Answer on the question #55505 - Chemistry - General chemistry
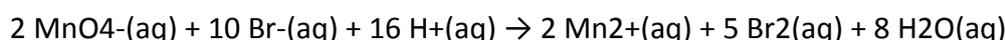
Question:

How many milliliters of a 0.240 M KMnO4 solution are needed to react completely with 3.215 g of oxalic acid?

What is the concentration of a KMnO4 solution if 29.65 mL reacts with 0.5050 g of oxalic acid? Express your answer using four significant figures.
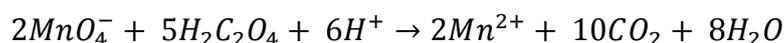
In the following reaction, the reducing agent is _____.
2 MnO4-(aq) + 10 Br-(aq) + 16 H+(aq) → 2 Mn2+(aq) + 5 Br2(aq) + 8 H2O(aq)
Express your answer as a chemical formula.

Answer:

➢ How many milliliters of a 0.240 M KMnO4 solution are needed to react completely with 3.215 g of oxalic acid?

The reaction of KMnO₄ with oxalic acid is:
$$2MnO_4^- + 5H_2C_2O_4 + 6H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$
Thus, the numbers of the moles of KMnO₄ and oxalic acid relate as:
$$\frac{n(MnO_4^-)}{2} = \frac{n(H_2C_2O_4)}{5}$$
The number of the moles of oxalic acid is:
$$n(H_2C_2O_4) = \frac{m(H_2C_2O_4)}{M(H_2C_2O_4)} = \frac{3.215\ g}{90.03\ \frac{g}{mol}} = 0.03571\ mol$$
Then, the number of the moles of KMnO₄ is:
$$n(MnO_4^-) = 2 \times \frac{n(H_2C_2O_4)}{5} = 2 \times \frac{0.03571}{5} = 0.01428\ mol$$
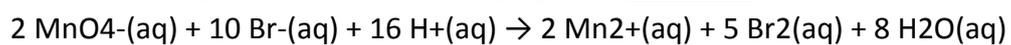Thus, the volume of 0.240 M solution that contains 0.01428 mol of KMnO₄ is:
$$V = \frac{n}{c} = \frac{0.01428\ mol}{0.240\ \frac{mol}{L}} = 0.05952\ L = 59.52\ mL$$

➢ What is the concentration of a KMnO4 solution if 29.65 mL reacts with 0.5050 g of oxalic acid?
Express your answer using four significant figures.

Using the formula from the first part of the question, we deduce:
$$c = \frac{n(MnO_4^-)}{V(MnO_4^-)} = \frac{2n(H_2C_2O_4)}{5V(MnO_4^-)} = \frac{2 \times m(H_2C_2O_4)}{5V(MnO_4^-) \times M(H_2C_2O_4)} = \frac{2 \times 0.5050\ g}{5 \times 0.02965\ L \times 90.03 g/mol}$$
$$= 0.07567\ M$$

➢ In the following reaction, the reducing agent is _____.
2 MnO4-(aq) + 10 Br-(aq) + 16 H+(aq) → 2 Mn2+(aq) + 5 Br2(aq) + 8 H2O(aq)
Express your answer as a chemical formula.

The reducing agent is Br⁻ ion, as it loses electrons and becomes neutral.