GCSE ADDITIONAL CHEMISTRY (C2) REVISION BOOKLET

Name _____

These are summary questions for all topics in the GCSE Chemistry exam. When you have completed the booklet go to the school's website, find the relevant mark scheme and mark your work.
Check off each section and enter your score.
If you find a section(s) produce low scores you can:

- **Come to catch up and ask for help**
- **Go online:**
  - **http://www.bbc.co.uk/schools/bitesize/**
  - **http://www.s-cool.co.uk/**
  - **http://web.aqa.org.uk/qual/newgcses/science/new/bio_materials.php?id=03&prev=03**
- **Use your notes and revision guides**
- **You can purchase revision guides from Mrs Fuller in the main science prep room.**

All the above will identify areas of weakness and give you strategies to swat up on.

	Score	Date	Grade	%	
C2.1 Structures and Bonding	___ / 33			90+	A*
C2.2 Structures and Properties	___ / 37			80	A
C2.3 How much?	___/ 39			70	B
C2.4 Rates of Reaction	___ / 36			60	C
C2.5 Energy and Reactions	___ / 32			50	D
C2.6 Electrolysis	___/ 47			40	E
C2.7 Acids, Alkalis and Salts	___/ 46			30	F
End of unit exam	___/ 46			20	G

Name: **Date:**

Summary questions

Fill in the gaps in the following sentences to test your recall of the facts you have learned in this chapter.

1 a) The centre of an atom is called the ..... .

b) In the centre of the atom there are two types of sub-atomic particles. These particles are the ..... and the ..... . The ..... are positively charged. The ..... have no charge. They are neutral.

c) The centre of the atom is ..... charged. This is because of the positively charged sub-atomic particles called ..... .

d) Around the centre are negatively charged sub-atomic particles called ..... .

e) The overall charge on an atom is zero. Therefore the number of ..... and ..... are equal.

f) The electrons are arranged in energy ..... around the centre of the atom.

g) The first energy ..... is nearest to the centre and can take a maximum of ..... electrons.

h) The second and third energy ..... can take a maximum of ..... electrons each.

i) The first ..... level is filled with electrons first and then the ..... and third ones.

j) When atoms bond with other atoms, the number of ..... in their outermost energy ..... changes.

2 a) In ionic bonding, electrons from one atom are ..... to another.

b) The charged particles formed are called ..... .

c) Negative ions are formed when atoms ..... electrons.

d) Positive ions are formed when atoms ..... electrons.

e) An example of an ionic compound is ..... chloride.

f) ..... bonds are formed when pairs of electrons are ..... between atoms.

g) An example of a ..... substance is water.

h) Diamond is an example of a ..... covalent substance.

i) Dots and ..... represent the electrons in these two types of bonding.

j) In metals the positively charged metal ..... are arranged in ..... .

k) The ..... of metal ions are in a ..... of free ..... .

Total = ___/33

Student Answer Booklet
CHEMISTRY

C2.1 Structures and Bonding

Answers to summary questions

1 a) The centre of an atom is called the **nucleus**.
b) In the centre of the atom there are two types of sub-atomic particles. These particles are the **proton** and the **neutron**. The **protons** are positively charged. The **neutrons** have no charge. They are neutral.
c) The centre of the atom is **positively** charged. This is because of the positively charged sub-atomic particles called **protons**.
d) Around the centre are negatively charged sub-atomic particles called **electrons**.
e) The overall charge on an atom is zero. Therefore the number of **electrons** and **protons** are equal.
f) The electrons are arranged in energy **levels** around the centre of the atom.
g) The first energy **level** is nearest to the centre and can take a maximum of **two** electrons.
h) The second and third energy **levels** can take a maximum of **eight** electrons each.
i) The first **level** is filled with electrons first and then the **second** and third ones.
j) When atoms bond with other atoms, the number of **electrons** in their outermost energy **level** changes.

2 a) In ionic bonding, electrons from one atom are **transferred/given** to another.
b) The charged particles formed are called **ions**.
c) Negative ions are formed when atoms **gain** electrons.
d) Positive ions are formed when atoms **lose** electrons.
e) An example of an ionic compound is **sodium/calcium/magnesium/potassium etc.** chloride.
f) **Covalent** bonds are formed when pairs of electrons are **shared** between atoms.
g) An example of a **covalent** substance is water.
h) Diamond is an example of a **giant** covalent substance.
i) Dots and **crosses** represent the electrons in these two types of bonding.
j) In metals the positively charged metal **ions/cations** are arranged in **layers**.
k) The **layers** of metal ions are in a **sea** of free **electrons**.

1 mark for each word in bold
Total = 33 marks

Name: **Date:**

Summary questions

Answer the following questions to test your recall and understanding of what you have learned in this chapter.

1 Decide which of these statements are true and which are false.

a) Ionic compounds have high melting points. **True/false**

b) This is because the bonds between the molecules present are strong. **True/false**

c) Ionic compounds conduct electricity in the solid state. **True/false**

d) In solid ionic compounds the ions can move and carry the current. **True/false**

e) Covalently bonded compounds tend to have low melting and boiling points. **True/false**

f) Intermolecular forces are strong and make it difficult to separate the molecules. **True/false**

g) Diamond and graphite are also simple covalent molecules. **True/false**

h) Covalent substances do not conduct electricity. **True/false**

i) Graphite conducts electricity. **True/false**

j) Graphite is slippery because the bonds between the atoms are weak covalent bonds. **True/false**

2 In this question, cross out the wrong alternatives.

Ionic compounds have **low/high** melting points because the forces of attraction between the **ions/molecules** are strong. When they are in **solid/liquid** form, ionic compounds are poor electrical conductors because the **ions/electrons** are **free/unable** to move and carry the electrical current. Covalent substances tend to be **good/poor** electrical conductors because the **ions/electrons** are **free/unable** to move. **Graphite/diamond** is an exception because it has **ions/electrons** which are **free/unable** to move and carry the electrical current. **Graphite/diamond** is the hardest natural substance known because all its bonds are **strong/weak** covalent bonds. **Graphite/diamond** is a very slippery substance because the bonds **between/inside** the layers of carbon atoms are **weak/strong** and easily broken so the layers can slide over each other easily.

Metals are **good/poor** electrical conductors because the **ions/electrons** are **free/unable** to move and carry the electrical current. These free **electrons/ions** are able to move in both the liquid and solid forms. The free **electrons/ions** hold the metal lattice together. Metals are **malleable/brittle** because the layers **can/cannot** slide over each other. This is because as the distortion to the metal lattice occurs, the **electrons/ions** can also move and hold the metal **molecules/ions** together.

Nanoparticles are very **small/large** particles that have properties **different from/the same as** the substances when they are in bulk form.

1 mark each = ___/37

Continued …

Answers to summary questions

1 a) **True**. Ionic bonds are strong.
b) **False**. Ionic compounds are not made up of molecules they are made up of ions.
c) **False**. They conduct electricity in the liquid state but not the solid state.
d) **False**. They are in fixed positions and cannot move.
e) **True**. Covalently bonded compounds tend to have low melting and boiling points.
f) **False**. The intermolecular forces are weak and this is why the boiling points are low.
g) **False**. They are giant covalent molecular substances.
h) **True**. They have no free electrons or ions (apart from graphite).
i) **True**. It has free electrons.
j) **False**. It is slippery but the reason given is wrong. The layers of atoms are held together by weak intermolecular forces called van der Waals forces.

2 The correct answers are in **bold**.

Ionic compounds have **high** melting points because the forces of attraction between the **ions** are strong. When they are in **solid** form, ionic compounds are poor electrical conductors because the **ions** are **unable** to move and carry the electrical current. Covalent substances tend to be **poor** electrical conductors because the **electrons** are **unable** to move. **Graphite** is an exception because it has **electrons** which are **free** to move and carry the electrical current. **Diamond** is the hardest natural substance known because all its bonds are **strong** covalent bonds. **Graphite** is a very slippery substance because the bonds **between** the layers of carbon atoms are **weak** and easily broken so the layers can slide over each other easily.

Metals are **good** electrical conductors because the **electrons** are **free** to move and carry the electrical current. These free **electrons** are able to move in both the liquid and solid forms. The free **electrons** hold the metal lattice together. Metals are **malleable** because the layers **can** slide over each other. This is because as the distortion to the metal lattice occurs, the **electrons** can also move and hold the metal **ions** together.

Nanoparticles are very **small** particles that have properties **different from** the substances when they are in bulk form.

1 mark each = 37 marks

Name: **Class:**

Summary questions

Answer the following questions to test your recall and understanding of what you have learned in this chapter.

1 a) What is the name given to atoms of the same element which have different mass numbers?

.....

b) These atoms have different numbers of which sub-atomic particle?

.....

c) In the periodic table which two properties of an element are usually given as numbers?

.....

d) How is the formula mass of a compound calculated?

.....

.....

.....

e) The relative atomic mass of carbon-12 expressed in grams is called a …… of carbon atoms.

f) In the reaction below, 1 mol of oxygen molecules reacts with how many moles of magnesium atoms?

$$2Mg + O_2 \rightarrow 2MgO$$

.....

g) What is the relative formula mass of MgO? [relative atomic masses: Mg = 24; O = 16]

.....

.....

h) If 92 g of sodium react with 32 g of oxygen. What is the empirical formula of the compound formed? [relative atomic masses: Na = 23; O = 16] [Higher]

.....

.....

.....

Continued …

2 a) Balance the following equations. [Higher]

i) ….Mg + ….CO_2 → ….MgO + ….C

ii) ….Fe + ….Cl_2 → ……$FeCl_3$

iii) ….N_2 + ….H_2 → ….NH_3

iv) ….Al + ….O_2 → ……Al_2O_3

v) ….NH_3 + ….CuO → ….Cu + ….N_2 + …..H_2O

b) In the reaction below what mass of fluorine will react exactly with 120 g of magnesium?

$Mg + F_2 \rightarrow MgF_2$ [relative atomic masses Mg = 24; F = 19] [Higher]

.....

.....

.....

.....

c) When the experiment in b) was done what mass of magnesium fluoride would you expect to be formed? [Higher]

.....

d) What is the percentage yield if 248 g of magnesium fluoride was actually formed? [Higher]

.....

.....

e) What is a reversible reaction?

.....

f) What symbol represents a reversible reaction? .....

g) What can you say about the forward and backward reaction if a reversible reaction when equilibrium is reached?

.....

3 a) What industrial process is used to make ammonia?

.....

b) What are the conditions for making ammonia?

.....

c) Give a major use of ammonia.

.....

d) Give one major environmental drawback of this use.

.....

Total = ___/39

Teacher notes

Answers to summary questions

Answers

1 a) Isotopes. *(1 mark)*
b) Neutrons. *(1 mark)*
c) Atomic or proton number and relative atomic mass or mass number. *(2 marks)*
d) By adding up the relative atomic masses of the atoms present. *(1 mark)*
e) Mole. *(1 mark)*
f) 2 mol of magnesium atoms react with one mole of oxygen molecules. *(1 mark)*
g) 24 + 16 = 40 *(1 mark)*
h) Sodium Oxygen [Higher]
92 g 32 g
$\frac{92}{23}$ mol $\frac{32}{16}$ mol *(1 mark)*
4 mol of sodium combine with 2 mol of oxygen. *(1 mark)*
$\therefore$ 2 mol of sodium combine with 1 mol of oxygen. *(1 mark)*
$\therefore$ formula is Na_2O ***(3 marks total)***

2 a) i) **2**Mg + CO_2 → **2**MgO + C [Higher] *(2 marks)*
ii) **2**Fe + **3**Cl_2 → **2**$FeCl_3$ [Higher] *(2 marks)*
iii) N_2 + **3**H_2 → **2**NH_3 [Higher] *(2 marks)*
iv) **4**Al + **3**O_2 → **2**Al_2O_3 [Higher] *(2 marks)*
or **2**Al + **1½**O_2 → Al_2O_3 [Higher] *(2 marks)*
v) **2**NH_3 + **3**CuO → **3**Cu + N_2 + **3**H_2O [Higher] *(2 marks)*
b) There are two ways of answering this. [Higher]
i) 120 g = $\frac{120}{24}$ mol of Mg
From the equation, 1 mol of Mg reacts with 1 mol of F_2
$\therefore$ 5 mol of Mg react with 5 mol of F_2
5 mol of F_2 = 5 × (2 × 19) = **190 g**
ii) From the equation, 24 g of Mg react with 38 g of F_2
$\therefore$ 1 g of Mg reacts with $\frac{38}{24}$ g of F_2
$\therefore$ 120 g of magnesium react with 120 × $\frac{38}{24}$ g of F_2 = **190 g** *(2 marks)*
c) 190 + 120 = **310 g** *(2 marks)*
d) Yield = $\frac{248}{310} \times 100\%$ = **80%** [Higher] *(2 marks)*
e) A reaction that can go both ways/backwards and forwards. *(2 marks)*
f) ⇌ *(1 mark)*
g) They have the same rate. *(1 mark)*

3 a) Haber. *(1 mark)*
b) 250 atmospheres, 450°C and an iron catalyst. *(3 marks)*
c) Fertilisers. *(1 mark)*
d) Eutrophication – they cause algal blooms when they leech into rivers and lakes. *(1 mark)*

Total = 39 marks

Name: **Class:**

Summary questions

Fill in the gaps in the following paragraphs to test your understanding of this chapter.

1 The rate of a chemical reaction can be found by measuring how ..... the reactants are ..... or how quickly the products are ..... .

An example of a chemical reaction is the reaction between calcium carbonate and hydrochloric acid: $CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

We could measure the rate of this reaction by measuring the ..... of the reaction mixture using a top-pan balance. Because .... gas is given off, the mass will ..... . To see how quickly the reaction is taking place we plot ..... in mass (vertical axis) against ..... (horizontal axis). The steeper the line obtained, the ..... the reaction. We could also measure how quickly the gas is given off by measuring its volume using a gas ..... .

In the reaction between sodium thiosulphate and hydrochloric acid, solid sulphur is formed. This makes the reaction mixture ..... and makes it more difficult to see ..... the mixture. Eventually we cannot see ..... the mixture at all and a ..... underneath it is ..... . We can measure the ..... it takes to do this.

2 There are four main factors that affect the rate of reaction. These are:

a) ..... . This is a measure of how crowded the particles are in a solution and the frequencies of ..... .

b) .... This is a measure of how much solid is exposed to reaction and therefore how many ..... take place.

c) ..... . This affects the energy of the particles and how quickly they ..... . It also affects the ..... with which the particles collide and how ..... the collisions are. The energy required for any reaction to take place is called the ..... energy for that reaction.

d) The presence of a ..... . A ..... will speed up a chemical reaction but is ..... chemically and weighs the same at the end of the reaction. ..... work by lowering the activation ..... for the reaction.

3 ..... are biological catalysts and are made up of proteins. They differ from other ..... in that they usually work best at 40°C. At higher temperatures they do not work because they are ..... . Enzymes are used in ..... detergents and in industries that use fermentation such as brewing and bread-making. They are also used in diagnostic kits for such diseases as ..... . Here the enzyme helps detect how much ..... is in the blood of the patient. **1 mark each = __/36 marks**

Answers to summary questions

1 The rate of a chemical reaction can be found by measuring how **quickly** the reactants are **used up/consumed** or how quickly the products are **formed/produced**.
An example of a chemical reaction is the reaction between calcium carbonate and hydrochloric acid.

$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

We could measure the rate of this reaction by measuring the **mass** of the reaction mixture using a top-pan balance. Because **carbon dioxide** gas is given off, the mass will **decrease/go down/be reduced**. To see how quickly the reaction is taking place we plot **loss** in mass (vertical axis) against **time** (horizontal axis). The steeper the line obtained, the **faster/quicker** the reaction. We could also measure how quickly the gas is given off by measuring its volume using a gas **syringe**.

In the reaction between sodium thiosulphate and hydrochloric acid, solid sulphur is formed. This makes the reaction mixture **cloudy** and makes it more difficult to see **through** the mixture. Eventually we cannot see **through** the mixture at all and a **cross/coin** underneath it is **obscured/not visible**. We can measure the **time** it takes to do this.

2 There are four main factors that affect the rate of reaction. These are:

a) **Concentration**. This is a measure of how crowded the particles are in a solution and the frequencies of **collision**.
b) **Surface area**. This is a measure of how much solid is exposed to reaction and therefore how many **collisions** take place.
c) **Temperature**. This affects the energy of the particles and how quickly they **move**. It also affects the **frequency** with which the particles collide and how **energetic/efficient** the collisions are. The energy required for any reaction to take place is called the **activation** energy for that reaction.
d) The presence of a **catalyst**. A **catalyst** will speed up a chemical reaction but is **unchanged** chemically and weighs the same at the end of the reaction. **Catalysts** work by lowering the activation **energy** for the reaction.

3 **Enzymes** are biological catalysts and are made up of proteins. They differ from other **catalysts** in that they usually work best at 40°C. At higher temperatures they do not work because they are **denatured**. Enzymes are used in **biological** detergents and in industries that use fermentation such as brewing and bread-making. They are also used in diagnostic kits for such diseases as **diabetes**. Here the enzyme helps detect how much **sugar/glucose** is in the blood of the patient.

1 mark each = 36 marks

Name: **Date:**

Summary questions

Fill in the gaps in the following sentences to test your recall of the facts you have learned in this chapter.

1 a) Exothermic reactions ..... heat to the surroundings whilst endothermic reactions ..... heat from the surroundings.

b) Respiration is an important ..... reaction because in the body it is used to produce ..... energy. ..... or burning is another example of this type of thermochemical reaction.

c) Photosynthesis is an important ..... reaction because it ..... light energy to produce sugars and ..... gas from ..... dioxide and water.

d) The type of reaction (exothermic or endothermic) can be tested by measuring ..... changes.

e) In reversible reactions if the forward reaction is exothermic then the backward reaction is ..... . The ..... amount of energy is released or absorbed in both ..... .

f) In a reversible ..... we can influence the amounts of products or ..... by changing the temperature. If the forward reaction is ..... we can make more of the products by ..... the temperature. If the forward reaction is ..... we can make more of the product by lowering the temperature. [Higher]

2 The equation for the formation of ammonia is given below: [Higher]

$$N_2(g) + 3H_2 \rightleftharpoons 2NH_3$$

a) On the left-hand side of the equation there are ..... gas molecules.

b) On the right-hand side of the equation there are ..... gas molecules.

c) If the pressure is raised the system will move to the side which ..... the pressure. It does this by making ..... gas molecules. Therefore the equilibrium will move to the .....-hand side making ..... ammonia. The actual pressure used is around ..... atmospheres.

d) In the Haber process an ..... catalyst is used to lower the amount of ..... needed for the reaction and to ..... the rate.

e) The forward reaction is exothermic and is therefore favoured by a ..... temperature. This would make the reaction too ..... and therefore a compromise temperature of .....°C is used. This makes ..... ammonia but makes it more quickly.

1 mark each = ___/32

Answers to summary questions

1 a) Exothermic reactions **transfer/lose/give out** heat to the surroundings whilst endothermic reactions **absorb** heat from the surroundings.
b) Respiration is an important **exothermic** reaction because in the body it is used to produce **heat** energy. **Combustion** or burning is another example of this type of thermochemical reaction.
c) Photosynthesis is an important **endothermic** reaction because it **absorbs/uses** light energy to produce sugars and **oxygen** gas from **carbon** dioxide and water.
d) The type of reaction (exothermic or endothermic) can be tested by measuring **temperature** changes.
e) In reversible reactions if the forward reaction is exothermic then the backward reaction is **endothermic**. The **same** amount of energy is released or absorbed in both **directions**.
f) In a reversible **reaction** we can influence the amounts of products or **reactants** by changing the temperature. If the forward reaction is **endothermic** we can make more of the products by **raising** the temperature. If the forward reaction is **exothermic** we can make more of the product by lowering the temperature. [Higher]

2 The equation for the formation of ammonia is given below: [Higher]

$N_2(g) + 3H_2 \rightleftharpoons 2NH_3$

a) On the left-hand side of the equation there are **4/more** gas molecules.
b) On the right-hand side of the equation there are **2/fewer** gas molecules.
c) If the pressure is raised the system will move to the side which **lowers/decreases** the pressure. It does this by making **fewer** gas molecules. Therefore the equilibrium will move to the **right**-hand side making **more** ammonia. The actual pressure used is around **250** atmospheres.
d) In the Haber process an **iron** catalyst is used to lower the amount of **energy** needed for the reaction and to **increases** the rate.
e) The forward reaction is exothermic and is therefore favoured by a **lower** temperature. This would make the reaction too **slow** and therefore a compromise temperature of **450**°C is used. This makes **less** ammonia but makes it more quickly.

1 mark each = 32 marks

C2.6 Electrolysis

Name: **Class:**

In each of these sentences select the correct alternatives.

1 a) Electrolysis is the **decomposition/synthesis** of a substance to give **simpler/more complex** substances. The substance being electrolysed has to be an **ionic/covalent** compound.

b) The substance being **decomposed/synthesised** is called the **electrolyte/voltameter**.

c) In electrolysis the electric current enters and leaves the **electrolyte/voltameter** by **insulating/conducting** rods called **diodes/electrodes.** The positive **diode/electrode** is called the **anode/cathode** and the negative **diode/electrode** is called the **anode/cathode**.

d) For electrolysis to occur the **electrolyte/voltameter** must be in **liquid/solid** form so that the **molecules/ions** are free to move.

e) In electrolysis the negative ions move towards the **anode/cathode**. When they get there they **gain/lose** electrons to form **neutral/charged** atoms. The positive ions move towards the **anode/cathode**. When they get there they **gain/lose** electrons to form **neutral/charged** atoms.

2 Complete the following electrode half-equations. [Higher]

a) $2Br^- \rightarrow Br_2 + ...e^-$ b) $..... \rightarrow Cl_2 + 2e^-$

c) $2O^{2-} \rightarrow ..... + 4e^-$ d) $Na^+ + e^- \rightarrow .....$

e) $Ca^{2+} + ... \rightarrow .....$ f) $..... + 2..... \rightarrow Mg$

3 a) Brine is a solution of .... in water. The solution contains four ions. These come from the NaCl and the H_2O.

From NaCl they are ..... and ..... ions. From H_2O they are ..... and ..... ions.

b) The incomplete symbol equation for the reaction taking place is given below.

i) Complete this equation. [Higher]

.....NaCl(aq) + ...H_2O(l) $\rightarrow$ 2NaOH(aq) + Cl_2(g) + H_2(g)

ii) Write the word equation for the reaction.

.....

iii) Explain these state symbols:

(aq) ..... (l) ..... (g) .....

4 Copper can be purified using electrolysis.

a) Name the electrolyte used for this purification.

b) What is the substance that is used for

i) the anode? ..... ii) the cathode? .....

1 mark each = ____/47

Answers to summary questions

1 a) Electrolysis is the **decomposition** of a substance to give **simpler** substances. The substance being electrolysed has to be an **ionic** compound.
b) The substance being **decomposed** is called the **electrolyte**.
c) In electrolysis the electric current enters and leaves the **electrolyte** by **conducting** rods called **electrodes.** The positive **electrode** is called the **anode** and the negative **electrode** is called the **cathode**.
d) For electrolysis to occur the **electrolyte** must be in **liquid** form so that the **ions** are free to move.
e) In electrolysis the negative ions move towards the **anode**. When they get there they **lose** electrons to form **neutral** atoms. The positive ions move towards the **cathode**. When they get there they **gain** electrons to form **neutral** atoms

2) i) $2Br^- \rightarrow Br_2 + \mathbf{2}e^-$ [Higher]
ii) $\mathbf{2Cl^-} \rightarrow Cl_2 + 2e^-$
iii) $2O^{2-} \rightarrow \mathbf{O_2} + 4e^-$
iv) $Na^+ + e^- \rightarrow \mathbf{Na}$
v) $Ca^{2+} + \mathbf{2e^-} \rightarrow \mathbf{Ca}$
vi) $\mathbf{Mg^{2+}} + 2\mathbf{e^-} \rightarrow Mg$

3 a)**Sodium chloride.**
Na^+ and **Cl^-**
H^+ and **OH^-**

b) i) $\mathbf{2}NaCl(aq) + \mathbf{2}H_2O(l) \rightarrow NaOH(aq) + Cl_2(g) + H_2(g)$ [Higher]
ii) **Sodium chloride(aq)** + **water(l)** → **sodium hydroxide(aq)** + **chlorine(g)** + **hydrogen(g)**
iii) (aq) **aqueous or dissolved in water.**
(l) **liquid.**
(g) **gas.**

4 a) **Copper sulfate solution**.
b) i) **impure copper**, ii) **pure copper.**

1 mark each = 47 marks

C2.7 Acids, alkalis and salts

Name: **Date:**

1 a) All acids ionise in water to give .....$^{+}$ ions.

b) For example, hydrochloric acid, HCl, ionises as follows:

HCl $\rightarrow$ ..... + Cl^{-}

c) All alkalis ionise in water to give ..... ions.

d) For example, sodium hydroxide, NaOH, ionises as follows:

NaOH $\rightarrow$ ..... + OH^{-}

e) The acidity of a solution is measured using the ..... scale. The lower the ..... the ..... the acid.

Neutral ..... has the value of .....

f) ..... are coloured substances that have different ..... in the presence of acids and alkalis. Universal indicator is a mixture of ..... . It is ..... with strong acid and ..... with strong alkali. At neutral pH it is ..... in colour.

2 Salts are substances that contain a metal (or ammonium) part and an acid part.

a) Fill in this table.

Name of acid	Type of salt formed
Hydro**chlor**ic	
Sulfuric	
Nitric	

b) Salts can be made by reacting acids with reactive metals.

The general equation is: acid + metal $\rightarrow$ salt + hydrogen

Complete this table.

	Acid	Metal	Name of salt	Other product
	Hydrochloric	Magnesium		
Equation for reaction	….HCl + Mg $\rightarrow$ $MgCl_2$ + …….			
	Sulfuric	Zinc		
Equation for reaction	…… + Zn $\rightarrow$ $ZnSO_4$ + …….			

Continued …

c) Salts can be made by reacting acids with insoluble metal oxides or hydroxides called **bases**.

The general equation is: acid + insoluble base → salt + water

Complete this table.

	Acid	Insoluble base	Name of salt	Other product
	Nitric	Magnesium oxide		
Equation for reaction	….HNO_3 + MgO → $Mg(NO_3)_2$ + …….			
	Sulfuric	Copper oxide		
Equation for reaction	……. + CuO → $CuSO_4$ + …….			

d) When preparing a salt from an insoluble base and acid, the acid is usually ..... . This speeds up the reaction. The base is added until it stops ..... . This tells us when the ..... is finished and all the acid has ..... . The unreacted base is then ..... off. The water can be ..... off by gentle ..... . The solution is then left for ..... to form.

e) If an acid and an alkali are used to form a salt, there is no way of seeing when the reaction is ..... . Therefore we use an ..... to tell us when this happens. The ..... changes colour when enough alkali has been added to ..... the acid.

1 mark each = ____/46

Answers to summary questions

1 a) **H^+**

b) $HCl \rightarrow \mathbf{H^+} + Cl^-$

c) **OH^-**

d) $NaOH \rightarrow \mathbf{Na^+} + OH^-$

e) The acidity of a solution is measured using the **pH** scale. The lower the **pH** the **stronger** the acid. Neutral **pH** has the value of **7**.

f) **Indicators** are coloured substances that have different **colours** in the presence of acids and alkalis. Universal indicator is a mixture of **indicators**. It is **red** with strong acid and **purple** with strong alkali. At neutral pH it is **green** in colour.

2 a)

Name of acid	Type of salt formed
Hydrochloric	**chloride**
Sulfuric	**sulfate**
Nitric	**nitrate**

b)

	Acid	Metal	Name of salt	Other product
	Hydrochloric	Magnesium	**Magnesium chloride**	**Hydrogen**
Equation for reaction	**2**HCl +	Mg →	$MgCl_2$ +	**H_2**
	Sulfuric	Zinc	**Zinc sulfate**	**Hydrogen**
Equation for reaction	**H_2SO_4** +	Zn →	$ZnSO_4$ +	**H_2**

c)

	Acid	Insoluble Base	Name of salt	Other product
	Nitric	Magnesium oxide	**Magnesium nitrate**	**Water**
Equation for reaction	**2**HNO_3 +	MgO →	$Mg(NO_3)_2$ +	**H_2O**
	Sulfuric	Copper oxide	**Copper sulfate**	**Water**
Equation for reaction	**H_2SO_4** +	CuO →	$CuSO_4$ +	**H_2O**

d) When preparing a salt from an insoluble base and acid, the acid is usually **warmed/heated**. This speeds up the reaction. The base is added until it stops **dissolving**. This tells us when the **reaction** is finished and all the

Continued …

acid has **reacted/been used up**. The unreacted base is then **filtered** off. The water can be **evaporated** off by gentle **heating**. The solution is then left for **crystals** to form.

e) If an acid and an alkali are used to form a salt, there is no way of seeing when the reaction is **complete/finished**. Therefore we use an **indicator** to tell us when this happens. The **indicator** changes colour when enough alkali has been added to **neutralise** the acid.

1 mark each = 46 marks

Name: **Class:**

Additional chemistry

1 Match these substances with the descriptions (a) to (e):

diamond, hydrogen chloride, magnesium, neon, sodium chloride

(a) A compound made of small molecules. .....

(b) A gas at room temperature made of single atoms. .....

(c) A giant lattice of atoms that are covalently bonded. .....

(d) An ionic solid with a high melting point. .....

(e) A giant lattice that conducts electricity when it is solid. ..... *(5 marks)*

2 (a) Draw a dot and cross diagram to show the electron arrangement of a lithium atom, atomic number 3.

(2 marks)

(b) Draw a dot and cross diagram to show the electron arrangement of a fluorine atom, atomic number 9.

(2 marks)

(c) Draw dot and cross diagrams to show the ions in lithium fluoride.

(3 marks)

3 Complete the table that shows information about some atoms.

Symbol	Atomic number	Mass number	Number of protons	Number of neutrons	Electron arrangement of atom	Formula of ion	Electron arrangement of ion
Al	13	27	(a)	14	(b)	Al^{3+}	$[2,8]^{3+}$
O	8	16	8	(c)	2,6	O^{2-}	(d)
K	19	(e)	19	20	2,8,8,1	(f)	$[2,8,8]^{+}$
Cl	17	35	17	(g)	2,7	Cl^{-}	(h)

(8 marks)

Continued …

4 A student added 20 g of marble chips to 50 cm^3 of dilute hydrochloric acid in a conical flask. The flask was put onto a balance. The table shows the mass of gas that was given off. Some marble chips were left in the flask at the end of the reaction.

Mass of gas given off (g)	0	0.14	0.27	0.38	0.47	0.51	0.57	0.59	0.60
Time (minutes)	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0

(a) Plot a graph of the results. Put time on the horizontal axis and mass lost on the vertical axis. Draw a smooth line through the points, omitting any result that is anomalous. *(5 marks)*

(b) The rate of this reaction decreases with time. Explain how you can tell this from the graph.

..... *(1 mark)*

The student decided to extend his work to see if temperature affected the rate at which the gas was produced.

(c) (i) Suggest one control variable he should use.

..... *(1 mark)*

(ii) Describe how he would control that variable.

..... *(1 mark)*

(d) Suggest a suitable range of temperatures he could use.

..... *(1 mark)*

(e) Suggest a suitable interval between temperatures.

..... *(1 mark)*

(f) Use the first set of data to suggest a suitable length of time to leave the reaction.

..... *(1 mark)*

Continued …

5 Complete the table that shows information about the electrolysis of different substances. Carbon electrodes were used.

Substance	Positive ions present	Negative ions present	Product at negative electrode	Product at positive electrode
Molten magnesium chloride	Mg^{2+}	Cl^-	magnesium	(a)
Aqueous solution of potassium chloride	K^+ H^+	(b)	hydrogen	chlorine
Dilute sulfuric acid	(c)	SO_4^{2-} OH^-	hydrogen	oxygen
Aqueous solution of copper(II) sulfate	Cu^{2+} H^+	SO_4^{2-} OH^-	(d)	(e)

(5 marks)

6 Ammonium sulfate $(NH_4)_2SO_4$, is an important fertiliser. It is made by reacting ammonia solution with sulfuric acid. The reaction can be represented by the equation:

$$H_2SO_4(aq) + 2NH_4OH(aq) \rightarrow (NH_4)_2SO_4(aq) + 2H_2O(l)$$

(a) How can you tell from the equation that ammonium sulfate is soluble?

..... *(1 mark)*

(b) (i) Which ions make the sulfuric acid solution acidic?

..... *(1 mark)*

(ii) Which ions make the ammonia solution alkaline?

..... *(1 mark)*

(iii) What name is used to describe the reaction between these ions?

..... *(1 mark)*

(c) A student made 15.4 g of ammonium sulfate from 0.2 moles of sulfuric acid.

(i) What is the mass of one mole of ammonium sulfate?

.....

..... *(2 marks)*

Continued …

(ii) What mass of ammonium sulfate can be made from 0.2 moles of sulfuric acid, according to the equation?

..... *(1 mark)*

(iii) What was the percentage yield of ammonium sulfate obtained by the student?

.....

..... *(2 marks)*

[Higher]

Total = ___/44 marks

Additional chemistry

1 (a) hydrogen chloride

(b) neon

(c) diamond

(d) sodium chloride

(e) magnesium *(1 mark each, total **5 marks**)*

2 (a) Li or dot at centre of two concentric circles, inner circle with two dots/crosses, outer circle with one dot/cross. *(all correct = **2 marks**, one error or omission = 1 mark)*

(b) For dot at centre of two concentric circles, inner circle with two dots/crosses, outer circle with seven dots/crosses. *(all correct = **2 marks**, one error or omission = 1 mark)*

(c) Lithium ion: EITHER Li^+ or $[Li]^+$ OR Li at centre of circle with two dots/crosses (with brackets) and $^+$ at top right-hand side. ***(1 mark)***
Fluoride ion: EITHER F at centre of two concentric circles with two dots/crosses on inner circle and eight dots/crosses on outer circle (surrounded by brackets) with $^-$ at top right-hand side OR F surrounded by eight dots/crosses with $^-$ at top right-hand side. ***(2 marks)***
(It is acceptable to show only the outer electrons in bonding diagrams)

3 (a) 13

(b) 2,8,3

(c) 8

(d) $[2,8]^{2-}$ *(allow 2,8)*

(e) 39

(f) K^+

(g) 18

(h) $[2,8,8]^-$ *(allow 2,8,8)* *(1 mark each, total **8 marks**)*

4 (a) *One mark each for:*
- Both axes labelled.
- Suitable scales used.
- All points correctly plotted (+/– half small square).
- Smooth line through points.
- Omitting point at 5 minutes. ***(5 marks)***

(b) Slope/gradient decreases with time OR slope/gradient/line is steeper at the beginning or becomes less steep or levels off. ***(1 mark)***

(c) (i) E.g. concentration of acid; size of marble chips. ***(1 mark)***
(ii) Linked to the above e.g. ensure that the same concentration of acid is used for each temperature. ***(1 mark)***

(d) E.g. 20°C to 60°C – reasonable within practical and safety limits. ***(1 mark)***

(e) At least five, equally spaced. ***(1 mark)***

(f) About four minutes. ***(1 mark)***

Continued…

5 (a) chlorine ***(1 mark)***

(b) Cl^- and OH^- *(accept with correct state symbols, i.e. aq)* ***(1 mark)***

(c) H^+ *(accept H_3O^+, $H^+(aq)$, $H_3O^+(aq)$)* ***(1 mark)***

(d) copper ***(1 mark)***

(e) oxygen ***(1 mark)***

6 (a) Its state symbol is (aq)/it is aqueous. ***(1 mark)***

(b) (i) Hydrogen ions/H^+/$H^+(aq)$/H_3O^+/$H_3O^+(aq)$. ***(1 mark)***
(ii) Hydroxide ions/OH^-/$OH^-(aq)$. ***(1 mark)***
(iii) Neutralisation. ***(1 mark)***

(c) (i) 132 g *(**2 marks** for correct answer with units)*
(correct working, e.g. $(14 + 4) \times 2 + 32 + (16 \times 4)$ *gains 1 mark)*
(ii) 26.4 g ***(1 mark)***
(iii) 58.3% *(**2 marks** for correct answer)*
(correct working, e.g. $15.4 \times 100/26.4$
(e.c.f. from (ii) can gain 2 marks)

Total = 44 marks