Marks
6
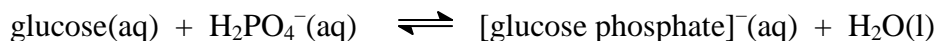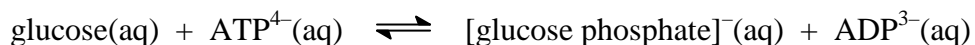
- The first step in the metabolism of glucose in biological systems is the addition of a phosphate group in a dehydration-condensation reaction:

    glucose(aq) + $H_2PO_4^-$(aq) $\rightleftharpoons$ [glucose phosphate]$^-$(aq) + H_2O(l)

The free energy change associated with this reaction is $\Delta G° = 13.8$ kJ mol^{-1}. The reaction is driven forwards by harnessing the free energy associated with the hydrolysis of adenosine triphosphate, ATP^{4-}, to adenosine diphosphate, ADP^{3-} :

    ATP^{4-}(aq) + H_2O(l) $\rightleftharpoons$ ADP^{3-}(aq) + $H_2PO_4^-$(aq)　　　　$\Delta G° = -30.5$ kJ mol^{-1}
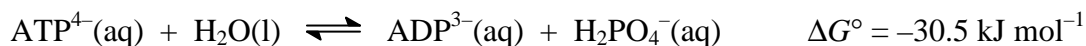
The overall reaction is thus:

    glucose(aq) + ATP^{4-}(aq) $\rightleftharpoons$ [glucose phosphate]$^-$(aq) + ADP^{3-}(aq)

Calculate the equilibrium constant associated with this overall reaction at body temperature (37 °C).

Answer:

This overall equilibrium reaction is investigated by adding 0.0100 mol of ATP^{4-} to a flask containing 175 mL of a 0.0500 M aqueous solution of glucose at 37 °C. What percentage of the ATP^{4-} will have been consumed when the system reaches equilibrium?

Answer: **87%**

Suggest two simple ways of further reducing the remaining percentage of ATP^{4-}.