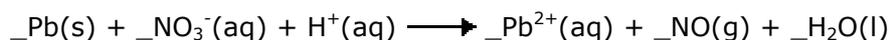## Exercise 8.22 – Half-equations involving hydrogen ions

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Q822-01 When the following oxidation reduction equation is balanced, what is the coefficient for $H^+(aq)$?

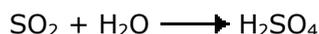$$Ag(s) + NO_3^-(aq) + H^+(aq) \longrightarrow Ag^+(aq) + NO(g) + H_2O(l)$$

    A. 1
    B. 2
    C. 3
    D. 4

Q822-02 What is the coefficient for H+ when the equation below is balanced?

$$\_Pb(s) + \_NO_3^-(aq) + H^+(aq) \longrightarrow \_Pb^{2+}(aq) + \_NO(g) + \_H_2O(l)$$

    A. 2
    B. 4
    C. 6
    D. 8

Q822-03 The unbalanced equation for the conversion of sulphur dioxide to sulphuric acid is given below:

$$SO_2 + H_2O \longrightarrow H_2SO_4$$

Which other species are used and on which side of the equation to balance it?
    A. H^+ and e^- on the left
    B. H^+ on the left and e^- on the right
    C. H^+ on the right and e^- on the left
    D. H^+ and e^- on the right

Q822-04 When the following equation is balanced what is the coefficient for Ce^{4+}?

$$SO_3^{2-} + H_2O + Ce^{4+} \longrightarrow SO_4^{2-} + H^+ + Ce^{3+}$$
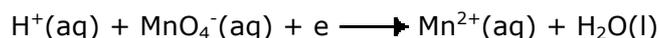
    A. 1
    B. 2
    C. 3
    D. 4

Q822-05 The element M forms an oxyanion MO_3^- that is readily converted into M^{2+} in acid solution. Calculate the oxidation number of M in the MO_3^- ion.
a) State and explain whether $MO_3^- \longrightarrow M^{2+}$ is an oxidation or a reduction process.
b) Write a balanced half equation for this reaction.

**Q822-06** What is the total of all of the coefficients in the balanced half-equation shown below?

$$H^+(aq) + MnO_4^-(aq) + e \longrightarrow Mn^{2+}(aq) + H_2O(l)$$

    A. 19
    B. 17
    C. 14
    D. 12

Q822-07 Iron in food in the form of Fe^{3+} reacts with ascorbic acid (vitamin C) $C_6H_8O_6$ to form dehydroascorbic acid, $C_6H_6O_6$
a) Write an ionic half equation to show the conversion of ascorbic acid to dehydroascorbic acid in aqueous solution.
b) In the other half equation the Fe^{3+}(aq) ions are converted to Fe^{2+}(aq) ions. Deduce the overall equation for the reaction between $C_6H_8O_6$ and Fe^{3+}(aq) ions.

Q822-08 Redox equations may be balanced using changes in oxidation number. For the following redox equation calculate the oxidation number of manganese and carbon. Use these values to balance the equation.

$$MnO_4^-(aq) + C_2O_4^{2-}(aq) + H^+(aq) \longrightarrow Mn^{2+}(aq) + CO_2(g) + H_2O(l)$$
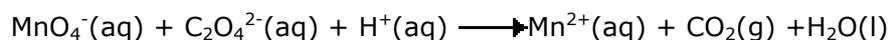
Q822-09 Hydrogen peroxide H_2O_2 can behave as both an oxidising agent and a reducing agent in acidic solution. When it behaves as an oxidising agent it forms hydroxide ions only. Write a balanced half equation for this reaction.

Q822-10 Chlorate ions ClO_3^-, are oxidising agents in acid medium, forming chloride ions in the process. Write the equation for the half-reaction when chlorate ions behave in this way.