WESTMINSTER SCHOOL
THE CHALLENGE 2014

CHEMISTRY

Thursday 1 May 2014

Time allowed: 30 minutes

Please write in black or blue ink.

Write your answers in the spaces provided.

For examiner use only

Total Mark	

Blank Page

C1 This question is about chemical changes

Complete the following word equations by filling in the gaps:

(a) zinc + copper oxide → _____ + _____

(b) oxygen + hydrogen → _____

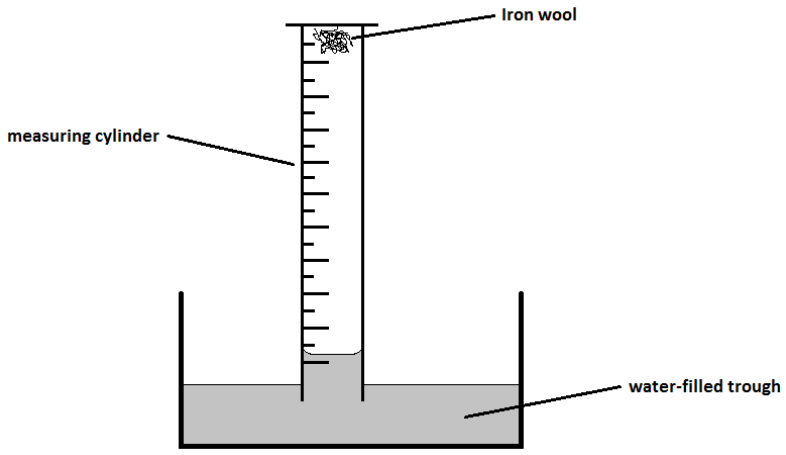
(c) sodium hydroxide + _____ → sodium chloride + water

(d) methane + oxygen → _____ + _____

[Total: 6]

C2 This question is about measuring the composition of the air

A Westminster student wants to determine the composition of air. She sets up the following apparatus and records the volume of gas in the upturned measuring cylinder at 9 am every day for 10 days. No air leaks in or out of the measuring cylinder.



Day	Volume of gas / cm^3
1	97.5
2	94.3
3	91.7
4	89.6
5	87.9
6	86.4
7	85.3
8	84.3
9	83.5
10	82.9

(a) Explain why the water level rises as the experiment proceeds.

……

……

(1)

(b) Using the graph paper on the opposite page plot these results. You should choose a suitable axis.

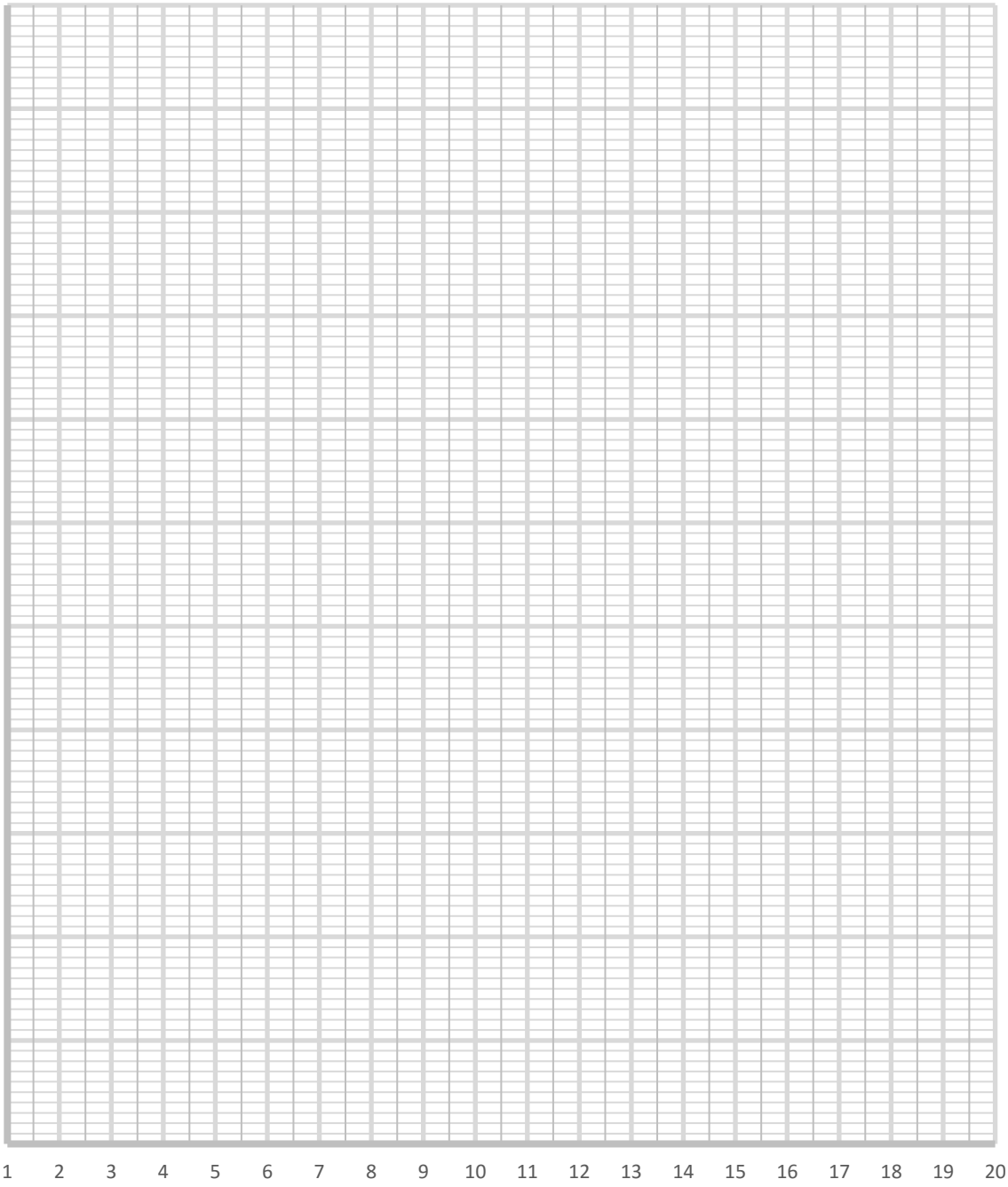
(2)

(c) The student says her experiment is not complete after 10 days. How does the data support this statement?

……

(1)

Volume of air vs time



(d) Estimate the final volume of air when the experiment has finished and hence calculate the percentage of oxygen in the air.

Final Volume ……..… cm^3

Percentage of oxygen in air ……..… %

(3)

(e) The accepted percentage of oxygen in the air is 21%. Compare this value to your answer to part (d) and explain any difference.

……..…

……..…

(1)

(f) The student weighed the iron wool both before and after the experiment. Which of the following statements about the iron wool is true (circle the correct letter)?

A The mass has decreased during the experiment

B The mass remains the same

C The mass has increased during the experiment

(1)

(g) The iron wool starts off a shiny metallic grey colour. What colour is it at the end of the experiment?

……..…

(1)

(h) The student places a glowing splint in the gas remaining at the end of the experiment. Predict what happens to the splint.

……..…

……..…

(1)

[Total: 11]

C3 This question is about the preparation of an inorganic salt

Another Westminster student wants to prepare a sample of copper sulphate crystals. He finds a copy of the Westminster School Chemistry IGSCE Revision Guide lying around and notices the rules that help predict the solubility of salts:

- all common sodium and potassium salts are soluble
- all nitrates are soluble
- common chlorides are soluble, except silver chloride
- common sulphates are soluble, except those of barium and calcium
- common carbonates are insoluble, except those of sodium and potassium

The student decides to use the following chemical reaction to prepare his copper sulphate crystals:

copper carbonate + sulphuric acid → copper sulphate + carbon dioxide + water

The steps he follows are:

1. Add an excess of copper carbonate to sulphuric acid whilst gently warming and stirring.
2. ……
3. Heat the remaining solution to evaporate half the water.
4. Leave solution to crystallize.
5. Dry crystals.

(a) Describe two observations that the student would make in step 1.

……..…

……..…

(2)

(b) Fill in the missing step 2 above.

(1)

(c) Why is the copper carbonate added in excess?

……

……

(1)

(d) Copper carbonate contains impurities such as copper oxide and copper hydroxide. Why will this not lower the yield of crystals the student obtains?

……

……

(1)

(e) Why could this method not be used to prepare barium sulphate from barium carbonate?

……

……

……

(1)

(f) Using the information given on the opposite page, describe the procedure you would follow to prepare a dry sample of barium sulphate:

……

……

……

……

(3)

[Total: 9]

C4 This question is about identifying unknown substances

(a) A sample of an unknown element **Q** is burnt in air. The product is collected and dissolved in water to give an acidic solution. A solid sample of **Q** is found to conduct electricity.

i. What information can be deduced about the identity of element **Q** from the nature of the resulting solution?

……

(1)

ii. Describe an experiment you could perform to show that the solution is acidic.

……

……

……

(2)

iii. Suggest the identity of element **Q**.

……

(1)

(b) When 10 g of compound **X**, a white powder, is heated for 6 hours at 1000°C, the mass of white powder remaining at the end is 5.6 g. When this is added to hydrochloric acid it dissolves to give a clear, colourless solution, with no other observations. When another sample of compound **X** is added directly to hydrochloric acid, vigorous effervescence is observed.

i. Suggest the identity of compound **X**.

……..…

(1)

ii. What has happened to the missing 4.4 g?

……..…

……..…

(1)

iii. What is the name given to the type of reaction when compound **X** is heated?

……..…

(1)

[Total: 7]

[Total marks for this section: 33]

END OF CHEMISTRY SECTION