

## Junior Chemistry Challenge 2023

### Mark Scheme

#### Question 1 – Multiple Choice

- a) C                                  f) A  
b) D                                  g) C  
c) B                                  h) E  
d) C                                  i) A  
e) D                                  j) E

Question	Answer	Additional Guidance	Mark
2(a)	Melting point: $-100\text{ }^{\circ}\text{C}$ <b>(1)</b> Boiling point: $65\text{ }^{\circ}\text{C}$ <b>(1)</b>	ALLOW both numbers even if not labelled melting/boiling point	2
2(b)	(Thermal/Heat) Energy is overcoming intermolecular forces <b>(1)</b> Rather than increasing {temperature/kinetic energy} of the methanol <b>(1)</b>	REJECT breaking bonds for MP1	2
2(c)	Heat Energy transfer = range 5000 - 5250 (J) AND Temperature change = (+) 50 $^{\circ}\text{C}$ <b>(1)</b> $(5000/50) = 100\text{ (J}/^{\circ}\text{C})$ <b>(1)</b>	ALLOW K for $^{\circ}\text{C}$ throughout ALLOW Answers in the range 90-110 J/ $^{\circ}\text{C}$	2
2(d)	Infinite/Infinity/ $\infty$ <b>(1)</b>	ALLOW undefined	1
2(e)	Helium with constant pressure will have a higher heat capacity <b>(1)</b> As heat energy transferred goes into expansion work (which cannot happen at constant volume) <b>(1)</b> So less energy is transferred into molecular kinetic energy/increasing the temperature <b>(1)</b>	ORA ALLOW work against external pressure ALLOW thermal energy	3

Question	Answer	Additional Guidance	Mark
3(a)	Giant covalent <b>(1)</b> Similar to diamond's structure <b>(1)</b>	ALLOW tetrahedral lattice	2
3(b)	Simple covalent <b>(1)</b>	ALLOW Covalent <b>molecule</b>	1
3(c)	$\text{SiH}_4 + \text{O}_2 \rightarrow \text{SiO}_2 + 2\text{H}_2$  Reactants and products correct <b>(1)</b> Balanced <b>(1)</b>	ALLOW multiples	2
3(d)	Melting Point: in range 1128 – 1609 (°C) Boiling Point: in range 1801 – 2229 (°C)	ALLOW both numbers even if not labelled melting/boiling point	1
3(e)(i)	Unchanged/(remain) uncondutive/insulators		1
3(e)(ii)	More conductive/become conductive		1
3(f)	Silicon (IV) oxide has a giant covalent structure AND carbon dioxide has a simple covalent structure <b>(1)</b> Less energy is required to overcome intermolecular forces between CO <sub>2</sub> than to break the Si-O bonds in SiO <sub>2</sub> <b>(1)</b>		2

Question	Answer	Additional Guidance	Mark
4(a)	$4 \text{FeS}_2 + 11 \text{O}_2 \rightarrow 2 \text{Fe}_2\text{O}_3 + 8 \text{SO}_2$ Reactants and products correct <b>(1)</b> Balanced <b>(1)</b>	ALLOW multiples	2
4(b)	$\text{SO}_3$ <b>(1)</b>	ALLOW sulphur trioxide/sulphur (VI) oxide	1
4(c)	Chemically unchanged/regenerated at the end of the reaction <b>(1)</b>	REJECT any answer about speeding up the reaction	1
4(d)(i)	Reduced <b>(1)</b>		1
4(d)(ii)	Oxidised <b>(1)</b>		1
4(d)(iii)	Reduced <b>(1)</b>		1
4(e)	$\text{H}_2\text{S}_2\text{O}_7$ <b>(1)</b>		1
4(f)	(For the same moles of sulphuric acid) oleum is {lighter/has a smaller molecular weight} than sulphuric acid <b>(1)</b> OR You do not have to transport the mass of (2 mol) of water <b>(1)</b>  AND  Therefore, cheaper to transport/more can be transported at the same cost <b>(1)</b>	REJECT Answers based on safety of oleum vs sulphuric acid	2