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Write your name here

Surname	Other names

Pearson Edexcel Certificate
Pearson Edexcel International GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry

Unit: KCH0/4CH0
Paper: 2C

Friday 16 January 2015 – Morning
Time: 1 hour

Paper Reference
KCH0/2C
4CH0/2C

You must have:
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 60.
- 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 ▶

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1/1/1/1/1/

P 4 4 2 5 5 A 0 1 2 0

PEARSON

THE PERIODIC TABLE

Period	1	2											3	4	5	6	7	0
	Group																	
1	1 H Hydrogen 1																	4 He Helium 2
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
3	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
4	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
5	86 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 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
6	133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	179 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	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
7	223 Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89															

Key

Relative atomic mass

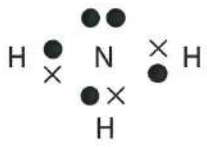
Symbol

Name

Atomic number

Answer ALL questions.

1 The diagram represents a particle of ammonia.



(a) This particle of ammonia is

(1)

- ☐ **A** an atom
- ☐ **B** an ion
- ☐ **C** a lattice
- ☒ **D** a molecule

1.14

(b) Which type of bonding is present in this particle of ammonia?

(1)

- ☒ **A** covalent
- ☐ **B** hydrogen
- ☐ **C** ionic
- ☐ **D** metallic

1.44

(c) What is the formula of ammonia?

(1)

NH_3

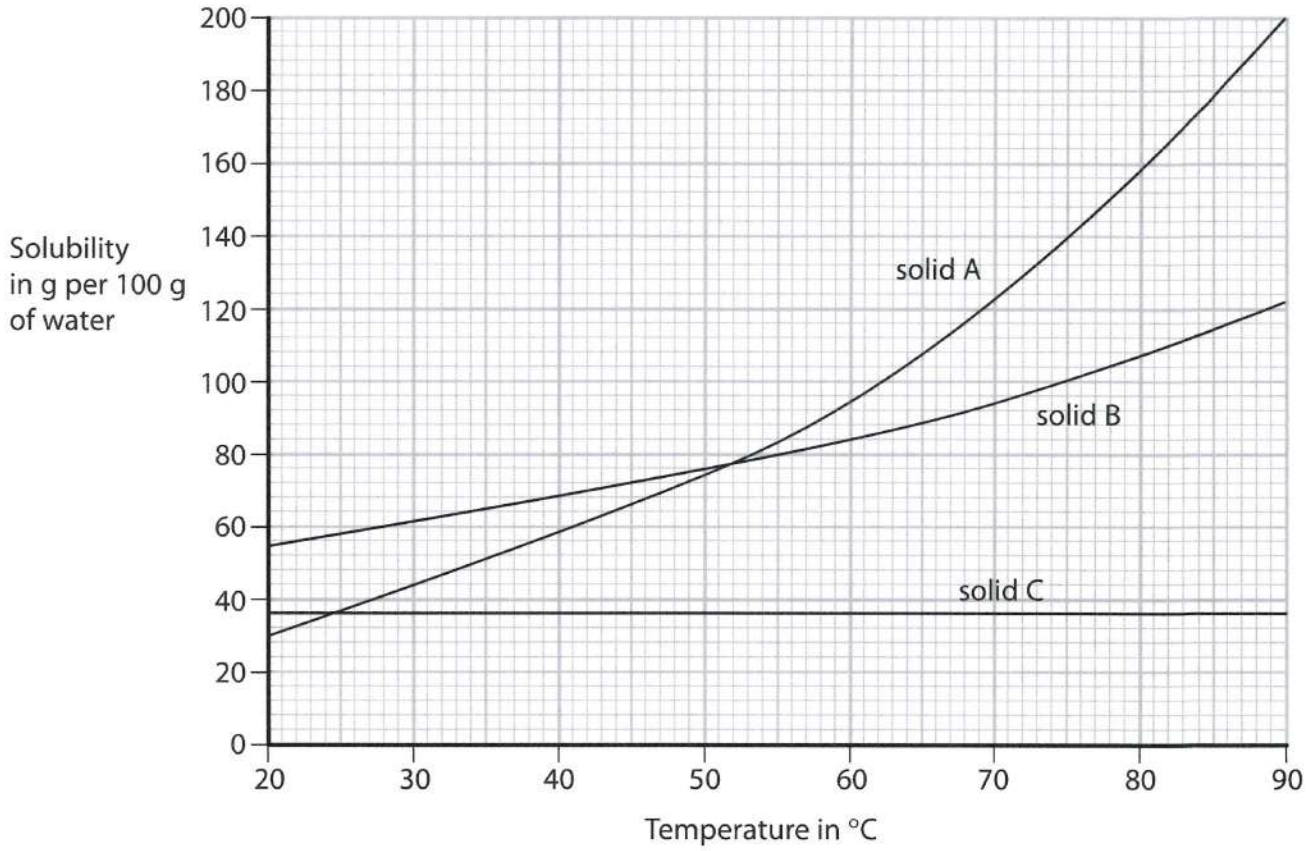
1.46

(Total for Question 1 = 3 marks)

2 The solubility of a solid in water is the maximum mass of the solid that can dissolve in 100 g of water at a given temperature.

An aqueous solution containing this maximum mass can be described as a saturated solution.

The graph shows the solubilities of three solids at different temperatures.



(a) (i) What is the relationship between solubility and temperature for solid A?

1.07C

(1)

Increases as temperature increases

(ii) Which solid is the most soluble at 30 °C?

1.06C

(1)

B

(b) Explain what you would observe if a saturated solution of solid A were cooled from 90 °C to 20 °C.

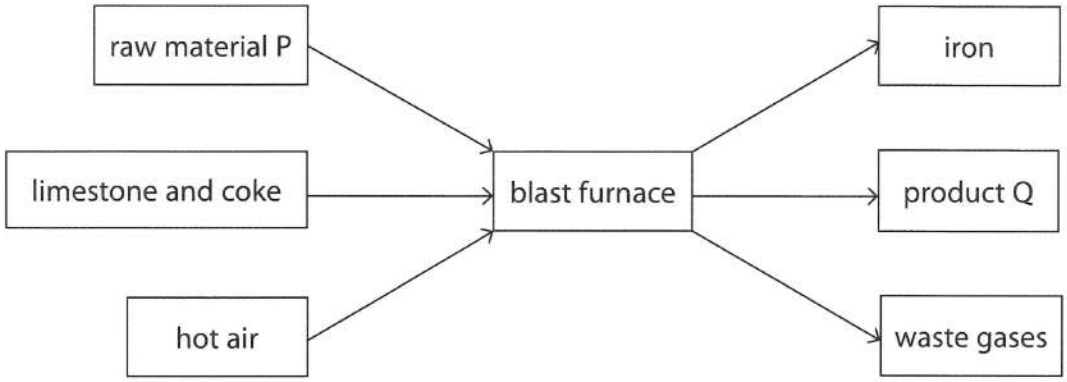
(2)

1.06C

• crystals would form as solid A becomes less soluble

(Total for Question 2 = 4 marks)

3 The diagram shows how iron is produced in a blast furnace.



(a) Give the name of raw material P and of product Q.

(2)

NOT IN SPEC

raw material P .....

product Q .....

(b) The equations for some reactions in a blast furnace are

A $C + O_2 \rightarrow CO_2$

B $C + CO_2 \rightarrow 2CO$

C $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

D $CaCO_3 \rightarrow CaO + CO_2$

E $CaO + SiO_2 \rightarrow CaSiO_3$

The table shows some types of reaction that occur in a blast furnace.

Complete the table by writing a letter, A, B, C, D, or E, to link each type of reaction to an appropriate reaction equation.

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

The first one has been done for you.

2.12
2.32
4.13

(3)

Type of reaction	Letter
one that gives out heat	A
one that is a thermal decomposition	D
one that is a neutralisation	E
one that forms a poisonous gas	B

(c) The rusting of iron objects is a major problem.

Name the two substances needed for iron to rust.

(2)

2.18

1 oxygen

2 water

(d) The order of reactivity of three metals is

most reactive
zinc
iron
tin
least reactive

Iron objects can be prevented from rusting by coating them with zinc or tin.

Some of these objects may be scratched when used, so the coating may come off.

Use the order of reactivity of the metals to suggest why coating these objects with zinc is more effective than coating them with tin.

2.19

(3)

- Zinc reacts instead of Iron as more reactive
- Iron reacts instead of tin as more reactive

(Total for Question 3 = 10 marks)

4 (a) Wine can be made from grapes.

The grapes are crushed to produce an aqueous solution containing glucose. Yeast is then added to this solution.

The solution is kept at a constant temperature for a period of time. The glucose is converted into ethanol.

(i) Name the process in which glucose is converted into ethanol.

(1)

4.32C Fermentation

(ii) What is the purpose of the yeast?

(1)

4.32C Provide the enzyme

(b) Grape vines can be attacked by a fungus that ruins the grapes. The fungus can be killed using Bordeaux mixture, a solid containing copper(II) sulfate and calcium hydroxide.

(i) State a test to show that Bordeaux mixture contains calcium ions.

(2)

2.46 test for calcium ions Flame test

observation Brick red

(ii) A sample of Bordeaux mixture is dissolved in water.

Describe separate tests to show that this solution contains copper(II) ions and sulfate ions.

(5)

2.47 test for copper(II) ions NaOH

observation Blue ppt

2.48 test for sulfate ions HCl and $BaCl_2$

observation White ppt

(c) Ethanol can be manufactured by passing a hot mixture of ethene and steam, at a high pressure, over a catalyst.

State the pressure used and name the catalyst.

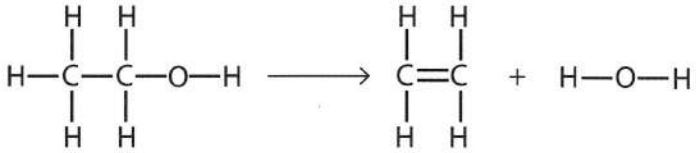
(2)

4.32C

pressure 60-70 atm

catalyst phosphoric acid

(d) The equation for the conversion of ethanol into ethene can be written using displayed formulae.



The table gives some average bond energies.

Bond	Average bond energy in kJ/mol
C—C	348
C=C	612
C—H	412
C—O	360
O—H	463

Use information from the table to calculate the enthalpy change, in kJ/mol, for the conversion of ethanol into ethene.

(4)

3.07C

Σ(bonds broken) = 348 + 412 + 360

= 1120

Σ(bonds made) = 612 + 463

= 1075

ΔH = Σ bonds broken − Σ bonds made

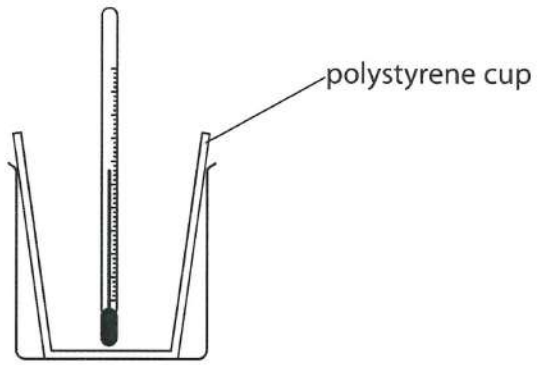
= 1120 − 1075

= +45 kJ/mol

enthalpy change = +45 kJ/mol

(Total for Question 4 = 15 marks)

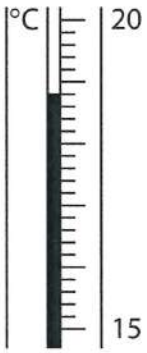
5 A student uses this apparatus to investigate the temperature change that occurs when potassium hydroxide is dissolved in water.



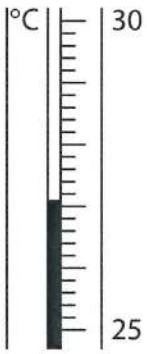
She uses this method.

- pour 50 cm^3 of water into the polystyrene cup and measure the temperature of the water
- add 3 g of potassium hydroxide and stir
- record the highest temperature of the solution

(a) These diagrams show the thermometer readings before and after the student added the potassium hydroxide.



before



after

Use the readings to complete the table.

(3)

temperature in °C after adding potassium hydroxide	27.1
temperature in °C before adding potassium hydroxide	18.8
temperature change in °C	8.3

(b) The student uses her results to calculate the enthalpy change for dissolving potassium hydroxide in water.

She compares her value with a data book value.

Student's value = – 32 kJ/mol.

Data book value = – 55 kJ/mol.

There are no errors in the student's method or in the calculation.

Suggest two reasons why the student's value differs from the data book value.

(2)

3.08

1 Thermal energy lost

2 Potassium hydroxide dissolves slowly

(Total for Question 5 = 5 marks)

6 Potassium sulfide is an ionic compound.

(a) Complete the table to show the arrangement of electrons in the ions formed when potassium and sulfur react to form potassium sulfide.

Give the charge on each of the ions.

(3)

1.15
1.19

Element	Arrangement of electrons in atom	Arrangement of electrons in ion	Charge on ion
K	2.8.8.1	2.8.8	+1
S	2.8.6	2.8.8	-2

1.43

(b) (i) Explain why potassium sulfide conducts electricity when molten.

(1)

Ions move

1.42

(ii) Explain why potassium sulfide has a high melting point.

(3)

- Electrostatic forces of attraction between oppositely charged ions
- Strong forces
- Large amount of energy required to overcome the forces

(Total for Question 6 = 7 marks)

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7 Sulfuric acid can be manufactured from sulfur in a four-stage process.

stage 1 sulfur is burned in air to form sulfur dioxide

$$S + O_2 \rightarrow SO_2$$

stage 2 the sulfur dioxide is reacted with more oxygen to form sulfur trioxide

$$SO_2 + \tfrac{1}{2}O_2 \rightarrow SO_3$$

stage 3 the sulfur trioxide is absorbed in concentrated sulfuric acid to make oleum

$$SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$$

stage 4 the oleum is carefully diluted with water to form sulfuric acid

(a) Write a chemical equation for the formation of sulfuric acid from oleum.

(1)

1.25

$H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

(b) A mass of 80 tonnes of sulfur is reacted with oxygen in stage 1.

Calculate the maximum mass, in tonnes, of sulfur trioxide that can be produced in stage 2.

[1 tonne = 1.0×10^6 g]

(3)

1.28

$n(S) = n(SO_3)$

$n(SO_3) = \frac{80}{32}$

$= 2.5 \text{ mol}$

$m(SO_3) = 2.5 \times 80$

$= 200$ tonnes

maximum mass = 200 tonnes

(c) Calculate the minimum volume at rtp, in cubic decimetres (dm^3), of oxygen required to completely react with 64 tonnes of sulfur dioxide.

[1 mol of oxygen at rtp has a volume of 24 dm^3]

(2)

$n(SO_2) = \frac{64 \times 10^6}{64}$

$= 1 \times 10^6$ mol

1.35C

$v(O_2) = \frac{1 \times 10^6}{2} \times 24$

$= 1.2 \times 10^7 dm^3$

volume of oxygen = 1.2×10^7 dm^3

(Total for Question 7 = 6 marks)

8 A student is supplied with aqueous solutions of these substances.

- bromine
- chlorine
- iodine
- potassium bromide
- potassium chloride
- potassium iodide

Describe two experiments the student could perform, using some of the solutions, to show the order of reactivity of bromine, chlorine and iodine.

Your answer should include the observations that the student would expect to make, and a chemical equation for one of the reactions.

(5)

2.07

(M1) • Add chlorine to KBr

(M2) • Solution turns orange

(M3) • Add bromine to KI

(M4) • Turns brown

(M5) $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$

OR

$Br_2 + 2KI \rightarrow I_2 + 2KBr$

(Total for Question 8 = 5 marks)

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9 Nitrogen dioxide (NO_2) is a brown gas.

Dinitrogen tetraoxide (N_2O_4) is a colourless gas.

The two gases can exist together in dynamic equilibrium according to the equation

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad \Delta H = -58\,kJ/mol$$

A mixture of nitrogen dioxide gas and dinitrogen tetraoxide gas is allowed to reach equilibrium in a sealed container at 20 °C. This equilibrium mixture is brown in colour.

(a) The sealed container is immersed in hot water at 60 °C.

As the temperature of the gas mixture increases, the pressure of the gas mixture also increases.

(i) Predict the effect of the increase in temperature on the position of equilibrium.

(1)

3.22C

Shifts to left

(ii) Predict the effect of the increase in pressure on the position of equilibrium.

(1)

3.22C

Shifts to right

(iii) Suggest why it is difficult to predict which way the equilibrium will shift.

(1)

3.22C

Impossible to know which shift is greater

(b) Suggest why the equilibrium mixture is a darker shade of brown at 60 °C than the equilibrium mixture at 20 °C.

(2)

3.22C

- Greater proportion of NO_2
- Increase of temperature has a greater effect than increase in pressure

(Total for Question 9 = 5 marks)

TOTAL FOR PAPER = 60 MARKS

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