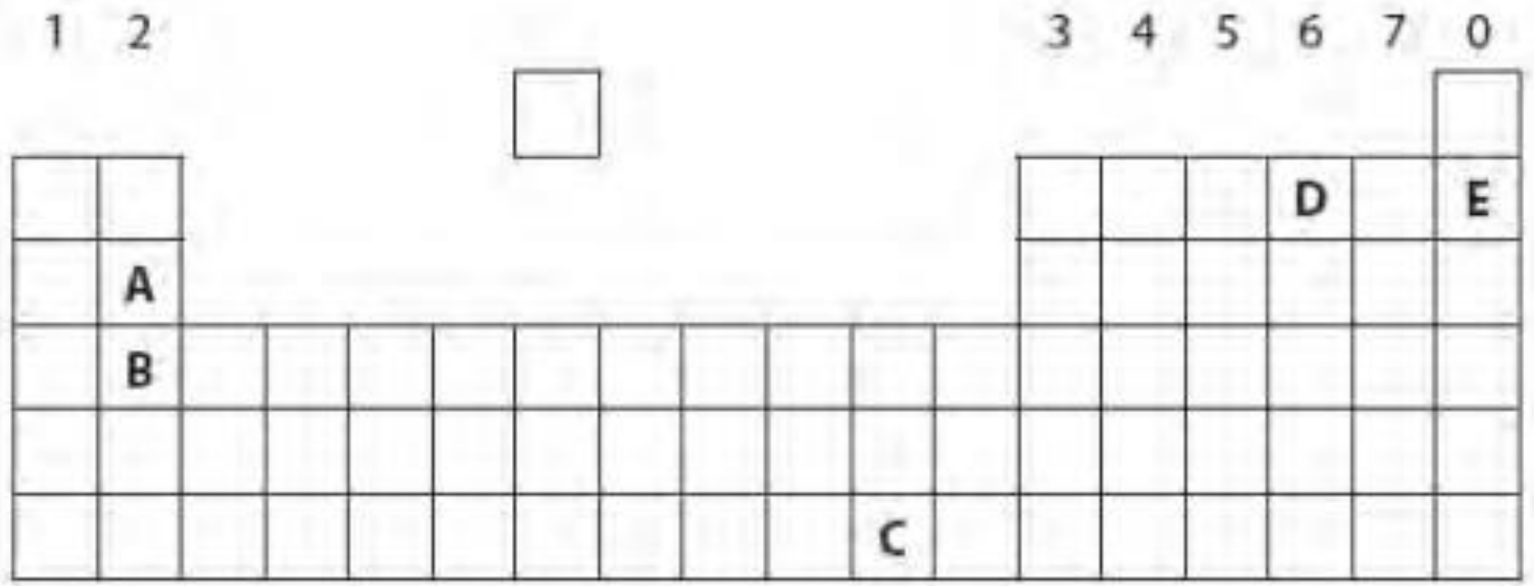
CC4 – What should you know?

- Describe how Mendeleev arranged the elements, known at that time, in a periodic table by using properties of these elements and their compounds
- Describe how Mendeleev used his table to predict the existence and properties of some elements not then discovered
- Explain that Mendeleev thought he had arranged elements in order of increasing relative atomic mass but this was not always true because of the relative abundance of isotopes of some pairs of elements in the periodic table
- Explain the meaning of atomic number of an element in terms of position in the periodic table and number of protons in the nucleus
- Describe that in the periodic table elements are arranged in order of increasing atomic number, in rows called periods and elements with similar properties are placed in the same vertical columns called groups
- Identify elements as metals or non-metals according to their position in the periodic table, explaining this division in terms of the atomic structures of the elements
- Predict the electronic configurations of the first 20 elements in the periodic table as diagrams and in the form, for example 2.8.1
- Explain how the electronic configuration of an element is related to its position in the periodic table

CC4 – Practise Question

The positions of five elements, **A**, **B**, **C**, **D** and **E**, are shown in the periodic table.

These letters are not the atomic symbols of these elements.



Questions:

1. Give the letters of all the elements that are metallic
2. Give the letters of the two elements that have the most similar chemical properties.
3. An atom of element B contains more protons than an atom of element A. State how many more protons there are in an atom of element B than in an atom of element A.

CC4 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	A, B and C	Mg Ca Au (any order) magnesium calcium gold (any order)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	A and B	Mg Ca (any order) magnesium calcium (any order)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	8 (protons)		**(1)**

CC5 – What should you know?

- Explain how ionic bonds are formed by the transfer of electrons between atoms to produce cations and anions, including the use of dot and cross diagrams
- Recall that an ion is an atom or group of atoms with a positive or negative charge
- Calculate the numbers of protons, neutrons and electrons in simple ions given the atomic number and mass number
- Explain the formation of ions in ionic compounds from their atoms, limited to compounds of elements in groups 1, 2, 6 and 7
- Explain the use of the endings –ide and –ate in the names of compounds
- Deduce the formulae of ionic compounds (including oxides, hydroxides, halides, nitrates, carbonates and sulfates) given the formulae of the constituent ions
- Explain the structure of an ionic compound as a lattice structure consisting of a regular arrangement of ions held together by strong electrostatic forces (ionic bonds) between oppositely-charged ions

CC5 – Practise Question

Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 6.

Figure 6

Complete Figure 7 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)

charge on ion ..... charge on ion .....

Figure 7

CC5 – Practise Question - Answer

Question number	Answer	Mark
1(c)	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	(4)

CC6 – What should you know?

- Explain how a covalent bond is formed when a pair of electrons is shared between two atoms
- Recall that covalent bonding results in the formation of molecules
- Recall the typical size (order of magnitude) of atoms and small molecules
- Explain the formation of simple molecular, covalent substances, using dot and cross diagrams, including: hydrogen, hydrogen chloride, water, methane, oxygen, carbon dioxide

CC6 – Practise Question

Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a **covalent bond**.

(2)

(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

CC6 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	An description including • shared (electrons) (1) • pair(s) of electrons (between atoms) (1)	Ignore reference to complete/full shells Ignore reference to between two metals Ignore reference to between metal and non-metal Ignore reference to between molecules Any reference to between ions scores 0	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	2.4		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)(iii)	diagram showing • any shared pair of electrons between a carbon and oxygen atom in CO_2 molecule (1) • rest of molecule correct (1)	Must have O C O arrangement If any atom labelled must be correct Ignore inner electrons even if wrong electrons can be on/in ring or no ring Ignore intersecting circles Accept all permutations of dots and crosses	**(2)**

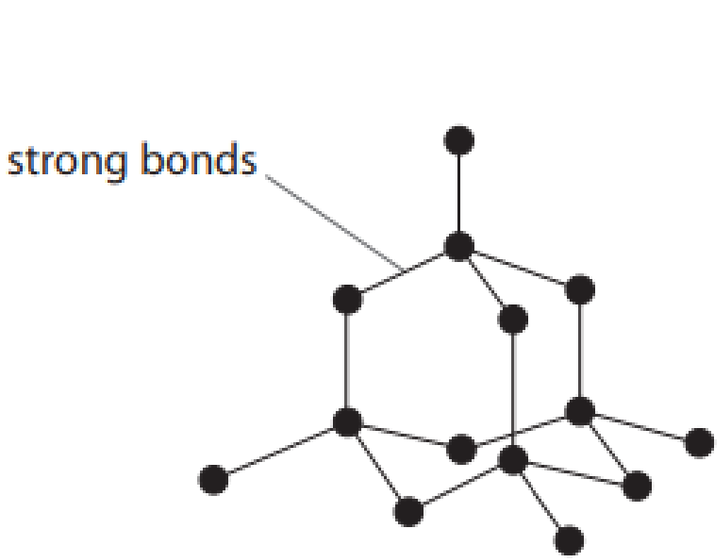
CC7 – What should you know?

- Explain why elements and compounds can be classified as: ionic, simple molecular (covalent), giant covalent, metallic
- Explain how the structure and bonding of these types of substances results in different physical properties, including relative melting point and boiling point, relative solubility in water and ability to conduct electricity (as solids and in solution)
- Explain the properties of ionic compounds limited to: high melting points and boiling points, in terms of forces between ions and whether or not they conduct electricity as solids, when molten and in aqueous solution
- Explain the properties of typical covalent, simple molecular compounds limited to: low melting points and boiling points, in terms of forces between molecules (intermolecular forces) and poor conduction of electricity
- Recall that graphite and diamond are different forms of carbon and that they are examples of giant covalent substances
- Describe the structures of graphite and diamond
- Explain, in terms of structure and bonding, why graphite is used to make electrodes and as a lubricant, whereas diamond is used in cutting tools
- Explain the properties of fullerenes including C60 and graphene in terms of their structures and bonding
- Describe, using poly(ethene) as the example, that simple polymers consist of large molecules containing chains of carbon atoms
- Explain the properties of metals, including malleability and the ability to conduct electricity
- Describe the limitations of particular representations and models to, include dot and cross, ball and stick models and two- and three-dimensional representations
- Describe most metals as shiny solids which have high melting points, high density and are good conductors of electricity whereas most non-metals have low boiling points and are poor conductors of electricity

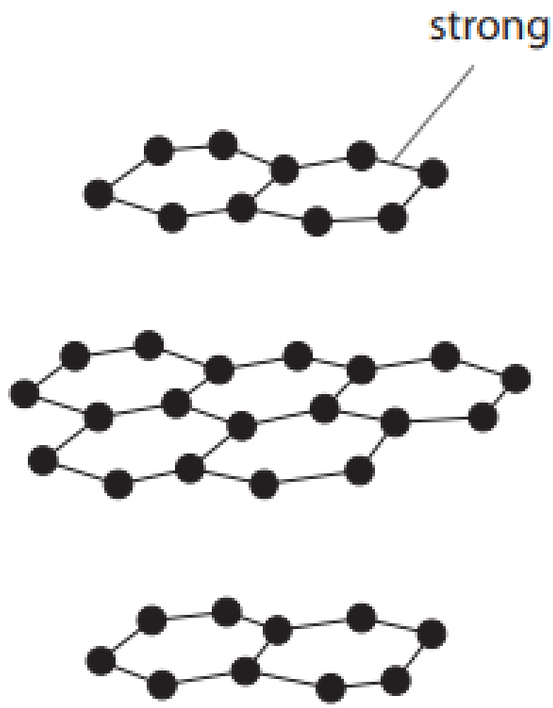
CC7 – Practise Question

The diagrams show the arrangements of carbon atoms in diamond and in graphite.

● = carbon atom



diamond



graphite

Compare a use of diamond with a use of graphite, explaining each use in terms of the bonding and structure. In your answer you should use information from the diagrams.

(6)

CC7 – Practise Question - Answer

QWC	**4(c)**	A response including some of the following points Note: (carbon to carbon) strong bonds is given in question Diamond: Uses and Properties • in cutting tools/engraving • drill bit • jewellery • diamond very hard/strong • attractive/lustrous • high melting point Explanations • giant molecular/covalent • each carbon atom bonded to four other carbon atoms • three dimensional structure • to break it lots of bonds would need to be broken • would need lot of energy/force Graphite: Uses and Properties • to make electrodes • a lubricant • sporting equipment • in pencils/drawing • graphite conducts electricity • soft Explanations • giant molecular/covalent • each carbon atom bonded to three other carbon atoms • each carbon atom has a free electron • delocalised electrons • (delocalised) electrons move to carry current • layers of carbon atoms • weak forces/bonds between layers/sheets • so layers/sheets can slide/rub off or over each other	**(6)**

CC8 – What should you know?

- Recall that acids in solution are sources of hydrogen ions and alkalis in solution are sources of hydroxide ions
- Recall that a neutral solution has a pH of 7 and that acidic solutions have lower pH values and alkaline solutions higher pH values
- Recall the effect of acids and alkalis on indicators, including litmus, methyl orange and phenolphthalein
- Recall that the higher the concentration of hydrogen ions in an acidic solution, the lower the pH; and the higher the concentration of hydroxide ions in an alkaline solution, the higher the pH
- Recall that as hydrogen ion concentration in a solution increases by a factor of 10, the pH of the solution decreases by 1
- Explain the terms dilute and concentrated, with respect to amount of substances in solution
- Explain the terms weak and strong acids, with respect to the degree of dissociation into ions
- Recall that a base is any substance that reacts with an acid to form a salt and water only
- Recall that alkalis are soluble bases
- Explain the general reactions of aqueous solutions of acids with: metals, metal oxides, metal hydroxides and metal carbonates to produce salts
- Describe the chemical test for: hydrogen and carbon dioxide (using limewater)
- Describe a neutralisation reaction as a reaction between an acid and a base
- Explain an acid-alkali neutralisation as a reaction in which hydrogen ions (H+) from the acid react with hydroxide ions (OH–) from the alkali to form water
- Explain how to prepare a soluble salt from an acid and an insoluble reactant
- Explain how to prepare a soluble salt from an acid and a soluble reactant
- Describe how to carry out an acid-alkali titration, using burette, pipette and a suitable indicator, to prepare a pure, dry salt
- Recall the general rules which describe the solubility of common types of substances in water
- Predict, using solubility rules, whether or not a precipitate will be formed when named solutions are mixed together, naming the precipitate if any
- Describe the method used to prepare a pure, dry sample of an insoluble salt

CC8 – Practise Question

(c) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Acids are neutralised by metal hydroxides to form

(1)

- ☒ **A** salt only
- ☒ **B** salt and hydrogen only
- ☒ **C** salt and oxygen only
- ☒ **D** salt and water only

(ii) Acids can also be neutralised by metal carbonates.

Dilute sulfuric acid is neutralised by copper carbonate as shown in the word equation.

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

Copper carbonate is a green powder.

Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

(2)

CC8 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	**D** salt and water only		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	A description to include two from • (green) solid {disappears / dissolves} (1) • effervesces / bubbles (of colourless gas) given off (1) • blue (solution) forms (1)	 ignore references to names of products fizz goes blue ignore incorrect colours of solution ignore temperature rise	**(2)**

CC9 – What should you know?

- Calculate relative formula mass given relative atomic masses and percentage by mass of an element in a compound given relative atomic masses
- Calculate the formulae of simple compounds from reacting masses or percentage composition and understand that these are empirical formulae
- Deduce: the empirical formula of a compound from the formula of its molecule and the molecular formula of a compound from its empirical formula and its relative molecular mass
- Describe an experiment to determine the empirical formula of a simple compound such as magnesium oxide
- Explain the law of conservation of mass applied to a closed system including a precipitation reaction in a closed flask and a non-enclosed system including a reaction in an open flask that takes in or gives out a gas
- Calculate masses of reactants and products from balanced equations, given the mass of one substance
- Calculate the concentration of solutions in g dm–3
- Recall that one mole of particles of a substance is defined as the Avogadro constant number of particles (6.02×10^{23} atoms, molecules, formulae or ions) of that substance
- Calculate the number of moles of particles of a substance in a given mass of that substance and vice versa
- Calculate the number of particles of a substance in a given number of moles of that substance and vice versa
- Calculate the number of particles of a substance in a given mass of that substance and vice versa
- Explain why, in a reaction, the mass of product formed is controlled by the mass of the reactant which is not in excess
- Deduce the stoichiometry of a reaction from the masses of the reactants and products

CC9 – Practise Question

(a) A compound of iron and chlorine was formed by reacting 2.80 g of iron with 3.55 g of chlorine.

Calculate the empirical formula of the compound.
(relative atomic masses: Cl = 35.5, Fe = 56.0)

(3)

empirical formula .....

(b) Sodium reacts with chlorine to form sodium chloride.

$$2Na + Cl_2 \rightarrow 2NaCl$$

Calculate the maximum mass of sodium chloride that could be formed by reacting 9.20 g of sodium with excess chlorine.
(relative atomic masses: Na = 23.0, Cl = 35.5)

(3)

CC9 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
3(a)	Fe Cl 2.8/56 3.55/35.5 (1) 0.05 0.1 or 1 2 (1) $FeCl_2$ (1)	Cl_2Fe $FeCl_2$ with no working (3) Consequential errors: if "upside down" ie 56 / 2.8 and 35.5 / 3.55 ratio 20 : 10 or 2 : 1 (1) empirical formula Fe_2Cl (1) allow 3 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula $FeCl_2$ allow 2 marks for 2.8 / 56 and 3.55 / 71 ratio 0.05: 0.05 or 1 : 1 empirical formula FeCl allow 2 marks for Fe Cl 2.8/56 3.55/35.5 (1) 0.5 0.1 (0) Fe_5Cl (1) - ECF	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(b)	**EITHER** 2x23 (1) g Na makes 2x58.5 (1) g NaCl 9.2 g Na makes $\frac{(2\times58.5)\times9.2}{46}$ g NaCl (1) (= 23.4 g) **OR** 23 g Na makes 58.5 (1) g NaCl 9.2 g Na makes $\frac{(58.5)\times9.2}{23}$ (1) g NaCl (1) (= 23.4 g) mark consequentially eg 46 (1) g Na makes (2x23+35.5) (0) g NaCl 9.2 g Na makes $\frac{(2\times23+35.5)\times9.2}{46}$ (1) g NaCl (= 16.3 g)	23.4 g with no working (3) 23.4 g from any method (3) do not accept 23(.0) mol Na used = 9.2/23 (1) (= 0.4) mol NaCl = 0.4 (1) mass NaCl = 0.4 x 58.5 (1) (= 23.4 g) Ignore units throughout unless incorrect mark consequentially awarding 2 marks for 46.8 g,11.7 g and 16.3 g (see last example opposite).	**(3)**

CC10 – What should you know?

- Recall that electrolytes are ionic compounds in the molten state or dissolved in water
- Describe electrolysis as a process in which electrical energy, from a direct current supply, decomposes electrolytes
- Explain the movement of ions during electrolysis, in which positively charged cations migrate to the negatively charged cathode and negatively charged anions migrate to the positively charged anode
- Explain the formation of the products in the electrolysis, using inert electrodes, of some electrolytes, including: copper chloride solution, sodium chloride solution, sodium sulfate solution, water acidified with sulfuric acid and molten lead bromide (demonstration)
- Predict the products of electrolysis of other binary, ionic compounds in the molten state
- Write half equations for reactions occurring at the anode and cathode in electrolysis
- Explain oxidation and reduction in terms of loss or gain of electrons
- Recall that reduction occurs at the cathode and that oxidation occurs at the anode in electrolysis reactions
- Explain the formation of the products in the electrolysis of copper sulfate solution, using copper electrodes, and how this electrolysis can be used to purify copper

CC10 – Practise Question

(a) The ions in sodium chloride solution are

sodium ions, Na^+
chloride ions, Cl^-
hydrogen ions, H^+
hydroxide ions, OH^-

Sodium chloride solution is electrolysed using a direct electric current.

(i) Which of these ions will be attracted to the cathode during the electrolysis of sodium chloride solution?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** H^+ ions only

☐ **B** H^+ and Na^+ ions

☐ **C** Cl^- ions only

☐ **D** Cl^- and OH^- ions

(ii) Chlorine is one of the products of the electrolysis.

The half-equation for the production of chlorine is

$$2Cl^- \rightarrow Cl_2 + 2e$$

Explain how the half-equation shows that chloride ions are oxidised.

(2)

(iii) Suggest why the solution remaining at the end of the electrolysis is alkaline.

(1)

CC10 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	B H^+ and Na^+ ions		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	An explanation linking • electron(s) (1) • (have been) lost/removed (1) conditional on electrons	ignore reference to number of electrons do not allow negative charge chlorine gains electrons (0) allow chlorine loses electrons (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	Any one from • it contains (excess) {hydroxide/OH^-} ions (1) • {sodium/Na^+} ions and {hydroxide/ OH^-} ions remain (1) • it is sodium hydroxide/NaOH (1) • {hydrogen/H^+} ions have been removed (at the cathode) (1)	ignore solution has pH greater than 7 allow no hydrogen ions left/acidic **ions** removed	**(1)**

CC11 – What should you know?

- Deduce the relative reactivity of some metals, by their reactions with water, acids and salt solutions
- Explain displacement reactions as redox reactions, in terms of gain or loss of electrons
- Explain the reactivity series of metals (potassium, sodium, calcium, magnesium, aluminium, (carbon), zinc, iron, (hydrogen), copper, silver, gold) in terms of the reactivity of the metals with water and dilute acids and that these reactions show the relative tendency of metal atoms to form cations
- Recall that most metals are extracted from ores found in the Earth's crust and unreactive metals are found in the Earth's crust as the uncombined elements
- Explain oxidation as the gain of oxygen and reduction as the loss of oxygen
- Recall that the extraction of metals involves reduction of ores
- Explain why the method used to extract a metal from its ore is related to its position in the reactivity series and the cost of the extraction process, illustrated by heating with carbon (including iron) and electrolysis (including aluminium)
- Evaluate alternative biological methods of metal extraction (bacterial and phytoextraction)
- Explain how a metal's relative resistance to oxidation is related to its position in the reactivity series
- Evaluate the advantages of recycling metals, including economic implications and how recycling can preserve both the environment and the supply of valuable raw materials
- Describe that a life-cycle assessment for a product involves consideration of the effect on the environment of obtaining the raw materials, manufacturing the product, using the product and disposing of the product when it is no longer useful
- Evaluate data from a life cycle assessment of a product

CC11 – Practise Question

(c) Part of the reactivity series is shown in Figure 8.

most reactive	magnesium
	aluminium
	iron
least reactive	silver

Figure 8

Iron is extracted from its ore by heating with carbon.
Aluminium is extracted from its ore using a different method.

(i) Give the name of the method used to extract aluminium.

(1)

.....

(ii) Explain why aluminium is extracted by a different method rather than heating the ore with carbon.

(2)

.....

.....

.....

.....

(d) The extraction of iron involves the reduction of iron oxide, Fe_2O_3, by carbon monoxide, CO. During this reaction, the iron oxide is reduced to iron, Fe, and the carbon monoxide is oxidised to carbon dioxide.

Write the balanced equation for the reaction.

(2)

CC11 – Practise Question - Answer

Question number	Answer	Mark
3(c)(i)	electrolysis (1)	(1)

Question number	Answer	Mark
3(c)(ii)	An answer that combines identification- knowledge (1 mark) and understanding (1 mark) and reasoning/justification- understanding (1 mark) • aluminium compounds are more stable than iron compounds (1) • so carbon is not a strong enough reducing agent to produce aluminium from its ore (1)	(2)

Question number	Answer	Mark
3(d)	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ • Correct formulae (1) • Balancing of correct formulae (1)	(2)

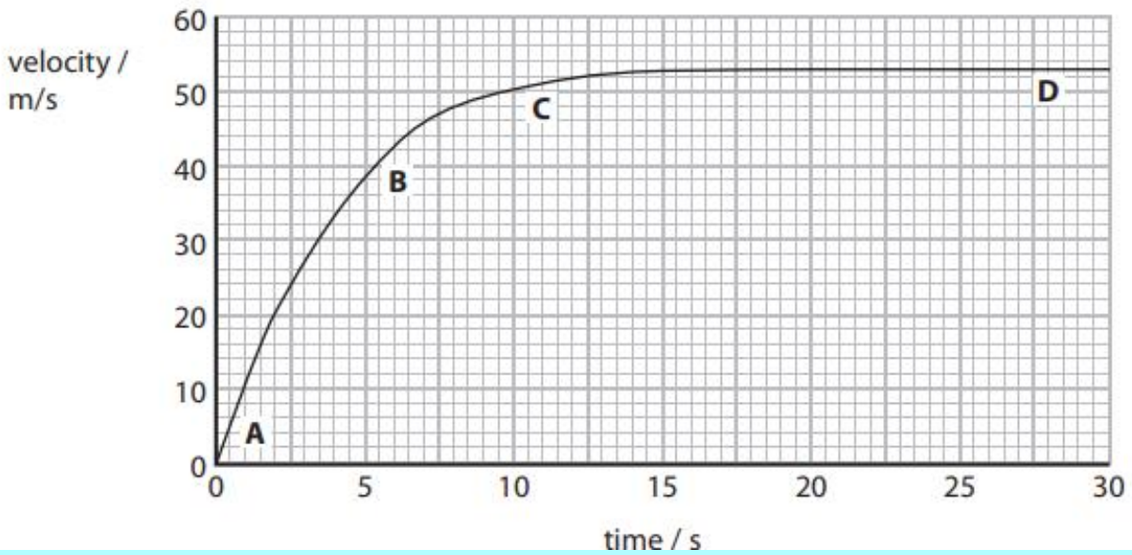
CP1 – What should you know?

- Explain that a scalar quantity has magnitude (size) but no specific direction
- Explain that a vector quantity has both magnitude (size) and a specific direction
- Explain the difference between vector and scalar quantities
- Recall vector and scalar quantities, including: displacement/distance, velocity/speed, acceleration, force, weight/mass, momentum, energy
- Recall that velocity is speed in a stated direction
- Recall and use the speed, distance, time equation
- Analyse distance/time graphs including determination of speed from the gradient
- Recall and use the equation: acceleration (metre per second squared, m/s2) = change in velocity (metre per second, m/s) ÷ time taken (second, s)
- Use the equation: (final velocity)2 ((metre/second)2, (m/s)2) – (initial velocity)2 ((metre/second)2, (m/s)2) = 2 × acceleration (metre per second squared, m/s2) × distance (metre, m)
- Analyse velocity/time graphs to: compare acceleration from gradients qualitatively, calculate the acceleration from the gradient (for uniform acceleration only) and determine the distance travelled using the area between the graph line and the time axis (for uniform acceleration only)
- Describe a range of laboratory methods for determining the speeds of objects such as the use of light gates
- Recall some typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems

CP1 – Practise Question

Christine is a free-fall parachutist.

This is a velocity–time graph for her jump.



Question:

1. The graph shows how Christine's velocity changes from the time she leaves the plane until she reaches terminal velocity. Explain, in terms of forces, why her velocity changes as shown in the graph.

CP1 – Practise Question - Answer

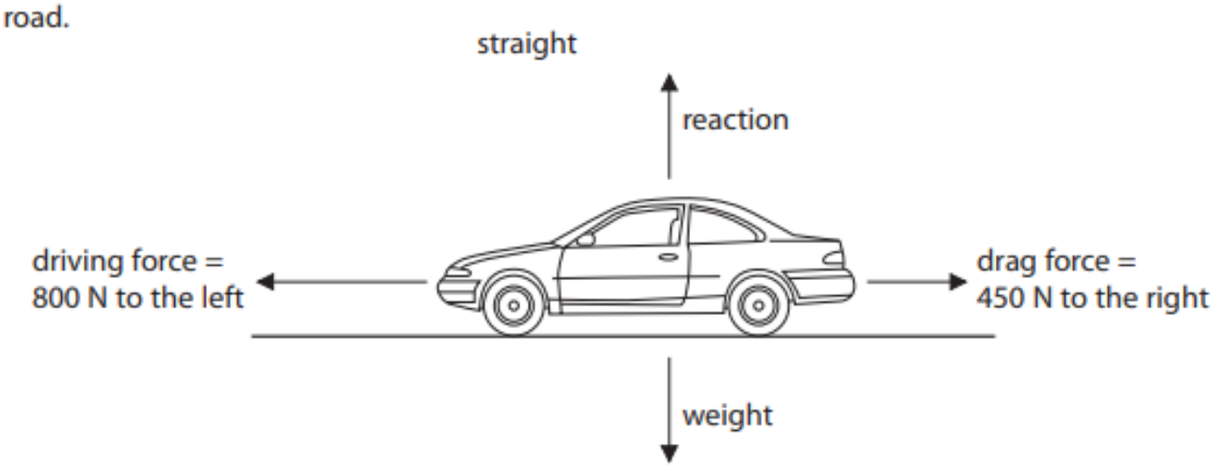
Question Number		Indicative Content	Mark
QWC	***5(d)**	An explanation linking some of the following **Forces acting** • weight down • air resistance up (opposing motion) **Forces during fall** • weight constant • air resistance increases • with speed • resultant force = W – R **Effect on shape of graph** • at start, resultant force is large so acceleration large / gradient steep • mid resultant force decreasing so acceleration decreasing / gradient decreasing • terminal velocity, resultant force is zero so acceleration zero / gradient zero	**(6)**
Level	**0**	No rewardable content	
1	**1 -2**	• a limited explanation linking a few facts from the indicative content. E.g. at terminal velocity, forces are equal so constant speed. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 -4**	• a simple explanation linking some of the indicative content to the shape of the graph e.g At the start weight > air resistance so acceleration and at the end weight = air resistance so no acceleration. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 -6**	• a detailed explanation linking most of the indicative content to the complete shape of the graph e.g. At the start weight > air resistance so acceleration. Then air resistance increases (with speed) so acceleration decreases. At the end weight = air resistance so no acceleration. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

CP2 – What should you know?

- Recall Newton's first law and use it in the following situations: where the resultant force on a body is zero, (i.e. the body is moving at a constant velocity or is at rest) and where the resultant force is not zero, (i.e. the speed and/or direction of the body changes)
- Recall and use Newton's second law as: force (newton, N) = mass (kilogram, kg) × acceleration (metre per second squared, m/s2)
- Define weight, recall and use the equation: weight (newton, N) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg)
- Describe how weight is measured
- Describe the relationship between the weight of a body and the gravitational field strength
- Recall that the acceleration, g, in free fall is 10 m/s2 and be able to estimate the magnitudes of everyday accelerations
- Explain that an object moving in a circular orbit at constant speed has a changing velocity (qualitative only)
- Explain that for motion in a circle there must be a resultant force known as a centripetal force that acts towards the centre of the circle
- Explain that inertial mass is a measure of how difficult it is to change the velocity of an object (including from rest) and know that it is defined as the ratio of force over acceleration
- Recall and apply Newton's third law both to equilibrium situations and to collision interactions and relate it to the conservation of momentum in collisions
- Define momentum, recall and use the equation: momentum (kilogram metre per second, kg m/s) = mass (kilogram, kg) × velocity (metre per second, m/s)
- Describe examples of momentum in collisions
- Use Newton's second law as: force (newton, N) = change in momentum (kilogram metre per second, kg m/s) ÷ time (second, s)
- Explain methods of measuring human reaction times and recall typical results
- Recall that the stopping distance of a vehicle is made up of the sum of the thinking distance and the braking distance
- Explain factors that affect the stopping distance of a vehicle
- Describe the factors affecting a driver's reaction time including drugs and distractions
- Explain the dangers caused by large decelerations and estimate the forces involved in typical situations on a public road

CP2 – Practise Question

2 The diagram shows the forces acting on a car which is travelling along a flat road.



(a) (i) The size of the resultant force on the car is 350 N.

In which direction is the resultant force acting?

Put a cross (☒) in the box next to your answer.

(1)

- ☐ **A** down ↓
- ☐ **B** to the left ←
- ☐ **C** to the right →
- ☐ **D** up ↑

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The car is

(1)

- ☐ **A** accelerating
- ☐ **B** decelerating
- ☐ **C** moving at a constant speed
- ☐ **D** not moving

(a) A car accelerates at a constant rate of 1.83 m/s^2 along a flat straight road.

The force acting on the car is 1.870 kN.

Calculate the mass of the car.

Give your answer to three significant figures.

(3)

mass = ... kg

(b) The car accelerates from rest for 16 s.

Calculate the speed of the car after 16 s.

(3)

speed = ... m/s

CP2 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	B to the left ←		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	A accelerating		**(1)**

Question number	Answer	Additional guidance	Mark
4(a)	Rearrangement (1) $m = \frac{f}{a}$ Substitution and conversion (1) $m = \frac{1870}{1.83}$ Answer and rounding to 3 s.f. (1) 1020 (kg)	maximum 2 marks if kN not converted to N award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Additional guidance	Mark
4(b)	Rearrangement of $\frac{(v-u)}{t} = a$ (1) $v = u + at$ Substitution (1) $v = 0 + 1.83 \times 16$ Answer (1) 29.3 (m/s)	award full marks for correct numerical answer without working	**(3)**

CP3 – What should you know?

- Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m)
- Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy (joule, J) = 2 1 × mass (kilogram, kg) × (speed)2
- Draw and interpret diagrams to represent energy transfers
- Explain what is meant by conservation of energy
- Analyse the changes involved in the way energy is stored when a system changes, including: an object projected upwards or up a slope, a moving object hitting an obstacle, an object being accelerated by a constant force, a vehicle slowing down, bringing water to a boil in an electric kettle
- Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system
- Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings
- Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways
- Explain ways of reducing unwanted energy transfer including through lubrication, thermal insulation
- Describe the effects of the thickness and thermal conductivity of the walls of a building on its rate of cooling qualitatively
- Recall and use the efficiency equation
- Explain how efficiency can be increased
- Describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydroelectricity, the tides and the Sun), and compare the ways in which both renewable and non-renewable sources are used
- Explain patterns and trends in the use of energy resources

CP3 – Practise Question

(b) This photograph shows a fan.

The blades of the fan are turned by an electric motor.

In one second, the motor gets 200 J of electrical energy from the mains supply.
Only 180 J of this energy is used to turn the blades of the fan.
The rest of the energy is wasted.

(i) Calculate how much of the 200 J of energy is wasted.

(1)

wasted energy = ... J

(ii) State what happens to the wasted energy.

(1)

.....

.....

(iii) Calculate the efficiency of the motor.

(2)

efficiency = ...

CP3 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	20 (J)	200 – 180 (even if calculated value from this is incorrect)	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	(changed to) {thermal energy / heat}	dissipated (lost) to {surroundings / motor / air / atmosphere} sound / noise **reject** if kinetic, light or chemical is mentioned	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)(iii)	$\frac{180}{200} \times 100$ (1) 90 (%) (1)	award full marks for correct answer with no working $\frac{180}{200}$ 0.9, 9/10 Or [100 – (20/200)] % not needed but if a unit is given then maximum score is 1	**(2)**

CP4 – What should you know?

- Recall that waves transfer energy and information without transferring matter
- Describe evidence that with water and sound waves it is the wave and not the water or air itself that travels
- Define and use the terms frequency and wavelength as applied to waves
- Use the terms amplitude, period, wave velocity and wavefront as applied to waves
- Describe the difference between longitudinal and transverse waves by referring to sound, electromagnetic, seismic and water waves
- Recall and use both the equations below for all waves: wave speed (metre/second, m/s) = frequency (hertz, Hz) × wavelength (metre, m) and wave speed (metre/second, m/s) = distance (metre, m) ÷ time (second, s)
- Describe how to measure the velocity of sound in air and ripples on water surfaces
- Explain how waves will be refracted at a boundary in terms of the change of direction and speed
- Recall that different substances may absorb, transmit, refract or reflect waves in ways that vary with wavelength

CP4 – Practise Question

(a) A man uses a dog whistle to call his dog.
The whistle uses ultrasound.

(i) The dog can hear the whistle but the man cannot.
Explain why the dog can hear the whistle but the man cannot hear the whistle.

(2)

.....

.....

.....

.....

(ii) The dog is 140 m away from the man.
The ultrasound takes 0.42 s to travel from the man to the dog.
Calculate the speed of ultrasound.
State the unit.

(3)

speed of ultrasound = ... unit = ...

CP4 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
4(a)(i)	an explanation linking: • frequency / Hz (1) • above 20 000 (1)	Pitch too high to be heard by the man "it is above 20kHz" 2 marks "The frequency is too loud" gets 1st mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(a)(ii)	substitution: (1) 140/0.42 evaluation: (1) 330 m/s (1)	award full marks for correct answer with no working allow 333(.333) independent mark allow ms^{-1}	**(3)**

CP5 – What should you know?

- Recall that all electromagnetic waves are transverse, that they travel at the same speed in a vacuum
- Explain, with examples, that all electromagnetic waves transfer energy from source to observer
- Recall the main groupings of the continuous electromagnetic spectrum including (in order) radio waves, microwaves, infrared, visible (including the colours of the visible spectrum), ultraviolet, x-rays and gamma rays
- Describe the electromagnetic spectrum as continuous from radio waves to gamma rays and that the radiations within it can be grouped in order of decreasing wavelength and increasing frequency
- Recall that our eyes can only detect a limited range of frequencies of electromagnetic radiation
- Recall that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength
- Explain the effects of differences in the velocities of electromagnetic waves in different substances
- Recall that the potential danger associated with an electromagnetic wave increases with increasing frequency
- Describe the harmful effects on people of excessive exposure to electromagnetic radiation, including: a microwaves: internal heating of body cells, infrared: skin burns, ultraviolet: damage to surface cells and eyes, leading to skin cancer and eye conditions, x-rays and gamma rays: mutation or damage to cells in the body
- Describe some uses of electromagnetic radiation
- Recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits
- Recall that changes in atoms and nuclei can generate radiations over a wide frequency range and can be caused by absorption of a range of radiations

CP5 – Practise Question

2 (a) The table shows most of the waves in the electromagnetic spectrum.
One type of wave is missing.

gamma rays
.....
ultraviolet
visible light
infrared
microwaves
radio waves

(i) Write the missing wave in the space in the table.

(1)

(ii) State which type of wave can be split into different colours.

(1)

.....

(iii) State which type of wave has the longest wavelength.

(1)

.....

(iv) State **one** type of wave that is ionising.

(1)

.....

CP5 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	X-ray	X	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	(visible) light	visible (waves)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iii)	radio (waves)		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(iv)	gamma / X-rays / ultraviolet	X / UV	**(1)**

CP6 – What should you know?

- Describe an atom as a positively charged nucleus, consisting of protons and neutrons, surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus
- Describe the structure of nuclei of isotopes using the terms atomic (proton) number and mass (nucleon) number
- Recall that the nucleus of each element has a characteristic positive charge, but that isotopes of an element differ in mass by having different numbers of neutrons
- Recall the relative masses and relative electric charges of protons, neutrons, electrons and positrons
- Recall that in an atom the number of protons equals the number of electrons and is therefore neutral
- Recall that in each atom its electrons orbit the nucleus at different set distances from the nucleus
- Explain that electrons change orbit when there is absorption or emission of electromagnetic radiation
- Explain how atoms may form positive ions by losing outer electrons
- Recall that alpha, β– (beta minus), β+ (positron), gamma rays and neutron radiation are emitted from unstable nuclei in a random process and that alpha, β– (beta minus), β+ (positron) and gamma rays are ionising radiations
- Explain what is meant by background radiation and its origins from Earth and space
- Describe methods for measuring and detecting radioactivity limited to photographic film and a Geiger–Müller tube
- Recall that an alpha particle is equivalent to a helium nucleus, a beta particle is an electron emitted from the nucleus and a gamma ray is electromagnetic radiation and compare alpha, beta and gamma radiations in terms of their abilities to penetrate and ionise
- Describe how and why the atomic model has changed over time including reference to the plum pudding model and Rutherford alpha particle scattering leading to the Bohr model
- Describe the process of β– decay (a neutron becomes a proton plus an electron)
- Describe the process of β+ decay (a proton becomes a neutron plus a positron)
- Explain the effects on the atomic (proton) number and mass (nucleon) number of radioactive decays (α, β, γ and neutron emission)
- Recall that nuclei that have undergone radioactive decay often undergo nuclear rearrangement with a loss of energy as gamma radiation
- Use given data to balance nuclear equations in terms of mass and charge
- Describe how the activity of a radioactive source decreases over a period of time using the unit of activity the Becquerel, Bq
- Explain that the half-life of a radioactive isotope is the time taken for half the undecayed nuclei to decay or the activity of a source to decay by half
- Explain that it cannot be predicted when a particular nucleus will decay but half-life enables the activity of a very large number of nuclei to be predicted during the decay process
- Use the concept of half-life to carry out simple calculations on the decay of a radioactive isotope, including graphical representations
- Describe the dangers of ionising radiation and explain the precautions taken to ensure the safety of people exposed to radiation
- Describe the differences between contamination and irradiation effects and compare the hazards associated with these two

CP6 – Practise Question

Hospitals use ionising radiation for many purposes.

(a) State **one** use of ionising radiation in a hospital.

(1)

(b) An isotope of technicium, technicium-99, has a half-life of 6 hours.

A hospital has a sample which contains 40 mg of technicium-99.

Calculate how much technicium-99 will be in this sample after 12 hours.

(2)

amount remaining = _____ mg

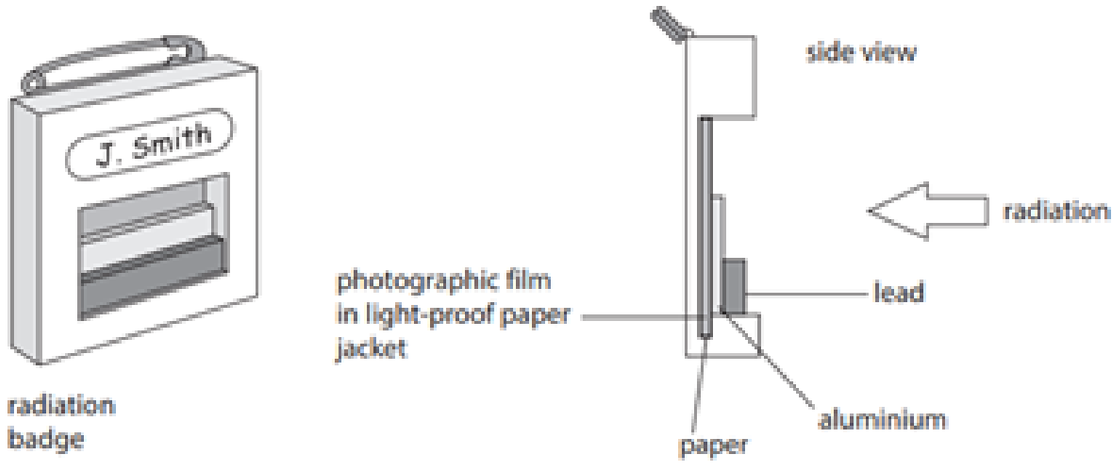
(c) Every hospital radiographer who works with radiation wears a radiation badge.

The badge is used to monitor the amount of radiation the radiographer absorbs each month.

(i) Explain why it is important to monitor the amount of radiation a radiographer absorbs each month.

(2)

*(iii) The radiation badge contains a photographic film which is sensitive to radiation.



The radiation badge is sent to a laboratory after a month and the film is checked.

Explain how the badge shows the amount of different types of radiation that the radiographer has been exposed to.

(6)

CP6 – Practise Question - Answer

Question Number	Answer	Acceptable answers	Mark
1(a)	Any one of Treatment of cancer / radiotherapy Imaging e.g.: looking at broken bones, tracers sterilizing (equipment/dressings) (1)	NOT ultrasound applications/ chemotherapy accept(to) cure/kill/detect cancer (cells) accept X-ray(s)/X-ray machine accept PET/CT scans ignore MRI scans accept (to) kill bacteria ignore medical treatment and similar vague statements	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	12 hours = 2 half lives (1) 10 (mg) (1)	idea of halving seen e.g. 40 ÷ 2 or 20 (mg) ignore 80 (mg) and 99 ÷ 2 OR idea of 2 half lives seen or 40/4 OR (6 is 1 half-life and)12 is 2 (half-lives) OR 1/4 Give full marks for correct answer with no working.	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	An explanation to include two from: Radiation is ionising (1) Radiation can cause specified damage e.g. cancer or damage/mutate DNA (1) if dose/exposure is too high (1)	 (causes) ionisation/ (can) ionise/ mutate cells/tissue ignore radiation poisoning/death/make you ill ignore {damage/kill} cells/tissue if absorb(ing) too much (radiation) or so you don't absorb too much (radiation) Accept for both marks: Too much radiation can cause cancer (after a while)	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	☒ **C** we have a better understanding of the risks from radiation (1)		**(1)**

Question Number		Indicative Content	Mark
QWC	***1(c)(iii)**	An explanation including some of the following points • identification of alpha, beta, gamma as possible types of radiation • identification of X-rays as possible type of radiation • film is dark(er)/changes colour where radiation is absorbed • different areas of the film are exposed to different types of radiation • gamma (or X-rays) affect all areas of film • beta absorbed/stopped by aluminium/passes through paper • beta only reaches (top) part of film • alpha unlikely to be detected at all • the lead will stop (some of) gamma or (some) gamma will pass through lead/aluminium/paper • the paper will stop/absorb alpha throughout the question accept symbols for types of radiation	**(6)**

Level		
Level	**0**	No rewardable content
1	**1 - 2**	• a limited explanation which gives one relevant fact about types of radiation or the film badge e.g. types of radiation are alpha, beta and gamma OR beta absorbed by aluminium OR the radiation affects the film OR gamma can pass through lead • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• A simple explanation, giving more than one relevant fact about types of radiation OR the film badge OR at least one fact about both. e.g. The 3 types of radiation are alpha, beta and gamma. Gamma can pass through lead. OR The 3 types of radiation are alpha, beta and gamma. Radiation makes the film change colour. OR beta will get through the paper but alpha will be stopped (by paper). OR Radiation makes the film change colour. The lab. will compare how much got through the paper, aluminium and lead • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• a detailed explanation giving more than two relevant points about the film badge OR at least one fact about the types of radiation AND more than one about the film badge e.g. Beta will get through the paper but alpha will be stopped (by paper).Gamma can penetrate the aluminium. OR The film detects radiation. The aluminium will stop beta but, not gamma. OR The 3 types of radiation are alpha, beta and gamma. Beta will get through the paper but alpha will be stopped (by paper). • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

CP7 & 8 – What should you know?

- Describe the changes involved in the way energy is stored when systems change
- Draw and interpret diagrams to represent energy transfers
- Explain that where there are energy transfers in a closed system there is no net change to the total energy in that system
- Identify the different ways that the energy of a system can be changed through work done by forces, in electrical equipment and in heating
- Describe how to measure the work done by a force and understand that energy transferred (joule, J) is equal to work done (joule, J)
- Recall and use the equation: work done (joule, J) = force (newton, N) × distance moved in the direction of the force (metre, m)
- Describe and calculate the changes in energy involved when a system is changed by work done by forces
- Recall and use the equation to calculate the change in gravitational PE when an object is raised above the ground: change in gravitational potential energy (joule, J) = mass (kilogram, kg) × gravitational field strength (newton per kilogram, N/kg) × change in vertical height (metre, m)
- Recall and use the equation to calculate the amounts of energy associated with a moving object: kinetic energy (joule, J) = 2 1 × mass (kilogram, kg) × (speed)2
- Explain, using examples, how in all system changes energy is dissipated so that it is stored in less useful ways
- Explain that mechanical processes become wasteful when they cause a rise in temperature so dissipating energy in heating the surroundings
- Define power as the rate at which energy is transferred and use examples to explain this definition
- Recall and use the equation: power (watt, W) = work done (joule, J) ÷ time taken (second, s)
- Recall that one watt is equal to one joule per second, J/s
- Recall and use the efficiency equation
- Describe, with examples, how objects can interact at a distance without contact, linking these to the gravitational, electrostatic and magnetic fields involved
- Describe, with examples, how objects can interact by contact, including normal contact force and friction
- Produce pairs of forces which can be represented as vectors
- Explain the difference between vector and scalar quantities using examples
- Use vector diagrams to illustrate resolution of forces, a net force, and equilibrium situations (scale drawings only)
- Draw and use free body force diagrams
- Explain the resultant force when many forces act on an object

CP7 & 8 – Practise Question

A man pulls a suitcase with a horizontal force, *F*, as shown in Figure 10.

Two other forces acting on the suitcase are labelled *P* and *Q*.

Not to scale

Figure 10

(a) (i) Which of these gives the correct names for the forces *P* and *Q*?

(1)

	name of	
	force *P*	**force *Q***
☐ **A**	upthrust	reaction
☐ **B**	reaction	friction
☐ **C**	reaction	reaction
☐ **D**	friction	upthrust

(ii) Draw an arrow on the diagram to represent the weight of the suitcase.

(1)

(b) The man pulls the suitcase for 80 m along a horizontal path.

The mass of the man and the suitcase is 85 kg.

The man does 1200 J of work on the suitcase as he pulls the suitcase along.

He walks with an average velocity of 1.5 m/s.

(i) Calculate the kinetic energy of the man and the suitcase.

(2)

kinetic energy = ... J

(ii) Calculate the horizontal force, *F*, that the man exerts on the suitcase.

Use the equation:

work done = force × distance moved in the direction of the force

(2)

force = ... N

CP7 & 8 – Practise Question - Answer

Question number	Answer	Mark
3(a)(i)	B	(1)

Question number	Answer	Mark
3(a)(ii)	vertical arrow, acting downward through the suitcase	(1)

Question number	Answer	Additional guidance	Mark
3(b)(i)	substitution (1) $(KE =) \frac{1}{2} \times 85 \times 1.5^2$ answer (1) 96 (J)	award full marks for correct numerical answer without working allow 95.625 (J)	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	substitution (1) $(KE =) \frac{1}{2} \times 85 \times 1.5^2$ answer (1) 96 (J)	award full marks for correct numerical answer without working allow 95.625 (J)	(2)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	rearrange (1) force = work done ÷ distance answer (1) (force) = 15 (N)	accept rearrangement with values subst., i.e. (force) = 1200 ÷ 80 award full marks for correct numerical answer without working	(2)