

Please check the examination details below before entering your candidate information

Candidate surname

Other names

**Pearson Edexcel**  
**International GCSE (9–1)**

Centre Number

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Candidate Number

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# Monday 20 January 2020

Afternoon (Time: 1 hour 15 minutes)

Paper Reference **4CH1/2CR**

## Chemistry

**Unit: 4CH1**

**Paper: 2CR**

**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.
- 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>O</b> oxygen 8	16 <b>F</b> fluorine 9	17 <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
37 <b>Rb</b> rubidium 37	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
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77
87 <b>Fr</b> francium 87	88 <b>Ra</b> radium 88	89 <b>Ac*</b> actinium 89	104 <b>Rf</b> rutherfordium 104	105 <b>Db</b> dubnium 105	106 <b>Sg</b> seaborgium 106	107 <b>Bh</b> bohrium 107	108 <b>Hs</b> hassium 108	109 <b>Mt</b> meitnerium 109
133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	186 <b>Re</b> rhenium 75	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77
223 <b>Fr</b> francium 87	226 <b>Ra</b> radium 88	227 <b>Ac*</b> actinium 89	261 <b>Rf</b> rutherfordium 104	262 <b>Db</b> dubnium 105	266 <b>Sg</b> seaborgium 106	264 <b>Bh</b> bohrium 107	277 <b>Hs</b> hassium 108	268 <b>Mt</b> meitnerium 109
122 <b>Sb</b> antimony 51	119 <b>Sn</b> tin 50	112 <b>Cd</b> cadmium 48	106 <b>Pd</b> palladium 46	103 <b>Rh</b> rhodium 45	101 <b>Ru</b> ruthenium 44	100 <b>Tc</b> technetium 43	108 <b>Ag</b> silver 47	110 <b>Pt</b> platinum 78
127 <b>I</b> iodine 53	128 <b>Te</b> tellurium 52	112 <b>Cd</b> cadmium 48	106 <b>Pd</b> palladium 46	103 <b>Rh</b> rhodium 45	101 <b>Ru</b> ruthenium 44	100 <b>Tc</b> technetium 43	108 <b>Ag</b> silver 47	110 <b>Pt</b> platinum 78
209 <b>Bi</b> bismuth 83	207 <b>Pb</b> lead 82	201 <b>Hg</b> mercury 80	197 <b>Au</b> gold 79	192 <b>Ir</b> iridium 77	190 <b>Os</b> osmium 76	186 <b>Re</b> rhenium 75	197 <b>Au</b> gold 79	201 <b>Hg</b> mercury 80
[222] <b>Rn</b> radon 86	[210] <b>At</b> astatine 85	[209] <b>Po</b> polonium 84	[272] <b>Rg</b> roentgenium 111	[271] <b>Ds</b> darmstadtium 110	[277] <b>Hs</b> hassium 108	[264] <b>Bh</b> bohrium 107	[272] <b>Rg</b> roentgenium 111	[222] <b>Rn</b> radon 86
Elements with atomic numbers 112-116 have been reported but not fully authenticated								

1  
**H**  
hydrogen  
1

**Key**  
relative atomic mass  
atomic symbol  
name  
atomic (proton) number

\* 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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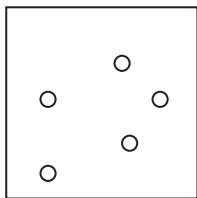
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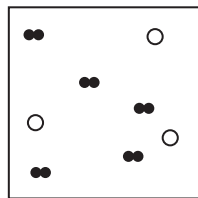
## Answer ALL questions.

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

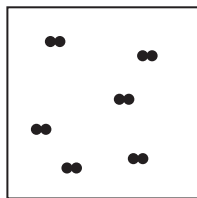
(a) Each box represents an element, a mixture or a compound.



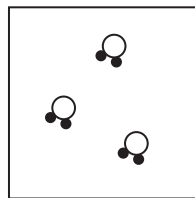
Box 1



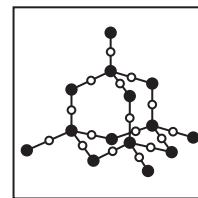
Box 2



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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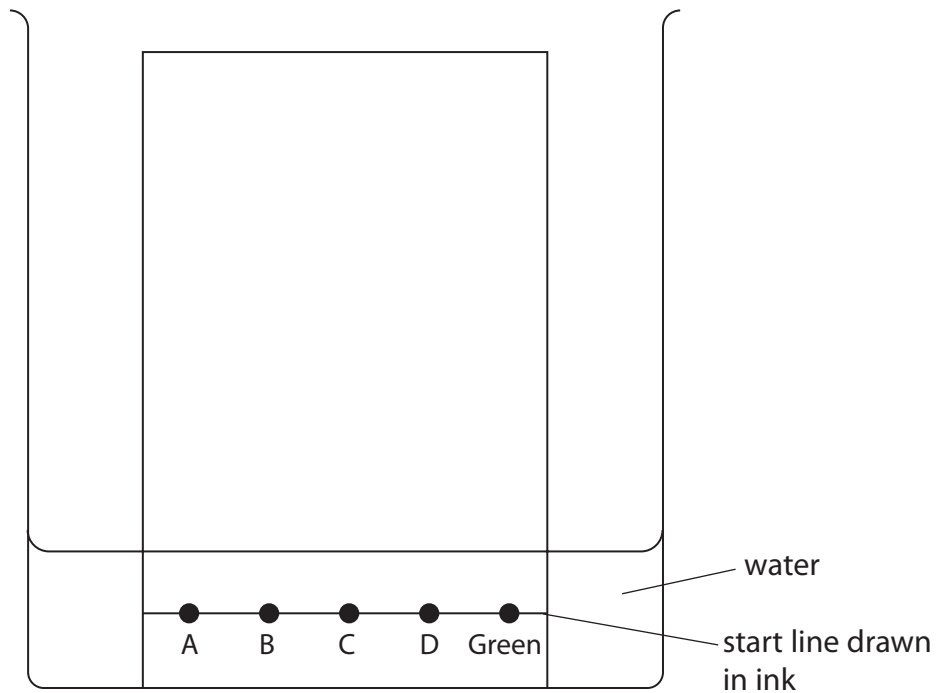


2 Chromatography is used to analyse mixtures.

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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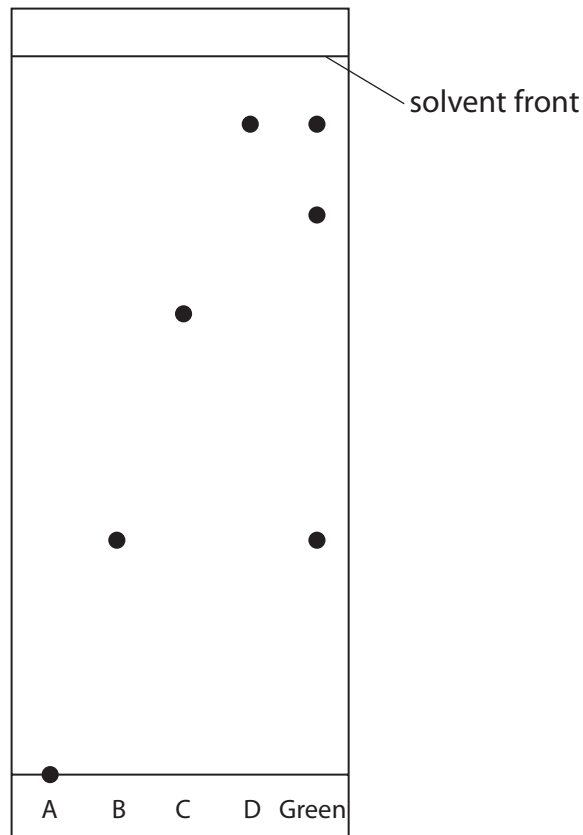
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(b) Another student does the chromatography experiment correctly.

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.....

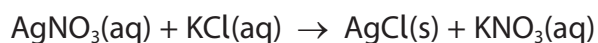
(c) Acidified silver nitrate solution is used to test for chloride ions.

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

(1)



- (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 cm<sup>3</sup> of 0.100 mol/dm<sup>3</sup> silver nitrate solution.

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

[M<sub>r</sub> of 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.

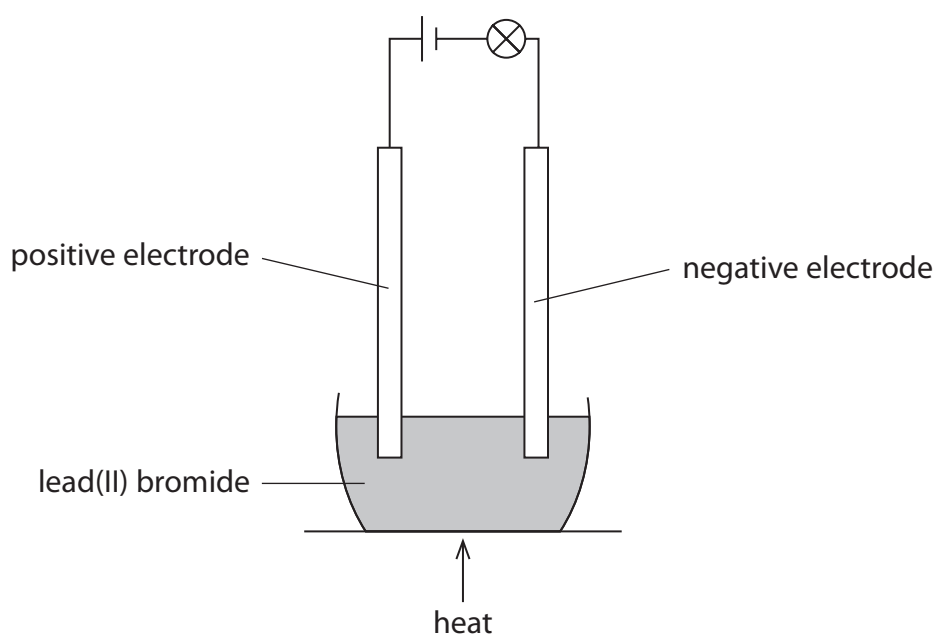
(2)

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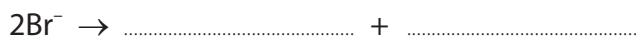
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(ii) Bromine is formed by the oxidation of bromide ions at the positive electrode.

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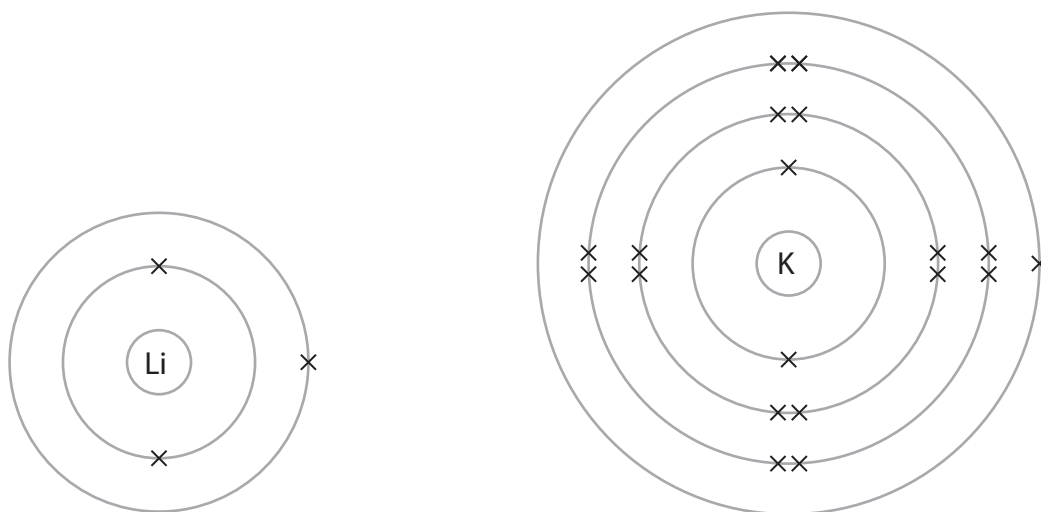
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(ii) The diagram represents an atom of lithium and an atom of potassium.



Explain why potassium is more reactive than lithium.

(3)

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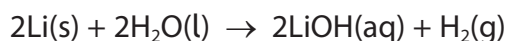
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(c) The equation for the reaction between lithium and water is



(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.

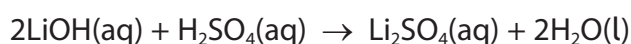
(3)

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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P 6 2 0 6 1 A 0 1 7 2 4

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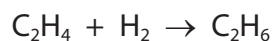
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(b) The equation for the reaction between ethene gas and hydrogen gas is



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)

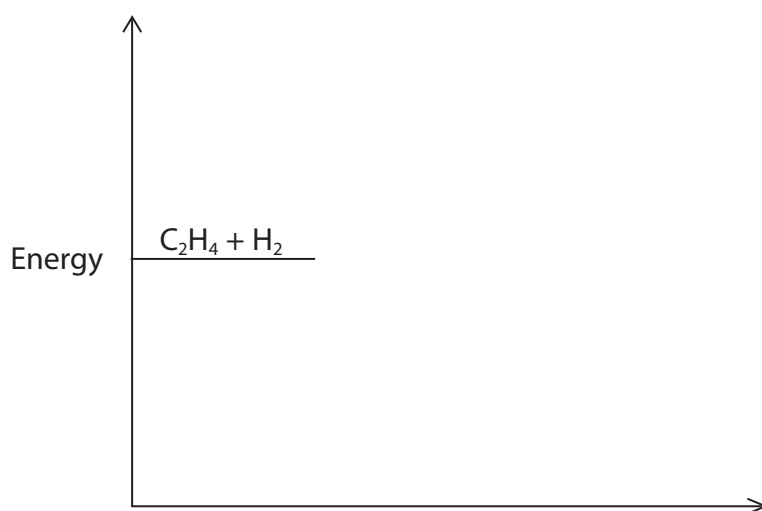
(iii) Give one other way that the rate of reaction between ethene gas and hydrogen gas can be increased.

(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)



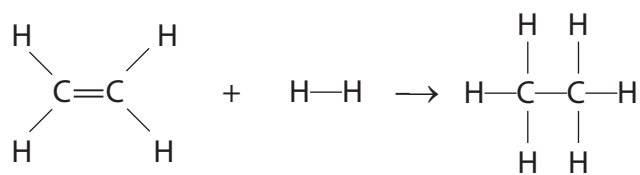
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(c) The reaction between ethene and hydrogen can be represented using displayed formulae.



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<sub>2</sub>H<sub>5</sub>OH, can be produced by the fermentation of glucose, C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>

(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°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<sub>r</sub> of C<sub>2</sub>H<sub>5</sub>OH = 46]

(2)

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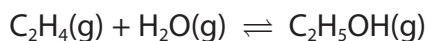
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(b) Ethanol can also be produced by the reaction between ethene and steam.

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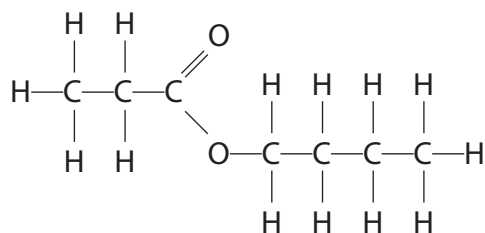
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(c) Carboxylic acids react with alcohols to form esters.

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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