Problem 3 (6 marks)
Current city has the population of 1,000,000, and collects 8×10^8 kg (80,000 tons) of MSW each year. Assume projected population growth rate as 3 %/yr over next 15 yrs. Also, assume constant waste production per capita. What will be the total additional waste generated 15 yrs from now?
Use the constant annual growth model: $P = P_o(1 + r)^t$

ANS:

...as below:

Problem 11 (2.25 marks).
Name 3 key drivers (or factors) of environmental change. (0.75 x3)
ANS:

(a)_____

(b)_____

(c)_____

Problem 12 (2.25 marks).
Name 3 main factors that determine the rate of technology adoption. (0.75 x 3)
ANS:

(a)_____

(b)_____

(c)_____

...ropriate spaces below:

Problem 4 (2 marks (=0.5 x 4)).
Trace metals with elevated concentrations may be toxic. Name the metal for following toxic effects.
ANS:
(i) Impaire functions of kidney: _____
(ii) Respiratory cancer and skin disease: _____
(iii) Damage nervous system and the brain: _____
(iv) Leaning and behavior disorder and motor coordination problem: _____

Problem 5 (3 marks).
(i) List pollutants associated with so-called "photochemical smog" (1 mark).
(ii) Briegly describe the formation of photochemical smog (1 mark).
(iii) name the phenomenon that traps the photochemical smog close to the ground (1 mark).
ANS
(i) _____
(ii) _____
_____
_____
(iii) _____

Problem 6 (4 marks).
(i) List 4 major pollutants from fuel power plant (e.g. coal)) (0.5 x 4);
(ii) also name the main environmental concern associated with each pollutant (0.5 x 4).
ANS:

Major pollutants	**Environmental concern**
(i)	
(ii)	
(iii)	
(iv)	

Problem 2. (8 marks)
Human subjects are involved in a medical study to represent certain segments of the population in terms of blood lead concentration, PbB. First, assume the normal distribution properly represents the population of children with the mean concentration of 22.5 μg/dl and the standard deviation σ of 5.8 μg/dl. Then, determine the range of PbB values (minimum and maximum) that should be used for the middle quarter (25 %) of the population, centered about the mean. Use the cumulative standard normal distribution table

ANS:

...spaces below:

PART A. THEORY (30 marks)

Problem 1 (3 marks (= 0.5 mark x 6)). What do the following abbreviations stand for? Define or explain them.

i) TSS:

ii) TDS:

iii) CEPA:

iv) MSW:

v) BOD:

vi) COD:

Problem 2 (2 marks).
(i) Briefly define " **Atmospheric window**" (1 mark).
(ii) CO2 emissions from energy use are the primary contributor of global warming. We have discussed the four key factors to determine CO_2 emissions at national level. List **...of the factors** (or terms) that are most closely related to **technology and ...echnological change** (1 mark (=0.5 +0.5)).

ANS:
i) Atmospheric window:

ii) 2 factors are: _____

and _____

Problem 3 (1.5 marks).
List **3 major steps** in **LCA**.

ANS:
Step 1: _____

Step 2: _____

Step 3: _____

ART B. CALCULATION PROBLEMS (20 marks)

Problem 1 (6 marks).
Assume that by 2015 the fraction of electricity generated from renewable energy sources will have increased to 20 %, with market share growth rate of 1.7 percent per year. If the market penetration of renewable technologies subsequently follows the following growth model, and a 50 % share is reached in 2050, in which year would the market share reach 95%? Assume P_{max} is 100 %.

$$P(t) = \frac{P_{max}}{1 + e^{-r(t-t_m)}} \qquad r = \frac{r_o}{1 - \frac{P_o}{P_{max}}}$$

ANS:

Problem 9 (3 marks).
(i)Describe or explain sources of uncertainties in assesing environmental risks for noncarcenogens (2 marks).
(ii) Also, explain how to deal with the uncertainties (1.0 mark)

ANS:
(i)

(ii)

Problem 10. (2.0 marks)
(i) Name (or provide mathematical representation of) the population growth model that follows the population growth of living organisms like bacteria (1 mark).
(ii)Human population growth pattern does not quite follow the model. Briefly explain the reason (1 mark).

ANS:
(i)

(ii)

Problem 9 (3 marks).
(i)Describe or explain sources of uncertainties in assesing environmental risks for noncarcenogens (2 marks).
(ii) Also, explain how to deal with the uncertainties (1.0 mark)

ANS:

(i)

(ii)

Problem 10. (2.0 marks)
(i) Name (or provide mathematical representation of) the population growth model that follows the population growth of living organisms like bacteria (1 mark).
(ii)Human population growth pattern does not quite follow the model. Briefly explain the reason (1 mark).

ANS:

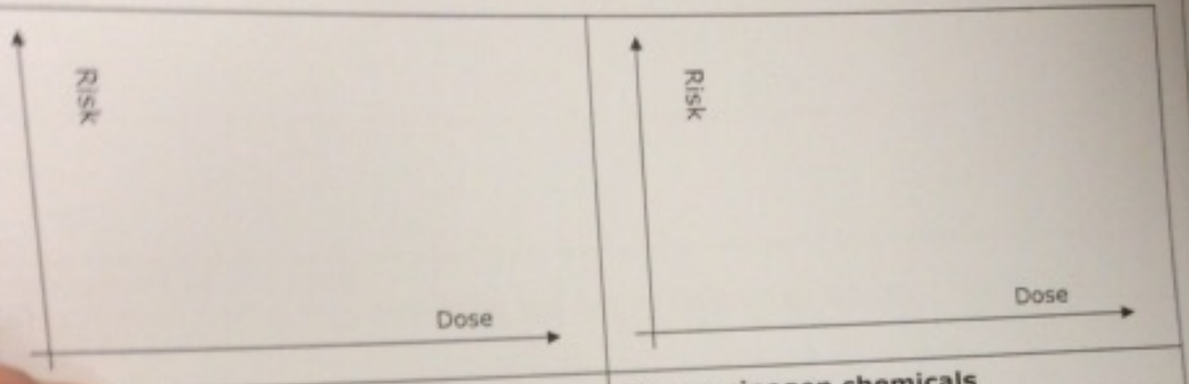
(i)

ii)

... appropriate spaces below:

Problem 7. (3 marks)
(i) Roughtly draw **typical dose response relationship graphs** for **carcinogenic** chemical and **noncarcenogenic** chemicals (2 makrs).
(ii) state the key assumption for each dose-response relationships (0.5 x 2 marks).

ANS:
(i)



...ogen chemicals | **Noncarcinogen chemicals**

...sumptions
Carcinogenic chemicals:

Non-carcinogenic chemicals:

Problem 8 (2 marks).
List 4 steps (or elements) of the risk assessment defined in 1983 by National Research Council (NRC) (0.5 x 4 marks)

ANS:
1. _____
2. _____
3. _____
4. _____