**Sectional Chemistry Test – 2015**
**Answer Key**

| Question Number | Answer | Question Number | Answer |
|---|---|---|---|
| 1 | E | 21 | C |
| 2 | E | 22 | A |
| 3 | C | 23 | C |
| 4 | A | 24 | D |
| 5 | E | 25 | B |
| 6 | B | 26 | A |
| 7 | E | 27 | B |
| 8 | A | 28 | D |
| 9 | A | 29 | E |
| 10 | D | 30 | B |
| 11 | C | 31 | B |
| 12 | C | 32 | B |
| 13 | D | 33 | D |
| 14 | B | 34 | B |
| 15 | D | 35 | E |
| 16 | E | 36 | B |
| 17 | A | 37 | B |
| 18 | A | 38 | C |
| 19 | D | 39 | B |
| 20 | D | 40 | E |

**2015 WYSE Academic Challenge Sectional Chemistry Exam Solution Set**

1. E. The answer is supported by proper unit conversion as follows:
$2.50\ \text{mile}^2 \times \frac{(1.6093\ \text{km})^2}{(1\ \text{mile})^2} = 6.47\ \text{km}^2$

2. E. The answer is supported by this setup.
$q = mc\Delta t.\ \therefore 444.7\ \text{J} = 15.0\ \text{g}\ H_2O \times \frac{4.184\ \text{J}}{\text{g.°C}} \times (t_f - 22.0\ °\text{C}).\ \therefore t_f = 29.09\ °\text{C}$

3. C. Answer is C.

4. A. Answer is A. The net ionic equation is $Ca^{2+}(aq) + S^{2-}(aq) \rightarrow CaS(s)$

5. E. Calculations support this answer as shown in the following setup.
$36.86\ \text{g N} \times \frac{1\ \text{mol N}}{14.01\ \text{g N}} = \frac{2.63\ \text{mol}}{2.63\ \text{mol}} = 1.00 \times 2 = 2$ for the subscript of N
$63.14\ \text{g O} \times \frac{1\ \text{mol O}}{16.00\ \text{g O}} = \frac{3.95\ \text{mol}}{2.63\ \text{mol}} = 1.50 \times 2 = 3$ for the subscript of O
Explanation: The empirical formula is the lowest whole number mole ratio of the atoms, therefore the answer is: $N_2O_3$.

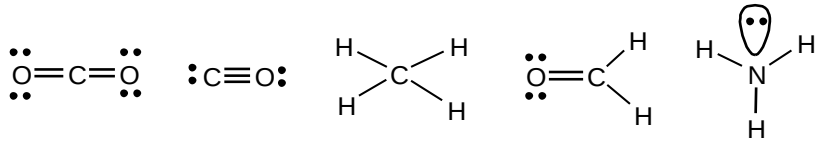
6. B. The answer is supported by the following setup.
$X_{N_2} = \frac{\text{mol } N_2}{\text{total mol}} = \frac{0.289\ \text{mol}}{(0.289+0.433)\ \text{mol}} = 0.400;\quad \therefore X_{O_2} = 1 - 0.400 = 0.600$

7. E. The answer is supported by the following setup.
$\frac{\text{mass, 6 H-atom}}{\text{mass, 1 } CH_3CH_2OH\text{-molecule}} \times 100 = \frac{6\ \text{amu}}{46\ \text{amu}} \times 100 = 13.0\%$

8. A. The concentration of $Cl^-$ ion will be twice of that of $Ca^{2+}$ due to the dissociation stoichiometry: $CaCl_2(aq) \rightarrow Ca^{2+}(aq) + 2\ Cl^-(aq)$.

9. A. Mg is oxidized in the reverse direction with $E^o = 2.37$ V (spontaneously). In that direction Mg will produce the largest voltage of all.

10. D. Only $CH_2O$ has trigonal planar geometry.



11. C. Answer is C.

12. C. $Cl^-$ ion is 18-electron species. The electron gain causes it to assume the electron configuration of Ar, the nearest noble gas.

13. D. Answer is D.

14. B. The answer is supported by the following setup.
pH = – log $[H^+]$ = – log (0.025 M) = 1.60; pOH = 14 – pH = 12.4

15. D. All formulas are correct; atoms are balanced, coefficients are the lowest whole number.

16. E. $CO_2$ (an acidic anhydride) from animal respiration will dissolve in water making it acidic due to the reaction: $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$.

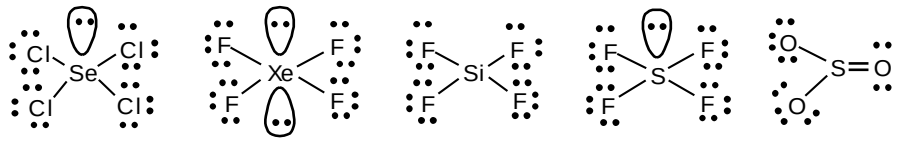
17. A. Lower pressure relates to higher volume. Higher volume will be utilized if the equilibrium shifts to the right where more gas molecules exist.

18. A. Answer is A.

19. D. The central atom S is surrounded by four electron domains, giving ~109.5º angle.

20. D. Overall it is <u>not</u> a second order reaction, but a third order one. Rate = $k[A]^0[B]^1[C]^2$

21. C. Only $SiF_4$ has tetrahedral angle (109.5º) according to the following drawings.




22. A. The answer is supported by this setup.
PV = nRT = $\frac{m}{M}$ RT; $D = \frac{m}{V} = \frac{PM}{RT} = \frac{660.0\ \text{mm Hg x } 70.9\ \text{g . mol}^{-1}}{0.0821\ \text{L . atm . mol}^{-1}\text{. K}^{-1}\ \text{x } 313\ \text{K}} \text{ x } \frac{1\ \text{atm}}{760\ \text{mm Hg}} = 2.40\ \text{g/L}$

23. C. Oxidation takes place at the anode with loss of electrons on the reactant side.

24. D. Answer is D.

25. B. The answer is supported by this setup.
$\Delta H_{rxn}$ = [(8 mol $\Delta H^o_f\ CO_2(g)$ + 9 mol $\Delta H^o_f\ H_2O(g)$] – [{1 mol $\Delta H^o_f\ C_8H_8(l)$}
+ (12½ mol $\Delta H^o_f\ O_2(g)$}] = [{8(–393.5)} + {9(–241.8)}] – [–269.7 + 0] = –5054.5 kJ

26. A. Answer is A.

27. B. The negative value of $\Delta G^o$ indicates spontaneity and negative value of $\Delta H^o$ indicates exothermic

28. D. $\Delta$ rate = $[C_2H_4]^1\ [Br_2]^2 = 2^1 \text{ x } 2^2 = 8$ times increase.

29. E. For first order reaction, $t_{1/2} = \frac{0.693}{k}$; $\therefore t_{1/2}$ is independent of initial concentration.

30. B. Answer is B.

31. B. Osmotic pressure of 0.10 M NaCl will be lower than that of 0.10 M $MgCl_2$ as it depends on the concentrations of the ionic particles.

32. B. Answer is B.

33. D. Pure solid and liquid do not appear in the equilibrium expressions.

34. B. Answer is B.

35. E. Pure water's pH decreases drastically and buffered water's pH remains nearly unchanged.

36. B. In complete ionization of $AB_2$, two mols of $B^-$ will be produced when one mol of $A^{2+}$ is produced in dissolution.

37. B. The answer is supported by this setup.
$\Delta E = hv = (6.626 \times 10^{-34}\ J.s) \times (1.11 \times 10^{14}\ s^{-1)} = 7.35 \times 10^{-20}\ J$

38. C. The answer is supported by this setup.
$PV = nRT;\ P_{tot} = \frac{nRT}{V_{tot}} = \frac{4\ mol \times 0.0821\ L\ .\ atm\ .\ mol^{-1}.\ K^{-1} \times 273\ K}{11.2\ L} = 8.00\ atm$
$x_{O_2} = 0.25;\ Po_2 = (P_{tot}\ .\ x_{O_2}) = 2.0\ atm$

39. B. Out of the given choices $CCl_3^-$ is produced in an earlier step and consumed at a later step following the property of an intermediate.

40. E. The answer is supported by this setup.
$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}\ ;\ \therefore V_2 = \frac{P_1V_1T_2}{P_2T_1} = \frac{4.25\ atm \times 3.8\ L \times 325\ K}{365\ K \times 1.75\ atm} = 8.42\ L$

References: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3. Chemistry, 5th edition, Martin Silberberg, McGraw Hill, 2009, 978-0073048598