

Name: _____

Teacher: _____

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YOU ARE TOLD BY THE SUPERVISOR TO BEGIN**



CHEMISTRY 2202

*FINAL EXAMINATION
June 2011*

Value: 80 Marks

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 marks)

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 (40 marks)

Answer ALL questions fully and concisely in the space provided. Show all work, and use correct units and significant digits in all final answers.

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!

Part I
Multiple Choice
Total Value: 40 Marks

1. What is the number of neutrons in ${}_{12}^{26}\text{Mg}$?
 - (A) 12
 - (B) 14
 - (C) 26
 - (D) 38

2. Which quantity represents a mole?
 - (A) 1 g of hydrogen-1
 - (B) 2.24 mL of hydrogen-1
 - (C) 6.02 atoms of carbon-12
 - (D) 12 g of carbon-12

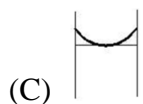
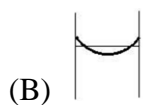
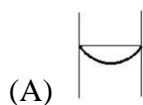
3. What is the number of moles in 3.5×10^{23} molecules of CH_4 ?
 - (A) 4.7×10^{-48} mol
 - (B) 0.58 mol
 - (C) 1.7 mol
 - (D) 2.1×10^{47} mol

4. An element has two naturally occurring isotopes. One isotope has a natural abundance of 60.11% and a mass of 68.93 amu. The second isotope has a natural abundance of 39.89% and a mass of 70.96 amu. What is the average atomic mass of the element?
 - (A) 58.71 amu
 - (B) 65.38 amu
 - (C) 69.74 amu
 - (D) 70.59 amu

5. What is the molar mass of $\text{Ba}(\text{NO}_3)_2$?
 - (A) 213.35 g/mol
 - (B) 247.34 g/mol
 - (C) 261.35 g/mol
 - (D) 384.67 g/mol

6. What is the number of moles in 5.00 g of He(g)?
- (A) 0.0500 mol
 - (B) 0.800 mol
 - (C) 1.25 mol
 - (D) 20.0 mol
7. What is the volume of 2.45 mol of Ar(g) at STP?
- (A) 0.109 L
 - (B) 0.914 L
 - (C) 54.9 L
 - (D) 97.9 L
8. A compound contains 3.38 g of P and 11.62 g of Cl. What is the percent composition of P?
- (A) 22.5 %
 - (B) 45.1 %
 - (C) 54.9 %
 - (D) 77.5 %
9. What is the percent composition of water in gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}(\text{s})$?
- (A) 2.346 %
 - (B) 10.47 %
 - (C) 20.93 %
 - (D) 79.07 %
10. What is the empirical formula of a compound which has the molecular formula of $\text{C}_9\text{H}_{12}\text{O}_3$?
- (A) $\text{C}_{2.25}\text{H}_3\text{O}$
 - (B) $\text{C}_3\text{H}_4\text{O}_{1.33}$
 - (C) $\text{C}_3\text{H}_4\text{O}$
 - (D) $\text{C}_9\text{H}_{12}\text{O}_3$

11. What is the percent by volume of an ethanol disinfectant solution if 50.0 mL of ethanol is dissolved in water to make 3.00 L of solution?
- (A) 1.67%
(B) 6.00%
(C) 94.0%
(D) 98.3%
12. The solubility of MgCl_2 is 25 g/100 mL of water. Which describes a saturated solution of magnesium chloride?
- (A) 5.0 g of MgCl_2 in 100 mL water
(B) 15 g of MgCl_2 in 100 mL water
(C) 25 g of MgCl_2 in 100 mL water
(D) 45 g of MgCl_2 in 100 mL water
13. What is the final concentration of a solution which is prepared by diluting 375 mL of a 0.420 mol/L solution in a volumetric flask to a final volume of 0.500 L?
- (A) 0.315 mol/L
(B) 0.446 mol/L
(C) 315 mol/L
(D) 446 mol/L
14. The cross-section sketch of the neck of a volumetric flask is shown. Which volumetric flask has been "made up to the mark" correctly?



15. A solution of $\text{Na}_3\text{PO}_4(\text{aq})$ has a sodium ion concentration of 0.750 mol/L. What is the concentration of the sodium phosphate solution?

- (A) 0.250 mol/L
- (B) 0.500 mol/L
- (C) 2.25 mol/L
- (D) 3.00 mol/L

16. The following mass measurements were obtained by a student in the lab:

mass of filter paper and dry product 3.68 g

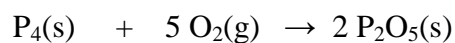
mass of fluted filter paper before use 2.18 g

mass of dry product ? g

What is the mass of the dry product?

- (A) 1.5 g
- (B) 1.50 g
- (C) 5.86 g
- (D) 5.9 g

17. For the reaction below, 2.50 mol of $\text{P}_4(\text{s})$ reacts with excess $\text{O}_2(\text{g})$. How many moles of $\text{P}_2\text{O}_5(\text{s})$ will form?



- (A) 1.25 mol
- (B) 2.50 mol
- (C) 5.00 mol
- (D) 10.0 mol

18. A student measured out 1.57 g of product in a chemical reaction in which she expected to produce 2.04 g of product. What was the percent yield of the experiment?

- (A) 23.1 %
- (B) 43.4 %
- (C) 56.5 %
- (D) 77.0 %

19. Which will conduct electricity in the solid state?

- (A) CuZn
- (B) NiNO₃
- (C) SiO₂
- (D) SO₂

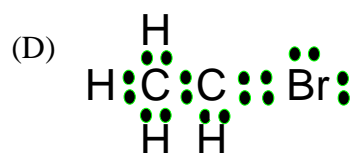
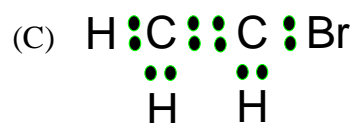
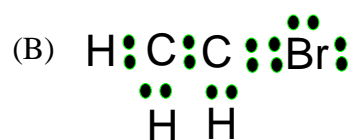
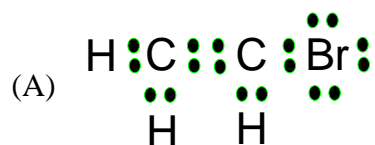
20. How many valence electrons does phosphorus have?

- (A) 1
- (B) 3
- (C) 5
- (D) 15

21. Which is the correct formula for a compound containing phosphorus and hydrogen atoms?

- (A) PH
- (B) PH₄
- (C) P₂H₄
- (D) P₂H₆

22. What is the correct Lewis diagram for C₂H₃Br?



23. What will be the shape of a molecule with 1 lone pair and 3 bonded groups around its central atom?

- (A) pyramidal
- (B) tetrahedral
- (C) trigonal planar
- (D) v-shaped (bent)

24. Which molecule has a trigonal planar shape?

- (A) H_2CS
- (B) HSiP
- (C) NCl_3
- (D) OF_2

25. Which is the most electronegative atom?

- (A) Ar
- (B) Mg
- (C) S
- (D) Si

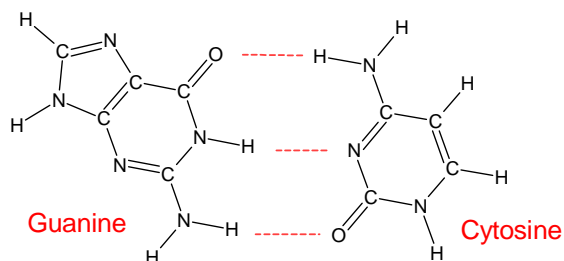
26. Which intermolecular force is the result of temporary dipoles?

- (A) covalent
- (B) dipole-dipole
- (C) hydrogen bonding
- (D) London dispersion

27. Which is the most polar bond?

- (A) C – S
- (B) H – Cl
- (C) P – Br
- (D) Si – F

28. In the diagram below, what type of force is indicated between the DNA bases?



- (A) covalent
 - (B) dipole-dipole
 - (C) hydrogen bonding
 - (D) London dispersion
29. Which is a network covalent compound?

- (A) CaCl_2
- (B) CH_4
- (C) Cr
- (D) SiC

30. Which is soluble in CCl_4 ?

- (A) C_5H_{12}
- (B) CH_3OH
- (C) H_2O
- (D) NH_3

31. Which compound is organic?

- (A) CaCO_3
- (B) CH_3OH
- (C) CoCl_3
- (D) HCN

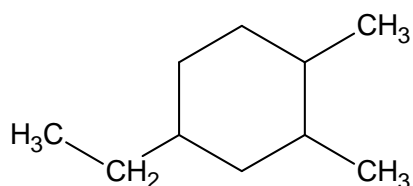
32. Which is an unsaturated straight chain hydrocarbon?

- (A) C_2H_6
- (B) C_4H_8
- (C) C_5H_{12}
- (D) $\text{C}_{12}\text{H}_{26}$

33. What is the IUPAC prefix for an alkyl group containing seven carbons?

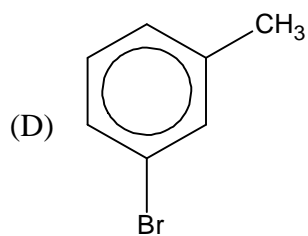
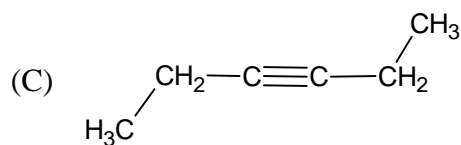
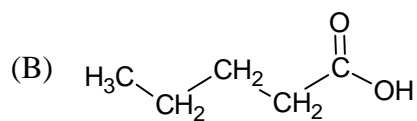
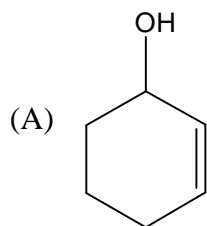
- (A) heptyl
- (B) hexyl
- (C) pentyl
- (D) propyl

34. What is the name of structure given?

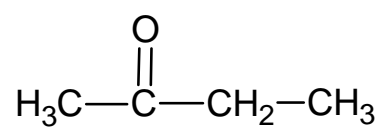


- (A) 1-ethyl-4,5-dimethylcyclohexane
- (B) 2-ethyl-3,4-dimethylcyclohexane
- (C) 4-ethyl-1,2-dimethylcyclohexane
- (D) 5-ethyl-1,2-dimethylcyclohexane

35. Which is an aromatic hydrocarbon?



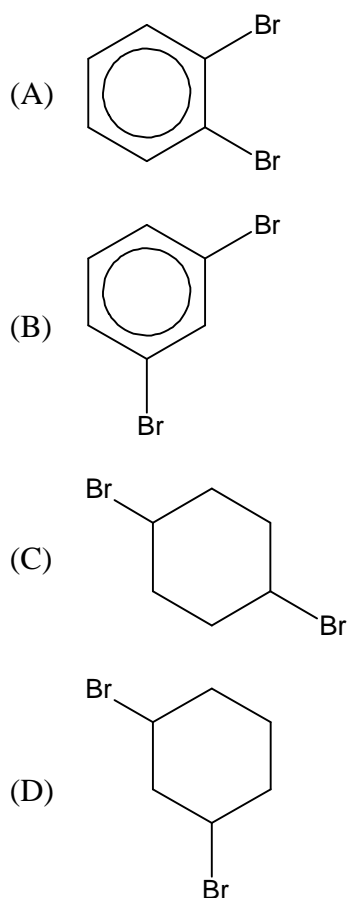
36. Which class of compounds is represented in the structure below?



- (A) alcohol
 - (B) aldehyde
 - (C) carboxylic acid
 - (D) ketone
37. Which compound would have the highest boiling point?

- (A) 1,2-difluoroethene
- (B) 1,2-difluoroethyne
- (C) ethane
- (D) ethyne

38. Which is *m*-dibromobenzene?



39. Which process is used by the petroleum industry to produce short chain hydrocarbons from long chain hydrocarbons?

- (A) addition polymerization
- (B) fractional distillation
- (C) thermal cracking
- (D) thermal reforming

40. What is the product formed by the reaction of ethanoic acid with 1-propanol?

- (A) 2-methyl-1-butanol
- (B) ethyl propanoate
- (C) ethyl propyl ether
- (D) propyl ethanoate

End of Part I

Part II
Constructed Response
Total Value: 40 Marks

Answer ALL questions in the space provided. Show all workings and report all final answers with correct significant digits and units.

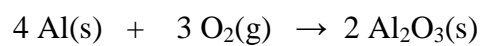
Value

- 3 41. (a) A compound contains 47.98 % C, 9.414 % H and 42.61 % O. What is the empirical formula of the compound?

- 2 (b) Which element would have 5.200×10^{22} atoms with a mass of 5.489 g?

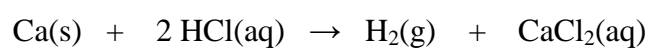
Value

- 3 41. (c) Given the reaction:



Calculate the mass of aluminum needed to react completely with 325 mL of oxygen gas at STP.

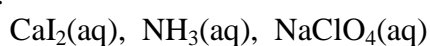
- 4 (d) Calculate the theoretical yield of hydrogen gas, in grams, produced when 20.0 g of calcium metal, Ca(s), reacts with 1.50 L of 0.500 mol/L hydrochloric acid, HCl(aq), according to the reaction below.



Value

- 3 41. (e) Calculate the volume of a 0.300 mol/L solution, $\text{Mg}(\text{ClO}_3)_2(\text{aq})$, that contains 75.0 g of magnesium chlorate solute.

- 3 (f) Three beakers are labeled A, B, and C. Each beaker contains one of the solutions below:



Each beaker's solution is tested for electrical conductivity and reaction with a solution of silver ions. The results are tabulated below:

	Electrical Conductivity	Reaction with $\text{Ag}^+(\text{aq})$
Beaker A	No	No precipitate
Beaker B	Yes	Precipitate forms
Beaker C	Yes	No precipitate

Identify the chemical formula of the solution in each beaker. Briefly explain your choices.

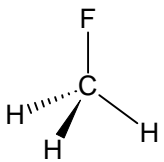
Value

- 3 42. (a) Complete the table for the molecule,
- PCl_3
- .

Lewis diagram	
VSEPR shape diagram	
Shape Name	
Polarity: (polar/non-polar)	

- 2 (b) For the molecules given;

- (i) List the intermolecular forces present.

Molecule		$\text{H}-\text{C}\equiv\text{C}-\text{H}$
Forces present		

- 1 (ii) Explain, using intermolecular forces, which molecule in (i) above has the highest boiling point.

Value

- 2 42. (c) Explain, using principles of bonding and a diagram, why ionic compounds are brittle.

- 4 (d) Draw and name two shape diagrams, one that is polar and one that is non-polar for a molecule composed of C, H, and F atoms.

	polar	Non-polar
Shape diagram		
Name		

Value

- 3 43. (a) Name each compound using IUPAC rules.

Structure	Name
$ \begin{array}{c} \text{H}_3\text{C} \\ \diagdown \\ \text{CH} - \text{C} \equiv \text{CH} \\ \diagup \\ \text{H}_3\text{C} \end{array} $	
$ \begin{array}{c} \text{H}_3\text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{C} \begin{array}{l} \text{O} \\ \parallel \\ \text{OH} \end{array} \end{array} $	
$ \begin{array}{c} \text{O} \quad \text{Cl} \\ \parallel \quad \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ \quad \quad \quad \quad \\ \quad \quad \quad \quad \text{H} \end{array} $	

- 2 (b) Draw a structural diagram for each compound.

Name	Structure
propanal	
3-methyl-2-pentanol	

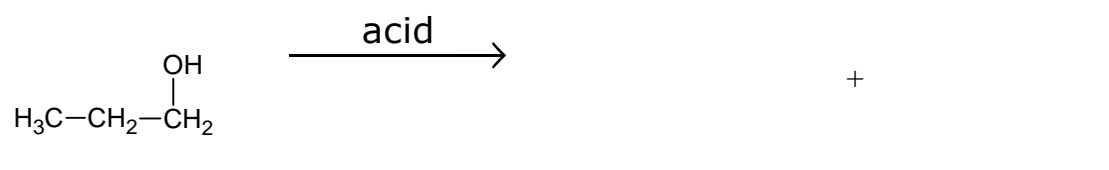
- 2 (c) Draw two isomers of C₃H₆O.

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Value

- 3 43. (d) In the lab, 1-propanol can be used to produce 1,2-dibromopropane in a two step process. Using structural diagrams, write the two reactions necessary for this process.

i) step 1:



ii) step 2:

