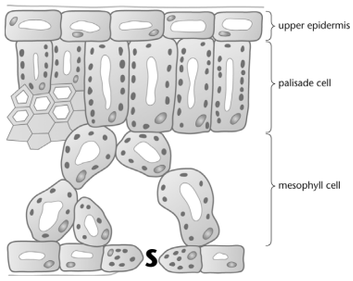
B4 answers

Remember: Check which grade you are working at.

Page 85 Who planted that there?

1 a *(See diagram)*



b *(See diagram)*

2 Diffusion

3 a Thin so gases/light do not have far to travel; chlorophyll to absorb light; network veins for support/transport; stomata for gas exchange

(Any 3 = 1 mark each)

b i Full of chloroplasts; to absorb a lot of light energy

ii Small and irregular; so they have a large surface area to volume ratio; for increased gas exchange

(Any 2 = 1 mark each)

Page 86 Water, water everywhere

1 a Higher concentration water inside potato; water moved out

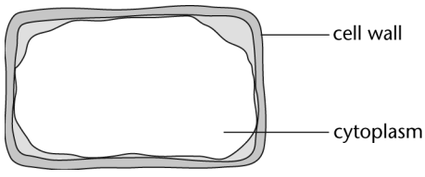
b Take on water; and burst (lysis)

c i Higher concentration of water outside cell; water moves into cell; increase in water pressure against cell wall; turgor pressure causes cell to be turgid

(Any two = 1 mark each)

ii Cell drawn with cytoplasm shrinking away from wall

iii Plasmolysed



2 a Photosynthesis; cooling; support *(Any 2 = 1 mark each)*

b Photosynthesis stops in dark; less sugar produced; water concentration in guard cell increases; water moves out by osmosis

(Any 3 = 1 mark each)

Page 87 Transport in plants

1 a A: phloem; B: xylem

b Transport water/minerals; from root to leaves; support plant *(Any 2 = 1 mark each)*

c Contains lignin; for strength/cells die to make tubes; to carry water through

2 a Any value below 7.4 g

b i Lowers rate

ii Increases humidity; which reduces evaporation

B4 answers

Page 88 Plants need minerals too

1 a

mineral	why the mineral is needed	how the mineral is used
phosphate	respiration or growth	used to make cell membranes or DNA
potassium	respiration or photosynthesis	make enzymes
magnesium	photosynthesis	make chlorophyll

b **i** Phosphate: poor root growth; discoloured leaves
ii Potassium: poor flower or fruit growth; discoloured leaves
iii Magnesium: yellow leaves

2 a **i** 0.0825
ii 0.01/0.0125

b Because there is a greater concentration in the cells; compared to the pond water

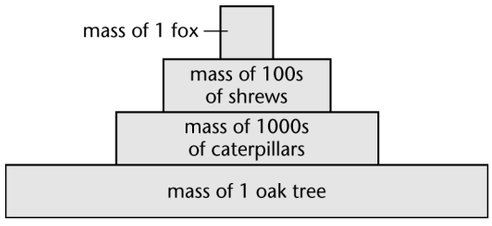
c Active transport

d Provide energy; needed for active transport

Page 89 Energy flow

1 a Numbers of organisms at each stage of food chain

b



c Heat from respiration/egestion of waste/movement

2 a Use seeds for next year; use as biofuel

b **i** 3090 – 1909 – 1022 = 159 kJ
ii $\frac{159}{3090} \times 100 = 5.1\%$

c More energy efficient

3 a Yeast is used to ferment the sugar; to produce alcohol; alcohol is mixed with petrol

(Any 2 = 1 mark each)

b Advantage: renewable energy source/cause less pollution/help countries become self reliant; disadvantage: can produce sulphur dioxide

B4 answers

Page 90 Farming

1 a DDT gets into plankton; passed along food chain; does not breakdown; builds up to toxic levels in seals

(Any 3 = 1 mark each)

b Less heat loss; less energy loss from movement

2 a By hydroponics; roots grow in water containing correct nutrients

b Advantage: control mineral supply/conditions/disease so lower cost; disadvantage: manufactured fertiliser cost/tall plants need support

3 a Use of animals manure/compost; nitrogen fixing crops; seeding; growing seeds at different times

(Any 2 = 1 mark each)

b Cannot grow enough crops

c **i** Biological control
ii No predators so population keeps increasing

Page 91 Decay

1 a **i** 6.2 – 5.8 = 0.4
ii Microorganisms had been killed

b Breaks up remains; increasing surface area

c **i** Bag C 40 °C
ii Optimum temperature; for enzymes involved

d Release enzymes onto food; enzymes digest food; fungi absorb digested food

(Any 2 = 1 mark each)

2 Kills bacteria/fungi by removing water

Page 92 Recycling

1 a i: burning; ii: respiration; iii: photosynthesis

b Photosynthesis

c Carry out respiration; when they break down the dead plant and animal material

d Turn into limestone; limestone weathered by acid rain; chemical reaction produces carbon dioxide

2 a To make proteins for growth

b Break down dead plants and animals; turning nitrogen compounds into nitrates

c Unreactive

d Nitrogen fixing bacteria; lightning

e Denitrifying

C4 answers

Remember: Check which grade you are working at.

Page 94 Acids and bases

1 a i An alkali is a base which dissolves in water

ii Acid; water

b Copper carbonate + sulphuric acid ⟶ copper sulphate + water + carbon dioxide

c The salt formed is sodium nitrate

d i NaCl

ii $2HCl + CaCO_3 \longrightarrow CaCl_2 + H_2O + CO_2$

2 a Hydrogen ions, H^+

b Hydroxide ions OH^-

c Water H_2O

3 a The pH at the start is low as alkali is added the pH increases

b The colour starts as purple. The pH falls as the acid neutralises the alkali; colour changes to blue; when neutral, the pH = 7; Colour is green

Page 95 Reacting masses

1 a 23 + 16 + 1 = 40

b 40 + 12 + (16 x 3) = 100

c 40 + 2 (16 + 1) = 40 + (2 x 17) = 74

d When chemicals react, the atoms of the reactants 'swap' places to make new compounds – the products; these products are made from just the same atoms as before; there is the same number of atoms at the end as there were at the start, so the overall mass stays the same

2 a i 28

ii 42

iii Actual yield x 100 = percentage yield

iv $\frac{28 \times 100}{42} = 66\%$

b i $ZnCO_3 \longrightarrow ZnO + CO_2$

ii Relative formula mass of $ZnCO_3$ is 65 + 12 + 16 + 16 + 16 = 125;
relative formula mass of CO_2 is 12 + 16 + 16 = 44;
so if 125 g $ZnCO_3$ gives 44 g CO_2;
then 12.5 g $ZnCO_3$ gives $\frac{12.5}{125} \times 44$
= 4.4 g CO_2

C4 answers

Page 96 Fertilisers and crop yield

1 a To increase their crop yields

b They are dissolved in water so they can be absorbed by plants through their roots

c It is needed to make plant protein for growth.

2 a $(NH_4)_2SO_4$
Mr = 2(14 + 4) + 32 + (16 x 4) = 132

b The relative formula mass of KNO_3 is 39 + 14 + (16 x 3) = 101;
mass of nitrogen = 14;
the percentage that is nitrogen is $\frac{14}{101}$ x 100 = 13.8%

3 a Water

b **i** Phosphoric acid
ii Ammonium hydroxide
iii Phosphoric acid + ammonium hydroxide ⟶ ammonium phosphate + water

c Phosphoric acid is reacted with ammonium hydroxide; the amounts used in the reaction must be exactly right, so a titration is carried out; titrate the alkali with the acid, using an indicator; repeat the titration until three consistent results are obtained; this is a neutral solution of potassium nitrate fertiliser, but it is contaminated with indicator; use the titration result to add the correct amounts of acid and alkali together without the indicator; the fertiliser made is dissolved in water, so most of the water is evaporated off using a hot water bath; leave the remaining solution to crystallise, then filter off the crystals

4 Eutrophication is caused by fertiliser run off increasing the amount of algae; this algal bloom prevents sunlight from reaching the plants below the water; anaerobic bacteria use up the oxygen in the water so fish die

Page 97 The Haber process

1 a Nitrogen is obtained from the air; hydrogen comes from natural gas; the gases are passed over an iron catalyst; under high pressure; an optimum temperature of 450 °C is chosen; there is a recycling system for unreacted nitrogen and hydrogen *(Any 3)*

b **i** A higher pressure increases the percentage yield but high pressures costs more
ii The high temperature decreases the percentage yield; however, higher temperatures make the reaction go faster
iii 450 °C is an optimum temperature; the yield is not as good, but that yield is made faster, so a satisfactory amount is produced in the right time

3 a 400 atmospheres

b Increases

c Decreases

d High temperature means higher rates but lower yields so it runs at the optimum temperature of 450 °C; this temperature means higher energy costs and also lower yields, but the increase in rate compensates; the plant produces more ammonia in a day at this temperature than it would at lower temperatures; total energy costs are not only due to heating costs; the plant needs compressors and pumps to achieve a high pressure; high pressure costs more so a lower, optimum pressure is used; although the reaction has a low percentage yield, the unreacted chemicals are recycled, and can go back into the reaction vessel, saving costs

(Any 3)

C4 answers

Page 98 Detergents

1 a Organic acid + alkali ⟶ detergent (salt) + water

b It is suitable for cleaning uses because; it dissolves grease stains; it dissolves in water at the same time *(Any 2)*

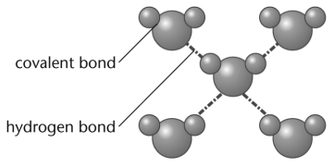
c i It is better to wash clothes at 40 °C instead of at high temperatures because washing machines have to heat up a lot of water; this needs energy; the lower the temperature of the water the less energy is used and less greenhouse gases are put into the atmosphere

ii As many dyes are easily damaged by high temperatures; it also means that many more fabrics can be machine washed as their structure would be damaged at higher temperatures

d The hydrophobic part of the molecule goes into the grease; 'hydrophobic' means water-fearing; the molecule forms bonds with the oil or grease; the hydrophilic part of the molecule forms bonds with the water; 'hydrophilic' means water-loving; the molecule forms bonds with the water and 'pulls' the grease off the fabric/dish into the water; the grease is pulled off the surface by the hydrophilic part forming bonds with water and lifting it away

2 a Intermolecular forces

b



Page 99 Batch or continuous?

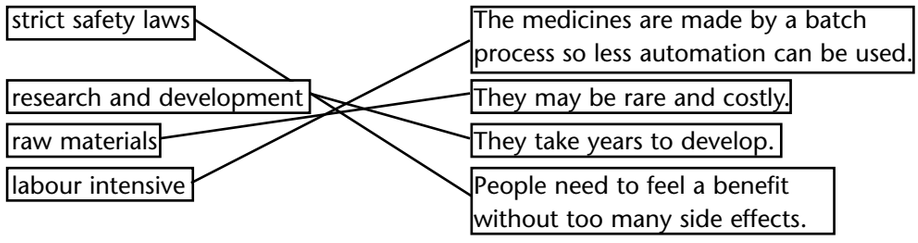
1 a New batches are made when the stored medicine runs low; if a lot of one medicine is needed, several batches can be made at the same time; once they have made a batch of one drug it is easy to switch to making a different drug *(Any 1)*

b The process keeps going all the time so can be automated more easily

c Because it works at full capacity all the time it costs an enormous amount to build, but once running, it makes a large amount of product; employs very few people; making the cost per tonne very small

d They are flexible; it is easy to change from making one compound to another

2

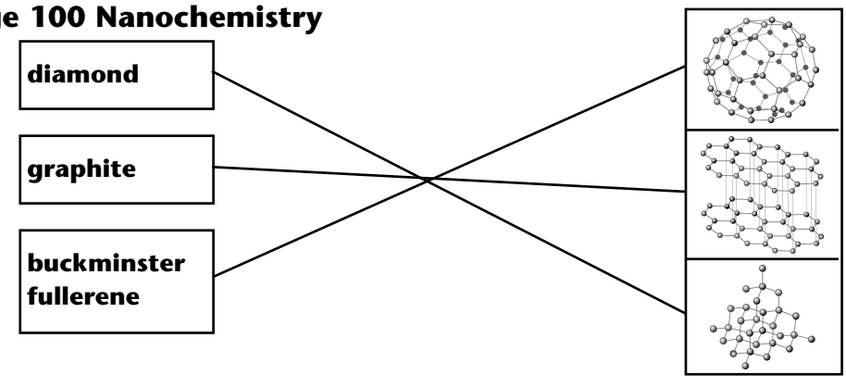


3 There has to be an anticipated demand for the drug and a potential market for it; there will be huge research and development costs as the time taken is often up to ten years; it is a very expensive process as labour costs are high; promising compounds often have dangerous side-effects so lots of similar compounds have to be made to find the best one with the fewest side-effects; tests can be made on as many as 10,000 compounds to find one effective drug; a new drug must be trial tested for safety, eventually using human trials and then submitted for approval; only then can it start earning money; the company patents the drug, so for the next 20 years or so they can sell it for a high price; the drugs company has to recoup all its development costs in that time as they have to cover the initial investment over the pay-back period; after that other companies can make their own version of the drug; these are called generic drugs *(Any 6)*

C4 answers

Page 100 Nanochemistry

1 a



b

	diamond	graphite
use	cutting tools/ jewellery	pencil lead
reason	very hard/lustrous and colourless	conducts electricity/ high melting point

c

diamond	graphite
Does not conduct electricity because it has no free electrons	Slippery because layers of carbon atoms are weakly held together and can slide easily over each other

2 a Allotropes

b In diamond, each atom is held by covalent bonds to four other atoms, tetrahedrally, which are bonded further in different directions; this is called a giant structure; so many strong covalent bonds make the diamond hard; the bonding results in no free electrons, so it does not conduct electricity

3 a Semi-conductors in electrical circuits; industrial catalysts; reinforcement of graphite in tennis rackets *(Any 2)*

b There is a very large surface area available

C4 answers

Page 101 How pure is our water?

1 a Sedimentation; filtration; chlorination

b Sedimentation: chemicals are added to make solid particles/bacteria settle out/larger bits drop to the bottom; filtration: a layer of sand on gravel filters out the remaining fine particles; some types of sand filter also remove microbes; chlorination: chlorine is added to kill microbes

c **i** Distillation is used to remove the dissolved substances

ii Distillation uses huge amounts of energy and is very expensive; it is only used when there is no fresh water

2 a Clean water saves more lives than medicines; that is why, after disasters and in developing countries, relief organisations concentrate on providing clean water supplies

b All water is recycled around the planet; if there is not enough rain in the winter, reservoirs do not fill up properly for the rest of the year

3 a Lead nitrate + potassium chloride $\longrightarrow$ lead chloride + potassium nitrate

b Silver nitrate + potassium bromide $\longrightarrow$ silver bromide + potassium nitrate

c $AgNO_{3(aq)} + KBr_{(aq)} \longrightarrow AgBr(s) + NaNO_{3(aq)}$

P4 answers

Remember: Check which grade you are working at.

Page 103 Sparks!

1 a i So that charge cannot pass through her
ii So that she does not get an electric shock
iii Sally becomes charged
iv All her hairs gain the same charge; like charges repel; so the hairs move away from each other

b Each ball has the same charge; like charges repel

c Electrons in uncharged ball are repelled from the negatively charged ball; this leaves the side of the uncharged ball nearest the charged ball positively charged; opposite charges attract so the balls move towards each other

2 a i The car becomes charged due to friction with the air on the journey; you are not charged so charge flows through you when you touch the car door
ii Lightning may strike the tree as it is the tallest object around so you can become charged if you are under the tree
iii Cling film becomes charged due to friction as it is unrolled (as electrons are transferred from one part of the film to another, areas acquire opposite charges, so attract)

b Due to friction of the moving parts

c So that charge cannot flow through them to earth giving them an electric shock

Page 104 Uses of electrostatics

1 a Makes the heart contract

b Place paddles firmly on chest; no clothes/hairs

c It only passes for a very short time

d 400 J

2 a Paint droplets all have the same charge; like charges repel

b To attract the paint droplets to the frames; as opposite charges attract

c i Positive
ii Further paint droplets are repelled by the positive charge on the frame

3 a Positive

b Negative

P4 answers

Page 105 Safe electricals

1 a i Varies the brightness

ii Ammeter in series; voltmeter in parallel with lamp

iii $R = \frac{V}{I}$

$= \frac{6}{0.25}$

$= 24$ ohms

b i $R = \frac{12}{0.4}$

$= 30$ ohms

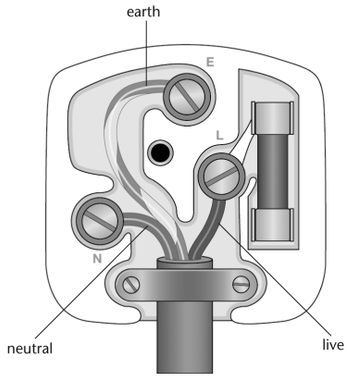
ii Electrons bump into atoms of the resistor giving them energy; atoms vibrate more; resistor gets hotter; its resistance increases

2 Battery is dc, mains is ac; battery is lower voltage than mains

3 a i *(Live: on right (to fuse); neutral: on left; earth: on top)*

ii Earth

iii Earth wire is connected to metal case of an appliance; if a fault occurs and the case becomes live any charge on it flows to the ground via the earth wire; it provides a low resistance path to the ground



b i 13 A

ii To break the circuit before current reaches the appliance

iii Earth wire is connected to metal case of an appliance; if the case becomes live a large current flows in the earth and live wires; and fuse 'blows'

Page 106 Ultrasound

1 a i Vibrations set up pressure wave in air; compressions (higher pressure) and rarefactions (lower pressure); make eardrum vibrate

ii Frequency increases

b Sound of a higher frequency than humans can hear

c Longitudinal: vibrations in same direction as wave travels; transverse: vibrations perpendicular to direction in which wave travels

2 a Pulse; tissues; reflected; echoes; image; gel; probe; skin; ultrasound/pulse; reflected; skin

b Densities of adjoining tissues; speed of sound in adjoining tissues

c i Its density needs to be similar to that of air so that nearly all the ultrasound is transmitted into the body at its surface (without the gel nearly all the ultrasound would be reflected at the surface of the body)

ii 1600 m/s

3 a Very rapid ultrasound vibrations break the stones down into small pieces that are excreted from the body in the normal way

b It needs to be powerful enough/carry enough energy; to break up the stones

P4 answers

Page 107 Treatment

1 a Both very penetrating/can pass into the body to treat internal organs

b Alpha particles cannot penetrate skin; beta particles would be stopped by a small thickness of tissue and by bone

c Nucleus decays; emits alpha or beta particle; any surplus energy is emitted as gamma radiation

2 a A tiny amount of a radioscope introduced into the body

b To investigate a problem without surgery

c Gamma

d Thyroid

e X-rays are produced in an X-ray tube; gamma rays can be emitted inside the body and their progress monitored

3 a **i** Gamma
ii Alpha particles cannot penetrate the skin; beta particles would be stopped by a small thickness of tissue and by bone

b So that the tumour receives the required dose of radiation to destroy it but healthy tissue only receives one third of the amount

c Rotate the source around the patient's head in a circle centred on the tumour

Page 108 What is radioactivity?

1 a

type of radiation	charge (+, – or 0)	what it is	particle or wave
alpha	+	helium nucleus	particle
beta	–	electron	particle
gamma	0	electromagnetic radiation	wave

b Gamma; alpha; alpha; gamma; beta

2 a The average time taken for half the nuclei in a sample of radioisotope to decay

b 5.5–5.9 years

3 a 86

b 134

c Alpha particle

d **i** $^{220}_{86}Rn \longrightarrow {}^{216}_{84}Po + {}^{4}_{2}He$
ii 220 = 216 + 4
86 = 84 + 2

e A neutron changes into a proton and an electron; the electron is emitted from the nucleus at high speed – beta particle

f $^{131}_{53}I \longrightarrow {}^{131}_{54}Xe + {}^{0}_{-1}\beta$

P4 answers

Page 109 Uses of radioisotopes

1 a Radioactive substances present in rocks (especially granite) and soil, cosmic rays from space

b Waste products from nuclear power stations; waste products from hospitals; man-made radioisotopes; nuclear weapons testing

(Any 2)

2 a Gamma; alpha and beta radiation would not penetrate pipe and soil to reach surface

b Geiger-Muller tube

c Count rate recorded will rise above the leak

3 a It is highly ionising/short range in air

b Alpha particles ionise atoms in the air; + and - ions move towards - and + plates respectively; this creates a tiny current which is detected; if present smoke particles attach themselves to the ions neutralising them; current falls setting off alarm

4 a Very little change in count rate over 200 year period

b Seeds; animal bone

c Rocks are not made from living matter

d 4000 years

Page 110 Fission

1 a Source of energy; water; steam; steam; turbine; generator

b The splitting of a large nucleus such as uranium with the release of energy

c Uranium containing a much higher proportion of the uranium-235 isotope than occurs naturally

d **i** Nucleus becomes unstable/splits; forming two daughter nuclei; extra neutrons; and energy
ii Extra neutrons can go on to split more uranium nuclei; emitting even more neutrons

2 a Embedded in glass discs and buried in the sea/incinerated under strict controls (very low waste only)

b Reprocessed

3 a **i** Slows down the neutrons
ii To increase the likelihood of a neutron being captured by a uranium nucleus
iii Boron absorbs neutrons; boron rods raised and lowered in the reactor to alter the number of neutrons available for fission

b Advantage: less pollution/does not produce acid rain/only a small amount of fuel needed/larger reserves of uranium than of fossil fuels; disadvantage: dangerous waste products/waste products radioactive for a long time/decommissioning problems/risk of nuclear accident

(Any 1 of each)