

Please check the examination details below before entering your candidate information

Candidate surname					Other names			
Centre Number					Candidate Number			
<b>Pearson Edexcel</b> <b>International GCSE (9–1)</b>					<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>			
<h1>Monday 20 January 2020</h1>								
Afternoon (Time: 1 hour 15 minutes)					Paper Reference <b>4CH1/2CR</b>			
<h2>Chemistry</h2> <p><b>Unit: 4CH1</b> <b>Paper: 2CR</b></p>								
<b>You must have:</b> 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.
- 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 70.
- 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 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>P</b> phosphorus 15	16 <b>O</b> oxygen 8	17 <b>F</b> fluorine 9	18 <b>Ne</b> neon 10																																																																																																																																																																																																																																												
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	33 <b>Ga</b> gallium 31	34 <b>Ge</b> germanium 32	35 <b>As</b> arsenic 33	36 <b>Se</b> selenium 34	37 <b>Br</b> bromine 35	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium 43	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54																																																																																																																																																																																																																				
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	58 <b>Hf</b> hafnium 58	59 <b>Ta</b> tantalum 59	60 <b>W</b> tungsten 60	61 <b>Re</b> rhenium 61	62 <b>Os</b> osmium 62	63 <b>Ir</b> iridium 63	64 <b>Pt</b> platinum 64	65 <b>Au</b> gold 65	66 <b>Hg</b> mercury 66	67 <b>Tl</b> thallium 67	68 <b>Pb</b> lead 68	69 <b>Bi</b> bismuth 69	70 <b>Po</b> polonium 70	71 <b>At</b> astatine 71	72 <b>Rn</b> radon 72	73 <b>Fr</b> francium 73	74 <b>Ra</b> radium 74	75 <b>Ac*</b> actinium 75	76 <b>Rf</b> rutherfordium 76	77 <b>Db</b> dubnium 77	78 <b>Sg</b> seaborgium 78	79 <b>Bh</b> bohrium 79	80 <b>Hs</b> hassium 80	81 <b>Mt</b> meitnerium 81	82 <b>Ds</b> darmstadtium 82	83 <b>Rg</b> roentgenium 83	84 <b>Uu</b> ununquadium 84	85 <b>Uub</b> ununbium 85	86 <b>Uut</b> ununtrium 86	87 <b>Uuq</b> ununquium 87	88 <b>Uubk</b> ununbium 88	89 <b>Uuqk</b> ununquium 89	90 <b>Uubk</b> ununbium 90	91 <b>Uuqk</b> ununquium 91	92 <b>Uubk</b> ununbium 92	93 <b>Uuqk</b> ununquium 93	94 <b>Uubk</b> ununbium 94	95 <b>Uuqk</b> ununquium 95	96 <b>Uubk</b> ununbium 96	97 <b>Uuqk</b> ununquium 97	98 <b>Uubk</b> ununbium 98	99 <b>Uuqk</b> ununquium 99	100 <b>Uubk</b> ununbium 100	101 <b>Uuqk</b> ununquium 101	102 <b>Uubk</b> ununbium 102	103 <b>Uuqk</b> ununquium 103	104 <b>Uubk</b> ununbium 104	105 <b>Uuqk</b> ununquium 105	106 <b>Uubk</b> ununbium 106	107 <b>Uuqk</b> ununquium 107	108 <b>Uubk</b> ununbium 108	109 <b>Uuqk</b> ununquium 109	110 <b>Uubk</b> ununbium 110	111 <b>Uuqk</b> ununquium 111	112 <b>Uubk</b> ununbium 112	113 <b>Uuqk</b> ununquium 113	114 <b>Uubk</b> ununbium 114	115 <b>Uuqk</b> ununquium 115	116 <b>Uubk</b> ununbium 116	117 <b>Uuqk</b> ununquium 117	118 <b>Uubk</b> ununbium 118	119 <b>Uuqk</b> ununquium 119	120 <b>Uubk</b> ununbium 120	121 <b>Uuqk</b> ununquium 121	122 <b>Uubk</b> ununbium 122	123 <b>Uuqk</b> ununquium 123	124 <b>Uubk</b> ununbium 124	125 <b>Uuqk</b> ununquium 125	126 <b>Uubk</b> ununbium 126	127 <b>Uuqk</b> ununquium 127	128 <b>Uubk</b> ununbium 128	129 <b>Uuqk</b> ununquium 129	130 <b>Uubk</b> ununbium 130	131 <b>Uuqk</b> ununquium 131	132 <b>Uubk</b> ununbium 132	133 <b>Uuqk</b> ununquium 133	134 <b>Uubk</b> ununbium 134	135 <b>Uuqk</b> ununquium 135	136 <b>Uubk</b> ununbium 136	137 <b>Uuqk</b> ununquium 137	138 <b>Uubk</b> ununbium 138	139 <b>Uuqk</b> ununquium 139	140 <b>Uubk</b> ununbium 140	141 <b>Uuqk</b> ununquium 141	142 <b>Uubk</b> ununbium 142	143 <b>Uuqk</b> ununquium 143	144 <b>Uubk</b> ununbium 144	145 <b>Uuqk</b> ununquium 145	146 <b>Uubk</b> ununbium 146	147 <b>Uuqk</b> ununquium 147	148 <b>Uubk</b> ununbium 148	149 <b>Uuqk</b> ununquium 149	150 <b>Uubk</b> ununbium 150	151 <b>Uuqk</b> ununquium 151	152 <b>Uubk</b> ununbium 152	153 <b>Uuqk</b> ununquium 153	154 <b>Uubk</b> ununbium 154	155 <b>Uuqk</b> ununquium 155	156 <b>Uubk</b> ununbium 156	157 <b>Uuqk</b> ununquium 157	158 <b>Uubk</b> ununbium 158	159 <b>Uuqk</b> ununquium 159	160 <b>Uubk</b> ununbium 160	161 <b>Uuqk</b> ununquium 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262	263 <b>Uuqk</b> ununquium 263	264 <b>Uubk</b> ununbium 264	265 <b>Uuqk</b> ununquium 265	266 <b>Uubk</b> ununbium 266	267 <b>Uuqk</b> ununquium 267	268 <b>Uubk</b> ununbium 268	269 <b>Uuqk</b> ununquium 269	270 <b>Uubk</b> ununbium 270	271 <b>Uuqk</b> ununquium 271	272 <b>Uubk</b> ununbium 272	273 <b>Uuqk</b> ununquium 273	274 <b>Uubk</b> ununbium 274	275 <b>Uuqk</b> ununquium 275	276 <b>Uubk</b> ununbium 276	277 <b>Uuqk</b> ununquium 277	278 <b>Uubk</b> ununbium 278	279 <b>Uuqk</b> ununquium 279	280 <b>Uubk</b> ununbium 280	281 <b>Uuqk</b> ununquium 281	282 <b>Uubk</b> ununbium 282	283 <b>Uuqk</b> ununquium 283	284 <b>Uubk</b> ununbium 284	285 <b>Uuqk</b> ununquium 285	286 <b>Uubk</b> ununbium 286	287 <b>Uuqk</b> ununquium 287	288 <b>Uubk</b> ununbium 288	289 <b>Uuqk</b> ununquium 289	290 <b>Uubk</b> ununbium 290	291 <b>Uuqk</b> ununquium 291	292 <b>Uubk</b> ununbium 292	293 <b>Uuqk</b> ununquium 293	294 <b>Uubk</b> ununbium 294	295 <b>Uuqk</b> ununquium 295	296 <b>Uubk</b> ununbium 296	297 <b>Uuqk</b> ununquium 297	298 <b>Uubk</b> ununbium 298	299 <b>Uuqk</b> ununquium 299	300 <b>Uubk</b> ununbium 300

1  
**H**  
hydrogen  
1

relative atomic mass  
atomic symbol  
name  
atomic (proton) number

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

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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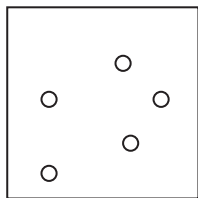
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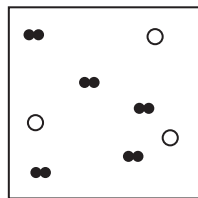
**Answer ALL questions.**

**1** Substances can be classified as elements, mixtures or compounds.

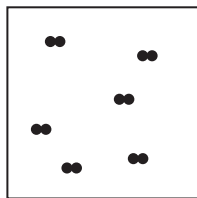
(a) Each box represents an element, a mixture or a compound.



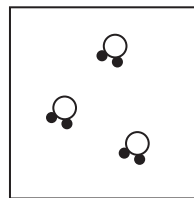
Box 1



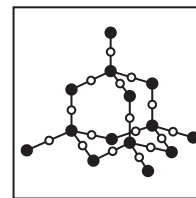
Box 2



Box 3



Box 4



Box 5

(i) Which box represents a mixture?

(1)

- A 1
- B 2
- C 3
- D 4

(ii) Which two boxes represent elements?

(1)

- A 1 and 2
- B 2 and 3
- C 1 and 3
- D 3 and 4

(iii) Explain why Box 5 represents a compound.

(2)

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(b) The Periodic Table contains all the known elements.

(i) How are the elements arranged in the Periodic Table?

(1)

- A increasing mass number
- B increasing number of neutrons
- C increasing number of protons
- D increasing reactivity

(ii) Elements in the same group have the same number of

(1)

- A electrons in the outer shell
- B electron shells
- C neutrons
- D protons

**(Total for Question 1 = 6 marks)**

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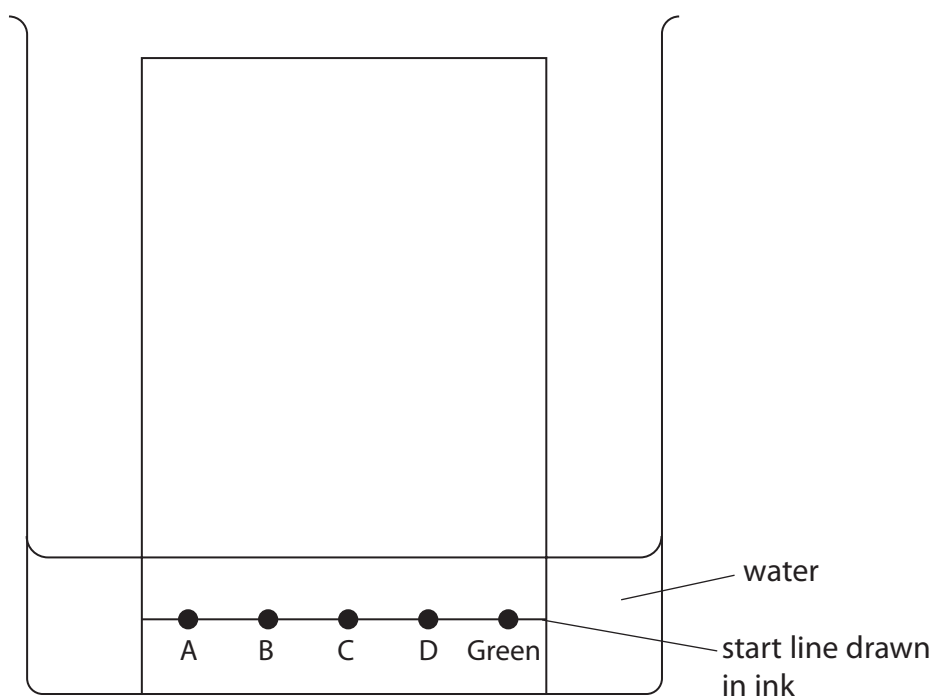


## 2 Chromatography is used to analyse mixtures.

A student does a chromatography experiment to analyse the composition of green food colouring in sweets.

She places four known dyes, A, B, C and D, and the green food colouring on chromatography paper.

The diagram shows the student's apparatus at the start of her experiment.



(a) The diagram shows that the student makes two mistakes when setting up her apparatus.

State the two changes that the student should make so that her experiment works.

(2)

1.....

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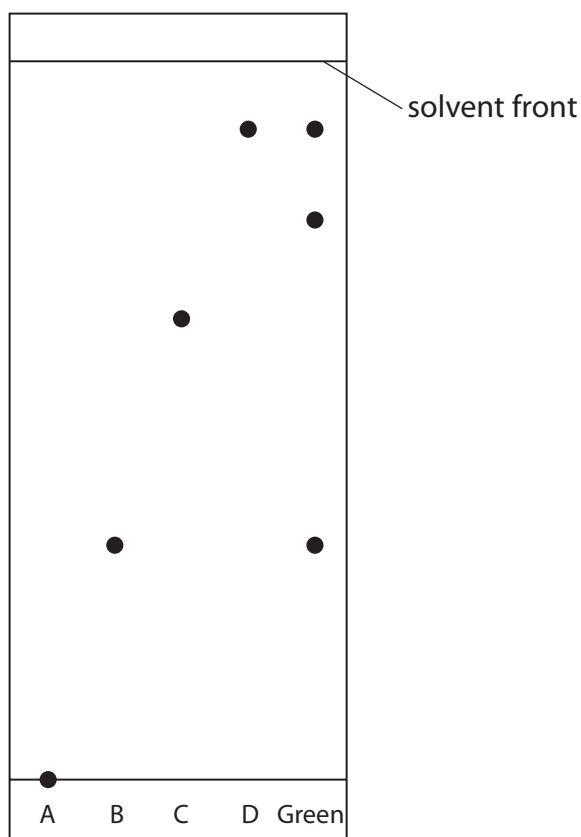
2.....

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(b) Another student does the chromatography experiment correctly.

The diagram shows her chromatogram at the end of the experiment.



(i) Explain what the chromatogram shows about the composition of the green food colouring.

(3)

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(ii) The distance between the start line and the spot for dye C is 6.2 cm.

Calculate the  $R_f$  value of dye C.

(3)

$R_f$  value = .....

(iii) Suggest why dye A does not move.

(1)

(Total for Question 2 = 9 marks)

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3 Solutions of silver nitrate and potassium chloride react together to make the insoluble salt, silver chloride.

A student uses this method to prepare a sample of silver chloride.

Step 1 add 25 cm<sup>3</sup> of silver nitrate solution to a conical flask

Step 2 add potassium chloride solution to the flask

Step 3 filter off the silver chloride

(a) What term is used for this reaction?

(1)

- A neutralisation
- B precipitation
- C redox
- D thermal decomposition

(b) Give two more steps that will produce a pure, dry sample of silver chloride.

(2)

Step 4.....

Step 5.....

(c) Acidified silver nitrate solution is used to test for chloride ions.

Give a reason why hydrochloric acid is not used to acidify silver nitrate solution.

(1)

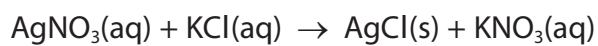
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- (d) The chemical equation for the reaction between solutions of silver nitrate and potassium chloride is



A student adds an excess of potassium chloride solution to  $25.0 \text{ cm}^3$  of  $0.100 \text{ mol/dm}^3$  silver nitrate solution.

Calculate the maximum mass of silver chloride, in grams, that can be produced.

[ $M_r$  of  $\text{AgCl} = 143.5$ ]

(2)

mass = ..... g

**(Total for Question 3 = 6 marks)**

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4 This question is about the metal, lead.

(a) Explain why metals, such as lead, are malleable.

(2)

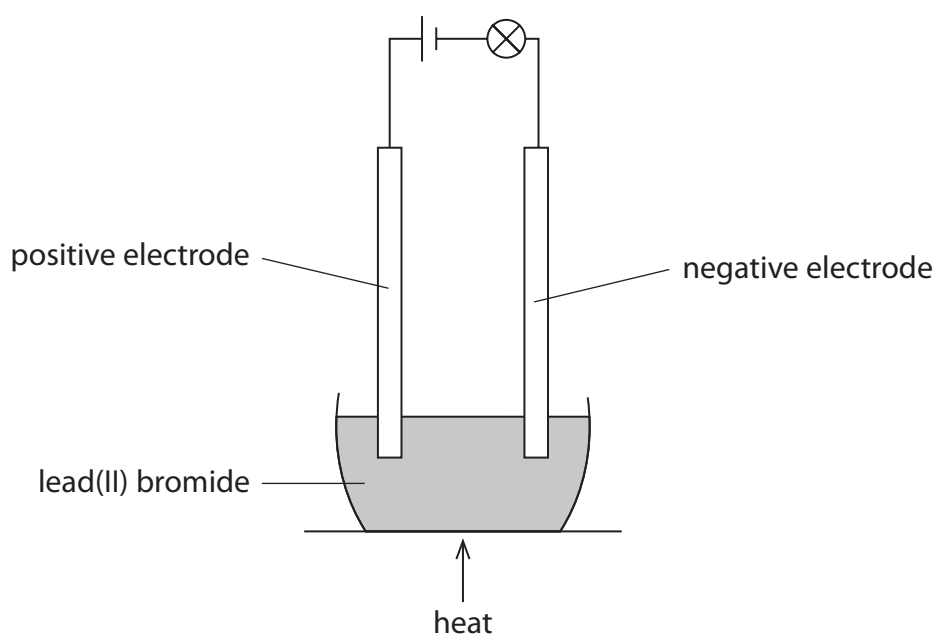
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(b) A teacher uses this apparatus in a fume cupboard to demonstrate the electrolysis of lead(II) bromide.



The lead(II) bromide is heated until it melts.

When the lead(II) bromide melts, the lamp lights.

One of the products of this electrolysis is lead.

(i) State why solid lead(II) bromide does not conduct electricity.

(1)

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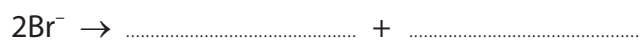
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(ii) Bromine is formed by the oxidation of bromide ions at the positive electrode.

Complete the ionic half-equation for the oxidation of bromide ions.

(1)



(iii) Explain why lead metal forms at the negative electrode.

(2)

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(iv) The teacher stops heating the mixture and allows it to solidify.

Suggest why the lamp stays alight.

(1)

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**(Total for Question 4 = 7 marks)**

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5 This question is about Group 1 metals and their reactions.

(a) When lithium is added to water, bubbles of hydrogen gas are observed.

(i) Give two other observations that could be made.

(2)

1 .....

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2 .....

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(ii) Give the test for hydrogen gas.

(1)

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(b) (i) Give one observation that would be different if potassium is used instead of lithium.

(1)

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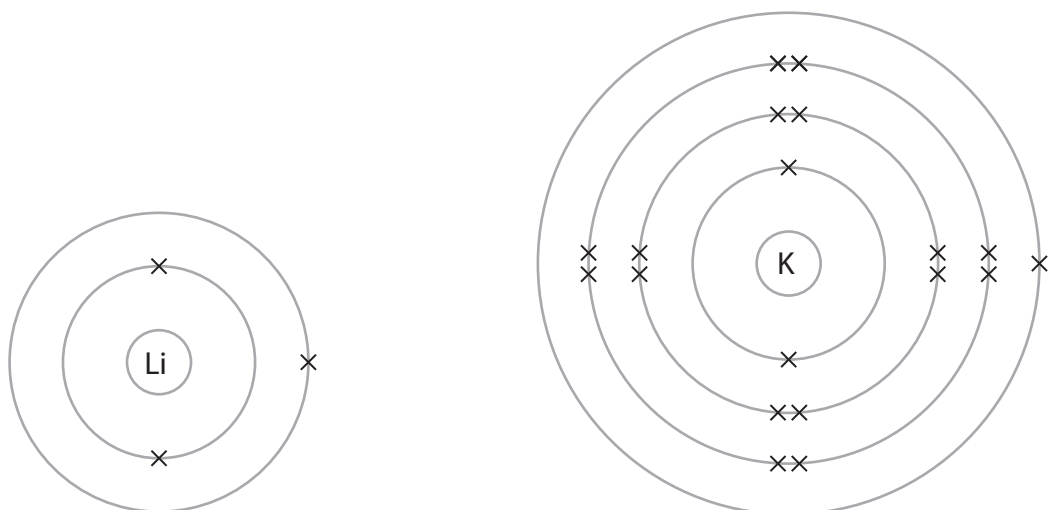
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(ii) The diagram represents an atom of lithium and an atom of potassium.



Explain why potassium is more reactive than lithium.

(3)

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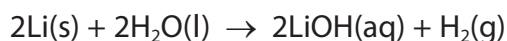
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(c) The equation for the reaction between lithium and water is



(i) A mass of 0.500 g of lithium reacts with an excess of water.

Calculate the volume, in  $\text{cm}^3$ , of hydrogen gas produced at rtp.

[molar volume of a gas at rtp =  $24\,000\text{ cm}^3$ ]

Give your answer to three significant figures.

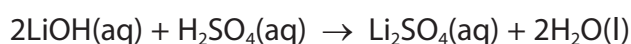
(3)

volume = .....  $\text{cm}^3$

(ii) In a reaction between lithium and water,  $150\text{ cm}^3$  of lithium hydroxide solution is formed.

The lithium hydroxide solution is then completely neutralised by  $24.85\text{ cm}^3$  of  $0.100\text{ mol/dm}^3$  sulfuric acid.

The equation for the neutralisation is



Calculate the concentration, in  $\text{mol/dm}^3$ , of the lithium hydroxide solution.

(3)

concentration = .....  $\text{mol/dm}^3$

**(Total for Question 5 = 13 marks)**





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6 This question is about ethane and ethene.

(a) Ethane can be obtained from crude oil.

Describe the industrial process used to separate crude oil into fractions.

(4)

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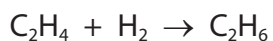
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(b) The equation for the reaction between ethene gas and hydrogen gas is



The rate of this reaction can be increased by increasing the pressure.

(i) Explain why increasing the pressure increases the rate of this reaction.

(2)

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(ii) The rate of this reaction can also be increased by using a catalyst.

Explain how using a catalyst increases the rate of a reaction.

(2)

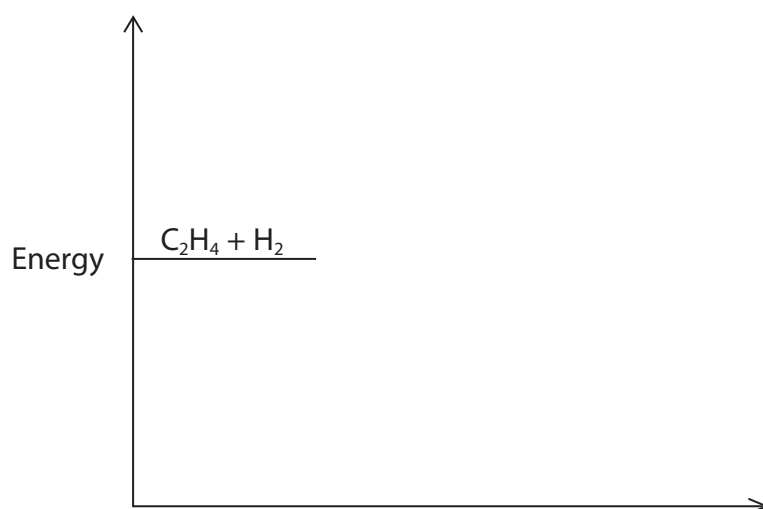
(iii) Give one other way that the rate of reaction between ethene gas and hydrogen gas can be increased.

(1)

(iv) The reaction between ethene and hydrogen is exothermic.

Complete the reaction profile diagram, including labels for the activation energy and the enthalpy change,  $\Delta H$ .

(3)



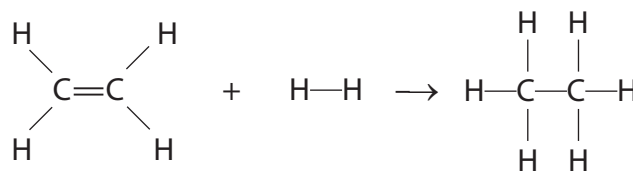
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(c) The reaction between ethene and hydrogen can be represented using displayed formulae.



Bond	Bond energy in kJ/mol
C=C	612
C—H	412
H—H	436
C—C	348

Use the bond energies in the table to calculate the enthalpy change,  $\Delta H$ , in kJ/mol for this reaction.

(3)

$\Delta H = \dots\dots\dots$  kJ/mol

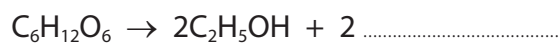
**(Total for Question 6 = 15 marks)**



7 (a) Ethanol,  $C_2H_5OH$ , can be produced by the fermentation of glucose,  $C_6H_{12}O_6$

(i) Complete the equation for the fermentation of glucose.

(1)



(ii) State why it is necessary for fermentation to be done in the absence of air.

(1)

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(iii) Explain why the temperature should not be higher than  $40^\circ C$ .

(2)

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(iv) When 4 mol of glucose is fermented, a mass of 55.2 g of ethanol is produced.

Show that the percentage yield of ethanol is 15%.

[ $M_r$  of  $C_2H_5OH = 46$ ]

(2)

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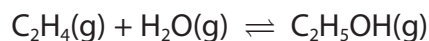
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(b) Ethanol can also be produced by the reaction between ethene and steam.

The equation for the reaction is



(i) This reaction is in dynamic equilibrium.

Give two features of a reaction in dynamic equilibrium.

(2)

1 .....

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2 .....

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(ii) When the equilibrium mixture is heated, the yield of ethanol decreases.

Explain whether the forward reaction is exothermic or endothermic.

(2)

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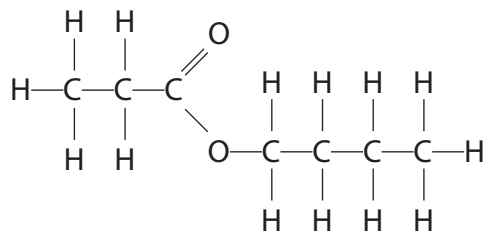
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(c) Carboxylic acids react with alcohols to form esters.

The displayed formula of an ester is



(i) Carboxylic acid A and alcohol B react to produce this ester.

Give the displayed formula of carboxylic acid A and of alcohol B.

(2)

Carboxylic acid A	Alcohol B

(ii) Indicators can be used to test for carboxylic acids.

Describe a different chemical test for a carboxylic acid.

(2)

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**(Total for Question 7 = 14 marks)**

**TOTAL FOR PAPER = 70 MARKS**



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