1. How many valence electrons does a tin (Sn) atom have? __4__

2. Which one of the **following** is most likely to be an ionic compound? **State your reasoning.**

    A. GaAs   B. SrBr$_2$ C. NO$_2$ D. CBr$_4$ E. H$_2$O

    Reasoning: Contains a metal and a nometal with a large difference in electronegativity values.

3. Which one of the following ionic solids would have the largest lattice energy?

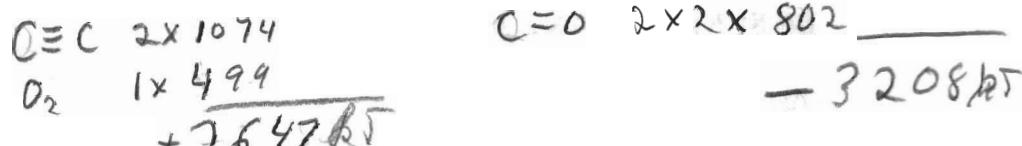   A. NaCl   B. **NaF**   C. CaBr$_2$ D. CsI   E. CaCl$_2$

    Reasoning:

    Lattice energy $\propto \dfrac{\text{cation charge} \times \text{Anion charge}}{\text{cation radius} + \text{anion radius}}$ $\left[\dfrac{Ca^{2+} \text{ vs } Na^{+}}{Ca^{2+} 100 pm \text{ vs } Na \, 102 pm}\right]$

4. The general electron configuration for atoms of all elements in Group 5A is

    A. ns^{2}np^6 B. ns^{2}np^5 C. ns^{2}np^4 D. ns^{2}np^3 E. ns^{2}np^1

5. Estimate the enthalpy change, ΔH, for the reaction $2C\equiv O + O_2 \rightarrow 2CO_2$ (O=C=O) **given the** following bond energies.

    Bond Breaking (Endo)(+)   Bond making (Exo)(-)

    BE(C≡O) = 1074 kJ/mol   C≡C 2×1074   C=O 2×2×802
    BE(O$_2$) = 499 kJ/mol   O$_2$ 1×499   ─3208 kJ
    BE(C=O) = 802 kJ/mol   +2647 kJ

    $2647 + {}^{-}3208 = \boxed{-561 \, kJ}$

6. Write the (shorthand notation) electron configurations for the following ions:

    a. S^{2-} [Ne] 3s^2 3p^6 b. Ca^{2+} [Ar]

    c. Cr^{3+} [Ar] 3d^3 d. Ni^{2+} [Ar] 3d^8

Key

7. What is the difference between a calcium atom and a calcium ion?

Calcium atom is larger and has 20 e^-'s and no charge

Calcium ion is smaller and has 18 e^-'s and a 2+ charge

8. Which one of the following is most likely to be a covalent compound?

A. KF   B. $CaCl_2$ (C. SF_4)   D. Al_2O_3 E. $CaSO_4$

Explain: Both are non metals.

9. Which of the following make an isoelectronic pair: $Cl-$, O^{2-}, F, Ca^{2+}, Fe^{3+}?

Cl^- and Ca^{2+} each a the [Ar] configuration

10. Consider an element with the following electron configuration. How would you classify this element?

← Iodine

$[Kr]5s^24d^{10}5p^5$

(A. a representative element)   B. a transition metal   C. an alkali metal
D. an actinide element   E. a noble gas

11. Use the Born-Haber cycle to calculate the lattice energy of NaBr(s). Given the following data:
BE SURE TO MAKE A DIAGRAM.

ΔH(sub) Na = 109 kJ/mol
IE (Na) = 496 kJ/mol
1/2D (Br-Br) = 96 kJ/mol
EA (Br) = 324 kJ/mol ← should be (−)
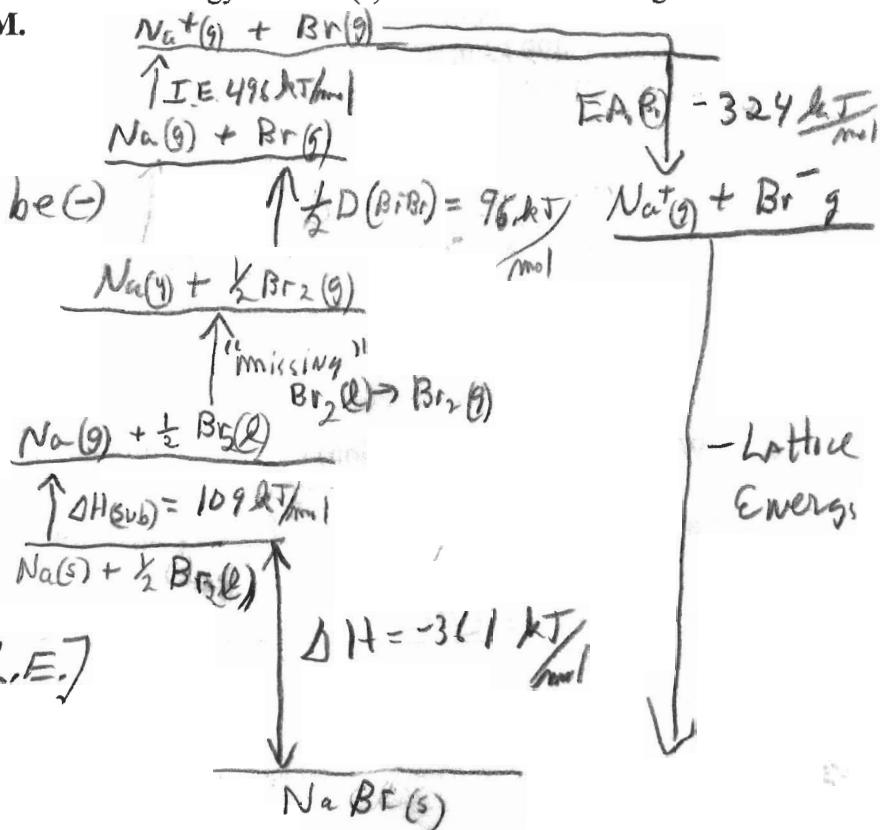ΔH= -361 kJ/mol

Take one step at a time
with up being "endo" (+) and
down being "exo" (−),

$|"up"| + |\Delta H_{RXN}| = |"down"|$

$|109 + 96 + 496 + 361| = |324 + L.E.|$

$L.E. = 738$ kJ

$Na^+(g) + Br(g)$

↑ I.E. 496 kJ/mol
$Na(g) + Br(g)$

EA$\circledR$ −324 kJ/mol

↑ ½D(Br-Br) = 96 kJ/mol $Na^+(g) + Br^-$ g

$Na(g) + ½Br_2(g)$

↑ "missing"
$Br_2(l) → Br_2(g)$

$Na(g) + ½Br_2(l)$

↑ ΔH(sub) = 109 kJ/mol
$Na(s) + ½Br_2(l)$

$\Delta H = -361$ kJ/mol

− Lattice Energy

$NaBr(s)$

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Overall RXN: $Na(g) + ½Br_2(l) → NaBr(s)$

12. Which element forms stable +2 cations?

    A. Kr   B. I   C. Se   D. Al   E. Ba

13. Which of the following solids would have the highest melting point?

    A. NaI   B. NaF   C. MgO   D. $MgCl_2$ E. KF

    Explain: *See # 3*

14. How many electrons are in the 4d orbitals of Tc?

    A. 1   B. 2   C. 3   D. 4   E. 5

15. Arrange the following ions in order of increasing ionic radius, K^+, P^{3-}, S^{2-}, Cl^-.

    Increasing radius

    All have the (Ar) configuration, but the number of protons are different

    $K^+ < Cl^- < S^{2-} < P^{3-}$

16. Estimate the enthalpy change (ΔH) for the combustion of one mole of acetylene, C_2H_2.

    $$H-C{\equiv}C-H(g) + \tfrac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(g) \qquad (O{=}C{=}O) \; (H{-}O{-}H)$$

    BE(C–H) = 456 kJ/mol

    BE(C≡C) = 962 kJ/mol

    BE(O_2) = 499 kJ/mol

    BE(C=O) = 802 kJ/mol

    BE(O–H) = 462 kJ/mol

    Bond Breaking "Endo" (+)

    C-H   2 × 456
    C≡C   1 × 962
    O_2 $\tfrac{5}{2}$ × 499
    _____
    +2623

    Bond Making "Exo" (-)

    C=O   2 × 2 × 802
    H-O   2 × 462
    _____
    -4132

    Add →

    ΔH = -1510

    -1759
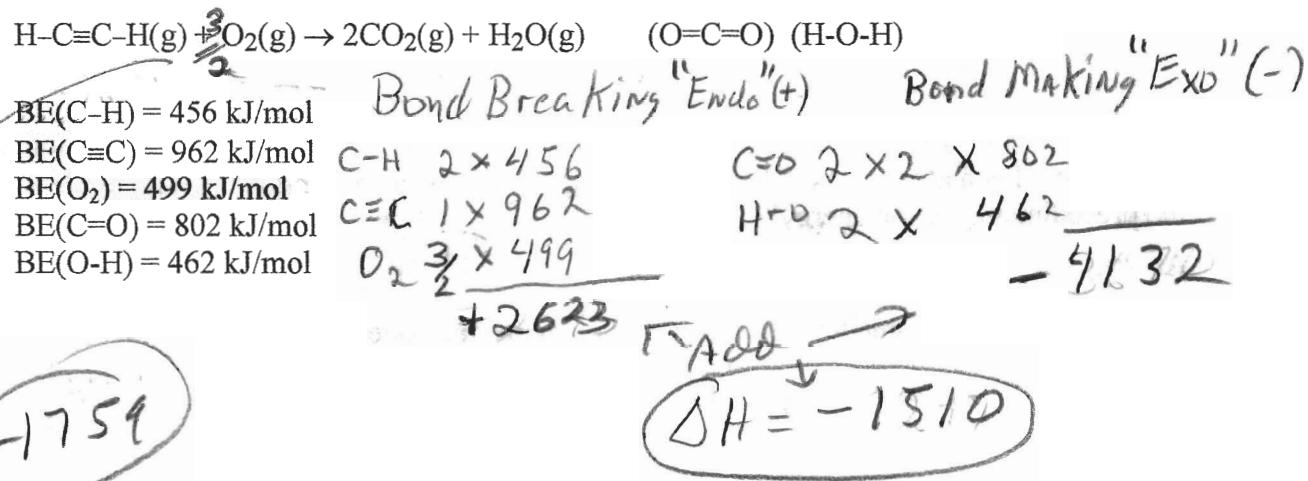
    If you did not catch the error.

17. Which of the bonds below would have the greatest polarity (highest percent ionic character)?

    A. Si-P   B. Si-S   C. Si-Se   D. Si-Cl   E. Si-I

    highest Electronegativity difference.

18. Use the Born-Haber cycle to calculate the lattice energy of LiCl(s). Given the following data

ΔH(sub) Li = 155.2 kJ/mol _

IE (Li) = 520 kJ/mol —

1/2D (Cl-Cl) = 121.4 kJ/mol ← *simpl* ...

EA (Cl) = 348 kJ/mol ← should be (−)

ΔH= -408.8 kJ/mol

857 kJ / mol

See #11

$|\Delta H_{sub} + IE + \frac{1}{2}D\text{-}D + + 408.8| = |121.4 + 348 + LE|$

19. Which element has the highest ionization energy?

(A. C)   B. Si   C. Ge   D. Sn   E. Pb

20. The **bonds** of oxygen molecules are broken by sunlight. The minimum energy required to break the oxygen-oxygen bond is 495 kJ/mol. What is the wavelength of sun-light that can cause this bond breakage? What type of electromagnetic radiation is this?

$E = h\nu$ $c = \lambda \nu$

(242 nm (u.v.))

$E = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{E} = 4.02 \times 10^{-3} m \cdot mol \times \frac{6.02 \times 10^{23}}{mol}$

21. **Successive** ionization energies, I_1, I_2, I_3, and so on, provide evidence for the shell structure of the **atom**. For silicon atoms, which ionization energy will show an exceptionally large increase over the preceding ionization energy?   *represents an inner shell e⁻*

A. 2nd   B. 3d   C. 4th   (D. 5th)   E. 6th

22. **Why is the** Mg²⁺ ion smaller than F⁻, even though they are isoelectronic?

12 protons holding 10 e⁻   vs.   9 protons holding 10 e⁻

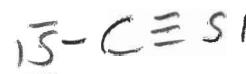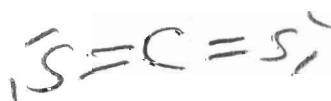23. Classify the C-Cl bond in CCl₄ as ionic, polar covalent, or **nonpolar covalent.**   *electronegativity difference*

A. ionic   (B. **polar covalent**)   C. nonpolar covalent

24. **Which has** the greater radius, an I⁻ ion or an I atom? Briefly explain.

I⁻   53 protons holding 54 e⁻ ← Bigger

I   53   ''   '' ''   53 e⁻

25. The Show theLewis structure for CS₂ .

:S=C=S;   :S̄—C≡S|

:S≡C—S̄|

Resonance Structures

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