Name: _

- 1. (d) < (a) < (e) < (c) < (b) = (f)
- 2. (a) $C_8H_{10}N_4O_2$, (b) 194.1902 u, (c) 49.48% C, 5.19% H, 28.85% N, and 16.48% O.
- 3. X is phosphorus
- 4. $C_6H_{12}O_6(s) + 6 O_2(g) \rightarrow 6 CO_2(g) + 6 H_2O(l)$
- 5. (a) arsenic trioxide (b) $4 \text{ HCl}(aq) + 3 \text{ As}_2\text{O}_3(s) + 4 \text{ NO}_3^-(aq) + 7 \text{ H}_2\text{O}(l) \rightarrow 4 \text{ NO}(g) + 6 \text{ H}_3\text{AsO}_4(aq) + 4 \text{ Cl}^-(aq)$ (c) Yes, since Na and K are in the same family
- (a) 4.74 × 10¹⁴ Hz
 (b) 0.314 aJ → this is one "photon" of energy of light with wavelength of 633 nm.
- (a) 1.33 × 10⁻¹⁸ J, 3.69 × 10⁻²⁵ kWh
 (b) see diagram to the right
 (c) 3 valence electrons; 2 core electrons
- 8. Li > Li⁺; Cu⁺ > Cu²⁺; Cl⁻ > Cl; $O^{2-} > O^{2+}$
- 9. (a) He < Ne < Ar < Kr, (b) Li < Na < K < Rb, (c) Ne < F < N < Be
- 10. $H-C\equiv C-H$ H-N=N-H $\vdots = C=N$:
- 11. There are four resonance forms for oxalate. One of them is to the right.
- 12. Lewis structures to the right.
 - ClO₂- has two resonance forms, is bent (AX₂E₂), and has a OClO bond angle that is less than 109.5 degrees.

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- ClO₃- has three resonance forms (with two double bonds and one single bond), is trigonal pyramidal (AX₃E), and has a OClO bond angle that is less than 109.5 degrees.
- ClO₄- has four resonance forms (with three double bonds and one single bond), is tetrahedral (AX₄), and has a OClO bond angle that is 109.5 degrees.
- The longest Cl–O bond is ClO₂- and the shortest is ClO₄-.
- ClO₂- and ClO₃- are both polar. Perchlorate is non-polar.
- 13. AsF₃, CH_2Cl_2 , and IOF_5 are polar.
- 14. (a) Mercury(I) chloride, chromium(III) nitrate, cobalt(II) bromide
 (b) Cu(CH₃CO₂)₂, Co₂(SO₃)₃, K₂Cr₂O₇
 (c) zinc sulfate monohydrate, barium chloride dihydrate, sodium sulfide nonahydrate
- (a) Ca is oxidized; Cl₂ is reduced (and is the oxidizing agent)
 (b) Al is oxidized, O₂ is reduced (and is the oxidizing agent)
 (c) Rb is oxidized, Br₂ is reduced
- 16. (a) $\operatorname{Fe}^{3+}(aq) + 3 \operatorname{OH}^{-}(aq) \rightarrow \operatorname{Fe}(\operatorname{OH})_{3}(s)$
 - (b) $\operatorname{Zn}^{2+}(aq) + \operatorname{S}^{2-}(aq) \to \operatorname{ZnS}(s)$
 - (c) $Pb^{2+}(aq) + 2 OH^{-}(aq) \rightarrow Pb(OH)_2(s)$ (d) $Zn^{2+}(aq) + CO_3^{2-}(aq) \rightarrow ZnCO_3(s)$
 - (u) 211 (uq) + 003 (uq) 211003(0)
- 17. (a) 0.500 mol Cl₂; 4.00 mol H₂; 0.33 mol Ca atoms; 8.8 × 10⁻¹² mol Ba
 (b) Ba is smallest collection of atoms, H is largest collection

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(c) $1.2 \times 10^{-9}\,{\rm g}\,{\rm Ba} < 8.00\,{\rm g}\,{\rm H} < 13.2\,{\rm g}\,{\rm Ca} < 35.5\,{\rm g}\,{\rm Cl}$







- 18. (a) HF is a molecular compound which dissolves as HF(*aq*). The dissolved HF *can* then react with the water according to the following reaction: HF(*aq*) + H₂O(*I*) → H₃O⁺(*aq*) + F⁻(*aq*)
 (b) 8.5 mM = 8.5 × 10⁻³ M
 (c) HF is a weak electrolyte. The initial concentration of HF was 0.4 M but only 0.0085 M has reacted → that is less
- than 100 % reaction but more than 0%. 19. (a) 21.4 mL
 - (b) 8.2 g of CaSO₄(s) forms; final concentrations are $[Cl^-] = 0.17$ M, $[Na^+] = 0.23$ M, $[SO_{4^{2-}}] = 0.03$ M
- 20. 4.2 mL
- 21. (a) 4.0×10^{-10} M, (b) 0.4 nM or 400 pM
- 22. 6×10^{17} molecules
- 23. (a) 4.76 mmol NaOH(*s*), because it took 4.76 mmol HCl to titrate (and so 4.76 mmol of OH- were present)
 (b) 52.1 %
- 24. 75 atm = 5.7×10^4 torr = 76 bar = 7600 kPa
- 25. (a) $2 \operatorname{NaN_3}(s) \rightarrow 2 \operatorname{Na}(s) + 3 \operatorname{N_2}(g)$ (b) 175.9 g
- 26. (a) $C_p = 5.1 \text{ J/K}$ (b) 2.0 g (c) 118 J/(mol K)
- 27. It takes 6580 L of O_2 at 1 bar 273 K to fully react with 1 gallon (23.2 moles) of octane. This means that it requires 31,333 L of air (or about 8,000 gallons of air).
- 28. (a) -3990 kJ
 - (b) -665 kJ
 - (c) 2660 kJ/mol
 - (d) -665 kJ/mol
- 29. $\Delta H_1 + 2\Delta H_3 (3/2)\Delta H_2 (1/2)\Delta H_4$
- 30. -154 kJ/mol
- 31. (a) -1470 kJ/mol(b) $q_v = -4875 \text{ J}$
- 32. (a) 138 kJ
 - (b) 3.5 g
 - (c) 290 L