HW 4

1) $K_a \approx 10^6$ $pK_a = -\log(K_a)$

$pH = pK_a + \log\left(\dfrac{[A^-]}{[HA]}\right)$ $\therefore \dfrac{[A^-]}{[HA]} = 10^{(pH-pK_a)}$

$\therefore$ @ pH 0 : $\dfrac{[Cl^-]}{[HCl]} = 10^{(0+6)} = \boxed{10^6}$

@ pH 14 : $\dfrac{[Cl^-]}{[HCl]} = 10^{(14+6)} = \boxed{10^{20}}$

HCl is a strong acid because it dissociates completely in solution.

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2) $pH = -\log[H^+]$ $\therefore$ @ pH 6.5 : $[H^+] = 10^{-6.5} \dfrac{mol}{L}$

@ pH 6 : $[H^+] = 10^{-6} \dfrac{mol}{L}$

$\therefore (1L + x) \cdot 10^{-6} - 1L \cdot 10^{-6.5} = 1 \cdot x$

$\rightarrow x = \dfrac{-10^{-6} + 10^{-6.5}}{10^{-6} - 1} = \boxed{6.84 \times 10^{-7} \, L}$

$K_a = 10^{-pK_a} = 10^{-5.5}$

	HA	H+	A-
i	1M	0	0
c	-x	+x	+x
e	1-x	x	x

$K_a = \dfrac{x^2}{1-x} \rightarrow x^2 + x K_a - K_a = 0$

$\rightarrow x = \dfrac{-K_a + \sqrt{K_a^2 + 4 \cdot K_a}}{2} = 1.78 \times 10^{-3} \, M$

$\therefore \boxed{[HA] = 0.998 \, M}$

Hw 4

3) for spores! $k_d = \alpha \exp(E/RT)$

$\alpha = 10^{36} \frac{1}{min}$, $E = 65 \frac{kcal}{mol}$, $R = 1.987 \frac{kcal}{k \cdot mol}$

$\therefore k_{d_{spore}} = 1 \times 10^{36} \frac{1}{min}$

→ using chart: $N_0 = 10^6$ $\therefore k_d t = 21$

→ $t = 2.1 \times 10^{-35}$ min

$X_{vit} = X_0 e^{-k_{d vit} t}$ $k_{d_{vit}} = \alpha \exp(-E/RT)$

$\alpha_{vit} = 10^4$ $E = 10$

$\therefore k_d = 9.9999 \times 10^3 \frac{1}{min}$

$\therefore X = 2.27 \times 10^7 \frac{mg}{in \ 10}$

$X = 30 \exp^{-9.99 \times 10^3 \cdot 2.1 \times 10^{-35}} \cdot 10 = 300 \ mg$ in 10 L

$X = 3.00 \times 10^5 \ mg$ in 10 000 L

HW 4

4) $\mu_{max} = \dfrac{\Delta \ln(x)}{\Delta t} \longrightarrow$ slope of plot of $\ln(x)$ vs t

attached is a spreadsheet with my work

$$\boxed{\mu_{max} = 0.685 \,\tfrac{1}{hr}}$$

$$Y_{x/s} = \dfrac{\Delta x}{\Delta s} = \dfrac{6.5 - 0.305}{100 - 0.5} \boxed{= 0.062}$$

$$X_{max} = X_0 + Y_{x/s} \cdot S_{total}$$

$$= 0.305 + 0.062 \cdot (50 - 0.5) \boxed{= 3.39 \,\tfrac{g}{L}}$$

	time (hr	x (g/l	s (g/l	ln x		slope	y	xmax (g/L)
1								
2	0	0.305	100	-1.1874435			0.062261	3.386935
3	2	1.2	95	0.182321557		0.684883		
4	4.00E+00	2.2	8.50E+01	0.78845736		0.303068		
5	8	4.4	58	1.481604541		0.173287		
6	10	5.2	30	1.648658626		0.083527		
7	12	5.7	15	1.740466175		0.045904		
8	14	6.15	5	1.816452082		0.037993		
9	16	6.19	2	1.822935087		0.003242		
10	18	6.5	0.5	1.871802177		0.024434		
11								
12								
13						max mu		
14						0.684883		

Growth Rate