OCR
Oxford Cambridge and RSA

Accredited

A Level Chemistry B (Salters)
H433/03 Practical skills in chemistry
Sample Question Paper

Date – Morning/Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the Insert
- the Data Sheet for Chemistry B (Salters)

You may use:
- a scientific or graphical calculator

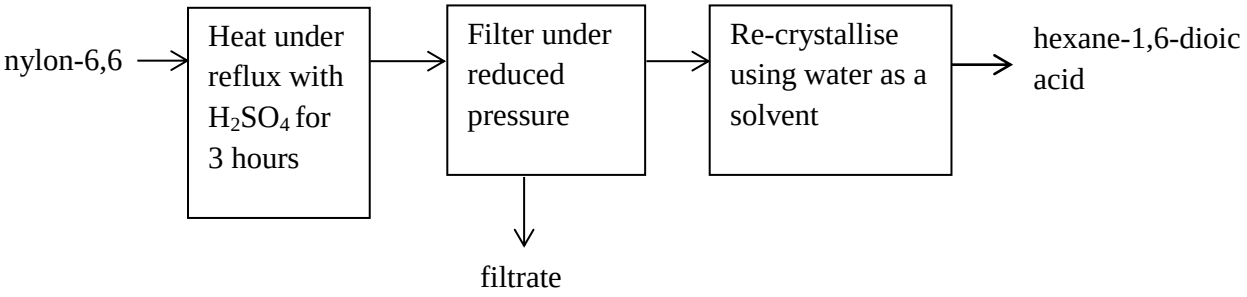
First name	
Last name	
Centre number	Candidate number

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **12** pages.

Answer **all** the questions.

1 **(a)** Scientists are investigating how best to recycle polymers including nylon-6,6. One approach is to break the polymer down into its monomers which can be re-used. The following flow chart shows how hexane-1,6-dioic acid can be produced from nylon-6,6.



(i) What is meant by *heating under reflux*?

……

…… **[2]**

(ii) Draw a labelled diagram to show how crystals of hexane-1,6-dioic acid can be collected by filtration under reduced pressure.

[3]

(iii) Describe the main steps involved in carrying out the recrystallization of hexane-1,6-dioic acid using water as a solvent.

In your account, describe what property of hexane-1,6-dioic acid this process depends upon.

……

……

……

……

…… **[4]**

(iv) 0.40 g of pure hexane-1,6-dioic acid (M_r = 146) are obtained from 2.0 g of nylon-6,6.

Calculate the percentage yield of the reaction.

yield = …… % **[2]**

(b) The student adds excess sodium hydroxide solution to the filtrate. The student notices that the mixture develops a 'fishy' smell characteristic of an amine.

Suggest the shortened structural formula of the compound responsible for the 'fishy' smell.

…… **[1]**

2 (a) A group of students set out to investigate the heating effect of volcanic lava on any carbonate rocks that it may flow over. They decide to devise an experiment to compare the thermal stability of magnesium carbonate and calcium carbonate.

The students have access to magnesium carbonate powder, lumps of calcium carbonate, calcium hydroxide powder, distilled water and whatever apparatus they need.

(i)* Describe how the students could carry out their experiment.

You should include in your answer:

- a labelled diagram of the apparatus used to safely heat the carbonate compounds
- the main steps in the experimental procedure and the names of the key apparatus (not included in the labelled diagram)
- the observations and measurements that should be recorded
- how to ensure the comparison is fair and the results are as accurate as possible.

……

……

……

……

……

……

……

……

……

……

…… **[6]**

(ii) The students find that the magnesium carbonate decomposes more readily than calcium carbonate and believe this can be explained by the difference in *charge density* of the magnesium and calcium ions.

What is meant by the term *charge density*?

……

…… **[1]**

(iii) Explain, in terms of the charge densities of the cations, the relative thermal stabilities of magnesium carbonate and calcium carbonate.

……

……

…… **[2]**

(iv) The enthalpy change of reaction, $\Delta_r H$, for the decomposition of magnesium carbonate is +118 kJ mol^{-1}.

The entropies for the compounds in this reaction are given in the table below.

	$MgCO_3$	**MgO**	**CO_2**
***S* / J mol^{-1} K^{-1}**	66	27	214

What is the minimum temperature to which the students must heat the magnesium carbonate powder for decomposition to occur?

Include units in your answer.

Show **all** your working.

minimum temperature = …….. **[3]**

(b) The students also investigate the volume of carbon dioxide released when carbonate rocks decompose.

They carry out an experiment in which a known mass of magnesium carbonate is heated and the gas evolved is collected in a 100 cm^3 gas syringe. The apparatus is allowed to cool to room temperature and the volume of the gas collected is measured.

(i) What is the maximum mass of magnesium carbonate that could be used in this experiment?

maximum mass = **……** g **[1]**

(ii) The students repeat the experiment using the same mass of calcium carbonate instead of magnesium carbonate.

Describe and explain how the volume of gas collected will compare to the volume collected when magnesium carbonate was decomposed.

……

……

…… **[2]**

3 A student investigates the use of spirit burners as alternative heating sources for laboratories without a gas supply.

A spirit burner containing ethanol is weighed. 100 cm^3 of water are measured into a beaker clamped above the spirit burner. The temperature of the water is recorded. The spirit burner wick is lit and allowed to heat the water. The thermometer is used to stir the water. After about 5 minutes the flame of the burner is extinguished, the maximum temperature reached by the water is recorded and the spirit burner is re-weighed.

The student records the following results.

Mass of spirit burner and ethanol before burning / g	20.33
Mass of spirit burner and ethanol after burning / g	18.92
Initial temperature of the water / ^oC	17.5
Maximum temperature reached by the water / ^oC	88.0

(a) (i) The temperatures are measured using a thermometer that has graduation marks at every 1 °C.

Calculate the percentage error associated with the temperature difference in the above results.

Give your answer to **two** significant figures.

percentage error = **……** % **[1]**

(ii) Using the student's results, calculate the enthalpy change of combustion of ethanol.

Assume that the density of water is 1.00 g cm^{-3}.

Show **all** your working.

enthalpy change of combustion = **……** kJ mol^{-1} **[3]**

(b) (i) The student repeats the experiment using a spirit burner containing methanol instead of ethanol. The same mass of fuel is burned in both experiments.

Suggest **two** reasons why the total energy transferred from the spirit burner is different in the two experiments.

……

……

…… **[2]**

(ii) Describe how the student can ensure that the same amount of energy is transferred from the spirit burner in the experiment using methanol as is transferred in the experiment described in **(a)(ii)**.

State the assumption you have made.

……

……

……

…… **[2]**

(c) At the end of the experiments the student notices that there is a black deposit on the bottom of the beaker.

Suggest what this might be and why it might have been formed.

……

……

…… **[2]**

4 This question refers to the ***Practical Insert*** that is provided as an insert to this paper.

(a) **(i)** Name a suitable piece of apparatus (with its size) that could be used to measure 25 cm^3 of dilute sulfuric acid into the conical flask in **Part 1**.

…… **[1]**

(ii) Suggest **two** reasons why the conical flask in **Part 1** was fitted with a bung carrying a capillary tube, apart from loss of spray.

……

……

…… **[2]**

(iii) Use the student's results in **Part 1** to calculate the percentage of iron in the paper clip.

Show **all** your working.

percentage of iron = **……** % **[4]**

(b) (i) In **Part 2**, the student was given a solution labelled '2% Mn'.

Calculate the concentration (in g dm^{-3}) of a solution of potassium manganate(VII) that contains the same concentration of Mn as would be in 100 cm^3 of a solution made from 0.25 g of paper clips if they contained '2% Mn' by mass.

Show **all** your working.

concentration = …… g dm^{-3} **[3]**

(ii) Explain why a '2% Mn' solution made by dissolving potassium manganate(VII) crystals would be more accurate than a '0.5% Mn' solution made using the same method.

……

…… **[1]**

(iii)* Describe how the student could use the '2% Mn' solution and a colorimeter to produce a calibration curve suitable for finding the concentration of manganese in the paper clip solution.

……

……

……

……

……

……

……

……

……

…… **[6]**

(iv) How could the student have improved the line drawn on the calibration graph in **Part 2** without doing further experiments?

……

…… **[1]**

(v) Use the line drawn by the student on the calibration graph to read off a value for the % Mn in the paper clip solution.

…….. **[1]**

(c) (i) In which titration could some of the paper clip solution have been spilled from the pipette onto the bench while it was being transferred to the conical flask?

Explain your answer.

……

……

…… **[2]**

(ii) The student suggests that the concentration of the MnO_4^- ions in the solution made from the paper clips could be determined by titrating it against a standard solution of Fe^{2+} ions.

Why would this method **not** give an accurate result?

……

…… **[1]**

(d) Suggest another method, other than using a titration or a colorimeter, that the student could use to find the concentration of Fe^{2+} ions in a solution made from paper clips.

……

…… **[1]**

END OF QUESTION PAPER