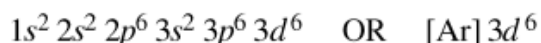


Answer the following questions relating to Fe and its ions, Fe^{2+} and Fe^{3+} .

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



1 point is earned for a correct electron configuration.

Ion	Ionic Radius (pm)
Fe^{2+}	92
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 Fe^{2+} ion is larger than the radius of the Fe^{3+} ion.

Both ions have the same nuclear charge; however, the greater number of electrons in the outermost shell of Fe^{2+} results in greater electron-electron repulsion within that shell, leading to a larger radius.

1 point is earned for a valid explanation.

(c) Fe^{3+} ions interact more strongly with water molecules in aqueous solution than Fe^{2+} ions do. Give one reason for this stronger interaction, and justify your answer using Coulomb's law.

Coulomb's law: $F \propto \frac{q_1 q_2}{r^2}$ (need not be explicitly stated)

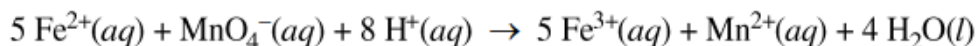
In comparison to the Fe^{2+} ion, the Fe^{3+} ion has a higher charge.

OR

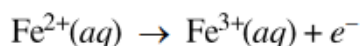
The smaller size of Fe^{3+} allows it to get closer to a water molecule.

1 point is earned for a valid explanation.

A student obtains a solution that contains an unknown concentration of $\text{Fe}^{2+}(aq)$. To determine the concentration of $\text{Fe}^{2+}(aq)$ in the solution, the student titrates a sample of the solution with $\text{MnO}_4^-(aq)$, which converts $\text{Fe}^{2+}(aq)$ to $\text{Fe}^{3+}(aq)$, as represented by the following equation.



(d) Write the balanced equation for the half-reaction for the oxidation of $\text{Fe}^{2+}(aq)$ to $\text{Fe}^{3+}(aq)$.



1 point is earned for the correct half-reaction.