WESTMINSTER SCHOOL

THE CHALLENGE 2015

CHEMISTRY

Thursday 30 April 2015

Time allowed: 30 minutes

Please write in black or blue ink.

Write your answers in the spaces provided.

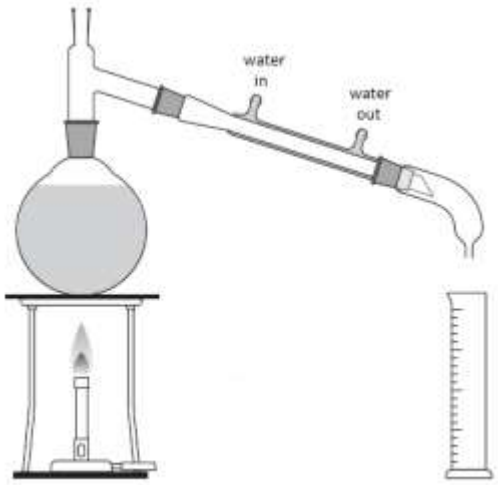
For examiner use only

Total Mark	

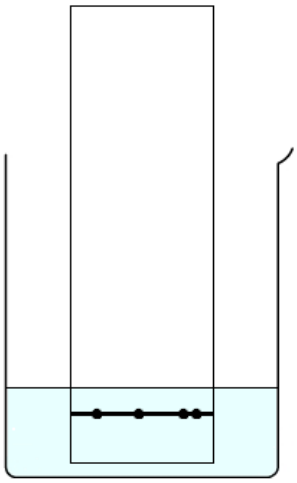
Blank Page

C1 This question is about separation techniques in chemistry

Below are two diagrams of apparatus used to perform separations.



Distillation



Chromatography

Identify five mistakes in the setup of the apparatus above. You should state the diagram to which you are referring and a brief description of the mistake.

Mistake 1 ……

……

Mistake 2……

……

Mistake 3……

……

Mistake 4……

……

Mistake 5……

……

[Total: 5]

C2 This question is about the preparation of salts

A salt is the product of a neutralisation reaction between an acid and either a metal oxide, metal hydroxide or metal carbonate. Sodium chloride is the most common salt.

a) Write the formula for sodium chloride.

……

[1]

b) Name a combination of reactants that would produce sodium chloride in a neutralisation reaction.

……

[1]

A sample of solid sodium chloride is accidently mixed with copper carbonate.

c) What would this mixture look like?

……

[1]

d) Design a procedure that would allow a student in your year group to prepare a pure, dry sample of solid copper sulphate from this mixture of sodium chloride and copper carbonate, making sure you state the name of any other reactants used.

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[5]

e) Apart from copper carbonate, name one other copper containing compound from which you can prepare copper sulphate.

……

[1]

[Total: 9]

C3 This question is about the solubility of salts

Potassium nitrate is a salt used in fertilisers and in fireworks. It dissolves readily in water at room temperature, but its solubility changes as the temperature of the water increases.

John decides to measure the solubility of potassium nitrate at different temperatures. He organizes his class so that they add different masses of potassium nitrate to different volumes of water and then warm the test tubes until all the solid dissolves. He then asks the students to record the temperature at which the solid first crystalises back out. At this point the solution is saturated and the solubility at this temperature can be calculated in grams of solute per 100 cm^3 of solvent. The following data was obtained.

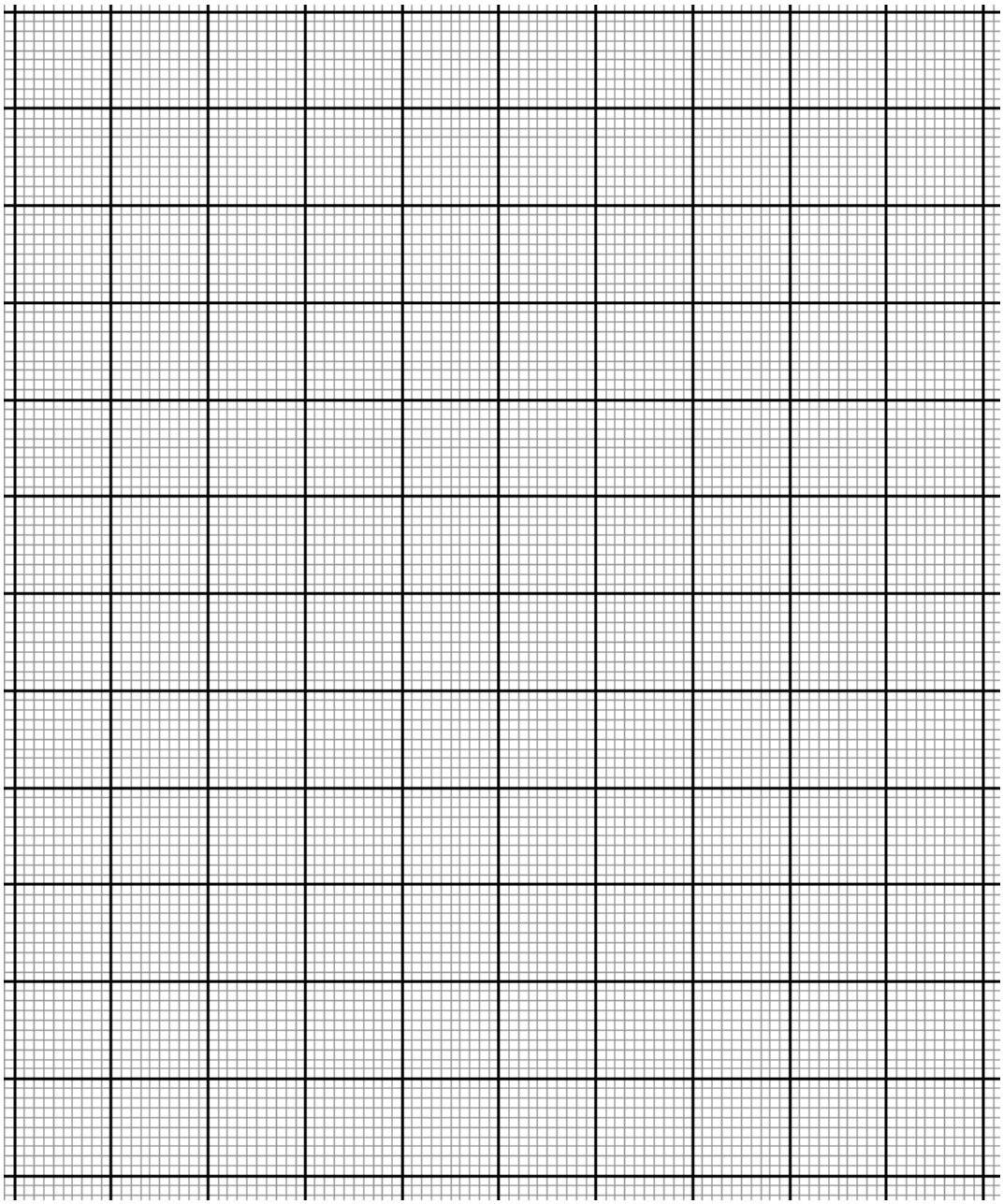
Mass of potassium nitrate (g)	Volume of water (cm^3)	Temperature of crystalisation (°C)	Solubility (g / 100 cm^3)
6.0	5	66	120
10.6	10	60	106
12.6	15	50	84
16.3	25	40	65
17.5	35	31	50
13.2	40	20	
11.0	50	10	22

a) Calculate the missing solubility value in the table.

[2]

b) Plot a graph of solubility on the vertical axis against temperature on the horizontal axis on the graph paper on the adjacent page. You should choose an appropriate scale.

[2]



c) Using your graph, calculate the maximum amount of potassium nitrate that could be dissolved in one litre (1000 cm^3) of water at 55°C.

[2]

d) One of John's class mates says that the solubility in water should be measured in 'grams of solute per 100 g of water', rather than 'grams of solute per 100 cm^3 of water'. Why are the values the same regardless of which of these units John chooses?

……

[1]

e) For any given temperature potassium nitrate is less soluble in the solvent propanone than it is in water. Using the same axes above, draw and label a line to show how the solubility of potassium nitrate might vary with temperature in **propanone**.

[1]

[Total: 8]

C4 This question is about combustion

10.0 g of substance **X,** a white powder, is combusted in pure oxygen producing 20.7 g of a mixture of two gases **A** and **B**. Gas **A** condenses at 100°C to give 6 g of a clear colourless liquid. Gas **B** is bubbled through limewater, turning it cloudy.

a) Calculate (i) the mass of oxygen that has reacted with **X** and (ii) the mass of gas **B**.

[2]

b) What is the boiling point of gas **A**?

……

[1]

c) Suggest the identity of gas **A**. You can give a name or formula.

……

[1]

d) What is the **formula** of gas **B**?

……

[1]

e) Predict the pH of the solution that is formed when gas **B** is bubbled through water.

……

[1]

f) Name **two** elements that are definitely present in substance **X**.

……

[2]

g) Suggest a possible identity of substance **X** consistent with the information above.

……

[1]

[Total: 9]

C5 This question is about the reactivity series

The elements aluminium, chromium and manganese are all moderately reactive metals. Use the following information to arrange them in order of decreasing reactivity, i.e. starting with the most reactive one.

- Chromium is manufactured by heating chromium oxide with aluminium.
- If manganese is heated with aluminium oxide, there is no reaction.
- If manganese is heated with chromium oxide, chromium is produced.

……

[2]

[Total: 2]

[Total marks for this section: 33]

END OF CHEMISTRY SECTION