New Specification

Rewarding Learning

Centre Number

Candidate Number

ADVANCED
General Certificate of Education
2018

Chemistry

Assessment Unit A2 3
assessing
Further Practical Chemistry
Practical Booklet B (Theory)

MV18

[ACH32]

WEDNESDAY 20 JUNE, MORNING

Time

1 hour 15 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write on blank pages.
Complete in black ink only.
Answer **all six** questions.

Information for Candidates

The total mark for this paper is 60.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
A Periodic Table of Elements (including some data) is provided.

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1 Complete the table giving the observations and the name of the metal ion. [6 marks]

metal ion	**colour of solution**	**addition of a few drops of dilute ammonia solution**	**addition of excess dilute ammonia solution**
iron(II)	green		
	pink	blue precipitate	
nickel(II)		green precipitate	

2 Two-way paper chromatography can be used to separate a mixture of amino acids. The R_f values of the amino acids, in two different solvents, are shown in the table below.

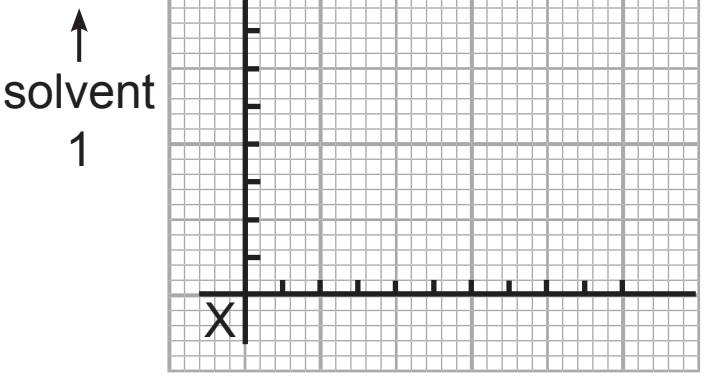
amino acid	**abbreviated name**	**R_f value**	
		solvent 1	**solvent 2**
glycine	gly	0.26	0.20
leucine	leu	0.73	0.58
tyrosine	tyr	0.45	0.42

(a) (i) Explain what is meant by the term **R_f value**.
[1 mark]

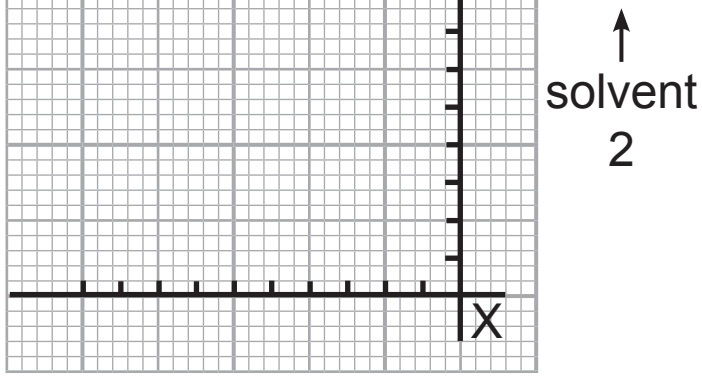
(ii) On the chromatograms below mark:

the position of each solvent front at 5 cm, and
the position of each amino acid labelled with the abbreviated name for the 2-way chromatography of a mixture containing the three amino acids opposite.
[3 marks]

Chromatogram 1

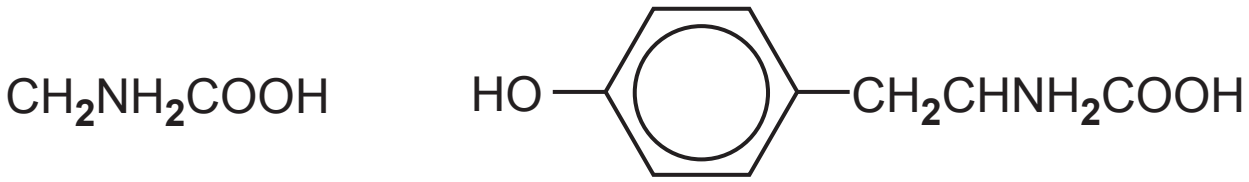


Chromatogram 2



X is the origin

(b) Amino acids can also be identified using infrared spectroscopy. The structures of glycine and tyrosine are shown below.



glycine tyrosine

(i) Using your data sheet identify the characteristic absorption ranges which will be seen on the infrared spectra of both glycine and tyrosine. [2 marks]

(ii) Using your data sheet identify the characteristic absorption range and the associated bond which will be seen on the infrared spectra of tyrosine but not glycine. [1 mark]

(c) Amino acids react with nitrous acid and sodium carbonate.

(i) Name the reagents and the conditions necessary to form nitrous acid. [2 marks]

(ii) Describe what is observed when a solution of glycine is reacted separately with nitrous acid and with sodium carbonate solution. [1 mark]

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3 The formula of a metal hydroxide, $M(OH)_x$, can be determined using a thermometric titration. Different volumes of a solution of the metal nitrate and sodium hydroxide solution were mixed and the temperatures recorded. The following results were obtained.

volume of metal nitrate solution /cm^3	**volume of sodium hydroxide solution /cm^3**	**initial temperature /°C**	**final temperature /°C**	**temperature rise /°C**
20	80	18.6	21.1	2.5
30	70	18.3	22.2	3.9
40	60	18.8		5.2
60	40	19.0	25.0	
70	30	18.2		4.7
80	20	19.0	22.8	

(a) Complete the table. [1 mark]

(b) The graph showing the temperature rise against the volume of the metal nitrate solution is shown opposite (on page 11).

What is the temperature rise and the volume of metal nitrate solution at **X**? [1 mark]

Temperature rise: _____

Volume of metal nitrate solution: _____

(c) Point **X** is used to determine the formula of the metal hydroxide.

The concentration of the metal nitrate solution is 1.0 mol dm^{-3} and the concentration of sodium hydroxide is 3.25 mol dm^{-3}.

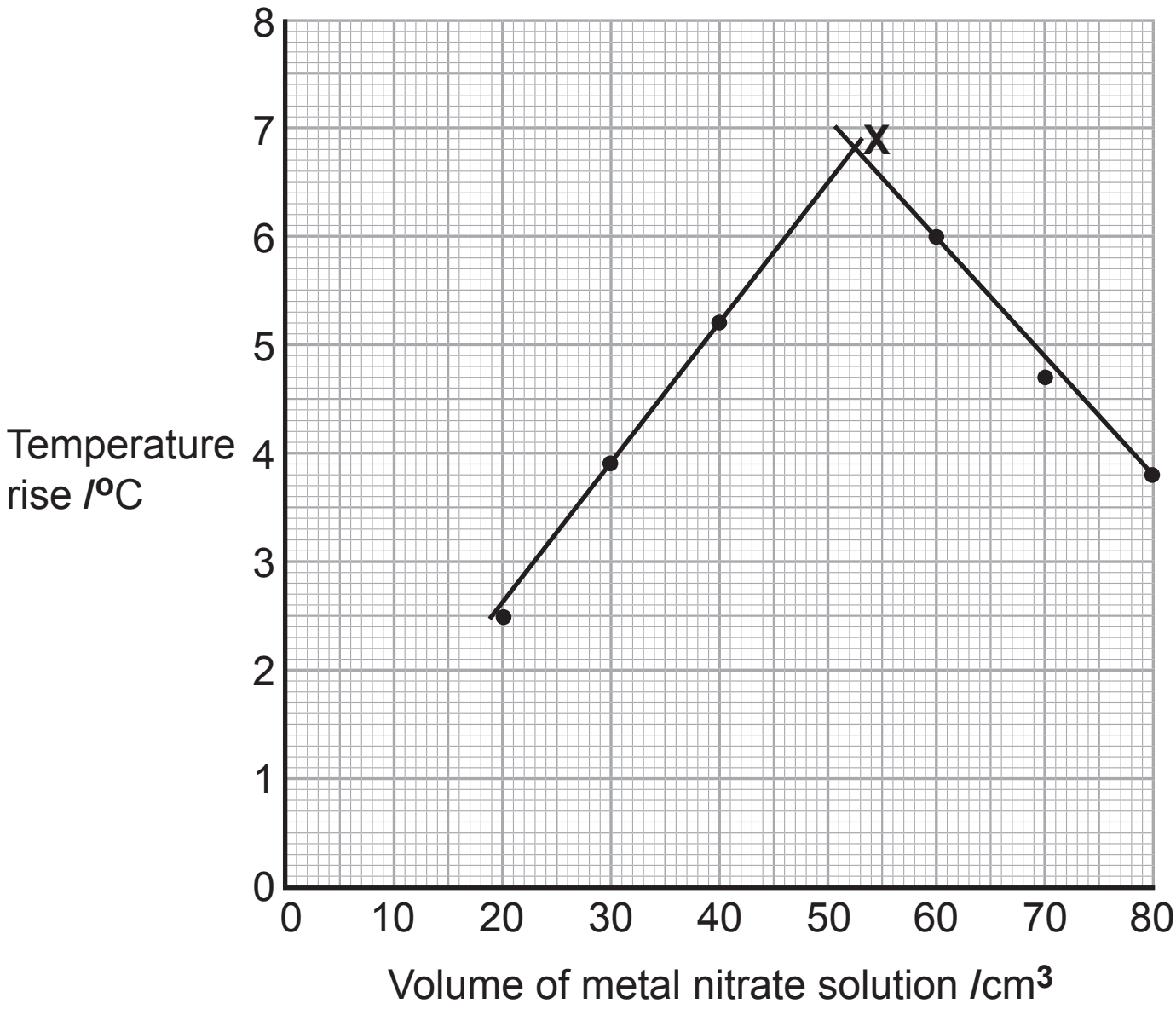
Calculate the ratio of moles of the metal nitrate to sodium hydroxide at point **X** and use this to deduce the formula of the metal hydroxide, $M(OH)_x$. [3 marks]

_____

_____

_____

(d) What differences would there be to the graph if 2.0 mol dm^{-3} sodium hydroxide solution had been used instead of the 3.25 mol dm^{-3} solution? [2 marks]

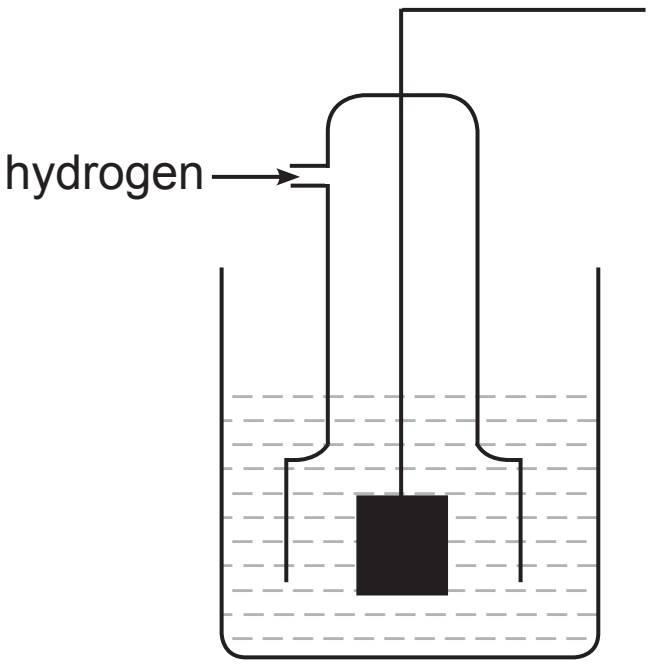


The two lines intersect at **X**

4 Electrode potentials are measured using a standard hydrogen half-cell.

(a) State the conditions required for a standard hydrogen half-cell. [2 marks]

(b) Complete and label the diagram below to show a cell in which the standard electrode potential of a zinc half-cell can be determined using a standard hydrogen half-cell. [4 marks]



(c) Ammonium metavanadate may be reduced using zinc.

(i) Describe how the reduction may be carried out in the laboratory. [2 marks]

_____

_____

_____

(ii) Complete the table below giving the formula and colour of each of the four ions containing vanadium present during the reduction. [4 marks]

ion	colour

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5 Standard potassium manganate(VII) solution is reduced in the absence of acid to form an insoluble oxide.

$MnO_4^- + 2H_2O + 3e^- \rightarrow MnO_2 + 4OH^-$

(a) (i) State the systematic name and suggest the colour of the MnO_2 formed. [2 marks]

(ii) What mass of potassium manganate(VII), given to two significant figures, is required to make 250 cm^3 of 0.0050 mol dm^{-3} potassium manganate(VII) solution? [2 marks]

(b) Iron tablets used as a dietary supplement contain hydrated iron(II) sulfate, $FeSO_4.7H_2O$. The percentage of hydrated iron(II) sulfate in the tablets can be found by titration with acidified potassium manganate(VII).

Five iron tablets were weighed, dissolved in water and the solution made up to 250.0 cm^3 in a volumetric flask. 25.0 cm^3 aliquots of this solution were titrated against 0.0050 mol dm^{-3} acidified potassium manganate(VII) solution and the following results were obtained.

Mass of five iron tablets = 1.85 g

titration	**initial burette reading /cm^3**	**final burette reading /cm^3**
rough	0.0	15.2
1	15.2	29.8
2	29.8	44.6

(i) What is the colour change at the end point? [2 marks]

(ii) Calculate the average titre. [1 mark]

(c) The half-equations for the reactions taking place are:

$Fe^{2+} \rightarrow Fe^{3+} + e^-$

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

Write the overall ionic equation for the reaction.
[1 mark]

(d) Calculate the percentage mass, to two decimal places, of hydrated iron(II) sulfate in a tablet. [4 marks]

6 The relative formula mass of a volatile dihalogenoalkane, Z, can be determined by the following method.

Two gas syringes are heated in an oven to 120 °C. A small amount of propanone and Z were injected, separately, from hypodermic syringes, into each of the gas syringes. The following results were obtained:

Initial mass of propanone and hypodermic syringe = 17.26 g
Final mass of propanone and hypodermic syringe = 17.16 g
Volume of propanone in gas syringe = 51 cm^3

Initial mass of Z and hypodermic syringe = 20.04 g
Final mass of Z and hypodermic syringe = 19.87 g
Volume of Z in gas syringe = 51 cm^3

(a) Suggest why the temperature and pressure of the oven are not required. [1 mark]

_____

_____

(b) (i) Calculate the mass of propanone and the mass of Z added to the gas syringes. [1 mark]

Propanone: _____

Z: _____

(ii) Calculate the density of propanone and Z. [2 marks]

Propanone: _____

Z: _____

(iii) The relative formula mass of propanone is 58.
Calculate the relative formula mass of Z. [2 marks]

(c) (i) What is meant by the term **dihalogenoalkane**?
[1 mark]

(ii) Use your answer to **(b)(iii)** to deduce the molecular formula of Z. [1 mark]

(d) (i) Explain how you could obtain the halide ion from the dihalogenoalkane. [2 marks]

(ii) Describe a chemical test to confirm the identity of the anion. [3 marks]

THIS IS THE END OF THE QUESTION PAPER

For Examiner's use only		
Question Number	**Examiner Mark**	**Remark**
1		
2		
3		
4		
5		
6		
Total Marks		