① 3-5 $H = 5.5e\text{-}3 \frac{atm\ m^3}{mol}$ benzene = "A"

Convert to dimensionless: From units on H:

$p_A = H C_A$ → convert to $y_A = H x_A$?

or $C_{A,G} = H C_{A,L}$?

$y_A = H x_A$? identities:

$\frac{mol\ A}{mol\ air}$ — $y_A = p_A / P$ — total pressure

$\frac{mol\ A}{mol\ H_2O}$ — $x_A = C_A / C$ — $\frac{mol\ A / vol\ H_2O}{mol\ H_2O / vol\ H_2O}$

$y_A P = H x_A C \Rightarrow y_A = \left(\frac{Hc}{P}\right) x_A$

"dimensionless H"

$\frac{Hc}{P} = 5.5e\text{-}3 \frac{atm\ m^3}{mol} \frac{C}{P}$ — molar density of H_2O = 55,556 mol/m³

P: 1 atm

$= 5.5e\text{-}3 \frac{atm\ m^3}{mol} \frac{55{,}556\ mol}{m^3} \frac{1}{1\ atm}$

$= 305.6$

So $y_A = 305.6\ x_A$

$C_{A,G} = H C_{A,L}$? $p_A = H C_{A,L}$ $p_A V = n_A RT$

$\frac{p_A}{RT} = \frac{H}{RT} C_{A,L}$ $\frac{n_A}{V} = C_{A,G} = \frac{p_A}{RT}$

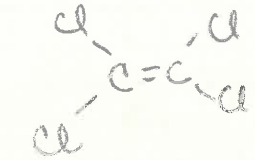
$C_{A,G} = \left(\frac{H}{RT}\right) C_{A,L}$

"dimensionless H"

$\frac{H}{RT} = \frac{5.5e\text{-}3\ atm\ m^3\ mol \cdot K\ 10^3 K}{0.0821\ K \cdot atm\ mol\ m^3\ 298 K}$

$= 0.225$

So $C_{A,G} = 0.225\ C_{A,L}$

(2) a)  C_2Cl_4

b) $MW = 165.82$
$Sol = 150$ mg/L
$P_{vap} = 60$ mm Hg
$H = \exp(12.5 - \frac{4920}{298})$
$= 0.018$ atm·m³/mol
$K_{oc} = 364$ mL/g mL H_2O/g O.C.
$\log K_{ow} = 2.6$
$BCF = 31.4$ L/kg L H_2O/kg biota

c) i) $P_A = HC_A$
$= 0.018 \frac{atm \cdot m^3}{mol} \; 58 \frac{mg}{L} \; \frac{mol}{165.82 g}$
$\times \frac{10^3 L}{m^3} \; \frac{g}{10^3 mg} = 6.34 \times 10^{-3}$ atm or 4.8 mm Hg

ii) $\frac{58}{150} \times 100 = 38.7\%$

iii) $K_{ow} = 10^{2.6} = 398 \gg 10 \Rightarrow$ prefers organic phase

iv) $f_{oc} = 0.12$ $\quad K_p = K_{oc} f_{oc} = 364 \frac{mL}{g} \; 0.12 = 44.1 \frac{mL}{g}$

$C_S = K_p C_w = 44.1 \frac{mL \; H_2O}{g \; soil} \; \frac{58 \; mg \; PCE}{L \; H_2O} \; \frac{L}{10^3 mL} \; \frac{10^3 g}{kg}$

$= 2556 \frac{mg \; PCE}{kg \; soil} = 2556$ ppm

(3)

50 mL octanol what is C_{oct} & C_w?
50 mL H_2O
0.2 g DDT

$\log K_{ow} = 6.19$

$K_{ow} = 1.55e6 = \frac{C_{oct}}{C_w} \Rightarrow C_{oct} = 1.55e6\, C_w$

$\frac{mg\ DDT}{L\ H_2O}$ $\frac{mg\ DDT}{L\ H_2O}$

Mass Balance on DDT

total mass DDT = mass DDT in Oct + mass DDT in H_2O

$0.2g = C_{oct}\ 50\,mL\ oct + C_w\ 50\,mL\ H_2O$

$0.2g = 1.55e6\, C_w\ 50\,mL\ oct + C_w\ 50\,mL\ H_2O$

$= 7.744e7\, C_w \frac{mL}{} \frac{L}{10^3 mL} + 50\, C_w \frac{mL}{} \frac{L}{10^3 mL}$

$= 7.744e4\, C_w(L) + 0.05\, C_w(L)$

$200\,mg = 7.744e4\, C_w \frac{mg\ DDT}{L\ H_2O}(L)$

$C_w = 0.0026\ mg/L$

$C_{oct} = 4003.1\ mg/L$

— other way...

$200\,mg = C_{oct}\ 50\,mL\ oct + 6.452e{-}7\, C_{oct}\ 50\,mL\ H_2O$

$= 0.05\, C_{oct}$

$C_{oct} = 4000\ mg/L$

$C_w = 0.0026\ mg/L$

(4)

$1000 m^3$ Lake
1000 fish
1 g DDT

1 fish = $100 cm^3$, 5% lipids

What is C_{tissue} in fatty tissue?

$$BCF = 54000 \frac{L}{kg} = \frac{C_{tissue}}{C_w} \quad \frac{mg\ DDT/kg\ tissue}{mg\ DDT/L\ H_2O}$$

Mass Balance on DDT

total mass DDT = mass DDT in lake H_2O + mass DDT in fish fatty tissue

$$1\ g = 1000 m^3 C_w \frac{10^3 L}{m^3} + (1000\ fish)\frac{100 cm^3}{fish}\frac{1\ g}{cm^3} C_{tissue} \times \frac{5\ kg\ tissue}{100\ kg\ fish}\frac{kg}{10^3 g}$$

$$1000\ mg = 10^6 L\, C_w + 5 (54000 C_w)$$

C_w in $\frac{mg}{L}$; $\frac{kg\ tissue}{kg} \cdot \frac{L}{kg}$

$$C_w = 0.000787\ mg/L$$

$$C_{tissue} = 42.5 \frac{mg\ DDT}{kg\ fat\ tissue}$$