

1. Volcanoes produce a variety of molten substances, including sulfur and silicon dioxide.

(a) Complete the table to show the strongest type of attraction that is broken when each substance melts.

Substance	Melting point (°C)	Strongest type of attraction broken when substance melts
sulfur	113	
silicon dioxide	1610	

(b) Volcanic sulfur can be put to a variety of uses. One such use involves reacting sulfur with phosphorus to make a compound with formula  $P_4S_3$ .

(i) Draw a possible structure for  $P_4S_3$ .

(ii) Explain why the covalent radius of sulfur is smaller than that of phosphorus.

1. (b) (continued)

(iii) The melting point of sulfur is much higher than that of phosphorus.

Explain fully, in terms of the structures of sulfur and phosphorus molecules and the intermolecular forces between molecules of each element, why the melting point of sulfur is much higher than that of phosphorus.

Question		Answer	Max Mark	Additional Guidance
1.	(a)	Sulfur - London dispersion forces / van der Waals / intermolecular forces (1)  Silicon dioxide - (polar)covalent (network) bonds (1)	2	Accept LDF for London dispersion forces  If candidate answers pure covalent, ignore pure.
2	(b) (i)	Any structure for $P_4S_3$ that obeys valency rules  	1	Only trivalent phosphorus structures accepted
1	(ii)	Increased nuclear attraction for electrons / increased nuclear charge / sulfur has more protons in nucleus	1	0 marks awarded for increased attraction of electrons for nucleus
1	(iii)	<b>1 mark</b> Correctly identify that the forces are stronger between sulfur (molecules) than between the phosphorus molecules  <b>1 mark</b> Correctly identifying that there are London dispersion forces between the molecules of both these elements  <b>1 mark</b> These forces are stronger due to sulfur structure being $S_8$ whereas phosphorus is $P_4$	3	This mark should only be awarded if no other forces are mentioned  Must mention $S_8$ and $P_4$ (A-mark)