3. Answer the following questions about BeC$_2$O$_4$(s) and its hydrate.

(a) Calculate the mass percent of carbon in the hydrated form of the solid that has the formula BeC$_2$O$_4$·3 H$_2$O

(b) When heated to 220.°C, BeC$_2$O$_4$·3 H$_2$O(s) dehydrates completely as represented below.

BeC$_2$O$_4$·3 H$_2$O(s) → BeC$_2$O$_4$(s) - 3 H$_2$O(g)

If 3.21 g of BeC$_2$O$_4$·3 H$_2$O(s) is heated to 220.°C, calculate

(i) the mass of BeC$_2$O$_4$(s) formed, and,

(ii) the volume of the H$_2$O(g) released, measured at 220.°C and 735 mm Hg.

(c) A 0.345 g sample of anhydrous BeC$_2$O$_4$, which contains an inert impurity, was dissolved in sufficient water to produce 100. mL of solution A 20.0 mL portion of the solution was titrated with KMnO$_4$(aq). The balanced equation for the reaction that occurred is as follows

$16$ H$^+(aq) + 2$ MnO$_4^-$$(aq) + 5$ C$_2$O$_4^{2-}$(aq) $→ 2$ Mn$^{2+}$(aq) + $10$ CO$_2$(g) + $8$ H$_2$O(l).

The volume of 0.0150 M KMnO$_4$(aq) required to reach the equivalence point was 17.80 mL.

(i) Identify the reducing agent in the titration reaction.

(ii) For the titration at the equivalence point, calculate the number of moles of each of the following that reacted.

• MnO$_4^-$(aq)
• C$_2$O$_4^{2-}$(aq)

(iii) Calculate the total number of moles of C$_2$O$_4^{2-}$(aq) that were present in the 100. mL of prepared solution.

(iv) Calculate the mass percent of BeC$_2$O$_4$(s) in the impure 0.345 g sample.

- Mass percent = \[
\frac{12.01 \times 2}{(9.012 + 2 \times 12.01 + 16.00 \times 4 + 3 \times 2 \times 1.01 + 3 \times 16.00)} \times 100 = 0.1590 \rightarrow 15.90\%
\]

- BeC$_2$O$_4$·3 H$_2$O

\[
\text{MM} = 151.09 \text{ g/mol}
\]

\[
\text{n}_\text{mol} = 0.0212 \text{ mol of BeC}_2\text{O}_4\cdot3\text{H}_2\text{O}
\]

\[
\text{mass of BeC}_2\text{O}_4 \text{ formed}
\]

\[
\text{coeff} \times 0.0212 \times \text{MM BeC}_2\text{O}_4 = \text{mass formed}
\]

\[
1 \times 0.0212 \times 97.03 \text{ g} = 2.06 \text{ g}
\]

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