## CAMBRIDGE INTERNATIONAL EXAMINATIONS

## MARK SCHEME for the May/June 2015 series

## 9701 CHEMISTRY

9701/23
Paper 2 (Structured Question AS Core), maximum raw mark 60

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Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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| 1 (a) | $\left(1 s^{2}\right) 2 s^{2} 2 p^{6}$ | [1] | [1] |
| (b) (i) | The amount of energy required/energy change when one electron is removed <br> from each atom in one mol of gaseous atoms | $\begin{aligned} & {[1]} \\ & {[1]} \\ & {[1]} \end{aligned}$ | [3] |
| (ii) | Greater nuclear charge/number of protons Same shielding/number of shells/energy level | $\begin{aligned} & {[1]} \\ & {[1]} \end{aligned}$ | [2] |
| (c) (i) | mean/average mass of the isotopes/an atom(s) relative to $1 / 12$ of the mass of an atom of ${ }^{12} \mathrm{C} /$ on a scale where an atom of ${ }^{12} \mathrm{C}$ is (exactly) 12 | $\begin{gathered} {[1]} \\ {[1]} \end{gathered}$ | [2] |
| (ii) | $\begin{aligned} & 20.2=\frac{(20 \times 90.48)+(21 \times 0.27)+(9.25 y)}{100} \\ & \frac{2020-1815.27}{9.25}=22.133 \\ & y=22 \end{aligned}$ | [1] <br> [1] | [2] |
| (d) (i) | $\begin{aligned} & \mathrm{pV}=\frac{\mathrm{mRT}}{\mathrm{M}_{\mathrm{r}}} \\ & \mathrm{M}_{\mathrm{r}}=\frac{\mathrm{mRT}}{\mathrm{pV}}=\frac{0.275 \times 8.31 \times 298}{100 \times 10^{3} \times 200 \times 10^{-6}} \\ & \mathrm{M}_{\mathrm{r}}=34.05 / 34.1 \end{aligned}$ | [1] <br> [1] | [2] |
| (ii) | $\begin{aligned} & (\text { Let } \% \mathrm{Ne}=\mathrm{x} \text { so } \% \mathrm{Ar}=100-\mathrm{x}) \\ & \frac{20.2 \mathrm{x}+39.9(100-\mathrm{x})}{100}=34.05 \\ & \% \mathrm{Ne}=29.7 \end{aligned}$ | [1] | [1] |
| 1 (e) (i) | Van der Waal's/London/dispersion Uneven electron distribution/temporary dipole Induced dipole-dipole attraction | $\begin{aligned} & {[1]} \\ & {[1]} \\ & {[1]} \end{aligned}$ | [3] |
| (ii) | more electrons more polarisable/greater attraction/stronger IMFs | $\begin{aligned} & {[1]} \\ & {[1]} \end{aligned}$ | [2] |
|  |  |  | [18] |


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| 2 (a) (i) | Reactivity increases down the group <br> OR reference to observations that indicate trend Outer electrons lost more easily down group Due to increased distance/shielding of outer electrons from nucleus | [1] <br> [1] <br> [1] | [3] |
| (ii) | $\mathrm{Mg}+2 \mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{Mg}(\mathrm{OH})_{2}+\mathrm{H}_{2}$ | [1] | [1] |
| (iii) | Magnesium hydroxide sparingly soluble/insoluble | [1] | [1] |
| (iv) | $\mathrm{Mg}+\mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{MgO}+\mathrm{H}_{2}$ | [1] | [1] |
| (b) (i) | $\mathrm{MgO}+2 \mathrm{HNO}_{3} \rightarrow \mathrm{Mg}\left(\mathrm{NO}_{3}\right)_{2}+\mathrm{H}_{2} \mathrm{O}$ | [1] | [1] |
| (ii) | (thermal stability) increases down the group | [1] | [1] |
| (iii) | $2 \mathrm{Mg}\left(\mathrm{NO}_{3}\right)_{2} \rightarrow 2 \mathrm{MgO}+4 \mathrm{NO}_{2}+\mathrm{O}_{2}$ | [1] | [1] |
| (iv) | $\mathrm{N} \text { from }(+) 5 \text { to }(+) 3$ <br> O from -2 to 0 <br> N is reduced and O is oxidised | $\begin{aligned} & {[1]} \\ & {[1]} \\ & {[1]} \end{aligned}$ | [3] |
| (c) | (Very) strong electrostatic attraction/ionic bond High charge (density) of cation and anion $/ \mathrm{Mg}^{2+}$ and $\mathrm{O}^{2-}$ | $\begin{aligned} & {[1]} \\ & {[1]} \end{aligned}$ | [2] |
| (d) (i) | $\begin{aligned} & \mathrm{CaCO}_{3} \rightarrow \mathrm{CaO}+\mathrm{CO}_{2} \\ & \mathrm{CaO}+\mathrm{H}_{2} \mathrm{O} \rightarrow \mathrm{Ca}(\mathrm{OH})_{2} \end{aligned}$ | $\begin{aligned} & {[1]} \\ & {[1]} \end{aligned}$ | [2] |
| (ii) | $2 \mathrm{H}^{+}+\mathrm{CO}_{3}{ }^{2-} \rightarrow \mathrm{CO}_{2}+\mathrm{H}_{2} \mathrm{O}$ | [1] | [1] |
| (iii) | $\begin{aligned} & 1 \times 10^{-4} \times 8000=0.8 \mathrm{~mol} \mathrm{H}^{+} \\ & \frac{0.8}{2} \times 100.1=\text { mass } \mathrm{CaCO}_{3}=40 \mathrm{~g} \end{aligned}$ | [1] <br> [1] | [2] |
|  |  |  | [19] |
| 3 (a) (i) | $A / B=$ | [1] <br> [1] <br> [1] | [3] |
| (ii) | Chain | [1] | [1] |
| (iii) | Silver mirror/ppt/solid (black/grey) | [1] | [1] |


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| (b) (i) | D $\mathrm{CH}_{2}=\mathrm{C}\left(\mathrm{CH}_{3}\right) \mathrm{CH}_{2} \mathrm{OH}$ <br> E <br> trans ORE <br> F $\mathrm{H}_{2} \mathrm{C}=\mathrm{CHCH}_{2} \mathrm{CH}_{2} \mathrm{OH}$ | E <br> cis OR Z | [1] $[1+1]$ <br> [1] <br> [1] | [5] |
| (ii) | Hydrogen |  | [1] | [1] |
| (c) (i) | $\mathrm{C}_{3} \mathrm{H}_{6} \mathrm{O}+[\mathrm{O}] \rightarrow \mathrm{C}_{3} \mathrm{H}_{6} \mathrm{O}_{2}$ |  | [1] | [1] |
| (ii) | $\mathrm{C}_{3} \mathrm{H}_{6} \mathrm{O}+2[\mathrm{H}] \rightarrow \mathrm{C}_{3} \mathrm{H}_{8} \mathrm{O}$ |  | [1] | [1] |
|  |  |  |  | [13] |
| $4 \quad$ (a) (i) |  |  | [1] | [1] |
| (ii) |  |  | [1] <br> [1] | [2] |


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| (b) (i) | M1 = 2 curly arrows <br> M2 = intermediate ion <br> $\mathrm{M} 3=\mathrm{Br}$ with -ve charge, lone pair and curly arrow to C+ | $\begin{gathered} {[1]} \\ {[1]} \\ {[1]} \end{gathered}$ | [3] |
| (ii) | dipole is induced by proximity to $\mathrm{C}=\mathrm{C}$ | [1] | [1] |
| (iii) | Optical | [1] | [1] |
| (iv) |   | [1+1] | [2] |
|  |  |  | [10] |

