AP® CHEMISTRY
2018 SCORING GUIDELINES

Question 4

Sulfur atom = ◯ Carbon atom = ● Oxygen atom = ○

Compound	Molecular Structure	Boiling Point at 1 atm (K)
CS_2		319
COS		223

The table above gives the molecular structures and boiling points for the compounds CS_2 and COS.

(a) In terms of the types and relative strengths of all the intermolecular forces in each compound, explain why the boiling point of $CS_2(l)$ is higher than that of COS(l).

CS_2 has only London dispersion forces, while COS has London dispersion forces and dipole-dipole forces. The London dispersion forces in CS_2 are stronger than the combination of London dispersion forces and dipole-dipole forces in COS.	1 point is earned for correctly identifying all of the intermolecular forces in **both** molecules. 1 point is earned for a valid explanation.

(b) A 10.0 g sample of $CS_2(l)$ is put in an evacuated 5.0 L rigid container. The container is sealed and heated to 325 K, at which temperature all of the $CS_2(l)$ has vaporized. What is the pressure in the container once all of the $CS_2(l)$ has vaporized?

$10.0 \text{ g } CS_2 \times \frac{1 \text{ mol } CS_2}{76.13 \text{ g } CS_2} = 0.131 \text{ mol } CS_2$ $P = \frac{nRT}{V} = \frac{(0.131 \text{ mol})(0.08206 \text{ L atm mol}^{-1}\text{K}^{-1})(325 \text{ K})}{5.0 \text{ L}}$ $= 0.70 \text{ atm}$	1 point is earned for the correct number of moles of CS_2. 1 point is earned for the correct calculation of pressure with appropriate units.