

Chemistry (Environmental Studies) L111
Environmental Concerns and Chemical Solutions
Professor Dransfield
Exam 1
February 22, 2007

Statistics

Total Point Available = 200 + 20 bonus

26 Exams Scored

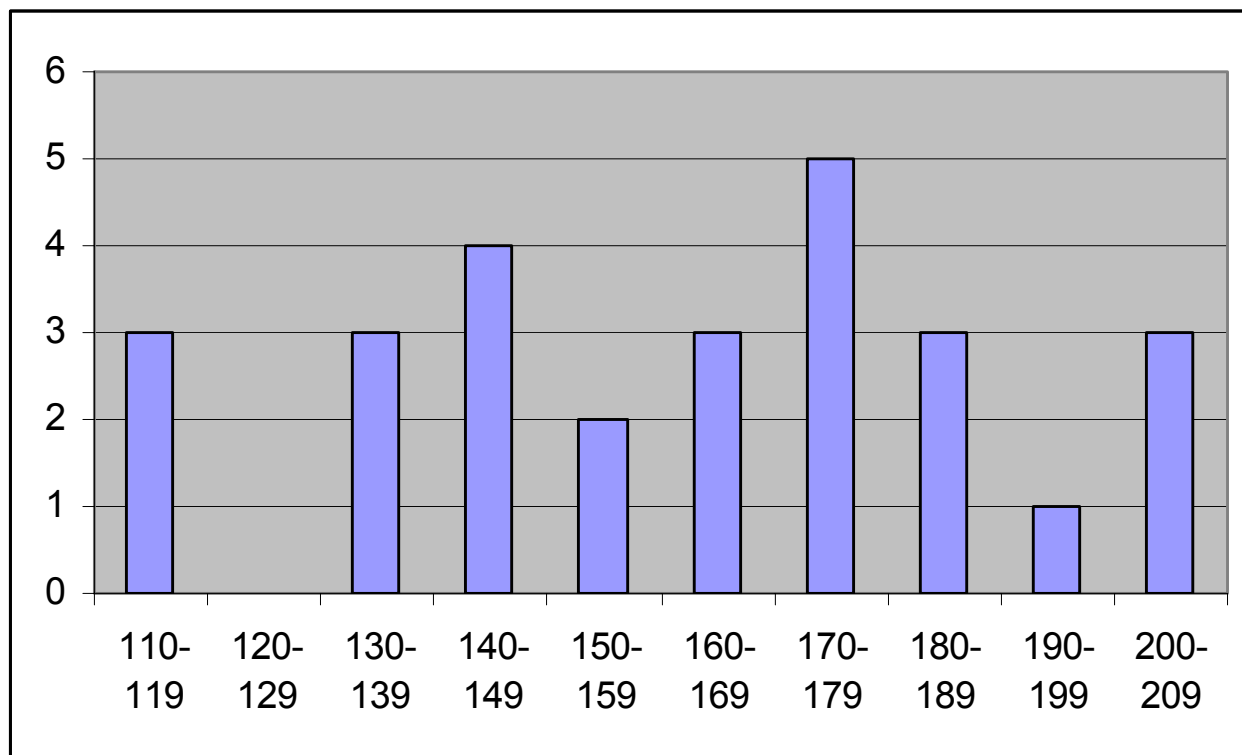
Average = 160

Median = 161

Standard Deviation = 27.5

High = 210

Low = 114

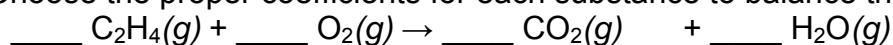


1. Ozone is considered an air pollutant in the _____ but is a valuable protective layer in the _____.
- A. **troposphere; stratosphere** **22/26 correct**
B. stratosphere; mesosphere
C. stratosphere; troposphere
D. mesosphere; stratosphere
2. Which is **not** a mixture?
- A. a jar filled with rocks and sand
B. sea water
C. a glass of Kool-Aid
D. **sodium chloride** **21/26**
3. O₂ and O₃ molecules are
- A. **allotropes.** **25/26**
B. structural isomers.
C. isotopes.
D. geometrical isomers.
4. Which is **not** a pure substance?
- A. helium
B. copper wire
C. **air** **19/26**
D. sucrose
5. The speed of light in air
- A. depends only on the frequency of the light.
B. depends only on the wavelength of light.
C. **is independent of the wavelength and frequency of light.** **21/26**
D. depends on both the wavelength and the frequency of light.
6. How many protons, neutrons, and electrons are there in the neutral atom of ${}^{19}_9\text{F}$?

	# protons	# neutrons	# electrons
A.	10	9	10
B.	9	9	9
C.	10	9	9
D.	9	10	9

← **17/26**

7. Choose the proper coefficients for each substance to balance this equation.



A. 1, 1, 2, 2

B. 1, 3, 2, 2

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C. 2, 3, 4, 2

D. 2, 2, 4, 2

8. Choose the name of the compound made by combining sulfur (S) with oxygen (O) to form SO_2 .

A. monosulfur dioxide

B. sulfur oxygenate

C. sulfur oxide

D. sulfur dioxide

25/26

9. The chemical properties of the elements are chiefly due to

A. the number of protons.

B. the number and distribution of the outer electrons.

17/26

C. the number and distribution of the inner electrons.

D. the number and distribution of the neutrons.

10. Halons differ from CFCs in that the atoms of

A. iodine replace some chlorine atoms.

B. hydrogen replace some chlorine atoms.

C. bromine replace some chlorine atoms.

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D. silicon replace some carbon atoms.

11. The production of which of the following classes of compounds was NOT limited by the Montreal Protocol of 1987 nor by its amendments:

A. CFCs

B. HCFCs

C. VOCs

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D. Halons

12. What is the primary component of an exhaled breath?

A. N_2

21/26

B. O_2

C. CO_2

D. H_2O

13. What level of the atmosphere occurs at the highest altitude?

A. ozone

B. stratosphere

C. mesosphere

20/26

D. troposphere

14. Free radicals are

- A. highly reactive chemical species.
- B. species with unpaired electrons.
- C. species such as $H\cdot$ and $\cdot OH$.
- D. All of the choices are correct.**

25/26

15. In the periodic table, which elements typically have similar properties?

- A. Those in the same rows.
- B. Those related diagonally.
- C. Those in the same columns.**
- D. Those on opposite sides.

24/26

16. Which symbols represent elements that are metals?

X														R		P	Q
															Y		
Z																	
																L	

- A. X and Z**
- B. X and Q
- C. P and L
- D. X, R, P, and Q

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17. Which symbol(s) represent elements having 7 valence electrons?

X														R		P	Q
															Y		
Z																	
																L	

- A. X and Z
- B. Y
- C. P and L**
- D. Q

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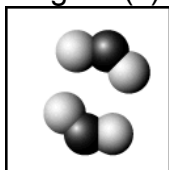
18. Light behaves like
A. a particle.
B. a wave.
C. both a particle and a wave. 21/26
D. neither a particle nor a wave.
19. The "ozone layer" is found
A. only around the equator.
B. in the troposphere.
C. in the stratosphere. 24/26
D. in the mesosphere.
20. The number 2×10^{15} is:
A. **greater than one** 24/26
B. less than one
C. more information is needed
D. smaller than 2.0×10^{-15}
21. The quantity 0.0000064 g expressed in scientific notation is
A. 6.4×10^6 g
B. 6.4×10^{-6} g 23/26
C. 6.4×10^7 g
D. 6.4×10^{-7} g
22. The _____ concentration in the air over the desert differs dramatically from that in the air in the tropical rainforest.
A. N₂
B. O₂
C. CO₂
D. H₂O 19/26
23. Which contributes to the ozone hole?
A. automobile exhaust
B. chlorofluorocarbons (CFCs) 17/26
C. loss of Northern forests
D. All of the choices are correct.
24. One wears sunscreen on one's skin in order for the sunscreen to _____ thereby protecting one's skin from some of the sun's radiation.
A. reflect infrared radiation,
B. reflect visible radiation and UV-B radiation,
C. transmit UV-A and UV-B radiation,
D. absorb UV-A and UV-B radiation, 20/26

25. Which is *not* a component used to determine an individual's exposure to a pollutant?
- A. length of contact time
 - B. concentration of pollutant in the air
 - C. toxicity** **22/26**
 - D. total amount (volume) of air inhaled
26. In which level of the atmosphere is the air pressure greatest?
- A. troposphere** **19/26**
 - B. stratosphere
 - C. ozone
 - D. mesosphere
27. During the Antarctic spring, ozone is destroyed at a greater rate than it is formed
- A. on the surface of atmospheric ice crystals.
 - B. in a process that is catalytic.
 - C. in polar stratospheric clouds.
 - D. All of the choices are correct.** **13/26**
28. Which pollutant could not be detected by its odor?
- A. CO** **18/26**
 - B. O₃
 - C. SO_x
 - D. NO_x
29. Which characteristic describes a compound but not a mixture?
- A. Two or more things combined.
 - B. The combining ratio is fixed.** **9/26**
 - C. Substances can be broken down into smaller parts.
 - D. Elements are combined.
30. Chlorofluorocarbons rise to the stratosphere and
- A. react directly with stratospheric ozone to destroy it.
 - B. after interacting with UV energy, become free radicals, which destroy ozone.** **25/26**
 - C. become free radicals that react with oxygen to create ozone.
 - D. react with free radicals to remove carbon dioxide.
31. What are the products of the complete combustion of ethane?
- A. carbon monoxide and oxygen
 - B. carbon monoxide and hydrogen
 - C. carbon dioxide and oxygen
 - D. carbon dioxide and water** **18/26**

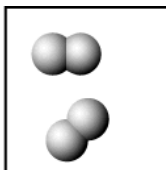
32. The nucleus of an atom contains
 A. electrons and protons only.
 B. protons only.
 C. electrons, protons, and neutrons.
 D. **protons and neutrons only**

18/26

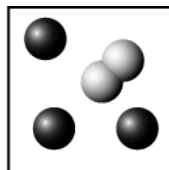
33. Which diagram(s) best characterize an element?



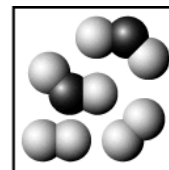
I



II



III

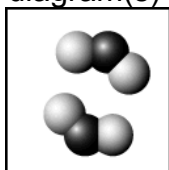


IV

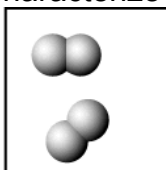
- A. I only
 B. **II only**
 C. I and II only
 D. III and IV only

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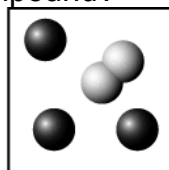
34. Which diagram(s) best characterize a compound?



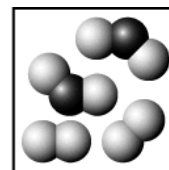
I



II



III



IV

- A. **I only**
 B. II only
 C. I and IV only
 D. II and III only

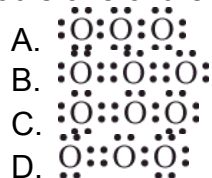
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35. Increasing wavelength of light goes in the order

- A. **ultraviolet > visible > infrared.**
 B. visible > infrared > ultraviolet.
 C. infrared > visible > ultraviolet.
 D. ultraviolet > infrared > visible.

16/26

36. What is one of the Lewis dot structures for ozone?



14/26

37. Which is the balanced chemical equation showing hydrogen peroxide (H_2O_2) decomposing into hydrogen (H_2) and oxygen (O_2)?

- A. $\text{H}_2\text{O}_2 \rightarrow \text{H}_2 + \text{O}_2$ **20/26**
 B. $\text{H}_2 + \text{O}_2 \rightarrow \text{H}_2\text{O}_2$
 C. $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}_2$
 D. $2 \text{H}_2\text{O}_2 \rightarrow 2 \text{H}_2 + \text{O}_2$

38. Green chemistry is:

- A. The evolution of green gases during a chemical reaction.
 B. The chemistry associated with plants.
 C. The study of green molecules and atoms.
 D. **The design of products and processes that reduce hazardous substances.** **25/26**

39. Ozone in our atmosphere is important because it

- A. **absorbs some UV radiation.** **25/26**
 B. helps trees grow.
 C. reacts with excess CO_2 .
 D. reflects IR radiation.

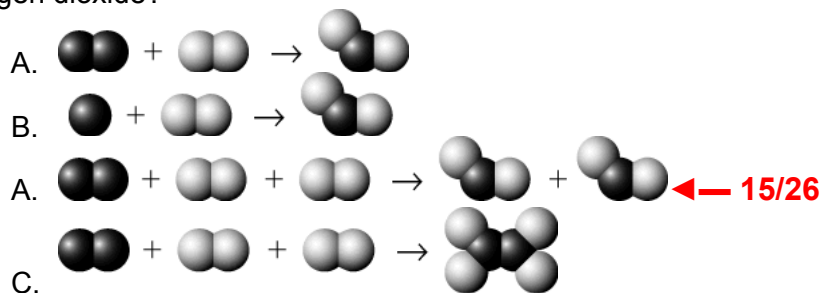
40. Wavelength is the

- A. number of waves passing a fixed point in one second.
 B. height of the wave.
 C. **distance between successive peaks in a wave.** **16/26**
 D. distance between a peak of one wave and the next trough.

41. The EPA limit for CO is 9 ppm. Express this number as a percentage.

- A. 90%
 B. 9%
 C. 0.09%
 D. **0.0009%** **22/26**

42. Which shows the balanced equation for nitrogen (●) reacts with oxygen (●) to form nitrogen dioxide?



43. Isotopes of an element have the same number of

- A. electrons, but different numbers of protons.
 B. **protons, but different numbers of neutrons.** **21/26**
 C. neutrons, but different numbers of protons.
 D. protons, but different numbers of electrons.

44. The ozone hole is most prominent on the Earth over
A. North America.
B. Europe.
C. Africa.
D. Antarctica. **26/26**
45. Which approach would reduce indoor air pollution?
A. air conditioning
B. sealing windows shut
C. increasing the air exchange **25/26**
D. dry cleaning clothes
46. The mass number of an isotope of an element is
A. the sum of the number of protons and electrons.
B. the number of protons.
C. the sum of the number of protons and neutrons. **16/26**
D. the sum of the number of protons, neutrons, and electrons.
47. As the ozone hole gets more pronounced with time, one expects the incidence of skin cancer to
A. decrease worldwide.
B. increase worldwide. **21/26**
C. increase in the northern hemisphere and decrease in the southern hemisphere.
D. decrease in the northern hemisphere and decrease in the northern hemisphere.
48. Catalytic converters reduce the amount of _____ in the car exhaust.
A. O₃
B. CO₂
C. CO **19/26**
D. SO₂
49. HFCs may be used to replace CFCs. Which compound is a HFC?
A. CHCl₂-CCl₂F
B. CH₂F₂ **22/26**
C. CF₂HCHClF
D. CH₂ClF
50. Single bonds, double bonds, and triple bonds
A. have 1, 2, and 3 shared electrons, respectively.
B. have 2, 4, and 6 shared electrons, respectively. **18/26**
C. have 3, 6, and 9 shared electrons, respectively.
D. are only possible between carbon atoms.

Bonus Problems (5 points each)

1) On the first day of lecture, we said that air is approximately 78% N₂, 21% O₂ and .04% CO₂. One atmosphere of pressure at room temperature represents 2.46x10¹⁹ molecules/cm³. There are 760 torr in one atmosphere. How many molecules (each!) of N₂, O₂ and CO₂ are there in one cubic centimeter of room temperature air at 50 torr?

$$\# \text{molecules } N_2 = 1 \text{ cm}^3 * \frac{78}{100} * \frac{50 \text{ torr}}{760 \text{ torr / atmosphere}} * 2.46 \times 10^{19} \text{ molecules / cm}^3 \text{ atmosphere} = 1.3 \times 10^{18} \text{ molecules}$$

$$\# \text{molecules } O_2 = 1 \text{ cm}^3 * \frac{21}{100} * \frac{50 \text{ torr}}{760 \text{ torr / atmosphere}} * 2.46 \times 10^{19} \text{ molecules / cm}^3 \text{ atmosphere} = 3.4 \times 10^{17} \text{ molecules}$$

$$\# \text{molecules } CO_2 = 1 \text{ cm}^3 * \frac{.04}{100} * \frac{50 \text{ torr}}{760 \text{ torr / atmosphere}} * 2.46 \times 10^{19} \text{ molecules / cm}^3 \text{ atmosphere} = 6.5 \times 10^{14} \text{ molecules}$$

2) Nitrogen dioxide (NO₂) dissociates when exposed to wavelengths of light less than 420 nm. Nitrous acid (HONO) dissociates at wavelengths less than 400 nm. Which molecule has the stronger bonds? Demonstrate this using simple Lewis structures. Note: these molecules may have more than one resonance structure. You do not need to draw all possible resonance forms, but draw 2 or 3 if appropriate.

- 400 nm is less than 420 nm, which means it is shorter wavelength, and thus higher frequency and higher energy. So the bonds in HONO are stronger than the bonds in NO₂ – they take more energy to break (1 point).

- Any attempt at a Lewis structure earned 1 point.

- A Lewis structure with the correct number of electrons earned another point.

- A fully correct Lewis structure for either compound earned another point.

- The realization that NO₂ has an odd number of electrons, and is thus a radical, and therefore unstable, earned the final point. Other logical conclusions could also earn the point.