Hwk #4

10: 16, 32, 34
11: 17, 24, 27, 31

(10.16) Statement is unknown

see table 10.5, page 186 for value of minerals. Need to know how much it would cost to remove the minerals from ~~a~~ 10^6 gal's. Guessing it would cost > \$6,500

(10.32) Calculate lifetimes, using 2000 use rates (from 10.1) & 1968 reserves Compare to tb. 10.3

Mat'l	Reserves (kt)	2000 Use (kt/yr)	Life time
Co	2,400	11	220
Fe	9.7×10^7	7.6×10^4	1280
Mn	7.4×10^5	800	925
Mo	5400	22	245
Ni	75,000	160	469
Al	1.2×10^6	7900	152
Mg	2.6×10^6	180	>1000
Ti	1.4×10^5	1200	117
Cu	3.1×10^5	3100	100
Fl	39,000	610	64
P	2.2×10^7	40,000	550
K	1.1×10^8	5,000	>1000

E & E HWK # 4 (2)

10.34 Molybdenum

2000 use rate = 22 kt/yr = N_0

1968 reserves = 5,400 kt

(years after 2000 → t; → (1/yr))

$$\text{Amt used} = \int_0^t N_0 e^{Gt}\, dt = \frac{N_0}{G} \exp(Gt)$$

$1.07 = \exp(G)$

$\ln(1.07) = G = .0677\ ^1/_{yr}$

$$5,400 = \frac{22}{.0677} \exp(Gt)$$

$$\frac{\ln\left(\frac{(5,400)(.0677)}{22}\right)}{.0677} = t$$

41.5 years = t

Cliffside coal-fired P.P.

2× 800 MW

How much CO_2 produced? (Assume 90% online)

$= (1.6 \times 10^9\ W)(365 \times .9 \times 86{,}400)\ \frac{d}{y}\ \frac{s}{d}$

Energy Output $= 4.54 \times 10^{16}\ J$

Assume 35% 1st-law efficiency

Energy input $= \frac{4.54 \times 10^{16}\ J}{.35} = 1.30 \times 10^{17}\ J$

Average coal heat of combustion (tab 6.1) $= 26.0\ \frac{MJ}{kg}$

$= 26 \times 10^6\ J/kg$

Mass coal burned (kg) $= \frac{1.3 \times 10^{17}\ J}{26 \times 10^6\ J/kg}$

Mass burned (kg) $= 4.99 \times 10^9\ kg/yr$

1 metric ton = 1000 kg $= 4.99 \times 10^6\ \frac{\text{metric tons}}{yr}$

$$C_{20}H_{22}O + 25O_2 \rightarrow 20CO_2 + 11H_2O$$

20×12 = 240
22
16
278 g Coal = 240
640
900 g CO_2

$$\text{Amt } CO_2 = \left(5\times10^6 \frac{\text{m.t}}{\text{yr}}\right)\left(\frac{900}{278}\right)$$

$$= 1.62\times10^7 \frac{\text{tons } CO_2}{\text{yr}}$$

16 million tons/yr