1993 B

I. $2\ Mn^{2+} + 4\ OH^- + O_2(g) \rightarrow 2\ MnO_2(s) + 2\ H_2O$

II. $MnO_2(s) + 2\ I^- + 4\ H^+ \rightarrow Mn^{2+} + I_2(aq) + 2\ H_2O$

III. $2\ S_2O_3^{2-} + I_2(aq) \rightarrow S_4O_6^{2-} + 2\ I^-$

The amount of oxygen, O_2, dissolved in water can be determined by titration. First, $MnSO_4$ and NaOH are added to a sample of water to convert all of the dissolved O_2 to MnO_2, as shown in equation I above. Then H_2SO_4 and KI are added and the reaction represented by equation II proceeds. Finally, the I_2 that is formed is titrated with standard sodium thiosulfate, $Na_2S_2O_3$, according to equation III.

(a) According to the equation above, how many moles of $S_2O_3^{2-}$ are required for analyzing 1.00 mole of O_2 dissolved in water?

(b) A student found that a 50.0-milliliter sample of water required 4.86 milliliters of 0.0112-molar $Na_2S_2O_3$ to reach the equivalence point. Calculate the number of moles of O_2 dissolved in this sample.

(c) How would the results in (b) be affected if some I_2 were lost before the $S_2O_3^{2-}$ was added? Explain.

(d) What volume of dry O_2 measured at 25°C and 1.00 atmosphere of pressure would have to be dissolved in 1.00 liter of pure water in order to prepare a solution of the same concentration as that obtained in (b)?

(e) Name an appropriate indicator for the reaction shown in equation III and describe the change you would observe at the end point of the titration.