Taibah University

Deanery of Academic Services

Unified Scientific Track

Answer Key

Mock Test For

Final Exam

Introduction to Chemistry (CHEM 101)

(Chapters 3, 4, 5 & 7)

Topics 08 – 17 & 19 – 21

For

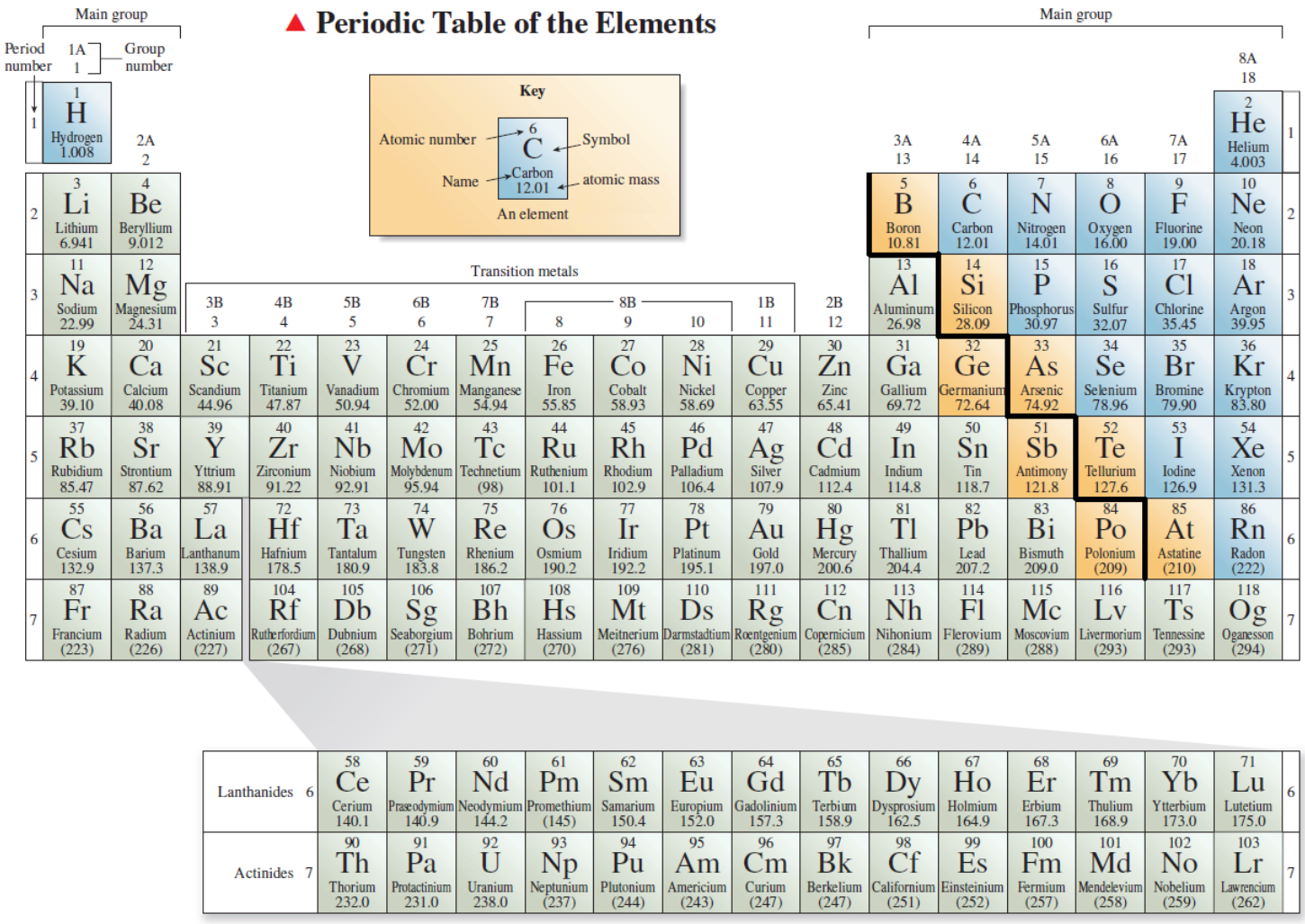
Unified Scientific Track Students

(All Campuses)

1st Semester

1441 | 2019 – 2020

▲ Periodic Table of the Elements



▲ CHEM 101 Supplemental Information

$d = \frac{m}{V}$	$°C = \frac{(°F - 32)}{1.8}$	$°F = 1.8\,(°C) + 32$	$°C = K - 273$	$K = (°C) + 273$
$M = \frac{n}{V}$	$M_1V_1 = M_2V_2$	$K_W = [H_3O^+] \times [OH^-] = 1 \times 10^{-14}$		$pH = -\log[H_3O^+]$
Molecular formula = empirical formula $\times\, n$ $n = \frac{\text{molar mass of molecular formula}}{\text{molar mass of empirical formula}}$		$\%\text{ mass of element X} = \frac{\text{mass of element X in 1 mol of compound}}{\text{mass of 1 mol of the compound}} \times 100\%$		$\%\ yield = \frac{\text{actual yield}}{\text{theoretical yield}}\ X\ 100$
$q = C \times \Delta T$	$w = -P\Delta V$	$q = m \times C_s \times \Delta T$	1 L.atm = 101.3 J	Avogadro's No. = 6.022×10^{23}

Atomic mass $= \sum_n$ (fraction of isotope n) $\times$ (mass of isotope n)
$=$ (fraction of isotope 1 $\times$ mass of isotope 1)
$+$ (fraction of isotope 2 $\times$ mass of isotope 2) $+ \cdots$

Mole Conversions: Grams of Substance ⇄ (÷ Molar Mass / × Molar Mass) Moles of Substance ⇄ (× Avo. Number / ÷ Avo. Number) Number of Atoms or Molecules

Answer The Following Questions:

1. Which type of chemical formulas gives only the relative number of atoms of each element in a compound?

❑ a. Molecular formula ☑ b. Empirical formula

❑ c. Structural formula ❑ d. Ball-and-stick model

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2. If we have 9.03×10^{24} aluminum atoms, how many moles of aluminum do we have?

❑ a. 5.4 mol ❑ b. 10 mol ☑ c. 15 mol ❑ d. 2.7 mol

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3. The systematic name of $CuNO_2$ is ……..

❑ a. copper(II) nitrate ❑ b. copper(I) nitrate

☑ c. copper(I) nitrite ❑ d. copper(II) nitrate

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4. What is the formula for the ionic compound formed by barium and phosphate ions?

❑ a. $Ba_2(PO_4)_3$ ☑ b. $Ba_3(PO_4)_2$ ❑ c. $Ba_3(PO_3)_2$ ❑ d. $BaPO_4$

---

5. How many grams are in a sample containing 2.71×10^{24} atoms of iron?

❑ a. 160.2 g ☑ b. 251.3 g ❑ c. 449.9 g ❑ d. 292.2 g

---

6. What are the coefficients (a, b, c and d) needed to balance the following equation?

$$\underline{a}\ PbCl_3 + \underline{b}\ Ca(OH)_2 \rightarrow \underline{c}\ CaCl_2 + \underline{d}\ Pb(OH)_3$$

❑ a. 3, 2, 2, 2 ☑ b. 2, 3, 3, 2 ❑ c. 4, 2, 2, 4 ❑ d. 4, 3, 3, 2

---

7. When the following equation is balanced, the coefficient of O_2 would be ……..

$$\ldots\ C_2H_4 + \ldots\ O_2 \rightarrow \ldots\ CO_2 + \ldots\ H_2O$$

❑ a. 1 ❑ b. 2 ☑ c. 3 ❑ d. 4

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8. What is the mass percent of calcium in calcium acetate, $Ca(C_2H_3O_2)_2$?

❑ a. 34.6% ☑ b. 25.3% ❑ c. 41.1% ❑ d. 35.2%

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9. The correct chemical formula for iron(II) oxide is ……..

❑ a. Fe_2O_3 ❑ b. Fe_2O ❑ c. FeO_2 ☑ d. FeO

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10. Calculate the molar mass of aluminum tartrate, $Al_2(C_4H_4O_6)_3$.

❑ a. 59 g/mol ❑ b. 71 g/mol ❑ c. 119 g/mol ☑ d. 498.1 g/mol

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11. How many covalent bonds will a nitrogen atom normally make?

❑ a. 1 ❑ b. 2 ☑ c. 3 ❑ d. 0

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12. Group 1A metals always have an oxidation state of …… in their compounds.

❑ a. +2 ❑ b. –2 ❑ c. 0 ☑ d. +1

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13. The oxidation number of nitrogen in $Ca(NO_3)_2$ is ……..

❑ a. +6 ☑ b. +5 ❑ c. +3 ❑ d. –3

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14. Identify the reducing agent in the following reaction:

$$Fe_2O_3 + 2\,Al \rightarrow Al_2O_3 + 2Fe$$

❑ a. Fe_2O_3 ☑ b. Al ❑ c. Al_2O_3 ❑ d. Fe

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15. The oxidation number of bicarbonate ion in its compounds is ……..

☑ a. –1 ❑ b. –2 ❑ c. –3 ❑ d. +1

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16. What is the empirical formula of glycolylurea which has the molecular formula $C_3H_4N_2O_2$?

❑ a. CH_2NO ❑ b. CH_4N_2O ☑ c. $C_3H_4N_2O_2$ ❑ d. C_2H_2NO

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17. If the empirical formula of a compound is C_2HCl and its molar mass is 181.44 g/mol, what is the molecular formula of this compound?

❑ a. $C_4H_3Cl_3$ ❑ b. $C_5H_3Cl_3$ ❑ c. $C_6H_4Cl_4$ ☑ d. $C_6H_3Cl_3$

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18. A compound contains 74.03 % C, 8.70 % H, and 17.27 % N. What is the empirical formula of this compound?

☑ a. C_5H_7N ❑ b. $C_4H_8N_2$ ❑ c. $C_6H_9N_3$ ❑ d. C_4H_7N

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19. How many moles of magnesium nitride, Mg_3N_2, would be produced when 3 g of magnesium completely react with excess N_2 according to the following equation?

$$3\,Mg_{(s)} + N_{2\,(g)} \rightarrow Mg_3N_{2\,(s)}$$

❑ a. 4.11 mol ☑ b. 0.041 mol ❑ c. 3.21 mol ❑ d. 14.02 mol

---

20. How many grams of K_2CO_3 are needed to prepare 200 mL of 0.150 M solution?

☑ a. 4.14 g ❑ b. 10.4 g ❑ c. 13.8 g ❑ d. 2.07 g

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21. Consider the following reaction, if the reaction of 2.5 g of Al with 2.5 g of O_2 produced 3.5 g of Al_2O_3. The % yield equals ……..

$$4\ Al_{(s)} + 3\ O_{2\,(g)} \rightarrow 2\ Al_2O_{3\,(s)}$$

☑ a. 74 % ❑ b. 37 % ❑ c. 47 % ❑ d. 66 %

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22. To what volume (in mL) shall we dilute 50.0 mL of a 12 M stock HNO_3 solution to obtain a 0.10 M HNO_3 solution?

❑ a. 416 mL ☑ b. 6000 mL ❑ c. 3200 mL ❑ d. 2.45 mL

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23. What is the final molarity of an HCl solution, if 40 mL of a 2.5 M HCl solution were diluted to a final volume of 500 mL?

❑ a. 5.0 M ❑ b. 31.25 M ☑ c. 0.20 M ❑ d. 2.45 M

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24. What mass (g) of NaF is contained in 0.35 L of a NaF solution that has a molarity of 2.20 M?

☑ a. 32.34 g ❑ b. 25.41 g ❑ c. 0.77 g ❑ d. 7.70 g

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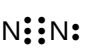
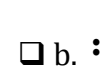
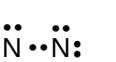
25. The Lewis dot structure for nitrogen molecule is ……..

☑ a.  ❑ b.  ❑ c.  ❑ d. 

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26. The Lewis dot structure of H_2S molecule has …… **bonding pairs and** …… **lone pairs of electrons.**

❑ a. 2, 4 ☑ b. 2, 2 ❑ c. 4, 2 ❑ d. 4 ,4

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27. What is the $[OH^-]$ in a solution that has a $[H_3O^+] = 1.0 \times 10^{-3}$ M?

❑ a. 1.0×10^{-3} M ❑ b. 1.0×10^{-6} M ❑ c. 1.0×10^{-8} M ☑ d. 1.0×10^{-11} M

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28. Calculate the pH of a solution that has $[H_3O^+] = 2.33 \times 10^{-9}$ M.

❑ a. 2.67 ❑ b. 6.81 ☑ c. 8.63 ❑ d. 4.34

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29. The compound HF is ……..

❑ a. a strong acid ❑ b. a weak base ☑ c. a weak acid ❑ d. an ionic compound

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30. Which of the following substances would give a solution that does not conduct electricity, when dissolved in distilled water?

❑ a. $Ca(NO_2)_2$ ❑ b. NaOH ❑ c. NH_4OH ☑ d. $C_6H_{12}O_6$

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31. A strong electrolyte solution will be formed when …… is dissolved in water.

☑ a. $Mg(NO_2)_2$ ❑ b. CH_3COOH ❑ c. NH_4OH ❑ d. $C_{12}H_{22}O_{11}$

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32. Which of the following acids will partially dissociates in aqueous solutions?

☑ a. H_2SO_4 ❑ b. HCl ☑ c. CH_3COOH ❑ d. HNO_3

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33. Which of the following substances is a Lewis acid?

❑ a. NH_3 ☑ b. CO_2 ❑ c. H_2O ❑ d. F^-

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34. Which of the following pairs of species is NOT a conjugate acid-base pair?

❑ a. H_2O/OH^- ❑ b. HSO_4^-/SO_4^{2-} ❑ c. H_2SO_4/HSO_4^- ☑ d. H_2SO_4/SO_4^{2-}

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35. Identify the Bronsted-Lowry conjugate acid in the following reaction:

$$\mathbf{CH_3COOH + HSO_4^- \rightleftharpoons H_2SO_4 + CH_3COO^-}$$

☑ a. H_2SO_4 ❑ b. CH_3COOH ❑ c. HSO_4 ❑ d. CH_3COO^-

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36. Consider the following reaction at equilibrium. What is the effect of increasing the pressure of the reaction mixture?

$$\mathbf{2\,H_2S_{(g)} + 3\,O_{2\,(g)} \rightleftharpoons 2\,H_2O_{(g)} + 2\,SO_{2\,(g)}}$$

❑ a. the reaction will shift to the left ☑ b. the reaction will shift to the right

❑ c. the equilibrium constant will decrease ❑ d. no effect will be observed

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37. According to Bronsted-Lowry concept of acids and bases, H_2O can be considered as ……

❑ a. a neutral substance ❑ b. an acid

❑ c. a base ☑ d. an amphoteric substance

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38. What is the effect of lowering the temperature on the following exothermic reaction?

$$\mathbf{CaO_{(s)} + H_2O_{(l)} \rightleftharpoons Ca(OH)_{2\,(s)} + heat}$$

☑ a. the reaction will shift forward ❑ b. the reaction will shift reverse

❑ c. $Ca(OH)_2$ will decrease ❑ d. no effect will be observed

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39. …… are compounds that have the same molecular formula but with different structures.

❑ a. aromatics ❑ b. cycloalkanes ❑ c. isotopes ☑ d. isomers

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40. Choose the correct expression for equilibrium constant, K_{eq}, for the following reaction:

$$16\ CH_3Cl_{(g)} + 8\ Cl_{2\,(g)} \rightleftharpoons 16\ CH_2Cl_{2\,(g)} + 8\ H_{2\,(g)}$$

❑ a. $K_{eq} = \frac{[CH_2Cl_2][H_2]}{[CH_3Cl][Cl_2]}$

☑ b. $K_{eq} = \frac{[CH_2Cl_2]^{16}\,[H_2]^8}{[CH_3Cl]^{16}\,[Cl_2]^8}$

❑ c. $K_{eq} = \frac{[CH_3Cl]^{16}\,[Cl_2]^8}{[CH_2Cl_2]^{16}\,[H_2]^8}$

❑ d. $K_{eq} = \frac{[CH_3Cl][Cl_2]}{[CH_2Cl_2][H_2]}$

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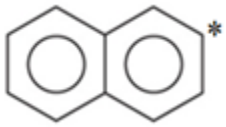
41. How many hydrogen atoms, H, shall be bonded to the carbon atom marked with (*) in the following compound?



❑ a. 0 ☑ b. 1 ❑ c. 2 ❑ d. 3

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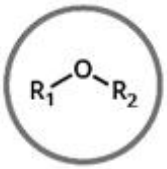
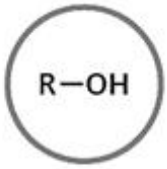
42. Identify the families of the following organic formulas:

Amine

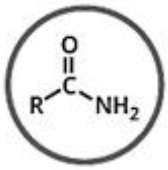


ether

carboxylic acid

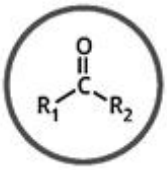


alcohol



amide

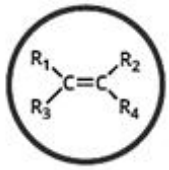
Aldehyde



ketone

alkyne

ester



alkene

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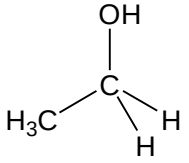
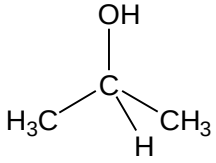
43. Identify the class of the organic compound whose molecular formula is $C_{18}H_{38}$.

☑ a. Alkane ❑ b. Alkene ❑ c. Alkyne ❑ d. Cycloalkane

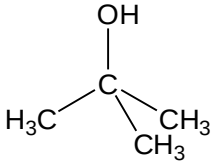
44, Identify the class of each alcohol (primary, secondary, tertiary):



Primary alcohol



Secondary alcohol



Tertiary alcohol

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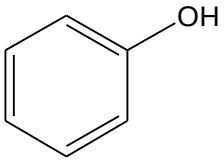
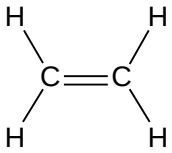
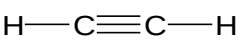
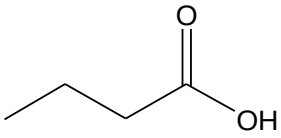
45. Write both "common" and "IUPAC" names of the following compounds:

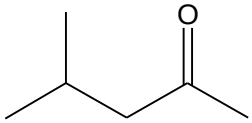
Compound			
Common name	Phenol	Ethylene	Acytelene
IUPAC name	Hydroxybenzene	Ethene	Ethyne

46. To which family does this compound belong?



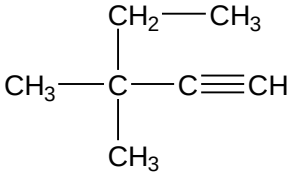
❑ a. esters ❑ b. aldehydes ❑ c. ketones ☑ d. carboxylic acids

47. What is the family of this organic compound?



❑ a. ethers ☑ b. ketones ❑ c. esters ❑ d. carboxylic acids

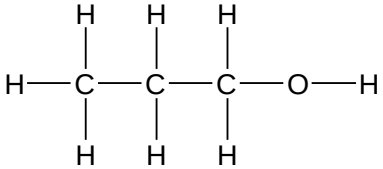
48. Choose the correct name of the following organic compound?

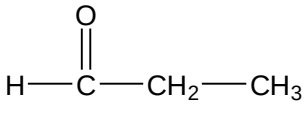


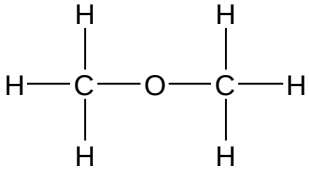
❑ a. 3,3-dimethyl-4-pentyne ☑ b. 3,3-dimethyl-1-pentyne

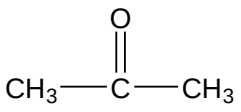
❑ c. 3-ethyl-3-methyl-1-butyne ❑ d. 3-methyl-3-ethyl-1-butyne

49. Identify the aldehyde:

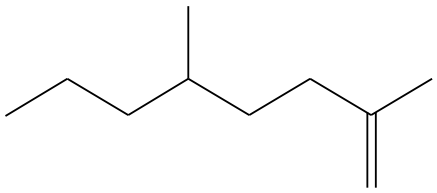
❑ a. 

☑ b. 

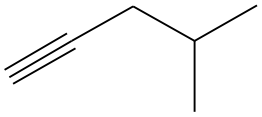
❑ c. 

❑ d. 

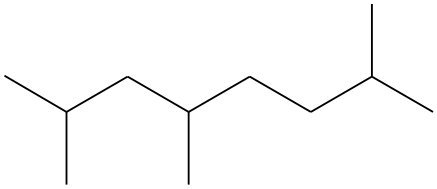
50. Give the IUPAC names for the following organic compounds:



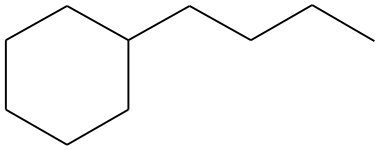
2,5-dimethyl-1-octene



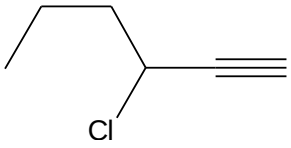
4-methyl-1-pentyne



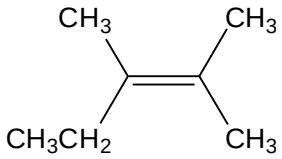
2,4,7-trimethyloctane



Butylcyclohexane



3-Chloro-1-hexyne



2,3-dimethyl-2-pentene

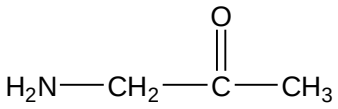
51. Which of the following suffixes refers to an organic compound that includes a C≡C?

❑ a. ane ❑ b. ene ☑ c. yne ❑ d. one

52. Which class of hydrocarbons has the general formula C_nH_{2n-2}?

❑ a. alkanes ❑ b. alkenes ☑ c. alkynes ❑ d. cycloalkanes

53. What functional group(s) are present in the following compound?



❑ a. amine ❑ b. ketone ❑ c. amide ☑ d. amine and ketone

Best Wishes

Al-Madinah, 2nd of December, 2019