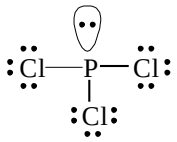
2018 WYSE State Chemistry Solution Set

Answer	Explanation
1. Answer is E.	CO_2 produces acid when water is added. All others produce base in aqueous solution.
2. Answer is B.	Oxidizing agents undergo reduction and reducing agents undergo oxidation. In this reaction N in NO_3^- went from +5 to +2 and S in H_2S went from –2 to 0
3. Answer is C.	PV = nRT produces $\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$. $\therefore P_2 = \frac{P_1V_1T_2}{V_2T_2} = \frac{1\text{ atm x }2.3\text{ L x }315\text{ K}}{4.5\text{ L x }308\text{ K}} = 0.52$ atm
4. Answer is D.	Use Hess' law for manipulation. $Na^+(g) + C\ell^-(g) \rightarrow \cancel{Na(g)} + \cancel{C\ell(g)}$ $\Delta H_1 = -147$ kJ $\cancel{Na(g)} + \cancel{C\ell(g)} \rightarrow \cancel{Na(s)} + \cancel{\frac{1}{2}C\ell_2(g)}$ $\Delta H_2 = -230$ kJ $\cancel{Na(s)} + \cancel{\frac{1}{2}C\ell_2(g)} \rightarrow NaC\ell(s)$ $\Delta H_3 = -411$ kJ $Na^+(g) + C\ell^-(g) \rightarrow NaC\ell(s)$ $\Delta H = -788$ kJ
5. Answer is C.	The other types of decays will cause a change in the mass (nucleon) number.
6. Answer is E.	<table><tr><th></th><th>N</th><th>H</th><th>C</th><th>O</th></tr><tr><td>mass, g</td><td>1.121</td><td>0.161</td><td>0.480</td><td>0.640</td></tr><tr><td>mol</td><td>0.080</td><td>0.159</td><td>0.040</td><td>0.040</td></tr><tr><td>ratio to fewest mol</td><td>2</td><td>4</td><td>1</td><td>1</td></tr></table>Empirical formula = CH_4N_2O
7. Answer is E.	$\upsilon = \frac{R_H}{h}\left[\frac{1}{n_{lo}^2} - \frac{1}{n_{hi}^2}\right] = \frac{2.18\text{ x }10^{-18}\text{J}}{6.626\text{ x }10^{-34}\text{J.s}}\left[\frac{1}{3^2} - \frac{1}{4^2}\right] = 1.60\text{ x }10^{14}\text{ s}^{-1}$ $\upsilon\lambda = c \quad \therefore \lambda = \frac{c}{\upsilon} = \frac{3.00\,x\,10^8\,m.s^{-1}}{1.60\text{ x }10^{14}.s^{-1}} = 1.88\text{ x }10^{-6}$ m
8. Answer is A.	By elimination, since all other responses are correct.
9. Answer is A.	When a central atom is surrounded by four electron groups, two being bonding pairs and two being nonbonding pairs the shape translates to "bent" according to the VSEPR model.
10. Answer is D.	The answer shows the increasing strength of intermolecular forces which correlates with the order of hardness and melting point.
11. Answer is C.	A strong acid and a weak base produces an acidic salt (strong dominates).
12. Answer is A.	$\frac{V_1}{V_2} = \frac{n_1}{n_2} \quad \therefore V_2 = \frac{V_1\text{ x }n_2}{n_1} = \frac{2.4\text{ L x }0.08\text{ mol}}{0.10\text{ mol}} = 1.9$ L
13. Answer is B.	By elimination, since all of the other answers are related to the spontaneity of a reaction.
14. Answer is B.	<table><tr><th></th><th>C</th><th>H</th><th>O</th></tr><tr><td>mass, g</td><td>75.7</td><td>8.80</td><td>15.5</td></tr><tr><td>mol</td><td>6.31</td><td>8.80</td><td>0.97</td></tr><tr><td>ratio to fewest mol</td><td>6.5</td><td>9.0</td><td>1</td></tr><tr><td>whole number ratio</td><td>13</td><td>18</td><td>2</td></tr></table>Simplest formula's ($C_{13}H_{18}O_2$) molar mass is 206 g/mol. The molar mass of the whole compound is 412 g/mol. Thus, the simplest formula occurs twice in the compound.
15. Answer is D.	For a value of n = 4, these are the only permissible "*l*" values.
16. Answer is C.	Na^+ is the spectator ion, since there has been no change in its oxidation state before and after the reaction.

17. Answer is D.		$PC\ell_3$ is trigonal pyramidal, with 3 bonding pair and one nonbonding pair of electrons around the P atom. This arrangement produces 107º angle between the bonds (little less than the ideal angle 109.5 º due to the presence of the nonbonding pair of electrons on the central atom.
18. Answer is B.	200 g Na x $\frac{1\text{ mol Na}}{23\text{ g Na}}$ x $\frac{1\text{ mol } Fe_2O_3}{6\text{ mol Na}}$ x $\frac{159.6\text{ g } Fe_2O_3}{1\text{ mol } Fe_2O_3}$ = 231 g **Fe_2O_3 used up.** ∴ **Left over** = 250 g – 231 g = 19 g.	
19. Answer is A.	Endothermic reactions are those where heat is absorbed.	
20. Answer is E.	Answer is self-explanatory.	
21. Answer is D.	The name heptane refers to a 7-carbon alkane. Trimethyl refers to the existence of three methyl groups ($-CH_3$) attached at carbons 2,2,4 of the heptane chain.	
22. Answer is C.	Isoelectronic configurations occur when two elements and/or ions have the same electronic configurations. C^{4+} would be isoelectronic with helium.	
23. Answer is A.	$\frac{7.62\text{ g}}{\text{cm}^3} \times \frac{1\text{ kg}}{1000\text{ g}} \times \frac{(100\text{ cm})^3}{(1\text{ m})^3} = 7.62 \times 10^3\ \text{kg/m}^3$	
24. Answer is B.	Both reflectivity and magnetism are classified as physical properties.	
25. Answer is A.	The formula for the polyatomic ion ammonium is NH_4^+. The formula for the polyatomic ion carbonate is CO_3^{2-}. Two ammonium ions are needed to balance one carbonate ion.	
26. Answer is D.	Atomic radius increases as you go down a group because each successive period has an additional occupied energy level (principal quantum number). The principal quantum number indicates energy levels as well as relative distance from the nucleus.	
27. Answer is B.	$\text{Mass percent} = \frac{\text{g solute}}{\text{g solution}}$ x 100 ∴ $7.0 = \frac{4.6\text{ g NaCl}}{\text{X g solution}}$ x 100	
28. Answer is E.	Equation for boiling point elevation = $\Delta T = i K_b \underline{m}$. All solutions are aqueous, so K_b does not need to be considered. Glucose does not ionize (i = 1), $CaCl_2$ makes 3 ions (i = 3), and KCl makes 2 ions (i = 2). Multiply molality by the van't Hoff factor (i).	
29. Answer is B.	Exothermic reactions have negative values for $\Delta H°$ and heat can be thought of as a product. If temperature is increased, the reaction will shift to the left, increasing the concentration of reactants. Therefore, the concentration of the only reactant, CO_2, would increase when the temperature is increased.	
30. Answer is E.	Follows integrated first-order rate law: $\ln[A]_t = -kt + \ln[A]_0$ $\ln[0.32] = -k(42.0\text{ min}) + \ln[0.45]$, solve for k $k = 8.12 \times 10^{-3}\ \text{min}^{-1}$ 90% complete leaves 0.045 *M* reactant $\ln[0.045] = -(8.12 \times 10^{-3})t + \ln[0.45]$ t = 284 minutes	
31. Answer is A.	Mass number is equal to the number of protons + neutrons. Therefore, there must be 13 protons present, which means there must be 13 electrons present in the atom. The element is Aℓ. When Aℓ forms an ion, it loses three of these electrons, for a total of 10 electrons.	
32. Answer is D.	(°F – 32) x 5/9 = °C (65 – 32) x 5/9 = 18 °C	°C + 273 = K 18 + 273 = 291 K

33. Answer is D.	Copper is a transition metal and requires the use of a Roman numeral when naming. The formula for cyanide is CN^-. Since there are two cyanide ions, copper would need to have a charge of 2+. Therefore, naming requires the use of the Roman numeral (II) after the copper name.
34. Answer is E.	The only property listed where lithium has a larger value than potassium is that of ionization energy. According to the trend, ionization energy increases as you go from left to right along a period and from bottom to top along a group. Lithium is above potassium on the periodic table.
35. Answer is C.	Solubility rules say "like dissolves like." Hexane is nonpolar and makes a good solvent for other nonpolar compounds. Of the compounds listed, the most nonpolar compound is the one that contains the most hydrocarbon content, and that is C.
36. Answer is B.	$\Delta T = i K_f \underline{m}$ 6.1 °C = (1) (30. °C kg mol^{-1}) (***x*** / 2.50 kg) 6.1 °C = (1) (12. °C mol^{-1}) (***x***) x = 0.51 mol 0.51 mol × 80.1 g/mol = 41 g
37. Answer is C.	$P_{H_2O} = P_{total} - P_{H_2}$ = (0.076−0.021) atm = 0.055 atm The equilibrium constant expression can be written, remembering that solids and pure liquids are ignored. $K_c = [H_2O]/[H_2]$ $K_p = (P_{H_2O})/(P_{H_2}) = K_p$ = (0.055 atm)/(0.021 atm) = 2.6
38. Answer is E.	A typical rate law can be expressed as: $\text{rate} = k[X]^A[Y]^B$ Since the reaction is found to be first order in X and second order in Y: $\text{rate} = k[X]^1[Y]^2$ Working with just units: $M/\text{s} = kM^1M^2 \quad \therefore \quad M/\text{s} = k\text{M}^3 \quad \therefore \quad \frac{M/\text{s}}{M^3} = k \quad \therefore \quad M^{-2}s^{-1} = k$
39. Answer is A.	Rutherford's experiment sent alpha particles at a thin sheet of gold. It was found that a small percentage of the particles were deflected, while a majority passed through the sheet. This caused Rutherford to conclude that the mass of an atom was concentrated at its center, known as the nucleus.
40. Answer is C.	Write ratios for the data from experiments 2 and 3 to determine the order with respect to B. Write ratios for the data from experiments 1 and 3 to determine the order with respect to A. $\frac{2.8\times10^{-3}M.\text{min}^{-1}}{7.0\times10^{-4}M.\text{min}^{-1}} = \frac{\text{k}[0.20]^{\text{n}}[0.60]^{\text{m}}}{\text{k}[0.20]^{\text{n}}[0.15]^{\text{m}}} \quad \therefore \text{m} = 1$ $\frac{6.3\times10^{-3}M.\text{min}^{-1}}{7.0\times10^{-4}M.\text{min}^{-1}} = \frac{\text{k}[0.60]^{\text{n}}[0.15]^{\text{m}}}{\text{k}[0.20]^{\text{n}}[0.15]^{\text{m}}} \quad \therefore \text{n} = 2$