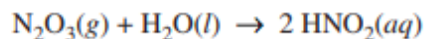


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$\text{N}_2\text{O}_3(g)$  reacts with water to form nitrous acid,  $\text{HNO}_2(aq)$ , a compound involved in the production of acid rain. The reaction is represented below.



(d) The skeletal structure of the  $\text{HNO}_2$  molecule is shown in the box below.

- (i) Complete the Lewis electron-dot diagram of the  $\text{HNO}_2$  molecule in the box below, including any lone pairs of electrons.



- (ii) Based on your completed diagram above, identify the **Shape** of the nitrogen atom in the  $\text{HNO}_2$  molecule.

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3. Answer the following questions relating to Fe and its ions,  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ .

(a) Write the ground-state electron configuration of the  $\text{Fe}^{2+}$  ion.

| Ion              | Ionic Radius (pm) |
|------------------|-------------------|
| $\text{Fe}^{2+}$ | 92                |
| $\text{Fe}^{3+}$ | 79                |

(b) The radii of the ions are given in the table above. Using principles of atomic structure, explain why the radius of the  $\text{Fe}^{2+}$  ion is larger than the radius of the  $\text{Fe}^{3+}$  ion.

(c)  $\text{Fe}^{3+}$  ions interact more strongly with water molecules in aqueous solution than  $\text{Fe}^{2+}$  ions do. Give one reason for this stronger interaction, and justify your answer using **Intermolecular Forces**

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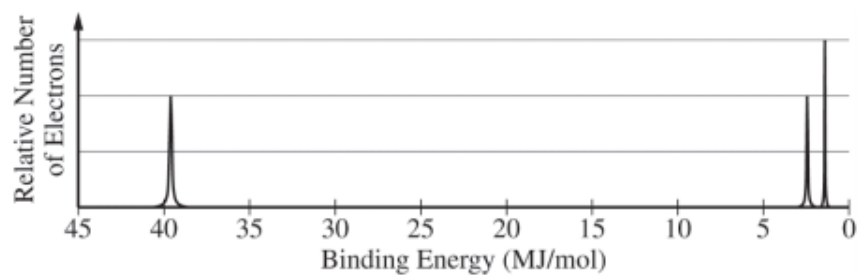
Sulfur atom =  Carbon atom =  Oxygen atom = 

| Compound        | Molecular Structure                                                               | Boiling Point at 1 atm (K) |
|-----------------|-----------------------------------------------------------------------------------|----------------------------|
| CS <sub>2</sub> |  | 319                        |
| COS             |  | 223                        |

Hint: There is a discrepancy here between what you know and the data. See Kinetic Molecular

4. The table above gives the molecular structures and boiling points for the compounds CS<sub>2</sub> 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<sub>2</sub>(*l*) is higher than that of COS(*l*).
- (b) A 10.0 g sample of CS<sub>2</sub>(*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<sub>2</sub>(*l*) has vaporized. What is the pressure in the container once all of the CS<sub>2</sub>(*l*) has vaporized?

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7. The complete photoelectron spectrum of an element is represented above.
- (a) Identify the element.