MODEL ANSWERS

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Wednesday 10 June 2020

Afternoon (Time: 1 hour 15 minutes) | Paper Reference **4CH1/2C**

Chemistry

Unit: 4CH1

Paper 2C

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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P 6 2 0 4 7 A 0 1 2 4

Pearson

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
																	4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1
H
hydrogen
1

**** 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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Answer ALL questions.

1 A student is given a mixture of salt solution and sand.

She wants to obtain pure water from the mixture.

(a) She separates the sand from the salt solution.

Which method of separation should she use?

(1)

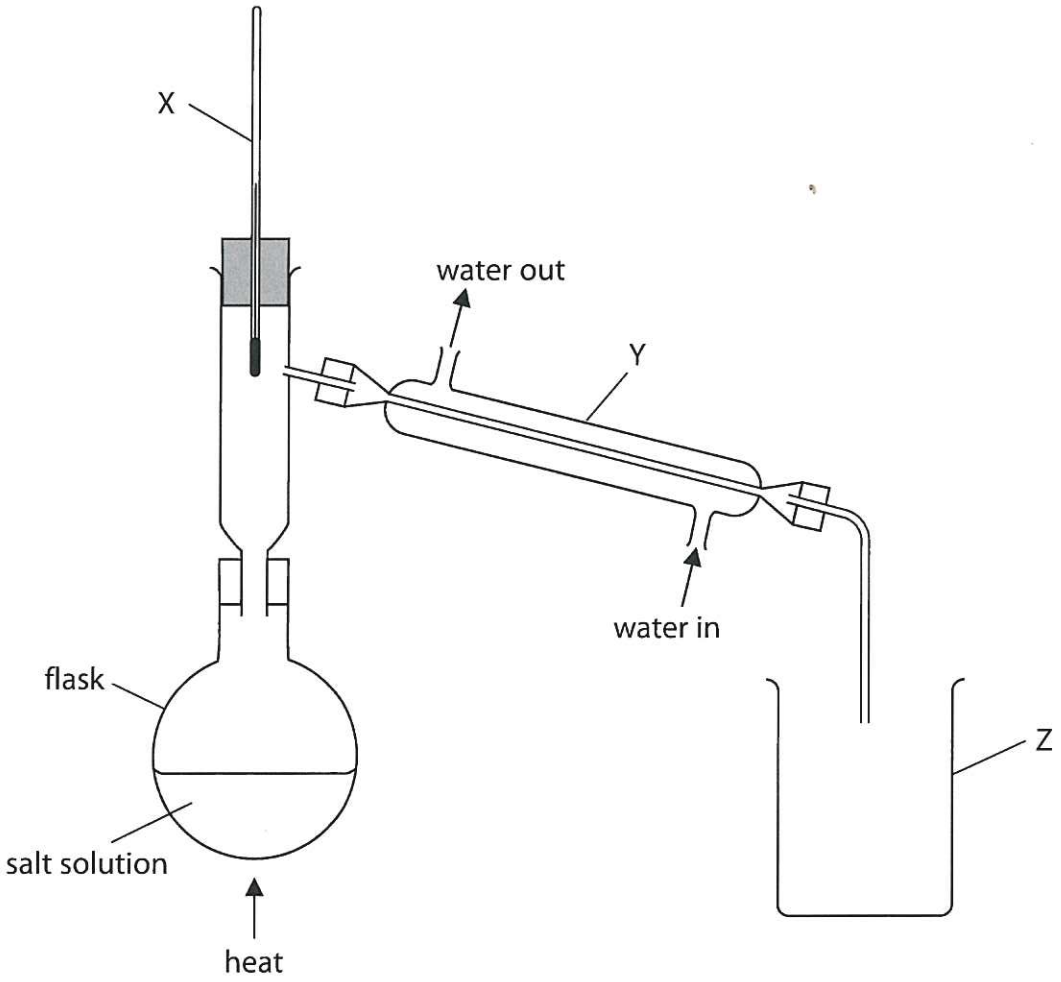
☐ **A** crystallisation

☒ **B** filtration

☐ **C** fractional distillation

☐ **D** simple distillation

(b) The student then uses this apparatus to obtain pure water from the salt solution.



(i) Name the pieces of apparatus labelled X, Y and Z.

(3)

X Thermometer

Y Liebig Condenser

Z Beaker

(ii) State what remains in the flask when the separation is complete.

(1)

Salt.

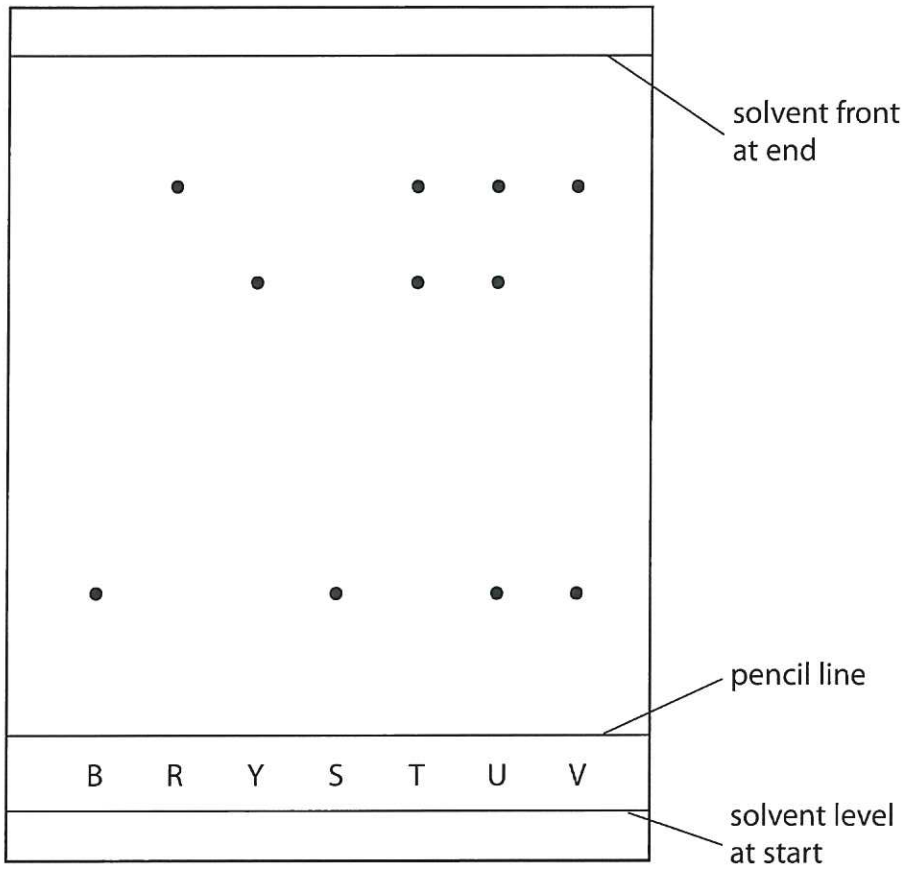
(Total for Question 1 = 5 marks)

2 In a chromatography experiment a student uses samples of three pure food dyes, blue (B), red (R) and yellow (Y).

He also uses samples of four unknown substances, S, T, U and V.

The student puts a small drop of each substance on the pencil line.

The diagram shows the student's chromatogram at the end of the experiment.



(a) Which of the unknown substances contains only one food dye?

(1)

☒ **A** substance S

☐ **B** substance T

☐ **C** substance U

☐ **D** substance V

(b) Explain which pure food dyes are in substance V.

(2)

V Contains B and R as V has Spots at the same height as those from B and R.

(c) (i) Calculate the R_f value of the yellow food dye Y.

(3)

R_f = distance travelled by Y / distance travelled by solvent front

= 6 / 9 = 0.667

R_f = 0.667

(ii) State how the chromatogram suggests that the yellow food dye Y is less soluble in the solvent than the red food dye R.

(1)

The Spot from Y doesn't move as far as the Spot from R up the paper.

(Total for Question 2 = 7 marks)

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3 (a) The box gives the names of some metals.

calcium	copper	iron	magnesium	silver	zinc

(i) Identify the metal from the box that burns with a bright white flame.

(1)

Magnesium.

(ii) In the Earth, metals are found either in ores or as uncombined elements.

Explain which metal from the box is most likely to be found as an uncombined element.

(2)

Silver - It is the least reactive of the listed metals.

(b) This is the order of reactivity of four metals.

most reactive	aluminium
↓	iron
	lead
least reactive	copper

The method used to obtain a metal from its oxide depends on the reactivity of the metal.

Two possible methods are

Method 1 heating the metal oxide with carbon

Method 2 electrolysis

Explain which method should be used to obtain lead from lead(II) oxide, PbO

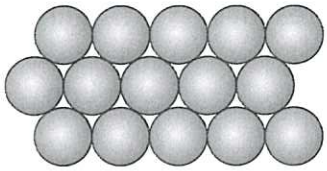
Include an equation for the formation of lead in your answer.

(3)

Method 1 as Lead is less reactive than iron and iron is obtained from iron oxide by Carbon extraction.

$2PbO + C \rightarrow 2Pb + CO_2$

(c) The diagram shows the arrangement of the particles in a pure metal.



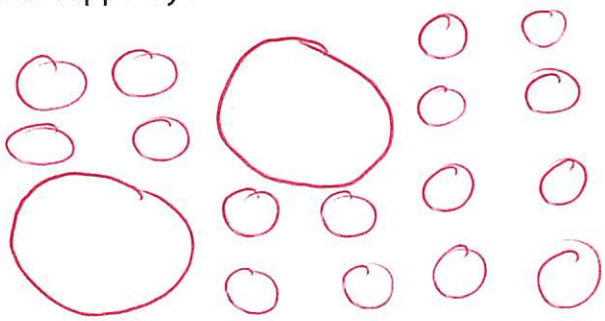
Metals are often made into alloys to make them harder.

Explain why alloys are harder than pure metals.

Draw a diagram to support your answer.

(4)

Alloy:



In a pure metal, the ions are in a regular arrangement so the layers of ions can easily slide over each other.

In an alloy having different sized metal ions breaks up the regular arrangement, so it is harder for the layers to slide over each other.

(Total for Question 3 = 10 marks)

4 Alcohols contain the functional group —OH

(a) Give the structural formula of the alcohol that contains one carbon atom.

(1)

CH_3OH

(b) Ethanol (C_2H_5OH) is an alcohol that can be obtained from glucose ($C_6H_{12}O_6$).

(i) Name the process that converts glucose into ethanol.

(1)

fermentation.

(ii) Explain why this process is carried out in the absence of air and at a temperature below 40°C.

(4)

Respiration must be anaerobic as in aerobic conditions ethanol isn't produced as CO_2 and H_2O would be instead produced.

If the temperature is above 40°C, the enzymes denature so the fermentation stops.

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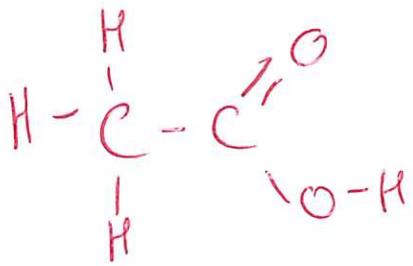
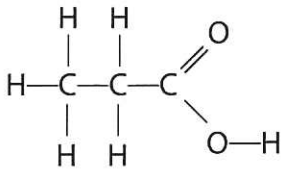
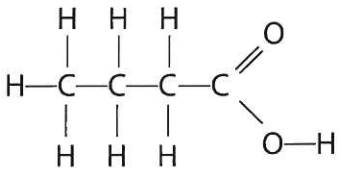
(c) The table gives information about some organic compounds in the same homologous series.

Compound	Molecular formula	Displayed formula
ethanoic acid	$C_2H_4O_2$	
propanoic acid	$C_3H_6O_2$	
Butanoic acid.	$C_4H_8O_2$	

(i) Complete the table by giving the missing information.

(3)

(ii) Name the homologous series that contains these compounds.

(1)

Carboxylic acids.

(d) The compounds in the table can react with alcohols to form esters.

When preparing esters, a small amount of concentrated sulfuric acid is also used.

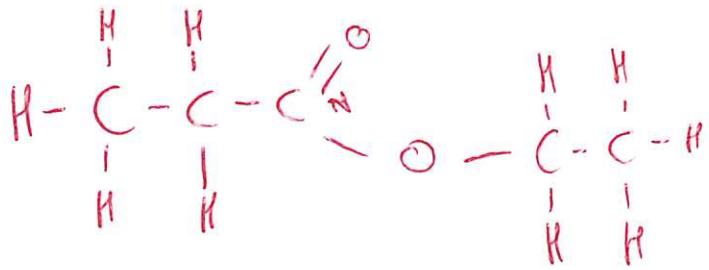
(i) State the purpose of the acid.

(1)

It acts as a Catalyst.

(ii) Draw the displayed formula of the ester that forms when propanoic acid reacts with ethanol.

(2)



(iii) Esters have particular uses that depend on their properties.

Give an example of a property and use of esters.

(2)

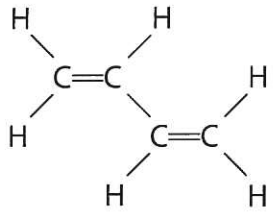
property distinctive sweet fruity smell

use perfumes or flavourings.

(Total for Question 4 = 15 marks)

5 The organic compound butadiene is a colourless gas used in the manufacture of synthetic rubber for tyres.

The displayed formula of butadiene is



(a) Explain why butadiene is described as an unsaturated hydrocarbon.

(3)

Unsaturated - It Contains two Carbon - Carbon double bonds

Hydrocarbon - Contains hydrogen and Carbon only.

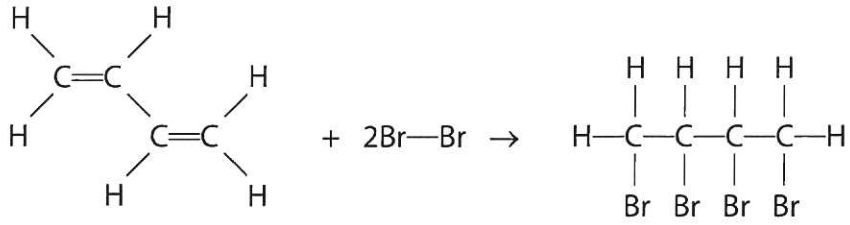
(b) (i) Butadiene reacts with bromine water.

State the colour change that occurs during this reaction.

(1)

from Orange to Colourless.

(ii) The equation for the reaction between butadiene and bromine can be shown using displayed formulae.



The table gives some bond energies.

Bond	C—H	C=C	Br—Br	C—C	C—Br
Bond energy in kJ/mol	412	612	193	348	276

Use this information to calculate the enthalpy change, ΔH, for the reaction.

Include a sign in your answer.

(4)

Breaking

6 C-H	6×412
2 C=C	2×612
1 C-C	348
2 Br-Br	2×193
Total	4430

Making

3 C-C	3(348)
6 C-H	6(412)
4 C-Br	4(276)
Total	4620

ΔH = Breaking - making

= 4430 - 4620

= -190

ΔH = -190 kJ/mol

(c) A scientist does an investigation to find out if butadiene would be a good fuel.

He burns a sample of butadiene gas and observes that carbon forms as black soot.

(i) Complete the equation to explain the scientist's observation.

(1)

$$2C_4H_6 + 7O_2 \rightarrow \underline{2}\,C + 4CO + 2CO_2 + \underline{6}\,H_2O$$

(ii) Explain how one of the products, other than carbon, may cause a problem.

(2)

Carbon monoxide is toxic as it reduces the capacity of the blood to carry oxygen.

Carbon dioxide is a greenhouse gas.

(iii) The equation for the combustion of butadiene in excess oxygen is

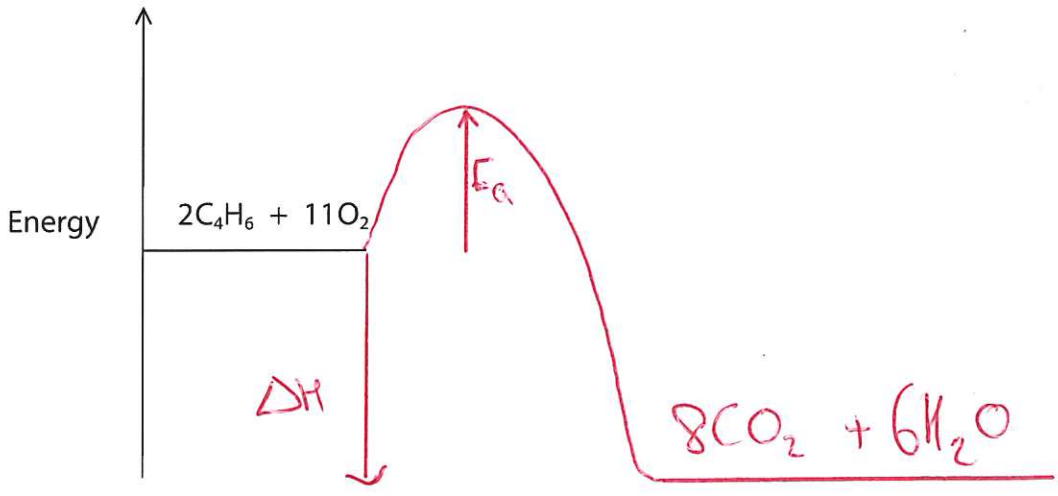
$$2C_4H_6 + 11O_2 \rightarrow 8CO_2 + 6H_2O$$

The enthalpy change for this reaction, ΔH, is – 3446 kJ/mol.

Complete the energy profile diagram for the reaction.

Label the enthalpy change for this reaction, ΔH, and the activation energy.

(4)



(Total for Question 5 = 15 marks)

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6 A student is provided with a bottle containing a colourless solution X.

Solution X is thought to be dilute sulfuric acid of concentration 0.10 mol/dm^3.

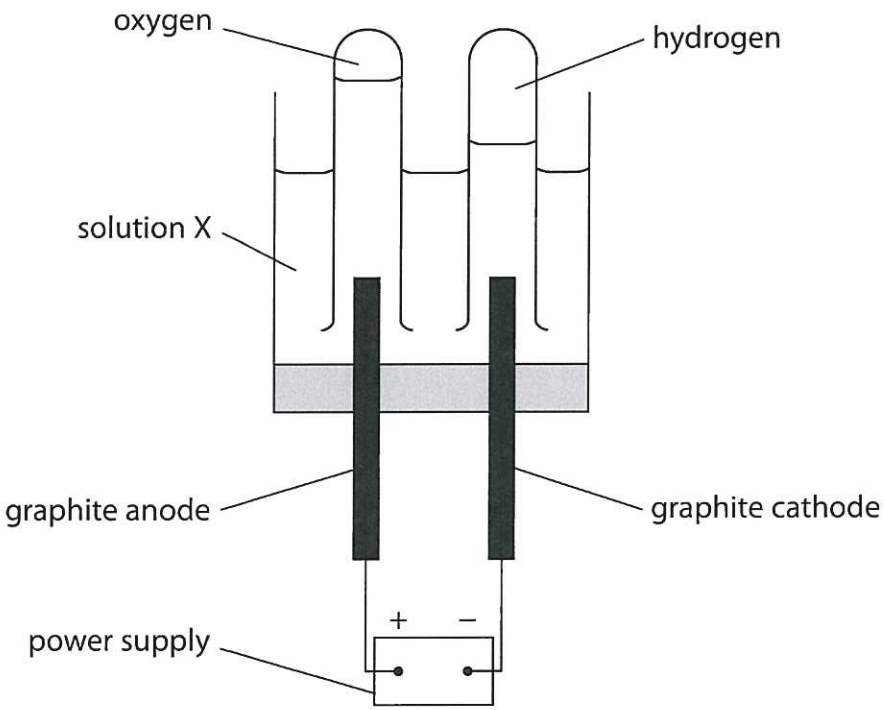
The student does some experiments on samples of solution X to try to show that it is dilute sulfuric acid.

The student adds a few drops of litmus to a sample of solution X.

The litmus turns red.

(a) The student knows that the products of the electrolysis of dilute sulfuric acid are hydrogen and oxygen.

She carries out the electrolysis using this apparatus.



(i) Suggest why the student does not use zinc electrodes in her experiment.

(1)

Zinc would react with Sulphuric acid.

(ii) State what is observed at both the anode and the cathode during the electrolysis.

(1)

Bubbles.

(iii) Which of these tests shows that the gas formed at the cathode is hydrogen?

(1)

- ☐ **A** a glowing splint relights
- ☒ **B** a burning splint gives a squeaky pop
- ☐ **C** a burning splint goes out
- ☐ **D** limewater turns cloudy

(b) Describe a test to show that solution X contains sulfate ions.

(2)

Add Barium Chloride, a white precipitate forms, showing Sulphate ions are present.

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(c) The student then does a titration to see if the concentration of the dilute sulfuric acid is 0.10 mol/dm^3.

She measures 25.0 cm^3 of potassium hydroxide solution into a conical flask, and then adds a few drops of indicator solution.

(i) Name the piece of apparatus the student should use to measure 25.0 cm^3 of the potassium hydroxide solution.

(1)

Volumetric pipette

(ii) The concentration of potassium hydroxide in the solution is 0.125 mol/dm^3.

Calculate the amount, in mol, of KOH in 25.0 cm^3 of this solution.

(2)

mol = Conc × Vol

$n(KOH) = 0.125 \times 25 \times 10^{-3}$

$= 3.125 \times 10^{-3}$

amount = 3.125×10^{-3} mol

(iii) The equation for the reaction in the titration is

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

Calculate the volume, in cm^3, of 0.10 mol/dm^3 sulfuric acid needed to neutralise 25.0 cm^3 of the potassium hydroxide solution.

(3)

$n(H_2SO_4) = \frac{3.125 \times 10^{-3}}{2} = 1.5625 \times 10^{-3}$ mol

$Vol(H_2SO_4) = \frac{mol}{Conc} = \frac{1.5625 \times 10^{-3}}{0.1} = 0.015625\ dm^3$

$= 15.625\ cm^3$

volume of sulfuric acid = 15.6 cm^3

(3 Sig Figs)

(Total for Question 6 = 11 marks)

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7 This question is about reactions involving gases.

(a) Potassium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The equation for the reaction is

$$K_2CO_3(s) + 2HCl(aq) \rightarrow 2KCl(aq) + H_2O(l) + CO_2(g)$$

Calculate the volume, in cm^3, of carbon dioxide gas produced when 6.9 g of potassium carbonate reacts with excess dilute hydrochloric acid.

[M_r of K_2CO_3 = 138]

[molar volume of CO_2 at rtp = 24 dm^3]

(3)

$n(K_2CO_3) = \frac{mass}{Mr} = \frac{6.9}{138} = 0.05mol$

$n(CO_2) = 0.05mol$

$V(CO_2) = 0.05 \times 24000 = 1200cm^3$

volume = 1200 cm^3

(b) This reaction involving gases is in dynamic equilibrium at a temperature of 225 °C.

$$H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g) \qquad \Delta H = +41\ kJ/mol$$

(i) Predict the effect on the yield of CO(g) at equilibrium when the temperature is increased without changing the pressure.

Give a reason for your answer.

(2)

There will be a higher yield of CO as equilibrium shifts to the right because the forward reaction is endothermic

(ii) Predict the effect on the yield of CO(g) at equilibrium when the pressure is increased without changing the temperature.

Give a reason for your answer.

(2)

There will be no effect as there are equal numbers of moles of gas on both sides.

(Total for Question 7 = 7 marks)

TOTAL FOR PAPER = 70 MARKS

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