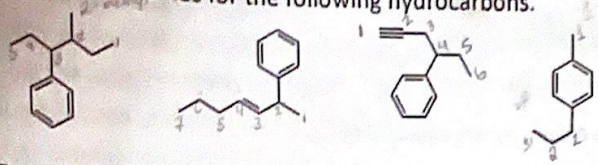
Orgo HW

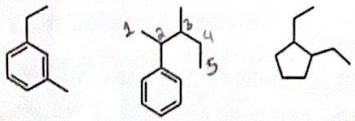
1. Write IUPAC names for the following hydrocarbons.



2. Draw structural diagrams for the following hydrocarbons.
   (a) 1,2,4-trimethylbenzene
   (b) 1-ethyl-2-methylbenzene
   (c) 3-phenylpentane
   (d) o-diethylbenzene
   (e) p-ethylmethylbenzene

3. Draw a structural diagram for each hydrocarbon.
   (a) methylcyclopentane
   (b) 1,2,4-triethylbenzene
   (c) 2-phenylpropane
   (d) p-diethylbenzene
   (e) 1,3-dimethylcyclohexane

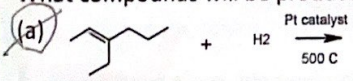
4. Write IUPAC names for the following structures.

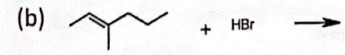


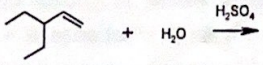
5. Draw a structural diagram for each of the following compounds and write the IUPAC name for each. If you don't recognize the compound by its common name, then google, google, google, my darlin's.
   (a) toluene, the toxic solvent used in many glues
   (b) the o-, m- and p- isomers of xylene, used in the synthesis of other organic compounds such as dyes

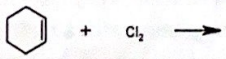
---

6. What compounds will be produced in the following addition reactions?

(a) 

(b) 

(c) 

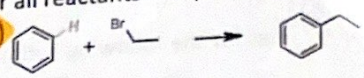
(d) 

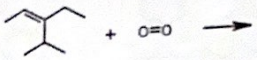
7. Explain the phrase "the rich get richer" as it applies to Markovnikov's rule.
8. Draw structural diagrams to represent the addition reactions to produce each of the following compounds. (Hint: "hydroxy" is a name for the –OH functional group.)
   (a) 2,3-dichlorohexane
   (b) 2-bromobutane
   (c) 2-hydroxy-3-methylpentane
   (d) 3-hydroxy-3-methylpentane
9. Predict the product(s) formed in each of the following reactions. Illustrate the complete reaction using structural diagrams for the organic substances. Also, include any appropriate conditions.
   (a) benzene + chlorine →
   (b) nitrobenzene + nitric acid →
10. Propose a reaction series that would produce 2-phenylbutane, starting with benzene and but-1-ene as reactants.
11. Which of the terms "addition," "substitution," or "halogenation" describes the reaction between benzene and bromine? Explain.
12. Write a balanced equation for each of the following types of reactions of acetylene.
    (a) addition (b) hydrogenation (c) halogenations (d) hydration

13. Classify each of the following reactions as one of the following types: addition, substitution, hydrogenation, halogenation or combustion. Write the names and the structures for all reactants and products.

(a) methylbut-2-ene + hydrogen →

(b) CH_3-C≡C-CH_3 + excess H_2 →

(c) 

(d) 

14. Classify and write structural formula equations for the following organic reactions.

(a) hex-3-ene + water → (conditions: H_2SO_4 catalyst)

(b) but-2-ene + hydrogen → butane

(c) 4,4-dimethylpent-2-yne + hydrogen → 2,2-dimethylpentane

(d) methylbenzene + oxygen → carbon dioxide + water

15. To make each of the following products, select the reactants and describe the experimental conditions needed.

(a) 2-hydroxypropane

(b) 2-methyl-2-hydroxypentane from an alkene

(c) chlorobenzene

---

16. What are CFCs (chlorofluorocarbons) and why are they an environmental hazard?

17. Classify the following as substitution or addition reactions. Predict all possible products for the initial reaction only. Complete the word equation and the structural diagram equation in each case. You need not balance the equations.

(a) propene + bromine →

(b) Cl-C≡C-Cl + F-F(excess) →

(c) CH_2=CH-CH_2-CH_3 + H-Cl →

(d) chlorobenzene + chlorine →

18. Draw structural diagrams to represent the elimination reaction of 2-chloropentane to form an alkene. Include reactants, reaction conditions and all possible products and their IUPAC names.

19. Classify and write structural formula equations for the following organic reactions.

(a) propane + chlorine → 1-chloropropane + 2-chloropropane + hydrogen chloride

(b) propene + bromine → 1,2-dibromopropane

(c) benzene + iodine → iodobenzene + hydrogen iodide

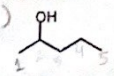
20. The synthesis of an organic compound typically involves a series of reactions, for example, some substitutions and some additions.

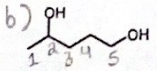
(a) Plan a reaction beginning with a hydrocarbon to prepare 1,1,2-trichloroethane.

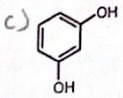
(b) What experimental complications might arise in attempting the reaction suggested in part (a)?

---

21. Write IUPAC names for the following compounds.

a) 

b) 

c) 

d) 

e) 

22. Draw the structural diagram for

(a) 3-methylbutan-1-ol

(b) propane-1,2-diol

(c) glycerol

(d) phenol

23. Draw structural diagrams showing

(a) an isomer of butanol that is a secondary alcohol

(b) all the isomers of pentanol

24. Explain why methanol has a higher boiling point than methane.

25. Arrange the following in order of increasing boiling point and explain your answer.

(a) butane (b) butan-1-ol (c) octane (d) octan-1-ol

26. Alcohols can be made by addition reactions. Draw structural diagrams to represent the reaction below.

but-2-ene + water → butan-2-ol

27. Elimination reactions of alcohols are generally slow and require an acid catalyst and heating.
(a) Draw structural diagrams to represent the reaction, propan-1-ol → propene + water.
(b) Write a word equation, with IUPAC names, for the dehydration reaction (in the presence of concentrated sulfuric acid) of butan-1-ol.

28. Only a few of the simpler alcohols are used in combustion reactions. Alcohol-gasoline mixtures, known as gasohol, are the most common examples. Write a balanced chemical equation, using molecular formulae, for the complete combustion of the following alcohols.
(a) ethanol (in gasohol) (b) propan-2-ol (rubbing alcohol)

29. The major disadvantages of using ethoxyethane as an anesthetic are its irritating effects on the respiratory system and the occurrence of post-anesthetic nausea and vomiting. For this reason, it has been largely replaced by methoxypropane, which is relatively free of side effects.
(a) Draw structural formulae of ethoxyethane and methoxypropane and determine if they are isomers.
(b) Write a structural diagram equation to show the formation of ethoxyethane from ethanol.

30. Write structural formulae and IUPAC names for all saturated alcohols with five carbon atoms and one hydroxyl group.

31. Explain why the propane that is used as fuel in a barbeque is a gas at room temperature, but propan-2-ol, used as rubbing alcohol, is a liquid at room temperature.

32. Draw the structures and write the IUPAC names of the two alkenes that are formed when hexan-2-ol undergoes a condensation reaction in the presence of an acid catalyst.

33. Write a structural diagram equation to show the production of each of the following alcohols from appropriate alkenes.
(a) butan-2-ol (b) 2-methylpropan-2-ol

34. Classify and write structural formula equations for the following organic reactions.
(a) ethene + water → ethanol (c) ethoxyethane + oxygen →
(b) butan-2-ol → but-1-ene + but-2-ene + water

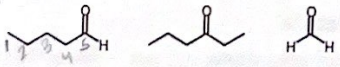
35. For each of the following pairs of compounds, select the one that has the higher boiling point. Give reasons for your answer.
(a) ethylene glycol or glycerol (c) methanol or propanol
(b) water or methoxymethane (d) methoxyethane or propanol

---

36. Draw structural diagrams for each of the following compounds.
(a) ethanal (b) hexan-2-one (c) pentanal (d) benzaldehyde

37. Write IUPAC names for
(a) all possible heptanones. (b) all possible heptanals.

38. Write IUPAC names for the following compounds.

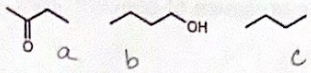


39. Write the IUPAC name for the following compounds.
(a) acetone (b) formaldehyde (c) acetaldehyde

40. Arrange the following compounds in increasing order of predicted boiling points. Give reasons for your answer. Also, draw structures for each compound.
(a) propanal (b) propane (c) propan-1-ol

41. Draw structural diagrams and write IUPAC names to illustrate the controlled oxidation of the following alcohols. Is the product an aldehyde or ketone?
(a) pentan-2-ol (b) hexan-1-ol

42. Predict the relative solubility of the following compounds in water, listing the compounds in increasing order of solubility. Give reasons for your answer.



43. Design an experimental procedure to prepare an alcohol, starting with acetone. Describe the main steps in the procedure, list experimental conditions needed, and draw structural diagrams and write IUPAC names to represent the reaction used.

44. Write an equation for a reaction involving an aldehyde to illustrate a hydrogenation reaction. Write IUPAC names for all reactants and products.

45. Explain why no numeral is needed as a prefix in the naming of butanal and butanone.

46. Draw structural diagrams and write IUPAC names for the product(s) formed when propan-1-ol undergoes the following reactions:

(a) controlled oxidation with sodium dichromate (b) complete combustion

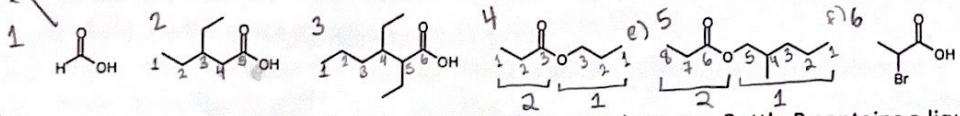
47. Suppose that you are given three alcohols: a primary alcohol, a secondary alcohol and a tertiary alcohol. Design an experimental procedure that you could carry out with commonly available materials and equipment that would identify the tertiary alcohol. Describe the main steps in the procedure and explain your experimental design.

---

48. Draw a structural diagram for each of the following compounds.

(a) octanoic acid (b) benzoic acid (c) 2-methylbutanoic acid

49. Give IUPAC and, if applicable, common named for these molecules:



50. The labels have fallen off three bottles. Bottle A contains a gas, Bottle B contains a liquid and Bottle C contains a solid. The labels indicate that the compounds have the same number of carbon atoms, one being an alkane, one an alcohol and the other a carboxylic acid. Suggest the identity of the contents of each bottle and provide reasons for your choices.

51. Write a series of chemical equations to illustrate the synthesis of a carboxylic acid from the controlled oxidation of propan-1-ol.

52. Name a draw a structure for the functional group in a carboxylic acid. Explain the effect of the components of this functional group on the molecule.

53. When a bottle of wine is left open to the air for a period of time, the wine often loses its alcoholic content and starts to taste sour. Write a series of equations to illustrate the reactions responsible for this observation.

54. Write complete structural diagram equations and word equations for the formation of the following esters. Identify the odour of each ester formed. (I think I smell a google coming on...)

(a) ethyl methanoate (c) methyl butnaoate

(b) ethyl benzoate (d) 3-methylbutyl ethanoate

55. Name the following esters and the acids and alcohols from which they could be prepared.

(a) $CH_3CH_2COOCH_2CH_3$ (c) $HCOOCH_2\,CH_2CH_2CH_3$

(b) $CH_3CH_2CH_2COOCH_3$ (d) $CH_3COOCH_2CH_2CH_3$

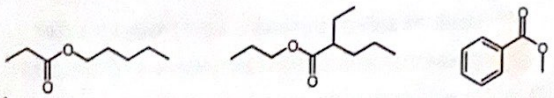
56. In what way is the functional group of an ester different from that of a carboxylic acid? How does this difference account for any differences in properties?

57. Describe the experimental conditions in the hydrolysis of ethyl formate. Write a structural equation for the reaction and name the products.

58. Write the IUPAC name for these compounds:

(a) acetic acid (b) benzoic acid

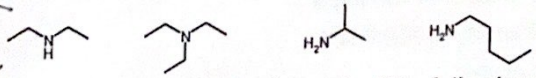
59. Draw structural diagrams for the following compounds:
   (a) methanoic acid
   (b) the product of the controlled oxidation of propanal
   (c) the acid formed from the saponification of butyl ethanoate
   (d) the ester that is produced in the esterification of propan-1-ol and formic acid
   (e) the ester that is produced in the esterification of phenol and vinegar
60. Draw the structures of the compounds formed by condensation reactions between the following reactants and write IUPAC names for each product.
   (a) formic acid and butan-2-ol (b) acetic acid and propan-1-ol (c) benzoic acid and methanol
61. Name the carboxylic acid and the alcohol that may be used to produce each of the following compounds:



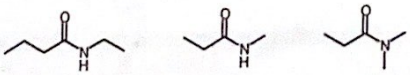
62. Describe an experimental procedure to carry out the saponification of propyl butanoate. Explain the evidence that will indicate that the reaction has been completed.

---

63. Write two names for each of the following structures and indicate whether they are 1°, 2° or 3° amines.



64. Draw structural diagrams for each of the following compounds.
   (a) 2,5-diaminohexane
   (b) dimethylethylamine
   (c) a tertiary amine with four carbon atoms
   (d) 1,2,4-triaminobenzene
   (e) two primary amines that are isomers of dimethylethylamine
65. Write the IUPAC name for each of the following compounds.

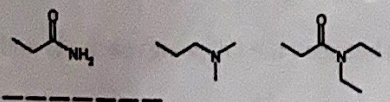


66. Draw structures for the following amides.
   (a) N,N-dimethyl hexanamide (b) N-methyl acetamide (c) hexanamide
67. Classify each of the following compounds as amines or amides and write the IUPAC name for each.
   (a) $CH_3CH_2CH_2NH_2$ (b) $CH_3NHCH_2CH_3$ (c) CH_3CONH_2
68. Draw structural diagrams and write IUPAC names for the carboxylic acid and amine which may be used to produce the following compound.

69. Explain why the formation of an amide from a carboxylic acid and an amine is a condensation reaction.
70. Write a series of equations to represent the formation of N-methyl ethanamide from methane, ethanol and inorganic compounds of your choice.
71. Write an equation to represent the formation of an amide linkage between propanoic acid and diethylamine.
72. Look at the following pairs of compounds and arrange each pair in order of increasing solubility in nonpolar solvents. Give reasons for your answer.
   (a) an alcohol and an amine of similar molecular mass
   (b) a primary amine and a tertiary amine of similar molecular mass
   (c) a hydrocarbon and tertiary amine of similar molecular mass.
   (d) a primary amine of low molecular mass and one of high molecular mass

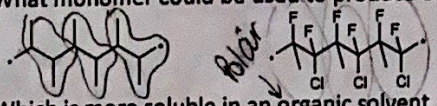
do on spare tomorrow

Draw structural diagrams for three isomers of C_3H_9N and classify them as primary, secondary or tertiary amines.
Write IUPAC names for each isomer.
Write structural formula equations to represent the formation of the following amides.
(a) methanamide (b) propanamide
Write IUPAC names for the following compounds.

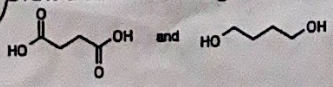


For each product, write a structural formula and an equation or a series of equations for a method of synthesis from other compounds.
(a) pentyl ethanoate from ethene and an alcohol
(b) phenyl ethanoate from an alkene and an alcohol
(c) octan-3-one from a simpler compound
(d) methyl benzoate from two alcohols
(e) sodium salt of butanoic acid from an ester
(f) trimethylamine from ammonia and alkanes
(g) N-ethylethanamide from an alkane and ammonia

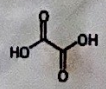
(a) Describe the intramolecular and intermolecular forces of attraction between long addition polymer chains.
(b) Explain why these polymers are more useful, as materials, than their monomers.
(c) Explain why these polymers are chemically more stable than their monomers.
. Chlorotrifluoroethene is a monomer that forms an addition polymer.
(a) Draw a structural diagram for three repeating units of this polymer.
(b) Predict the properties of this polymer in terms of solubility in organic solvents, rigidity and resistance to heating.
. What monomer could be used to produce each of the following polymers?



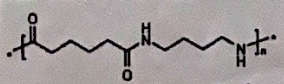
. Which is more soluble in an organic solvent, such as acetone, a polymer whose monomer contains a methyl group or one that contains a carbonyl group?
. Describe the structural features necessary in a monomer that is added for crosslinking polymer chains. Illustrate your answer with a structural diagram of an example.
. What characteristics must a molecule have to be part of
(a) a condensation polymer? (b) an addition polymer?
. Draw a structural diagram to show the trimer formed from the following compounds.



. Explain the difference in the structure of a polyester and a polyamide, and give an example of each.
. Draw the structure and write the name of the monomers that make up the polyamide nylon-5,10. (Hint: the 5 and 10 tell you the number of carbons in the diamine and dicarboxylic monomers respectively.)
. Oxalic acid is a toxic dicarboxylic acid found in rhubarb and spinach. Its structure is shown to the right.



Draw three repeating units of the condensation polymer made from oxalic acid and ethanediol.
Nylon 6, used for making strong ropes, is a condensation polymer of only one type of monomer, 6-aminohexanoic acid. Draw a structural diagram of the monomer and a repeating unit of the polymer.
. Draw structural diagrams and write the names of the monomers used in the synthesis of the following polyamide.



. The "superabsorbancy" of sodium polymethylacrylate is ideally suited to its use in baby diapers and other hygiene products. Suggest other applications for which this polymer would be useful.