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1. distribution coefficient, $K_d = 200$

↳ analogous to octanol-water partitioning coef.

$$K_d = \frac{\text{conc. iodine in } C_6H_{11}OH}{\text{conc. iodine in water}}$$

$$200 = \frac{375}{C_{i,w}}$$

$$C_{i,w} = 1.875 \text{ g/m}^3$$

2. partitioning coefs are temperature dependant.

from tables:

T (°C)	K_{H,O_2}
5	0.000033 atm^{-1}
25	0.0000272 atm^{-1}

assume → $P_{atm} = 1 atm$ i.e. total pressure

→ 20.9% O_2 by volume

Henry's law:

$$K_H' = \frac{[C_{i,w}]}{P_i} \rightarrow [C_{i,w}] = K_H' P_i$$

∴ we need to calculate K_H' and P_i

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K_H': @ 5°C → $K_{H,O_2}' = 55.6(0.000033) = 0.00183$ mol L^{-1} atm^{-1}

@ 25°C → $K_{H,O_2}' = 55.6(0.0000222) = 0.00124$ mol L^{-1} atm^{-1}

P_O: mole fraction, given 20.9% mol. or vol. fraction in gas phase

$$x_i = \frac{P_i}{P_{tot}} \rightarrow P_{O_2} = x_{O_2} P_{tot}$$

$$P_{O_2} = (0.209)(1\ atm)$$

$$P_{O_2} = 0.209\ atm$$

$$[C_{O_2,w}] = K_H' P_{O_2}$$

∴ @ 5°C $[C_{O_2,w}] = (0.00183)(0.209) = 0.000382 \frac{mol}{L}$

$$C_{O_2,w} = 0.000382 \frac{mol}{L} \times 32 \frac{g}{mol} \times 1000 \frac{mg}{g} = \underline{12.24\ mg/L}$$

∴ @ 25°C $[C_{O_2,w}] = (0.00124)(0.209) = 0.000259 \frac{mol}{L}$

$$C_{O_2,w} = 0.000259 \frac{mol}{L} \times 32 \frac{g}{mol} \times 1000 \frac{mg}{g} = \underline{8.25\ mg/L}$$

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3. from tables: Aroclor 1254 → $P_v = 7.71 \times 10^{-5}$ mm Hg @ 20°C

→ $S = 1.2 \times 10^{-2}$ mg/L

→ MW = 326.5 g/mol

• assume P_v @ 17°C = P_v @ 20°C

$C_g = \frac{P_v \cdot gmw}{RT}$, note T has units in Kelvin

→ generally, this is $C_g = \frac{P_i \cdot gmw}{RT}$, where P_i is partial pressure of gas

→ the partial pressure of i over a pure liquid of i is $P_i = P_v$

→ however, the partial pressure of i over a mixture of i and something else is $P_i = X_i P^v$, where X_i is the mole fraction of i in the liquid.

↳ this question concerns a mixture of PCB (Aroclor 1254) and water, so we need to find X_i.

aside $P_v V = nRT$

$P_v V = \frac{mass}{gmw} RT$

$P_v \cdot gmw = \frac{mass}{V} RT$

$P_v \cdot gmw = C_g RT$

$\therefore C_g = \frac{P_v \cdot gmw}{RT}$

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determine X_i (i.e. X_{PCB})

- assume 1L of solution

$$n_{H_2O} = 1L \times 1\frac{kg}{L} \times 1000\frac{g}{kg} \times \frac{mol}{18g} = 55.6\ mol$$

$$n_{PCB} = 1L \times 1.2\times10^{-2}\frac{mg}{L} \times \frac{1g}{1000\ mg} \times \frac{mol}{326.5\ g} = 3.7\times10^{-8}\ mol$$

$$X_{PCB} = \frac{n_{PCB}}{n_{PCB} + n_{H_2O}} = \frac{(3.7\times10^{-8})}{(3.7\times10^{-8}) + (55.6)} = 6.7\times10^{-10}$$

- convert P_v from mm H_g to atm

$$P_v = 7.71\times10^{-5}\ mm\ H_g \times \frac{1\ atm}{760\ mm\ H_g} = 1.01\times10^{-7}\ atm$$

- convert T from °C to °K

$$T = 17° + 273° = 290°K$$

$$C_g = \frac{P_v \cdot gmw}{RT} \quad \text{pure phase liquid}$$

$$\therefore C_g = \frac{X_{PCB}\, P_{v,PCB} \cdot gmw}{RT} \quad \text{mixture (i.e. PCB \& } H_2O\text{)}$$

$$C_g = \frac{(6.7\times10^{-10})(1.01\times10^{-7})(326.5)}{(0.082)(290)}$$

$$C_g = 9.3\times10^{-16}\ g/L$$

$$C_g = 9.3\times10^{-16}\frac{g}{L} \times 1000\frac{mg}{g} = \underline{\underline{9.3\times10^{-13}\ mg/L}}$$

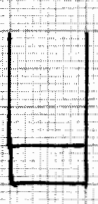
4. $P_{v,A} = 100 \text{ mm } Hg$

$P_{v,B} = 60 \text{ mm } Hg$

$$C_g = \frac{P_v \cdot gmw}{RT}$$

∴ under the same conditions, liquid A poses a greater health risk (since it has a greater P_v).

5. a)



- for this case, a pure phase liquid (i.e. $C_2H_2Cl_4$) is in contact with a gas phase and thus, the partial pressure is equal to the vapor pressure.

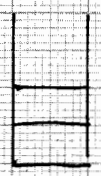
$$C_g = \frac{P_v \cdot gmw}{RT} \qquad T = 20°C \rightarrow 293°K$$

$$C_g = \frac{(0.00658)(167.85)}{(0.082)(293)}$$

$$C_g = 0.04597 \frac{g}{L}$$

$$C_g = 0.04597 \frac{g}{L} \times 1000 \frac{mg}{g} = \underline{45.97 \text{ mg/L}}$$

5.6)



- step 1: water in contact with pure phase liquid will have a concentration of $C_2H_2Cl_4$ equal to the of this compound in water.
- step 2: partioning between the air phase concentration and water is given by Henry's Law.

→ step 1: under equilibrium conditions $C_w = 2900$ mg/L

→ step 2: · choose appropriate form of Henry's Law

$$H = \frac{C_g}{C_w} \rightarrow C_g = H C_w$$

· Henry's constant given as $K_H' = 2.63 \frac{mol}{L\,atm}$

$$H = \frac{1}{RTK_H'} \quad \text{(p. 4-12 course notes)}$$

$$H = \frac{1}{(0.082)(293)(2.63)}$$

$$H = 0.0158 \quad \text{(unitless)}$$

$\therefore C_g = H C_w$

$C_g = (0.0158)(2900)$

$C_g = 45.82$ mg/L

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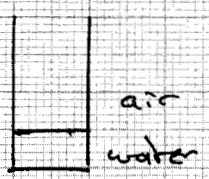
5. c)



drinking water standard, $C_w = 0.17 \mu g/L$

$$C_w = 0.17 \frac{\mu g}{L} \times \frac{mg}{1000 \mu g} = 0.00017$$

$\therefore C_g = H C_w$

$C_g = (0.0158)(0.00017)$

$C_g = 2.69 \times 10^{-6} \, mg/L$