SCH 4U – GRADE 12 CHEMISTRY

PRACTICE	EXAM
PRACTICE EXAM	
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NAME: _____

TEACHER: Anyone

DATE: Anytime

TIME: 2 Hours

_____

THIS EXAMINATION HAS 10 PAGES AND ONE PERIODIC TABLE.

READ EACH QUESTION CAREFULLY. ANSWER MULTIPLE CHOICE QUESTIONS ON THE SCANTRON CARD AND SHORT ANSWER QUESTIONS IN THE SPACE PROVIDED. EXTRA SPACE IS AVAILABLE ON THE BACK OF EACH PAGE.

NON-PROGRAMMABLE CALCULATORS ARE ALLOWED BUT CANNOT BE SHARED. GRAPHING CALCULATORS, CELL PHONES, AND LISTENING DEVICES ARE NOT PERMITTED.

ALL TABLES REQUIRED ARE PROVIDED AND MAY BE REMOVED FROM THE EXAMINATION BOOKLET.

ALL MATERIALS MUST BE HANDED IN, INCLUDING THE EXAMINATION BOOKLET, MULTIPLE CHOICE QUESTIONS, TABLES, AND ANY SCRAP PAPER.

GOOD LUCK!

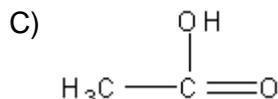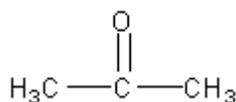|	Suggested Time	
PART A – Multiple Choice **Knowledge – 35 Marks**	*40 minutes*	**/ 35**

PART B – Short Answer
    Knowledge – 6 Marks
    Application – 40 Marks
    Communication – 10 Marks
    Thinking/Inquiry – 9 Marks
	80 minutes	**/ 65**

TOTAL	*120 minutes*	**/ 100**

PART A – Knowledge (35 Marks)

Multiple Choice: MARK THE BUBBLE REPRESENTING THE BEST ANSWER TO THE QUESTION ON THE SCANTRON CARD PROVIDED. <u>WRITE YOUR NAME ON THE SCANTRON CARD</u>!

1. Which of the following is an alcohol?
   A) NaOH
   B) H_3C —— NH_2
   C)

   H_3C —— C $=$ O (with OH above)

   D) CH_3CH_2OH
   E)
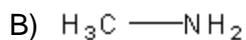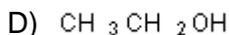
   H_3C —— C —— CH_3 (with O double bonded above)

2. How many actual double bonds does the benzene ring possess?
   A) 4
   B) 3
   C) 2
   D) 1
   E) 0

3. The general formula for a cycloalkane can be represented by which of the following?
   A) C_nH_n
   B) C_nH_{2n+2}
   C) C_nH_{2n}
   D) C_nH_{2n-2}

4.

   The correct name for the compound given above is which of the following?
   A) 1,3-cyclopentadiene
   B) 1,4-cyclopentadiene
   C) 1,4-cyclopentene
   D) 1,3-cyclopentene

5. Of the five names listed below, four contain deliberate errors. Which is the only name is correct?
   A) 2-pentanal
   B) 2,3-dichloropentane
   C) 3-methylpropanoic acid
   D) 1,2-dimethylpropanoate
   E) n-methylpropanamide

6. Which type of reaction will an alkene **not** undergo?
   A) addition
   B) polymerization
   C) oxidation
   D) dehydration
   E) hydration

7. Which of the following compounds is a secondary alcohol?
   A) 1-pentanol
   B) 2-pentanol
   C) 2-pentanone
   D) 2-methyl-2-butanol

8. The arrangement of electrons around the nucleus of an atom is known as
   A) the Bohr model
   B) the ground state
   C) the principal quantum number
   D) the diagonal rule
   E) the electron configuration

9. Energy released when "excited" electrons return to lower energy levels produce...
   A) line spectra
   B) ionization energies
   C) electron affinities
   D) all of the above
   E) none of the above

10. A substance is a brittle crystal that conducts electricity in molten liquid state only. Which type of substance is it?
    A) metallic crystal
    B) ionic crystal
    C) covalent crystal
    D) molecular crystal
    E) frozen gas

11. Which of the following is a covalent network solid?
    A) sodium chloride
    B) carbon dioxide
    C) brass
    D) asbestos
    E) phosphorus

12. What would be the shape of a molecule containing a central atom attached to two other atoms with one lone pair of electrons?
    A) linear
    B) bent
    C) trigonal planar
    D) tetrahedral
   E) trigonal bipyramidal

13. Which of the following substances would be polar?
    A) carbon dioxide
    B) boron trifluoride
    C) ammonia
    D) ammonium ion
    E) sulfate ion

14. Which statement is the best description of carbon tetrachloride, CF_4?
    A) polar molecule
    B) polar bonds, non polar molecule
    C) non polar molecule
    D) ionic compound
    E) none of the above

15. An exothermic reaction is one where
    A) heat is transferred from the surroundings into a system
    B) heat is transferred from a system into the surroundings
    C) kinetic energy is transformed into potential energy
    D) there is no transfer of heat
    E) none of the above

16. The molar heat of vaporization of water is 42 kJ/mol. How much energy is released by the condensation of 3.0 g of water?
    A) 0.88 kJ
    B) 7.0 kJ
    C) 130 kJ
    D) 250 kJ
    E) 0.07 kJ

17. In a calorimeter, a 1.0 g sample of magnesium is burned to form MgO. In doing so, 25.5 kJ of energy are released. What is the Heat of Combustion in kJ/mol of magnesium?
    A) 306.2
    B) 1.54×10^{25}
    C) 0.0392
    D) 25.5
    E) 620

18. Which of the following is not a factor that controls the rate of the reaction
    A) chemical nature of the reactants
    B) concentration of the reactants
    C) the number of products formed
    D) surface area
    E) temperature

19. If for the reaction, $aX + bY \longrightarrow products$, the rate law is determined to be $r = k[X]^1[Y]^2$, then the order of the reaction is which of the following?
    A) 1
    B) 2
    C) 3
    D) 4
    E) 5

20. Rates of reaction can be explained by
    A) atomic theory
    B) collision theory
    C) kinetic molecular theory
    D) rate theory
    E) all of the above

21. The activated complex
    A) is an unstable molecule
    B) has the maximum potential energy possible
    C) may continue on to produce products
    D) may revert to reactants
    E) all of the above

22. When solid lead(II) phosphate is in equilibrium with its ions, the ratio of lead(II) ions to phosphate ions is which of the following?
    A) 1:1
    B) 1:2
    C) 2:1
    D) 2:3
    E) 3:2

23. For the equilibrium system below, which of the following would result in an increase in the quantity of $PCl_5(g)$?

    $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g) + 45$ kJ

    A) increasing temperature
    B) increasing the size of the container
    C) decreasing temperature
    D) removing some $Cl_2(g)$
    E) injecting some He gas

24. 10.0 mol of ammonia gas is injected into a 4.0 L container. At equilibrium 1.2 mol of nitrogen gas is found in the container. The number of moles of ammonia gas left in the container must be which of the following?

    $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) + 94$ kJ

    A) 8.8
    B) 2.4
    C) 7.6
    D) 6.4
    E) 9.2

25. The equilibrium system shown below was analyzed and the concentrations of H_2(g), I_2(g) and HI(g), were found, in mol/L, to be 4.2, 3.8, 1.6 respectively. The equilibrium constant must be which of the following?

H_2(g) + I_2(g) $\rightleftharpoons$ 2HI(g) + 65 kJ

A) 0.10   D) 2.3
B) 28   E) 1.4
C) 0.16
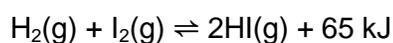
26. If the equilibrium shown below is heated at a constant pressure.

H_2(g) + I_2(g) $\rightleftharpoons$ 2HI(g) + 65 kJ

What is most likely to happen?
A) K gets larger   D) both a and c
B) K gets smaller   E) both b and c
C) [H_2] gets smaller

27. When 45 mL of 0.25 mol/L sulfuric acid is mixed with 25 mL of 0.48 mol/L calcium hydroxide the solution is/has a
A) acidic   D) pH below 7
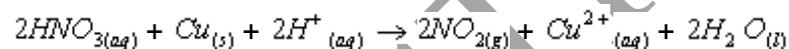B) neutral   E) both a and d
C) basic

28. A small amount of HCl(aq) is added to this buffer system

NO_3^{1-} + H_2O $\rightleftharpoons$ OH^{1-} + HNO_3
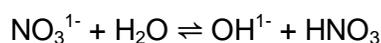
Which one of the following statements are true?
A) the pH drops only a little since the equilibrium shifts right
B) the pH rises only a little since the equilibrium shifts left
C) the pH drops only a little since the equilibrium shifts left
D) the pH rises only a little since the equilibrium shifts right
E) the pH does not change since the buffer uses up all the HCl(aq)

29. If the K_a of a weak acid is 1.6×10^{-8}, the K_b of its conjugate base partner must be which of the following?
A) 6.20   D) 6.3×10^{-7}
B) 1.0×10^{-14} E) 7.80
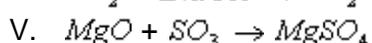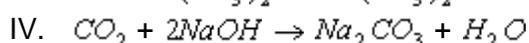C) 6.8×10^{-7}

30. In the reaction

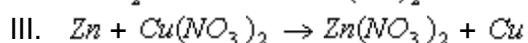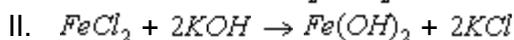$2HNO_{3(aq)} + Cu_{(s)} + 2H^+_{(aq)} \rightarrow 2NO_{2(g)} + Cu^{2+}_{(aq)} + 2H_2O_{(l)}$

Which of the following statements is correct?
A) HNO_3 is the reducing agent, and Cu is the oxidizing agent
B) HNO_3 is the reducing agent, and H^+ is the oxidizing agent
C) Cu is the reducing agent, and H^+ is the oxidizing agent
D) Cu is the reducing agent, and HNO_3 is the oxidizing agent
E) H^+ is the reducing agent, and Cu is the oxidizing agent

31. In $Fe_2(SO_4)_3$ the oxidation numbers of Fe, S, and O respectively are
A) +2, +3, −4   D) +2, +4, −2
B) +3, +6, −2   E) +4, +5, −3
C) +2, +4, −8

32. Which of the following reactions are oxidation-reduction reactions?
   I. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$
   II. $FeCl_2 + 2KOH \rightarrow Fe(OH)_2 + 2KCl$
   III. $Zn + Cu(NO_3)_2 \rightarrow Zn(NO_3)_2 + Cu$
   IV. $CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$
   V. $MgO + SO_3 \rightarrow MgSO_4$

A) II and III   D) II, IV and V
B) I and V   E) I and III
C) IV and V

33. Experiments were performed with four strips of metals *A, B, C,* and *D*, and their corresponding nitrate solutions $A(NO_3)_2$, $B(NO_3)_2$, $C(NO_3)_2$, and $D(NO_3)_2$. Metal *D* was placed in each of the solutions and reactions were observed only in solutions containing A^{2+} and B^{2+} ions. Metal *B* did not react in any of the solutions. Metal *C* reacted in the solution containing D^{2+} ions, but was not tested in the other solutions. A list of the metals in order of decreasing strength as reducing agents (strongest reducing agent is listed first) is

A) *B A D C*   D) *D A C B*
B) *C B D A*   E) *B C A D*
C) *C D A B*

Fe^{2+} (Aq)   Fe   Cr Cr^{3+} (Aq)
    1M   1M

34. Given the following half-cell reactions:

$$Fe^{2+}_{(aq)} + 2e^- \rightarrow Fe_{(s)} \qquad E^\circ = -0.44\ V$$

$$Cr^{3+}_{(aq)} + 3e^- \rightarrow Cr_{(s)} \qquad E^\circ = -0.74V$$

At 25□C, the initial cell voltage of the cell shown in the diagram above is
A) +1.18 V   D) +0.30 V
B) −0.30 V   E) +1.34 V
C) −1.18 V

35. Consider the above cell:

The standard reduction potentials are

$$Fe^{2+}_{(aq)} + 2e^- \rightarrow Fe_{(s)} \qquad E^\circ = -0.44\ V$$

$$Cr^{3+}_{(aq)} + 3e^- \rightarrow Cr_{(s)} \qquad E^\circ = -0.74V$$

Which of the following statements about this cell is false?
A) the chromium (Cr) electrode is the anode
B) reduction occurs at the iron (Fe) electrode
C) electrons flow from the iron (Fe) electrode to the chromium (Cr) electrode in the external circuit
D) the iron (Fe) electrode is the positive terminal
E) oxidation occurs at the chromium (Cr) electrode

PART B – Short Answer (65 Marks)
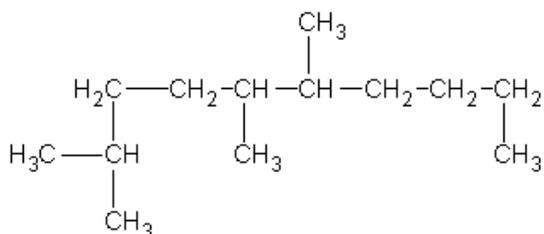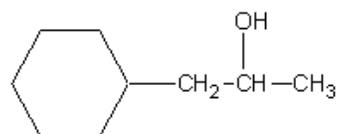
1. Name the following compounds.
[C:2]

   a)   b)

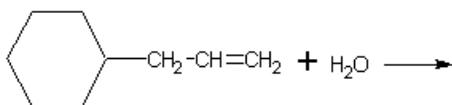
   _____   _____

2. Draw the following compounds.
[C:2] a) cis-2-methyl-4-propyl-3-octene   b) N-phenyl-3-methylbutanamide

3. Write the primary product of the reaction below.
[K:4]

4. Propene can be used as starting material for either propanal or propanol. Explain how this is possible.
[A:4]

5. In the future, you are employed as an organic chemist in a petrochemical company. The work day is almost finished when you realize that you forgot your perfume/cologne for your date that evening. You decide to quickly prepare the ester shown below from 3-phenyl-1-propene and ethene. Outline the process you would use.
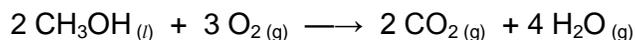[T:5]
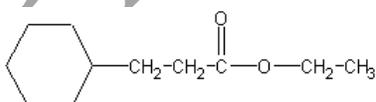
6. Draw the energy level diagram for oxygen and explain how you use the Aufbau Principle, Hund's Rule, and the Pauli Exclusion principle to do it.
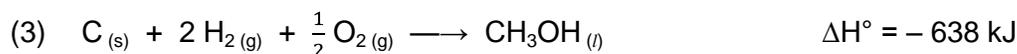
[C:4]

7. a) Draw the Lewis structure for PF_5.

[C:2]

   b) Predict the shape of PF_5. Indicate the bond angles.

[A:2]

   c) Identify the hybrid orbitals used to make this molecule. Draw a diagram showing all the orbitals around the central atom and the bonding orbitals of the attached atoms. Identify all orbital overlaps as either σ or π bonds.

[A:4]

8. The combustion of methanol is shown by the following equation:

$$2\ CH_3OH_{(l)}\ +\ 3\ O_{2\,(g)}\ \longrightarrow\ 2\ CO_{2\,(g)}\ +\ 4\ H_2O_{(g)}$$

Given the following data,

(1) $C_{(s)}\ +\ O_{2\,(g)}\ \longrightarrow\ CO_{2\,(g)}$ $\Delta H° = -\ 393$ kJ

(2) $H_{2\,(g)}\ +\ \frac{1}{2}\,O_{2\,(g)}\ \longrightarrow\ H_2O_{(g)}$ $\Delta H° = -\ 242$ kJ

(3) $C_{(s)}\ +\ 2\ H_{2\,(g)}\ +\ \frac{1}{2}\,O_{2\,(g)}\ \longrightarrow\ CH_3OH_{(l)}$ $\Delta H° = -\ 638$ kJ

a) Find the enthalpy of reaction for the equation above.
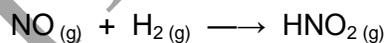
[T:4]

b) State the molar enthalpy of combustion of methanol.

[K:1]

c) State whether the reaction is endothermic or exothermic.
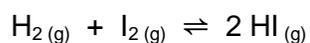
[K:1]

9.   Use the following data to calculate the rate law for the system, including the rate constant.

$$NO_{(g)}\ +\ H_{2\,(g)}\ \longrightarrow\ HNO_{2\,(g)}$$

Experiment	NO (mol/L)	H_2 (mol/L)	Initial Rate of Reaction (mol·L^{-1}·s^{-1})
1	0.001	0.004	0.002
2	0.002	0.004	0.008
3	0.003	0.004	0.018
4	0.004	0.001	0.008
5	0.004	0.002	0.016
6	0.004	0.003	0.024

[A:4]

10. Consider the equilibrium below:

$$H_{2\ (g)} + I_{2\ (g)} \rightleftharpoons 2\ HI_{(g)}$$

If 1.6 mol of HI was placed in a 1.0 L container and allowed to reach equilibrium, what would the equilibrium concentrations be for $H_{2\ (g)}$, $I_{2\ (g)}$, and $HI_{(g)}$ if K = 36?
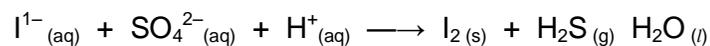
[A:4]

11. What mass of Cu_2S would be found in 34 L of a saturated solution of Cu_2S is the K_{sp} of Cu_2S is 1.6×10^{-48}?

[A:4]

12. What is the pH of a 1.24 mol/L solution of $HCN_{(aq)}$ if its $K_a = 2.7 \times 10^{-10}$?

[A:5]

13. Balance the following redox equation, using the method of your choice. Identify the oxidizing and reducing agents.

$$I^{1-}_{(aq)} + SO_4^{2-}_{(aq)} + H^+_{(aq)} \longrightarrow I_{2\,(s)} + H_2S_{(g)}\ H_2O_{(l)}$$

[A:5]

14. Choose from the following half-reactions and standard reduction potentials to make a galvanic cell.

Half-Reactions	**E⁰ (V)**
$Fe^{2+}_{(aq)} + 2\ e^- \rightleftharpoons Fe_{(s)}$	$-\,0.447$
$Al^{3+}_{(aq)} + 3\ e^- \rightleftharpoons Al_{(s)}$	$-\,1.662$

a) Draw the cell with appropriate solutions. Label
- the anode and cathode, including their charges
- the place of oxidation and reduction
- the half reaction at each electrode
- the ion(s) and electron flow

[A:5]

b) Write the balanced overall equation and find the standard cell potential.

[A:3]