Answer on Question #63367, Chemistry / General Chemistry

The pH of a 0.0745 M solution of a weak acid is 2.706. What is the Ka of the acid?
What is Keq for the following reaction:
HPO42-(aq) + H3O+(aq) H2PO4-(aq) + H2O(l)
Some possibly useful equilibrium constants are: 0.0070, 6.3E-8, and 4.8E-13, for the Ka1, Ka2, and Ka3 of phosphoric acid.

Solution:

$[H+] = 10^{-2.706} = 0.001968$ M
HA <----> $H^+ + A^-$
[H+] = [HA] = 0.001968 M
[HA] = 0.0745 - 0.001968 = 0.073 M
$Ka = (0.001968)^2 / 0.073 = 5.30 \times 10^{-5}$

HPO_4^{2-} => H^+ & PO_4^{3-}
$K_{a3} = [H^+] [PO_4^{3-}] / [HPO_4^{2-}]$
Whose $K_{a3} = 4.8\ 10^{-13}$
The reverse of the ionization of water
$Kw = [H_2O] / [H^{+}] [OH^-]$
Whose $Kw = 1\ 10^{-14}$
So
$Keq = K_{a3} / Kw$
$Keq = 4.8\ 10^{-13} / 1\ 10^{-14}$
Keq = 48

Answer: 5.30×10^{-5} and 48