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**CHEMISTRY**

**0620/31**

Paper 3 Theory (Core)

**May/June 2017**

MARK SCHEME

Maximum Mark: 80

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**Published**

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This document consists of **7** printed pages.

| Question  | Answer   | Marks    |
|-----------|--|----------|
| 1(a)(i)   | <b>A</b>   | <b>1</b> |
| 1(a)(ii)  | <b>E</b>   | <b>1</b> |
| 1(a)(iii) | <b>C</b>   | <b>1</b> |
| 1(a)(iv)  | <b>B</b>   | <b>1</b> |
| 1(a)(v)   | <b>C</b>   | <b>1</b> |
| 1(b)      | number of electrons in $\text{Br}^- = 36$  | <b>1</b> |
|           | number of neutrons in $\text{Cl} = 18$   | <b>1</b> |
|           | number of protons in $\text{Cl} = 17$ <b>AND</b> number of protons in $\text{Br}^- = 35$ | <b>1</b> |

| Question  | Answer                    | Marks    |
|-----------|---------------------------|----------|
| 2(a)(i)   | $\text{Na}^+$ / sodium    | <b>1</b> |
| 2(a)(ii)  | sulfite / sulfate(IV)     | <b>1</b> |
| 2(a)(iii) | 3 (mg)                    | <b>1</b> |
| 2(a)(iv)  | 36.3 (mg)                 | <b>1</b> |
| 2(a)(v)   | calcium hydrogencarbonate | <b>1</b> |
| 2(b)      | flame test                | <b>1</b> |
|           | yellow                    | <b>1</b> |
| 2(c)      | $\text{MgCl}_2$           | <b>1</b> |

| Question | Answer   | Marks |
|----------|--|-------|
| 2(d)     | negative electrode: calcium / Ca               | 1     |
|          | positive electrode: chlorine / Cl <sub>2</sub> | 1     |

| Question | Answer   | Marks |
|----------|--|-------|
| 3(a)     | <p>any 5 of:</p> <p><b>X</b> has covalent bonding</p> <p><b>X</b> particles are randomly arranged / irregularly arranged</p> <p><b>X</b> particles are moving rapidly / freely / randomly / irregularly</p> <p><b>Y</b> has ionic bonding / ionic</p> <p><b>Y</b> particles are regularly arranged / lattice / in rows / uniformly arranged</p> <p><b>Y</b> particles (only) vibrate / do not move from place to place</p> <p><b>Z</b> has covalent bonding</p> <p><b>Z</b> particles are regularly arranged / lattice / in a tetrahedral shape</p> <p><b>Z</b> particles (only) vibrate / do not move from place to place</p> | 5     |
| 3(b)     | volume gets smaller  | 1     |
|          | particles get closer together  | 1     |
| 3(c)     | drill tips / drills / cutting (tools)  | 1     |
| 3(d)     | <b>A</b> / substance <b>Y</b> dissolves easily in water  | 1     |
|          | <b>C</b> / substance <b>Y</b> melts (at 8015 °C)   | 1     |
|          | the change can be reversed by altering the conditions  | 1     |

| Question  | Answer  | Marks |
|-----------|---|-------|
| 4(a)      | has two atoms in a molecule/two atoms combined  | 1     |
| 4(b)(i)   | the chlorine has displaced/replaced the bromine (in KBr)  | 1     |
| 4(b)(ii)  | (from green / colourless) to orange   | 1     |
| 4(b)(iii) | I <sub>2</sub>  | 1     |
|           | KBr   | 1     |
| 4(c)      | add (nitric acid then aqueous) silver nitrate   | 1     |
|           | yellow precipitate  | 1     |
| 4(d)(i)   | water purification / water treatment / killing bacteria / in (swimming) pools / disinfectant  | 1     |
| 4(d)(ii)  | breaking down of a compound / breaking down of a substance  | 1     |
|           | (using) heat  | 1     |
| 4(d)(iii) | any 2 distinct pollution problems: <ul style="list-style-type: none"> <li>• litter <b>OR</b> eyesore</li> <li>• sticks in gullets <b>OR</b> throats of birds / animals</li> <li>• blocking of drains <b>OR</b> watercourses</li> <li>• animals gets trapped <b>OR</b> tangled (in plastic)</li> <li>• poisonous vapours <b>when burned</b></li> <li>• fills landfill sites</li> </ul> | 2     |

| Question  | Answer   | Marks |
|-----------|--|-------|
| 5(a)      | circle drawn around the OH group   | 1     |
| 5(b)      | 20   | 1     |
| 5(c)      | C=C double bond  | 1     |
| 5(d)(i)   | increases with an increasing number of carbon atoms <b>ORA</b>   | 1     |
| 5(d)(ii)  | any value between $-88$ and $0$ ( $^{\circ}\text{C}$ ) (exclusive of these values)   | 1     |
| 5(d)(iii) | there is no (clear) trend / the numbers go down and up   | 1     |
| 5(d)(iv)  | liquid   | 1     |
|           | 30 $^{\circ}\text{C}$ is between melting and boiling point / 30 $^{\circ}\text{C}$ is above the melting point and below the boiling point                    | 1     |
| 5(d)(v)   | substance containing carbon and hydrogen   | 1     |
|           | only / and no other element  | 1     |
| 5(d)(vi)  | $  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $ | 1     |
| 5(d)(vii) | 3 ( $\text{CO}_2$ )  | 1     |
|           | 5 ( $\text{O}_2$ )   | 1     |

| Question  | Answer   | Marks |
|-----------|--|-------|
| 6(a)(i)   | aluminium  |       |
|           | low density  | 1     |
|           | good electrical conductivity   | 1     |
| 6(a)(ii)  | iron is cheap(er)/tungsten is (too) expensive<br><b>OR</b><br>iron is strong(er)/tungsten is weaker  | 1     |
| 6(a)(iii) | tungsten because it has a (very) high melting point  | 1     |
| 6(b)      | any 2 properties:<br><ul style="list-style-type: none"> <li>• high melting point / high boiling point</li> <li>• high density</li> <li>• hard / strong</li> <li>• sonorous / rings (when hit)</li> <li>• ions are coloured / compounds are coloured</li> </ul> | 2     |
| 6(c)      | 2 (W)  | 1     |
|           | 3 (O <sub>2</sub> )  | 1     |
| 6(d)      | tungsten < cobalt < iron < magnesium<br><b>IF</b> full credit is not awarded, allow 1 mark for either a correct sequence apart from a consecutive pair reversed <b>OR</b> for the whole sequence reversed  | 2     |
| 6(e)(i)   | the more concentrated the acid, the greater the rate <b>ORA</b>  | 1     |
| 6(e)(ii)  | nitric (acid)  | 1     |
| 6(e)(iii) | any value between 19 and 39 hours (exclusive of these values)  | 1     |
| 6(e)(iv)  | pH 4   | 1     |

| Question | Answer  | Marks    |
|----------|---|----------|
| 7(a)     | the energy of the reactants is greater than the energy of the products / the product has less energy than the reactants / the arrow is going down (from reactants to product)   | <b>1</b> |
| 7(b)     | any 2 sources: <ul style="list-style-type: none"> <li>• carbon monoxide from incomplete combustion of fossil fuels / named fossil fuel / named carbon-containing fuel</li> <li>• carbon dioxide from combustion of fossil fuels / respiration</li> <li>• methane from animal flatulence / rice paddy fields / bacteria / decomposition of vegetation / decomposition of animals</li> </ul> any 3 effects: <ul style="list-style-type: none"> <li>• carbon dioxide: global warming / greenhouse effect / acidification of oceans</li> <li>• methane: global warming / greenhouse effect</li> <li>• carbon monoxide: poisonous / toxic</li> </ul> | <b>5</b> |
| 7(c)(i)  | making mortar / whitewash / neutralising (acidic) soils / neutralising acidic lakes / flue gas desulfurisation / steelmaking / glassmaking / making plaster   | <b>1</b> |
| 7(c)(ii) | 100<br><b>IF</b> full credit is not awarded, allow 1 mark for (Ca =) 40, (C =) 12 and (O =) 16  | <b>2</b> |
| 7(d)     | add hydrochloric acid to the mixture  | <b>1</b> |
|          | filter off the carbon   | <b>1</b> |
|          | wash carbon (with water or other solvent) <b>AND</b> dry in an oven / air dry / leave in air / leave to dry   | <b>1</b> |