Name: _____

Teacher: _____

DO NOT OPEN THE EXAMINATION PAPER UNTIL

YOU ARE TOLD BY THE SUPERVISOR TO BEGIN

Chemistry 2202

FINAL EXAMINATION

June 2010

Value: 100%

General Instructions

This examination consists of two parts. Both parts are contained in this booklet and further general instructions are provided on appropriate pages.

Part I – Multiple Choice (40%)

Select the letter of the correct response from those provided. EITHER shade the letter on your computer scorable card OR place the letter in the blank provided on your Multiple Choice Answer Sheet, whichever format is being used by your school for this exam. **Do ALL questions in this section**.

Part II – Constructed Response (60%)

Answer ALL questions fully and concisely in the space provided.

Student Checklist

The items below are your responsibility. Please ensure that they are completed.

Write your name and teacher's name on the top of this page.

Write your name, teacher's name, course name and number on the Part I answer sheet.

Check the exam to see that there are no missing pages.

ALL MATERIALS MUST BE PASSED IN WITH THIS EXAM.
Use your time wisely. Good luck!

1. Carbon-12 and carbon-14 are isotopes of carbon. How are these isotopes different?

   (A) number of electrons

   (B) number of neutrons

   (C) number of photons

   (D) number of protons

2. How many atoms are in 1.00 mol of beryllium?

   (A) 9.01

   (B) 22.4

   (C) 6.02×10^{23}

   (D) 1.20×10^{47}

3. Which isotope has 52 protons and 75 neutrons?

   (A) Rhenium - 75

   (B) Rhenium - 127

   (C) Tellurium - 52

   (D) Tellurium - 127

4. What is the molar mass of $Al_2(SO_4)_3$?

   (A) 214.17 g/mol

   (B) 278.03 g/mol

   (C) 342.17 g/mol

   (D) 450.09 g/mol

5. What is the percent composition of water in Plaster of Paris, $(CaSO_4)_2 \cdot H_2O$?

   (A) 6.207%

   (B) 13.81%

   (C) 33.09%

   (D) 93.79%

6. Gas filled glass tubes are used as lighted stores signs. A purple sign contains 19% argon, 3% helium, 21% neon, and 57% xenon. Which gas is the solvent?

(A) argon

(B) helium

(C) neon

(D) xenon

7. Which is the most concentrated solution?

(A) 1.23 mol/L

(B) 5.83 mol/L

(C) 7.60 mol/L

(D) 8.00 mol/L

8. Which has high solubility in water?

(A) AgBr

(B) $AgNO_3$

(C) Ag_2S

(D) Ag_2SO_4

9. Which defines an electrolytic solution?

(A) bright colored

(B) conducts electricity

(C) conducts heat

(D) contains excess solute

10. A 500.0 mL container of homogenized milk is 3.50% (m/v) fat. How much fat is in this container of milk?

(A) 1.75 g

(B) 17.5 g

(C) 1.43×10^2 g

(D) 1.43×10^4 g

11. Sodium chloride, $NaCl_{(s)}$, crystals are added to an existing sodium chloride solution. The crystals settle at the bottom of the container without undergoing a change in mass. Which describes the original solution?

(A) monounsaturated

(B) saturated

(C) supersaturated

(D) unsaturated

12. A lab technician prepares a dilute solution of hydrochloric acid. If 50.0 mL of 2.50 mol/L hydrochloric acid is added to 450.0 mL of water, what is the new concentration?

(A) 0.250 mol/L

(B) 0.278 mol/L

(C) 3.60 mol/L

(D) 4.00 mol/L

13. What is the correct dissociation equation for iron (III) sulfate?

(A) $Fe_2(SO_4)_{3\,(s)} \longrightarrow Fe^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

(B) $Fe_2(SO_4)_{3\,(s)} \longrightarrow Fe^{3+}_{(aq)} + SO_4^{2-}{}_{(aq)}$

(C) $Fe_2(SO_4)_{3\,(s)} \longrightarrow 2\,Fe^{3+}_{(aq)} + 3\,SO_4^{2-}{}_{(aq)}$

(D) $Fe_2(SO_4)_{3\,(s)} \longrightarrow 3\,Fe^{2+}_{(aq)} + 3\,SO_4^{2-}{}_{(aq)}$

14. If 6.76 mol of $Fe_{(s)}$ reacts with excess $O_{2(g)}$, how many moles of solid product should be formed?

$$4\,Fe_{(s)} + 3\,O_{2\,(g)} \longrightarrow 2\,Fe_2O_{3\,(s)}$$

(A) 3.38 mol

(B) 5.07 mol

(C) 9.01 mol

(D) 13.5 mol

15. What volume does 22.2 g of chlorine gas, $Cl_{2\,(g)}$, occupy at STP?

(A) 7.01 L

(B) 14.0 L

(C) 35.8 L

(D) 71.8 L

16. A chemist completes a chemical reaction in the laboratory where 2.34 g of product is recovered. What does this mass represent?

(A) actual yield

(B) percent difference

(C) percent yield

(D) theoretical yield

17. A candle completely burns in air until there is no wax left. Which term best describes the wax?

(A) actual yield

(B) excess reagent

(C) limiting reagent

(D) theoretical yield

18. If 0.269 mol of nickel are recovered in an experiment and the theoretical yield is 0.556 mol, what is the percent yield?

(A) 48.4%

(B) 51.6%

(C) 55.6%

(D) 207%

19. Which substance has the highest melting point?

(A) CO_2

(B) CH_3Br

(C) PH_2F

(D) ZnO

20. Which element has the highest electronegativity?

(A) Cl

(B) F

(C) H

(D) O

21. How many valence electrons does a sodium atom possess?

(A) 1

(B) 2

(C) 8

(D) 11

22. According to the VSEPR theory, what is the shape about the central atom with three bonding groups and one lone pair?

(A) bent

(B) pyramidal

(C) tetrahedral

(D) trigonal planar

23. What is the shape around the central atom in $SiHF_3$?

(A) bent

(B) linear

(C) pyramidal

(D) tetrahedral

24. What happens when a bond between hydrogen and oxygen atoms is broken?

(A) energy is absorbed to break the bond

(B) energy is released to break the bond

(C) energy is transferred from hydrogen to oxygen

(D) energy is transferred from oxygen to hydrogen

25. Which is an intramolecular force?

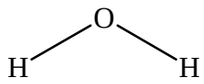
(A) covalent bond

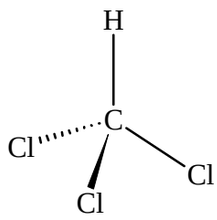
(B) dipole-dipole force

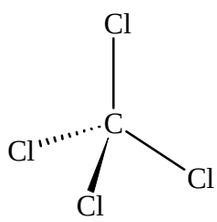
(C) hydrogen bonding

(D) London dispersion force

26. Which is non-polar?

(A) 

(B) 

(C) 

(D) H—Cl

27. Which substance has hydrogen bonding force?

(A) $CH_{4\,(l)}$

(B) $HI_{\,(l)}$

(C) $H_2S_{\,(l)}$

(D) $NH_{3\,(l)}$

28. How is diamond, $C_{(s)}$, classified?

(A) ionic

(B) metallic

(C) network covalent

(D) polar covalent

29. What characterizes the attraction in an ionic bond?

(A) attraction between momentary dipoles

(B) attraction by ions for dipoles

(C) attraction involving cations and anions

(D) attraction of a nucleus to an electron pair

30. Which compound will dissolve in carbon tetrachloride, CCl_4?

(A) CO_2

(B) HI

(C) H_2O

(D) NH_3

31. Which bond has the **least** ionic character?

(A) H-C

(B) H-F

(C) H-N

(D) H-P

32. What property of carbon accounts for the fact that over 90% of all known compounds are organic?

(A) four bonding electrons

(B) high natural abundance on Earth

(C) presence in many polyatomic ions

(D) small molar mass

33. Which compound is classified as organic?

(A) CsCN

(B) H_2CO

(C) Na_2CO_3

(D) NH_2Cl

34. Which is a hydrocarbon?

(A) methanal

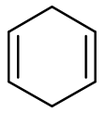
(B) methanamide

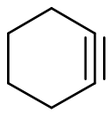
(C) methane

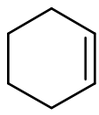
(D) methanol

35. Which is a structural isomer of 2-hexyne?

(A) 

(B) 

(C) 

(D) 

36. Which term represents a process that uses heat, in the absence of air, to break large hydrocarbon molecules into smaller molecules?

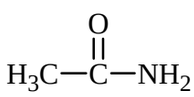
(A) fractional distillation

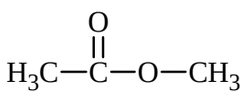
(B) hydrocarbon cracking

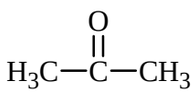
(C) reforming

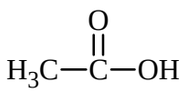
(D) substitution

37. Which represents a ketone?

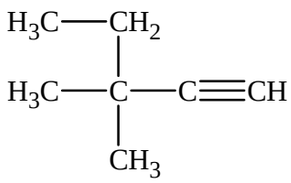
(A) 

(B) 

(C) 

(D) 

38. What is the name of this compound?



(A) 3,3-dimethyl-1-pentyne

(B) 3-ethyl-3-methyl-1-butyne

(C) 3,3-dimethyl-1-ethyl-1-propyne

(D) 2-ethyl-2-methyl-3-butyne

39. Which pair could be used to produce octyl ethanoate?

(A) ethanol and octanoic acid

(B) heptanol and ethanoic acid

(C) octanol and ethanoic acid

(D) octanol and methanoic acid

40. Reacting water with ethyl propanoate produces an alcohol and propanoic acid. What product is formed if this alcohol is heated in the presence of concentrated sulfuric acid?

(A) $H_3C—CH_3$

(B) $H_3C—CH_2—CH_3$

(C) $H_3C—CH=CH_2$

(D) $H_2C=CH_2$

Part II- Constructed Response

Total Value: 60%

Answer All questions in the space provided. All necessary workings must be shown to receive full marks

Value

3 41. (a) Data was collected on three isotopes of a newly discovered element, Novium. Calculate the average atomic mass.

Isotope Name	Percent Abundance (%)	Atomic Mass (amu)
Novium-272	70.69	271.853
Novium -276	17.71	275.985
Novium -280	11.60	279.859

3 (b) Calculate the number of molecules of propanoic acid (C_2H_5COOH) in a 3.45 g sample.

4 41. (c) A compound's molar mass is 283.88 g/mol. Its percentage composition is 43.64% P and 56.36% O. Determine the molecular formula for this compound.

4 (d) A student prepared 1.500 L solution of $KMnO_4$.

(i) Using the data in the table, calculate the concentration of the solution.

Mass of $KMnO_4$ + vial	15.6 g
Mass of empty vial	10.4g

3 41. (d) (ii) List the steps and equipment required to prepare the solution in part (i).

3 (e) Calcium chloride, $CaCl_2$, dissociates to form calcium and chloride ions.

$$CaCl_{2\,(aq)} \longrightarrow Ca^{2+}{}_{(aq)} + 2Cl^{-}{}_{(aq)}$$

Calculate the mass of $CaCl_2$ required to produce 4.0 L of solution that has a chloride ion concentration of 0.26 mol/L.

3 41. (f) Calculate the volume of hydrogen gas, H_2, required to produce 154 g of ammonia, NH_3, at STP. (Molar mass of NH_3 = 17.04 g/mol)

$$N_{2\,(g)} + 3\,H_{2\,(g)} \longrightarrow 2\,NH_{3\,(g)}$$

4 (g) By calculation, determine the limiting reagent in the reaction below.

$$2\,AgNO_{3\,(aq)} + CaCl_{2\,(aq)} \longrightarrow 2\,AgCl_{\,(s)} + Ca(NO_3)_{2\,(aq)}$$

75.0 mL	75.0 mL
1.25 mol/L	0.775 mol/L

42. (a) For the molecule H_2CO:

2 (i) Draw the Lewis Dot Diagram.

2 (ii) Draw the VSEPR shape diagram and provide the name of the shape around the central atom.

2 (iii) Is H_2CO a polar molecule? Explain.

3 (b) Use Lewis dot diagrams to show the formation of the ionic compound barium nitride from atoms of barium and nitrogen.

3 42. (c) Explain using bonding theories why sodium metal bends when struck with a hammer while sodium chloride shatters. Support your answer with a labeled diagram.

(d) Two molecular substances have identical molecular formulas, C_2H_6O, but different physical and chemical properties. Different structures are suspected.

2 (i) Sketch a possible structural diagram **OR** Lewis diagram for each compound.

3 (ii) Which of your diagrammed molecules should have the higher boiling point? Explain by identifying the intermolecular forces in each substance.

43. (a) Draw a structural diagram for each compound.

2 (i) 3-ethyl-4-methyl-1-hexene

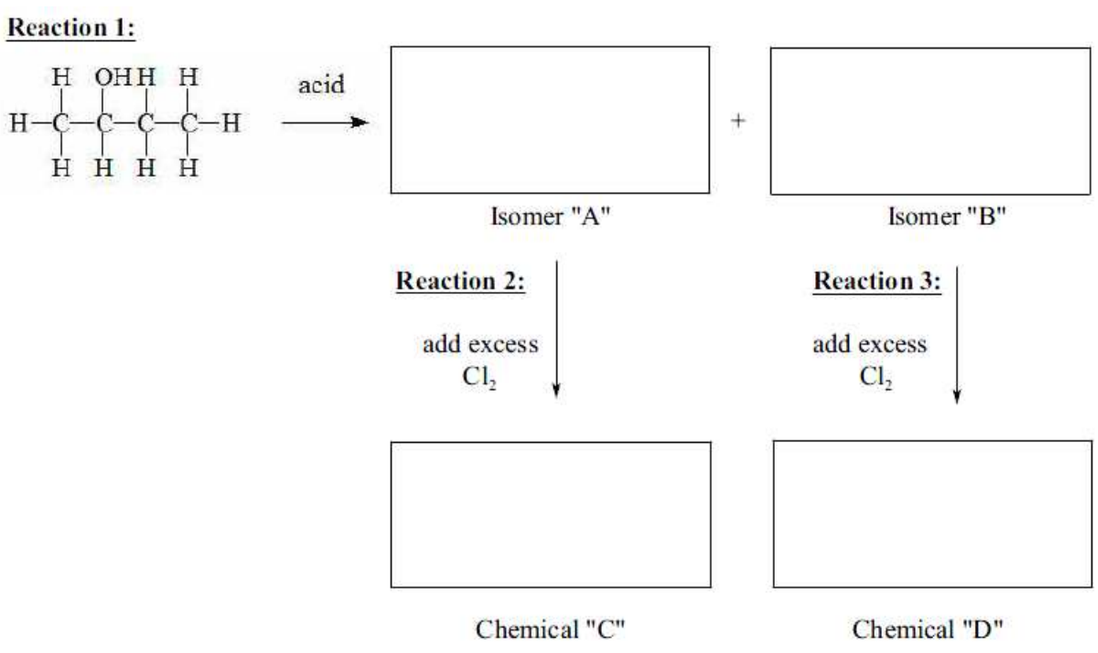
2 (ii) butylethyl ether

2 (iii) 2,3-dimethyl-1-pentanol

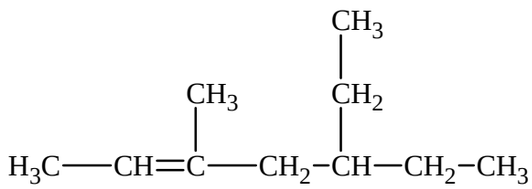
4 (b) In Reaction 1 of an experiment, 2-butanol undergoes an elimination reaction to produce isomers A and B.

In Reaction 2, isomers A and B are exposed to excess chlorine and products C and D are formed.

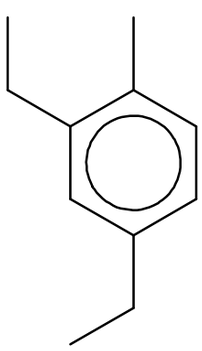
Draw and name structures for each chemical produced (A, B, C, and D).



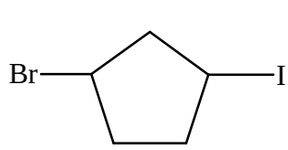
43. (C) Give the IUPAC name for the following structures.



2 (i) Name: _____



2 (ii) Name: _____



2 (iii) Name: _____