1. Given: Soil contamination by Cd, carcinogen $SF = 6.10 \left(\frac{mg}{kg\,d}\right)^{-1}$
$CA = 5.4 \times 10^{-4} \frac{mg}{m^3}$ in off-site air

Find: [A] CInh for offsite resident children 1-6 yrs & adults
[B] Find cancer risks due to these CInh values

[A] $CInh = \frac{(CA)(IR)(RR)(ABS_s)(ET)(EF)(ED)}{(BW)(AT)}$

$CA = 5.4 \times 10^{-4}$ mg/m³
$IR = 0.25$ m³/hr (Child, 1-6) 0.83 m³/hr (adult)
$RR = 100\% = 1$
$ABS_s = 100\% = 1$
$EF = 365$ d/yr
$ED = 5$ yr (Child 1-6) 58 yr (adult)
$ET = 12$ hr/d
$BW = 16$ kg (Child, 1-6) 70 kg (adult)
$AT = 70$ yr

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Child 1-6

$$CInh_{1-6} = \frac{\left(5.4\times10^{-4}\frac{mg}{m^3}\right)\left(0.25\frac{m^3}{hr}\right)(1)(1)\left(12\frac{hr}{d}\right)(5\,yr)\left(365\frac{d}{yr}\right)}{(16\,kg)(70\,yr)\left(365\frac{d}{yr}\right)}$$

$$= 7.2\times10^{-6}\ \frac{mg}{kg\,d}$$

Adult

$$CInh_{adult} = \frac{\left(5.4\times10^{-4}\frac{mg}{m^3}\right)\left(0.83\frac{m^3}{hr}\right)(1)(1)\left(12\frac{hr}{d}\right)(58\,yr)\left(365\frac{d}{yr}\right)}{(70\,kg)(70\,yr)\left(365\frac{d}{yr}\right)}$$

$$= 6.4\times10^{-5}\ \frac{mg}{kg\,d}$$

[B] $CR = (SF)(CInh)$

Child 1-6

$$CR_{1-6} = 6.10\left(\frac{mg}{kg\,d}\right)^{-1}\left(7.2\times10^{-6}\frac{mg}{kg\,d}\right)$$

$$= 4.4\times10^{-5}$$

b

$$CR_{adult} = 6.10\left(\frac{mg}{kg\,d}\right)^{-1}\left(6.4\times10^{-5}\frac{mg}{kg\,d}\right)$$

$$= 3.9\times10^{-4}$$

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2] Given: Off-site Pb, non-cancer effects. $RfD = 6.9 \times 10^{-4} \frac{mg}{kg\,d}$
Dermal exposures
$CS = 260\ mg/kg$ in soil absorption factor 10% child$_{1-6}$, 5% adult

Find: [A] NCDEX for off-site resident: Child$_{1-6}$, adults
[B] Find HQ for each

[A] $$NCDEX_{1-6} = \frac{(CS)(CF)(SA)(AF)(ABS_d)(SM)(EF)(ED)}{(BW)(AT)}$$

$CS = 260 \frac{mg}{kg\,soil}$
$CF = 1 \times 10^{-6} \frac{kg}{mg}$
$SA = 6980\ cm^2$ (Child$_{1-6}$) 18150 cm^2 (adult)
$AT = 20$ yrs (Child$_{1-6}$) 10 yrs (adult)
$AF = 12.75\ mg/cm^2$
$ABS_d = 10\%$ (Child$_{1-6}$) 5% (adult)
$SM = 0.15$
$EF = 330\ d/yr$
$ED = 5$ yr (Child$_{1-6}$) 58 yr (adult)
$BW = 16$ kg (Child$_{1-6}$) 70 kg (adult)
$AT = 5$ yr (Child$_{1-6}$) 58 yr (adult)

Child$_{1-6}$

$$NCDEX_{1-6} = \frac{(260 \frac{mg}{kg\,soil})(10^{-6})(6980\ cm^2)(0.20)(0.75 \frac{mg}{cm^2})(0.10)(0.15)(330\ d/yr)(5\ yr)}{(16\ kg)(5\ yr)(365\ d/yr)}$$

$$= 2.3 \times 10^{-4} \frac{mg}{kg\,d}$$

Adult

$$NCDEX_{adult} = \frac{(260 \frac{mg}{kg})(10^{-6})(18150 \frac{cm^2}{d})(0.10)(0.75 \frac{mg}{cm^2})(0.05)(0.15)(330\ d/yr)(58\ yr)}{(70\ kg)(58\ yr)(365\ d/yr)}$$

$$= 3.4 \times 10^{-5} \frac{mg}{kg\,d}$$

[B] $$HQ = \frac{E}{RfD}$$

$$HQ_{1-6} = \frac{2.3 \times 10^{-4} \frac{mg}{kg\,d}}{6.9 \times 10^{-4} \frac{mg}{kg\,d}} = 0.33$$

$$HQ_{adult} = \frac{3.4 \times 10^{-5} \frac{mg}{kg\,d}}{6.9 \times 10^{-4} \frac{mg}{kg\,d}} = 0.049$$

3 Given: Contaminated groundwater $CW_{Mn} = 0.36\ mg/L$ $RfD_{Mn} = 0.10\ mg/kg\cdot d$
Children 6-12 drink 1 L/d, Adults 2 L/d

Find: [A] $NCIng_{6-12}$ & $NCIng_{adult}$
[B] HQ for each

[A] $$NCIng = \frac{(CW)(IR)(FI)(ABS_g)(EF)(ED)}{(BW)(AT)}$$

$CW = 0.36\ mg/L$
$IR = 1\ L/d$ (Child$_{6-12}$) $2\ L/d$ (adult)
$FI = 1.0$
$ABS_g = 1.0$
$EF = 365\ d/yr$
$ED = 6\ yr$ (Child$_{6-12}$) $58\ yr$ (adult)
$BW = 29\ kg$ (Child$_{6-12}$) $70\ kg$ (adult)

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Child$_{6-12}$

$$NCIng_{6-12} = \frac{\left(0.36\ \frac{mg}{L}\right)(1\ L/d)(1)(1)(365\ d/yr)(6\ yr)}{(29\ kg)(6\ yr)(365\ d/yr)}$$

$$NCIng_{6-12} = 1.2\times10^{-2}\ \frac{mg}{kg\cdot d}$$

Adult

$$NCIng_{adult} = \frac{(0.36\ mg/L)(2\ L/d)(1)(1)(365\ d/yr)(58\ yr)}{(70\ kg)(58\ yr)(365\ d/yr)}$$

$$NCIng_{adult} = 1.0\times10^{-2}\ \frac{mg}{kg\cdot d}$$

[B] $$HQ = \frac{E}{RfD}$$

Child$_{6-12}$

$$HQ_{6-12} = \frac{1.2\times10^{-2}\ \frac{mg}{kg\cdot d}}{0.10\ \frac{mg}{kg\cdot d}}$$

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$$HQ_{6-12} = 0.12$$

Adult

$$HQ_{adult} = \frac{1.0\times10^{-2}\ \frac{mg}{kg\cdot d}}{0.1\ mg/kg\cdot d}$$

$$HQ_{adult} = 0.10$$

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#4 Given: Animal exposure test for drinking water concentration of non-carcinogen. Rats. Non-zero threshold.

Control Group
100 rats, 3 w/liver disease
sacrificed @ 18 mo

Test Group
Lowest observed effect 140 mg/L, 30 mL/d, expose 12 mo
Sacrificed at 18 mo
Adult weight = 0.4 kg
100 rats, 12 w/liver disease

Find: [A] LOAEL for rats
[B] RfD for humans - subchronic animal data, no human
[C] Convert RfD to acceptable DWEL

[A] $NC\text{Ing}_{mat} = \frac{(CW)(IR)(FI)(ABS_G)(EF)(ED)}{(BW)(AT)} = LOAEL$

$CW = 140\ mg/L$
$IR = 30\ mL/d = 0.030\ L/d$
$FI = 1$
$ABS_G = 1$
$EF = 365\ d/yr$
$ED = 1\ yr$
$BW = 0.4\ kg$
$AT = 1\ yr$

$$NC\text{Ing} = LOAEL = \frac{(140\ mg/L)(0.030\ L/d)(1)(1)(365\ d/yr)(1\ yr)}{(0.4\ kg)(365\ d/yr)(1\ yr)}$$

$$LOAEL = 10.5\ \frac{mg}{kg\cdot d}$$

[B] $RfD = \frac{LOAEL}{(UF)(MF)}$

$UF = (10H)(10A)(10S)(10L) = 10^4$ $\quad MF = 1$

$$RfD = \frac{10.5\ \frac{mg}{kg\cdot d}}{(10^4)(1)}$$

$$RfD = 1.05\times10^{-3}\ \frac{mg}{kg\cdot d}$$

[C] $DWEL = \frac{(RfD)(BW)}{(IR)} = \frac{(1.05\times10^{-3}\ \frac{mg}{kg\cdot d})(70\ kg)}{(2\ L/d)}$

$$DWEL = 0.037\ \frac{mg}{L}$$