

1. If the frequency of a microwave is 3.8×10^{10} Hz, what is the energy of one quantum of this radiation?

- a) 7.9×10^{-3} J
- b) 1.1×10^{-19} J
- c) 2.5×10^{-23} J
- d) 4.1×10^{-47} J
- e) 6.2×10^{-42} J

$$E = h\nu$$

$$E = \frac{6.63 \times 10^{-34} \text{ J}\cdot\text{s} \times 3.8 \times 10^{10}}{\text{s}} = \text{J}$$

2. Calculate the wavelength of light emitted when an electron changes from a state of principal quantum number 3 ($n=3$) to a state of principal quantum number 1 ($n=1$) in the H atom.

- a) 3.44×10^{-9} m
- b) 7.24×10^{-4} m
- c) 1.02×10^{-7} m
- d) 1.57×10^{-5} m
- e) 2.75×10^{-37} m



$$\Delta E = -R_H \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) = 1.95 \times 10^{-18}$$

$$E = h\nu$$

$$\nu = 2.923 \times 10^{15}$$

$$\frac{c}{\nu} = \lambda = 1.02 \times 10^{-7} \text{ m}$$

3. The number of orbitals in a 4d subshell is

- a) one
- b) four
- c) five
- d) eight
- e) sixteen

4. What is the frequency of yellow light having a wavelength of 562 nanometers?

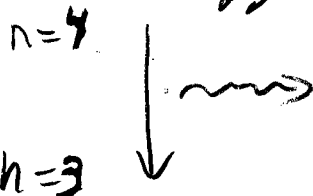
- a) 5.33×10^{14} s⁻¹
- b) 5.33×10^5 s⁻¹
- c) 1.87×10^{16} s⁻¹
- d) 1.87×10^{15} s⁻¹
- e) 1.87×10^{27} s⁻¹

$$c = \nu \lambda$$

$$\nu = \frac{c}{\lambda} = \frac{3.0 \times 10^8 \text{ m/s}}{562 \times 10^{-9} \text{ m}} = \text{s}^{-1}$$

5. Which of the following transitions in the hydrogen atom results in the emission of light of the longest wavelength? *← lowest energy*

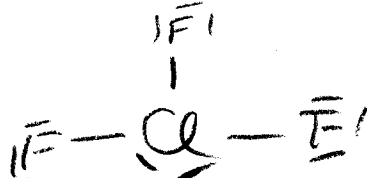
- a) $n = 1$ to $n = 2$
- b) $n = 3$ to $n = 1$
- c) $n = 2$ to $n = 1$
- d) $n = 4$ to $n = 3$
- e) $n = 1$ to $n = 4$



emission
↑
gives off

6. Based on the VSEPR Theory, what is the molecular shape of ClF₃?

- a) triangular planar
- b) T-shaped
- c) linear
- d) tetrahedral
- e) square planar



28 v.e.s

Key

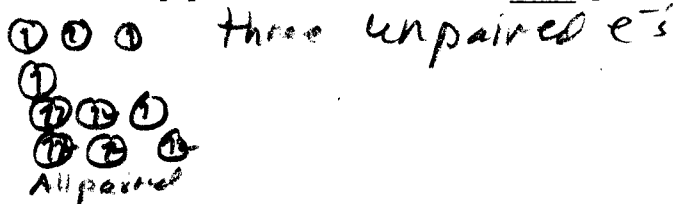
7. Rank Na, Mg, Ca, and Zn in order of increasing 1st ionization energy.

lowest \rightarrow highest

- a) Na < Mg < Ca < Zn
- b) Na < Ca < Mg < Zn
- c) Zn < Mg < Ca < Na
- d) Ca < Mg < Zn < Na
- e) Ca < Na < Mg < Zn

8. Which of the following particles would be most paramagnetic?

- a) P
- b) Ga
- c) Br
- d) Cl⁻
- e) Na⁺

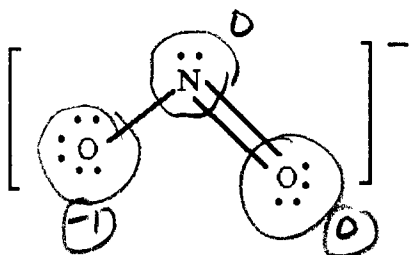


9. Which of the following particles has the lowest 2nd ionization energy?

- a) F
- b) O
- c) Na
- d) Mg
- e) Li

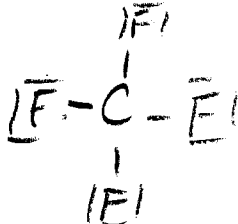
10. What is the formal charge on each atom in the following structure for the nitrite ion, NO₂⁻?

- a) nitrogen is 2-, oxygen on the left is 1-, oxygen on the right is 0
- b) nitrogen is 0, oxygen on the left is 0, oxygen on the right is 1-
- c) nitrogen is 0, oxygen on the left is 1-, oxygen on the right is 0
- d) nitrogen is 3-, oxygen on the left is 1-, oxygen on the right is -2
- e) nitrogen is 1+, oxygen on the left is 2-, oxygen on the right is 1-



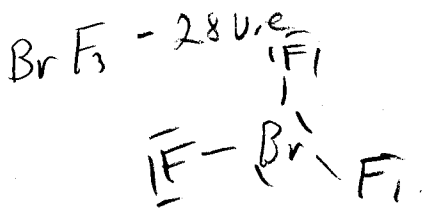
11. Based on the VSEPR Theory, what is the molecular shape of CF₄?

- a) triangular planar
- b) T-shaped
- c) linear
- d) tetrahedral
- e) angular (bent)



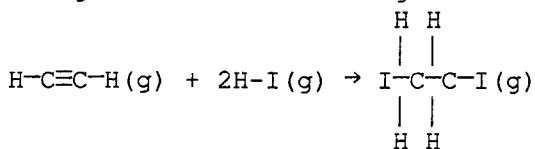
12. Which species has more than eight electrons around the central atom?

- a) BF₃
- b) BF₄⁻
- c) BrF₃
- d) PF₃
- e) OF₂



Key

13. Using the table of average bond energies below, the ΔH for the reaction:



is _____ kJ.

Bond:	$\text{C}\equiv\text{C}$	$\text{C}-\text{C}$	$\text{H}-\text{I}$	$\text{C}-\text{I}$	$\text{C}-\text{H}$
BE (kJ/mol):	839	348	299	240	413

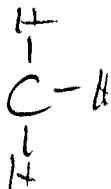
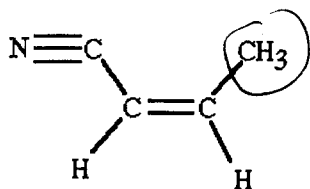
- a) +160
- b) -160
- c) -217
- d) -63
- e) +63

Breaking (+)	MAKING (-)
$\text{C}-\text{H} \quad 2 \times 413 = 826$	$\text{C}-\text{H} \quad 4 \times 413 = 1652$
$\text{C}\equiv\text{C} \quad 1 \times 839 = 839$	$\text{C}-\text{I} \quad 2 \times 240 = 480$
$\text{H}-\text{I} \quad 2 \times 299 = 598$	$\text{C}-\text{C} \quad 1 \times 348 = 348$
+ 2263	- 2480

$+2263 + (-2480) = -217$

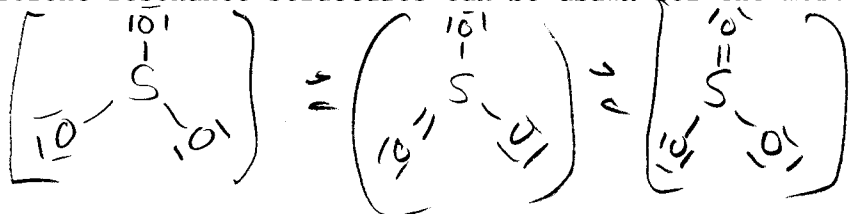
14. How many sigma (σ) bonds are in the following molecule?

- a) 3
- b) 7
- c) 8
- d) 9
- e) 12



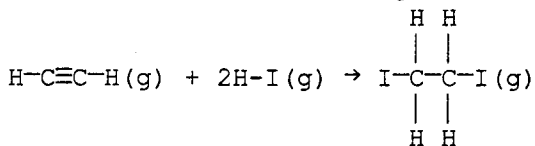
15. How many different resonance structures can be drawn for the molecule SO_3 ?

- a) 5
- b) 2
- c) 1
- d) 4
- e) 3



$\frac{3 \times 6}{1 \times 6} = 24$

16. Using the table of average bond energies below, the ΔH for the reaction:



is _____ kJ.

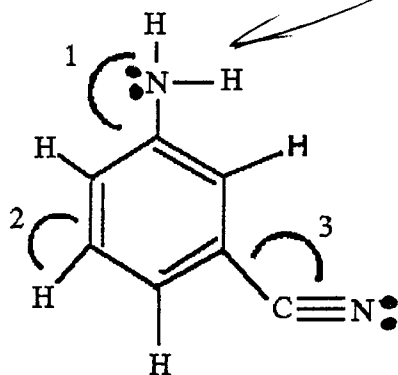
Bond:	$\text{C}\equiv\text{C}$	$\text{C}-\text{C}$	$\text{H}-\text{I}$	$\text{C}-\text{I}$	$\text{C}-\text{H}$
BE (kJ/mol):	839	348	299	240	413

- a) +160
- b) -160
- c) -217
- d) -63
- e) +63

Same as B

17. What are the approximate bond angles of 1, 2, and 3 respectively?

- a) 120°, 120°, 180°
- b) 109.5°, 120°, 180°
- c) 109.5°, 120°, 120°
- d) 180°, 120°, 120°
- e) 109.5°, 109.5°, 180°



Don't forget lone pairs

18. What is the oxidation number of sulfur in H₂SO₄?

- a) +8
- b) +7
- c) +6
- d) +4
- e) -2

$$\frac{2(+1)}{H} + \frac{x}{S} + \frac{4(-2)}{O} = 0$$

$$x = +6$$

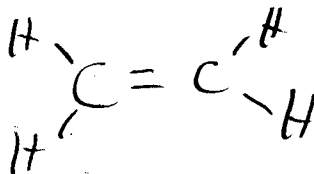
19. Which of the following particles has the largest radius?

- a) Ne
- b) F⁻
- c) O²⁻
- d) Na⁺
- e) N³⁻

All have same # of e⁻s but N³⁻ has least protons

20. What is the approximate H-C-C bond angle in H₂C=CH₂ (Hint: Write out the complete structure)?

- a) 180°
- b) 120°
- c) 109.5°
- d) 90°
- e) 60°



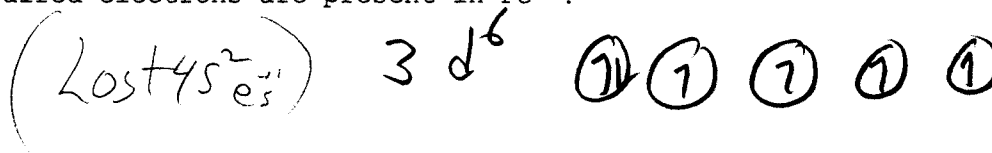
21. Which of the following compounds would have the highest melting point?

- a) LiF ← smallest
- b) LiCl
- c) NaBr
- d) CsF
- e) NaCl

Look at size/charge ratios

22. How many unpaired electrons are present in Fe^{2+} ?

- a) 0
- b) 2
- c) 4
- d) 5
- e) 6



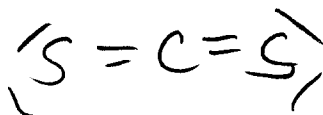
23. Which of the following groups contains *no* ionic compounds?

- a) H_2O , MgO , NO_2
- b) CO_2 , SO_2 , H_2S
- c) CCl_4 , CaCl_2 , HCl
- d) Na_2S , SO_2 , CS_2
- e) Mg_3N_2 , NCl_3 , HOCl

 = ionic

24. What is the hybridization of the carbon atom in CS_2 ?

- a) sp
- b) sp^2
- c) sp^3
- d) sp^3d
- e) sp^3d^2



25. Based on the VSEPR Theory, what is the molecular shape of NH_3 ?

- a) triangular planar
- b) T-shaped
- c) triangular-pyramidal
- d) tetrahedral
- e) octahedral

