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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

Wednesday 18 January 2017 – Afternoon
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.
- 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 ▶

P48389A

1/2/1/1/1/1/

P 4 8 3 8 9 A 0 1 2 0

Pearson

THE PERIODIC TABLE

Period	1	2					Group						3	4	5	6	7	0
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 box contains the names of some substances.

air	chlorine	hydrogen	iron
nitrogen	oxygen	potassium	sodium

Choose a substance from the box that best matches each description.

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

(a) Which substance is a mixture?

(1) 1.0

Air

(b) Which substance is a gas that makes a squeaky pop when ignited?

(1) 2.44

Hydrogen

(c) Which substance is an element that is a green gas at room temperature?

(1) 2.0

chlorine

(d) Which substance is used to sterilise water?

(1)

Chlorine

(e) Which substance is a metal that can be made by heating its oxide with carbon?

(1)

Iron

(Total for Question 1 = 5 marks)

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2 Oxides can be made by burning elements in air.

The table gives some information about the oxides of four elements.

Element	Physical state of oxide at room temperature	Solubility of oxide in water	Type of solution formed when oxide dissolves in water
calcium	solid	slightly soluble	alkaline
carbon	gas	slightly soluble	acidic
magnesium	solid	slightly soluble	alkaline
sulfur	gas	very soluble	acidic

(a) Calcium and magnesium are metals. Carbon and sulfur are non-metals.

(i) Using only information from the table, state two ways in which the oxides of the metals are similar to each other.

(1)

0.00

- Both solids
- Form alkaline solutions

(ii) Using only information from the table, state two ways in which the oxides of the non-metals are similar to each other.

(1)

0.00

- Both gases
- Form acidic solutions

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(b) A teacher tells his students that when phosphorus burns in air a white solid oxide forms. This oxide is very soluble in water and forms an acidic solution.

(i) One student states that phosphorus is a metal.

Use information from the table to suggest why the student made this statement.

(1)

0.00

The oxide is solid

(ii) Another student states that phosphorus is a non-metal.

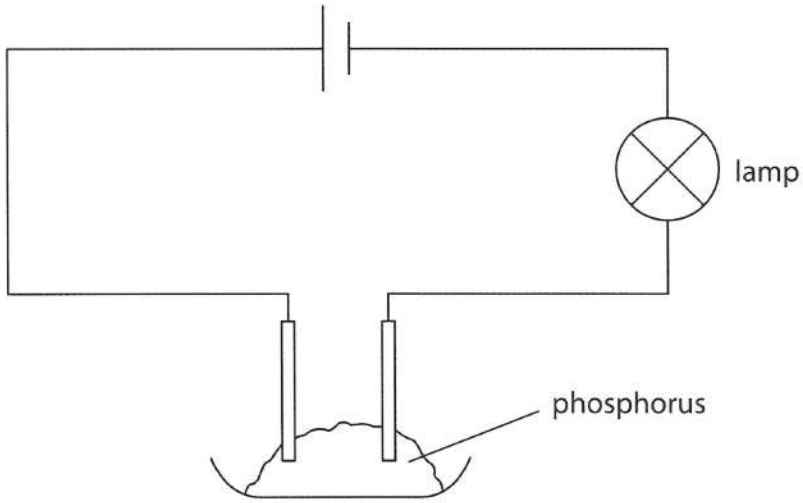
Use information from the table to suggest why the student made this statement.

(1)

0,00

Oxide forms an acidic solution

(c) An experiment using this apparatus shows that phosphorus is a non-metal.



Explain how this experiment shows that phosphorus is a non-metal.

(2)

1.54C

• The lamp does not light up

∴ Does not conduct electricity

(Total for Question 2 = 6 marks)

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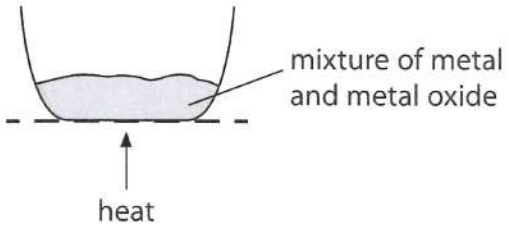
3 This question is about the reactivity of metals.

(a) This apparatus can be used to compare the reactivities of different metals.



A metal is heated with the oxide of a different metal.

The table shows the results of two experiments.

Mixture	Result
titanium + tin oxide	reaction
titanium + calcium oxide	no reaction

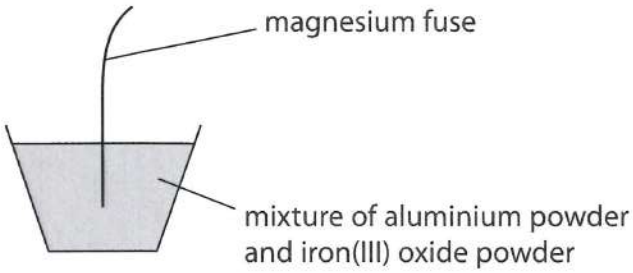
Explain how these results show the order of reactivity of calcium, tin and titanium.

(3)

2.16

- calcium most reactive and tin least reactive
- Titanium displaces tin
- Titanium does not displace calcium

(b) The diagram shows a method of making iron.



(i) The word equation for the reaction that occurs is

aluminium + iron(III) oxide → aluminium oxide + iron

Write a chemical equation for this reaction.

(1) 1.25

$2Al + Fe_2O_3 \rightarrow Al_2O_3 + 2Fe$

(ii) Explain which substance is oxidised in this reaction.

(2) 2.20

• Aluminium because it has gained oxygen / lost electrons / oxidation no. increased (0 → +3)

(iii) Explain why aluminium and iron(III) oxide are used in powdered form rather than large pieces.

(2) 3.10

• Larger surface area

• Faster reaction

(Total for Question 3 = 8 marks)

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4 Chemical tests can be used to detect ions in solids and in aqueous solutions.

(a) A solid produces a gas when heated with sodium hydroxide solution. Damp red litmus paper is turned blue by the gas.

Which of these ions is present in the solid?

(1)

2.28

- ☐ **A** Cu^{2+}
- ☐ **B** Fe^{2+}
- ☐ **C** Fe^{3+}
- ☒ **D** NH_4^+

(b) When dilute nitric acid is added to an aqueous solution, followed by silver nitrate solution, a yellow precipitate forms.

Which of these halide ions is present in the aqueous solution?

(1)

2.48

- ☐ **A** Br^-
- ☐ **B** Cl^-
- ☐ **C** F^-
- ☒ **D** I^-

(c) When dilute hydrochloric acid is added to a solid, a gas forms.

Which of these ions is present in the solid?

(1)

2.48

- ☒ **A** carbonate
- ☐ **B** hydroxide
- ☐ **C** nitrate
- ☐ **D** sulfate

(d) Sodium hydroxide solution is added separately to three solutions.

One solution contains Cu^{2+} ions, another contains Fe^{2+} ions and the third solution contains Fe^{3+} ions.

Which row shows the correct colours of the precipitates that form?

(1)

	Cu^{2+}	Fe^{2+}	Fe^{3+}
☐ **A**	green	blue	brown
☐ **B**	brown	green	blue
☒ **C**	blue	green	brown
☐ **D**	blue	brown	green

2.47

(e) When barium chloride solution is added to an aqueous solution of a compound, a white precipitate forms. When dilute hydrochloric acid is added to the mixture, the precipitate disappears and a colourless solution forms.

Which of these ions is present in the aqueous solution?

(1)

2.48

☒ **A** carbonate

☐ **B** chloride

☐ **C** nitrate

☐ **D** sulfate

(Total for Question 4 = 5 marks)

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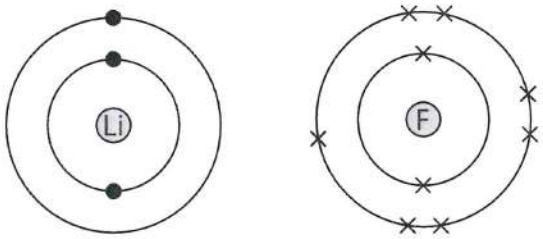
5 Lithium and carbon both form fluorides.

(a) Lithium reacts with fluorine to produce the ionic compound lithium fluoride.

The diagrams show the arrangement of electrons in a lithium atom and in a fluorine atom.



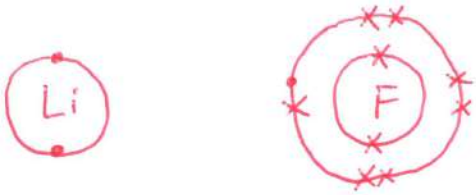
lithium atom fluorine atom

Draw similar diagrams to show the arrangement of the electrons in the ions formed when lithium reacts with fluorine.

Show all the electrons in each ion.

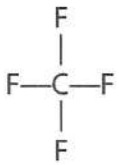
(2)

1.40



(b) Carbon tetrafluoride is a simple molecular compound.

The displayed formula for a molecule of carbon tetrafluoride is

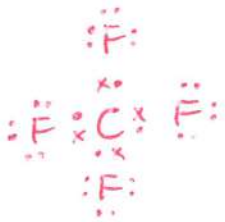


1.46

Draw a dot and cross diagram to show the arrangement of the electrons in this molecule.

Show only the outer electrons.

(2)



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(c) The table shows some properties of lithium fluoride and carbon tetrafluoride.

Compound	Melting point	Ability to conduct electricity when molten or liquid
lithium fluoride	high	good
carbon tetrafluoride	low	poor

Explain these properties of each compound.

(4)

1.42 + 1.43

lithium fluoride

- Strong forces of attraction between oppositely charged ions
- Ions are mobile

carbon tetrafluoride

- Weak intermolecular forces of attraction
- Molecules are not charged

1.47

(Total for Question 5 = 8 marks)

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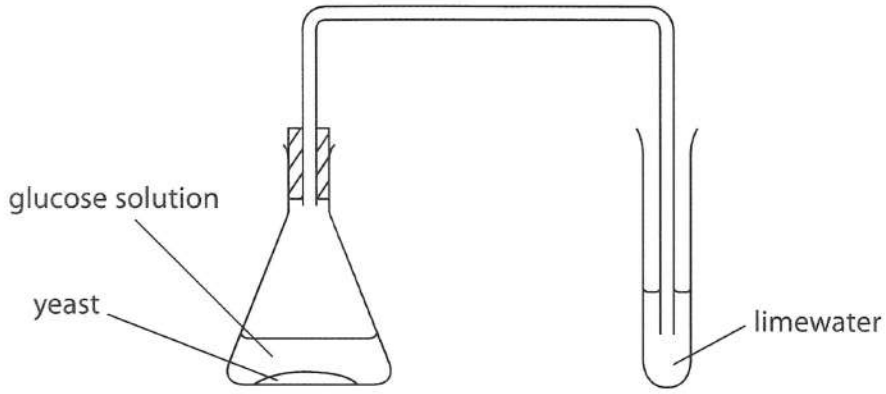
6 Ethanol can be produced when yeast is added to a glucose solution.

This apparatus is used to investigate the reaction.



(a) The equation for the reaction is

$$C_6H_{12}O_6(aq) \rightarrow 2C_2H_5OH(aq) + 2CO_2(g)$$

(i) State the purpose of the yeast.

(1)

4.32C • Provide the enzyme

(ii) State how the appearance of the limewater changes during the reaction.

2.44 (1)

Turns milky OR white ppt

(iii) State the temperature at which this reaction is carried out in industry.

4.32C (1)

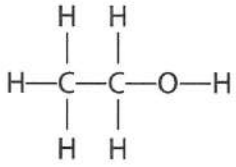
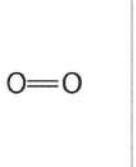
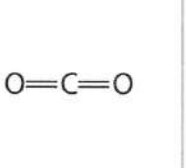
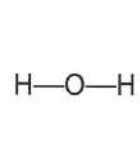
30°C

(b) Ethanol can be used as a fuel.

This is the equation for the complete combustion of ethanol.

$$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$$

These are the displayed formulae for ethanol, oxygen, carbon dioxide and water.

			
ethanol	oxygen	carbon dioxide	water

The table gives some average (mean) bond energies.

Bond	Average bond energy in kJ/mol
C—C	348
C—H	412
C—O	360
H—O	463
O=O	496
C=O	743

Use this information to calculate the enthalpy change (ΔH) when one mole of ethanol is completely burned.

(4)

3.07

Σ (bonds broken) = 348 + (5 × 412) + 360 + 463 + 3(496)

= 4719 kJ/mol

Σ (bonds made) = (4 × 743) + (6 × 463)

= 5750 kJ/mol

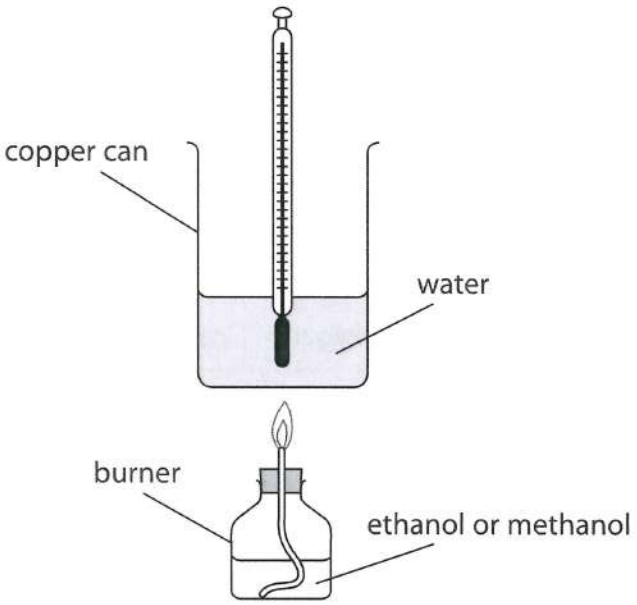
ΔH = 4719 − 5750

ΔH = −1031 kJ/mol

enthalpy change (ΔH) = −1031 kJ/mol

(c) Ethanol and methanol can both be used as fuels.

A student uses this apparatus to find out how much energy is produced when one mole of ethanol and one mole of methanol are burned.



The table shows some of the student's results.

1.28

Fuel	Formula mass of fuel	Energy given out by 1.00 g of fuel in kJ	Energy given out by 1 mol of fuel in kJ
ethanol (C_2H_5OH)	46.0	20.9	961
methanol (CH_3OH)	32	15.6	500

(i) Calculate the energy given out by 1 mol of methanol.

(2)

Energy = 32 × 15.6
= 500 kJ

energy given out = 500 kJ

(ii) The student uses the same burner and copper can in each experiment.

State two other factors that the student should keep the same in each experiment.

(2)

ANY 2

1 • Mass of water

2 • Distance of flame from the can

• Length of wick

3.02

(iii) A data book states that the energy given out when 1 mol of ethanol is burned is 1371 kJ.

Suggest two reasons why the student's value is much less than this.

(2)

ANY 2

1 • Heat / thermal energy lost to surroundings

2 • Incomplete combustion

• Evaporation of water / fuel

3.02

(Total for Question 6 = 13 marks)

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7 Magnesium chloride can be made by reacting excess magnesium carbonate with dilute hydrochloric acid.

The equation for the reaction is

$$MgCO_3 + 2HCl \rightarrow MgCl_2 + H_2O + CO_2$$

(a) (i) In one experiment, a sample of 0.050 mol of $MgCO_3$ is added to 0.080 mol of HCl.

Show, by calculation, that the $MgCO_3$ is in excess.

(2)

1.28

- 0.080 mol of HCl react with 0.040mol of $MgCO_3$
- 0.050 > 0.040 OR HCl to $MgCO_3$, 2:1 0.08 to 0.05, 2:1.25

(ii) Calculate the maximum volume, in cm^3, of carbon dioxide, measured at room temperature and pressure, that would be obtained when 0.080 mol of HCl react completely with $MgCO_3$.

1.35C

[One mole of any gas occupies 24 000 cm^3 at room temperature and pressure.]

(2)

$n(CO_2) = \frac{1}{2} \times 0.080$

$= 0.040mol$

volume $(CO_2) = 0.040 \times 24000$

$= 960cm^3$

maximum volume of carbon dioxide = 960 cm^3

(b) In another experiment 0.050 mol of $MgCO_3$ reacts with excess HCl.

A yield of 5.5 g of $MgCl_2.6H_2O$ is obtained.

(i) Calculate the percentage yield of $MgCl_2.6H_2O$

(2)

1.3C

$Mr\ (MgCl_2.6H_2O) = 203$

$\%\ yield = \left(\frac{5.5}{203 \times 0.05}\right) \times 100$

$= 54$

percentage yield = 54 %

(ii) Suggest why the percentage yield is less than 100%.

(1)

0.0C

ANY 1

- some crystals remained in the filtrate
- solution not allowed to cool for long enough
- Magnesium carbonate impure

(Total for Question 7 = 7 marks)

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8 When nitrogen dioxide gas (NO_2) is placed in a sealed flask, it reacts to form dinitrogen tetraoxide gas (N_2O_4).

The equation for the reaction is

$$\underset{\text{brown gas}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless gas}}{N_2O_4(g)}$$

A sample of pure NO_2 is placed in a sealed flask at 25 °C. The flask is left until a dynamic equilibrium is reached.

(a) For a reaction that is in dynamic equilibrium, the forward and backward reactions occur at the same time.

State two other features of a reaction that is in dynamic equilibrium.

(2)

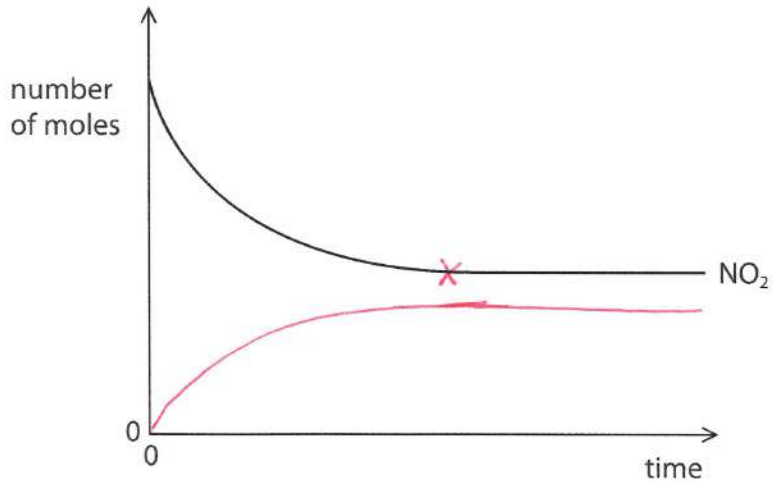
3.20C 1 Rate of forward reaction = rate of backward reaction

2 concentrations of reactants and products remain constant

(b) At equilibrium there is more NO_2 than N_2O_4

The graph shows how the number of moles of NO_2 in the sealed flask changes with time.

3.20C



(i) Draw a cross (X) on the graph at the point where the reaction reaches equilibrium.

(1)

(ii) Draw a curve on the graph to show how the number of moles of N_2O_4 in the sealed flask changes over the same time period.

(3)

(c) The sealed flask containing the equilibrium mixture is placed in water at a temperature of 50 °C. The mixture goes darker in colour.

Explain what this observation shows about the equilibrium reaction.

(2)

3.22

• Equilibrium has shifted to the left OR more NO_2 has been produced

∴ Backward reaction endothermic

(Total for Question 8 = 8 marks)

TOTAL FOR PAPER = 60 MARKS

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