

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS International General Certificate of Secondary Education

| CANDIDATE | | | |
|-----------------|-----------------------------|-----------|-------------------|
| NAME | | | |
| | | | |
| CENTRE | | CANDIDATE | |
| NUMBER | | NUMBER | |
| | | | |
| CHEMISTRY | | | 0620/22 |
| Paper 2 | | | May/June 2010 |
| | | | 1 hour 15 minutes |
| Candidates ans | swer on the Question Paper. | | |
| No Additional N | Materials are required. | | |

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page. Write in dark blue or black pen.

You may need to use a pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

A copy of the Periodic Table is printed on page 16.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

| For Examiner's Use | | | |
|--------------------|--|--|--|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| Total | | | |

This document consists of 15 printed pages and 1 blank page.



[Total: 8]

1 The diagram shows part of the Periodic Table. Only some of the elements are shown.

| Li | | | |
|----|----|----|----|
| Na | Mg | | |
| K | Ca | Ti | ٧ |
| | | Zr | Nb |

| (a) | Answer the | following | questions | by | choosing | only | from | the | elements | shown | in | the |
|-----|------------|-----------|-----------|----|----------|------|------|-----|----------|-------|----|-----|
| | diagram. | | | | | | | | | | | |

You can use each element once, more than once or not at all.

| (| (i) State the names of two transition elements shown in the diagram. | |
|-----|--|-----|
| | and | [2] |
| (i | ii) State the name of an element which is in Period 3 of the Periodic Table. | |
| | | [1] |
| (ii | ii) Which element has the electronic structure 2,8,1? | |
| | | [1] |
| (iv | v) Which element has the fastest reaction with water? | |
| | | [1] |
| (\ | v) Which element has 23 protons in its nucleus? | |
| | | [1] |
| | Sodium reacts with oxygen to form sodium peroxide, ${\rm Na_2O_2}$. Complete the symbol equation for this reaction. | |
| | Na + \rightarrow Na ₂ O ₂ | |
| | | [2] |

© UCLES 2010 0620/22/M/J/10

2 The list describes five types of chemical structures.

giant covalent giant ionic metallic simple atomic simple molecular

(a) The diagrams below show four types of chemical structures.

| Α | | В | С | D |
|-------|---|--------------------|-------------------------|--|
| | (*) [-] (A) | Ar) Ar) Ar) Ar) | | Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn Zn |
| (i) L | Ise the list to ma | atch these structu | ures with the diagrams. | |

| (-) | ess are not to mater, areas caractares man are diagrams. | |
|-----|--|----|
| | structure A is | 1] |

| structure B is | . [1] |
|-----------------------|-------|

| structure C is[1] |
|--------------------------|
|--------------------------|

| structure D is | [1 | 1] | |
|---|----|-----|--|
| of dotal of the second of the | Γ, | , 1 | |

| (ii) | Which two of the structures A , B , C or D have low melting points? |
|------|--|
| | |

| | and | [1 |] |
|--|-----|--------|---|
| | | | |

(b) Sodium chloride is an ionic solid.Complete the following sentences using words from the list.

| | electrons | ionic | molecular | molten | solid |
|-------|---------------------|---------------|--------------------|---------|---------------------|
| Sodiu | m chloride does | not conduct | t electricity when | it is a | |
| becau | se the ions cann | ot move. Wh | en it is | s | odium chloride does |
| condu | ct electricity beca | ause the ions | are free to move | | [2] |

[Total: 7]

| (a) State one use of water in industry. (b) Describe a chemical test for water. test | vvater i | s an important raw m | naterial in industi | ~y. | | | |
|---|------------------|---------------------------------|-----------------------------|-------------------|------------------------|------------------|----------|
| (b) Describe a chemical test for water. test | (a) Sta | | • | | | | |
| result | (b) De | | | | | | |
| (c) A small piece of potassium was placed in a beaker of water. The equation for the reaction is 2K(s) + 2H₂O(l) → 2KOH(aq) + H₂(g) (i) Describe a test for the gas given off in this reaction. test | tes | st | | | | | |
| The equation for the reaction is $2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$ (i) Describe a test for the gas given off in this reaction. test | res | sult | | | | | |
| (i) Describe a test for the gas given off in this reaction. test | | | | in a beake | er of water. | | |
| test | | 2K(s | s) + $2H_2O(I) \rightarrow$ | 2KOH(ac |) + H ₂ (g) | | |
| result | (i) | Describe a test for | the gas given of | f in this rea | action. | | |
| (ii) What is the most likely pH of the solution in the beaker when the read complete? Put a ring around the correct answer. pH2 pH6 pH7 pH8 pH12 (d) Water is formed when propane burns. (i) Complete the equation for this reaction. C₃H₈ + 5O₂ →CO₂ +H₂O (ii) Which of the following best describes this reaction? Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4g of propane are burnt in excess oxygen, 7.2g of water are formed | | test | | | | | |
| complete? Put a ring around the correct answer. $pH2 \qquad pH6 \qquad pH7 \qquad pH8 \qquad pH12$ (d) Water is formed when propane burns. $ (i) \qquad \text{Complete the equation for this reaction.} $ $ C_3H_8 + 5O_2 \rightarrow \dots CO_2 + \dots H_2O $ (ii) Which of the following best describes this reaction? Put a ring around the correct answer. $ \text{carbonisation} \qquad \text{combustion} \qquad \text{dehydration} \qquad \text{hydrogenation} $ (iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed | | result | | | | | |
| (d) Water is formed when propane burns. (i) Complete the equation for this reaction. C₃H₈ + 5O₂ →CO₂ +H₂O (ii) Which of the following best describes this reaction? Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed | (ii) | complete? | • | | in the be | aker when the | reaction |
| (i) Complete the equation for this reaction. C₃H₈ + 5O₂ →CO₂ +H₂O (ii) Which of the following best describes this reaction? Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4g of propane are burnt in excess oxygen, 7.2g of water are formed | | pH2 | рН6 | рН7 | рН8 | pH12 | |
| $C_3H_8+5O_2 \rightarrowCO_2+H_2O$ (ii) Which of the following best describes this reaction? Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4g of propane are burnt in excess oxygen, 7.2g of water are formed | (d) Wa | ater is formed when p | propane burns. | | | | |
| (ii) Which of the following best describes this reaction? Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4g of propane are burnt in excess oxygen, 7.2g of water are formed | (i) | Complete the equa | tion for this reac | tion. | | | |
| Put a ring around the correct answer. carbonisation combustion dehydration hydrogenation (iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed | | C ₃ H ₈ + | 5O ₂ → | CO ₂ + | ŀ | H ₂ O | |
| (iii) When 4.4 g of propane are burnt in excess oxygen, 7.2 g of water are formed | (ii) | | • | | ction? | | |
| | | carbonisation | combustion | dehy | dration | hydrogenatio | n |
| | (iii) | | | | | | rmed. |
| | | | | | | | |

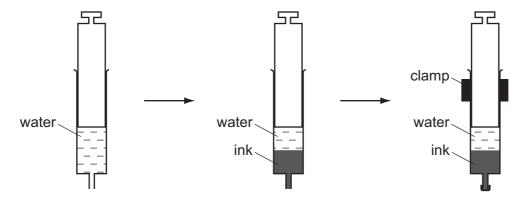
[1]

[Total: 10]

4 A student half-filled a syringe with water.

She then carefully drew up some blue ink into the syringe so that it formed a separate layer below the water.

She then left the syringe in a clamp for twenty hours.



After twenty hours the blue colour of the ink had spread throughout the water.

| (a) | Use | e the kinetic particle theory to | o explain these observations. | |
|-----|-----|--|--|-----|
| | | | | |
| | | | | |
| | | | | [2] |
| (b) | | is a mixture of many chemic at do you understand by the | | |
| | | | | |
| | | | | [1] |
| (c) | The | e list shows some of the sub | stances present in ink. | |
| | | | carboxylic acids cobalt(II) ions ethanol iron(II) ions nickel(II) ions tannins water | |
| | (i) | Water is a good solvent. From the list choose one o | ther substance that is a good solvent. | |
| | | | | 11 |

| (ii) | What is the meaning of the symbol (II) in iron(II)? |
|------|---|
| | Tick one box. |

the number of outer shell electrons

the difference between the neutron and proton number

the oxidation state

[1]

(iii) Tannins are polymers.

the type of isotope

What do you understand by the term *polymer*?

[2]

(d) One of the carboxylic acids present in ink is gallic acid.

The structure of gallic acid is shown below.

(i) On the structure above, put a ring around the carboxylic acid functional group. [1]

(ii) Gallic acid is a good reducing agent.
What do you understand by the term *reduction*?

.....[1]

[Total: 9]

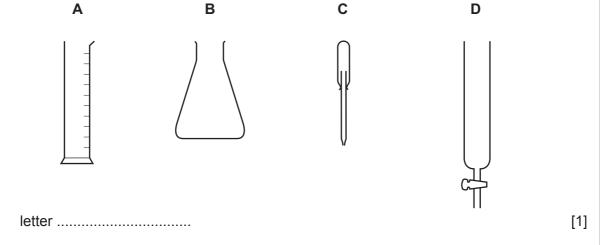
© UCLES 2010 0620/22/M/J/10

| 5 | A student wants to separate the coloured pigments in a plant leaf by chromatography. |
|---|--|
| | He grinds the plant leaf and separates the solids from the green solution. |

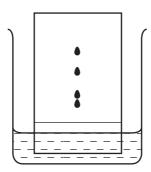
| (a) | what method can he use to separate the solids from the solution? | |
|-----|--|--|
| | | |

(b) The student takes a drop of the green solution and puts a spot of it onto a piece of chromatography paper.

From the diagrams below choose the letter for the most suitable piece of apparatus for this task.



- **(c)** The student sets up the chromatography apparatus as shown.
 - (i) Label the diagram to show:
 - the solvent,
 - the original position of the spot of green solution,
 - the chromatography paper.



[3]

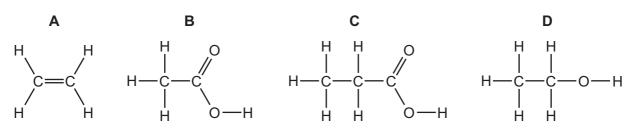
(ii) How many different pigments were present in the plant leaf?

.....[1

For Examiner's Use

[Total: 12]

(d) The structure of some organic compounds found in plant leaves are shown below.



| (i) | Which one of these compounds is an unsaturated hydrocarbon? | |
|-------|---|-----|
| | | [1] |
| (ii) | Describe a chemical test for an unsaturated hydrocarbon. | |
| | test | |
| | result | [2] |
| (iii) | What do you understand by the term hydrocarbon? | |
| | | [1] |
| (iv) | State the name of compound B . | |
| | | [1] |
| (v) | To which homologous series does compound D belong? | |
| | | [1] |

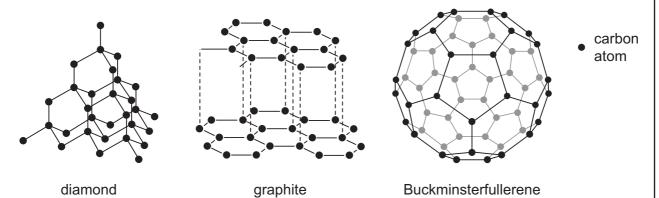
0620/22/M/J/10

© UCLES 2010

| o) To | which Grou | ıp in the Periodic Table o | loes lead belong | ? | |
|--------------|--|---|--|-------------|-----------------------|
| | | | | | |
| Co of | omplete the lead. | lead has the mass numb table to show the numbe dic Table to help you. | | articles in | an atom of this isoto |
| | | type of particle | number of pa | articles |] |
| | | electrons | | | |
| | | protons | | | |
| | | neutrons | | | |
| - | | heated in oxygen, lead(I equation for this reation. | I) oxide is formed | d. | |
| | rite a word e | equation for this reation. | | | noxide are formed. |
| | rite a word e | equation for this reation. oxide is heated with car | | | |
| | rite a word e | equation for this reation. oxide is heated with car | bon, lead and ca → Pb + CO | rbon mor | |
| e) W | rite a word e | oxide is heated with car PbO + C ostance becomes oxidise | bon, lead and ca → Pb + CO ed during this rea | rbon mor | |
| e) W | rite a word e | equation for this reation. oxide is heated with car PbO + C ostance becomes oxidise conoxide is a covalent cole of these statements ab | bon, lead and ca → Pb + CO ed during this rea mpound. | rbon mor | noxide are formed. |
| (i) | rite a word ehen lead(II) Which sub Carbon m Which one b | equation for this reation. oxide is heated with car PbO + C ostance becomes oxidise conoxide is a covalent cole of these statements ab | bon, lead and ca → Pb + CO ed during this rea mpound. bout carbon mone | rbon mor | noxide are formed. |
| (i) | hen lead(II) Which sub Carbon m Which one Tick one b | equation for this reation. oxide is heated with car PbO + C ostance becomes oxidise conoxide is a covalent core of these statements aboox. | bon, lead and ca → Pb + CO ed during this rea mpound. pout carbon mond point. | rbon mor | noxide are formed. |
| ∌) W! | tite a word end which subsection of the subsecti | oxide is heated with car PbO + C ostance becomes oxidise conoxide is a covalent core of these statements aboox. | bon, lead and ca → Pb + CO ed during this rea mpound. pout carbon mono point. | rbon mor | noxide are formed. |
| : Wi | hen lead(II) Which sub Carbon m Which one Tick one b It is a It cone | equation for this reation. oxide is heated with car PbO + C ostance becomes oxidise conoxide is a covalent core of these statements abox. solid with a high melting ducts electricity when it is | bon, lead and ca → Pb + CO ed during this rea mpound. pout carbon mono point. is a liquid. e. | rbon mor | noxide are formed. |

BLANK PAGE

7 Three forms of carbon are diamond, graphite and Buckminsterfullerene.



| (a) | (i) | State one difference in structure between Buckminsterfullerene and diamond. | |
|-----|------|--|-----|
| , | ••• | | |
| (| ii) | State two differences in structure between graphite and diamond. | |
| | | | |
| | | | [2] |
| (b) | Stat | te the type of bonding between the carbon atoms in diamond. | |
| | | | [1] |
| (c) | _ | gest why graphite is used as a lubricant. er to the layers in your answer. | |
| | | | |
| (d) | Stat | te one use for diamond. | |
| | | | [1] |

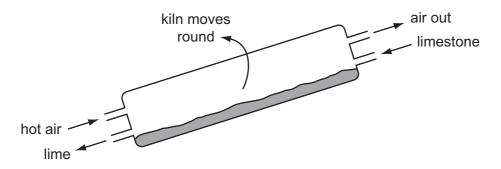
For Examiner's Use

| (e) | Wh Exp | en coal i | | ioxide is produc | | ion in the atm | opshere affects the | е |
|-----|-----------|-----------|---------------------------------------|-------------------|-------------|----------------|---------------------|----|
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | [| 2] |
| (f) | | | ontains small amo burning coal lea | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | [2 | 2] |
| (g) | Me | thane is | a fuel. | | | | | |
| | (i) | Which on | one of the followine box. | ng is a natural s | source of m | nethane? | | |
| | | | waste gases fro | om respiration i | n plants | | | |
| | | | waste gases from | om digestion in | animals | | | |
| | | | gases from pho | otosynthesis in | plants | | | |
| | | | gases from fore | est fires | | | | |
| | | | | | | | [| 1] |

0620/22/M/J/10

| (ii) | Draw a diagram to show the arrangement of the electrons in a molecule of methane, $\mathrm{CH_4}$. |
|-------|---|
| | Use ● for an electron from a carbon atom × for an electron from a hydrogen atom |
| | |
| | [1] |
| (iii) | Methane belongs to the alkane homologous series. Name one other alkane. |
| | [1] |
| | [Total: 13] |

8 The diagram shows a rotary kiln used to make lime from limestone. Limestone is fed in at the top of the kiln and lime comes out at the bottom.



| (a) |) What is | the | chemical | name | for | lime' |
|-----|-----------|-----|----------|------|-----|-------|
|-----|-----------|-----|----------|------|-----|-------|

| [ˈ | 1 |
|--------|---|
| | |

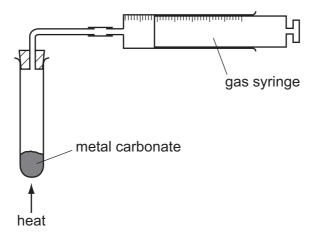
- (b) State the name of the type of chemical reaction that takes place in the rotary lime kiln.
 - Suggest why the air coming out of the rotany kiln has a greater percentage of carbon

......[1]

- (c) Suggest why the air coming out of the rotary kiln has a greater percentage of carbon dioxide than the air entering the kiln.
 -[1]
- (d) State one use for lime.



(e) A student compared the speed of reaction of three metal carbonates. She measured the volume of gas released using the apparatus shown.



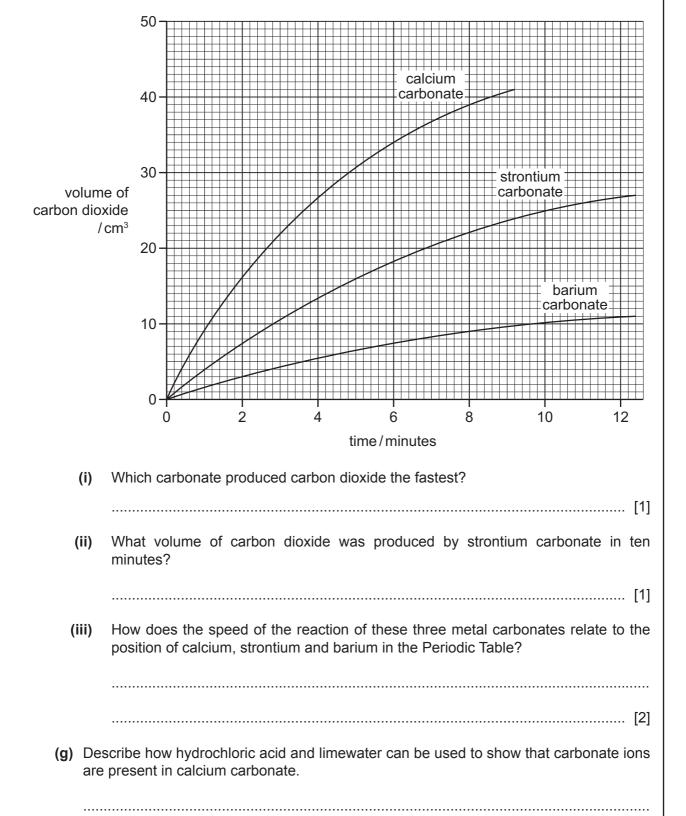
State **one** thing that must be kept constant if the speeds of these reactions are to be compared in a fair way.



© UCLES 2010 0620/22/M/J/10

For Examiner's Use

(f) The graph shows the volume of carbon dioxide released when the three metal carbonates are heated.



[Total: 12]

DATA SHEET
The Periodic Table of the Elements

| | 0 | 4 He Helium | 20 Ne Neon 10 Argon | 18 | 8 7 | Krypton 36 | 131 | Xenon Xenon 54 | | Radon 86 | | 175 Lu Lutetium 71 | | 100 E |
|-------|-----|--------------------|---|----|----------------|-----------------|-----|------------------------------|-----------------|-------------------|-----------------------------|---|--|----------------------------|
| Group | II/ | | 19 Fluorine 9 35.5 C1 | 17 | | m | | lodine 53 | Δţ | Astatine 85 | | Yb Ytterbium | o _N | Nobelium 102 |
| | > | | 16 Oxygen 8 32 Suffur Sulfur | | | = | 1 | Te Tellurium 52 | | Polonium 84 | | 169 Tm Thulium | M | Ę |
| | > | | Nitrogen 7 31 Phosphorus | | | | | Sb Antimony 51 | 209 | Bismuth 83 | | 167 Er Erbium 68 | Fa | Fermium 100 |
| | 2 | | Carbon 6 Carbon 8 Silicon Silicon | 14 | ي ع | Ε | | S 0 | 207 | | | 165 Ho Holmium 67 | | Einsteinium 99 |
| | = | | 11 B Boron 27 A1 Aluminium | 13 | ۶ ر | Gallium 31 | 115 | In Indium | 204 | Thallium 81 | | 162 Dy Dysprosium 66 | Ç | Californium 98 |
| | | | | | 65 | 30 | | Cadmium | 201 | Mercury 80 | | 159 Tb Terbium | 쑮 | Berkelium 97 |
| | | | | | ⁸ 5 | Copper 29 | 108 | Ag Silver | 197 | Gold 79 | | 157 Gd Gadolinium 64 | Ë | |
| | | | | | 69 Έ | | | Pd Palladium 46 | 195 | Platinum 78 | | 152 Eu Europium 63 | Am | Americium 95 |
| | | | | | ₉ ک | Cobalt 27 | 103 | Rhodium | 1 | | | Sm Samarium | Pu | Plutonium 94 |
| | | T Hydrogen | | | Э2 Ц | lron 26 | 101 | Rut Ruthenium | 1 | Osmium 76 | | Pm Promethium | a Q | Neptunium 93 |
| | | | | | 22 | 2≥ ≤ | | Tc Technetium 43 | 186 | _ | | 144 Neodymium 60 | 238 C | Uranium 92 |
| | | | | | ۇ 25 | Chromium 24 | 96 | Molybdenum | 184 | _ | | Pr Praseodymium | Pa | Protactinium 91 |
| | | | | | 5 > | Vanadium 23 | | Niobium 41 | 181 L | Tantalum 73 | | 140 Ce Cerium | 232 Th | Thorium 90 |
| | | | | | 84 F | Titanium 22 | 91 | Zr Zirconium 40 | 178 ‡ | 72 | | | nic mass bol | nic) number |
| | | | | | 54 Q | Scandium 21 | 68 | Yttrium | 139 | Lanthanum 57 * | Actinium t | l series eries | a = relative atomic massX = atomic symbol | b = proton (atomic) number |
| | = | | Beryllium 4 24 Mg Magnesium | 12 | 9 6 | Calcium 20 | 88 | Strontium | 137 Q | Barium 56 | 226 Ra Radium | *58-71 Lanthanoid series 190-103 Actinoid series | <i>a</i> × | - P |
| | _ | | Lithium 3 23 8 Sodium | 11 | 38 | Potassium 19 | 85 | Rb Rubidium | 133 | Caesium 55 | Fr Francium 87 | *58-71 L | Key | ٩ |

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included the publisher will be pleased to make amends at the earliest possible opportunity.

University of Cambridge International Examinations is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.