FINAL EXAM 2012

ENGR 202

**PROBLEM #1:** Define or explain the following terminology

-- **CAA:** Clean Air Act

-- **TDS:** Total Dissolved Solid

-- **NOAEL:** No Observable Adverse Effects Level

-- **IPCC:** Intergovernmental Panel on Climate Change

-- **MCL:** Maximum Contaminant Level

**PROBLEM #2:**

a) Name two major contaminants for ground waters and their sources?

- Petroleum compounds (organic chemicals)- Leaking underground storage tanks LUST
- Nitrates - Agricultural fertilizers

b) Give two benefits of designing a product to fit into a life cycle?

- It minimizes adverse impacts of wastes.
- It reduces the use of natural resources to make new products.

(raw materials)

**PROBLEM #3:**

a) What is a pathogen?

(1) Are disease-causing agents such as bacteria, viruses, protozoa and parasitic worms. (2) These microorganisms are commonly found in the intestines of infected people or animals, and they are excreted in the feces that enter sewer systems or fall onto the ground. (3) The can cause human illnesses such as typhoid, cholera, diarrhea, gastrointestinal, respiratory, and skin diseases.

b) Define MCL for drinking water

**Maximum contaminant level (MCL).** An MCL of 1 mg/L is equivalent to one unit of contaminant per million units of water on a mass basis.

**PROBLEM #4:** Among the many toxic metals the quantitative analysis on mercury is one of the most widely studied. Give me some reasons why mercury has received attention in scientific studies?

Mercury can damage the central nervous system and the brain. Exposure to any of these metals can be fatal at sufficiently high levels. Mercury bio accumulates in the blood. Mercury tends to bioaccumulate in tissues of fish and other organisms. Humans can then be affected through the consumption of fish.

**PROBLEM #5:**

a) What is the difference between Potency Factor and Chronic Daily Intake for a carcinogenic chemical?

PF & CDI

The potency factor represents the incremental lifetime cancer risk corresponding to a chronic daily intake of 1mg/kg-da of a particular chemical.

Chronic daily intake (CDI) is the average daily dose of a chemical over the lifetime of an individual.

b) Explain some of the uncertainties in assessing risk for non-carcinogens?

**The reference dose** is a key parameter used in risk assessments to characterize the safe dose of a noncarcinogenic chemical.

**Hazard quotient (HQ)** is the metric used in risk assessments to compare an actual dose of a chemical to the reference dose. Is defined as the ratio of the average daily dose (ADD) of a chemical divided by the reference dose.

**PROBLEM #6**

a) What are the 3 major factors affecting increase in $CO_2$ emissions?

- Population Growth

**PROBLEM #8**

CDI = 3 ug/da

The chronic daily intake of a carcinogenic chemical is equal to the value of 3 ug/da from the oral total dose and 16 ug/da for the adult male weighting 70 kg. Using the potency factor values from table 14.3, find his incremental lifetime cancer risk if the chemical of concern is a) arsenic, b) Trichloroethylene (TCE). How do these risks compare to the EPA guideline of $1 \times 10^{-6}$ ? Give your answers as a ratio of multiple (such as 150 times greater, or smaller, than $10^{-6}$ )

$PF = 1.5 \times 3 \times 10^{-3}$

① CDI x PF =

② CDI x PF =

Incremental life time risk = CDI X PF

$3 \times 10^{-3} \times 1.5$

$4.5 \times 10^{-3}$

4500

33 : 1

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**PROBLEM #9**

A well has 2.0 mg/L of zinc, 2.5 mg/L formaldehyde and 70 ug/L of chloroform. Would there be any concern about carcinogenic health effects of using this water for drinking purposes?

zinc $\frac{2\,(2)}{70} = \frac{0.057}{3\times10^{-1}} = 0.19$ ADD's / HQ's

formaldehyde $\frac{2.5\,(2)}{70} = \frac{0.071}{0.2} = 0.355$

chloroform $\frac{(70\times10^{-3})\,(2)}{70} = \frac{2\times10^{-3}}{1\times10^{-2}} = 0.2$

$\longrightarrow HI = \Sigma HQ's$

$HI = 0.745$

Less than 1 is good.

200 mg × 1 Kg / 1000 g = 604 CDI =

**PROBLEM #10**

A contaminated site has 100 mg/kg of chloroform. Is the cancer risk low enough for the site to be used as a playground for children according to the EPA guideline of $1x10^{-6}$ ? Assume that a child would use it 4 hours/day, 350 days/year for 12 years.

$3.654 \times 10^{-5}$

$\frac{200}{1000}$

CDI → $\frac{100\text{mg} \times .2 \times 10^{-4}}{15}$ × $\frac{4 \times 350 \times 12}{24 \times 365 \times 70}$ = 0.088

$1.33 \times 10^{-3}$ ×

→ Incremental = CDI × PF

$= \frac{0.088}{3.6 \times 10^{-5}} \times \boxed{.0081} = \frac{2.196 \times 10^{-7}}{\text{EPA } 1 \times 10^{-6}}$

table PF

$\frac{.000219}{.000001}$

0.199 : 1

0.222

he can play

**PROBLEM #11**

a) What are the 3 key factors that influence the environmental change?

- Housing and industrial development
- Agriculture
- Emissions of chemical substances to land, air and water

b) The population of a city is currently 1 million people. Using a constant annual growth rate, what is the percent increase in population after 10 years with an annual growth rate of 5 percent?

Po= 1,000,000

r= 0.05

t= 10 years

$P= Po\ (1+r)^t$

$P= 1{,}000{,}000\ (1 + 0.05)^{10}$

P=1,628,894.63

**BONUS**

a) What is "bad ozone" and its source?

Air pollutant ozone found at ground level. **Sources:** Automobiles, power plants, factories.

b) What is eutrophication and what is its cause?

Eutrophication is the over-enrichment of water by nutrients such as nitrogen and phosphorus in lakes, rivers and streams.

Cause