

NAME: _____

10 pages
2.5 hours

BLUEVALE COLLEGIATE INSTITUTE SCH4UI PRACTICE EXAM

Friday, January 27, 2012, 8:30am-11:00am

- You may use a(n) i) non-programmable calculator, ii) exam aid sheet (8.5 x 11 double sided, must be handed in with exam), iii) periodic table provided.
- No other electronic devices are permitted.
- Keep your eyes on your own exam, looking at others' exams may result in a mark of ZERO!

PART A: Multiple Choice # (1-50)		50 marks
PART B: Quicks # (51-70)		20 marks
PART C: Calculations # (71-80)		80 marks
Total:		150 marks

Part A: Multiple Choice. Identify the letter of the choice that best completes the statement or answers the question.
Transfer your answer on to the scantron card provided.

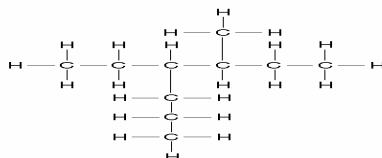
____ 1. Name $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$.

- iso-ethanol
- tertiary-propanol
- butanol
- propanol
- 2-propanol

____ 2. Which organic compound is saturated?

- ethylcyclopentane
- 2-methyl-3-ethylpentene
- 1,1-dimethylhexane
- cyclohexane
- 1,3,5-trimethyl-2-octene

____ 3. Name the following compound.

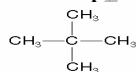


- 4-ethyl-3-methylheptane
- 4-methyl-3-propylhexane
- 3-propyl-4-methylhexane
- 4-ethyl-3-methylhexene
- 3-ethyl-4-propylheptane

____ 4. Which feature do all aromatic hydrocarbons have?

- an amine group
- halogens
- a benzene ring structure
- an aldehyde group
- all double bonds in a ring

____ 5. Which compound is a structural isomer of the compound shown below?



- propane
- butane
- methane
- pentane
- hexane

____ 6. Which statement describes an oxidation reaction in organic chemistry?

- The product has fewer carbon-oxygen bonds than the reactant.
- The product has one methyl group more than the reactant.
- The product has more carbon-oxygen bonds than the reactant.
- The product has more carbon-hydrogen bonds than the reactant.
- Ring structures usually form.

____ 7. What forms when water reacts with an alkene?

- an ester
- an acid
- an alcohol
- an amine
- a ketone

____ 8. Which of the following statements is false?

- Different compounds with the same molecular formula are called isomers.
- The most common intermolecular force for organic molecules is hydrogen bonding.
- The carbon atoms of organic compounds may join together in long chains or rings.
- In an electron-dot formula, four dots between a pair of atoms represents a double bond.

e. Alkanes, alkenes, and alkynes are all aliphatic hydrocarbons.

- ____ 9. Considering the same number of carbons, which molecule would have the highest boiling point?
- alkane
 - aromatic
 - alcohol
 - amine
 - ether
- ____ 10. Which of the following statements is false?
- In general, as the number of carbon atoms increases, we observe an increase in boiling points.
 - In the alkane class, branched chain isomers have higher boiling points than their straight-chain isomers.
 - Molecules of straight-chain alkanes are tetrahedral at each carbon.
 - As dispersion forces are the only type of intermolecular force between alkane molecules, alkanes would not be miscible with water.
 - Because of the weak intermolecular forces, alkanes have low densities compared to water.
- ____ 11. An electron has the following set of quantum numbers:
- $$n = 3, l = 1, m_l = 1, m_s = +\frac{1}{2}$$
- In which orbital is this electron found?
- 3s
 - 3p
 - 3d
 - 3f
 - 4p
- ____ 12. Which set of quantum numbers is not possible?
- $n = 3, l = 0, m_l = 0, m_s = \frac{1}{2}$
 - $n = 5, l = 3, m_l = 2, m_s = \frac{1}{2}$
 - $n = 4, l = 3, m_l = -1, m_s = -\frac{1}{2}$
 - $n = 5, l = 3, m_l = -3, m_s = -\frac{1}{2}$
 - $n = 4, l = 4, m_l = 2, m_s = -\frac{1}{2}$
- ____ 13. What did Heisenberg contribute to the quantum mechanical model of the atom?
- Uncertainty principle
 - Hund's rule
 - Aufbau principle
 - Wave equation
- ____ 14. What did Schrodinger contribute to the quantum mechanical model of the atom?
- Uncertainty principle
 - Hund's rule
 - Aufbau principle
 - Wave equation
- ____ 15. Which electron configuration represents a reactive non-metallic element?
- $1s^2 2s^2 2p^6 3s^2 3p^5$
 - $1s^2 2s^2 2p^6 3s^2 3p^1$
 - $1s^2 2s^2 2p^6 3s^2$
 - $1s^2 2s^2 2p^6 3s^2 3p^6$
 - $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- ____ 16. What is the maximum number of electrons in $n = 3$?
- 2
 - 3
 - 6
 - 9
 - 18
- ____ 17. Which sublevel, when full, corresponds to the lanthanide series of elements?
- 3d
 - 3f
 - 4d
 - 4f
 - 5f
- ____ 18. Which element has the highest electron affinity?
- Li
 - N
 - O
 - F
 - Ni
- ____ 19. Which pair of atoms and/or ions is isoelectric?
- O^{2-} and Cl^-
 - Ca^{2+} and Cl^-
 - F^- and N^{2-}
 - Li^+ and Na^+
 - K^+ and Kr
- ____ 20. Which element has the lowest first ionization energy?
- Ca
 - Cs
 - Br
 - O
 - Ba
- ____ 21. A 20.0 g sample of aluminum is cooled 7.5°C. The specific heat capacity of aluminum is 0.900 J/g•°C. What is the energy change for this sample?
- 140 kJ
 - 140 kJ
 - 1.4 kJ
 - 140 J
 - 140 J

22. Which statement describes an exothermic reaction?
- The energy absorbed in bond breaking is more than the energy released in bond formation.
 - The energy absorbed in bond breaking is less than the energy released in bond formation.
 - The system absorbs energy.
 - The surroundings cool down.
 - The potential energy of the reactants is less than the potential energy of the products.
23. Which statement does not describe an endothermic reaction?
- The surroundings cool down.
 - $\Delta H^\circ_{\text{rxn}}$ is positive.
 - Heat is released by the system.
 - Heat is absorbed by the system.
 - The potential energy of the products is greater than the potential energy of the reactants.
24. Which expression does not represent the rate of the following reaction?
- $$\text{Mg}_{(s)} + 2\text{HCl}_{(aq)} \rightarrow \text{MgCl}_{2(aq)} + \text{H}_{2(g)}$$
- $\frac{\Delta[\text{Mg}]}{\Delta t}$
 - $\frac{\Delta[\text{H}_2]}{\Delta t}$
 - $-\frac{1}{2} \left(\frac{\Delta[\text{HCl}]}{\Delta t} \right)$
 - $\frac{\Delta[\text{MgCl}_2]}{\Delta t}$
25. In the following reaction, what is equal to the rate of production of NO gas?
- $$4\text{NH}_{3(g)} + 5\text{O}_{2(g)} \rightarrow 4\text{NO}_{(g)} + 6\text{H}_2\text{O}_{(g)}$$
- the rate of production of NH_3 gas
 - one third the rate of production of water
 - four fifths the rate of disappearance of O_2 gas
 - one quarter the rate of disappearance of NH_3 gas
 - six times the production of water vapour
26. In the following reaction, butane is consumed at the rate of $0.0333 \text{ mol}/(\text{L}\cdot\text{s})$. Determine the rate at which CO_2 is produced.
- $$\text{C}_4\text{H}_{10(g)} + \frac{13}{2}\text{O}_{2(g)} \rightarrow 4\text{CO}_{2(g)} + 5\text{H}_2\text{O}_{(g)}$$
- $0.00825 \text{ mol}/(\text{L}\cdot\text{s})$
 - $0.0165 \text{ mol}/(\text{L}\cdot\text{s})$
 - $0.0333 \text{ mol}/(\text{L}\cdot\text{s})$
 - $0.0667 \text{ mol}/(\text{L}\cdot\text{s})$
 - $0.133 \text{ mol}/(\text{L}\cdot\text{s})$
27. Which statement about the factors that affect reaction rates is false?
- Decreasing the concentrations of the reacting particles decreases the chance of collision.
 - A collision with poor orientation requires a higher activation energy than a collision with optimum orientation.
 - Increasing the pressure in a gaseous reaction increases the chance of collision.
 - A reaction occurs every time particles of the reactants collide.
 - Increasing the temperature increases the reaction rate.
28. Given the following reaction mechanism, what is the equation for the overall reaction?
- $$\begin{aligned} 2\text{A} &\rightarrow \text{B} + 2\text{C} \text{ (slow)} \\ \text{B} + \text{C} &\rightarrow \text{D} + \text{E} \text{ (fast)} \\ \text{C} + \text{D} &\rightarrow \text{E} + \text{F} \text{ (fast)} \end{aligned}$$
- $2\text{A} \rightarrow 2\text{E} + \text{F}$
 - $2\text{A} + \text{B} + 2\text{C} \rightarrow \text{D} + 2\text{E} + \text{F}$
 - $2\text{A} + 2\text{C} \rightarrow 2\text{E} + \text{F}$
 - $2\text{A} + \text{C} \rightarrow 2\text{E} + \text{F}$
29. Which quantity does not increase when the temperature of a reaction system is raised?
- activation energy
 - # of collisions
 - # of effective collisions
 - average kinetic energy of the particles
30. Which statement about the instantaneous rate of a reaction is not correct?
- The higher the rate, the greater is the slope of a line on a concentration-time graph.
 - The instantaneous rate is the slope of the tangent to a line on a concentration-time graph.
 - The instantaneous rate is the slope of the secant to a line on a concentration-time graph.
 - The instantaneous rate decreases over time.
31. A reaction quotient is calculated to be 3.2×10^{-5} . The equilibrium constant for the same reaction is 5.4×10^{-5} . Which statement is correct?
- The system is at equilibrium.
 - The concentrations of the products are greater than their concentrations at equilibrium.
 - The system will attain equilibrium by moving to the right.
 - The system will attain equilibrium by moving to the left.
32. What will happen if the pH of the following equilibrium system is increased?
- $$\text{H}^+_{(aq)} + 2\text{CrO}_4^{2-}_{(aq)} \rightleftharpoons \text{Cr}_2\text{O}_7^{2-}_{(aq)} + \text{OH}^-_{(aq)}$$
- yellow orange
- The solution will turn yellow.
 - The solution will turn a darker orange.
 - The concentration of $\text{H}^+_{(aq)}$ will decrease.
 - All hydroxide ion will be used up.
 - The concentration of $\text{OH}^-_{(aq)}$ will increase.

33. Use Le Châtelier's principle to predict what will happen if CoCl_4^{2-} is added to the following equilibrium system. $\text{Co}(\text{H}_2\text{O})_6^{2+}(\text{aq}) + 4\text{Cl}^-(\text{aq}) \rightleftharpoons \text{CoCl}_4^{2-}(\text{aq}) + 6\text{H}_2\text{O}(\text{l})$
pink purple/blue
a. The solution will become more pink. c. The concentration of chloride will decrease.
b. The solution will become more purple. d. The pH of the system will increase.
34. If the equation in question 33 had a K_c of 0.1, the reaction vessel would appear
a. colourless b. blue c. pink d. purple/blue
35. What will happen to the following equilibrium if an inert gas is added while the volume remains constant?
 $2\text{IBr}(\text{g}) \rightleftharpoons \text{I}_2(\text{g}) + \text{Br}_2(\text{g})$
a. The concentration of IBr will increase. c. There will be no change to the equilibrium system.
b. The concentration of I_2 will increase. d. The concentration of Br_2 will decrease.
36. If the equation in question 35 has the pressure increased, what will happen to the equilibrium?
a. The concentration of IBr will increase. c. The concentration of I_2 will increase.
b. The concentration of Br_2 will decrease. d. There will be no change to the equilibrium system.
37. What is the relationship between the ion product and the solubility product constant when a precipitate forms?
a., $Q_{\text{sp}} > K_{\text{sp}}$ b., $Q_{\text{sp}} \leq K_{\text{sp}}$ c., $Q_{\text{sp}} < K_{\text{sp}}$ d., $Q_{\text{sp}} = K_{\text{sp}}$
38. What is the conjugate acid of $\text{H}_2\text{PO}_4^{-(\text{aq})}$?
a. $\text{H}_3\text{O}^+(\text{aq})$ b. $\text{OH}^-(\text{aq})$ c. $\text{H}_3\text{PO}_4(\text{aq})$ d. $\text{HPO}_4^{2-}(\text{aq})$
39. What is the conjugate acid of $\text{H}_2\text{PO}_4^{-(\text{aq})}$?
a. $\text{H}_3\text{O}^+(\text{aq})$ b. $\text{OH}^-(\text{aq})$ c. $\text{H}_3\text{PO}_4(\text{aq})$ d. $\text{HPO}_4^{2-}(\text{aq})$
40. What is the Brønsted-Lowry definition of a base?
a. a substance that accepts protons c. a substance that dissolves in water to form H^+ ions
b. a substance that donates protons d. a substance that dissolves in water to form OH^- ions
41. What is the oxidation number of P in PO_3^{3-} ?
a. -6 c. +3
b. -3 d. +6
e. +5
42. How does the oxidation number of Bi change when BiO_3^- reacts to form $\text{Bi}(\text{OH})_3$?
a. decreases by 3 c. no change
b. decreases by 2 d. increase by 1
e. increases by 4
43. Using the following reaction, identify the OXIDIZING agent.
 $5\text{VO}^{2+} + \text{MnO}_4^- + \text{H}_2\text{O} \rightarrow 5\text{VO}_2^+ + \text{Mn}^{2+} + 2\text{H}^+$
a. Mn b. O c. V d. H e. not a redox reaction
44. Which substance is the strongest oxidizing agent?
a. Fe c. Cu^{2+}
b. Br_2 d. Zn^{2+}
e. H_2
45. What does the double line || represent in galvanic cell notation?
a. change in phase c. separation of electrodes
b. the anode d. salt bridge
e. electrolyte
46. Electrons leave the cathode of a battery and return through the anode.
a. true b. false
47. In a galvanic cell, oxidation occurs at the cathode.
a. true b. false
48. Corrosion will occur in aluminum faster than in iron because aluminum is higher on the activity series.
a. true b. false
49. The oxidation number of an element increases as the element is oxidized
a. true b. false
50. Reduction refers to the loss of electrons.
a. true b. false

Part B: Quicks: Complete the following Quicks in the space provided. (20)

51. The IUPAC name of $\text{H}_3\text{C} - \text{O} - \text{CH}_2\text{CH}_3$ is _____
52. Ketones are reduced to produce _____
53. Aldehydes are oxidized to produce _____
54. The IUPAC name of the smallest possible carboxylic acid _____
55. The name of the product formed from the condensation of propanoic acid and N-ethylbutanamine

56. What is another correct name for methylethanoate? _____
57. Write the electron configuration for Cl^- _____
58. Write the principle level distribution for Ag^+ _____
59. What ion or atom has the principle level distribution $[\text{Ar}] 4s^2$, charge = 4^+ ? _____
60. When thermochemical equations are added to find ΔH of an unknown reaction is using _____
61. If the temperature of 50 g of water increased by 7°C , $Q_{\text{gained}} =$ _____
62. Reactions that make up steps in a reaction mechanism are called _____
63. A catalyst (lowers ΔH OR lowers **activation energy**) circle one _____
64. The units for the rate constant, k of a third order overall reaction is _____
65. In an exothermic reaction the equation for ΔH with respect to E_a forward and E_a reverse is _____
66. What will you observe when $Q_{\text{sp}} > K_{\text{sp}}$ _____
67. What is the $[\text{OH}^-]$ in 1.0M $\text{CH}_2\text{O}_2\text{H}$, $K_a = 1.8 \times 10^{-4}$, $\text{pH} = 3.1$? _____
68. The conjugate acid of H_2PO_4^- is _____
69. Calculate K_b when $K_a = 1.8 \times 10^{-6}$ _____
70. The charge of Cr in $\text{Cr}_2\text{O}_7^{2-}$ is _____

Part C: Short Answer. Complete the following questions in the space provided (80)

**Make sure to include FULL solutions to receive FULL marks **

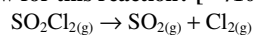
71. Complete the following table. [/10]

Reaction	Type of reaction	Class of organic product
$\text{CH}_3\text{CH}_2\text{OH} + \text{HCl} \rightarrow$ $\text{CH}_3\text{CH}_2\text{Cl} + \text{H}_2\text{O}$		
$\text{CH}_3\text{CHOHCH}_3 \xrightarrow[\text{heat}]{\text{H}_2\text{SO}_4}$ $\text{CH}_2=\text{CHCH}_3 + \text{H}_2\text{O}$		
$\text{CH}_3\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{OH} + \text{NaOH} \rightarrow$ $\text{CH}_3\text{CH}_2\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{ONa} + \text{H}_2\text{O}$		
$\text{CH}_3\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{NHCH}_3 + \text{H}_2\text{O} \xrightarrow[\text{heat}]{\text{H}_2\text{SO}_4}$ $\text{CH}_3\text{CH}_2-\overset{\text{O}}{\parallel}\text{C}-\text{OH} + \text{H}_2\text{NCH}_3$		
$\left(\text{CH}_3-\underset{\text{Ph}}{\text{CH}} \right)_n \rightarrow \left(-\text{CH}_2-\underset{\text{Ph}}{\text{CH}}-\text{CH}_2-\underset{\text{Ph}}{\text{CH}}- \right)_n$		

72. Complete the following table by drawing Lewis Structures for the following molecules: [/10]

Molecule	Noble Gas e ⁻ (0.5)	Valence e ⁻ (0.5)	# of bonds (0.5)	# of lone e ⁻ (0.5)	Lewis diagram (Indicate co-ordinate covalent bonds, or resonance structures, where appropriate) (1)	3-D Diagram (draw 3-D and include bond angles and name of the general and specific name of the shape) (2)
XeI₂						General: Specific:
BBr₃						General: Specific:

73. The experimental data in the table below were collected for the following decomposition of $\text{SO}_2\text{Cl}_{2(g)}$. What is the rate law for this reaction? [/10]



Trial	Initial concentration of $\text{SO}_2\text{Cl}_{2(g)}$ (mol/L)	Initial reaction rate [mol/(L•s)]
1	0.100	2.2×10^{-6}
2	0.200	4.4×10^{-6}
3	0.300	6.6×10^{-6}

74. a) The initial concentration of morphine (a base), $\text{C}_{17}\text{H}_{19}\text{NO}_3$, in a solution is 3.6×10^{-3} mol/L. The pOH of the solution is 4.53. Calculate K_b for morphine. [/8]

Concentration				
Initial (mol/L)				
Change				
Equilibrium (mol/L)				

- b) Calculate the percent ionization of morphine. [/2]

75. 300.0 mL of 0.00325 mol/L barium chloride is added to an equal volume of 0.00400 mol/L sodium sulfate. What is the concentration of barium ions after the precipitation of barium sulfate ($K_{sp} = 1.50 \times 10^{-9}$) is complete? [/10]

Concentration			
Initial (mol/L)			
Change			
Equilibrium (mol/L)			

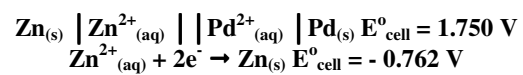
76. a) Calculate the pH at equivalence when 20 mL of 0.20 mol/L $\text{NH}_3(\text{aq})$ is titrated against 0.20 mol/L $\text{HCl}(\text{aq})$. K_b for ammonia, NH_3 , is 1.8×10^{-5} [/15]

Concentration (mol/L)				
Initial				
Change				
Equilibrium				

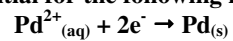
- b) Draw a fully labeled titration curve for the titration in part a) [/5]



78. The cell potential for the following galvanic cell is given.



a) Determine the standard reduction potential for the following half reaction. [/3]



b) Draw a fully labeled diagram of this galvanic cell with a salt bridge of $\text{NaNO}_{3(aq)}$. [/7]

PRACTICE EXAM