Form Code X NAME________________________________________________________________________

CHM 2045, Spring 2018, Final Review Packet (Broward Teaching Center)

Final Packet Instructions: Do your best and do not be anxious. Read the question, re-read the question, write down all given or valuable information, and write down what you want to find. As on all graded events, the loving of moles applies.

1. Determine the simplest formula for a hydrocarbon if the complete combustion of a sample produces 5.28 g of CO2 and 2.7 g of H2O.
   (1) CH (2) C2H3 (3) CH3 (4) C2H5 (5) CH

2. If 5.76x1013 Argon atoms (spherical) were laid in a line, each touching the next, the line would measure 10.30 miles. What is the diameter of an Argon atom in Å?
   (1) 0.92 Å (2) 0.71 Å (3) 1.86 Å (4) 1.44 Å (5) 1.74 Å

3. Pure acetic acid (CH3COOH), known as "glacial" acetic acid, is a liquid with a density of 1.049 g/mL at 25°C. Calculate the molarity of a solution of acetic acid made by dissolving 20.00 mL of glacial acetic acid at 25°C in enough pure water to make 100.0 mL of solution.
   (1) 1.049 M (2) 2.098 M (3) 3.494 M (4) 0.6993 M (5) 1.747 M

4. Citric acid is a triprotic acid found in citrus fruits. A 40.00 mL solution containing an unknown concentration of citric acid is titrated with 22.62 mL of 0.2000 M NaOH solution. Calculate the molarity of the citric acid solution.
   (1) 0.1131 M (2) 0.07224 M (3) 0.03770 M (4) 0.1768 M (5) 0.05655 M

5. Predict the net ionic equation for precipitation of which solid (if any) when an aqueous solution of sodium chloride is mixed with an aqueous solution of magnesium sulfate.
   (1) MgSO4(aq) + 2NaCl(aq) → MgCl2(s) + Na2SO4(aq)
   (2) Mg2+(aq) + 2Cl−(aq) → MgCl2(s)
   (3) 2NaCl(aq) + MgSO4(aq) → Na2SO4(s) + MgCl2(aq)
   (4) 2Na+(aq) + SO42−(aq) → Na2SO4(s)
   (5) mixing these two aqueous solutions together would not be expected to result in a precipitate

6. Determine the mass percent composition of potassium chromate.
   (1) 26.6% K, 35.4% Cr, 38.1% O
   (2) 17.5% K, 46.6% Cr, 35.9% O
   (3) 40.3% K, 26.8% Cr, 33.0% O
   (4) 37.2% K, 24.7% Cr, 38.1% O
   (5) none of the above
7. A 110.64 g piece of pure metal "M" was heated to 100.°C and then immediately placed into an insulated cup (of negligible heat capacity) containing 100. g of pure water with an initial temperature of 25.0°C. When thermal equilibrium was reached, the temperature of the water was 29.3°C. Which of the following is the most likely identity of metal "M"? (density of water is 1.00 g/mL and specific heat capacity "s" of water is 4.184 J/°C•g)
(1) cadmium (s = 0.230 J/°C•g)
(2) cobalt (s = 0.419 J/°C•g)
(3) nickel (s = 0.509 J/°C•g)
(4) scandium (s = 0.586 J/°C•g)
(5) vanadium (s = 0.486 J/°C•g)

8. Consider the ground state electron configuration of chromium and select which of the following oxides is least likely to appear as a compound.
(1) CrO (2) Cr2O3 (3) CrO2 (4) Cr2O7 (5) CrO3

9. Consider separate 1L containers at 25°C, one filled with 10 g of H2 and one filled with 1 g of O2. Which of the following statements will necessarily be true?
(1) Both will have the same mass density due to Graham’s Law
(2) O2 will have a higher pressure
(3) O2 will have a higher average kinetic energy
(4) H2 will have a higher average velocity
(5) O2 will have a higher number of molecule

10. The laser emits photons with λ = 700 nm. How many photons from this laser would be required to heat 19.0 g of pure solid lead (specific heat capacity = 0.127 J/°C•g) from 25°C to its melting point (327°C)?
(1) 2.56 x 1021 photons (2) 5.18 x 1020 photons (3) 9.51 x 1023 photons
(4) 5.15 x 1023 photons (5) 6.62 x 1019 photons

11. Given the overall reaction, A + C → D + F, and the following mechanism, what is the rate law?
step 1: A ⇌ 2B (fast, equilibrium)
step 2: B + C → D + E (slow)
step 3: B + E → F (fast)
(1) k[A][C] (2) k[A]1/2[C] (3) k[B][C] (4) k[A]2[C] (5) k[A]1/2

12. Which set(s) give(s) the atoms/ions in order of increasing ionization energy?
I. H < B < C < F
II. C < O < N < F
III. Br < Cl < F < He
(1) I only (2) III only (3) I and II (4) I and III (5) II and III

13. In the properly-drawn Lewis structure for water, which of the following is true?
(1) the O atom is hybridized sp2 around which is exhibited a bent geometry
(2) the H atom is hybridized sp2 and its hybrid orbitals are oriented in a linear geometry
(3) the lone pairs on the Oxygen exist in a hybridized sp3 orbital
(4) the overall molecule is planar
(5) None of the Above
14. Which of the following is diamagnetic?

core: \( \sigma_1s < \sigma^*1s \) valence: \( \sigma_2s < \sigma^*2s < \sigma_2px < \pi_2py = \pi^*2py < \pi^*2pz < \sigma^*2px \)

(1) O\(_2\) (2) O\(_2^+\) (3) F\(_2\) (4) F\(_2^-\) (5) F\(_2^0\)

15. Predict the most acidic and the most basic oxide from among the following:

Al\(_2\)O\(_3\) SiO\(_2\) CO\(_2\) P\(_4\)O\(_{10}\) MgO Rb\(_2\)O N\(_2\)O\(_5\)

(1) most acidic = N\(_2\)O\(_5\); most basic = Rb\(_2\)O (2) most acidic = Al\(_2\)O\(_3\); most basic = MgO

(3) most acidic = CO\(_2\); most basic = SiO\(_2\) (4) most acidic = P\(_4\)O\(_{10}\); most basic = Rb\(_2\)O

(5) most acidic = N\(_2\)O\(_5\); most basic = MgO

16. Which of the following molecular geometry designations is incorrect?

(1) AsF\(_5\) is trigonal bipyramidal (2) SeO\(_3\) is trigonal planar (3) ICl\(_3\) is T-shaped

(4) TeF\(_4\) is square planar (5) SbH\(_3\) is trigonal pyramid

24. A pure liquid with \( \Delta H^\circ_{\text{vap}} = 48.5 \text{ kJ/mol} \) exhibits a vapor pressure of 60.0 Torr at 25.0°C. Based on these data, what is the normal boiling point of the liquid?

(1) 56°C (2) 69°C (3) 75°C (4) 83°C (5) 92°C

17. Which pair of aqueous solutions is given in order of increasing freezing point?

(1) 0.010m Na\(_3\)PO\(_4\) < 0.030m NaCl

(2) 0.020m NaI < 0.030m glucose

(3) 0.010m CaCl\(_2\) < 0.020m KCl

(4) 0.010m Na\(_3\)PO\(_4\) < 0.020m Na\(_3\)PO\(_4\)

(5) 0.020m glucose < 0.010m CaCl\(_2\)

18. What are the strongest types of intermolecular forces that must be overcome in order to: (a) evaporate isopentane \(((\text{CH}_3)_2\text{CHCH}_2\text{CH}_3)\) (b) boil Tert-Butanol \((\text{CH}_3)_3\text{COH}\) (c) boil water

(1) (a) dispersion (b) dipole induced (c) dipole-dipole

(2) (a) dispersion (b) H-Bond induced (c) H-Bond

(3) (a) dispersion (b) H-Bond (c) dipole-dipole

(4) (a) dipole-dipole (b) H-Bonding (c) H-bonding

(5) (a) dispersion (b) H-Bonding (c) H-bonding

19. Palladium crystallizes in a face-centered cubic unit cell. Its density is 12.023 g/cm\(^3\). Calculate the atomic radius of palladium.

1) 1.3748 x \(10^{-8}\) cm

2) 3.88845 x \(10^{-8}\) cm

3) 5.8793545 x \(10^{-23}\) cm

4) 7.068748 x \(10^{-22}\) cm

5) 1.767187 x \(10^{-22}\) cm
20. Nickel crystallizes in a face-centered cubic structure with an edge length $a = 388$ pm. Based on this information, calculate the approximate density of nickel.

(1) 6.8  (2) 2.4  (3) 9.3  (4) 8.7  (5) 7.6

21. Which of the following is not true?

(1) 0.12 m $\text{Na}_2\text{SO}_4$ has a higher boiling point than 0.12 m KBr
(2) 0.10 m $\text{CaCl}_2$ has a lower freezing point than 0.20 m $\text{HOCH}_2\text{CH}_2\text{OH}$
(3) According to the phase diagram, the solid has a lower density than the liquid.
(4) According to the phase diagram, the temperature corresponding to Point E is the normal boiling point.
(5) All of the following are true.

22. Which of the following substances exhibits hydrogen-bonding intermolecular forces in its liquid state? (1) CH$_3$NH$_2$ (2) CH$_3$OCH$_3$ (3) CH$_3$F (4) H$_2$S (5) (CH$_3$)$_3$N

23. Which member in each pair has the highest vapor pressure at a given temperature? A: C$_2$H$_6$ or C$_4$H$_{10}$ B: CH$_3$CH$_2$OH or CH$_3$CH$_2$F C: NH$_3$ or PH$_3$

(1) C$_2$H$_6$, CH$_3$CH$_2$OH, NH$_3$
(2) C$_2$H$_6$, CH$_3$CH$_2$F, PH$_3$
(3) C$_4$H$_{10}$, CH$_3$CH$_2$F, PH$_3$
(4) C$_2$H$_6$, CH$_3$CH$_2$F, NH$_3$
(5) C$_4$H$_{10}$, CH$_3$CH$_2$OH, NH$_3$

24. Select the pair of substances in which the one with the lowest normal boiling point is listed first. (1) C$_7$H$_{16}$, C$_5$H$_{12}$ (2) Xe, Kr (3) H$_2$O, H$_2$S (4) CH$_3$CH$_2$OH, CH$_3$-O-CH$_3$ (5) CF$_4$, CCl$_4$

25. Which of the following aqueous solutions has the highest normal boiling point? Assume ideal solutions where ionic compounds dissociate completely into ions in water.

(1) 0.20 m glucose (2) 0.12 m Na$_2$SO$_4$ (3) 0.10 m CaCl$_2$ (4) 0.12 m KF (5) 0.10 m NaCl
GOOD LUCK, SMILE ON THE EXAM, and remember to love your moles: all $6.022 \times 10^{23}$ of them!

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