

Write your name here

Surname

Other names

Edexcel

International GCSE

Centre Number

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Candidate Number

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Chemistry

Unit: 4CH0

Science (Double Award) 4SC0

Paper: 1CR

Monday 20 May 2013 – Afternoon

Time: 2 hours

Paper Reference

4CH0/1CR

4SC0/1CR

You must have:

Ruler

Calculator

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

Information

- The total mark for this paper is 120.
- 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.
- Keep an eye on the time.
- 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 ►

P43317A

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1/1/1/1/



P 4 3 3 1 7 A 0 1 3 6

PEARSON

THE PERIODIC TABLE

Period 1 2 3 4 5 6 7 0

Group

1	1	2	3	4	5	6	7	0
1	7	9	11	13	15	17	19	21
2	3	4	5	6	7	8	9	10
3	11	12	13	14	15	16	17	18
4	19	20	21	22	23	24	25	26
5	27	28	29	30	31	32	33	34
6	35	36	37	38	39	40	41	42
7	43	44	45	46	47	48	49	50
8	51	52	53	54	55	56	57	58
9	59	60	61	62	63	64	65	66
10	67	68	69	70	71	72	73	74
11	75	76	77	78	79	80	81	82
12	83	84	85	86	87	88	89	90
13	91	92	93	94	95	96	97	98
14	99	100	101	102	103	104	105	106
15	107	108	109	110	111	112	113	114
16	115	116	117	118	119	120	121	122
17	123	124	125	126	127	128	129	130
18	131	132	133	134	135	136	137	138
19	139	140	141	142	143	144	145	146
20	147	148	149	150	151	152	153	154
21	155	156	157	158	159	160	161	162
22	163	164	165	166	167	168	169	170
23	171	172	173	174	175	176	177	178
24	179	180	181	182	183	184	185	186
25	187	188	189	190	191	192	193	194
26	195	196	197	198	199	200	201	202
27	203	204	205	206	207	208	209	210
28	211	212	213	214	215	216	217	218
29	219	220	221	222	223	224	225	226
30	227	228	229	230	231	232	233	234
31	235	236	237	238	239	240	241	242
32	243	244	245	246	247	248	249	250
33	251	252	253	254	255	256	257	258
34	259	260	261	262	263	264	265	266
35	267	268	269	270	271	272	273	274
36	275	276	277	278	279	280	281	282
37	283	284	285	286	287	288	289	290
38	291	292	293	294	295	296	297	298
39	299	300	301	302	303	304	305	306
40	307	308	309	310	311	312	313	314
41	315	316	317	318	319	320	321	322
42	323	324	325	326	327	328	329	330
43	331	332	333	334	335	336	337	338
44	339	340	341	342	343	344	345	346
45	347	348	349	350	351	352	353	354
46	355	356	357	358	359	360	361	362
47	363	364	365	366	367	368	369	370
48	371	372	373	374	375	376	377	378
49	379	380	381	382	383	384	385	386
50	387	388	389	390	391	392	393	394
51	395	396	397	398	399	400	401	402
52	403	404	405	406	407	408	409	410
53	411	412	413	414	415	416	417	418
54	419	420	421	422	423	424	425	426
55	427	428	429	430	431	432	433	434
56	435	436	437	438	439	440	441	442
57	443	444	445	446	447	448	449	450
58	451	452	453	454	455	456	457	458
59	459	460	461	462	463	464	465	466
60	467	468	469	470	471	472	473	474
61	475	476	477	478	479	480	481	482
62	483	484	485	486	487	488	489	490
63	491	492	493	494	495	496	497	498
64	499	500	501	502	503	504	505	506
65	507	508	509	510	511	512	513	514
66	515	516	517	518	519	520	521	522
67	523	524	525	526	527	528	529	530
68	531	532	533	534	535	536	537	538
69	539	540	541	542	543	544	545	546
70	547	548	549	550	551	552	553	554
71	555	556	557	558	559	560	561	562
72	563	564	565	566	567	568	569	570
73	571	572	573	574	575	576	577	578
74	579	580	581	582	583	584	585	586
75	587	588	589	590	591	592	593	594
76	595	596	597	598	599	600	601	602
77	603	604	605	606	607	608	609	610
78	611	612	613	614	615	616	617	618
79	619	620	621	622	623	624	625	626
80	627	628	629	630	631	632	633	634
81	635	636	637	638	639	640	641	642
82	643	644	645	646	647	648	649	650
83	651	652	653	654	655	656	657	658
84	659	660	661	662	663	664	665	666
85	667	668	669	670	671	672	673	674
86	675	676	677	678	679	680	681	682
87	683	684	685	686	687	688	689	690
88	691	692	693	694	695	696	697	698
89	699	700	701	702	703	704	705	706
90	707	708	709	710	711	712	713	714
91	715	716	717	718	719	720	721	722
92	723	724	725	726	727	728	729	730
93	731	732	733	734	735	736	737	738
94	739	740	741	742	743	744	745	746
95	747	748	749	750	751	752	753	754
96	755	756	757	758	759	760	761	762
97	763	764	765	766	767	768	769	770
98	771	772	773	774	775	776	777	778
99	779	780	781	782	783	784	785	786
100	787	788	789	790	791	792	793	794
101	795	796	797	798	799	800	801	802
102	803	804	805	806	807	808	809	810
103	811	812	813	814	815	816	817	818
104	819	820	821	822	823	824	825	826
105	827	828	829	830	831	832	833	834
106	835	836	837	838	839	840	841	842
107	843	844	845	846	847	848	849	850
108	851	852	853	854	855	856	857	858
109	859	860	861	862	863	864	865	866
110	867	868	869	870	871	872	873	874
111	875	876	877	878	879	880	881	882
112	883	884	885	886	887	888	889	890
113	891	892	893	894	895	896	897	898
114	899	900	901	902	903	904	905	906
115	907	908	909	910	911	912	913	914
116	915	916	917	918	919	920	921	922
117	923	924	925	926	927	928	929	930
118	931	932	933	934	935	936	937	938
119	939	940	941	942	943	944	945	946
120	947	948	949	950	951	952	953	954
121	955	956	957	958	959	960	961	962
122	963	964	965	966	967	968	969	970
123	971	972	973	974	975	976	977	978
124	979	980	981	982	983	984	985	986
125	987	988	989	990	991	992	993	994
126	995	996	997	998	999	1000	1001	1002

Key

Relative atomic mass
Symbol
Name
Atomic number



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Answer ALL questions.

1 Some of the gases used in industry are stored in cylinders.

(a) The cylinders are painted in different colours according to which gas is stored in them.

Why is it an advantage to use different colours?

(1)

(b) The table gives information about five gases. There is no information given about air.

Name of gas	argon	carbon dioxide	helium	oxygen	hydrogen	air
Formula of gas	Ar	CO ₂	He	O ₂	H ₂	
Relative formula mass (M_r) of gas	40	44	4	32	2	

(i) Which two gases in the table are noble gases?

(1)

..... and

(ii) Which gas in the table makes up approximately 21% of air?

(1)

(iii) Why is it not possible to give the information about air in the table?

(1)

(iv) Hydrogen and helium have both been used in balloons.

State one advantage of using helium instead of hydrogen.

(1)



(c) State which one of the gases in the table is used in

(i) the manufacture of ammonia

(1)

(ii) the manufacture of fire extinguishers

(1)

(iii) the manufacture of fizzy drinks

(1)

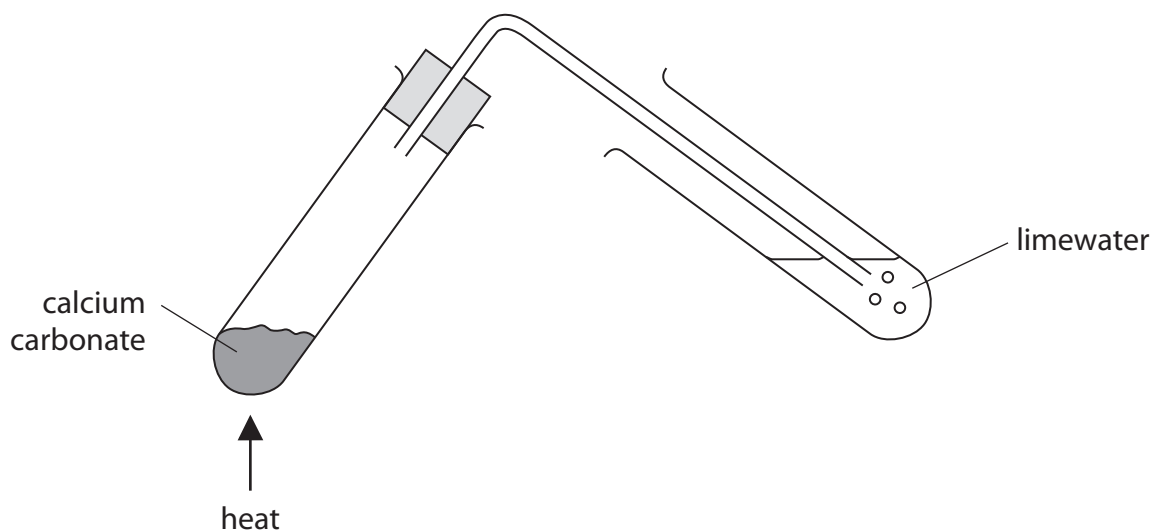
(Total for Question 1 = 8 marks)



P 4 3 3 1 7 A 0 5 3 6

2 Some powdered calcium carbonate was heated strongly in a test tube.

The gas given off was bubbled through limewater.



The equation for the reaction taking place in the heated tube is



(a) What type of chemical reaction is taking place when calcium carbonate is heated?

(1)

- ☐ A dehydration
- ☐ B oxidation
- ☐ C reduction
- ☐ D thermal decomposition

(b) State the appearance of the limewater before and after the gas was bubbled through it.

(2)

appearance before

appearance after



- (c) The Taj Mahal is a famous building in India. It is made out of a form of calcium carbonate called marble.



The appearance of the marble has changed gradually over the years because of the effects of sulfur dioxide in the atmosphere.

Describe how sulfur dioxide has caused this change in appearance.

(3)

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(Total for Question 2 = 6 marks)



3 The table gives information about barium salts.

Barium salt	Formula	Solubility in water	Toxic (poisonous)
barium chloride		soluble	yes
barium nitrate	$\text{Ba}(\text{NO}_3)_2$	soluble	yes
barium carbonate		insoluble	no
barium sulfate	BaSO_4	insoluble	no

(a) Complete the table by giving the formula of barium chloride and of barium carbonate. (2)

(b) The human stomach contains hydrochloric acid.

Suggest why barium carbonate may cause poisoning when it enters the stomach. (2)

.....

.....

.....

(c) Before patients have stomach X-rays they are given a barium salt to swallow.

Which salt in the table is safe to use? (1)

.....

(d) A student accidentally swallowed a small amount of barium hydroxide solution, which is poisonous.

Suggest a reason why a solution of magnesium sulfate could be given to the student to swallow as a first aid treatment. Write a word equation for the reaction that takes place.

(3)

Reason.....

.....

.....

Word equation

.....



(e) The table gives information about the first five elements in Group 2 of the Periodic Table.

Element	Atomic number	Reaction with cold water	Reaction with air
beryllium	4	no reaction	burns when strongly heated
magnesium	12	reacts very slowly	burns when heated
calcium	20	reacts slowly	reacts slowly without heating
strontium	38	reacts quickly	reacts quickly without heating
barium	56		

Use the information in the table to help you answer the questions.

(i) Suggest how barium reacts with cold water and with air.

(2)

Reaction with cold water

.....

Reaction with air

.....

(ii) Use your answer to (e)(i) to suggest how barium should be stored.

(1)

.....

.....

(iii) Suggest a connection between the atomic number and the reactivity of the elements in Group 2.

(1)

.....

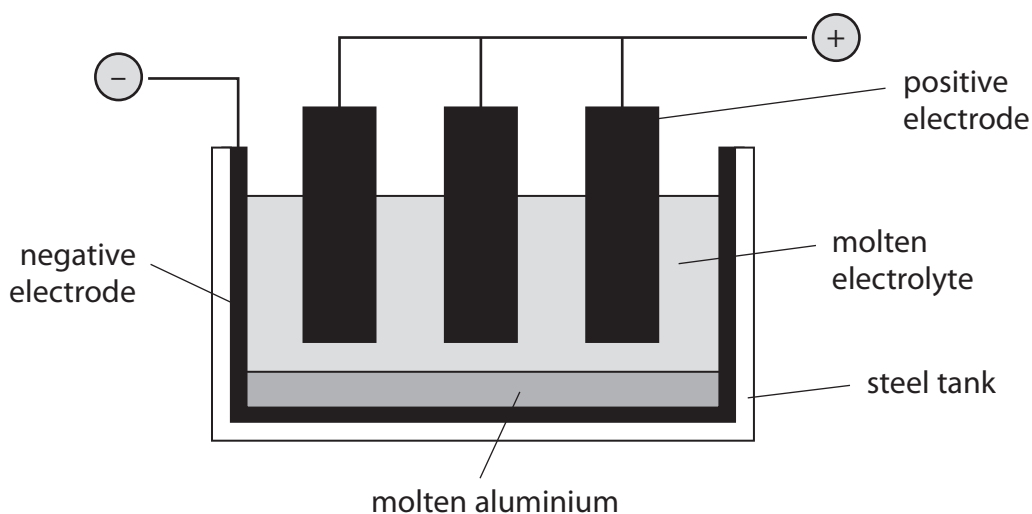
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(Total for Question 3 = 12 marks)



4 This question is about the extraction and uses of aluminium.

(a) Aluminium is extracted from aluminium oxide by electrolysis.



What are the electrodes made of?

(2)

Negative electrode

Positive electrode

(b) (i) Explain why the operating temperature would need to be very high if pure aluminium oxide were used as the electrolyte.

(1)

(ii) Describe how the operating temperature is kept low.

(1)



(c) The ionic half-equation for the reaction at the negative electrode is



What type of reaction is occurring at the negative electrode?

Explain your answer.

(2)

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(d) The waste gases escaping from the electrolysis cell contain carbon dioxide.

Describe how the carbon dioxide is formed.

(2)

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(e) Aluminium is used to make cans for food and drinks.



State two properties of aluminium that make it suitable for this use.

You should not refer to cost in your answers.

(2)

1

2

(Total for Question 4 = 10 marks)

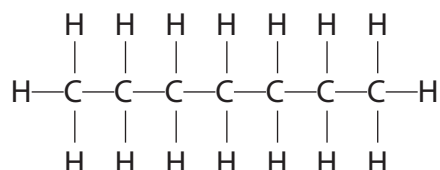
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5 (a) Explain what is meant by the term **isomerism**.

(2)

(b) The displayed formula of heptane (C_7H_{16}) is



Which one of the displayed formulae below does **not** represent an isomer of heptane?

Place a cross (☒) in the box to indicate your answer.

(1)

<pre> H H-C-H H C H H H H H — C — C — C — C — C — H H H H H H H-C-H H </pre>	<pre> H H H H H H — C — C — C — C — C — H H H H H-C-H H H-C-H H-C-H H </pre>
A ☒	B ☒

<pre> H H H H H H H — C — C — C — C — C — C — H H H H-C-H H H H H-C-H H </pre>	<pre> H H H H H — C — C — C — C — H H H H H-C-H H-C-H H-C-H H </pre>
C ☒	D ☒



(c) Heptane belongs to a homologous series of compounds called alkanes.

The general formula of the alkanes is C_nH_{2n+2}

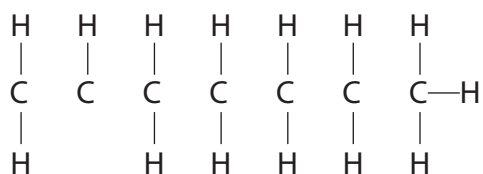
(i) Heptene belongs to a homologous series of compounds called alkenes.

Give the general formula of the alkenes.

(1)

(ii) Complete the following diagram to show the structural formula of heptene (C_7H_{14}) by inserting lines to represent the covalent bonds between the carbon atoms.

(2)



(d) When heptene is added to bromine water, and the mixture is shaken, a reaction occurs.

State the type of reaction and give the colour of the bromine water before and after the reaction with heptene.

(3)

Type of reaction.....

Colour before.....

Colour after.....

(e) Explain, in terms of the bonds present, why heptane is described as saturated and heptene as unsaturated.

(2)

.....

.....

.....

.....

(Total for Question 5 = 11 marks)



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6 The table gives information about the first four elements in Group 7 of the Periodic Table.

Element	Atomic number	Electronic configuration	Physical state at 20 °C	Colour at 20 °C
fluorine	9	2.7	gas	pale yellow
chlorine	17	2.8.7	gas	pale green
bromine	35	2.8.18.7	liquid	red-brown
iodine	53	2.8.18.18.7	solid	dark grey

(a) Astatine (At) has an atomic number of 85 and is the fifth element in Group 7.

It is possible to make predictions about astatine by comparison with the other elements in Group 7.

(i) How many electrons does an atom of astatine have in its outer shell?

(1)

(ii) What physical state and colour would you expect for astatine at 20 °C?

(2)

Physical state

Colour

(iii) Predict the formula of the compound formed between astatine and hydrogen.

Suggest a name for this compound.

(2)

Formula

Name

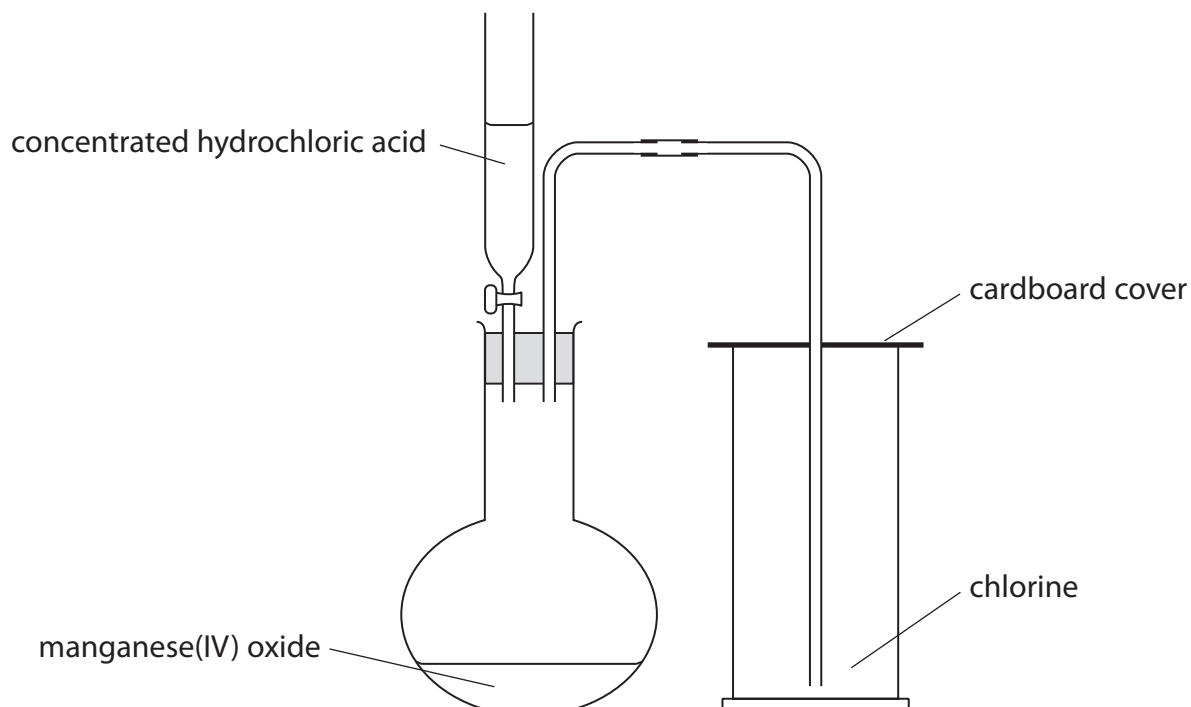
(iv) Suggest how the reactivity of astatine compares to that of iodine.

Explain your answer.

(2)



- (b) Chlorine gas can be prepared by heating a mixture of concentrated hydrochloric acid and manganese(IV) oxide using this apparatus.



- (i) Balance the equation for the reaction.

(1)



- (ii) State what you would observe when a piece of damp litmus paper is placed into the gas jar containing chlorine.

(1)

.....

.....



(c) Chlorine can be used to obtain bromine (Br_2) from sea water.

Sea water contains bromide ions, Br^-

The pH of sea water is usually within the range of 7.5 to 8.4

The stages in the extraction of bromine from sea water are

Stage 1 The pH of the sea water is lowered to about 3.5

Stage 2 An excess of chlorine is bubbled through the sea water

Stage 3 The bromine (Br_2) is removed from the mixture and reacted with sulfur dioxide (SO_2) and water. This reaction converts the bromine to hydrogen bromide (HBr) and sulfuric acid (H_2SO_4)

Stage 4 The hydrogen bromide is reacted with chlorine to form bromine (Br_2)

(i) Suggest a substance that could be added to lower the pH of sea water in Stage 1. (1)

(ii) Why is an excess of chlorine added in Stage 2? (1)

(iii) Write a chemical equation for the reaction in Stage 3. (2)

(iv) Write a chemical equation for the reaction in Stage 4. (1)

(d) State the colour change observed when bromine is added to an aqueous solution of potassium iodide. (2)

Colour of potassium iodide solution at start.....

Colour of final reaction mixture.....

(Total for Question 6 = 16 marks)



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- 7 Some students investigated the rate of the reaction between marble chips (calcium carbonate) and dilute hydrochloric acid.

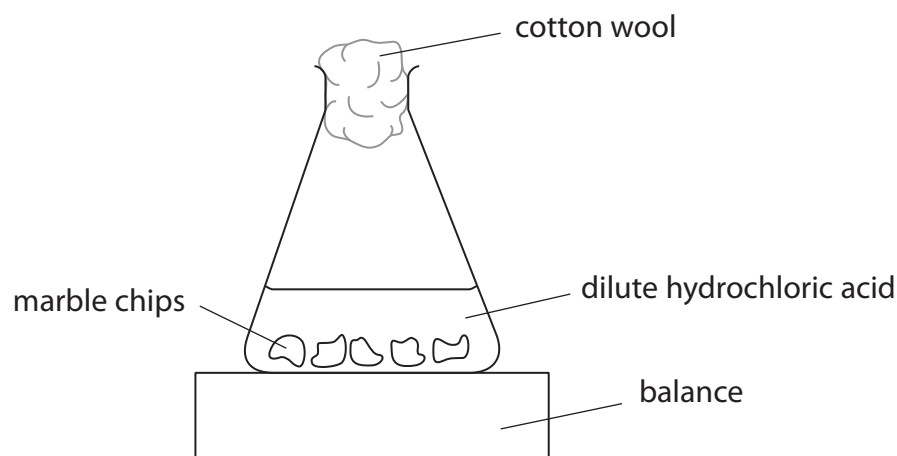
(a) The equation for the reaction is



Insert state symbols after each formula.

(2)

(b) One of the students used this apparatus.



(i) What is the purpose of the cotton wool?

(1)

(ii) He recorded the total mass of the conical flask and contents every 30 seconds for several minutes. He plotted the results as a graph of total mass (y-axis) against time.

Which of the graphs could represent his results?

Put a cross (X) in a box to indicate your answer.

(1)

A ☐	B ☐	C ☐	D ☐

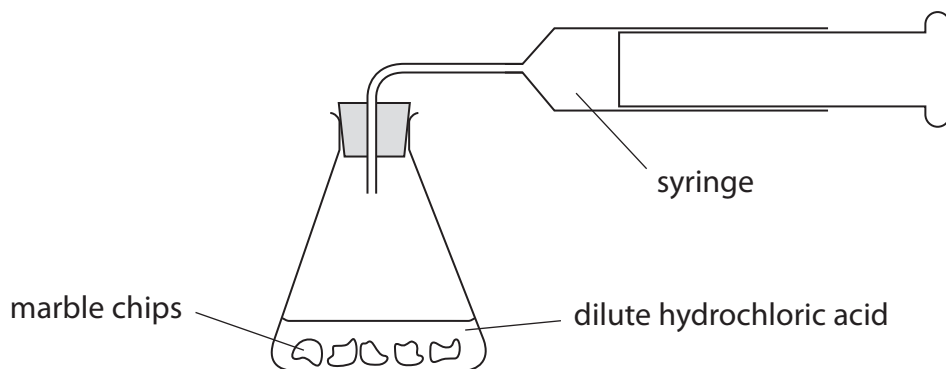


- (c) Another student carried out three experiments to investigate the effect of changing the concentration and temperature of hydrochloric acid on the rate of reaction.

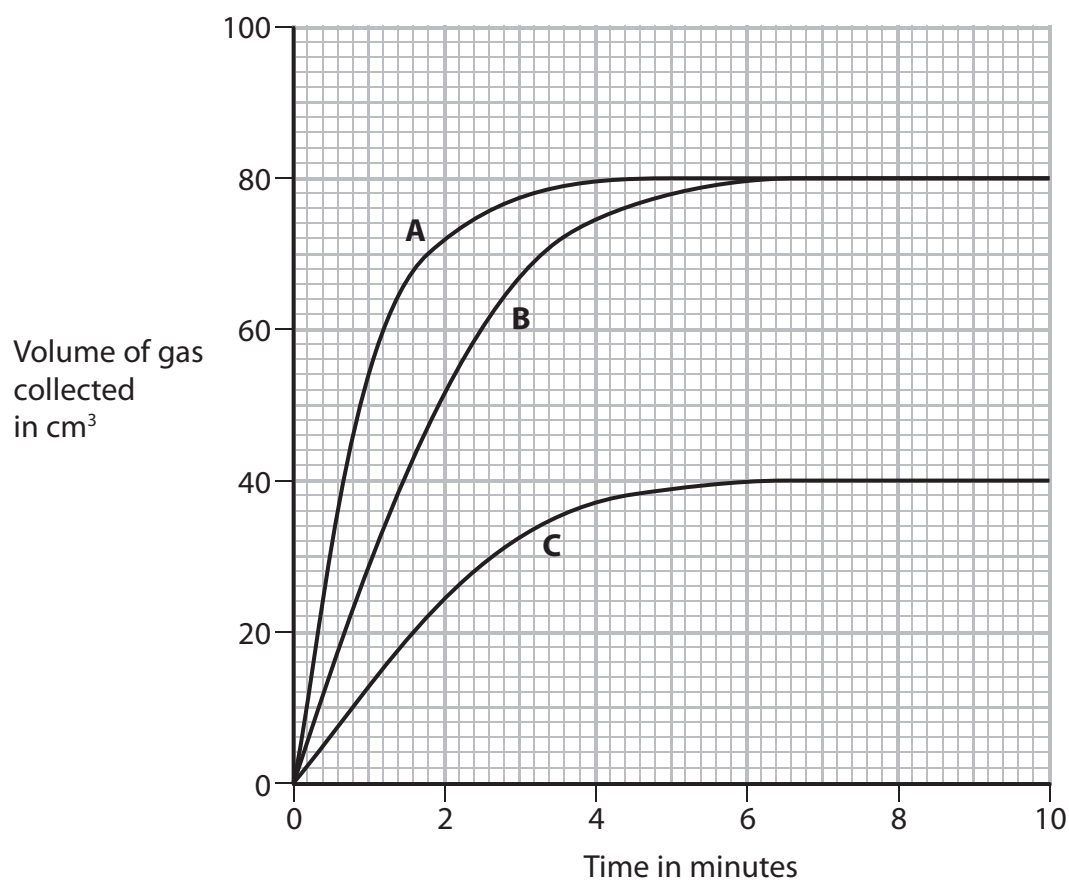
She kept the number and size of marble chips the same in each experiment.

The marble chips were in excess.

In each experiment she measured the volume of gas collected at different times, using this apparatus.



The graph shows the results of her experiments.



- (i) Experiments **A** and **B** represent experiments using the same concentration of hydrochloric acid but at different temperatures.

Which letter represents the experiment at the higher temperature?

Give a reason for your choice.

(2)

Letter

Reason

.....

.....

- (ii) Experiments **B** and **C** represent experiments at the same temperatures and using the same volumes of hydrochloric acid.

The concentration of hydrochloric acid used in experiment **B** is 0.20 mol/dm^3 .

What is the concentration of hydrochloric acid used in experiment **C**?

Explain how you worked out your answer.

(2)

Concentration

Explanation

.....

.....



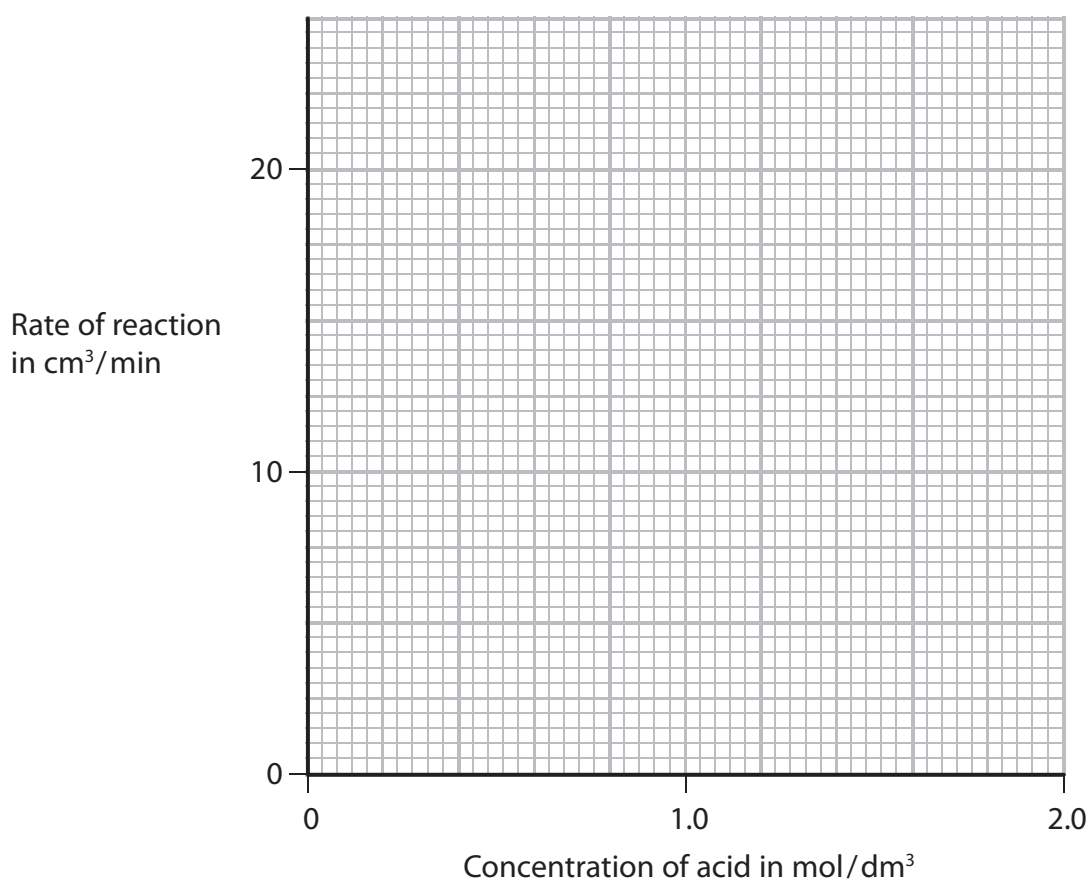
(d) (i) A third student calculated the rate of reaction in his experiments.

The table shows his results.

Rate of reaction in cm^3/min	4.0	9.0	13.5	18.5	23.0
Concentration of acid in mol/dm^3	0.4	0.8	1.2	1.6	2.0

Plot these results on the grid. Draw a straight line of best fit through the points.

(3)



(ii) Describe the relationship between rate of reaction and concentration of acid shown by the graph.

(2)

.....

.....

.....

.....



(iii) Explain why increasing the concentration has this effect on the rate of reaction.

(3)

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.....

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.....

(Total for Question 7 = 16 marks)



8 A student was asked by his teacher to perform a flame test on a solid.

He used this method.

- dip the tip of a clean platinum wire into hydrochloric acid and then into the solid
- adjust the air hole of the Bunsen burner to obtain a non-roaring, non-luminous Bunsen flame
- place the tip of the platinum wire into the edge of the flame
- observe the colour in the flame

(a) (i) Why is it important that the platinum wire is clean?

(1)

(ii) Why is it important to use a non-luminous flame?

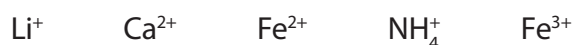
(1)

(iii) What colour would be observed in the flame if the solid contained sodium ions?

(1)



- (b) Another student was given a pale violet solid. He was told that it contained two cations (positive ions) from this list



He performed a flame test on the solid.

He then dissolved a small sample of the solid in water. A yellow solution was formed.

He added sodium hydroxide solution and then warmed the mixture.

The table shows his observations.

Test	Observation
flame test	no positive result
add sodium hydroxide solution and warm	brown precipitate a pungent-smelling gas was evolved the gas turned damp red litmus paper blue

- (i) The flame test gave no positive result.

State the two cations from the list that are **not** present in the solid.

(1)

..... and

- (ii) Identify the pungent-smelling gas given off and explain why the red litmus paper must be damp before it is used.

(2)

.....

- (iii) Identify the two cations present in the pale violet solid.

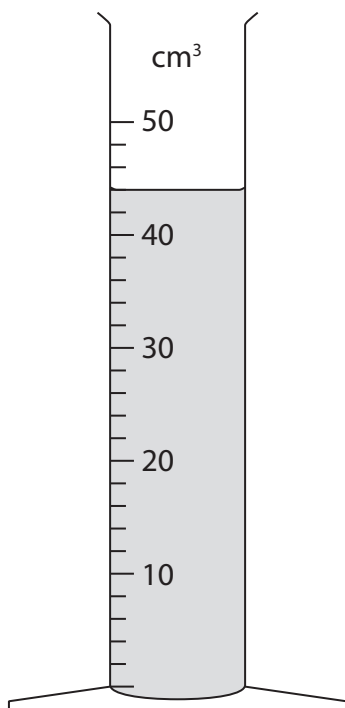
(2)

..... and

(Total for Question 8 = 8 marks)



- 9 The piece of apparatus shown contains 0.010 mol/dm^3 hydrochloric acid.



- (a) (i) Give the name of this piece of apparatus.

(1)

- (ii) What volume of hydrochloric acid is in the apparatus?

(2)

- (iii) Use your answer in (a)(ii) to calculate the amount, in moles, of hydrochloric acid in the apparatus.

(2)

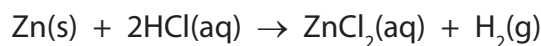
Amount = mol



(b) A student poured a solution containing 0.010 mol of hydrochloric acid into a beaker.

He then added 0.0075 mol of zinc powder and collected the hydrogen given off in a gas syringe.

The equation for the reaction is



Is the zinc or the hydrochloric acid in excess? Explain your answer.

(2)

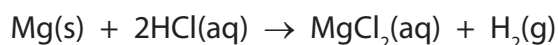
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(c) The student repeated the experiment with 0.0075 mol of magnesium powder with the same total surface area as the zinc.

The equation for the reaction is



(i) What effect would this change have on the rate at which the hydrogen is given off?

(1)

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(ii) What effect would this change have on the volume of hydrogen produced?

(1)

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(Total for Question 9 = 9 marks)

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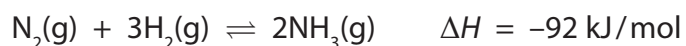
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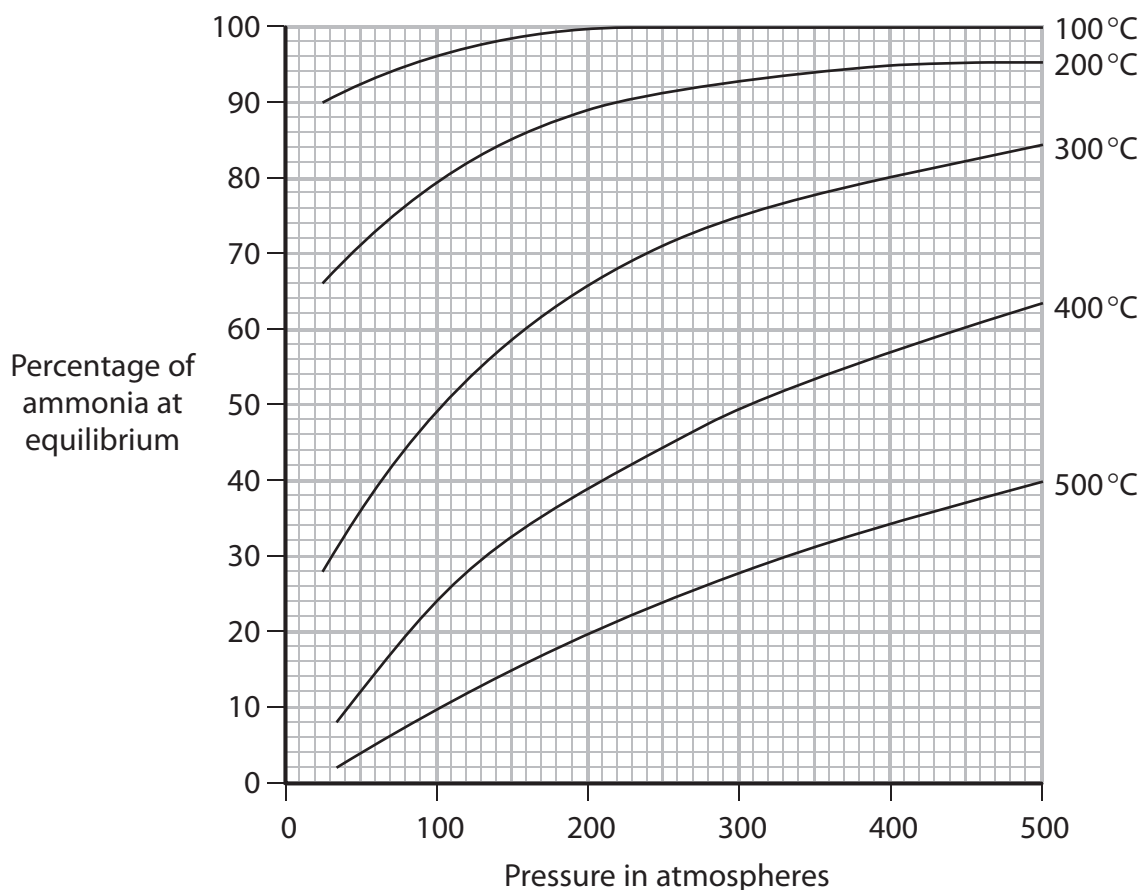


- 10 Ammonia (NH₃) can be made by reacting nitrogen and hydrogen, in the presence of an iron catalyst, according to the equation



The reaction is reversible and the reaction mixture can, if left for long enough, reach a position of dynamic equilibrium.

The graph shows how the percentage of ammonia at equilibrium depends on the temperature and pressure used.



- (a) State two features of a reaction mixture that is in dynamic equilibrium.

(2)

1

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2

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(b) (i) Use the graph to state the effect on the percentage of ammonia at equilibrium of the following changes

- an increase in temperature at constant pressure
- an increase in pressure at constant temperature.

Write your answers in the table.

(2)

	Effect on percentage of ammonia at equilibrium
increase in temperature	
increase in pressure	

(ii) Explain why these changes have the effects you have given in (b)(i).

(2)

Increase in temperature.....

.....

Increase in pressure.....

.....

(c) The reaction between nitrogen and hydrogen is used to manufacture ammonia in the Haber process. This process operates at a pressure of 200 atmospheres and a temperature of 450 °C, with an iron catalyst.

If the reaction mixture reached a position of equilibrium, the expected yield of ammonia would be about 30%.

The actual yield of ammonia obtained in the Haber process is about 15%.

(i) Suggest why the actual yield of ammonia is lower than the expected yield.

(1)

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(ii) How is the ammonia separated from the unreacted nitrogen and hydrogen?

(2)

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(iii) What happens to the unreacted nitrogen and hydrogen?

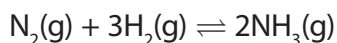
(1)

(d) The reaction would be faster if a higher temperature were used.

Suggest why a higher temperature is not used in the Haber process.

(1)

(e) The equation for the formation of ammonia is



(i) Calculate the amount, in moles, of ammonia, that could be formed in the Haber process from 112 kilograms of nitrogen, assuming all the nitrogen is converted into ammonia.

(3)

Amount of ammonia = mol

(ii) Only 15% of the nitrogen is converted into ammonia.

Calculate the actual amount, in moles, of ammonia that is formed from 112 kilograms of nitrogen.

(1)

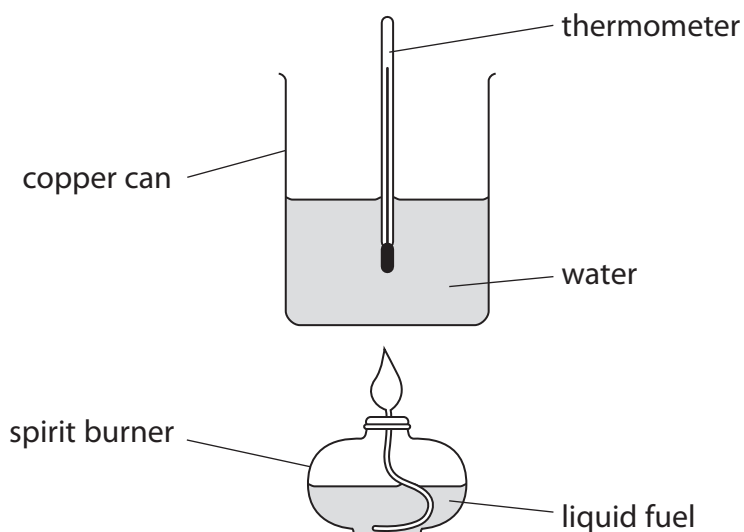
Amount of ammonia = mol

(Total for Question 10 = 15 marks)



- 11 A student burned four liquid fuels in order to compare the amount of energy they released, in the form of heat.

She used this apparatus.



The energy released when each fuel was burned was used to raise the temperature of 100 g of water. For each fuel, the student recorded the mass of fuel burned and the increase in temperature of the water.

Her results are shown in the table.

Fuel	Average relative formula mass	Mass of fuel burned in g	Amount of fuel burned in mol	Increase in temperature in °C
diesel	170	4	0.024	15
ethanol	46	3	0.065	10
methanol	32	2	0.063	5
petrol	114	1	0.009	4

The best fuel is the one that releases the most energy.

- (a) The student suggested that petrol was the best fuel.

Explain why, using the information in the table.

(1)

- (b) Another student suggested that diesel was the best fuel.

Explain why, using the information in the table.

(1)



- (c) In another experiment, a student burned propanol and then used his results to calculate the energy released when one mole of propanol was burned.

He then compared his result with a value from a data book.

The values are shown in the table.

	Energy released per mole of propanol burned in kJ
Student's result	1020
Data book value	2010

Suggest two reasons why the student's result is lower than the data book value.

(2)

1

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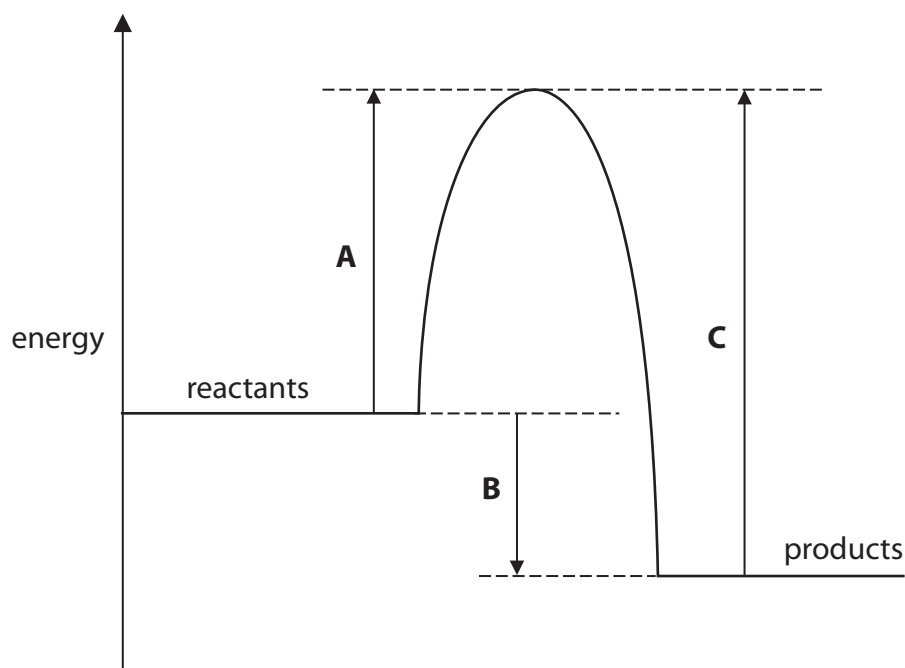
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(d) The diagram shows the energy profile for burning a fuel.



Which of the energy changes A, B or C represents

- the activation energy for the reaction
- the amount of energy given out during the reaction?

(2)

Activation energy =

Energy released =

(e) Explain, in terms of bond breaking and bond making, why this reaction gives out energy.

(3)

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(Total for Question 11 = 9 marks)

TOTAL FOR PAPER = 120 MARKS



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