Mark scheme – Atomic Structure (H)

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>C ✓</td><td>1
(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>C ✓</td><td>1
(AO2.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td>C ✓</td><td>1
(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>4</td><td></td><td></td><td>B ✓</td><td>1(AO1.1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>5</td><td></td><td></td><td>C</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>1</td><td></td></tr>
<tr><td>6</td><td>a</td><td></td><td>idea of the nuclear atom (1)</td><td>1</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td><table><tr><th></th><th>Charge</th><th>Mass in atomic mass units</th></tr><tr><td>proton</td><td>positive /+</td><td>1</td></tr><tr><td>neutron</td><td>neutral / no charge</td><td>1</td></tr><tr><td>electron</td><td>negative</td><td>0.0005</td></tr></table></td><td>2</td><td>one mark scored for each correct column (2)

ALLOW
1/1760
or 1/1836
or 1/2000</td></tr>
<tr><td></td><td>c</td><td></td><td><table><tr><th>Particle</th><th>Atomic number</th><th>Mass number</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th><th>Electronic structure</th></tr><tr><td>A</td><td>11</td><td>23</td><td>11</td><td>12</td><td>11</td><td>2.8.1</td></tr><tr><td>B</td><td>9</td><td>19</td><td>9</td><td>10</td><td>9</td><td>2.7</td></tr><tr><td>C</td><td>17</td><td>37</td><td>17</td><td>20</td><td>17</td><td>2.8.7</td></tr><tr><td>D</td><td>13</td><td>27</td><td>13</td><td>14</td><td>10</td><td>2.8</td></tr></table></td><td>4</td><td>one mark scored for each correct line</td></tr>
<tr><td></td><td>d</td><td></td><td>particle A – one electron in outer shell or energy level (1)
particle D – has more protons than electrons (1)</td><td>2</td><td></td></tr>
<tr><td></td><td>e</td><td></td><td>group 7 (1) as 7 electrons in outer shell (1)
period 3 (1) as 3 shells occupied (1)</td><td>4</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>13</td><td></td></tr>
<tr><td>7</td><td></td><td>i</td><td></td><td>2(AO1.1)</td><td><u>Examiner's Comments</u></td></tr>
</table>

			<table><tr><th>Isotope</th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr><tr><td>Chlorine-35</td><td>17</td><td>18</td><td>17</td></tr><tr><td>Chlorine-37</td><td>17</td><td>20</td><td>17</td></tr></table> ✓ ✓		Most candidates were able to correctly deduce the numbers of sub-atomic particles in these two isotopes of chlorine.
		ii	$Cl_2 + 2e^- \rightarrow 2Cl^-$ ✓	1(AO2.1)	**ALLOW** $Cl_2 \rightarrow 2Cl^- - 2e^-$ **ALLOW** any correct multiple, including fractions **ALLOW** = / ⇌ instead of → **DO NOT ALLOW** and / & instead of '+' balancing mark is dependent on the correct formulae but **Examiner's Comments** Lower ability candidates often gave the reverse equation, i.e. $2Cl^- \rightarrow Cl_2 + 2e^-$. Other common errors included equations with the following incorrect species: Cl_2^-, Cl^+ or Cl_2^+.
		iii	Ba^{2+} (aq) + SO_4^{2-} (aq) → $BaSO_4$ (s) Equation ✓ State symbols ✓	2(AO2.1)	**ALLOW** any correct multiple, including fractions **ALLOW** = / ⇌ instead of → **DO NOT ALLOW** and / & instead of '+' **Mark for state symbols is dependent on correct species**

					ALLOW a full **balanced** ionic equation Ba^{2+} (aq) + $2Cl^-$ (aq) + $2Na^+$(aq) + SO_4^{2-} (aq) → $BaSO_4$(s) + $2Na^+$(aq) + $2Cl^-$ (aq) **Examiner's Comments** Many candidates wrote a balanced **symbol** equation for this reaction rather than a balanced **ionic** equation. Another common error was to omit the state symbols.
			Total	**5**	
8		i	Unreactive ✓ Full outer shell (of electrons) ✓	2 (AO2.1 1.1)	**ALLOW** doesn't bond / doesn't lose or gain electrons / doesn't share electrons **ALLOW** (argon has a) stable electronic structure / 8 electrons in outer shell
		ii	<table><tr><th></th><th>$^{20}_{10}$Ne</th><th>$^{22}_{10}$Ne</th></tr><tr><td>**Proton**</td><td>10</td><td>10</td><td>✓</td></tr><tr><td>**Neutron**</td><td>10</td><td>12</td><td>✓</td></tr><tr><td>**Electron**</td><td>10</td><td>10</td><td>✓</td></tr></table>	3 (AO2.1)	1 mark for each row
			Total	**5**	