

1)

Correct Answer	Reject	Mark
B		<b>1</b>

2)

Correct Answer	Reject	Mark
D		<b>1</b>

3)

Correct Answer	Reject	Mark
B		<b>1</b>

4)

Correct Answer	Reject	Mark
D		<b>1</b>

5)

Correct Answer	Reject	Mark
A		<b>1</b>

6)

Correct Answer	Mark
D	<b>1</b>

7)

Correct Answer	Reject	Mark
C		<b>1</b>

8)

Correct Answer	Reject	Mark
B		<b>1</b>

9)

Correct Answer	Reject	Mark
C		<b>1</b>

10)

Correct Answer	Reject	Mark
B		<b>1</b>

11)

Correct Answer	Reject	Mark
A		<b>1</b>

12)

<b>(a)</b>	<p><b>First mark:-</b> Makes mention of energy/enthalpy/(heat) energy/heat (change) AND to remove an electron AND one mole/1 mol</p> <p><b>Second mark:</b> Makes mention of <b>gaseous atom(s)</b></p> <p><b>ALTERNATIVE ANSWER</b></p> <p>Energy change per mole for (1)</p> <p><math>X(g) \rightarrow X^+(g) + e^{(-)}</math> (1)</p> <p>Mark the two points independently</p> <p>IGNORE any references to standard conditions</p>	<p>"Energy given out..." for first mark</p> <p>Just 'gaseous element'/'gaseous substance'</p>	<b>2</b>
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Question number	Acceptable Answers	Reject	Mark
<b>2(b)</b>	<p><b>Any two from three:-</b> (Atomic) radius increases/there are more shells/(outermost) electron further from the nucleus (1)</p> <p>there is '<b>more</b> shielding' or '<b>more</b> screening' (down group) (1)</p> <p>the nuclear attraction decreases OR attraction between nucleus and (outermost) electron decreases OR the increased shielding/increased distance outweighs the increased nuclear charge (1)</p> <p>IGNORE any references to 'more protons' and/just 'increasing nuclear charge' IGNORE references to "effective nuclear charge"</p>	Ionic radius increases	<b>2</b>

number			
(c)(i)	<p><b>Any ONE from:</b>          (Electrons are being removed from an) increasingly positive ion/          charge on the ion (successively) increases/          increasing proton : electron ratio/          same number of protons (attracting) fewer electrons /          ions get smaller/          the electron repulsion decreases/          the shielding decreases/          electrons (being removed are) closer to the nucleus/  <b>effective nuclear charge increases</b></p>		<b>1</b>
total			
(c)(ii)	<p><b>First mark: Two jumps</b></p> <p><b>Two</b> (large) jumps (between 1<sup>st</sup> and 2<sup>nd</sup> and 9<sup>th</sup> and 10<sup>th</sup> IEs) <b>(1)</b></p> <p>NOTE: A sketch graph with <b>two</b> (large) jumps can score this first mark</p> <p>Note if the jumps are specified, they must be between 1<sup>st</sup> and 2<sup>nd</sup> and 9<sup>th</sup> and 10<sup>th</sup> IEs</p> <p><b>Second mark: Electronic configuration of Na</b></p> <p>2, 8, 1 mentioned in words, <b>annotated</b> on a sketch graph or drawn out in a diagram (e.g. electrons shown in orbits/shells around the centre of the atom) but NOT just inferred <b>(1)</b></p> <p>ALLOW "1, 8, 2" OR <math>1s^2 2s^2 2p^6 3s^1</math></p> <p>Mark the two points independently</p>	<p>1<sup>st</sup> mark if the graph is sketched 'back to front'</p>	<b>2</b>

Question number (d)(i)	<p>Credit any of the following representations (but need <b>BOTH</b> Mg <b>AND</b> Al to be correct)</p> <p>Mg <math>1s^2 2s^2 2p^6 3s^2</math> and Al <math>1s^2 2s^2 2p^6 3s^2 3p^1</math></p> <p>Mg <math>1s_2 2s_2 2p_6 3s_2</math> and Al <math>1s_2 2s_2 2p_6 3s_2 3p_1</math></p> <p>Mg <math>1S^2 2S^2 2P^6 3S^2</math> and Al <math>1S^2 2S^2 2P^6 3S^2 3P^1</math></p> <p>Mg <math>1S_2 2S_2 2P_6 3S_2</math> and Al <math>1S_2 2S_2 2P_6 3S_2 3P_1</math></p>		1
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Question number	Acceptable Answers	Reject	Mark
(d)(ii)	<p><b>NOTE:</b> ALLOW an argument focusing on <b>either</b> the Al <b>or</b> the Mg atom</p> <p><b>EITHER</b> <b>In Al</b>, (3p) <b>electron</b> (lost is) at higher energy/more shielded (by 3s electrons)/further from the nucleus IGNORE any reference to an unpaired electron in Al</p> <p><b>OR</b> <b>In Mg</b>, (3s) <b>electron</b> (lost is) at lower energy/less shielded/ nearer to the nucleus/from a <b>full subshell</b>/from a full orbital/from (stable) <math>(3)s^2</math></p> <p>Any reference to an Al atom being <b>larger</b> in size than an Mg atom scores zero overall.</p>	<p>Al has one more <b>shell</b> than Mg</p> <p><b>Just</b> (lost from) a new sub-shell</p> <p>Electron lost in Mg from a "full <b>shell</b>"</p>	1

13)

Question number	Acceptable Answers	Reject	Mark
(a)	(Electrostatic) attraction between (bonding) electrons and nuclei/protons	Just a 'shared pair of electrons'	1

- IGNORE ANY INNER SHELL ELECTRONS DRAWN
- ONLY THE TOTAL NUMBERS OF ELECTRONS IN OUTER SHELLS ARE BEING ASSESSED
- ALLOW ELECTRONS TO BE ALL DOTS OR ALL CROSSES OR BOTH

Question number	Acceptable Answers	Reject	Mark
(b)(i)			1

Question number	Acceptable Answers	Reject	Mark
(b)(ii)			1

Question number	Acceptable Answers	Reject	Mark
(b)(iii)	<p>NOTE: The lone pair of electrons on each N atom do not have to be shown as a pair</p>		1

Question number	Acceptable Answers	Reject	Mark
(b)(iv)	<p>The + sign can be shown anywhere Ignore missing brackets Ignore if the + is missing</p>		1

(c)(i)	<p>IGNORE any references to 'molecules' in this part only</p> <p><b>First mark: Location of silicon's electrons</b></p> <p>Silicon's (outer) electrons are fixed (in covalent bonds)/ silicon's (outer) electrons are in fixed positions (in covalent bonds)/ silicon's (outer) electrons are involved in bonding (1)</p> <p><b>Second mark: Lack of mobility of silicon's electrons</b></p> <p>(therefore) silicon's electrons are not free (to move)/ silicon has no free electrons/ there are no mobile electrons in silicon/ silicon has no delocalized electrons/ silicon's electrons cannot flow (1)</p> <p>IGNORE references to <b>lack of ions</b></p>	<p>'Silicon is ionic' scores (0) for the question</p> <p>'silicon's <b>ions</b> are not free to move' scores (0) for the question</p>	<b>2</b>
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Question number	Acceptable Answers	Reject	Mark
(c)(ii)	<p>(The covalent) bonds are <b>strong</b> (throughout the lattice) (1)</p> <p>(therefore) a lot of <b>energy</b> is required to break the bonds / a lot of <b>energy</b> is needed to overcome the attractions (1)</p> <p>IGNORE any references to 'giant molecular'</p>	<p>'(simple) molecular silicon' (0)</p> <p>'/molecules of silicon' (0)</p> <p>'/silicon has ions' (0)</p> <p>'/intermolecular forces' / 'van der Waals' forces' / 'London forces' (0)</p> <p>ALL THE ABOVE SCORE (0) OVERALL</p>	<b>2</b>

14)

(a) 1/1C	<p>(Strong) covalent bonds between atoms within the layers / good overlap of electron orbitals in layers (1)</p> <p>(Weak) London / dispersion / induced dipole-induced dipole (ALLOW van der Waals) forces between layers (1)</p>	Intermolecular forces alone	<b>2</b>
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Question number	Acceptable Answers	Reject	Mark
(b)	<p>Within a layer, one electron per carbon is (ALLOW electrons are) <b>delocalized</b> (so electrons can move easily along layers) (1)</p> <p>Energy gap (ALLOW distance) between layers is too large for (easy) electron transfer (1)</p>	Electrons between layers not delocalized	<b>2</b>

Question number	Acceptable Answers	Reject	Mark
(c)	<p>N has one more (outer shell) electron than C(1)</p> <p>Would increase number of (delocalised) electrons ...</p> <p>contributing to the London / dispersion (ALLOW van der Waals) forces (1)</p> <p>OR</p> <p>holding layers together (1)</p>	Just London / dispersion / van der Waals forces stronger	<b>2</b>

Question number	Acceptable Answers	Reject	Mark
(d)	No heat energy required / low energy requirement / high temperatures not needed / sunlight (which is renewable) could be used  Ignore generalisations such as 'greener', 'environmentally friendly' 'smaller carbon footprint' cheaper or fossil fuels not used.		1

Question number	Acceptable Answers	Reject	Mark
(e)	$\text{CO} + 2\text{H}_2 \rightarrow \text{CH}_3\text{OH}$ OR Structural and displayed formulae  ALLOW $\text{CH}_4\text{O}$ for $\text{CH}_3\text{OH}$		1

(f) 12 marks	Score 1 mark for each clearly made point  <ol style="list-style-type: none"> <li>1. Need energy to make benzene / catalyst / hydrogen</li> <li>2. High energy / temperature / pressure needed for the reaction (ALLOW stated T or P)</li> <li>3. Fossil fuel (oil or coal) used as source of energy, benzene or hydrogen</li> <li>4. Hydrogen has to be manufactured</li> <li>5. Hydrogen has to be stored</li> <li>6. Fossil fuels non-renewable</li> <li>7. Reduces <math>\text{CO}_2</math> in atmosphere / recycles <math>\text{CO}_2</math></li> <li>8. <math>\text{CO}_2</math> is a greenhouse gas / causes global warming</li> <li>9. CO toxic</li> <li>10. Benzene toxic / carcinogenic</li> <li>11. 100% atom economy in making methanol</li> <li>12. Beneficial if phenol useful / not beneficial if phenol a waste product</li> </ol> Ignore generalisations such as 'greener', 'smaller carbon footprint' or 'environmentally friendly'.	References to the ozone layer	6
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Question number	Acceptable Answers	Reject	Mark
(g)	Delivering drugs to cells ALLOW Delivering drugs to specific / targeted parts of the body  Catalyst with big surface area	Just drug delivery	1