

Announcements – 11/27/00

■ Exam #3

- Solution Key online
- Exams returned at end of class
- Exam *post mortem* today!

■ Exam #3: Take Home Addendum

- two problems (similar to those on exam)
- 5 points each (no partial credit)
- due by Friday at start of class (NO EXCEPTIONS)**
- download (PDF file) or pickup hardcopy after class Wed.

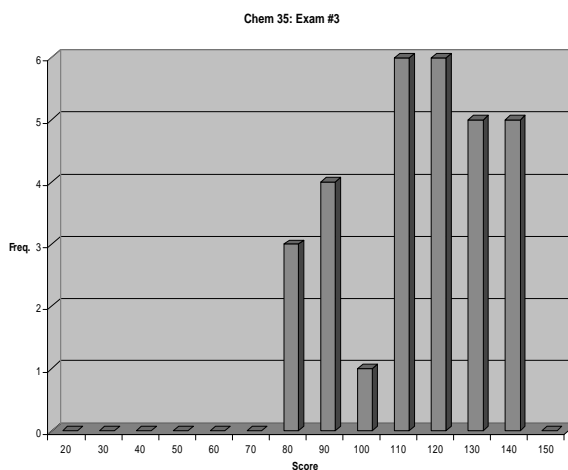
■ **Demo Today!**

1

Exam #3 Results

Average: 109/150
(73%)

Range: 71 - 140



The Carbon Cycle

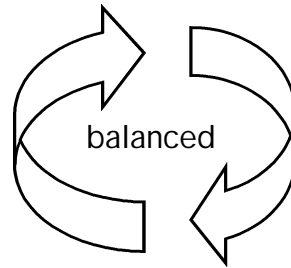
"Natural" Emission of CO₂:

- 25% from respiration
- 25% from plant/animal decomposition
- 50% from rock (CaCO₃) decomposition

"Natural" Uptake of CO₂

- 50% from photosynthesis
- 50% dissolves in oceans: $\text{CO}_2 + \text{H}_2\text{O} \rightarrow 2\text{H}^+ + \text{CO}_3^{2-}$
 $\text{CO}_3^{2-} + \text{Ca}^{2+} \rightarrow \text{CaCO}_3(\text{s})$

-burning fossil fuels *increases CO₂ emission* by about 3 billion tons/year (out of more than 200 billions tons emitted "naturally").



3

What do we *know*?

■ Two things that most agree on:

1. Increases in CO₂ (and other greenhouse gases) can result in global warming
2. CO₂ levels are rising AND global temperatures are rising

■ Two things that are *hotly disputed*:

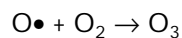
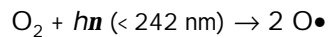
1. The *magnitude* of the temperature increases
2. The *impact* of such temp increases on life on Earth

4

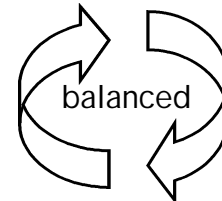
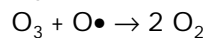
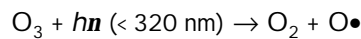
What about the "Ozone Layer"?

- Another *spectroscopy-related* issue

-ozone (O₃) is produced in the upper atmosphere (stratosphere) by *photolytic decomposition of oxygen*:



-ozone is also *destroyed* photolytically:



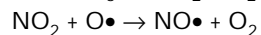
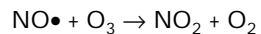
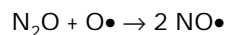
The Chapman Cycle

- 300 million tons of ozone created and destroyed each day
- Typical ozone molecule survives 100 - 200 secs

5

Environmental Implications

- Photolytic ozone creation and depletion shields the surface of the Earth from 95 - 99% of UV light from the Sun
- Other (naturally occurring) compounds can also participate in the Chapman Cycle:



-this reduces the amount of ozone in the stratosphere

6

Chlorofluorocarbons (CFC's)

- Developed in the 1930's by Dupont as a safe refrigerant to replace **toxic and corrosive** NH_3 and SO_2

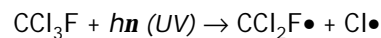
Example: CFC-12 (CF_2Cl_2)

- very unreactive -noncorrosive
 - non-flammable
 - a gas at room temperature (B.P. $\sim 30^\circ\text{C}$)
 - a chemistry success story!
- Very popular (850,000 tons produced/year by 1985)

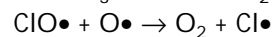
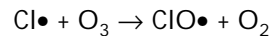
7

Where do CFC's go?

- **Unforeseen problem:** CFC's are so unreactive that they do not decompose in the lower atmosphere
- After 2-5 years, CFC's drift into the stratosphere (upper atmosphere) where they *photodissociate*:



- $\text{Cl}\cdot$ reacts with O_3 :



-this cycle can repeat as many as 100,000 times before terminating and forming HCl or ClONO_2

8