Chem1B, Fall15, MC, FinalTest Name________________________________

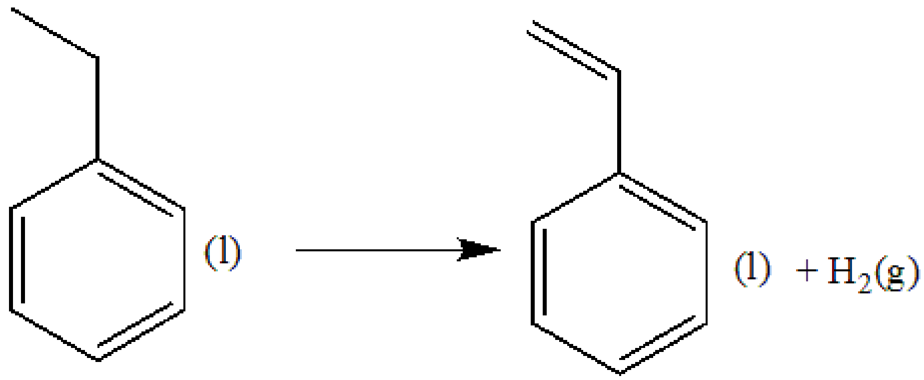
Read the questions carefully to understand it, before answering on the question paper. Write clearly and concisely. Write set-up equation, then put the raw numbers with units before doing your calculation. Use the reverse side of your answer paper as scratch. Ask your instructor if you don't understand anything. A periodic table & some formulas are on the back. (Total pts.= 64 + (3*26=) 78 = 144).

SHORT ANSWER. To get full points, show all your work in details with set up equation and units.

1) Calculate the pH of a 0.075M acetic acid (CH_3COOH) solution. For your calculation show what happens in a stepwise fashion, with ICE chart if necessary . ($K_a = 1.8 \times 10^{-5}$) (6 pts.) 1) _______________

2) Calculate the pH of a buffer solution that has 0.075M ammonium chloride and 0.065M ammonia. ($K_a = 5.6 \times 10^{-10}$) (6 pts.) 2) _______________

3) Styrene is produced by catalytic dehydrogenation at high temperatures based on the reaction below. Calculate the $\Delta_r G°$ (kJ/mol) and the equilibrium constant, K, at 25°C (6 pts.). Is the reaction spontaneous at 25°C using the following information in the table below (2 pts.) (Total 8 pts.)? 3) ____________



ethylbenzene, C_8H_{10} styrene, C_8H_8

	ethylbenzene (l)	styrene (l)	hydrogen (g)
$\Delta_f H°(kJmol^{-1})$	-12.5	103.8	0
$S°(Jmol^{-1}K^{-1})$	255	238	130.6

4) Benzoic acid is a monoprotic acid. A student dissolves 0.25g of benzoic acid ($C_6H_5CO_2H$) in 1.00 x 10^2 mL of water. The student titrates the benzoic acid solution with 0.15M NaOH solution. What is the pH of the solution at the equivalence point? ($K_a = 6.4 \times 10^{-5}$) (10 pts.) 4) ____________

5) The molecule 2-chloro-4-methylhexane, the product, is made by addition of HCl to an alkene, the reactant . Write a balanced chemical equation using condensed or skeleton structures of the reactants (3 pts.) and products (3 pts.) for this reaction. Also name the reactant (3 pts.) (10 pts. tot.). 5) ____________

6) The amount of fissionable material necessary to maintain a chain reactions is called the __________ . (2 pts) 6) ____________

7) What is the coordination number of the iron atom in $CaNa[Fe(CN)_6]$ (2 pts.)? 7) ____________

8) The most common coordination numbers are __________ (4 pts.). 8) ____________

9) Strontium-90 is a byproduct in nuclear reactors fueled by the radioisotope uranium-235. The half-life of strontium-90 is 28.8 yr. What percentage of a strontium-90 sample remains after 70.0 yr (8 pts.)? 9) ______________

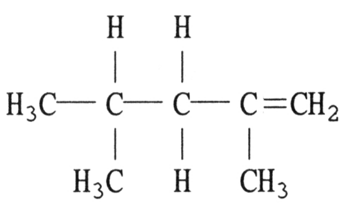
10) Write d electron configuration of the metal ion (2 pts.), draw the crystal-field energy-level diagrams (to the right of the formula, 1 pt.) and show the placement of electrons (1 pts.) for the following complexes: (2 x 4 = 8 pts. total) 10) ______________

(a) $[VCl_6]^{3-}$

(b) $[FeF_6]^{3-}$ (a high-spin complex)

MULTIPLE CHOICE. On your scantron start from line 14 to answer the questions. Choose the one alternative that best completes the statement or answers the question (3 pts each).

11) What is the name of the compound below? 11) ______



A) 2,4-methylbutene
B) 2,4-ethylbutene
C) 2,4-dimethyl-1-pentene
D) 2,5-dimethylpentane
E) 2,4-dimethyl-4-pentene

12) $C_{12}H_{26}$ molecules are held together by _________. 12) ______

A) ion-ion interactions
B) dispersion forces
C) ion-dipole interactions
D) hydrogen bonding
E) dipole-dipole interactions

13) Large intermolecular forces in a substance are manifested by _________. 13) ______

A) high boiling point
B) high heats of fusion and vaporization
C) low vapor pressure
D) high critical temperatures and pressures
E) all of the above

14) One difference between first- and second-order reactions is that _________. 14) ______

A) the rate of both first-order and second-order reactions do not depend on reactant concentrations
B) the rate of a first-order reaction depends on reactant concentrations; the rate of a second-order reaction does not depend on reactant concentrations
C) a first-order reaction can be catalyzed; a second-order reaction cannot be catalyzed
D) the half-life of a first-order reaction does not depend on $[A]_0$; the half-life of a second-order reaction does depend on $[A]_0$
E) None of the above are true.

15) Given the following reaction at equilibrium, if $K_c = 6.44 \times 10^5$ at 230.0°C, K_p = _________. 15) ______

$$2NO\,(g) + O_2\,(g) \rightleftharpoons 2NO_2\,(g)$$

A) 2.67×10^7
B) 3.67×10^{-2}
C) 6.44×10^5
D) 1.56×10^4
E) 2.66×10^6

16) A saturated solution _________. 16) ______

A) cannot be attained
B) contains no double bonds
C) contains dissolved solute in equilibrium with undissolved solute
D) contains as much solvent as it can hold
E) will rapidly precipitate if a seed crystal is added

17) Calculate the molality of a 25.4% (by mass) aqueous solution of phosphoric acid (H_3PO_4). 17) ______

A) 25.4 m
B) 2.59 m
C) 4.45 m
D) 3.47 m
E) The density of the solution is needed to solve the problem.

18) For a first-order reaction, a plot of _________ versus _________ is linear. 18) ______

A) $t, \frac{1}{[A]_t}$ B) $\frac{1}{[A]_t}, t$ C) $\ln [A]_t, \frac{1}{t}$ D) $\ln [A]_t, t$ E) $[A]_t, t$

19) What change will be caused by addition of a small amount of HCl to a solution containing fluoride ions and hydrogen fluoride? 19) ______

A) The concentration of fluoride ions will increase as will the concentration of hydronium ions.
B) The concentration of hydronium ions will increase significantly.
C) The concentration of fluoride ion will decrease and the concentration of hydrogen fluoride will increase.
D) The concentration of hydrogen fluoride will decrease and the concentration of fluoride ions will increase.
E) The fluoride ions will precipitate out of solution as its acid salt.

20) Formation of solutions where the process is endothermic can be spontaneous provided that _________. 20) ______

A) the solvent is water and the solute is a gas
B) they are accompanied by another process that is exothermic
C) they are accompanied by an increase in disorder
D) the solvent is a gas and the solute is a solid
E) they are accompanied by an increase in order

21) The half-reaction occurring at the anode in the balanced reaction shown below is _________. 21) ______

$$3MnO_4^- (aq) + 24H^+ (aq) + 5Fe (s) \rightarrow 3Mn^{2+} (aq) + 5Fe^{3+} (aq) + 12H_2O (l)$$

A) $MnO_4^- (aq) + 8H^+ (aq) + 5e^- \rightarrow Mn^{2+} (aq) + 4H_2O (l)$
B) $Fe (s) \rightarrow Fe^{3+} (aq) + 3e^-$
C) $Fe^{2+} (aq) \rightarrow Fe^{3+} (aq) + e^-$
D) $2MnO_4^- (aq) + 12H^+ (aq) + 6e^- \rightarrow 2Mn^{2+} (aq) + 3H_2O (l)$
E) $Fe (s) \rightarrow Fe^{2+} (aq) + 2e^-$

Table 20.2

Half-reaction	E° (V)
$Cr^{3+} (aq) + 3e^- \rightarrow Cr (s)$	-0.74
$Fe^{2+} (aq) + 2e^- \rightarrow Fe (s)$	-0.440
$Fe^{3+} (aq) + e^- \rightarrow Fe^{2+} (s)$	+0.771
$Sn^{4+} (aq) + 2e^- \rightarrow Sn^{2+} (aq)$	+0.154

22) The standard cell potential ($E°_{cell}$) for the voltaic cell based on the reaction below is _________ V. 22) ______

$$Sn^{2+} (aq) + 2Fe^{3+} (aq) \rightarrow 2Fe^{2+} (aq) + Sn^{4+} (aq)$$

A) +0.46 B) -0.46 C) +1.39 D) +0.617 E) +1.21

23) Consider an electrochemical cell based on the reaction: 23) ______

$$2H^{+} (aq) + Sn (s) \rightarrow Sn^{2+} (aq) + H_2 (g)$$

Which of the following actions would <u>not</u> change the measured cell potential?

A) increasing the tin (II) ion concentration in the anode compartment
B) lowering the pH in the cathode compartment
C) increasing the pressure of hydrogen gas in the cathode compartment
D) addition of more tin metal to the anode compartment
E) Any of the above will change the measured cell potential.

24) Nuclei above the belt of stability can lower their neutron-to-proton ratio by __________. 24) ______

A) gamma emission
B) beta emission
C) positron emission
D) electron capture
E) Any of the above processes will lower the neutron-to-proton ratio.

25) How many neutrons are emitted when a californium-249 nucleus (Z=98) is bombarded with a carbon-12 nucleus to produce a $^{257}_{104}Rf$ nucleus? 25) ______

A) one B) four C) zero D) three E) two

26) ^{131}I has a half-life of 8.04 days. Assuming you start with a 1.53 mg sample of ^{131}I, how many mg will remain after 13.0 days? 26) ______

A) 0.835 B) 0.268 C) 0.422 D) 0.499 E) 0.440

27) The mass of a proton is 1.00728 amu and that of a neutron is 1.00867 amu. What is the mass defect (in amu) of a $^{60}_{27}Co$ nucleus? (The mass of a cobalt-60 nucleus is 59.9338 amu.) __________.? 27) ______

A) 27.7830 B) 0.4827 C) 0.0662 D) 0.5489 E) 0.5405

28) Which one of the following ions <u>cannot</u> form both a high spin and a low spin octahedral complex ion? 28) ______

A) Cr^{3+} B) Cr^{2+} C) Mn^{3+} D) Co^{2+} E) Fe^{3+}

29) A complex that absorbs light at 700 nm will appear __________. 29) ______

A) yellow B) violet C) red D) orange E) green

30) Which one of the following substances has three unpaired d electrons? 30) ______

A) $[Ag(NH_3)_2]^{+}$
B) $[Zn(NH_3)_4]^{2+}$
C) $[Cr(CN)_6]^{3-}$
D) $[V(H_2O)_6]^{4+}$
E) $[Cu(NH_3)_4]^{2+}$

TRUE/FALSE. Circle 'A' if the statement is true and 'B' if the statement is false (3 pts each).

31) A solution with a solute concentration greater than the solubility is called a supercritical solution. 31) ______

32) The value of the boiling-point-elevation constant (K_b) depends on the identity of the solvent. 32) _______

33) The solubility of slightly soluble salts containing basic anions is proportional to the pH of the solution. 33) _______

34) Rates of reaction can be positive or negative. 34) _______

35) Transition metal complexes are colored because of the energy gap between the d orbitals. 35) _______

36) Positron emission causes a decrease of one in the atomic number. 36) _______