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1. B. This statement is incorrect because there is one electron ejected per 1 photon absorbed. This does not change if the photon has a higher energy than the threshold frequency.

2. E. For this problem, the Clausius-Clapeyron equation should be used. The temperatures should be converted to K and the ΔH_{vap} to J/mol.

$\ln (P_2/P_1) = -\Delta H_{vap}/R\ (1/T_2 - 1/T_1)$
$\ln (401/P_1) = -\ 26x10^3/8.314\ (1/291 - 1/313)$
$P_1 = 853$ mmHg

3. E. One mole SO_2 only contains molecules of SO_2, no O_2.

4. B. The answer is Ti.

	Ca^{2+}	**Ti^{2+}**	V^{2+}	Sr^{2+}	Zr^{2+}
Protons	20	**22**	23	38	40
Electrons	18	**20**	21	36	38

5. C. mass/molecule = 2.77 g/$8.05x10^{21}$ = $3.44x10^{-22}$ g/molecule.
Mass single Xe = [131.3 g/mol][1 mol Xe / $6.022x10^{23}$] = $2.18x10^{-22}$ g/atom
Mass F = $3.44x10^{-22}$ g – $2.18x10^{-22}$ = $1.26x10^{-22}$ g of F.
Mass single F atom = 19.00 g / $6.022x10^{23}$ = $3.16x10^{-23}$ g
Number of F atoms = $1.26x10^{-22}$ / $3.16x10^{-23}$ = 4

6. B.

[100g soln/70 gHNO_3][63.02g HNO_3 / 1mol HNO_3][15.9 mol/1L soln][1L/1000 mL] = 1.43 g/mL

7. E. Use $M_1V_1 = M_2V_2$ to determine the volume left in the morning. (0.230 L)(0.275 M) = (xL)(1.10 M). x = 0.0575. So .230 L to start – 0.0575L left = 0.1725L = 173 mL

8. C. First, balance the equation: N_2 (g) + $3H_2$ (g) ➔ $2NH_3$ (g). Then calculate what the mass would be if it was 100% yield.

Mass = 15 kg NH_3[1000g/1kg][1mol NH_3/17g NH_3][1mol N_2/2mol NH_3]
[28g/1mol][1kg/1000g] = 12.4 kg

But the yield is only 82%: 12.4/82 = x/100. X=15.0 kg

9. C. $Fe(NO_3)_3$ (aq) + 3KOH (aq) ➔ $Fe(OH)_3$ (s) + $3KNO_3$ (aq)
KOH (aq) + HCl (aq) ➔ H_2O (l)

Total mol KOH = 0.009 mol
Total mol KOH reacted in acid/base reaction = (0.050)(0.125) = 0.00625 mol
Mol reacted with Fe^{3+} in ppt reaction = 0.009 mol – 0.00625 mol

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Mass $Fe(NO_3)_3$ = 0.00275 mol KOH [1mol $Fe(NO_3)_3$/3mol KOH][241.86g/1mol]= 0.222 g.

10. A. This reaction is dependent on the concentration of the solutions (intensive property). Therefore, the temperature change will be the same in both reactions.

11. D. Calculate number of moles of each atom.

mol C = 18.26 g/ 12.011 g mol^{-1} = 1.5203 mol C
mol O = 6.081 g/ 15.994 g mol^{-1} = 0.3801 mol O
mol N = 10.65 g/ 14.00 g mol^{-1} = 0.7607 mol N
mol H = 1.91 g/ 1.008 g mol^{-1} = 1.8948 mol H

Divide by the smallest value to get the empirical formula ie. divide each by 0.3801 mol. The empirical formula is $C_4H_5N_2O$ This formula weight is 97 g/mol. If the molecular weight is between 170 and 200 g/mol, then the molecular formula must be twice the empirical. $C_8H_{10}N_4O_2$.

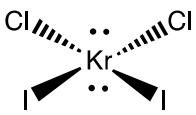
12. E. As (X=33) does not have any 4d electrons, so n = 4, l=2 is an invalid quantum number.

13. E. Use the Bohr equation: $\Delta E = B(1/n_f^2 - 1/n_i^2)$ To calculate ΔE, use Planck's equation.

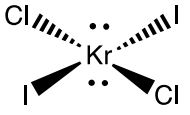
$\Delta E = h(c/\lambda) = 6.626x10^{-34}$ J s x $(3.0x10^8$ m $s^{-1}/93.8x10^{-9}$ m) = $2.119x10^{-18}$ J

$2.119x10^{-18}$ J = $-2.18x10^{-18}(1/n_f^2 - 1/1^2)$ $n_f = 6$

14. D. Both compounds are NOT polar. See structures below.

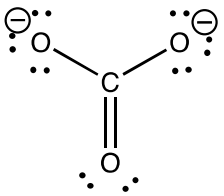


polar

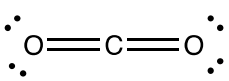


nonpolar

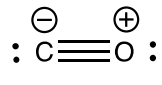
15. C. Bond length corresponds to bond order.



Bond order 1.3 (resonance)



2



3

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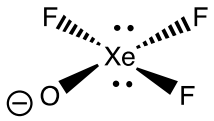
16. E. If the structure is square planar, it must have 2 lone pairs on the central atom. The only atom that provides enough electrons to meet this criteria is Xe.



17. B. The balanced equation is:

$5\ SO_3^{2-} + 2MnO_4^- + 6H^+ \rightarrow 5\ SO_4^{2-} + 2Mn^{2+} + 3H_2O$

18. B. Order can be determined either by looking at the units provided in the answers (☺) or by method of initial rates:

$$\left(\frac{1.62\ x\ 10^{-3}}{7.69\ x\ 10^{-4}}\right) = \left(\frac{0.450}{0.310}\right)^m$$

$2.10 = 1.45^x$
$m = 2$

Then take any one experiment and plug the data in to get the rate constant. Using the first experiment:

$1.62 \times 10^{-3} = k(.450\ M)^2$
$k = 0.008\ \text{L mol}^{-1}\text{s}^{-1}$

19. B. The rate law is determined from the slowest (ie. rate-determining) step. Only B has an elementary slow step with a rate law of $k[NO_2]^2$.

20. B. Acid b has an endpoint at the largest volume of NaOH.

21. E. Acid e is the weakest acid in the series and therefore has the strongest conjugate base.

22. E. In this case you are reacting 0.40 mol of a weak base with 0.2 mol of a strong acid (HCl). This will result in half of the base being converted to the conjugate acid and you will have a NH_3/NH_4^+ buffer system.

23. D. You need to calculate i (van Hoff factor).

$1.4 = (i)(1.35\ m)(0.52)$ i = 2. KCl ionizes into 2 ions in solution.

24. B. Only iv describes chemical property – the others describe physical properties of a bulk amount.

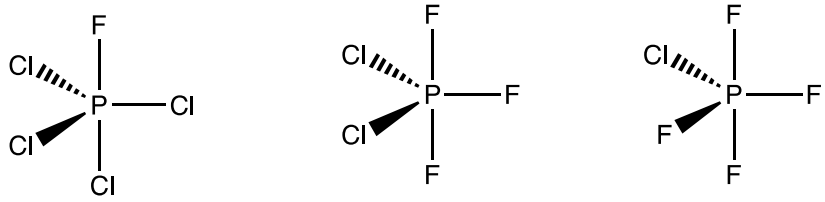
25. C. First calculate how much energy is released as the iron cools from 625°C to 100°C.
$q_{Fe} = (519\ g)(0.450)(100\text{-}625) = -122.613\ x10^3\ J$

Then determine how much energy is required to raise the temperature of the water to 25°C. q_{H2O} = (101)(4.18)(100-25) = 31663.5 J

Then calculate the excess energy to vaporize the water.
122.613 kJ – 31.6635 kJ = 90.95 kJ.

Then calculate the mass vaporized = 90.95 kJ[1 mol/40.6 kJ][18.01 g/mol] = 40.4 g.

26. C. There are 3. See polar structures below.



27. A. Qsp = $(Cd^{2+})(F^-)^2$ = (0.35M)$(0.20M)^2$ = 0.014. Therefore Qsp > Ksp and precipitation will occur.

28. D. There is a 1:2 ratio between M_2O_3:MS. Set x = MW of M

Moles M_2O_3 = 0.622 g/(2x+48) Moles MS = 0.685/(x+32.07)

1/2 = (0.622/(2x+48)) / ((0.685/(x+32.07)) Solve for x. x= 55.7 g/mol. This corresponds to Mn.

29. C. Use Boyle's Law and Dalton's Law of partial pressures.

(3L)(1.5 atm) = (5 L total)(P_2) (2L)(1 atm) = (5 L total)(P_2)
P_2 = 0.9 atm P_2 = 0.4 atm

P_{total} = 0.9 atm + 0.4 atm = 1.3 atm

30. B. Ammonia has 4 times as many atoms as Ne, so the same number of atoms will occupy ¼ the volume.

31. E. Negatively charged ions have the lowest ionization energies. O is lower than N (exception to periodic trend), and N^+ has the highest ionization energy.

32. A. Since -40°C is below the boiling point, the condensation will be spontaneous and ΔG is negative. ΔH for condensations are negative. The entropy decreases going from a gas to a liquid, so ΔS is negative.

33. B. The answer is B.

34. A. If there is .5 mol V and it takes 2 mole e-, there has to be a 4+ charge on V.

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35. E. pH is based on a logarithmic scale, so a change in pH of 3 units indicates a 1000-fold difference in H^+ concentration.

36. B. The substance with the highest vapor pressure will have the lowest normal boiling point.

37. E. Calcium nitrate has a van Hoff factor of 3, raising the boiling point of water the most.

38. A. The molecules do not have the same number of atoms.

39. E. The answer is E.

40. D. $Al_2(SO_4)_3$ has 3 sulfate ions. Moles sulfate=3(0.20)(0.030) = 0.018 moles