Rewarding Learning

General Certificate of Secondary Education
2024

Centre Number

Candidate Number

Chemistry

Unit 3: Practical Skills

Booklet A

MV24

Higher Tier

[GCM33]

Time

2 hours, 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.
Write your answers in the spaces provided in this question paper.
Answer **all** questions.

Information for Candidates

The total mark for this paper is **30**.
Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.
Follow all health and safety instructions.
You may use a ruler and calculator if required.
The apparatus and materials required to complete the task(s) are provided.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 You are provided with a solid, labelled X. Carry out the following tests and record your observations in the table.

Test	Observations
1 Describe the appearance of X.	[2 marks]
2 Place a spatula-measure of X on a watch glass. Dip a piece of nichrome wire into a beaker containing some deionised water. Dip the wire into the solid sample of X on the watch glass and hold the wire in a blue Bunsen burner flame.	[1 mark]

3	Place one spatula-measure of X into a small beaker and add approximately 50 cm^3 of deionised water. Stir with a glass rod. **Keep this solution of X for use in tests 4 and 5.**	[1 mark]
4	Quarter fill a test tube with the solution of X. (a) Add 5 drops of nitric acid to the test tube. (b) Add 5 drops of silver nitrate solution to the test tube. (c) Add approximately 2 cm^3 of ammonia solution to the test tube using a disposable pipette and shake gently.	[4 marks]

5	Using a 25 cm^3 measuring cylinder, place 20 cm^3 of the solution of X into a small beaker. Add the iodine crystals provided and stir with a glass rod. **Keep this solution for test 6.**	[1 mark]
6	Using a disposable pipette, place approximately 3 cm^3 of the solution prepared in test 5 into a test tube. Add three drops of starch solution. Shake gently. Add approximately 2 cm^3 of sodium thiosulfate solution dropwise using a disposable pipette.	[2 marks]

2 (a) In this experiment, you will investigate the rate of the reaction between sodium thiosulfate solution and hydrochloric acid.

(i) Carry out the steps below and record all measurements and observations in the table on page 8. [8 marks]

In this experiment, a **stop-bath** is provided to neutralise the used reaction mixtures.

1. You are provided with four conical flasks labelled 1, 2, 3 and 4.
2. Using the 10 cm^3 measuring cylinder, place the volume of sodium thiosulfate solution shown in the table opposite into the conical flasks labelled 1, 2, 3 and 4.
3. Rinse out the measuring cylinder with deionised water and place the volume of deionised water shown in the table opposite into each conical flask. Note that there is no deionised water to be added to conical flask 1.

Conical flask	Volume of sodium thiosulfate solution /cm^3	Volume of deionised water /cm^3
1	10	0
2	8	2
3	6	4
4	4	6

4. Using the same 10 cm^3 measuring cylinder, measure out 10 cm^3 of hydrochloric acid.
5. Add the hydrochloric acid to the sodium thiosulfate solution in conical flask 1 and immediately start the stop clock.
6. Swirl the contents of the conical flask once to ensure mixing and place the conical flask onto the filter paper marked with an X.
7. In the results table on page 8, record the time taken in seconds until the X is no longer visible. Record the time to the **nearest whole number**.

8. Dispose of the reaction mixture in a stop-bath as instructed by your teacher.
9. Repeat steps 4 to 8 with conical flasks labelled 2, 3 and 4.

Results table

Conical flask	Volume of sodium thiosulfate solution/cm^3	Volume of deionised water/cm^3	Time taken/s	Rate
1	10	0		
2	8	2		
3	6	4		
4	4	6		
Appearance of sodium thiosulfate solution				
Observations during the reaction				

(ii) State the trend in the **time taken** as the volume of sodium thiosulfate solution increases. [1 mark]

_____

_____

(iii) Calculate the rate of the reaction in each conical flask, to 1 decimal place, using the expression below.
[2 marks]

Insert these values into the table.

$$\text{rate} = \frac{1000}{\text{time taken}}$$

(b) (i) Carry out the steps below and record all observations and measurements in the relevant tables.

1. Using a 25 cm^3 measuring cylinder, measure out 25 cm^3 of sodium thiosulfate solution and place it in a small beaker.
2. Set the small beaker onto the filter paper marked with an X.

3. Using a 50 cm^3 measuring cylinder, measure out 40 cm^3 of iron(III) nitrate solution. Record the appearance of the iron(III) nitrate solution in the observations table opposite.
4. Add the iron(III) nitrate solution to the sodium thiosulfate solution in the small beaker and immediately start the stop clock.
5. Stop the stop clock when the X can be seen through the solution and record this time in seconds in the results table on page 12. Record the time taken to the **nearest whole number**.
6. Record the colour change for this step in the observations table opposite.
7. Rinse the small beaker thoroughly with deionised water and dry.
8. Record the appearance of the copper(II) sulfate solution in the observations table opposite.

9. Repeat steps 1–5 but add one drop of copper(II) sulfate solution to the iron(III) nitrate solution in the measuring cylinder before adding it to the sodium thiosulfate solution in the small beaker.

Observations table

Appearance of iron(III) nitrate solution	[1 mark]
Colour change	[2 marks]
Appearance of copper(II) sulfate solution	[1 mark]

Results table

Experiment	Time /s
Sodium thiosulfate solution + iron(III) nitrate solution	
Sodium thiosulfate solution + iron(III) nitrate solution + 1 drop of copper(II) sulfate solution	

[2 marks]

(ii) State and explain the effect of adding the copper(II) sulfate solution to the reaction mixture. [2 marks]

This is the end of the question paper

For Examiner's use only	
Question Number	**Marks**
1	
2	
Total Marks	

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Butanoate	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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Data Leaflet

Including the Periodic Table of the Elements

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

gcse examinations

chemistry

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THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
1 H Hydrogen 1																	4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	98 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 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	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 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

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a
X
b

a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

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