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Sample Assessment Materials
For international centres only

GCE Chemistry

Edexcel Advanced Subsidiary GCE in Chemistry (8CH07)
First examination 2009

Edexcel Advanced GCE in Chemistry (9CH07)
First examination 2010

International Alternative to Internal Assessment
(Units 3B and 6B)

January 2008

A PEARSON COMPANY

Contents

A Introduction

These sample assessment materials have been prepared to support the specification.

Their aim is to provide the candidates and centres with a general impression and flavour of the actual question papers and mark schemes in advance of the first operational examinations.

B Sample question papers

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	C	H	0	7	/	1	Signature	

Paper Reference(s)

6CH07/1

Edexcel GCE

Chemistry

Advanced Subsidiary

Unit 3B: Chemistry Laboratory Skills I Alternative

Sample Assessment Material

International Alternative to Internal Assessment

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Candidates may use a calculator

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use blue or black ink.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 4 questions in this question paper. The total mark for this paper is 50.
There are 12 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.

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Leave blank

Answer ALL the questions. Write your answers in the spaces provided.

1. (a) Compound **A** is a white solid that contains one cation and one anion. Complete the table below.

	Test	Observation	Inference
(i)	Flame test	..... flame	The cation in **A** is potassium.
(ii)	To a solution of **A**, add dilute nitric acid followed by silver nitrate solution.	White precipitate	The anion in **A** is .....
(iii)	To solid **A** in a test tube, add concentrated sulfuric acid. Hold a piece of cotton wool soaked in ammonia solution above the test tube.	A vigorous reaction occurs with ..... forming above the test tube.	The gas formed in the reaction between **A** and concentrated sulfuric acid is .....

(4)

(iv) Write an equation to show the reaction occurring between ammonia and the gas formed in the reaction between **A** and concentrated sulfuric acid. State symbols are **not** required.

.....

(1)

(v) Describe how you would carry out a flame test in the laboratory.

.....

.....

.....

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.....

.....

(3)

Leave blank

(b) Compound **B** is a white solid that contains one cation and one anion. Complete the table below.

	Test	Observation	Inference
(i)	Flame test	Pale green flame	The cation in **A** is .....
(ii)	Heat a sample of **B** in a test tube, testing any gases evolved with a glowing splint.	Brown gas evolved.	.....
		Splint re-lights.	.....
(iii)	Add a few drops of dilute sulfuric acid to a solution of **B**.	White precipitate	The white precipitate is .....

(4)

(iv) Give the formula of compound **B**.

.....

(1)

Q1

(Total 13 marks)

Leave blank

2. (a) An organic compound **C** has the structure $CH_2{=}CH{-}CH_2Br$.

Describe a test and its result to show the presence of the C=C group in **C**.

Test .....

Result .....

(2)

(b) When **C** is warmed with excess aqueous potassium hydroxide, the following reaction occurs.

$$CH_2{=}CH{-}CH_2Br + OH^- \rightarrow CH_2{=}CH{-}CH_2OH + Br^-$$

To test for the presence of the bromide ions formed, dilute nitric acid followed by aqueous silver nitrate is added to the cooled mixture.

(i) Why is dilute nitric acid added?

.....

(1)

(ii) Describe what you would see as the aqueous silver nitrate is added.

.....

(1)

(c) (i) Describe **two** observations that you would expect to make when a small piece of sodium is added to some $CH_2{=}CH{-}CH_2OH$ in a crucible.

Observation 1 .....

.....

Observation 2 .....

.....

(2)

(ii) Why is it important that the crucible is dry before it is used in this test?

.....

(1) **Q2**

(Total 7 marks)

Leave blank

3. A student followed the procedure below to investigate the enthalpy change for the reaction between zinc and copper(II) sulfate solution.

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$

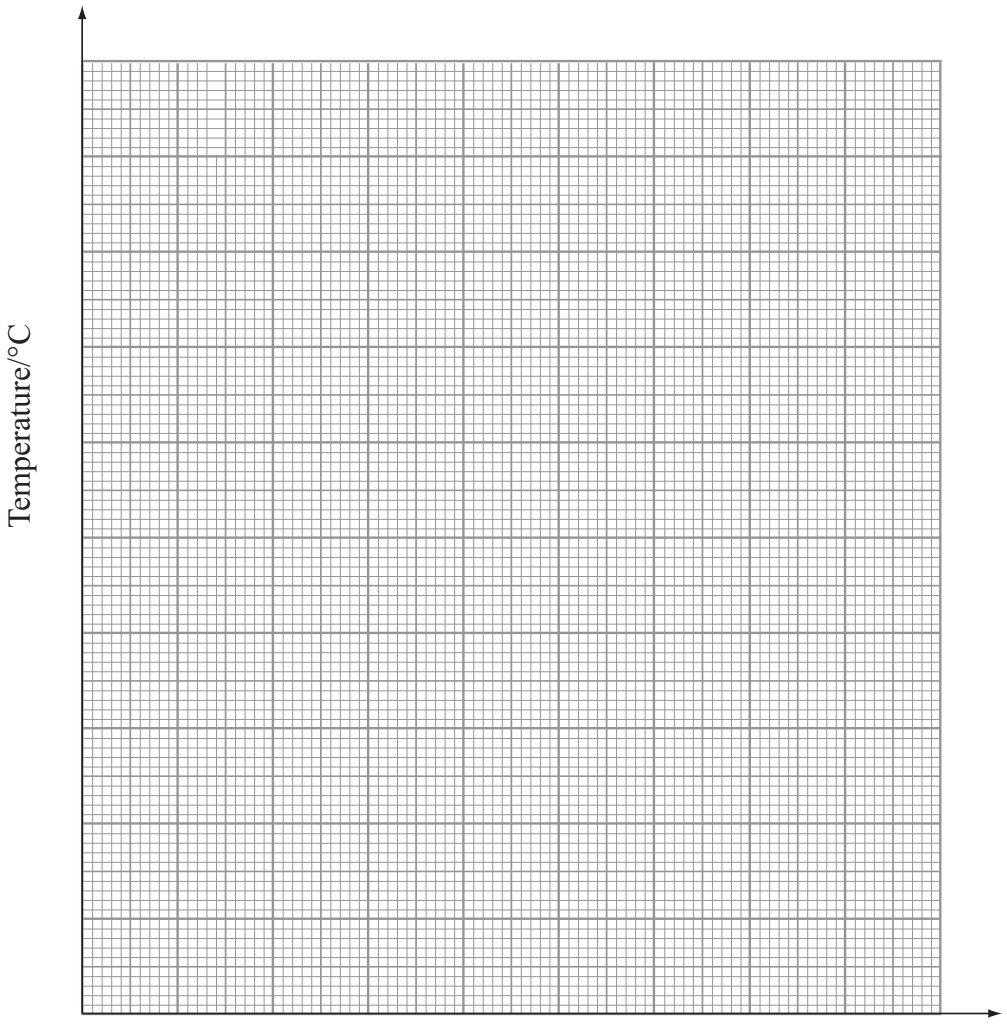
Procedure

1. Weigh about 5 g of zinc powder (an excess).
2. Using a measuring cylinder, transfer 50 cm^3 of 1.00 mol dm^{-3} copper(II) sulfate into a small beaker.
3. Place a thermometer in the solution. Record the temperature of the solution at one minute intervals for the first three minutes.
4. At 3.5 minutes add the zinc powder to the copper(II) sulfate solution.
5. Record the temperature every minute from 4.0 to 9.0 minutes.

The student's results are shown in the table below.

Time/min	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
Temperature/°C	20.0	20.0	20.0	20.0	63.0	60.5	59.0	57.0	55.5	53.0

(a) (i) On the grid below plot a graph of temperature (°C) against time (mins).



(3)

Leave blank

(ii) Use your graph to find the maximum temperature change, ΔT. Show your working clearly on the graph.

ΔT = ... °C

(2)

(iii) Suggest **one** reason why a series of temperature readings is taken rather than just the initial and final temperatures.

.....

.....

.....

(1)

(b) (i) Calculate the energy transferred to the solution. Express your answer in kJ. [Assume that the specific heat capacity of the solution is 4.2 J g^{-1} $°C^{-1}$]

$$\text{energy transferred in kJ} = \frac{\text{mass of solution} \times \text{specific heat capacity} \times \Delta T}{1000}$$

(2)

Leave blank

(ii) Calculate the number of moles of copper(II) sulfate in 50 cm^3 of 1.00 mol dm^{-3} solution.

(1)

(iii) Calculate the enthalpy change, ΔH, for this reaction. Give your answer in kJ mol^{-1} and to **two** significant figures. Include a sign with your answer.

ΔH = ... kJ mol^{-1}

(3)

(c) Suggest **two** improvements to the procedure that may give more accurate results.

Improvement 1

.....

.....

Improvement 2

.....

.....

(2)

Q3

(Total 14 marks)

Leave blank

4. An experiment to prepare a sample of cyclohexene makes use of the reaction in which cyclohexanol is dehydrated when it is warmed with concentrated phosphoric acid.

$$\underset{\text{cyclohexanol}}{C_6H_{11}OH(l)} \rightarrow \underset{\text{cyclohexene}}{C_6H_{10}(l)} + H_2O(l)$$

Procedure

1. Assemble a distillation apparatus with a water-cooled condenser and a thermometer in the neck of a round-bottomed distillation flask.
2. Measure 0.1 mol of cyclohexanol into the round-bottomed flask.
3. Add 4 cm^3 of concentrated phosphoric acid to the flask.
4. Gently heat the mixture in the flask and collect the liquid that boils off between 70°C and 90°C. This is impure cyclohexene.
5. Transfer the liquid to a separating funnel, then add an equal volume of saturated salt solution to it. Shake the funnel gently. Allow the funnel to stand for a few minutes until the layers have separated.
6. Run off the cyclohexene layer into a small flask and add some anhydrous calcium chloride to it. Allow the mixture to stand until the cyclohexene becomes clear.
7. Decant off the cyclohexene into a clean flask. Re-assemble the distillation apparatus.
8. Heat the cyclohexene and collect the liquid that distils off between 81°C and 85°C.

Data

Property	Cyclohexanol	Cyclohexene
Density / g cm^{-3}	0.96	0.81
Molar mass / g mol^{-1}	100.0	82.0
Boiling temperature / °C	161.0	83.3

(a) Calculate the mass and volume of cyclohexanol to be used in the preparation.

(2)

(b) Suggest the most appropriate piece of apparatus for measuring the volume of cyclohexanol calculated in (a). The volume need only be measured to an accuracy of ± 0.5 cm^3.

.....

(1)

Leave blank

(c) Draw a labelled diagram of the apparatus you would use to carry out the instruction described in point 4 of the procedure.

(4)

(d) How would you make up a saturated salt solution?

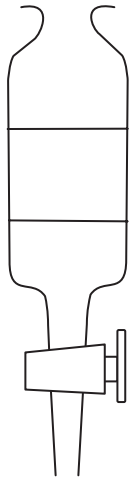
.....

.....

(1)

Leave blank

(e) On the diagram of the separating funnel, label the cyclohexene layer. Explain how you would use the separating funnel to transfer the cyclohexene layer to a small flask.



.....

.....

.....

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(2)

(f) Why is anhydrous calcium chloride added to the cyclohexene?

.....

(1)

(g) Suggest **one** reason why the instruction in point 8 of the procedure is to collect the liquid that distils off between 81°C and 85°C, rather than just at the boiling temperature of cyclohexene.

.....

.....

(1)

(h) (i) Calculate the maximum yield, in grams, of cylcohexene that may be prepared from 0.1 mol of cyclohexanol.

(1)

Leave blank

(ii) Using the procedure described, a student prepares 4.10 g of cyclohexene. Calculate the percentage yield of cyclohexene in the preparation.

(1)

(iii) Suggest **two** reasons why this preparation does not produce a 100 % yield.

1 .....

.....

.....

2 .....

.....

.....

(2)

Q4

(Total 16 marks)

TOTAL FOR PAPER: 50 MARKS

END

The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key: relative atomic mass / atomic symbol / name / atomic (proton) number									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 38	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lathanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series

* Actinide series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	C	H	0	8	/	1	Signature	

Paper Reference(s)

6CH08/1

Edexcel GCE

Chemistry

Advanced

Unit 6B: Chemistry Laboratory Skills II
Alternative

Sample Assessment Material

International Alternative to Internal Assessment

Time: 1 hour 15 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
Total	

Materials required for examination
Nil

Items included with question papers
Nil

Candidates may use a calculator

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initials and signature.
Check that you have the correct question paper.
Answer ALL the questions. Write your answers in the spaces provided in this question paper.
Do not use pencil. Use blue or black ink.

Information for Candidates

The marks for individual questions and the parts of questions are shown in round brackets: e.g. **(2)**.
There are 4 questions in this question paper. The total mark for this paper is 50.
There are 16 pages in this question paper. Any blank pages are indicated.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.

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Answer ALL questions.

1. **S**, **T** and **U** are different organic liquids, each of which has **three carbon atoms** and each contains only one functional group.

(a) Complete the table below by filling in the **inferences** column. In each case you should indicate what the test and observations tell you about the original compound.

	Test	Observations	Inferences
(i)	Add a small piece of sodium to 2 cm^3 of **S**.	Vigorous reaction takes place and the sodium disappears.	
(ii)	Add equal volumes of potassium dichromate(VI) and dilute sulfuric acid to 2 cm^3 of **S** and heat the mixture on a water bath.	Orange solution goes green.	

(1)

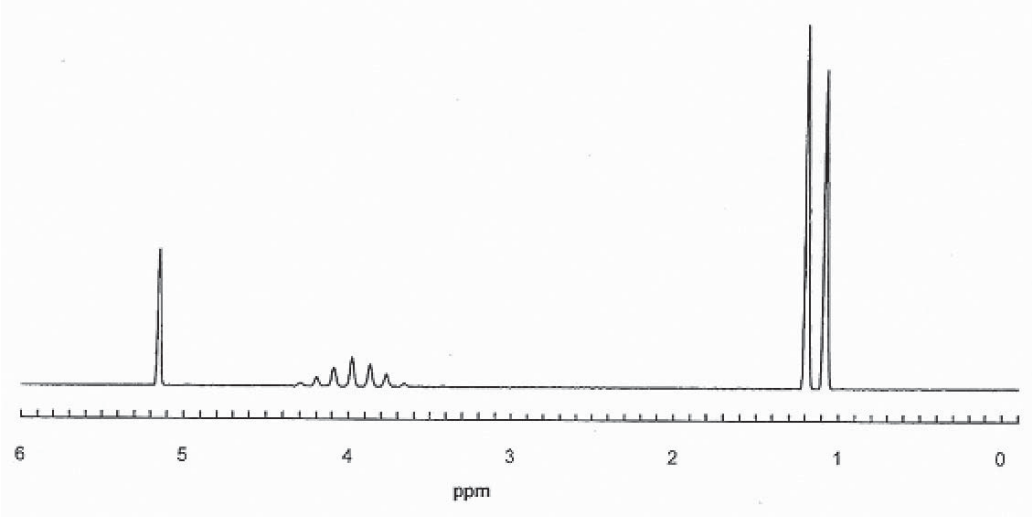
(1)

(iii) Use the information and results above to suggest the **displayed formulae** for two possible structures for **S**.

(1)

Leave blank

(iv) The nmr spectrum of **S** is shown below. Use the spectrum to identify compound **S**. Explain your choice.



S is .....

Explanation .....

.....

.....

(2)

(b) Complete the table below by filling in the **inferences** column. In each case you should indicate what the test and observations tell you about the original compound.

	Test	Observations	Inferences	
(i)	Add 1 cm^3 of **T** to 2 cm^3 of 2,4-dinitrophenylhydrazine solution. Leave the mixture to stand.	An orange precipitate forms.		**(1)**
(ii)	Add 1 cm^3 of **T** to Tollens' reagent (a solution of silver nitrate in ammonia) and warm the mixture.	A silver mirror is produced on the inside of the tube.		**(1)**

Leave blank

(iii) Use your inferences in (i) and (ii) to suggest a **displayed formula** for **T**

(1)

(c) Complete the table below by filling in the inferences column. In each case you should indicate what the test and observations tell you about the original compound.

	Test	Observations	Inferences
(i)	Add 1 cm^3 of sodium carbonate solution to 2 cm^3 of **U**. Test the gas evolved with limewater.	Vigorous effervescence. Gas evolved turns limewater cloudy.	
(ii)	Mix 2 cm^3 of **S** with an equal volume of **U**. Add 1 cm^3 of concentrated sulfuric acid and heat the mixture. Pour the mixture into a beaker of sodium carbonate solution.	Fruity smelling liquid produced.	

(1)

(1)

(iii) Based on your inferences from (i) and (ii) suggest a **displayed formula** for **U**.

(1)

Leave blank

(d) Write the equation for the reaction between **S** and **U**. In your answer show the **structural formula** of the product.

(1)

Q1

(Total 12 marks)

2. **Compound X** is an anhydrous salt.
Complete the table below by filling in the **inferences** column.

	Test	Observations	Inferences	
(a)	Colour	**X** is a brown solid.		**(1)**
(b)	Add 2 cm^3 of water to 0.5 g of solid **X**.	Heat evolved and a green solution is produced.		**(1)**
(c)	Divide the solution from (b) into two equal portions and to one portion add excess dilute ammonia solution.	A pale blue precipitate is produced which dissolves in excess ammonia solution to give a deep blue solution.		**(1)**
(d)	To the second portion add 3 cm^3 dilute nitric acid (an excess), followed by 1 cm^3 of silver nitrate solution.	A white precipitate is produced.		**(1)**

(e) Which observation suggests that **X** is anhydrous?

.....

(1)

Q2

(Total 5 marks)

Leave blank

3. In an exercise to investigate the percentage by mass of iron in an iron(II) compound, a student made up 250 cm^3 of the solution of the iron(II) compound in a volumetric flask using dilute sulfuric acid. The student then titrated 25.0 cm^3 portions of the solution, to which excess dilute sulfuric acid had been added, with 0.0200 mol dm^{-3} aqueous potassium manganate(VII) solution.

The equation for the reaction is:

$$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

(a) Suggest **one** reason why the iron(II) solution was made up in dilute sulfuric acid and more dilute sulfuric acid was added before each titration was carried out.

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(1)

(b) The student's results are given in the tables below.

Table 1

Mass of weighing bottle + iron(II) compound	11.68 g
Mass of emptied weighing bottle	4.52 g
Mass of iron(II) compound used	7.16 g

Table 2

Solution in burette: 0.0200 mol dm^{-3} potassium manganate(VII).
Solution in flask: 25.00 cm^3 of iron(II) compound.

Titration number	**Trial**	**1**	**2**	**3**	**4**
Burette reading (final) /cm^3	26.50	25.85	26.60	26.00	26.80
Burette reading (initial) /cm^3	0.00	0.15	0.30	0.20	1.05
Titre / cm^3	26.50				

Complete **Table 2** by filling in the missing data.

(1)

Leave blank

(c) Outline the procedure that should be followed to carry out titration number 1. Include in your answer the names of any apparatus used and explain how you will recognise the end-point of the titration.

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(5)

(d) List the numbers of the titrations that you should use to calculate the mean titre.

.....

Calculation of mean

= ..... cm^3

(2)

Leave blank

(e) (i) Calculate the mass of iron in 250 cm^3 of the iron(II) solution. Use the Periodic Table as a source of data.

(4)

(ii) Calculate the percentage by mass of iron in the iron(II) salt.

(1)

Leave blank

(f) When making up the solution of the iron(II) salt, another student, by mistake, added **too much** dilute sulfuric acid to the graduated flask before shaking the contents so that the total volume was over 250 cm^3.

Explain the effect this mistake would have on the student's volume of potassium manganate(VII) solution used in the titration.

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(2)

Q3

(Total 16 marks)

Leave blank

4. Methyl benzoate can be hydrolysed by heating under reflux with a solution of sodium hydroxide to form sodium benzoate and methanol.

$$C_6H_5CO_2CH_3(l) + NaOH(aq) \rightarrow C_6H_5CO_2^- Na^+(aq) + CH_3OH(aq)$$

The sodium benzoate can be converted into benzoic acid by adding excess hydrochloric acid.

$$C_6H_5CO_2^-(aq) + H^+(aq) \rightarrow C_6H_5CO_2H(s)$$

A student was asked to make 5.0 g of benzoic acid and told that the procedure used gives a 60 % yield of benzoic acid.

(a) Calculate the mass of methyl benzoate that should be used to produce 5.0 g of benzoic acid.
[Molar Masses: $C_6H_5CO_2CH_3 = 136$ g mol^{-1} $C_6H_5CO_2H = 122$ g mol^{-1}]

(2)

(b) The student was told to add 20 cm^3 of 4.0 mol dm^{-3} sodium hydroxide solution (an excess) to the methyl benzoate.

(i) Is it better to measure out the volume of sodium hydroxide solution using a pipette, a burette or a measuring cylinder? Justify your answer.

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(2)

(ii) In addition to wearing goggles and a laboratory coat, what other safety precaution should be taken when handling 4.0 mol dm^{-3} sodium hydroxide solution? Justify your answer.

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(1)

Leave blank

(c) The mixture was heated under reflux for 15 minutes and then poured into a 100 cm^3 beaker.

Draw a fully labelled diagram of the apparatus used for heating under reflux.

(4)

(d) Dilute hydrochloric acid was added to the beaker, stirring continuously, until the solution was acidic.

Suggest how you would carry out a simple test to indicate that you have added sufficient hydrochloric acid.

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(2)

Leave blank

(e) The benzoic acid was separated from the mixture by filtration and recrystallized from hot water.

Describe how the recrystallization is carried out, explaining how the method would remove both soluble and insoluble impurities.

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(4)

Leave blank

(f) The melting temperature of benzoic acid is 122 °C. The student's sample was impure. Suggest how the melting temperature of the sample would differ from that of pure benzoic acid.

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(2)

Q4

(Total 17 marks)

TOTAL FOR PAPER: 50 MARKS

END

The Periodic Table of Elements

1	2											3	4	5	6	7	0 (8) (18)
							1.0 H hydrogen 1										4.0 He helium 2
(1)	(2)		Key									(13)	(14)	(15)	(16)	(17)	
6.9 Li lithium 3	9.0 Be beryllium 4		relative atomic mass atomic symbol name atomic (proton) number									10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	[98] Tc technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La* lathanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190.2 Os osmium 76	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111							

Elements with atomic numbers 112-116 have been reported but not fully authenticated

* Lanthanide series	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	[147] Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
* Actinide series	232 Th thorium 90	[231] Pa protactinium 91	238 U uranium 92	[237] Np neptunium 93	[242] Pu plutonium 94	[243] Am americium 95	[247] Cm curium 96	[245] Bk berkelium 97	[251] Cf californium 98	[254] Es einsteinium 99	[253] Fm fermium 100	[256] Md mendelevium 101	[254] No nobelium 102	[257] Lr lawrencium 103

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C Sample mark schemes

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. The strands are as follows:

  i) ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear
  ii) select and use a form and style of writing appropriate to purpose and to complex subject matter
  iii) organise information clearly and coherently, using specialist vocabulary when appropriate

Unit 3B: Chemistry Laboratory Skills I Alternative

Question Number.	Question		
1(a)(i)	.....flame		
	Acceptable answers	Reject	Mark
	Lilac	Purple/mauve	**1**

Question Number.	Question		
1(a)(ii)	The anion in **A** is		
	Acceptable answers	Reject	Mark
	Chloride / Cl^-	Chlorine/Cl/Cl_2	**1**

Question Number.	Question		
1(a)(iii)	A vigorous reaction occurs with.....forming above the test tube		
	Acceptable answers	Reject	Mark
	White smoke/fumes	Steamy fumes	**1**
1(a)(iii)	The gas formed in the reaction between A and concentrated sulfuric acid is.....		
	Acceptable answers	Reject	Mark
	Hydrogen chloride / HCl		**1**

Question Number.	Question		
1(a)(iv)	Write an equation to show the reaction occurring between ammonia and the gas formed in the reaction between A and concentrated sulfuric acid. State symbols are **not** required.		
	Acceptable answers	Reject	Mark
	$NH_3 + HCl \longrightarrow NH_4Cl$ Ignore state symbols Consequential on the halide in 1 (a)(ii)		**1**

Question Number..	Question		
1(a)(v)	Describe how you would carry out a flame test in the laboratory.		
	Acceptable answers	Reject	Mark
	Add (any) HCl (to **A) (1)** Dip platinum/nichrome wire/silica rod in sample **(1)** Hold wire in flame **(1)** **Or** other acceptable methods		**3**

Question Number.	Question		
1(b)(i)	The cation in **A** is.....		
	Acceptable answers	Reject	Mark
	Barium / Ba^{2+}	Ba	**1**

Question Number..	Question		
1(b)(ii)	Brown gas evolved.		
	Acceptable answers	Reject	Mark
	Nitrogen dioxide / NO_2 **(1)**		**1**
1(b)(ii)	Splint re-lights.		
	Acceptable answers	Reject	Mark
	Oxygen / O_2 **(1)**		**1**

Question Number.	Question		
1(b)(iii)	The white precipitate is.....		
	Acceptable answers	Reject	Mark
	$BaSO_4$ / barium sulfate		**1**

Question Number.	Question		
1(b)(iv)	Give the formula of compound **B**		
	Acceptable answers	Reject	Mark
	$Ba(NO_3)_2$ Consequential on cation in 1 (b)(i)		**1**

Question Number..	Question		
2(a)	Describe a test and its result to show the presence of the C=C group in **C**.		
	Acceptable answers	Reject	Mark
	Test Bromine / Br_2 water / solution/aqueous bromine **(1)** Result Yellow to colourless / Yellow is decolorised **(1)** **OR** Test acidified $KMnO_4$/potassium manganate(VII) **(1)** Result Purple to colourless / purple decolorised **(1)** **OR** Test alkaline $KMnO_4$/potassium manganate (VII) **(1)** Result purple to green **(1)** **OR** Test neutral solution of $KMnO_4$/potassium manganate (VII) **(1)** Result Purple to brown precipitate **(1)**	Bromine / Br_2 alone Decolorised alone	**2**

Question Number.	Question		
2(b)(i)	When C is warmed with excess aqueous potassium hydroxide the following reaction occurs. $CH_2{=}CH{-}CH_2Br + OH^- \longrightarrow CH_2{=}CH{-}CH_2OH + Br^-$ To test for the presence of the bromide ions formed dilute nitric acid followed by aqueous silver nitrate is added to the cooled mixture. Why is dilute nitric acid added?		
	Acceptable answers	Reject	Mark
	Neutralise (KOH/OH^-) Ignore 'acidify'		**1**

Question Number..	Question		
2(b)(ii)	Describe what you would see as the aqueous silver nitrate is added.		
	Acceptable answers	Reject	Mark
	Cream/off-white/pale yellow precipitate	White/yellow precipitate	**1**

Question Number..	Question		
2(c)(i)	Describe **two** observations that you would expect to make when a small piece of sodium is added to some CH_2=CH–CH_2OH in a crucible.		
	Acceptable answers	Reject	Mark
	Any two: Bubbles/effervescence/fizzing **(1)** Na disappears **(1)** White solid formed **(1)**	Gas/ hydrogen	**2**

Question Number..	Question		
2(c)(ii)	Why is it important that the crucible is dry before it is used in this test?		
	Acceptable answers	Reject	Mark
	Water reacts with Na	Dangerous	**1**

Question Number.	Question		
3(a)(i)	On the grid below plot a graph of temperature(°C) against time (mins)		
	Acceptable answers	Reject	Mark
	Appropriate scales **(1)** Plotting points **(1)** Joining points with straight lines **(1)**		**3**

Question Number..	Question		
3(a)(ii)	Use your graph to find the maximum temperature change, ΔT. Show your working on the graph.		
	Acceptable answers	Reject	Mark
	Working on graph to show temperature at 3.5 minutes **(1)** Calculating temperature change must be in the range 43.5 – 44.5 **(1)**		**2**

Question Number..	Question		
3(a)(iii)	Suggest **one** reason why a series of temperature readings is taken rather than the initial and final temperatures.		
	Acceptable answers	Reject	Mark
	Allows for cooling (correction) **(1)**	More accurate.	**1**

Question Number..	Question		
3(b)(i)	Calculate the energy transferred to the solution. Express your answer in kJ. [Assume that the specific heat capacity of the solution is 4.18 J K^{-1} g^{-1}]		
	Acceptable answers	Reject	Mark
	$\frac{50 \times 4.2 \times 44}{1000} = 9.2/9.24\ kJ$ Use of 50 **(1)** Answer in kJ **(1)** must be at least 2 sf Mark for answer only. Cq on ΔT.	Answer in J	**2**

Question Number..	Question		
3(b)(ii)	Calculate the number of moles of copper(II) sulfate in 50 cm^3 of 1.00 mol dm^{-3} solution.		
	Acceptable answers	Reject	Mark
	$\frac{50 \times 1.00}{1000} = 0.050$ (mol) Mark for answer only		**1**

Question Number..	Question		
3(b)(iii)	Calculate the enthalpy change, ΔH, for this reaction. Give your answer in kJ mol^{-1} and to three significant figures. Include a sign with your answer.		
	Acceptable answers	Reject	Mark
	$\frac{Answer\ to\ (b)(i)}{Answer\ to\ (b)(ii)} = -180\ (kJ\ mol^{-1})$ **(1)** Value of ΔH to 2sf (–18)**(1)** Negative sign **(1)**		**3**

Question Number..	Question		
3(c)	Suggest **two** improvements to the procedure that may give more accurate results.		
	Acceptable answers	Reject	Mark
	Any two: Pipette to measure $CuSO_4$ **(1)** Polystyrene cup not beaker **(1)** Stirring **(1)** Add a lid **(1)** Take account of specific heat capacity and mass of beaker **(1)**	More accurate thermometer / repeat the experiment	**2**

Question Number	Question		
4(a)	Calculate the mass and volume of cyclohexanol to be used in the preparation.		
	Acceptable answers	Reject	Mark
	0.1 x 100.0 = 10.0 / 10 g **(1)** 10 ÷ 0.96 = 10.4 cm^3 **(1)** Must include units		**2**

Question Number..	Question		
4(b)	Suggest the most appropriate piece of apparatus for measuring the volume of cyclohexanol calculated in (a). The volume need only be measured to an accuracy of $\pm$ 0.5 cm^3.		
	Acceptable answers	Reject	Mark
	Measuring cylinder	Pipette, burette.	**1**

Question Number..	Question		
4(c)	Draw a diagram of the apparatus you would use to carry out the procedure described in point 4 of the procedure.		
	Acceptable answers	Reject	Mark
	RB flask heated **(1)** Thermometer bulb in correct position **(1)** Water-cooled condenser and Water flow correct **(1)** Apparatus overall correct and safe – not sealed **(1)** 1st three marks may be awarded independently.		**4**

Question Number..	Question		
4(d)	How would you make up a saturated salt solution?		
	Acceptable answers	Reject	Mark
	Add salt to water until no more dissolves, OR heat mixture of salt and water, allow to cool (and decant saturated solution) **(1)**		**1**

Question Number..	Question		
4(e)	On the diagram of the separating funnel label the cyclohexene layer. Explain how you would use the separating funnel to transfer the cyclohexene layer to a small flask		
	Acceptable answers	Reject	Mark
	Upper layer is cyclohexene. **(1)** Run off lower layer (to waste) **then** run off upper layer(to flask)/pour out upper layer **(1)** 2nd mark cq on layer mark.		**2**

Question Number.	Question		
4(f)	Why is anhydrous calcium chloride added to the cyclohexene?		
	Acceptable answers	Reject	Mark
	To dry it / drying agent **(1)**	Purify	**1**

Question Number.	Question		
4(g)	Suggest **one** reason why the instruction in point 8 of the procedure is to collect the liquid that distils off between 81°C and 85°C rather than just at the boiling temperature of cyclohexene.		
	Acceptable answers	Reject	Mark
	Cyclohexene still impure **/** thermometer reading not steady		**1**

Question Number..	Question		
4(h)(i)	Calculate the maximum yield, in grams, of cyclohexene that may be prepared from 0.1 mol of cyclohexanol.		
	Acceptable answers	Reject	Mark
	0.1 x 82.0 = 8.20 / 8.2 g Accept answer only.	Any other answers.	**1**

Question Number..	Question		
4(h)(ii)	A student following the procedure described prepares 4.10g of cyclohexene. Calculate the percentage yield of cyclohexene in the preparation.		
	Acceptable answers	Reject	Mark
	$\frac{4.10}{8.20}$ x 100 = 50.0/ 50 % Cq on answer in (h)(i). Accept answer only.		**1**

Question Number..	Question		
4(h)(iii)	Suggest **two** reasons why this preparation does not produce a 100% yield.		
	Acceptable answers	Reject	Mark
	Two from Reaction is incomplete **(1)** Side reactions / other products **(1)** Stays in aqueous layer **(1)**		**2**

Unit 6B: Chemistry Laboratory Skills II Alternative

Question Number.	Question
1(a)(i)	**S**, **T** and **U** are organic liquids each of which has **three carbon atoms** and each contains only one functional group. Complete the table below by filling in the **inferences** column. In each case you should indicate what the test and observations tell you about the original compound.

Test	Observation	Inferences
Add a small piece of sodium to 2 cm^3 of **S**	Vigorous reaction takes place and the sodium disappears	

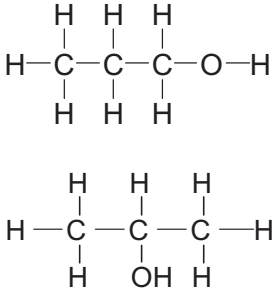
	Acceptable answers	Reject	Mark
	Alcohol or carboxylic acid (group present) both required. **OR** "OH or COOH" both required		**1**

Question Number.	Question
1 (a) (ii)	

Test	Observation	Inferences
Add equal volumes of potassium dichromate(VI) and dilute sulfuric acid to 2 cm^3 of **S** and heat the mixture on a water bath	Orange solution goes green	

	Acceptable answers	Reject	Mark
	"Primary or secondary alcohol" / not acid /OH / "not COOH"	"not COOH" on its own unless "OH or COOH" given in (a) (i)	**1**

Question Number	Question
1 (a) (iii)	Use the information and results above to suggest the **displayed formulae** for two possible structures for **S**.

	Acceptable answers	Reject	Mark
			**1**

Question Number.	Question		
1 (a) (iv)	The nmr spectrum of **S** is shown below. Use the spectrum to identify compound **S.** Explain your choice.		
	Acceptable answers	Reject	Mark
	Propan – 2-ol or formula (1) 3 peaks so three different types of proton (1) Argument based on it not being propan-1-ol which would show 4 peaks		**2**

Question Number	Question		
1 (b) (i)	Complete the table below by filling in the **inferences** column. In each case you should indicate what the test and observations tell you about the original compound.		

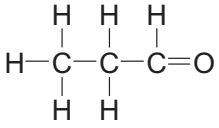
Test	Observation	Inferences
Add 1 cm^3 of **T** to 2 cm^3 of 2,4-dinitrophenylhydrazine solution. Leave the mixture to stand.	An orange precipitate forms.	

	Acceptable answers	Reject	Mark
	Carbonyl group / C=O Or "Aldehyde or ketone" - both needed for mark		**1**

Question Number	Question		
1 (b) (ii)			

Test	Observation	Inferences
Add 1 cm^3 of **T** to Tollens' reagent (a solution of silver nitrate in ammonia) and warm the mixture.	A silver mirror is produced on the inside of the tube.	

	Acceptable answers	Reject	Mark
	(Reducing agent so) Aldehyde / CHO (not ketone)	"not ketone" on its own unless aldehyde or ketone given in (b) (i)	**1**

Question Number	Question		
1 (b) (iii)	Use your inferences in (i) and (ii) to suggest a **displayed formula** for **T.**		
	Acceptable answers	Reject	Mark
		Name	**1**

Question Number	Question
1 (c) (i)	Complete the table below by filling in the inferences column. In each case you should indicate what the test and observations tell you about the original compound.

Test	Observation	Inferences
Add 1 cm^3 of sodium carbonate solution to 2 cm^3 of **U.** Test the gas evolved with limewater.	Vigorous effervescence. Gas evolved turns limewater cloudy.	

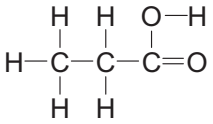
	Acceptable answers	Reject	Mark
	(Carbon dioxide evolved) acid group / COOH (present)		**1**

Question Number	Question
1 (c) (ii)	

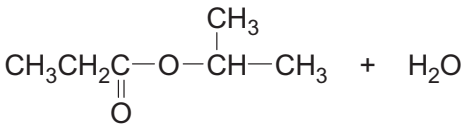
Test	Observation	Inferences
Mix 2 cm^3 of **S** with an equal volume of **U.** Add 1 cm^3 of concentrated sulfuric acid and heat the mixture. Pour the mixture into a beaker of sodium carbonate solution.	Fruity smelling liquid produced.	

	Acceptable answers	Reject	Mark
	Ester (formed from acid U and alcohol S)		**1**

Question Number	Question
1 (c) (iii)	Based on your inferences from (i) and (ii) suggest a **displayed formula** for **U**.

	Acceptable answers	Reject	Mark
			**1**

Question Number	Question
1 (d)	Write the equation for the reaction between **S** and **U**. In your answer show the **structural formula** of the product.

	Acceptable answers	Reject	Mark
	$CH_3CH(OH)CH_3 + CH_3CH_2COOH \rightarrow$  allow TE on (a) (iv) if propan-1-ol given		**1**

Question Number	Question		
2 (a)	**Compound X** is an anhydrous salt. Complete the table below by filling in the **inferences** column. **Test** | **Observation** | **Inferences** Colour | **X** is a brown solid. |		
	Acceptable answers	Reject	Mark
	Transition metal compound		**1**

Question Number	Question		
2 (b)	**Test** | **Observation** | **Inferences** Add 2 cm^3 of water to 0.5 g of solid **X.** | Heat evolved and a green solution is produced. |		
	Acceptable answers	Reject	Mark
	Any two from: Copper 2+, Nickel 2+, Chromium 3+, Iron 2+ **OR** Cu^{2+} Ni^{2+} Cr^{3+} Fe^{2+}		**1**

Question Number.	Question		
2 (c)	**Test** | **Observation** | **Inferences** Divide the solution from (b) into two equal portions and to one portion add excess dilute ammonia solution. | A pale blue precipitate is produced which dissolves in excess ammonia solution to give a deep blue solution. |		
	Acceptable answers	Reject	Mark
	Copper 2+ (complex formed - $Cu(NH_3)\varnothing^+$) Ignore $Cu(OH)_2$ ppt.		**1**

Question Number	Question		
2 (d)	**Test** | **Observation** | **Inferences** To the second portion add 3 cm^3 dilute nitric acid (an excess) followed by 1 cm^3 of silver nitrate solution. | A white precipitate is produced. |		
	Acceptable answers	Reject	Mark
	Chloride /Cl^-		**1**

Question Number	Question		
2 (e)	Which observation suggests that X is anhydrous?		
	Acceptable answers	Reject	Mark
	Heat evolved **OR** Colour change when water added **(1)**		**1**

Question Number	Question		
3 (a)	In an exercise to investigate the percentage by mass of iron in an iron(II) compound, a student made up 250 cm^3 of the solution of the iron(II) compound in a volumetric flask using dilute sulfuric acid. The student then titrated 25.0 cm^3 portions of the solution to which excess dilute sulfuric acid had been added, with 0.0200 mol dm^{-3} aqueous potassium manganate(VII) solution. The equation for the reaction is: $MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$ Suggest **one** reason why the iron(II) solution was made up in dilute sulfuric acid and more dilute sulfuric acid was added before each titration was carried out.		
	Acceptable answers	Reject	Mark
	8 mols of H^+ are needed in the equation for the titration reaction **OR** to prevent oxidation by the air (of Fe^{2+})		**1**

Question Number	Question					
3 (b)	Complete **Table 2** by filling in the missing data.					
	Answer					Mark
	Titration number	Trial	1	2	3	4	**1**
	Burette reading (final) /cm^3	26.50	25.85	26.60	26.00	26.80	
	Burette reading (initial) /cm^3	0.00	0.15	0.30	0.20	1.05	
	Titre / cm^3	26.50	**25.70**	**26.30**	**25.80**	**25.75**	
	All four answers correct						

Question Number	Question		
3 (c)	Outline the procedure that should be followed to carry out titration number 1. Include in your answer the names of any apparatus used and explain how you will recognise the end-point of the titration.		
	Acceptable answers	Reject	Mark
	• Transfer 25.0 cm^3 of the iron(II) solution using **a pipette and pipette filler** to a **titration / conical flask (1)** • Add (25 cm^3) / an excess / any stated amount > 10 cm^3 of dilute sulphuric acid **(1)** • Add 23 - 24 cm^3 / some reasonable volume of the potassium manganate(VII) with shaking from burette **(1)** • Add the potassium manganate solution one drop at a time / drop wise **(1)** • Until the first sign of a **permanent** pink colour**(1)** • No mark for use of white tile • NB: If answer does not run in a reasonable amount before dropwise addition to end point max 4		**5**

Question Number	Question		
3 (d)	List the numbers of the titrations that you will use to calculate the mean titre.		
	Acceptable answers	Reject	Mark
	Titres used Numbers 1, 3 and 4 **(1)** Mean $\frac{25.7 + 25.8 + 25.75}{3} = 25.75\ cm^3$ **(1)** Allow TE		**2**

Question Number	Question		
3 (e) (i)	Calculate the mass of iron in 250 cm^3 of the iron(II) solution. Use the periodic table as a source of data.		
	Acceptable answers	Reject	Mark
	Mols of manganate(VII) used in titration $= \frac{25.75 \times 0.0200}{1000} = 5.15x10^{-4}$ mols **(1)** Mols of iron(II) in 25.00 cm^3 of solution $= 5.15 \times 10^{-4} \times 5$ **(1)** $= 2.575 \times 10^{-3}$ mols Mols of iron(II) in 250 cm^3 of solution $= 2.575 \times 10^{-3} \times 10$ **(1)** = 0.02575 mols Mass of iron in 250 cm^3 of solution = 0.02575 x 55.8 = 1.44g **(1)** consequential or mean titre		**4**

Question Number	Question		
3 (e) (ii)	Calculate the percentage by mass of iron in the iron(II) salt.		
	Acceptable answers	Reject	Mark
	% iron in compound $= \frac{(1.437)}{7.16} \times 100 = 20.07\% / 20.1\%$ **(1)** correct answer with no working **(1)**		**1**

Question Number	Question		
3 (f)	When making up the solution of the iron(II) salt, another student, by mistake, added **too much** dilute sulfuric acid to the graduated flask before shaking the contents so that the total volume was over 250 cm^3. Explain the effect this mistake would have on the student's volume of potassium manganate(VII) solution used in the titration.		
	Acceptable answers	Reject	Mark
	The volume of potassium manganate(VII) used will be smaller than the correct figure **(1)**		**2**

Question Number	Question		
4 (a)	Calculate the mass of methyl benzoate that should be used to produce 5.0 g of benzoic acid. [Molar Masses: $C_6H_5CO_2CH_3$ = 136 g mol^{-1} $C_6H_5CO_2H$ = 122 g mol^{-1}]		
	Acceptable answers	Reject	Mark
	$\frac{5 \times 100 \times 136}{122 \times 60} = 9.29$ g **1 mark for expression** **1 mark for correct answer** **correct answer with no working (2)**		**2**

Question Number	Question		
4 (b) (i)	The student was told to add 20 cm^3 of 4.0 mol dm^{-3} sodium hydroxide solution (an excess) to the methyl benzoate. Is it better to measure out the volume of sodium hydroxide solution using a pipette, a burette or a measuring cylinder? Justify your answer.		
	Acceptable answers	Reject	Mark
	Measuring cylinder **(1)** Sodium hydroxide in excess so no need for great accuracy / safer / quicker **(1)**		**2**

Question Number	Question		
4 (b) (ii)	In addition to wearing goggles and a laboratory coat, what other safety precaution should be taken when handling 4.0 mol dm^{-3} sodium hydroxide solution? Justify your answer.		
	Acceptable answers	Reject	Mark
	Gloves because 4 M NaOH corrosive		**1**

Question Number	Question		
4 (c)	The mixture was heated under reflux for 15 minutes and then poured into a 100 cm^3 beaker. Draw a fully labelled diagram of the apparatus used for heating under reflux.		
	Acceptable answers	Reject	Mark
	Flask +contents + heating **(1)** **Vertical** condenser **(1)** condenser water flow **(1)** Apparatus overall correct and safe – not sealed **(1)**		**4**

Question Number	Question		
4 (d)	Dilute hydrochloric acid was added to the beaker, stirring continuously, until the solution was acidic. Suggest how you would carry out a simple test to indicate that you have added sufficient hydrochloric acid.		
	Acceptable answers	Reject	Mark
	Remove sample on a glass rod**(1)** test with suitable indicator paper until acidic **(1)**		**2**

Question Number	Question		
4 (e)	The benzoic acid was separated from the mixture by filtration and recrystallized from hot water. Describe how the recrystallization is carried out, explaining how the method would remove both soluble and insoluble impurities.		
	Acceptable answers	Reject	Mark
	Dissolve in minimum of hot water**(1)** Filter hot to remove insoluble impurities**(1)** Cool (in ice bath) **(1)** Filter cold to remove soluble impurities / leave soluble impurities in the solution**(1)**		**4**

Question Number	Question		
4 (f)	The melting temperature of benzoic acid is 122°C. The student's sample was impure. Suggest how the melting temperature of the sample would differ from that of pure benzoic acid.		
	Acceptable answers	Reject	Mark
	Lower than 122°C**(1)** Melt over a range of temperatures/sharp **(1)** – stand alone		**2**

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Authorised by David Davies

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