Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | Candidate Number

Wednesday 12 June 2019

Morning (Time: 1 hour 45 minutes) | Paper Reference **1CH0/2H**

Chemistry
Paper 2

Higher Tier

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- A periodic table is printed on the back cover of this paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

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P 5 6 4 2 3 A 0 1 2 8

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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 ☒.

1 (a) (i) Titanium(IV) oxide is an ionic solid.
Many ionic solids are soluble in water.

Titanium(IV) oxide is not soluble in water.
Its other physical properties are typical of ionic solids.

Predict **one** other physical property of titanium(IV) oxide that would be typical of ionic solids.

(1)

....

(ii) The formula of titanium(IV) oxide is TiO_2.

Deduce the charge of the titanium ion in titanium(IV) oxide.

(1)

....

....

(b) Nanoparticles are very small particles that have unusual properties.

(i) Particles less than 100 nanometres in size are classified as nanoparticles.

100 nanometres is

(1)

☒ **A** 1×10^{-4} metres

☒ **B** 1×10^{-5} metres

☒ **C** 1×10^{-7} metres

☒ **D** 1×10^{-9} metres

(ii) Nanoparticles of titanium(IV) oxide are used in some sunscreens.

Describe a reason why nanoparticles of titanium(IV) oxide are used in some sunscreens.

(2)

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(iii) Some people are concerned that there is a risk when sunscreens containing nanoparticles are used.

Explain a possible risk associated with using nanoparticles in sunscreens.

(2)

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(Total for Question 1 = 7 marks)

2 Most of the fuels used today are obtained from crude oil.

(a) Which statement about crude oil is correct?

(1)

☒ **A** crude oil is a compound of different hydrocarbons

☒ **B** crude oil is a mixture of hydrocarbons

☒ **C** crude oil contains different hydrocarbons, all with the same molecular formula

☒ **D** crude oil is an unlimited supply of hydrocarbons

(b) Crude oil is separated into several fractions by fractional distillation.
Two of these fractions are kerosene and diesel oil.

(i) State a use for each of these fractions.

(2)

kerosene ....

diesel oil ....

(ii) Figure 1 shows where the fractions kerosene and diesel oil are produced in the fractionating column.

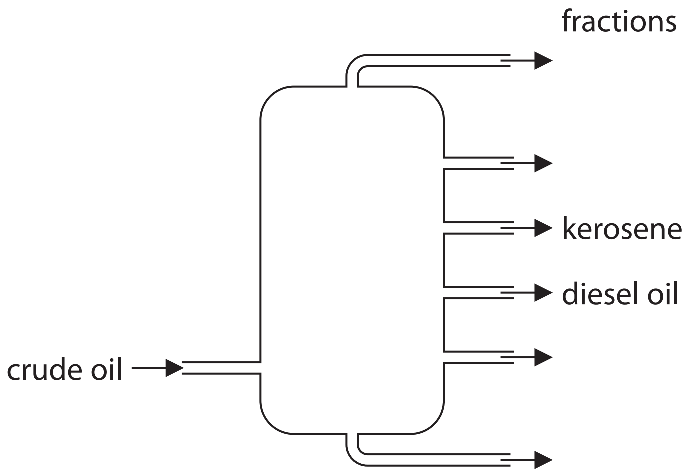


Figure 1

Kerosene is obtained higher up the column than diesel oil.
Kerosene and diesel oil fractions have slightly different properties.

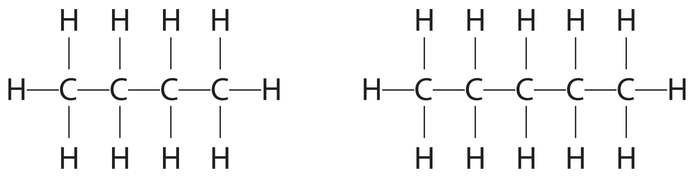
Choose a property.
State how this property for kerosene compares with the property for diesel oil.

(1)

property ....

comparison ....

(c) Figure 2 shows the formulae of a molecule of butane and of a molecule of pentane. Butane and pentane are neighbouring members of the same homologous series.



butane pentane

Figure 2

(i) Explain, using these formulae, why butane and pentane are neighbouring members of the same homologous series.

(2)

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....

(ii) Butane has the formula C_4H_{10}.

Calculate the mass of carbon in 100 g of butane.

Give your answer to three significant figures.

(relative atomic masses: H = 1.00, C = 12.0;
relative formula mass: C_4H_{10} = 58.0)

You must show your working.

(3)

....

....

....

mass of carbon = ... g

(Total for Question 2 = 9 marks)

Turn over

3 (a) An aluminium atom has the atomic number 13 and the mass number 27.

Which row shows the numbers of subatomic particles present in an aluminium ion, Al^{3+}?

(1)

	protons	neutrons	electrons
☒ **A**	13	14	13
☒ **B**	13	14	10
☒ **C**	14	13	10
☒ **D**	14	13	17

(b) Magnesium burns in excess oxygen to form magnesium oxide.
The balanced equation for this reaction is

$$2Mg + O_2 \rightarrow 2MgO$$

Starting with 1.35 g of magnesium, calculate the maximum mass of magnesium oxide that could be formed in this reaction.
(relative atomic masses: O = 16.0, Mg = 24.0)

You must show your working.

(3)

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mass of magnesium oxide = ... g

(c) Chlorine reacts with hydrogen to form hydrogen chloride.

Write the balanced equation for this reaction.

(3)

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(d) Sodium reacts with chlorine to form sodium chloride.

The electronic configuration of the sodium atom is 2.8.1 and the electronic configuration of the chlorine atom is 2.8.7.

Give the electronic configurations of the ions formed.

(2)

Na^+ ....

Cl^- ....

(Total for Question 3 = 9 marks)

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4 (a) Ethanol is made by fermentation of a carbohydrate dissolved in water, in the presence of yeast.

The reaction is carried out at 30 °C.

Explain why the reaction is carried out at a temperature of 30 °C rather than at a temperature of 80 °C.

(2)

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(b) Ethanol, C_2H_5OH, can be converted into ethanoic acid, CH_3COOH.

(i) In this reaction ethanol is

(1)

☒ **A** hydrated

☒ **B** oxidised

☒ **C** polymerised

☒ **D** reduced

(ii) Draw the structure of a molecule of ethanoic acid, CH_3COOH, showing all covalent bonds.

(2)

(c) (i) The apparatus in Figure 3 can be used to investigate the temperature rise produced in a known mass of water when a sample of ethanol is burned.

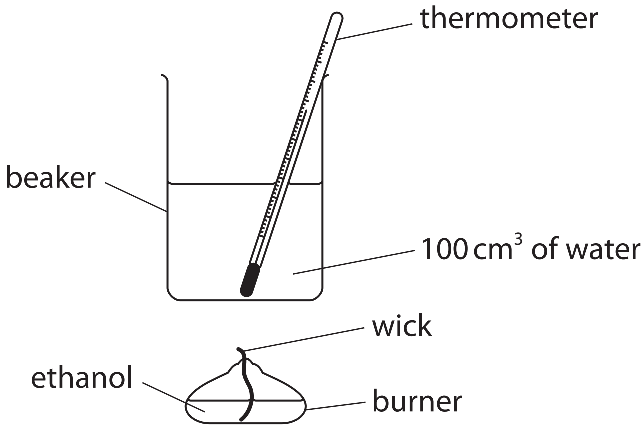

Figure 3

The first steps of the method are

1. put 100 cm^3 of water into a beaker
2. determine the mass of the burner containing ethanol
3. measure the initial temperature of the water
4. place the burner under the beaker of water
5. light the wick

Describe the remaining steps of the method that are needed to determine the mass of ethanol required to raise the temperature of the water by 30 °C.

(3)

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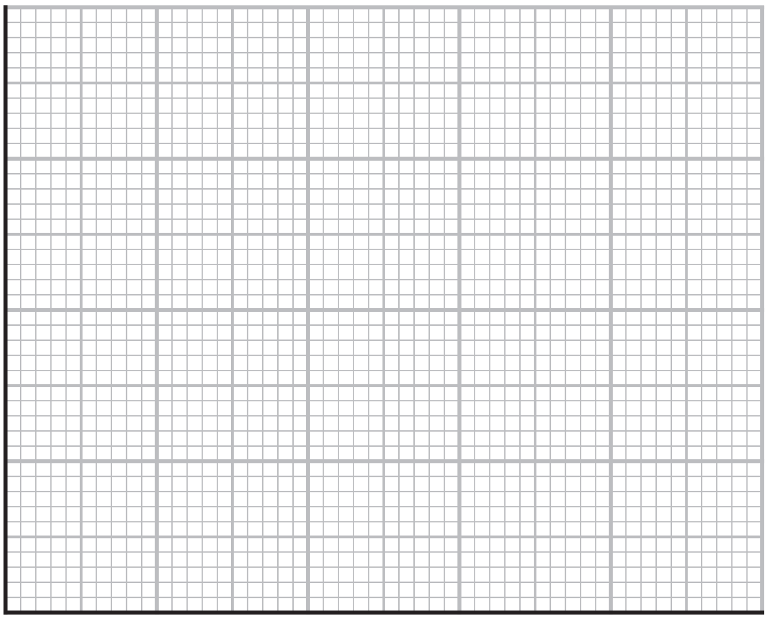
(ii) In a different experiment, separate samples of the alcohols methanol, ethanol, propanol, butanol and pentanol were burned to determine the mass of each alcohol that needs to be burned to raise the temperature of 100 cm^3 water by 10 °C.

alcohol	**number of carbon atoms in one molecule of alcohol**	**mass of alcohol burned in g**
methanol	1	0.37
ethanol	2	0.28
propanol	3	0.25
butanol	4	0.23
pentanol	5	0.22

Draw a graph of the mass of each alcohol required to raise the temperature of 100 cm^3 of water by 10 °C against the number of carbon atoms in one molecule of that alcohol.

(3)

mass of alcohol burned in g



number of carbon atoms in one molecule of alcohol

(Total for Question 4 = 11 marks)

5 (a) Carbon dioxide is one of the gases in the Earth's atmosphere.
The percentage of carbon dioxide in the Earth's atmosphere has changed over time.

(i) Which row of the table shows the approximate percentage of carbon dioxide thought to be in the Earth's early atmosphere and how this percentage changed to form the Earth's atmosphere today?

(1)

		approximate percentage of carbon dioxide in the Earth's early atmosphere	change in percentage carbon dioxide to form the Earth's atmosphere today.
☒	**A**	5	increased
☒	**B**	5	decreased
☒	**C**	95	increased
☒	**D**	95	decreased

(ii) The actual percentage of carbon dioxide in the Earth's atmosphere today varies.

Explain **two** factors that cause the percentage of carbon dioxide in today's atmosphere to vary.

(4)

factor 1 ....

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factor 2 ....

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P 5 6 4 2 3 A 0 1 2 2 8

(b) Carbon dioxide is a simple molecular, covalent compound.

It has a low boiling point of –78.5 °C.

Explain why carbon dioxide has a low boiling point.

(2)

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(c) Calculate the number of molecules in 0.11 g of carbon dioxide.

Give your answer to two significant figures.

(relative formula mass : $CO_2 = 44$
Avogadro constant = 6.02×10^{23})

(3)

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number of molecules = ...

(Total for Question 5 = 10 marks)

6 Some of the elements in the periodic table are metals.

(a) The electronic configuration of a metal is 2.8.3

Which row shows the group and period of the periodic table where this metal is found?

(1)

	group	period
☒ **A**	2	3
☒ **B**	2	8
☒ **C**	3	2
☒ **D**	3	3

(b) Lithium, potassium and rubidium are alkali metals.

(i) Describe what you would see when a small piece of rubidium is dropped on to water.

(2)

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(ii) The electronic configuration of lithium is 2.1
The electronic configuration of potassium is 2.8.8.1
Lithium is less reactive than potassium.

Explain, in terms of their electronic configurations, why lithium is less reactive than potassium.

(3)

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(c) Lithium has two naturally occurring isotopes, lithium-6 and lithium-7.

A sample of lithium contains
7.59% of lithium-6
92.41% of lithium-7.

Calculate the relative atomic mass of lithium in this sample.

Give your answer to two decimal places.
You must show your working.

(4)

relative atomic mass of lithium = ...

(Total for Question 6 = 10 marks)

7 Ethene, C_2H_4, is an unsaturated hydrocarbon.

(a) Explain why ethene is an **unsaturated hydrocarbon**.

(2)

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....

(b) A sample of ethene is burned completely in oxygen.

Write the balanced equation for this reaction.

(3)

....

(c) Ethene can be polymerised to form poly(ethene).

Describe what you would **see** when a sample of ethene and a sample of poly(ethene) are shaken with separate, small volumes of bromine water.

(3)

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(d) A different hydrocarbon has a relative formula mass of 84.
It has an empirical formula of CH_2.

Deduce the molecular formula of this hydrocarbon.

You must show your working.

(relative atomic masses : H=1, C=12)

(3)

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molecular formula = ...

(Total for Question 7 = 11 marks)

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8 Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, water and carbon dioxide.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

(a) A student wanted to measure the amount of gas produced in two minutes.

The student suggested that this could be done by counting the number of bubbles formed.
However, the bubbles are produced too quickly to count them.

Figure 4 shows a conical flask in which the calcium carbonate and dilute hydrochloric acid are reacting.

Complete Figure 4 to show the apparatus that could be used to measure accurately the volume of gas given off in two minutes.

(2)

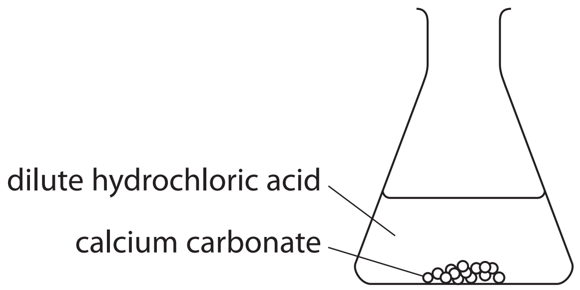

Figure 4

(b) The reaction between calcium carbonate and dilute hydrochloric acid is exothermic.

Explain, in terms of bond breaking and bond making, why some reactions are exothermic.

(3)

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*(c) An investigation was carried out into the rate of reaction of calcium carbonate with dilute hydrochloric acid.

5.0 g of small lumps of calcium carbonate were reacted with 50 cm^3 of 0.50 mol dm^{-3} hydrochloric acid.
Another 5.0 g of the same sized lumps of calcium carbonate were reacted with 50 cm^3 of 1.0 mol dm^{-3} hydrochloric acid.
The volume of gas collected in two minutes was recorded for each experiment.

The two experiments were then repeated, each using 5.0 g of large lumps of calcium carbonate.

Figure 5 shows the results.

concentration of hydrochloric acid in mol dm^{-3}	volume of gas collected in cm^3	
	small lumps of calcium carbonate	large lumps of calcium carbonate
0.50	17.2	3.1
1.0	35.1	5.6

Figure 5

Explain, in terms of collision of particles, how these results show the effect of the size of the lumps of calcium carbonate and the effect of the concentration of the acid on the rate of this reaction.

(6)

(Total for Question 8 = 11 marks)

9 Fluorine, chlorine, bromine, iodine and astatine are elements in group 7.

(a) Describe the test to show that a gas is chlorine.

(2)

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(b) Bromine reacts with hydrogen to form hydrogen bromide.
Hydrogen bromide dissolves in water to form a solution.

State the name of the solution formed.

(1)

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(c) There is a trend in the colour and the state of the halogens at room temperature.

Predict the colour and state of astatine at room temperature.

(2)

colour ....

state ....

(d) Bromine, chlorine and iodine are dissolved in water to make aqueous solutions. Potassium iodide solution is added to each of these solutions.

Figure 6 shows the observations.

halogen	**initial colour of aqueous solution**	**final colour of mixture**
bromine	orange	brown
chlorine	pale green	brown
iodine	brown	brown

Figure 6

Explain the observations shown in the table.

(4)

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(e) Fluorine reacts vigorously with iron to produce iron(III) fluoride, FeF_3.

Write the balanced equation for this reaction.

(2)

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(Total for Question 9 = 11 marks)

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10 (a) A sample of potassium carbonate is contaminated with a small amount of sodium carbonate.
When a flame test is carried out on the sample, a bright yellow flame is seen.

Describe how you could show that potassium and sodium ions are present in this sample.

(2)

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(b) Hydrochloric acid reacts with a solution of sodium carbonate.

$$2HCl(aq) + Na_2CO_3(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$$

(3)

Write the ionic equation for this reaction.

....

P 5 6 4 2 3 A 0 2 5 2 8

*(c) A student tests solutions of three ionic substances, **K**, **L** and **M**.

The student carries out the same two tests on each of the three solutions.

Test 1 add dilute nitric acid and then silver nitrate solution.

Test 2 add a few drops of sodium hydroxide solution and warm the mixture.

Figure 7 shows the results of the tests and the student's conclusions about the identity of each substance.

ionic substance	test 1	test 2	student's conclusion
K	white precipitate	colourless solution	ammonium chloride
L	white precipitate	white precipitate	aluminium chloride
M	no precipitate	green precipitate	iron(II) sulfate

Figure 7

None of the student's conclusions are fully justified.

Explain which part of each conclusion is justified and what further work can be carried out to fully justify each conclusion.

(6)

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

The periodic table of the elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										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

***** The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.*

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