

Name: .....

School Year: .....

School: .....

Answer all questions in the spaces provided.

Please write your answers clearly.

The total marks allocated to the paper are 40 marks (Section A 10 marks, Section B 30 marks)

The time allocated to the paper is 30 minutes.

Scoring: Section A ..... / 10

Section B ..... / 30

Total ..... / 40

### SECTION A General chemistry knowledge

1. Name **two** elements that are liquid at room temperature (2 marks)

*bromine and mercury* .....

2. Four new elements were added to the Periodic Table at the start of 2016.

Name any **one** of the elements. (1 mark)

*ununtrium / ununpentium / ununseptium / ununoctium (any one, must be spelt correctly)* .....

3. Name the element that can exist in one of three allotropes; diamond, graphite or fullerene. (1 mark)

*carbon* .....

4. Name the radioactive element, an isotope of which was believed to be used to poison the Russian security agent, Alexander Litvinenko in 2006. (1 mark)

*polonium (-210) ignore 210* .....

5. The phrase 'as mad as a hatter' is believed to be a result of hat makers being exposed to the vapours of which element during the hat making process. (1 mark)

*mercury* .....

6. Name the process you would use to separate a liquid from an **insoluble** solid. (1 mark)

*filtration / filtering (or any variation)* .....

7. Name the process you would use to separate a liquid from a soluble solid. (1 mark)

*distillation (ignore fractional or simple)* .....

8. Name the compound found in dry ice. (1 mark)

*carbon dioxide (must be name, not chemical formula)* .....

9. State the chemical name for vinegar. (1 mark)

*ethanoic acid* .....

**Total: 10 marks**

**SECTION B Questions linked to this year's theme of Energy**

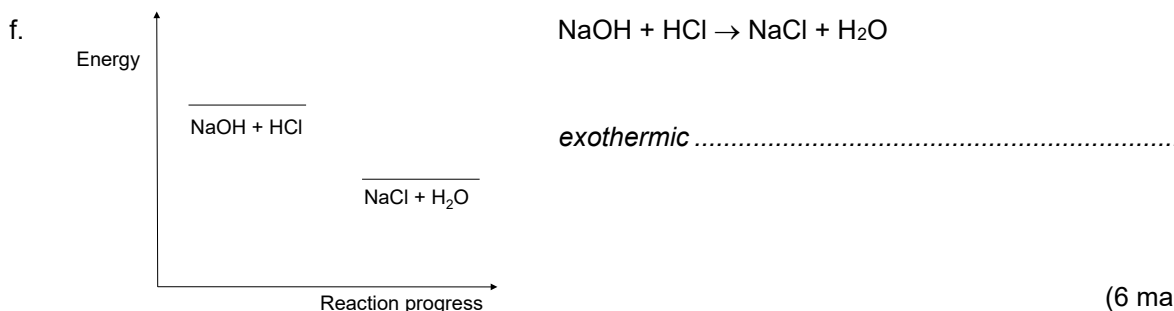
10. An **endothermic process** is a process that *takes in energy from the surroundings*.

An **exothermic process** is a process that *gives out energy to the surroundings*.

For example respiration is an example of an exothermic process as energy is given out during the process.

State if the following processes are **endothermic** or **exothermic**;

- a. evaporation - *endothermic*.....
- b. melting an ice cube - *endothermic* .....
- c. burning wood - *exothermic* .....
- d. photosynthesis - *endothermic* .....
- e. thermal decomposition of copper carbonate - *endothermic* .....



11. A student is investigating the reaction of magnesium metal with hydrochloric acid. She reacts 25 cm<sup>3</sup> of hydrochloric acid with a concentration of 1 mol/dm<sup>3</sup> with a 3 cm strip of magnesium ribbon.

a. i. Complete the word equation for the reaction. (1 mark)

magnesium + hydrochloric acid → *magnesium chloride + hydrogen*.....  
*(both products correctly named for 1 mark)*.....

ii. Write a balanced symbol equation for the reaction. (2 marks)

$Mg + 2HCl \rightarrow MgCl_2 + H_2$  *(1 mark correct symbols, 1 mark balancing)*.....

b. The hydrochloric acid is **in excess**. Explain what this means. (1 mark)

*The hydrochloric acid doesn't control/limit the amount of products produced / some hydrochloric acid will be left over unreacted at the end of the reaction (or words to this effect)* .....

The student measures the temperature change during the experiment. Her results are shown in the table below;

Temperature of hydrochloric acid at start / °C	18.5
Temperature of hydrochloric acid at end / °C	21.5
Temperature change / °C	3.0 (must be .0)

- c. i. Complete the table by calculating the temperature change for the experiment. (1 mark)
- ii. State if the reaction is **endothermic** or **exothermic**. (1 mark)

*exothermic* .....

- d. The student wishes to investigate what effect increasing the volume of hydrochloric acid will have on the temperature change recorded.
- i. Describe the experiment the student could carry out to investigate how increasing the volume of hydrochloric acid affects the temperature change.

Include details about how to make the experiment a fair test. (4 marks)

*Repeat the experiment using:*.....

- *same amount / 3 cm strip of magnesium ribbon (1 mark)* .....

- *same concentration of hydrochloric acid (1 mark)* .....

- *double / increased volume of hydrochloric acid (1 mark)* .....

*Record the new temperature change or description of recording temperature at start and at end (1 mark)* .....

.....

.....

.....

- ii. A **hypothesis** is an idea about what will happen in an experiment.

Write a hypothesis to predict what effect increasing the volume of the hydrochloric acid will have on the temperature change observed.

Explain the reasons behind your hypothesis. (3 marks)

*The more hydrochloric acid used the lower the temperature change (1 mark)*.....

*Same amount of magnesium reacting so same energy given out (1 mark)*.....

*But a larger volume of solution to heat up with this energy resulting in a lower temperature change (1 mark)*.....

## 12. Humans obtain the energy they need to survive from the food they eat.

The energy content of foods is given along with other nutritional information on the side of a food packet.

Josh looks at this label on a packet of biscuits. It shows the nutritional information for **100 g** of biscuits.

Nutrient	Value
Energy / kJ	2179
Energy / kcal	521
Fat / g	27.3
of which saturates / g	15.8
Carbohydrates / g	61.3
of which sugars / g	40.1
Fibre / g	2.5 g
Protein / g	6.3 g

- a. If one biscuit has a mass of 10 g, calculate the energy content in kJ in a single biscuit. (1 mark)

$2179 \text{ kJ} / 10 = \underline{217.9 \text{ kJ or } 218 \text{ kJ}}$  .....

- b. The Guideline Daily Amount (GDA) for energy is 2000 kcal. Calculate the percentage of the GDA for energy in 100 g of biscuits. (2 marks)

$\text{Energy in } 100 \text{ g of biscuits} = 521 \text{ kJ (1 mark)}$  .....

$\text{As percentage of GDA} = (521 / 2000) \times 100\% = 26.05 / 26.1 / 26 \% (1 \text{ mark})$  .....

- c. Using the information in the table, calculate the amount of energy in kJ that is equivalent to 1 kcal. (1 mark)

$521 \text{ kcal} = 2179 \text{ kJ}$  .....

$1 \text{ kcal} = (2179 / 521) \text{ kJ}$  .....

$1 \text{ kcal} = \underline{4.18}$ ..... kJ

(allow any accuracy)

13. Combustion is an **exothermic** process. Heat energy is given out from the combustion of a fuel.

- a. Complete the diagram of the fire triangle by writing the three elements a fire needs to ignite around the edges of the triangle. (3 marks)



- Heat
  - Fuel
  - Oxygen
- (in any order)

(Image © Shutterstock)

- b. Complete combustion of any fuel requires a plentiful supply of oxygen and produces carbon dioxide and water only.

Write a balanced symbol equation for the complete combustion of ethanol, C<sub>2</sub>H<sub>5</sub>OH. (2 marks)

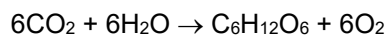
*C<sub>2</sub>H<sub>5</sub>OH + 3O<sub>2</sub> → 2CO<sub>2</sub> + 3H<sub>2</sub>O (1 mark symbols, 1 mark balancing) (allow multiples) .....*

Many conventional petrol engines will run on ethanol, or mixtures of petrol and ethanol. Much of the petrol sold in the UK at present has 5-10% ethanol added.

One method for producing ethanol is via the fermentation of glucose. A balanced symbol equation for fermentation is shown below;



The glucose needed for fermentation is made from plants during photosynthesis. A balanced symbol equation for fermentation is shown below;



- c. Ethanol made by fermentation is sometimes termed **carbon neutral**. This means that the *carbon dioxide released when it is produced and burnt is balanced by the carbon dioxide absorbed by the plant from which it is originally obtained, during photosynthesis.*

Use the equations above and your answer part (b) to prove that ethanol is a carbon neutral fuel.

CO<sub>2</sub> taken in during photosynthesis = 6 CO<sub>2</sub> (6CO<sub>2</sub> + 6H<sub>2</sub>O → C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> + 6O<sub>2</sub>).....

CO<sub>2</sub> given out during fermentation = 2 CO<sub>2</sub> (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> → 2C<sub>2</sub>H<sub>5</sub>OH + 2CO<sub>2</sub>).....

CO<sub>2</sub> given out during combustion of fuel = 4 CO<sub>2</sub> (2C<sub>2</sub>H<sub>5</sub>OH + 6O<sub>2</sub> → 4CO<sub>2</sub> + 6H<sub>2</sub>O)

Total in 6CO<sub>2</sub> (1 mark) = total out 4+2 CO<sub>2</sub> (1 mark) ..... (2 marks)

*Essentially 2 marks here for demonstrating that total CO<sub>2</sub> taken in = total CO<sub>2</sub> given out*

**Total: 30 marks**