

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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Pearson Edexcel International GCSE (9–1)

Friday 17 May 2024

Morning (Time: 2 hours)

Paper

reference

4CH1/1CR 4SD0/1CR

Chemistry

UNIT: 4CH1

Science (Double Award) 4SD0

PAPER: 1CR

You must have:

Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 110.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	58 Hf hafnium 58	59 Ta tantalum 59	60 W tungsten 60	61 Re rhenium 61	62 Os osmium 62	63 Ir iridium 63
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	90 Rf rutherfordium 90	91 Db dubnium 91	92 Sg seaborgium 92	93 Bh bohrium 93	94 Hs hassium 94	95 Mt meitnerium 95
133 Cs caesium 133	137 Ba barium 137	138 La* lanthanum 138	139 Hf hafnium 139	140 Ta tantalum 140	141 W tungsten 141	142 Re rhenium 142	143 Os osmium 143	144 Ir iridium 144
187 Rb rubidium 187	188 Sr strontium 188	189 Y yttrium 189	190 Zr zirconium 190	191 Nb niobium 191	192 Mo molybdenum 192	193 Tc technetium 193	194 Ru ruthenium 194	195 Rh rhodium 195
223 Fr francium 223	226 Ra radium 226	227 Ac* actinium 227	228 Rf rutherfordium 228	229 Db dubnium 229	230 Sg seaborgium 230	231 Bh bohrium 231	232 Hs hassium 232	233 Mt meitnerium 233
285 Cs caesium 285	286 Ba barium 286	287 La* lanthanum 287	288 Hf hafnium 288	289 Ta tantalum 289	290 W tungsten 290	291 Re rhenium 291	292 Os osmium 292	293 Ir iridium 293
337 Rb rubidium 337	338 Sr strontium 338	339 Y yttrium 339	340 Zr zirconium 340	341 Nb niobium 341	342 Mo molybdenum 342	343 Tc technetium 343	344 Ru ruthenium 344	345 Rh rhodium 345
399 Cs caesium 399	401 Ba barium 401	402 La* lanthanum 402	403 Hf hafnium 403	404 Ta tantalum 404	405 W tungsten 405	406 Re rhenium 406	407 Os osmium 407	408 Ir iridium 408
449 Rb rubidium 449	450 Sr strontium 450	451 Y yttrium 451	452 Zr zirconium 452	453 Nb niobium 453	454 Mo molybdenum 454	455 Tc technetium 455	456 Ru ruthenium 456	457 Rh rhodium 457
503 Cs caesium 503	505 Ba barium 505	506 La* lanthanum 506	507 Hf hafnium 507	508 Ta tantalum 508	509 W tungsten 509	510 Re rhenium 510	511 Os osmium 511	512 Ir iridium 512
589 Rb rubidium 589	590 Sr strontium 590	591 Y yttrium 591	592 Zr zirconium 592	593 Nb niobium 593	594 Mo molybdenum 594	595 Tc technetium 595	596 Ru ruthenium 596	597 Rh rhodium 597
639 Cs caesium 639	641 Ba barium 641	642 La* lanthanum 642	643 Hf hafnium 643	644 Ta tantalum 644	645 W tungsten 645	646 Re rhenium 646	647 Os osmium 647	648 Ir iridium 648
701 Rb rubidium 701	702 Sr strontium 702	703 Y yttrium 703	704 Zr zirconium 704	705 Nb niobium 705	706 Mo molybdenum 706	707 Tc technetium 707	708 Ru ruthenium 708	709 Rh rhodium 709
761 Cs caesium 761	763 Ba barium 763	764 La* lanthanum 764	765 Hf hafnium 765	766 Ta tantalum 766	767 W tungsten 767	768 Re rhenium 768	769 Os osmium 769	770 Ir iridium 770
801 Rb rubidium 801	802 Sr strontium 802	803 Y yttrium 803	804 Zr zirconium 804	805 Nb niobium 805	806 Mo molybdenum 806	807 Tc technetium 807	808 Ru ruthenium 808	809 Rh rhodium 809
851 Cs caesium 851	853 Ba barium 853	854 La* lanthanum 854	855 Hf hafnium 855	856 Ta tantalum 856	857 W tungsten 857	858 Re rhenium 858	859 Os osmium 859	860 Ir iridium 860
911 Rb rubidium 911	912 Sr strontium 912	913 Y yttrium 913	914 Zr zirconium 914	915 Nb niobium 915	916 Mo molybdenum 916	917 Tc technetium 917	918 Ru ruthenium 918	919 Rh rhodium 919
961 Cs caesium 961	963 Ba barium 963	964 La* lanthanum 964	965 Hf hafnium 965	966 Ta tantalum 966	967 W tungsten 967	968 Re rhenium 968	969 Os osmium 969	970 Ir iridium 970
1011 Rb rubidium 1011	1012 Sr strontium 1012	1013 Y yttrium 1013	1014 Zr zirconium 1014	1015 Nb niobium 1015	1016 Mo molybdenum 1016	1017 Tc technetium 1017	1018 Ru ruthenium 1018	1019 Rh rhodium 1019
1061 Cs caesium 1061	1063 Ba barium 1063	1064 La* lanthanum 1064	1065 Hf hafnium 1065	1066 Ta tantalum 1066	1067 W tungsten 1067	1068 Re rhenium 1068	1069 Os osmium 1069	1070 Ir iridium 1070
1111 Rb rubidium 1111	1112 Sr strontium 1112	1113 Y yttrium 1113	1114 Zr zirconium 1114	1115 Nb niobium 1115	1116 Mo molybdenum 1116	1117 Tc technetium 1117	1118 Ru ruthenium 1118	1119 Rh rhodium 1119
1161 Cs caesium 1161	1163 Ba barium 1163	1164 La* lanthanum 1164	1165 Hf hafnium 1165	1166 Ta tantalum 1166	1167 W tungsten 1167	1168 Re rhenium 1168	1169 Os osmium 1169	1170 Ir iridium 1170
1211 Rb rubidium 1211	1212 Sr strontium 1212	1213 Y yttrium 1213	1214 Zr zirconium 1214	1215 Nb niobium 1215	1216 Mo molybdenum 1216	1217 Tc technetium 1217	1218 Ru ruthenium 1218	1219 Rh rhodium 1219
1261 Cs caesium 1261	1263 Ba barium 1263	1264 La* lanthanum 1264	1265 Hf hafnium 1265	1266 Ta tantalum 1266	1267 W tungsten 1267	1268 Re rhenium 1268	1269 Os osmium 1269	1270 Ir iridium 1270
1311 Rb rubidium 1311	1312 Sr strontium 1312	1313 Y yttrium 1313	1314 Zr zirconium 1314	1315 Nb niobium 1315	1316 Mo molybdenum 1316	1317 Tc technetium 1317	1318 Ru ruthenium 1318	1319 Rh rhodium 1319
1361 Cs caesium 1361	1363 Ba barium 1363	1364 La* lanthanum 1364	1365 Hf hafnium 1365	1366 Ta tantalum 1366	1367 W tungsten 1367	1368 Re rhenium 1368	1369 Os osmium 1369	1370 Ir iridium 1370
1411 Rb rubidium 1411	1412 Sr strontium 1412	1413 Y yttrium 1413	1414 Zr zirconium 1414	1415 Nb niobium 1415	1416 Mo molybdenum 1416	1417 Tc technetium 1417	1418 Ru ruthenium 1418	1419 Rh rhodium 1419
1461 Cs caesium 1461	1463 Ba barium 1463	1464 La* lanthanum 1464	1465 Hf hafnium 1465	1466 Ta tantalum 1466	1467 W tungsten 1467	1468 Re rhenium 1468	1469 Os osmium 1469	1470 Ir iridium 1470
1511 Rb rubidium 1511	1512 Sr strontium 1512	1513 Y yttrium 1513	1514 Zr zirconium 1514	1515 Nb niobium 1515	1516 Mo molybdenum 1516	1517 Tc technetium 1517	1518 Ru ruthenium 1518	1519 Rh rhodium 1519
1561 Cs caesium 1561	1563 Ba barium 1563	1564 La* lanthanum 1564	1565 Hf hafnium 1565	1566 Ta tantalum 1566	1567 W tungsten 1567	1568 Re rhenium 1568	1569 Os osmium 1569	1570 Ir iridium 1570
1611 Rb rubidium 1611	1612 Sr strontium 1612	1613 Y yttrium 1613	1614 Zr zirconium 1614	1615 Nb niobium 1615	1616 Mo molybdenum 1616	1617 Tc technetium 1617	1618 Ru ruthenium 1618	1619 Rh rhodium 1619
1661 Cs caesium 1661	1663 Ba barium 1663	1664 La* lanthanum 1664	1665 Hf hafnium 1665	1666 Ta tantalum 1666	1667 W tungsten 1667	1668 Re rhenium 1668	1669 Os osmium 1669	1670 Ir iridium 1670
1711 Rb rubidium 1711	1712 Sr strontium 1712	1713 Y yttrium 1713	1714 Zr zirconium 1714	1715 Nb niobium 1715	1716 Mo molybdenum 1716	1717 Tc technetium 1717	1718 Ru ruthenium 1718	1719 Rh rhodium 1719
1761 Cs caesium 1761	1763 Ba barium 1763	1764 La* lanthanum 1764	1765 Hf hafnium 1765	1766 Ta tantalum 1766	1767 W tungsten 1767	1768 Re rhenium 1768	1769 Os osmium 1769	1770 Ir iridium 1770
1811 Rb rubidium 1811	1812 Sr strontium 1812	1813 Y yttrium 1813	1814 Zr zirconium 1814	1815 Nb niobium 1815	1816 Mo molybdenum 1816	1817 Tc technetium 1817	1818 Ru ruthenium 1818	1819 Rh rhodium 1819
1861 Cs caesium 1861	1863 Ba barium 1863	1864 La* lanthanum 1864	1865 Hf hafnium 1865	1866 Ta tantalum 1866	1867 W tungsten 1867	1868 Re rhenium 1868	1869 Os osmium 1869	1870 Ir iridium 1870
1911 Rb rubidium 1911	1912 Sr strontium 1912	1913 Y yttrium 1913	1914 Zr zirconium 1914	1915 Nb niobium 1915	1916 Mo molybdenum 1916	1917 Tc technetium 1917	1918 Ru ruthenium 1918	1919 Rh rhodium 1919
1961 Cs caesium 1961	1963 Ba barium 1963	1964 La* lanthanum 1964	1965 Hf hafnium 1965	1966 Ta tantalum 1966	1967 W tungsten 1967	1968 Re rhenium 1968	1969 Os osmium 1969	1970 Ir iridium 1970
2011 Rb rubidium 2011	2012 Sr strontium 2012	2013 Y yttrium 2013	2014 Zr zirconium 2014	2015 Nb niobium 2015	2016 Mo molybdenum 2016	2017 Tc technetium 2017	2018 Ru ruthenium 2018	2019 Rh rhodium 2019
2061 Cs caesium 2061	2063 Ba barium 2063	2064 La* lanthanum 2064	2065 Hf hafnium 2065	2066 Ta tantalum 2066	2067 W tungsten 2067	2068 Re rhenium 2068	2069 Os osmium 2069	2070 Ir iridium 2070
2111 Rb rubidium 2111	2112 Sr strontium 2112	2113 Y yttrium 2113	2114 Zr zirconium 2114	2115 Nb niobium 2115	2116 Mo molybdenum 2116	2117 Tc technetium 2117	2118 Ru ruthenium 2118	2119 Rh rhodium 2119
2161 Cs caesium 2161	2163 Ba barium 2163	2164 La* lanthanum 2164	2165 Hf hafnium 2165	2166 Ta tantalum 2166	2167 W tungsten 2167	2168 Re rhenium 2168	2169 Os osmium 2169	2170 Ir iridium 2170
2211 Rb rubidium 2211	2212 Sr strontium 2212	2213 Y yttrium 2213	2214 Zr zirconium 2214	2215 Nb niobium 2215	2216 Mo molybdenum 2216	2217 Tc technetium 2217	2218 Ru ruthenium 2218	2219 Rh rhodium 2219
2261 Cs caesium 2261	2263 Ba barium 2263	2264 La* lanthanum 2264	2265 Hf hafnium 2265	2266 Ta tantalum 2266	2267 W tungsten 2267	2268 Re rhenium 2268	2269 Os osmium 2269	2270 Ir iridium 2270
2311 Rb rubidium 2311	2312 Sr strontium 2312	2313 Y yttrium 2313	2314 Zr zirconium 2314	2315 Nb niobium 2315	2316 Mo molybdenum 2316	2317 Tc <		

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Answer ALL questions.

Some questions must be answered with a cross \boxtimes . If you change your mind about an answer, put a line through the box \boxtimes and then mark your new answer with a cross \boxtimes .

1 This question is about atomic structure.

(a) The table shows the number of protons, neutrons and electrons in five species, V, W, X, Y and Z.

The letters represent the species but are **not** symbols from the Periodic Table.

Species	Number of protons	Number of neutrons	Number of electrons
V	29	38	27
W	12	12	12
X	9	10	10
Y	6	6	8
Z	7	7	10

Choose letters from the table to answer these questions.

Each letter may be used once, more than once or not at all.

(i) Which species is an atom? (1)

(ii) Which species is an ion with a positive charge? (1)

(iii) Which species is an ion with a 3⁻ charge? (1)

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(b) (i) State what is meant by the term **atomic number**.

(1)

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(ii) State what is meant by the term **mass number**.

(1)

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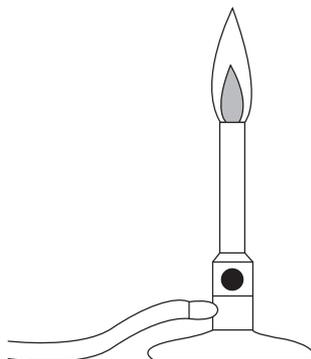
(Total for Question 1 = 5 marks)

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2 This question is about methane, CH₄

The diagram shows a Bunsen burner that uses methane.



(a) During combustion, methane reacts with a gas in the air.

Give the name of this gas.

(1)

(b) Give the two products of the complete combustion of methane.

(2)

(c) During the incomplete combustion of methane, carbon monoxide forms.

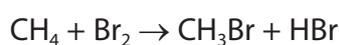
(i) Give a reason why carbon monoxide forms during incomplete combustion.

(1)

(ii) State why carbon monoxide is poisonous.

(1)

(d) The equation shows the reaction of methane with bromine.



Give the name of this type of chemical reaction.

(1)

(Total for Question 2 = 6 marks)



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3 This question is about elements, mixtures and compounds.

(a) The box gives some methods used to separate mixtures.

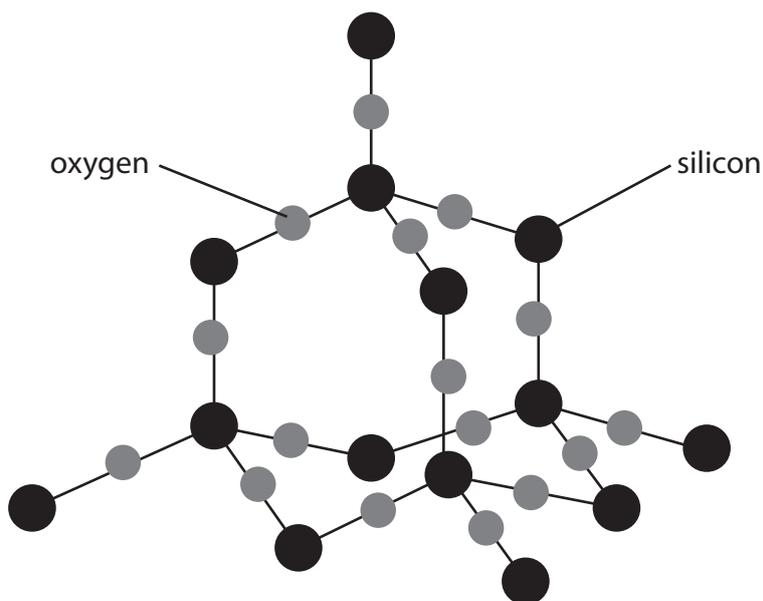
crystallisation	filtration
fractional distillation	simple distillation

Choose methods from the box to answer these questions.

(i) Identify a method to remove sand from a mixture of sand and seawater. (1)

(ii) Identify a method to separate a mixture of liquids with different boiling points. (1)

(b) The diagram shows part of the structure of silicon dioxide.



Explain why silicon dioxide is a compound. (2)



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(c) The molecular formula of the compound insulin is $C_{257}H_{383}N_{65}O_{77}S_6$

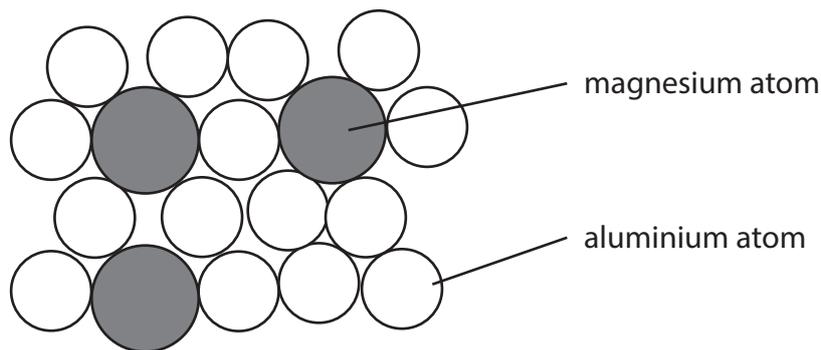
(i) Determine the number of different elements in $C_{257}H_{383}N_{65}O_{77}S_6$ (1)

(ii) Determine the number of atoms in a molecule of $C_{257}H_{383}N_{65}O_{77}S_6$ (1)

number of atoms =

(d) Magnalium is a mixture of magnesium atoms and aluminium atoms.

The diagram shows a sample of magnalium.



Calculate the percentage of magnesium atoms in this sample. (2)

percentage = %

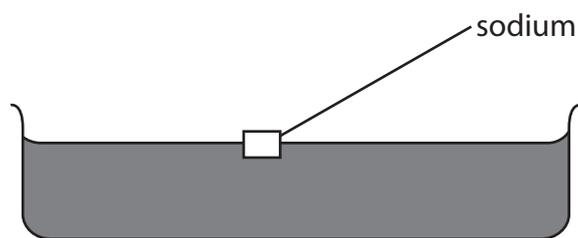
(Total for Question 3 = 8 marks)



4 This question is about the alkali metals.

A teacher demonstrates the reaction between sodium and water.

The teacher fills a trough with water and then adds a piece of sodium.



(a) The sodium reacts with the water, forming bubbles of hydrogen gas and a colourless solution.

State two other observations that would be made.

(2)

1

2

(b) Give a test to show that, at the end of the reaction, the solution contains sodium ions.

(2)

.....

.....

.....



(c) Lithium, sodium and potassium react in a similar way when added to water.

- (i) State, with reference to the electronic configurations of atoms, why these elements have similar reactions.

(1)

- (ii) The table shows the atomic radius of a lithium atom, a sodium atom and a potassium atom.

Atom	Atomic radius in cm
lithium	1.82×10^{-12}
sodium	2.27×10^{-12}
potassium	2.80×10^{-12}

Deduce the relationship between the atomic radius and the reactivity of the metals.

(1)

(Total for Question 4 = 6 marks)



5 Chromatography is used to separate the components in a mixture.

(a) Diagram 1 shows the apparatus used to separate the different dyes in a food colouring.

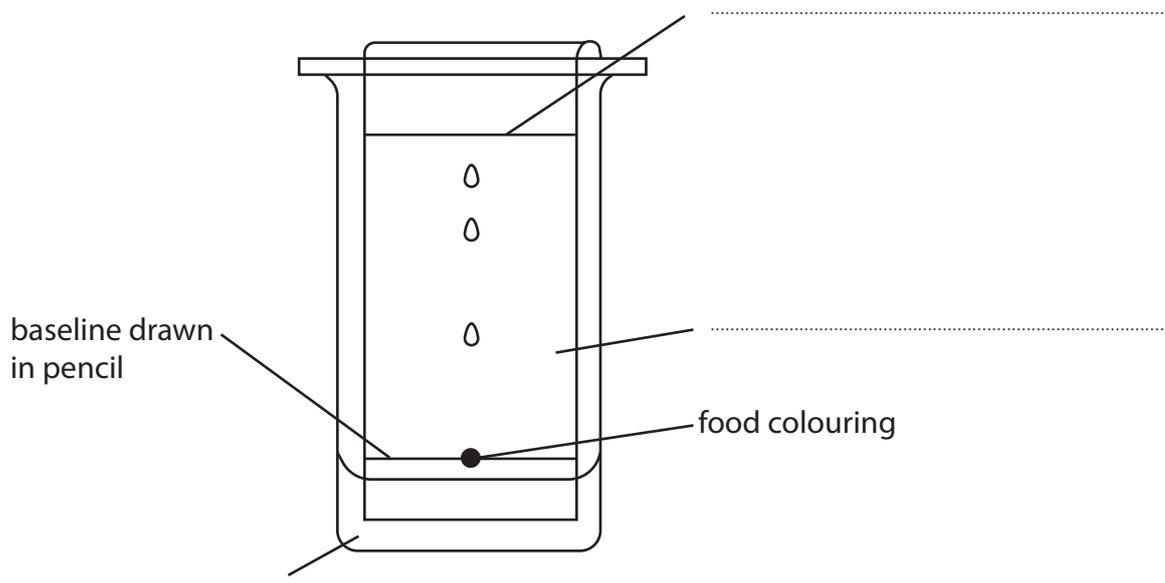


Diagram 1

- (i) Complete the diagram by adding the missing labels. (3)

- (ii) Give a reason why the baseline is drawn in pencil. (1)



(b) Diagram 2 shows a chromatogram produced from four different food colourings, W, X, Y and Z.

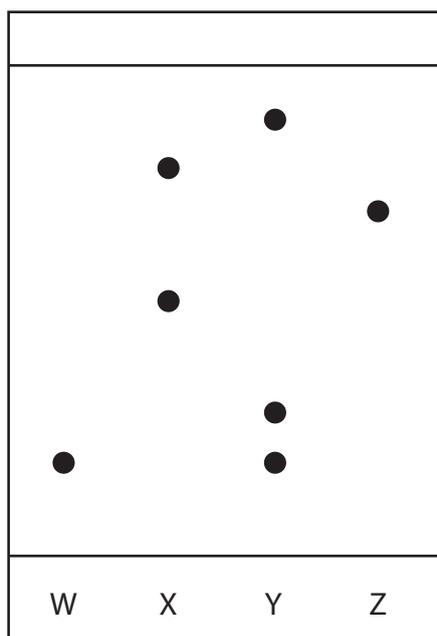


Diagram 2

(i) Which two food colourings contain the same dye?

(1)

- A W and X
- B W and Y
- C X and Z
- D Y and Z

(ii) Calculate the R_f value of the dye in food colouring W.

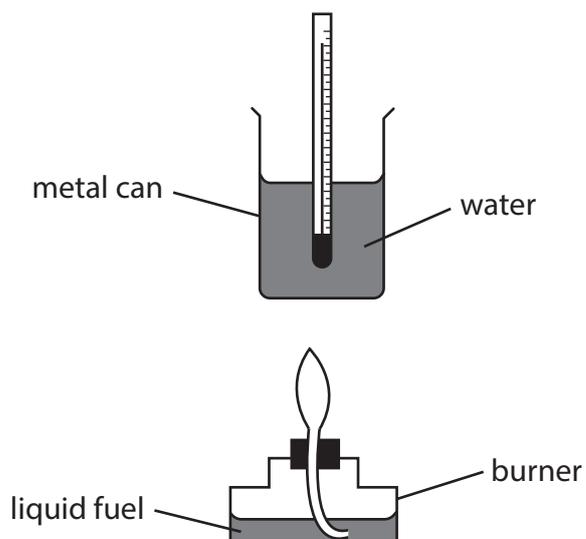
(2)

$R_f = \dots\dots\dots$

(Total for Question 5 = 7 marks)



- 6 A student uses this apparatus to find the heat energy released by the combustion of liquid fuels.



- (a) Explain what is meant by the term **fuel**.

(2)

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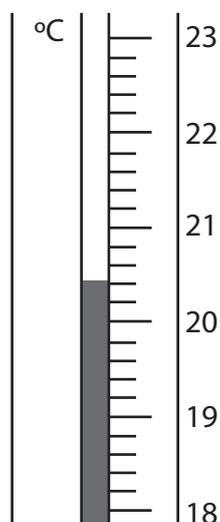
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- (b) (i) In one experiment, the student uses liquid ethanol as the fuel.

The thermometer shows the temperature of the water at the start of the experiment.



Complete the table by giving the temperatures to the nearest 0.1 °C.

(2)

temperature of the water at the start in °C	
highest temperature reached in °C	
temperature rise in °C	57.2

- (ii) The metal can contains water of mass 150 g.

Show, by calculation, that the heat energy change (Q) for this reaction is approximately 36 000 J.

[for water, $c = 4.2 \text{ J/g/}^\circ\text{C}$]

(2)

$$Q = \dots\dots\dots \text{ J}$$

- (iii) In the experiment, 2.3 g of ethanol ($M_r = 46$) is burned.

Calculate the molar enthalpy change (ΔH), in kJ/mol, for the combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}$

Include a sign in your answer.

Give your answer to two significant figures.

(4)

$$\Delta H = \dots\dots\dots \text{ kJ/mol}$$

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(c) In this experiment, the calculated value of ΔH is less than the value given in a data book.

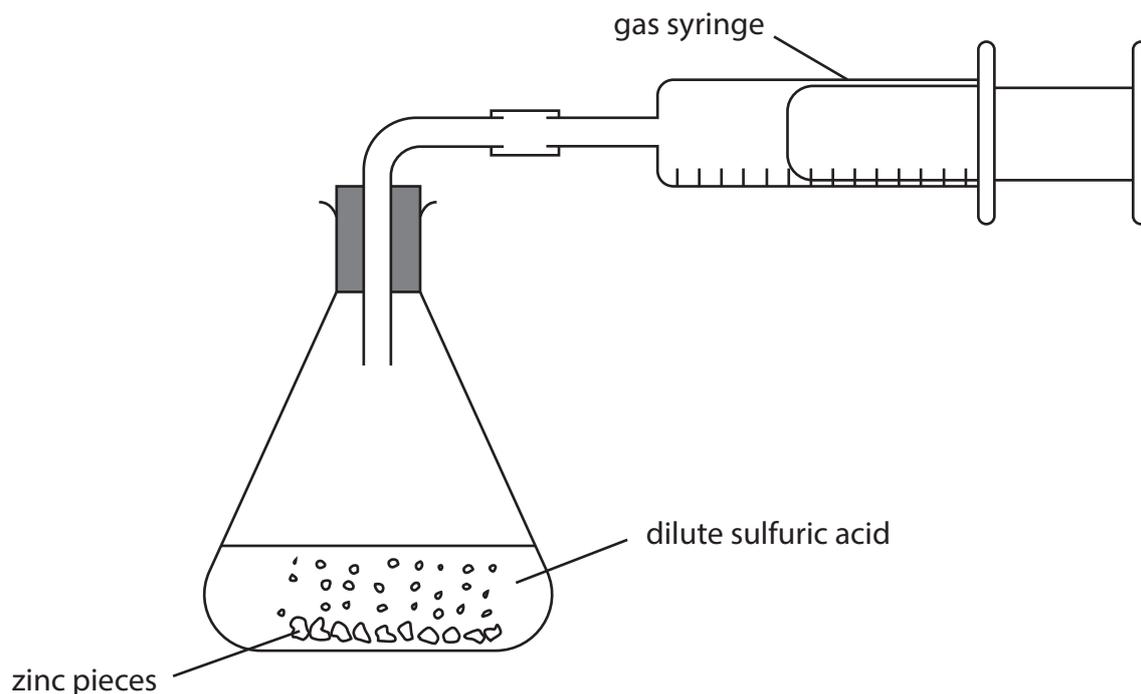
Give a possible reason for the difference in values.

(1)

(Total for Question 6 = 11 marks)



- 7 A student uses this apparatus to investigate the rate of reaction between dilute sulfuric acid and an excess of small pieces of zinc.



This is the student's method.

Step 1 use 50 cm^3 of dilute sulfuric acid

Step 2 add approximately 5 g of small zinc pieces to the sulfuric acid

Step 3 quickly connect the gas syringe

Step 4 record the reading on the gas syringe every 30 seconds until the reaction stops

- (a) (i) Name a suitable piece of apparatus to measure the volume of sulfuric acid. (1)

- (ii) Give a reason why the mass of zinc pieces does not need to be measured accurately. (1)

- (iii) Give a reason why the student quickly connects the gas syringe in step 3. (1)



(iv) State how the student would know when the reaction stops.

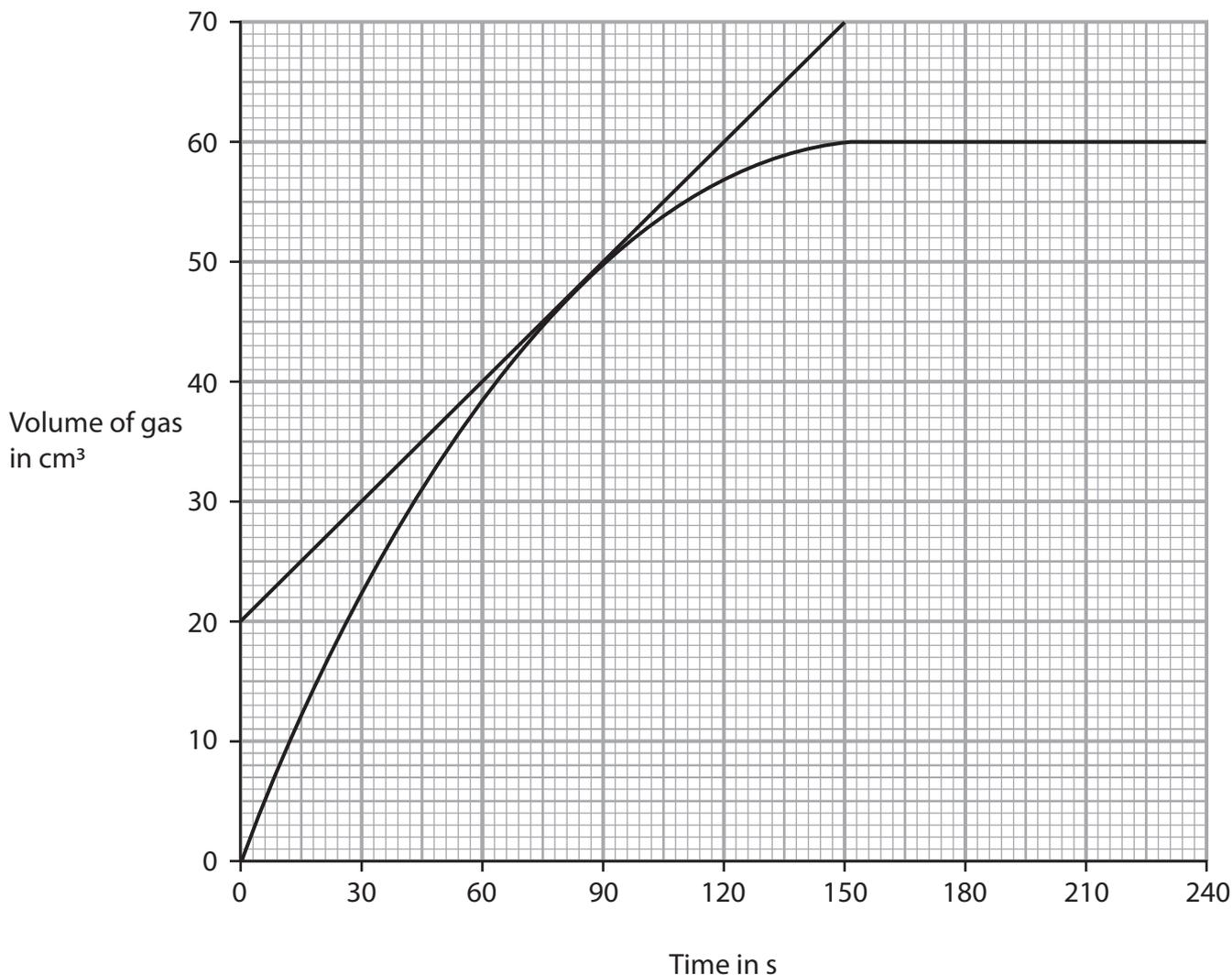
(1)

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(b) The graph shows the volume of gas collected in the syringe during the experiment.



(i) A tangent to the curve has been drawn at a time of 80 s.

Use the tangent to calculate the rate of reaction at 80 s.

Show your working on the graph.

Give the unit.

(3)

rate of reaction = unit



(ii) Explain the shape of the graph in these regions.

(6)

from 0 s to 60 s

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from 60 s to 150 s

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from 150 s to 240 s

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(Total for Question 7 = 13 marks)

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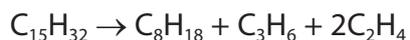
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(b) Some of the products of fractional distillation are then cracked.

This equation represents a reaction that occurs during cracking.



Explain why cracking is an important process in the oil industry.

(4)

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(c) Fuels obtained from crude oil may contain impurities.

Explain how an impurity found in fuels can cause an environmental problem.

(3)

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(Total for Question 8 = 11 marks)



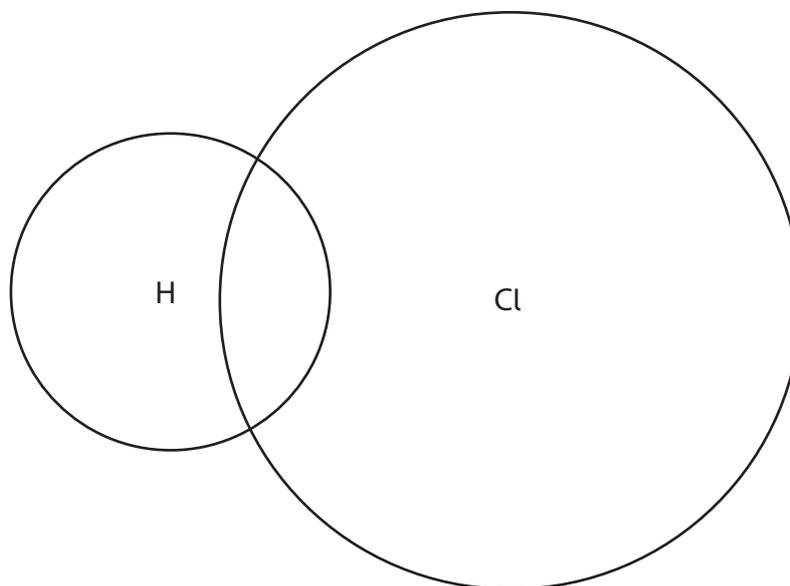
- 9 (a) The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Cl^-	O^{2-}	SO_4^{2-}
Na^+		Na_2O	Na_2SO_4
NH_4^+	NH_4Cl		
Zn^{2+}	ZnCl_2		ZnSO_4

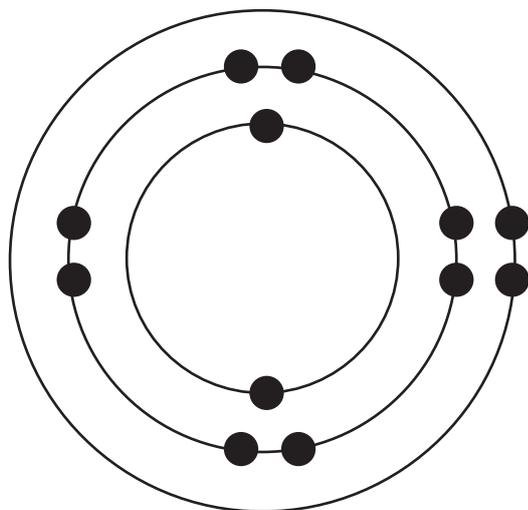
- (i) Complete the table by giving the formulae of the missing compounds. (3)
- (ii) Give the name of the compound with the formula ZnSO_4 . (1)

- (b) Hydrogen chloride and magnesium chloride have different types of bonding and have different structures.

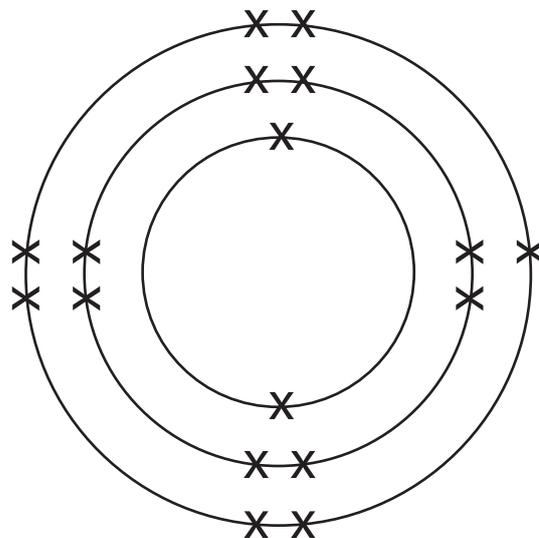
- (i) Complete the dot-and-cross diagram to show the outer shell electrons in a molecule of hydrogen chloride. (2)



(ii) The diagram shows the electronic configuration of a magnesium atom and of a chlorine atom.



magnesium



chlorine

Draw the electronic configuration of a magnesium ion and of a chloride ion in the boxes.

Show the charge on each ion.

(3)

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magnesium ion

chloride ion

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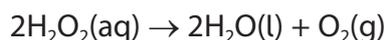
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P 7 3 4 2 4 A 0 2 5 3 2

10 This is the equation for the decomposition of hydrogen peroxide.



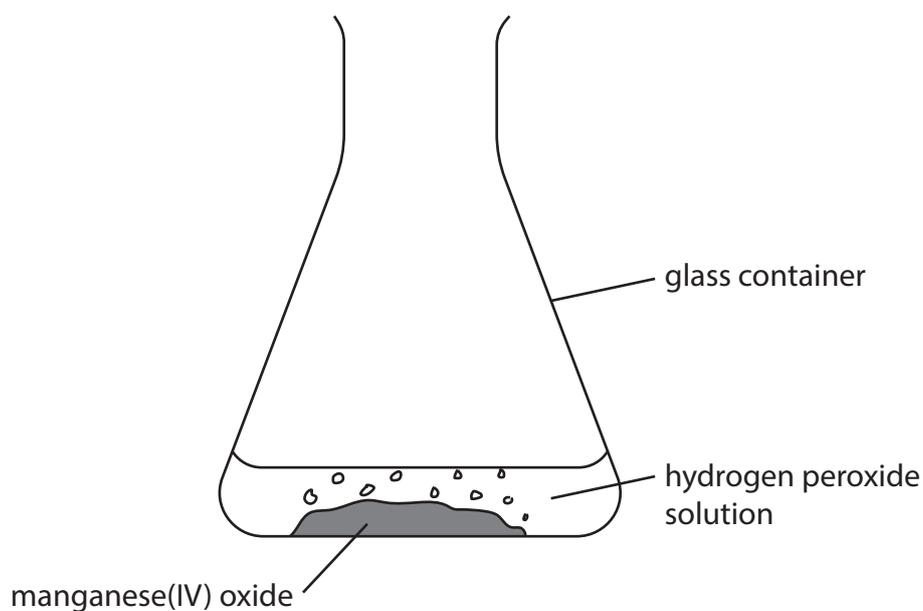
The rate of reaction increases when a catalyst of manganese(IV) oxide is added.

(a) Describe how a catalyst increases the rate of a reaction.

(2)

(b) A student adds 50 cm³ of hydrogen peroxide solution to a glass container and then adds 1.0 g of manganese(IV) oxide.

The diagram shows the apparatus the student uses.



(i) Name the glass container the student uses.

(1)



- (ii) The student waits until the hydrogen peroxide solution completely decomposes.

Describe how the student could then show that the manganese(IV) oxide was a catalyst and not a reactant.

(3)

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(Total for Question 10 = 6 marks)

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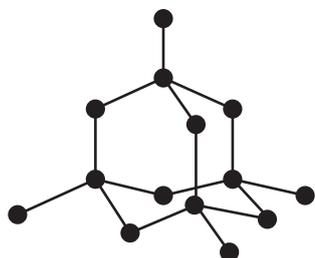
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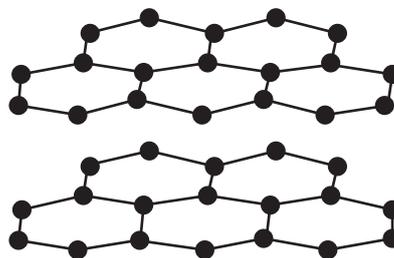
11 Diamond and graphite are both forms of the element carbon.

Diamond and graphite both have covalent bonds and giant covalent structures.

The diagram represents the structure of diamond and the structure of graphite.



diamond



graphite

(a) Give a reason why diamond is an element.

(1)

(b) Describe the forces of attraction in a covalent bond.

(2)

(c) (i) Explain why graphite conducts electricity.

(2)



(ii) Explain why diamond is hard but graphite is soft.

(4)

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(d) Another form of carbon has molecules with the formula C_x
 x represents the number of carbon atoms in each molecule.

Each molecule of C_x has a mass of 1.40×10^{-21} g.

One mole of C_x contains 6.02×10^{23} molecules.

Calculate the M_r of C_x and the value of x

[for carbon, $A_r = 12$]

(3)

$M_r =$

$x =$

(Total for Question 11 = 12 marks)

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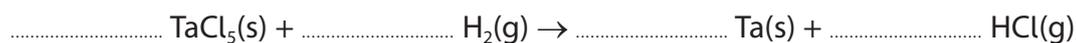
12 This question is about the metal tantalum, Ta.

Tantalum metal can be produced by heating tantalum chloride (TaCl_5) and hydrogen gas in a furnace.

The other product of the reaction is hydrogen chloride.

(a) Complete the equation for the reaction.

(1)



(b) As tantalum chloride is heated, the mass of solid in the furnace decreases leaving tantalum as the only solid product.

The table shows the mass of solid in the furnace at one-hour intervals.

Time in hours	Mass of solid in the furnace in kg
0	2510
1	2207
2	1960
3	1506
4	1329
5	1267
6	1267
7	1267



(i) State how the data in the table shows that the reaction is complete.

(1)

(ii) Use the data to show that the formula of tantalum chloride is TaCl_5

[for tantalum, $A_r = 181$ for chlorine, $A_r = 35.5$]

(3)

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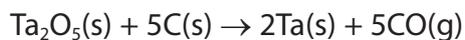
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QUESTION 12 CONTINUES ON NEXT PAGE.



- (c) Another method of extracting tantalum is by reacting tantalum(V) oxide with carbon.

This is the equation for the reaction.



- (i) Explain why this is a redox reaction.

(2)

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- (ii) 2000 mol of tantalum(V) oxide is heated with 500 000 g of carbon.

Show by calculation that the carbon is in excess.

[for carbon, $A_r = 12$]

(2)

- (iii) Calculate the maximum mass, in grams, of tantalum that can be obtained from 2000 mol of tantalum(V) oxide.

[for tantalum, $A_r = 181$]

(2)

mass = g

(Total for Question 12 = 11 marks)

TOTAL FOR PAPER = 110 MARKS

