Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2017–2018

Double Award Science: Chemistry

GSD22

Unit C1
Higher Tier

[GSD22]

THURSDAY 22 FEBRUARY 2018, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **6**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

1 This question is about atomic structure.

Examiner Only

Marks	Remark

(a) Use your knowledge of atomic structure to complete the table below.

Atom/ion	Mass number	Number of protons	Number of neutrons	Number of electrons
Atom P	9		5	4
Atom Q		18	22	18
Ion R	19	9		10
Ion S	24	12	12	
Atom T	37	17	20	

[5]

(b) Atom T is one of a number of **isotopes** of that element.
What is meant by the term **isotope**?

_____

_____ [1]

Examiner Only	
Marks	Remark

2 Read the information about elements **X** and **Y** and then answer the questions that follow.

- X has an electronic configuration of 2,8,8,2
- Y has an electronic configuration of 2,7
- X forms an ionic bond with Y

(a) (i) How many electrons need to be transferred from an atom of element X when it bonds with element Y?

_____ [1]

(ii) How many electrons does an atom of element Y need in order to become stable?

_____ [1]

(iii) Write a formula **using the symbols X and Y** for the compound formed when they bond ionically.

_____ [1]

(iv) Ionic bonding involves cations and anions.
What is a **cation**?

_____ [1]

(b) In the space below draw a dot and cross diagram to show how covalent bonding occurs in ammonia, NH_3. Label any lone pairs of electrons. **All** electrons should be shown.

[4]

(c) The bonding in nitrogen gas (N_2), involves a multiple bond which is a **triple bond**. How many electrons are needed to form the triple covalent bond in N_2?

_____ [1]

3 The table below gives information about five gold alloys.

Alloy	Percentage Gold	Percentage Other metals	Price/ g	Relative hardness
9 carat gold	37.50%	62.50%	£11.60	170
12 carat gold	50.00%	50.00%	£15.40	165
14 carat gold	58.30%		£18.10	160
18 carat gold	75.00%	25.00%	£23.20	200
22 carat gold	91.67%	8.33%	£28.30	75

(a) Complete the table by calculating the percentage of other metals present in 14 carat gold.

_____ % [1]

(b) Use the information in the table to explain why these forms of gold are described as alloys.

_____

_____ [2]

(c) **(i)** Describe the general trend in hardness for these gold alloys.

_____

_____ [1]

(ii) Which gold alloy does not follow the general trend in hardness?

_____ [1]

(d) Suggest why 18 carat gold is a very good choice for making jewellery.

_____

_____ [2]

Examiner Only

Marks	Remark

(e) Calculate the difference in cost of making a 5.0 gram bracelet from 22 carat gold or making it from 9 carat gold.

Show your working.

Difference in cost _____ [3]

Examiner Only	
Marks	Remark

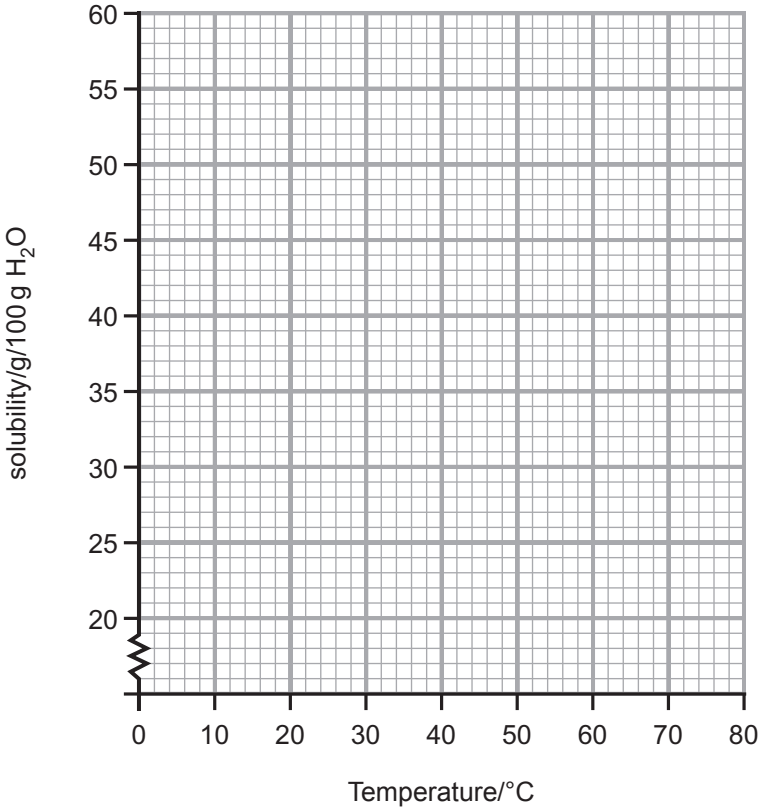
Examiner Only

Marks	Remark

4 The table below shows the results of an investigation that was carried out to find the solubility of potassium chloride in water at different temperatures.

Temperature/°C	0	10	20	30	40	50	60	70
Solubility/ g/100 g H_2O	27.8	30.9	34.0	37.1	40.0	42.9	45.8	48.5

(a) On the grid below draw the solubility curve for potassium chloride. [3]



(b) Describe the trend in solubility for potassium chloride.

_____

_____ [1]

(c) At 80 °C, 10.25 g of potassium chloride will saturate 20 g of water. Calculate the solubility of potassium chloride at 80 °C.

Show your working.

_____ g/100 g H_2O [1]

(d) Use the graph to calculate the mass of solid that would be deposited or precipitated if a solution containing 44.0 g of potassium chloride dissolved in 100 g of water at 60 °C was allowed to cool to 26 °C.

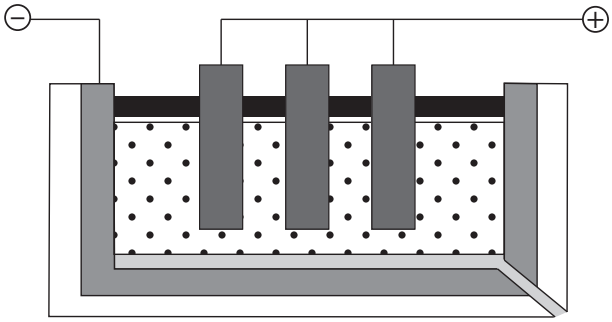
Show your working.

_____ grams [2]

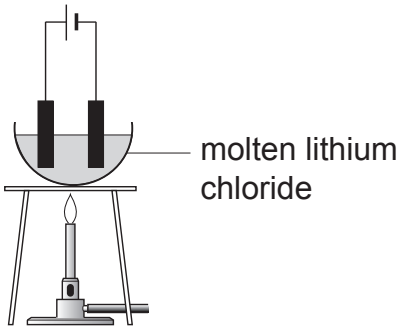
Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

5 **(a)** The diagrams below show two different electrolysis processes.



production of aluminium from aluminium oxide



In both these processes the electrolyte needs to be molten. The electrolysis of lithium chloride can be carried out in a laboratory but the temperatures needed for aluminium oxide electrolysis are too high for this to be done.

(i) Give two other similarities between the two processes.

1. _____

2. _____ [2]

(ii) Give one other difference between the two processes.

_____ [1]

(b) What is the name of the ore from which alumina (aluminium oxide) has been purified?

_____ [1]

(c) Give two reasons why it is better to recycle aluminium than to extract more of it from its ore.

1. _____

2. _____ [2]

(d) Write a half equation for the reaction that takes place at the **anode** in the extraction of aluminium from alumina.

_____ [3]

(e) The cost of the process to manufacture aluminium is very high.

Examiner Only	
Marks	Remark

(i) Explain how the use of cryolite helps to minimise manufacturing costs.

_____

_____

_____

_____ [3]

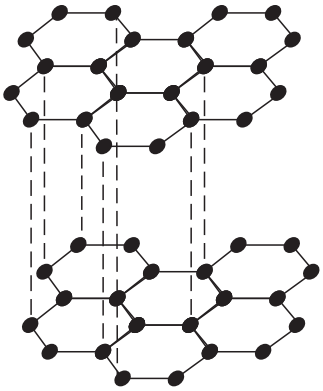
(ii) Explain how the aluminium oxide crust on the surface of the electrolyte helps to minimise manufacturing costs.

_____

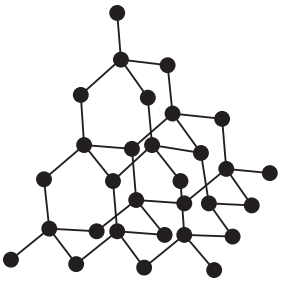
_____

_____ [2]

6 The diagrams below show two structural models.



Structure A



Structure B

Both of these structures represent allotropes of carbon. Their structures mean that A and B have particular physical properties. The uses of A and B relate to their structures and properties.

Demonstrate your understanding of the above paragraph by:

- Explaining the meaning of the term “allotrope” and giving the names of the allotropes represented by Structure A and Structure B.
- Explaining why the allotrope with Structure A conducts electricity and why it can be used in pencils.
- Explaining why the allotrope with Structure B has a very high melting point and why it can be used in cutting tools.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

The meaning of the term “allotrope” and the names of the allotropes A and B:

Examiner Only

Marks	Remark

Why allotrope A conducts electricity and why it can be used in pencils:

Why allotrope B has a very high melting point and why it can be used in cutting tools:

[6]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

7 Acids react with bases, alkalis, carbonates and metals to produce salts.

(a) Complete and balance the equations below.

(i) $\_\_ + \_\_ \longrightarrow MgCl_2 + H_2$ [3]

(ii) $\_\_ + H_2SO_4 \longrightarrow Na_2SO_4 + \_\_ + CO_2$ [2]

(b) Describe a test to identify the carbon dioxide gas produced in equation (ii).

_____

_____ [2]

(c) When alkalis dissolve in water what is the **name** of the ion which is always produced?

_____ [1]

(d) Write an **ionic** equation, with state symbols, to describe neutralisation.

_____ [3]

Examiner Only

Marks	Remark

8 The table below gives information on some reactions of the halogens with solutions of halides.

halogen	with potassium chloride solution	with potassium bromide solution	with potassium iodide solution
bromine	no reaction		colourless to dark brown
iodine	no reaction	no reaction	
chlorine		colourless to orange/brown	colourless to dark brown

(a) Name the type of reaction that takes place when chlorine is mixed with potassium iodide solution.

_____ [1]

(b) Explain why there is no reaction between bromine and potassium chloride solution.

_____

_____ [2]

(c) Write a balanced symbol equation for the reaction between fluorine and potassium chloride.

_____ [3]

(d) Why do the halogens have similar chemical properties?

_____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
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

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.

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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	99 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	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

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

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

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	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