B3 answers

Remember: Check which grade you are working at.

Page 58 Molecules of life

1 a Mitochondria

2 a James; pattern is identical

b DNA isolated; DNA cut into fragment; fragments separated; by electric current/ electrophoresis; banding compared with a reference

(Any 3 = 1 mark each)

c i 5
ii ATATAC ATTTTTGTT

3 a Biological catalyst; that speeds up reactions in body

b As temperature increases the rate increases; until 40 °C when it falls

c 40–42 °C/any temperature in this range

d High temperature denatures enzyme; enzyme changes shape; so can no longer fit substrate

Page 59 Diffusion

1 a Movement of substances; from a region of high concentration to low concentration

b Increasing surface area; decreasing diffusion distance; greater concentration difference

2 a Carbon dioxide; waste

b Alveoli

3 Higher concentration of carbon dioxide in the air; diffuses through stomata; used in photosynthesis; which keeps concentration low in leaf

(Any 3 = 1 mark each)

4 Releases transmitter substance; transmitter substance diffuses across gap; transmitter triggers impulse in next neurone

Page 60 Keep it moving

1 a Disc-shaped: large surface area takes up oxygen quicker; no nucleus: more space to carry more oxygen

b Haemoglobin

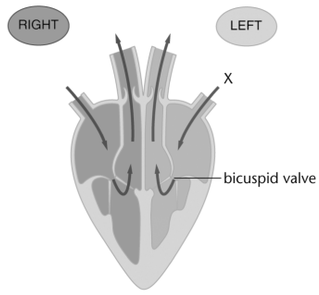
2 a i *(See diagram)*
ii *(See diagram)*

b Needs to pump blood further; at higher pressure

c i Rejection; waiting for donor; need for anti-rejection drugs

(Any 2 = 1 mark each)

ii Advantage: no need to replace batteries; disadvantage: have to wait for suitable donor



3 a Arteries transport blood away from heart; capillaries allow the exchange of materials with tissue; veins transport blood back to heart

b Blood going to body can be pumped at much higher pressure; provides greater flow to all organs

B3 answers

Page 61 Divide and rule

1 a Limits size organism can grow to; no cell differentiation; unable to form complex tissue e.g. nerves *(Any 2 = 1 mark each)*

b i

cube	surface area in cm^2	volume in cm^3	ratio
A	24	8	24/8 = 3
B	54	27	54/27 = 2
C	96	64	96/64 = 1.5
D	150	125	150/125 = 1.2

ii Larger cells have much smaller surface are compared to volume; difficult to absorb enough food/oxygen

2 a Mitosis

b Cells are diploid; chromosomes separate to opposite poles

3 a Contains enzymes; to break down egg membrane

b i Meiosis

ii Homologous chromosomes separate; haploid cells form; variation occurs/ new cells are different from each other; four cells produced *(Any 1 = 1 mark)*

c Only contain one of each pair of chromosomes/contain half the number of chromosomes found in body cells

Page 62 Growing up

1 a Similar: both have cytoplasm/cell membrane; different: plant cell has cell wall/ vacuole/chloroplasts

b i Stem cells

ii Embryos die; unethical; religious beliefs *(Any 2 = 1 mark each)*

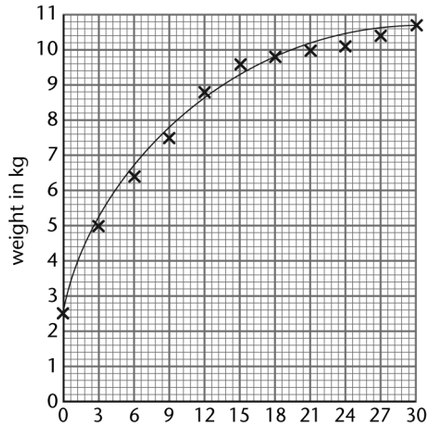
2 a i *(See diagram)* *(9 correct = 3; 5, 6 or 7 correct = 2; 3 or 4 correct = 1)*

ii *(See diagram)*

iii Weight increases; as age increases

iv Infancy

b Poor diet/problems with digestive system



B3 answers

Page 63 Controlling plant growth

1 a Stimulates root growth

b **i** Speeds up growth too much; so they die
ii Narrow leaves; they do not absorb as much weedkiller

2 a **i** Geotropism
ii Because it grows in the same direction as gravity

b **i** Auxin
ii Produced in tip; more collects on the dark side; causes cell elongation on dark side
iii No tip; so no auxin produced

Page 64 New genes for old

1 a Select characteristics; cross-breed; select the best offspring; breed these offspring over many generations

(Any 3 = 1 mark each)

2 a TG just before AAA have swapped round to GTAA

b Change in base sequence that codes for enzyme B; protein (enzyme) made is the wrong shape; red pigment cannot be turned into purple

3 a Find the gene for beta-carotene in carrots; remove gene; put gene into rice

b Advantage: produces organisms with new characteristics; disadvantage: may have harmful effects

Page 65 More of the same

1 a Sperm collected from bull; cows artificially inseminated; embryo collected; embryo cloned; embryo implanted in surrogate cow

(Any 3 = 1 mark each)

b **i** Pig organs used for transplants instead of humans; reduces need to wait for donors to die
ii Breeding pigs just to kill them; may not want an animal's organ; religious reasons

(Any 1 = 1 mark)

c **i** Nucleus removed from body cell; no fertilisation takes place; clone of the adult

(Any 1 = 1 mark)

ii B; because the nucleus came from cell from sheep B

2 a Advantage: characteristics all the same/mass produce plants quickly; disadvantage: susceptible to new disease/changes in the environment/lack variation

b Plant cell retains ability to differentiate; into all the different types of cells; easier to separate plant cells

C3 answers

Page 67 What are atoms like?

1 a Protons; neutrons *(Both = 1 mark)*

b

	relative charge	relative mass
electron	–1	0.0005 (zero)
proton	+1	1
neutron	0	1

c The number of protons in an atom

d The total number of protons and neutrons in an atom

e Fluorine

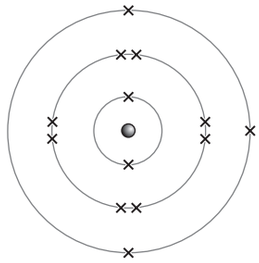
f **i** 17
ii 18

2 a Isotopes are elements that have the same atomic number but different mass numbers

b

isotope	electrons	protons	neutrons
$^{12}_{6}C$	6	6	6
$^{14}_{6}C$	6	6	8

3 The first shell can only take 2 electrons; the second shell can only take up to eight; which is why a 3rd shell is needed



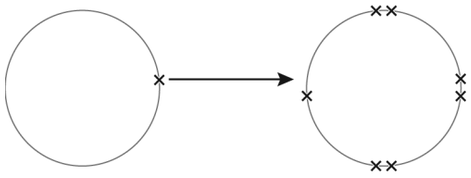
Aluminium

C3 answers

Page 68 Ionic bonding

1 a An atom which has extra electrons in its outer shell and needs to lose them to be stable

b

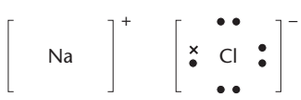


c **i** Positive
ii Magnesium/calcium

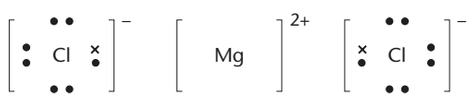
d **i** Gaining
ii Fluorine/chlorine/bromine/iodine

e Positive; negative; lattice

f



g



h Sodium chloride solution; molten (melted) magnesium oxide; molten sodium chloride

i **i** High
ii Conduct electricity
iii Ions can move

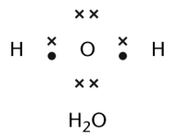
Page 69 Covalent bonding

1 a Covalent bonding

b A molecule of water is made up of three atoms; two hydrogen and one oxygen; oxygen has six electrons in its outer shell; it needs two more electrons to be complete; hydrogen atoms each have one electron in their only shell; the oxygen outer shell is shared with each of the hydrogen electrons; so each of the hydrogen atoms has a share of two more electrons making the shell full

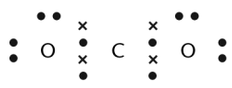
c Because they are covalently bonded

d **i**



H_2O

ii



CO_2

2 a They are simple molecules with weak intermolecular forces; they are easy to separate so the substances have low melting points

3 a The group number is the same as the number of electrons in the outer shell; it has 1 electron in the outer shell

b 7

c **i** 2
ii There are electrons occupying 2 shells

d 6

C3 answers

Page 70 The group 1 elements

1 a **i** Hydrogen gas

ii Their density is less than the density of water

b Sodium + water ⟶ sodium hydroxide + hydrogen

c reactivity increases down ↓

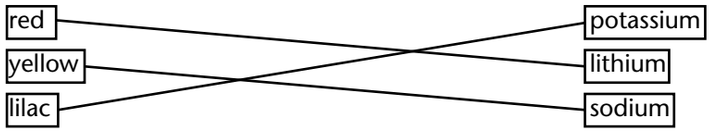
	melting point in °C	boiling point in °C
$_{3}Li$	179	1317
$_{11}Na$	98	892
$_{19}K$	64	774

d Group 1 metals all have 1 electron in their outer shell so they react in a similar way

e $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

2 a They moistened a flame test wire with dilute hydrochloric acid; dipped the flame test wire into the sample of solid chemical; held the flame test wire in a blue Bunsen burner flame; put on safety goggles; recorded the colour of the flame in a table

b



3 a $Li - e^- \longrightarrow Li^+/Li \longrightarrow Li^+ + e^-$

b Lithium loses its outer electron from its second shell; sodium loses its outer electron from its third shell; the third shell is further away from the attractive 'pulling force' of the nucleus so the electron from sodium is more easily lost than the electron from lithium; sodium is therefore more reactive than lithium

c Oxidation

C3 answers

Page 71 The group 7 elements

1 a

chlorine	green gas
iodine	grey solid

b They all have seven electrons in their outer shell

c **i** $Cl + e^- \longrightarrow Cl$

ii Reduction

iii Fluorine gains its last electron into its second shell; chlorine gains its last electron into its third shell; the third shell is further away from the attractive 'pulling force' of the nucleus so the electron to fluorine is more easily gained than the electron to chlorine; fluorine is therefore more reactive than chlorine

2 a Potassium + iodine $\longrightarrow$ potassium iodide

b $2K + I_2 \longrightarrow 2KI$

3 a **i** Chlorine displaces the bromide ions which become bromine solution which is red-brown/ a displacement reaction occurs

ii This is because chlorine is more reactive than bromine so bromine does not displace the chloride ions

b **i** Bromine + potassium iodide $\longrightarrow$ potassium bromide + iodine

ii $Br_2 + 2KI \longrightarrow 2KBr + I_2$

C3 answers

Page 72 Electrolysis

1 a The electrolyte is a dilute solution of sulphuric acid; two electrodes are connected to a dc source of electric current, between 6 V and 12 V, and placed into the electrolyte; the electrode connected to the negative terminal is the cathode; the electrode connected to the positive terminal is the anode; when the current is switched on bubbles of gas appear at both electrodes; water splits into two ions: H^+ is the positive ion and OH^- is the negative ion; H^+ is attracted to the negative cathode and discharged as hydrogen gas, H_2; OH^- is attracted to the positive anode and discharged as oxygen gas, O_2

b Because the formula of the compound breaking up is H_2O

2 a At the cathode: the water and sodium chloride split up into ions and the ions are free to move; the positive H^+ and Na^+ ions migrate towards the negative cathode; only the H+ ions are discharged; each H^+ ion gains one extra electron from the cathode; a pair of atoms then bonds to become a molecule of hydrogen that forms part of the gas; $2H^+ + 2^{e-} \longrightarrow H_2$

(Any 3)

b The negative hydroxyl OH^- and Cl^- ions migrate to the positive anode; only the OH^- ions are discharged; four OH^- ions each gain one electron and combine to form an oxygen molecule and two water molecules; $4OH^- - 4^{e-} \longrightarrow 2H_2O + O_2$ *(Any 3)*

3 a The ore of aluminium oxide is bauxite; aluminium oxide is melted; aluminium is formed at the graphite cathode; oxygen is formed at the graphite anode; the anodes are gradually worn away by oxidation; this forms carbon dioxide; the process requires a high electrical energy input

b Aluminium oxide $\longrightarrow$ aluminium + oxygen

c At the cathode: electrons have been gained; this is an example of reduction;
$Al^{3+} + 3^{e-} \longrightarrow 3Al$
at the anode: electrons have been lost; this is an example of oxidation;
$2O^{2-} - 2^{e-} \longrightarrow 2O_2$

d Aluminium oxide requires large amounts of electricity to melt at very high temperatures, which is very expensive; cryolite lowers the melting point

C3 answers

Page 73 Transition elements

1 a i Copper compounds are blue
ii Iron(II) compounds are pale green
iii Iron(III) compounds are orange/brown

b i Iron is used in the Haber process to make ammonia
ii It is a transition metal, because it is in the transition metal block

c Copper carbonate ⟶ copper oxide and carbon dioxide

2 a

ion	colour
Cu^{2+}	form a blue solid
Fe^{2+}	form a grey/green solid
Fe^{3+}	form an orange gelatinous solid

3 a $CuCO3 \longrightarrow CuO + CO_2$

b $Fe^{3+} + 3OH^- \longrightarrow Fe(OH)_3$

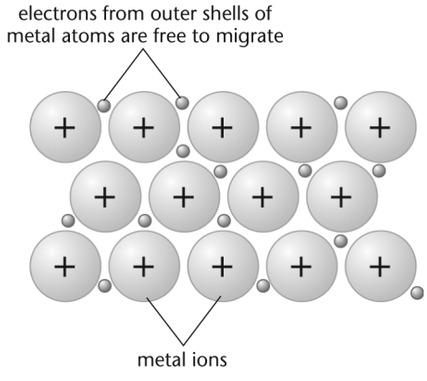
Page 74 Metal structure and properties

1 a Lustrous; malleable

b Resistant to attack by oxygen/acids

c It has a low density

d *(It is close-packed positive metal ions; held together by a strong electrostatic force of attraction; between a 'sea' of delocalised electrons)*



e Because a lot of energy is needed to overcome the strong attraction between the delocalised electrons and the positive metal ions

2 a Materials that conduct electricity with little/no resistance

b Loss-free power transmission; super-fast electronic circuits; powerful electromagnets *(Any 2)*

c Superconductors only work at very low temperatures

d Because delocalised electrons within its structure can move easily

e i C
ii A

P3 answers

Remember: Check which grade you are working at.

Page 76 Speed

1 a Average speed $= \frac{\text{distance}}{\text{time}}$

$= \frac{390}{3}$

$= 130$ km/h

b Car cannot maintain the same speed throughout

c Yes; if average speed is 130 km/h the car must have gone faster (and slower) than this at times

2 a i Distance = 5000 m

$\text{Time} = \frac{\text{distance}}{\text{average speed}}$

$= \frac{5000}{12.5}$

$= 400$ s

ii Average speed $= \frac{\text{distance}}{\text{time}}$

$= \frac{500}{35}$

$= 14.3$ m/s

iii Distance = 9 x 500

$= 4500$ m

Time $= 400 - 35$

$= 365$ s

Average speed $= \frac{4500}{365}$

$= 12.3$ m/s

b i D to E

ii Speed = gradient of OA

$= \frac{40}{40}$

$= 1$ m/s

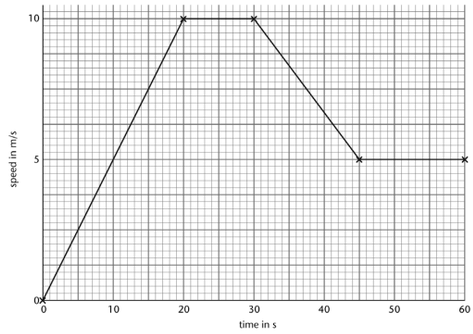
iii Speed $= \frac{40}{80}$

$= 0.5$m/s

P3 answers

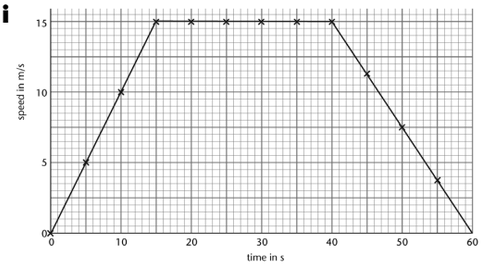
Page 77 Changing speed

1 a



b Area under graph

c i



ii Yes; 50km/h = 50 000 m/h

$$= \frac{50\ 000}{3600}\ \text{m/s}$$

$$= 13.9\ \text{m/s}$$

iii Acceleration = gradient of graph from 0 to 15 s

$$= \frac{15}{15}$$

$$= 1\text{m/s}^2$$

iv Distance travelled = area under graph

$$= \tfrac{1}{2}\,(25 + 60) \times 15$$

$$= 637.5\ \text{m}$$

2 a

$$\text{Acceleration} = \frac{\text{change in speed}}{\text{time}}$$

$$= \frac{(40 - 10)}{6}$$

$$= 5\ \text{m/s}^2$$

b

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

Change in velocity = acceleration x time

$$= 6 \times 5$$

$$= 30\ \text{m/s}$$

Starts from rest so velocity after 5 s is 30 m/s

P3 answers

Page 78 Forces and motion

1 a $a = \frac{(v - u)}{t}$

$= \frac{(40 - 0)}{20}$

$= 2\ m/s^2$

b F = ma

= 500 x 2

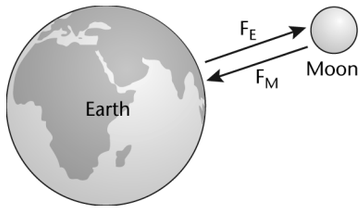
= 1000 N

c Resistive forces ignored

d $a = \frac{F}{m}$

$= \frac{1250}{500}$

$= 2.5\ m/s^2$



e **i** *(See diagram)*

ii *(See diagram)*

iii Equal in size; opposite in direction; act on different bodies; mass of Earth is much greater than mass of Moon *(Any 3)*

2 a Tired; under influence of alcohol/other drugs; distracted/lacking concentration; icy/wet road; worn tyres; poor brakes *(Any 2)*

b **i** Increase

ii Thinking/reaction time unchanged; but she will travel a greater distance in that time at a higher speed

c Very little tread; less grip on road/car may skid

P3 answers

Page 79 Work and power

1 a WD = force x distance
= 80 x 2
= 160 J

b $\text{Distance} = \frac{\text{WD}}{\text{force}}$

$= \frac{160}{60}$

= 2.67 m

c i KE lost = braking force x braking distance

$\text{braking distance} = \frac{\text{KE}}{\text{force}}$

$= \frac{300\ 000}{6\ 000}$

= 50 m

ii As heat; in tyres/road

2 a 60 x 10 = 600 N

b WD = force x distance

= 600 x 3
= 1800 J

c $\text{Chris' power} = \frac{\text{WD}}{\text{time taken}}$

$= \frac{1800}{8}$

= 225 W

d Priya's mass: WD = 225 x 10

= 2250 J

2250 J = Priya's weight x 3

weight = 750 N

mass = 75 kg

3 Fuel pollutes the environment; car exhaust gases are harmful; carbon dioxide is a major source of greenhouse gases; carbon dioxide contributes to global warming

(Any 3)

P3 answers

Page 80 Energy on the move

1 a Fewer road junctions, speed changes, gear changes *(Any 2)*

b $\frac{96}{24} = 4$

c Less

d Land Rover has a bigger engine capacity

2 a B; C

b **i** $KE = \frac{1}{2} mv^2$
$= \frac{1}{2} 1200 \times (20)^2$
$= 240\,000$ J

ii Loss in KE = braking force x braking distance force $= \frac{KE}{distance}$

$= \frac{240\,000}{32}$

$= 7500$ N

iii No; KE proportional to v^2/quartered; so braking distance quartered, not halved

3 a Recharging requires electricity from power stations which cause pollution

b Energy from Sun so cause no pollution; do not have batteries that need recharging; do not use electricity from power stations *(Any 1)*

c Sun does not always shine; does not have a constant energy source *(Any 1)*

P3 answers

Page 81 Crumple zones

1 a

safety feature	how it works
seatbelt	designed to stretch a little so that some of a person's KE is converted to elastic energy
crumple zones	absorb some of the car's KE by changing shape (crumpling) on impact
air bag	absorbs some of a person's KE by squashing up around them

b **i** Directly improve the safety of a car
ii Indirectly improve the safety of a car

c Traction control stops the wheels on a vehicle from spinning during rapid acceleration

d Active safety features have a more immediate effect; passive safety features contribute to good driving

e **i** Anti-lock braking system
ii Driver gets maximum braking force without skidding; can still steer car

2 a Force on people in car = mass x acceleration (F = ma); to reduce the force the deceleration (negative acceleration) must be reduced

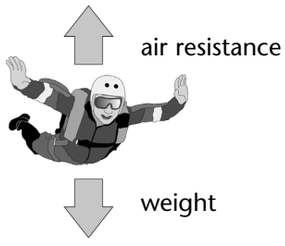
b Crumple zones crumple up (or crush) slowing the car down more slowly

Page 82 Falling safely

1 a Golf ball heavier than ping pong ball; so air resistance has a bigger effect on ping pong ball

b **i** 10 m/s^2

c **i** *(See diagram)*
ii Weight greater than air resistance



d The faster she falls the more air molecules she displaces each second; so the greater the air resistance force; net/resultant force is less so acceleration is less

e **i** Terminal speed
ii Balanced/equal in size but opposite in direction

f **i** Larger; he reaches terminal speed when air resistance force = 1000 N; instead of 600 N in Sarah's case; so he must be moving faster before forces on him are balanced

g **i** Weight unchanged; upward force/air resistance suddenly increases by a large amount
ii Net upward force; so Sarah decelerates/slows down; air resistance force gradually reduces until it is again equal to Sally's weight; so she falls at a new, slower terminal speed

2 a Balanced

b Pull of engine/air resistance force

c Streamlined shape

P3 answers

Page 83 The energy of theme rides

1 a Energy converted into thermal energy and sound

b GPE = mgh

= 0.040 x 10 x 1.2

= 0.48 J

c When weight = air resistance force

2 a B

b C

c GPE to KE

d Energy transferred to other forms; e.g. sound/thermal energy (due to friction)

e Make B higher so that it gains greater GPE; its maximum GPE will be greater; GPE lost = KE gained + energy transferred to heat due to friction

3 a 65 x 10 = 650 N

b $\frac{400}{65}$ = 6.15 N/kg