

Name: _____

Teacher: _____

***DO NOT OPEN THE EXAMINATION PAPER UNTIL
YOU ARE TOLD BY THE SUPERVISOR TO BEGIN***



CHEMISTRY 2202

SAMPLE EXAMINATION

June, 2008

Value: 100%

Time: 2 hours

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. Show all work, and use correct units and significant digits in all final answers.

A Periodic Table and a Chemistry Data Sheet are 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!

Part I
Total Value: 40%

- How many moles of CO_2 are present in 5.83×10^{24} CO_2 molecules?
 - 0.103 mol
 - 0.220 mol
 - 9.68 mol
 - 426 mol
- Which represents sulfur-34?
 - ${}^{34}_{16}\text{S}$
 - ${}^{34}_{18}\text{S}$
 - ${}^{16}_{34}\text{S}$
 - ${}^{18}_{34}\text{S}$
- How can the molar mass values for each element in a periodic table be calculated?
 - adding the total mass number of protons and neutrons for an isotope
 - dividing the mass number by the atomic number for all isotopes
 - multiplying the charge on the element by the isotope mass number
 - taking the average mass of all naturally occurring isotopes for the element
- What is the molar mass of ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$?
 - 78.06 g/mol
 - 82.10 g/mol
 - 92.07 g/mol
 - 96.11 g/mol
- How many moles of helium are present in a 7.00 L balloon at STP?
 - 0.313
 - 0.571
 - 28.0
 - 157
- How many atoms are in a 25.0 g sample of $\text{Cu}(\text{SCN})_2(\text{s})$? The molar mass of $\text{Cu}(\text{SCN})_2(\text{s})$ is 179.59 g/mol.
 - 1.20×10^{22}
 - 8.37×10^{22}
 - 2.51×10^{23}
 - 5.86×10^{23}
- What is the percent composition of potassium in potassium dichromate, $\text{K}_2\text{Cr}_2\text{O}_7(\text{s})$? The molar mass of $\text{K}_2\text{Cr}_2\text{O}_7(\text{s})$ is 294.20 g/mol.
 - 10.1 %
 - 13.3 %
 - 15.3 %
 - 26.6 %

8. A student performs a lab to determine the percent composition of water in a hydrated ionic compound. The following measurements were obtained:

mass of beaker and hydrated ionic compound BEFORE heating	<u>2.5435 g</u>
mass of beaker and contents AFTER heating	<u>1.1215 g</u>

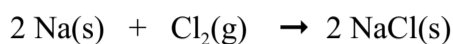
What is the mass of the original hydrated ionic compound?

- (A) 1.422 g
(B) 1.4220 g
(C) 3.665 g
(D) 3.6650 g
9. What is the mass of 0.750 mol of $\text{Zn}(\text{NO}_3)_2(\text{s})$? The molar mass of $\text{Zn}(\text{NO}_3)_2(\text{s})$ is 189.40 g/mol.
- (A) 3.96×10^{-3} g
(B) 7.04×10^{-3} g
(C) 142 g
(D) 253 g
10. In which type of solution is the maximum amount of solvent dissolved?
- (A) dilute
(B) saturated
(C) supersaturated
(D) unsaturated
11. Which is an aqueous solution?
- (A) gasoline
(B) oil
(C) pure water
(D) salt water
12. Which substance, when dissolved in water, is considered to be a non-electrolyte?
- (A) CH_3OH
(B) HCl
(C) NaCl
(D) NH_4OH
13. Which solution is the most concentrated?
- (A) 150. mL of 2.00 mol/L $\text{HCl}(\text{aq})$
(B) 200. mL of 0.100 mol/L $\text{MgCr}_2\text{O}_7(\text{aq})$
(C) 350. mL of 1.50 mol/L $\text{LiNO}_3(\text{aq})$
(D) 500. mL of 0.250 mol/L $\text{NH}_4\text{HCO}_3(\text{aq})$
14. What is the final concentration when 2.00 L of 0.50 mol/L $\text{HCl}(\text{aq})$ is diluted to 10.0 L?
- (A) 0.10 mol/L
(B) 0.40 mol/L
(C) 2.5 mol/L
(D) 10. mol/L
15. Which compound has low solubility in water?
- (A) AgNO_3
(B) HClO_4
(C) Na_2SO_4
(D) PbCl_2

16. What mass of mercury would be in a 325 g salmon fillet that contains 0.50 ppm (parts per million) of mercury?

- (A) 1.63×10^{-4} g
- (B) 1.63×10^{-7} g
- (C) 6.15×10^3 g
- (D) 6.15×10^6 g

17. In the equation below, how many moles of $\text{Cl}_2(\text{g})$ would react with four moles of $\text{Na}(\text{s})$?



- (A) 1
- (B) 2
- (C) 4
- (D) 8

18. Which is used to determine the purity of gypsum, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}(\text{s})$, which is made synthetically from $\text{CaCO}_3(\text{s})$ and $\text{SO}_2(\text{g})$?

- (A) Avagadro's Number
- (B) percent composition
- (C) percent yield
- (D) Standard Pressure

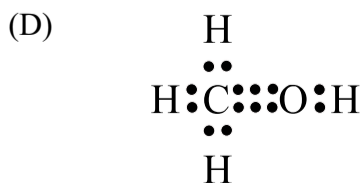
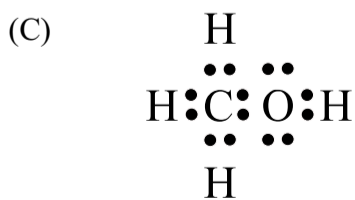
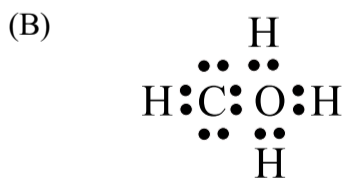
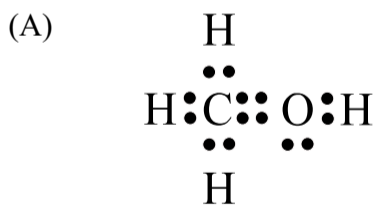
19. Which type of bonding mostly involves the transfer of electrons?

- (A) covalent
- (B) hydrogen
- (C) ionic
- (D) metallic

20. How many bonding electrons are in an atom of nitrogen?

- (A) 2
- (B) 3
- (C) 5
- (D) 8

21. Which is the electron dot formula for methanol?

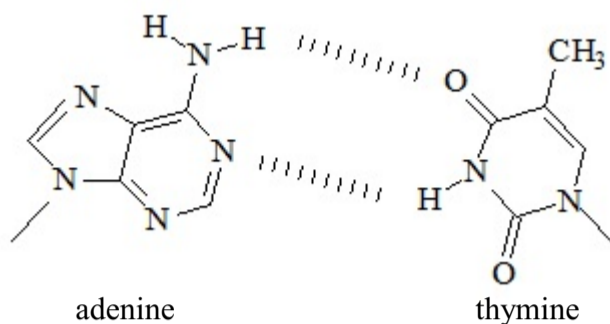


22. Which has a multiple covalent bond?
- (A) H_2
 - (B) HBr
 - (C) NaCl
 - (D) O_2
23. Which VSEPR shape corresponds to a molecule with two lone pairs of electrons and two bonded groups of electrons around its central atom?
- (A) linear
 - (B) pyramidal
 - (C) tetrahedral
 - (D) V-shaped (bent)
24. Which atom would have the greatest electronegativity for electrons in a bond?
- (A) Br
 - (B) Cs
 - (C) F
 - (D) Na
25. Which molecule contains polar covalent bonds, yet the molecule itself is nonpolar?
- (A) CH_2O (trigonal planar)
 - (B) CO_2 (linear)
 - (C) H_2O (V-shaped)
 - (D) NH_3 (pyramidal)
26. A chemical has the formula "XCO", where "X" is an unknown nonmetal. What is the identity of X if the compound is polar?
- (A) F
 - (B) N
 - (C) O
 - (D) S
27. Which intermolecular force involves temporary dipoles attracting in neighboring molecules?
- (A) Dipole-Dipole
 - (B) Hydrogen Bonding
 - (C) London dispersion
 - (D) Network Covalent
28. Which bond is slightly polar covalent?
- (A) Br-Cl
 - (B) Cs-F
 - (C) F-F
 - (D) H-F
29. Which substance would be expected to be brittle and conduct electricity when molten, yet not conduct electricity as a pure solid?
- (A) $\text{C}_{12}\text{H}_{22}\text{O}_{11}$
 - (B) NaCl
 - (C) $(\text{NH}_2)_2\text{CO}$
 - (D) SiO_2

30. Which is an example of a network covalent solid?

- (A) CH_4
- (B) MgBr_2
- (C) NCl_3
- (D) SiC

31. Which force of attraction binds together the nitrogenous bases below?

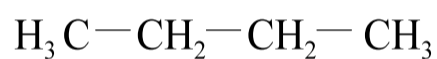


- (A) Dipole-Dipole
- (B) Hydrogen Bonding
- (C) London dispersion
- (D) Network Covalent

32. Which is an organic compound?

- (A) CH_4
- (B) CO
- (C) CO_2
- (D) CS_2

33. What is the name of the molecule below?

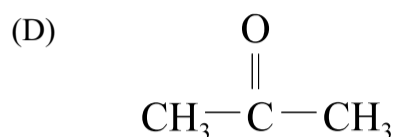
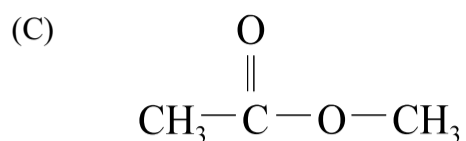
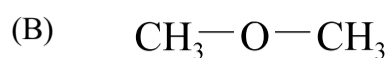
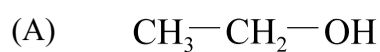


- (A) butane
- (B) pentane
- (C) propane
- (D) tetrane

34. Which molecule is "*p*-ethylmethylbenzene"?

- (A)
- (B)
- (C)
- (D)

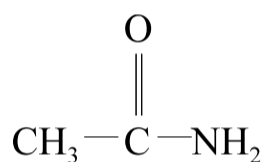
35. Which is an ether?



36. What type of compound is CH_3COOH ?

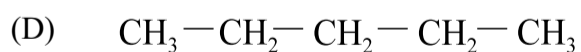
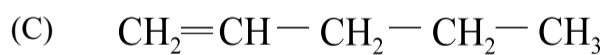
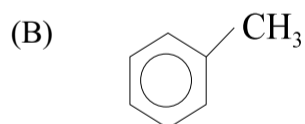
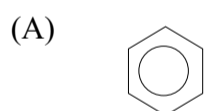
- (A) aldehyde
- (B) carboxylic acid
- (C) ketone
- (D) ester

37. What is the IUPAC name of the compound below?

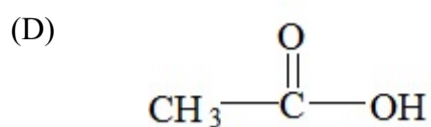
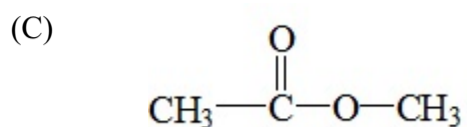
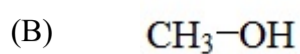
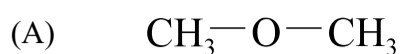


- (A) methanamide
- (B) methanamine
- (C) ethanamine
- (D) ethanamide

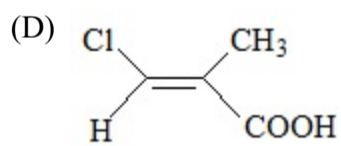
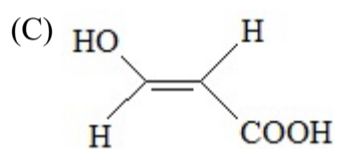
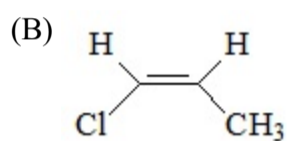
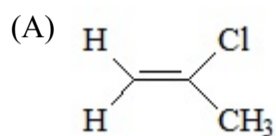
38. Which compound can react in an addition reaction?



39. Which compound reacts with ethanoic acid to produce a substance which has an odour similar to oranges?



40. Which monomer would be used to produce the polymer $\left(\begin{array}{cc} \text{Cl} & \text{CH}_3 \\ | & | \\ \text{—C—} & \text{—C—} \\ | & | \\ \text{H} & \text{H} \end{array} \right)_n$?



END OF PART I

Part II
Constructed Response
Total Value: 60%

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

Value

41. (a) A compound contains 65.45% carbon, 5.49% hydrogen, and 29.06% oxygen by mass.

4 (i) Find the empirical formula of the compound.

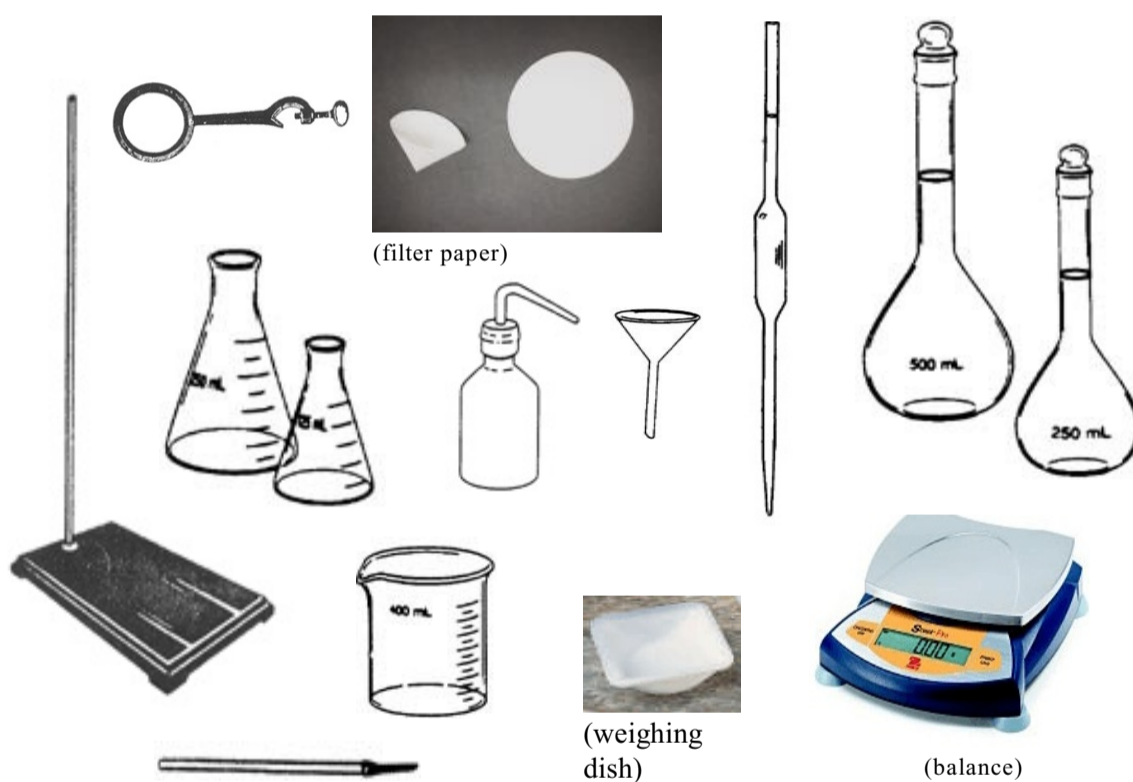
2 (ii) Find the molecular formula of the compound if its molar mass is 110.10 g/mol.

41. (continued)

Value

- 3 (b) (i) Calculate the mass of sodium sulfate, Na_2SO_4 , required to make 250.0 mL of solution with a concentration of 0.800 mol/L.

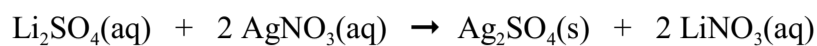
- 2 (ii) Briefly state the steps you would use to make the $\text{Na}_2\text{SO}_4(\text{aq})$ solution (above) in the lab. You may wish to refer to the lab equipment below in your response. NOTE: Not all of the apparatus would need to be used.



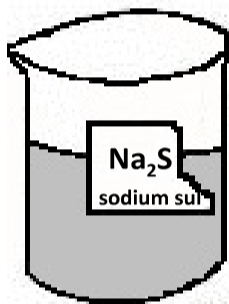
41. (continued)

Value

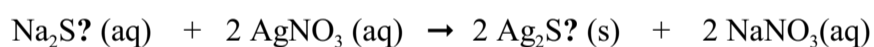
- 4 (c) For the reaction below, calculate the mass of $\text{Ag}_2\text{SO}_4(\text{s})$ that is expected if 250.0 mL of 0.500 mol/L $\text{AgNO}_3(\text{aq})$ reacts completely with excess $\text{Li}_2\text{SO}_4(\text{aq})$.



- 7 (d) The beaker below was found with a torn label that reads $\text{Na}_2\text{S?}$ ("sodium sulf...") where the ending of the compound's name is missing.



In order to determine the identity of the unknown compound, the complete reaction below was performed using 5.000 g of the unknown compound $\text{Na}_2\text{S?}(\text{aq})$ and 634.7 mL of 0.1250 mol/L $\text{AgNO}_3(\text{aq})$.



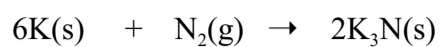
(Note: "S?" is the unknown sulfur-containing anion.)

What is the identity of the unknown compound, $\text{Na}_2\text{S?}(\text{aq})$? Show workings.

41. (continued)

Value

(e) When potassium metal is heated in nitrogen, red, explosive $K_3N(s)$ powder forms.



5

If the reaction above is performed using 80.0 g of $K(s)$ and 40.0 L of $N_2(g)$ at STP, determine the theoretical yield of $K_3N(s)$, in grams.

42. (a) For the molecule, PFH_2 :

6 (i) Draw the electron dot diagram.

(ii) Draw the VSEPR shape diagram.

(iii) What is the name of the molecular shape? _____

(iv) Is the molecule polar or nonpolar? _____

42. (continued)

Value

5

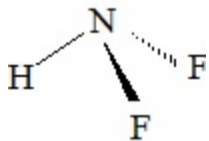
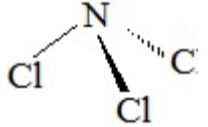
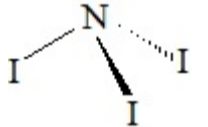
(b) A molecular compound contains only carbon, hydrogen and oxygen. The compound is polar, and contains **one** multiple bond, **one** carbon atom, and **two** oxygen atoms. Draw the electron dot diagram and the VSEPR shape diagram for this compound.

electron dot diagram	VSEPR shape diagram
----------------------	---------------------

(c) The VSEPR shapes of three molecules are given below.

3

(i) Under each shape, indicate with a yes (Y) or no (N) the type of intermolecular force present in each molecule.

	<i>Molecule "A"</i>	<i>Molecule "B"</i>	<i>Molecule "C"</i>
			
London Dispersion			
Dipole-Dipole			
Hydrogen Bonding			

3

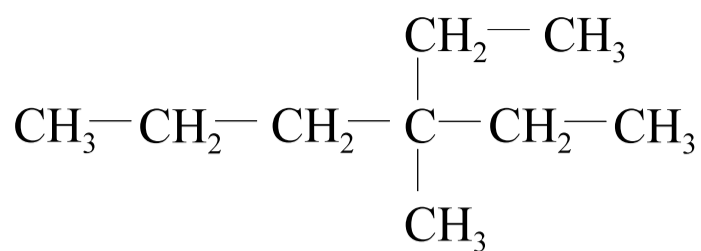
(ii) Explain, using intermolecular forces, which molecule in (i) above has the highest boiling point and which one has the lowest boiling point.

43. (a) *Name* each compound using IUPAC naming rules.

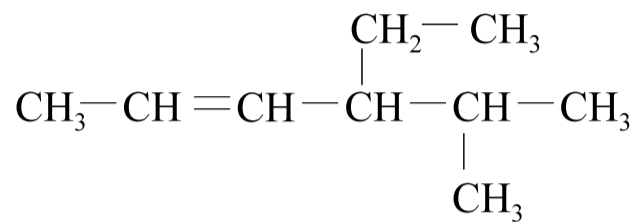
Value

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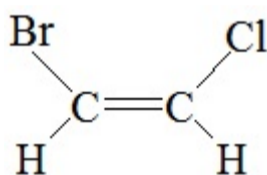
(i) Name: _____



(ii) Name: _____



(iii) Name: _____



4 (b) Draw structural diagrams for the following:

(i) ethyl propanoate

(ii) 2-chloro-3-hexanone

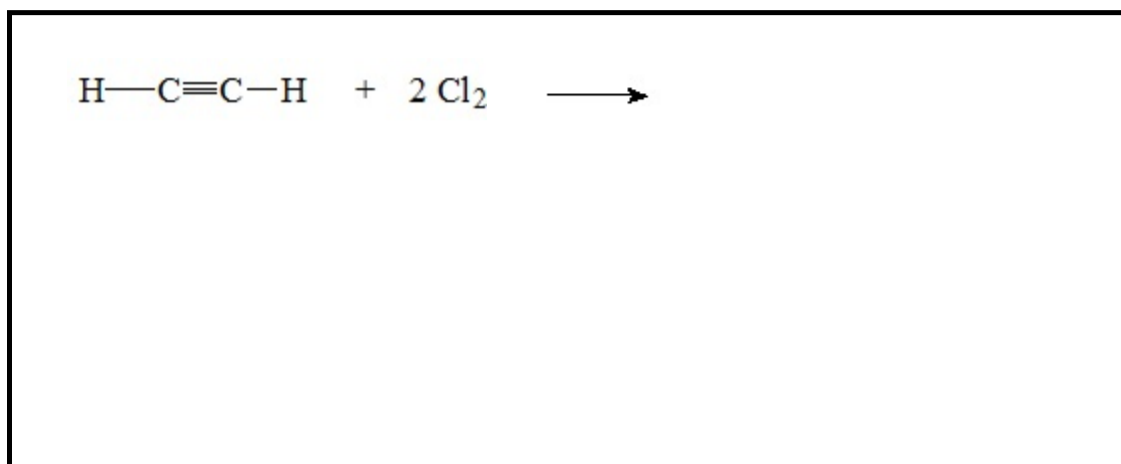
43. (continued)

Value

3

(c) For the reaction below:

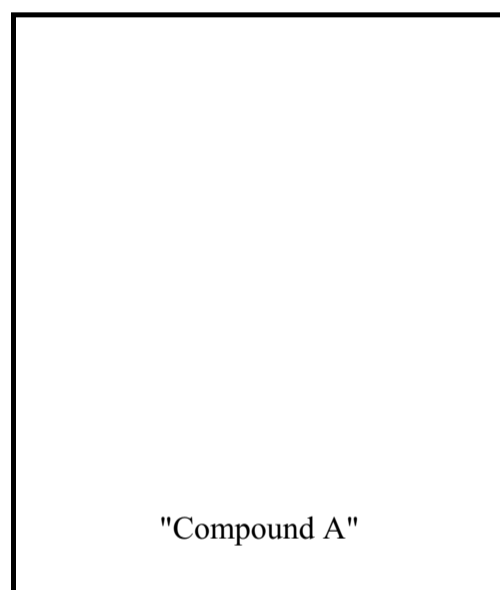
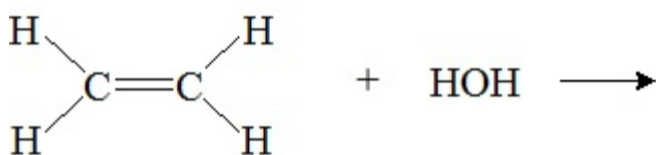
- (i) identify the *reaction type*. _____
- (ii) complete and balance the reaction.
- (iii) show structures for all organic molecules.



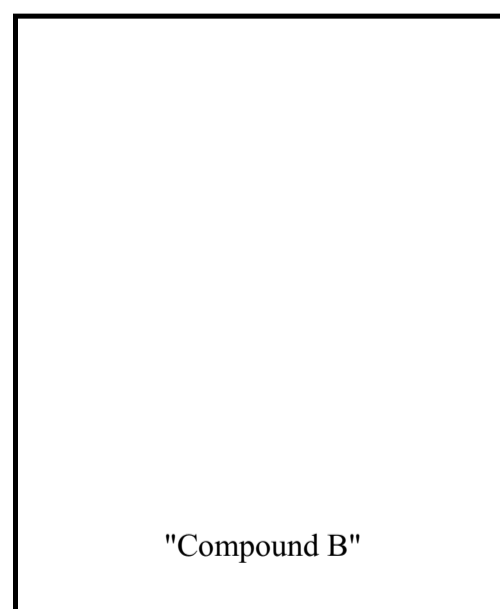
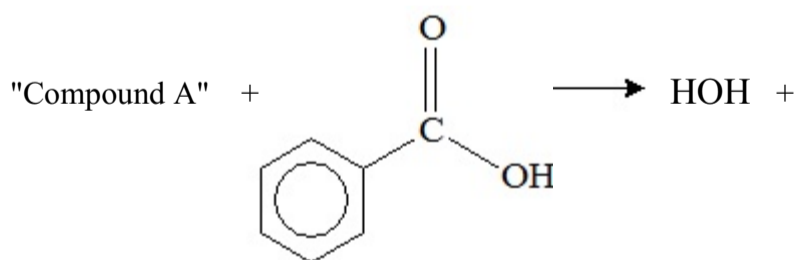
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(d) Complete the two-step reaction process from start to finish by filling in the organic structures for "Compound A" and "Compound B".

Step 1:



Step 2:



END OF PART II