C2a answers

Remember: Check which grade you are working at.

Page 90 Atomic structure 2

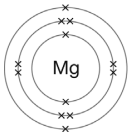
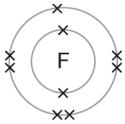
1 a Contains 3 protons *(1)*; and 4 neutrons *(1)*

b

Type of reaction	Ionisation	Nuclear fission	Nuclear fusion
Change in mass of nucleus (increases/decreases/ stays the same)	**Stays the same**	**Decreases**	**Increases**
Change to the atom	Loss or gain of electrons	**Nucleus splits; into two**	Two nuclei join together

Page 90 Electronic structure

2 a

Periodic table element	$^{23}_{11}$Na sodium	$^{24}_{12}$Mg magnesium	$^{19}_{9}$F fluorine
Number of electrons	11	12	**9**
Electron arrangement			
Notation	2, 8, 1	**2, 8, 2**	**2, 8**

b 2, 8

3 a Calcium carbonate *(1)*; calcium magnesium carbonate *(1)*

b Mention of exchange of ions *(1)*; magnesium exchanges for calcium *(1)*

Page 91 Mass number and isotopes

1 a (Similarity:) Both have 1 electron in the outer shell *(1)*
(Difference:) Different numbers of electrons / sodium has more electrons / has an extra shell / has 8 more electron *(1)*

b *(Any 3:)* Different atoms of chlorine have different masses; chlorine exists as isotopes; the relative atomic mass is an average value; takes into account differences in abundancy as well as mass

Page 91 Ionic bonding

2 a Ca^{2+}

b $CaCl_2$

3 a Ions are charged *(1)*; ions can move *(1)*

b Pure water does not conduct electricity *(1)*; because it does not contain any ions *(1)*

C2a answers

Page 92 Ionic compounds

1 a Ions are charged / have positive and negative charges *(1)*; and are free to move *(1)*

b Ions in the solid cannot move *(1)*

2 a Cross on the jewellery at the negative electrode *(1)*

b Ions gain electrons *(1)*; one electron is gained *(1)*

Page 92 Covalent bonding

3 a Double *(1)*

b 4 shared electrons *(1)*

c Oxygen atoms have 6 electrons in their outer shell *(1)*; so need to gain two electrons to form a stable arrangement *(1)*

d Atoms in the molecule are held together by strong bonds *(1)*; forces between molecules (intermolecular forces) are very weak *(1)*

Page 93 Simple molecules

1 a Water; it has a much higher melting and boiling point; due to stronger forces between the molecules *(1)*

b **i** Low boiling point so will evaporate too easily / perfume would not last in the bottle idea *(1)*

ii Ethanol dissolves the fragrant oil and its boiling point is not far above body temperature *(1)*

iii Boiling point too high so would not evaporate off the persons' body *(1)*

c Toxicity/ whether harmful to people / reactivity / if it breaks down easily etc. *(1)*

Page 93 Giant covalent structures

2 a Graphite has weak bonds between layers *(1)*; layers can break off *(1)*; all bonds in diamond are very strong *(1)*

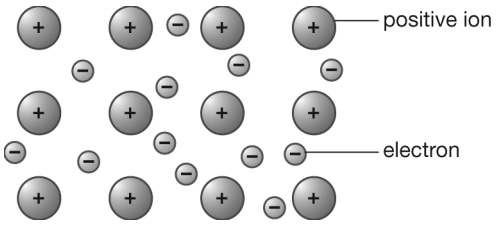
b There are spaces between layers *(1)*

c Electrons are free to move *(1)*

C2a answers

Page 94 Metals

1 a



(2)

b Electrons can move *(1)*

2 a Atoms in the metal slide over each other *(1)*

b i Conducts electricity *(1)*; conducts heat *(1)*

ii Delocalised electrons are free to move *(1)*

Page 94 Alkali metals

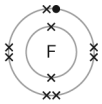
3 a Have only one or two electrons in outer shell *(1)*

b Atom A *(1)*; has one electron in outer shell *(1)*

c Atom B *(1)*; numbers of protons are the same as number of electrons in an atom *(1)*

Page 95 Halogens

1 a



(1)

b –1 *(1)*

c Sodium *(1)*

2 a i

Solution of compound	Does it react with fluorine gas?	Colour after reaction
Sodium chloride	Yes	Very pale green
Sodium bromide	Yes	**Orange/brown**
Sodium iodide	Yes	**Brown**

(2)

ii Sodium fluoride; chlorine *(1)*

b

Solution of compound	Does it react with bromine?
Sodium fluoride	**No**
Sodium chloride	**No**
Sodium iodide	**Yes**

All 3 correct = (2) 2 or 1 correct = (1)

Page 95 Nanoparticles

3 a Particles containing a few hundred atoms *(1)*; very small *(1)*

b They are in the form of hollow tubes *(1)*; with a very high surface area *(1)*

c (*Any 3:)* Companies invest in new research that might make profits in the future; nanoparticles have many uses that can be sold to make money; examples of uses of nanoparticles (example of uses of nanoparticles:) biosensors; harder wearing or stain resistant materials; information processors; catalysts

C2a answers

Page 96 Smart materials

1 Spectacles: A; car dials: D; helmet: B; mugs C *All correct = (4) 2 or 3 correct = (2) 1 correct = (1)*

Page 96 Compounds

2 a Elements contain only one type of atom *(1)*; compounds contain more than one type of atom chemically joined together *(1)*

b *(Any 3:)* In a mixture the elements are not chemically joined together; in a compound the elements are chemically joined together; mixtures have different properties to the compounds of the same elements; for example: hydrogen and oxygen are gases, water is a liquid

c The formula of water is H_2O *(1)*; which shows that hydrogen and oxygen always react in a 2:1 ratio *(1)*

3 a N_2 + **3** H_2 → **2** NH_3

b Mg + **2** HNO_3 → $Mg(NO_3)_2$ + **H_2** *(4)*

Page 97 Percentage composition

1 a Compound A is CO *(1)*; compound B is CO_2 *(1)*

b Compound B contains a higher percentage than A *(1)*

Page 97 Moles

2 a 32 g *(1)*; 64 g *(1)*

b Mass of oxygen in SO_2 = 32

Percentage mass of sulfur in SO_2 = (64 ÷ 32) x 100 *(1)*

= 50 % *(1)*

c 640 tonnes *(2)*

C2a answers

Page 98 Percentage yield

1 a *(Any 2:)* Makes more product; less reactants wasted; saves energy / fuel

b *(Any 2:)* Most of the atoms in the reactants are used up; to form products; few atoms are left unreacted

c Theoretical yield is the maximum calculated yield *(1)*; actual yield is the amount obtained in practice *(1)*

2 a Mass of 1 mole magnesium = 24 g; mass of 1 mole magnesium oxide = 40 g *(1)*

Mass of magnesium oxide made $= \frac{40}{24} \times 2.4$ or $\frac{40}{10}$ *(1)*

$= 4.0$ g *(1)*

b percentage yield $= \frac{\text{actual yield}}{\text{theoretical yield}}$

percentage yield $= \frac{3}{4} \times 100$ *(1)*

$= 75\%$ *(1)*

Page 98 Reversible reactions

3 a $C_2H_4 + H_2O \rightleftharpoons C_2H_5OH$ *Correct layout and formulae = (1) reversible sign correct = (1)*

b i H_2O / CH_5OH *(1)*

ii C_2H_4 *(1)*

C2a answers

Page 99 Equilibrium 1

1 a A *(1)*

b *(Any 2:)* reaction is reversible; do not get 100% yield; recycling gases means more will react / better yield

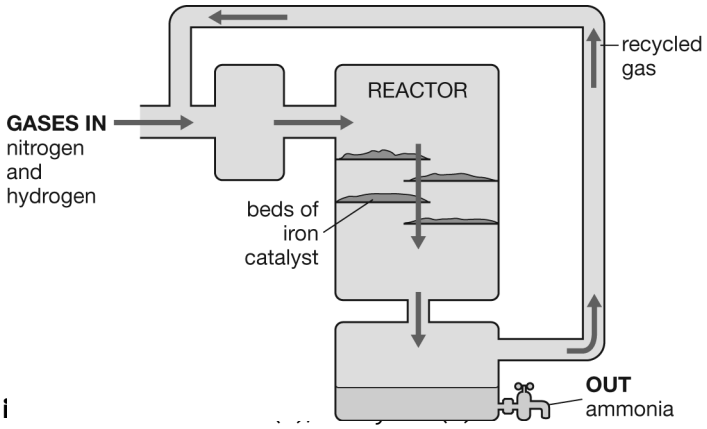
c

Change to reaction condition	Effect on yield (increases/ decreases/stays the same)
A higher temperature	**Decreases**
A higher pressure	**Increases**
Using less catalyst	**Stays the same**

(3)

Page 99 Haber process

2 a



(3)

b i

ii High pressures are expensive / difficult to maintain / equipment needs to be specially designed / danger of leaks / not as safe to work with *(1)*

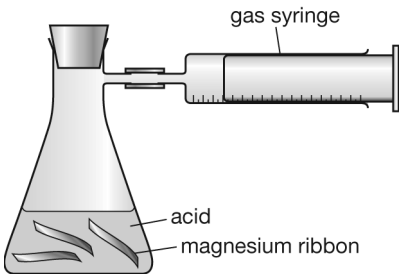
c *(Any 2:)* Reaction is reversible; so do not get a high yield; recycles unreacted hydrogen and nitrogen; increases yield of ammonia

C2b answers

Remember: Check which grade you are working at.

Page 101 Rates of reactions

1 a



(3)

b i $\frac{90}{50} = 1.8$ *(2)*

ii Acid B *(1)*; fastest reaction *(1)*

c 1 temperature *(1)*; 2 mass of magnesium *(1)*; 3 volume of acid *(1)*

Page 101 Following the rate of reaction

2 a Time *(1)*; volume of gas *(1)*

b No more gas will be made *(1)*

c Mass *(1)*

Page 102 Collision theory

1 a i Acid particles are closer together (not just more acid particles) higher temperature *(1)*

ii The particles move faster *(1)*

b *(Any 2:)* Increased surface area of zinc; higher frequency of collisions / more successful collisions (not just 'more collisions); higher temperature / higher concentration / smaller lumps

2 a At a higher temperature, the concentration decreases *(1)*; particles move away from each other and the gas expands *(1)*

b At a higher pressure, the concentration increases *(1)*; gas particles are pushed together *(1)*

Page 102 Heating things up

3 a Flask loses mass / gets lighter *(1)*; because reaction produces carbon dioxide *(1)*; which is a gas / leaves the flask / is lost *(1)*

b *(Any 3:)* Collisions are more frequent *(1)*; more particles have enough energy to react *(1)*; double the number of successful collisions occur per second *(1)*

C2b answers

Page 103 Grind it up, speed it up

1 a Large surface area *(1)*; most concentrated acid *(1)*; highest temperature *(1)*

b i Any value less than 4.5 cm^3/s *(1)*; acid is less concentrated *(1)*; so reaction is slower *(1)*

ii Any value higher than 4.5 cm^3/s (with units) *(1)*; higher temperature *(1)*; increases reaction rate *(1)*

Page 103 Concentrate now

2 a The acid *(2)*

b Acid is being used up *(1)*; concentration of acid falls *(1)*; reactions are slower at lower concentrations *(1)*

c Experiment 2 is less concentrated acid *(1)*; so is at a slower rate *(1)*

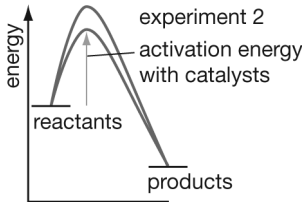
d i 5 cm^3 *(1)*

ii Because this would exactly half the concentration of the acid *(1)*; this will cause the rate to also halve *(1)*

Page 104 Catalysts

1 a $2H_2O + O_2$ *Formulae correct = (1) balancing correct = (1)*

b



(2)

c 0.2g / the same mass *(1)*; because a catalyst is not used up in the reaction *(1)*

2 a It is not used up *(1)*

b *(Any 2:)* They have a very long lifetime / are not used up; they make reactions faster; link to cost: more products made quickly / do not need to buy more catalyst very often / works out cheaper over time

Page 104 Energy changes

3 a

Reaction	Temperature change	Exothermic or endothermic?
Dissolving ammonium nitrate in water	Decreases	**Endothermic**
Adding zinc powder to copper	**Increases**	Exothermic
Adding magnesium ribbon to an acid	Increases	**Exothermic**

(2)

b Oxidation *(1)*; neutralisation *(1)*

C2b answers

Page 105 Equilibrium 2

1 a Carbon monoxide *(1)*

b The forward reaction is endothermic *(1)*; therefore a low temperature will increase the forward reaction *(1)*

c Higher temperatures increase the rate of reaction *(1)*

Page 105 Industrial processes

2 a Nitrogen + hydrogen $\rightleftharpoons$ ammonia *Correct names = (1) reversible sign correct = (1)*

b i Iron acts as a catalyst *(2)*

ii Increases surface area; speeds up rate of reaction *(2)*

c i Nitrogen *(1)*; hydrogen *(1)*

ii Reaction is reversible / reaches equilibrium *(1)*

3 a Less than 15% *(1)*

b i A low temperature gives too low a reaction rate *(1)*; a high temperature gives too low a yield *(1)*

ii A higher pressure gives a higher yield *(1)*; and a faster rate of reaction *(1)*

iii Optimum conditions are a compromise *(1)*; between yield and rate *(1)*

Page 106 Free ions

1 a Contains charged ions *(1)*; in a regular arrangement *(1)*

b Ions cannot move in solid *(1)*; ions move freely in solution *(1)*

c i Chlorine *(1)*

ii *(Any 2:)* Positive electrode / cathode; because it forms from chloride ions; which are negatively charged

Page 106 Electrolysis equations

2 a Hydrogen *(1)*

ii Sodium more reactive than hydrogen / sodium very reactive *(1)*

b To melt the sodium chloride *(1)*; sodium chloride has a high melting point *(1)*

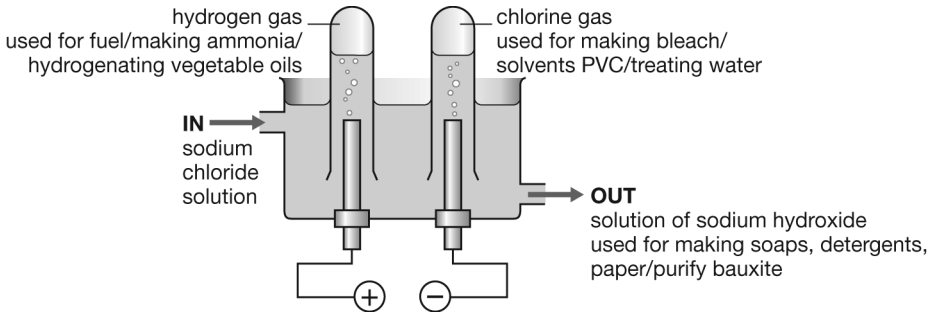
c i $Na^+ + e^-$ *(1)* $\rightarrow$ Na *(1)*

ii Reaction involves gain of electrons *(1)*

C2b answers

Page 107 Uses for elctrolysis

1 a



(6)

2 a Copper *(1)*; positive *(1)*; gaining *(1)*

b

Positive electrode	**Negative electrode**
$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

Page 107 Acids and metals

3 a Add both metals to samples of the acid *(1)*; zinc reacts / fizzes because it is more reactive than hydrogen *(1)*; copper does not react because it is less reactive than hydrogen *(1)*

Page 108 Making salts from bases

1 a Zinc chloride *(1)*

b i Copper is too unreactive to react with an acid *(1)*

ii Copper carbonate *(1)*

Page 108 Acids and alkalis

2 a From **blue** to **red** *(1)*

b Because it only has two colours / needs to be different colours at different pHs *(1)*

c i Use the indicator to find out how much acid he needs to add *(1)*; repeat without indicator *(1)*; using same amounts of acid and alkali *(1)*

ii By evaporating the solution *(1)*

3 a All contain nitrogen / all contain ammonium ions *(1)*

b Ammonium nitrate *(1)*

c Sulfuric acid *(1)*; H_2SO_4 *(1)*

d Compound C *(1)*

C2b answers

Page 109 Neutralisation

1 a

Solution	Type of positive ion	Type of negative ion
NaOH	Na^+	OH^-
H_2SO_4	H^+	SO_4^{2-}
Na_2SO_4	Na^+	SO_4^{2-}
HBr	H^+	**Br^-**

(2)

b i NaOH / Sodium hydroxide *(1)*

ii Copper carbonate *(1)*

2 a $HCl(aq) \rightarrow H^+(aq) + Cl^-(aq)$ *Ions correct = (1) state symbols correct = (1)*

b i $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ *(1)*

ii All acids contain H^+ *(1)*; all alkalis contain OH^- *(1)*; neutralisation reaction is the same every time *(1)*

iii Lithium chloride *(1)*

Page 109 Percipitation

3 a Lead carbonate; lead hydroxide *(1)*

b Calcium phosphate *(1)*

c They are precipitates / solids *(1)*; which can be easily filtered off *(1)*