

DAWSON COLLEGE
DEPARTMENT OF CHEMISTRY AND CHEMICAL TECHNOLOGY
ORGANIC CHEMISTRY I 202-BZF-05
Fall 2009**Final Examination****Instructors:** D. Adley, B. Seivewright, E. Cadieux, S. Holden, H. Khouri, & S. Mäkinen

Write your name here: _____

Sign your name here: _____

Instructions:

1. This examination package contains **19** questions and **16** pages. It is your responsibility to check that there are no pages missing.
2. Fill in your name before answering the questions.
3. Answer **ALL** questions in the **space provided**.
4. Answer the questions in **ink** and do **not use liquid white** or correction tape, otherwise, your right to contest your grade will be compromised.
5. Write **CLEARLY**, messy answers will not be marked.
6. Do not detach **any** of the sheets in this booklet.
7. Please note that **NON-PROGRAMMABLE CALCULATORS** and **MOLECULAR MODELS** are permitted but cannot be passed around.
8. Whenever required, structural formulae must be shown **complete**.
9. Your attention is drawn to the college policy on cheating. This policy will be enforced.

Marking Scheme:

1. ____ /12 2. ____ /6 3. ____ /4 4. ____ /5

5. ____ /6 6. ____ /2 7. ____ /4 8. ____ /5

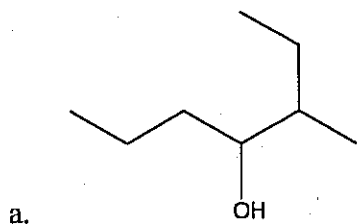
9. ____ /9 10. ____ /1 11. ____ /7 12. ____ /4

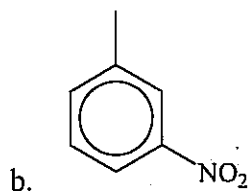
13. ____ /4 14. ____ /5 15. ____ /6 16. ____ /4

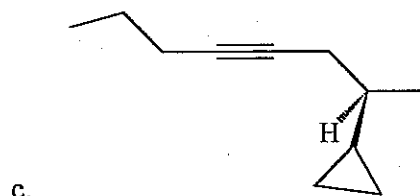
17. ____ /10 18. ____ /2 19. ____ /4

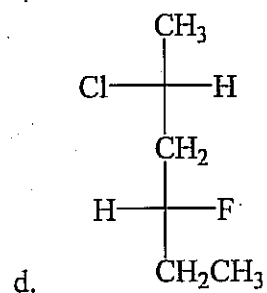
TOTAL ____ /100**TOTAL** ____ /40

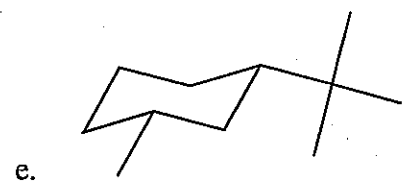
1. Give IUPAC names for the following compounds. Include R/S & E/Z nomenclature where necessary. (2 pts each, total 12 pts)

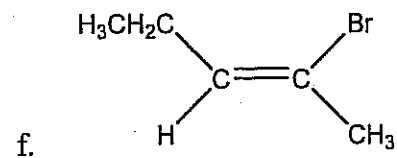












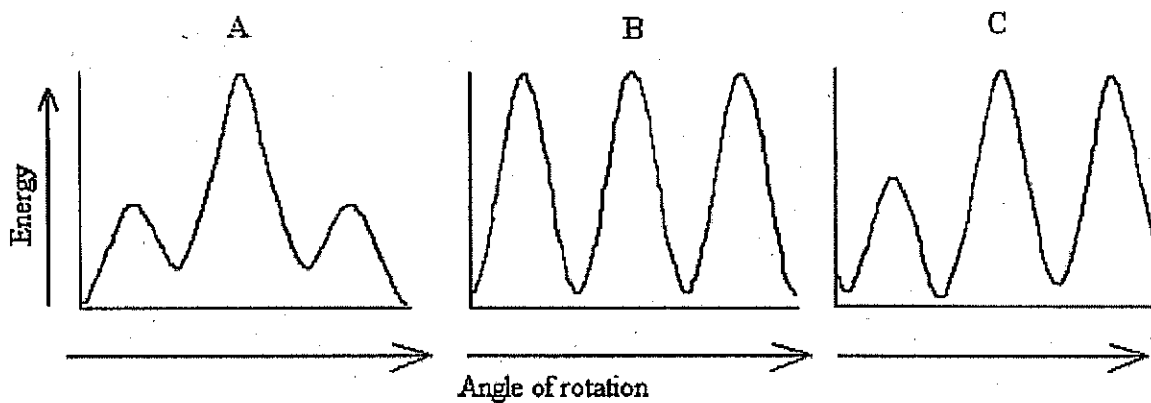
2.

- a. Draw the Newman projection formulas of the most stable conformation and the least stable conformation of butane, along the C2-C3 bond. (2 pts)

- b. For the least stable conformation, the relative positions of the two methyl groups is best described as _____ . (1 pt)

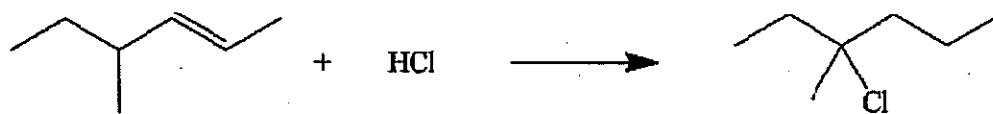
- c. Which of the following corresponds to the potential energy diagram for the rotation about the C2-C3 bond of butane? (1 pt)

Answer:



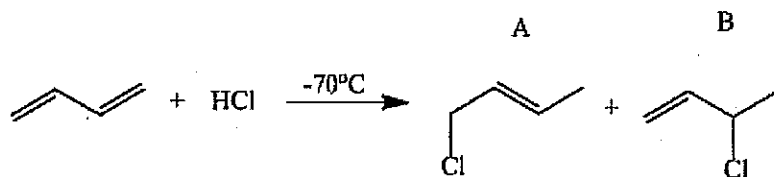
- d. List two reasons responsible for making the least stable conformation higher in energy. (2 pts)

3. Draw the mechanism to account for the given product using curved arrows. (4 pts)



4.

a. Draw the mechanism to account for the given products using curved arrows. (4 pts)

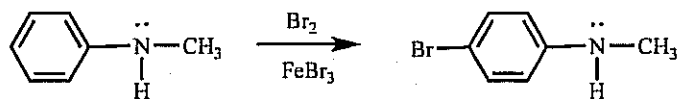


b. Which product, A or B, is the major product of the above reaction under these conditions? (1 pt)

Answer:

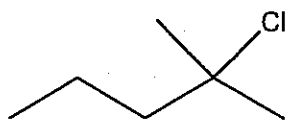
5.

- a. Draw the mechanism of the reaction below. Use the $\text{Br}-\text{Br}^+-\text{Fe}^-\text{Br}_3$ as the electrophile. Show all resonance structures of the carbocation (arenium ion) intermediate. (4 pts)



- b. Draw the resonance structures of the carbocation intermediate that would lead to the meta product. Use these structures to explain why the meta product is not formed to any significant quantities. (2 pts)

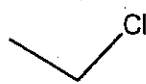
6. Arrange the following substrates in order of their increasing S_N2 reactivity with NaCN. (2 pts)



A



slowest



B

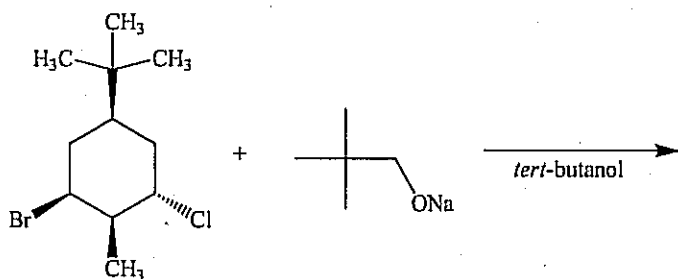


fastest

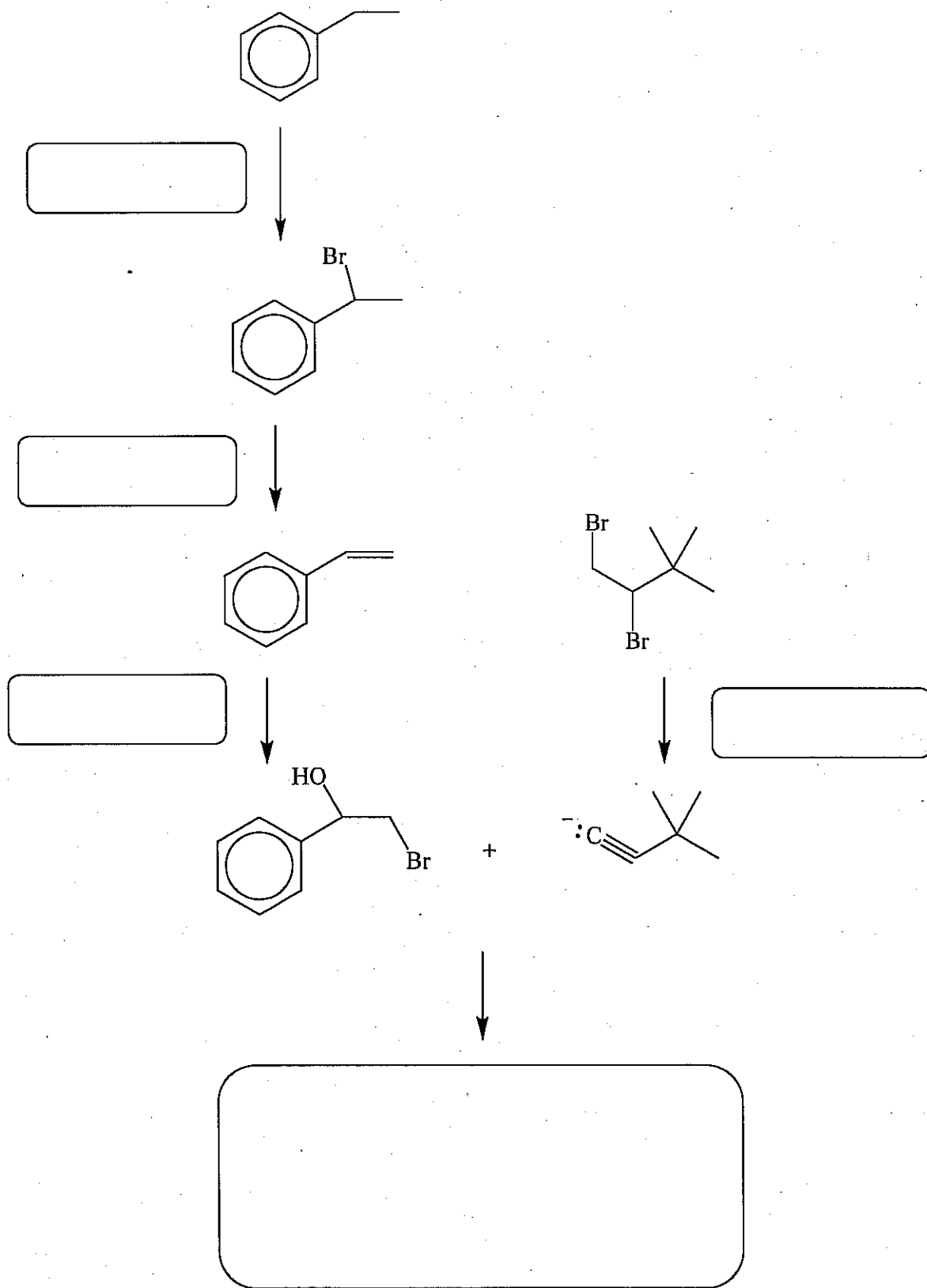


C

7. Draw the mechanism which accounts for the formation of the major organic product, when the two compounds are allowed to react. Draw in 3D when necessary. Use curved arrow notation. Draw and indicate clearly the structure of the major product. (4 pts)

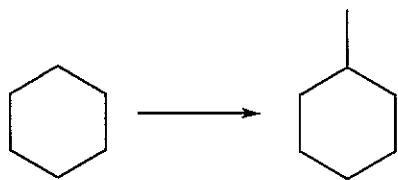


8. Show the required reagents to synthesize the following compounds: Mechanisms are **not required**. Give the final product in the last box. (5 pts)

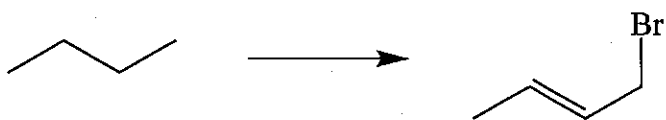


9. Show the required steps to synthesize the following compounds. Show all intermediate products. Use **any inorganic and organic reagents** necessary. Mechanisms are not required. (9 pts)

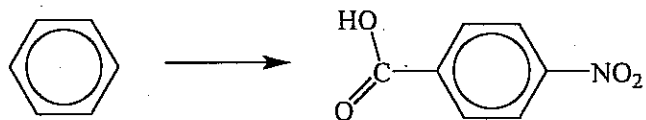
a.



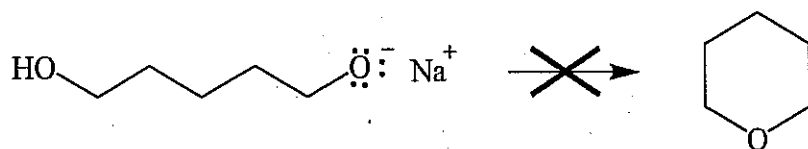
b.



c.

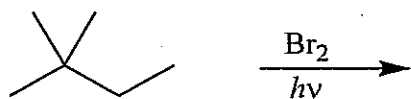


10. Explain why the following reaction does not occur. (1 pt)



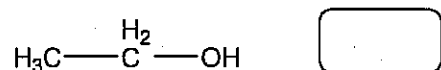
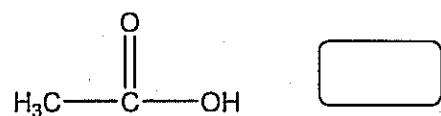
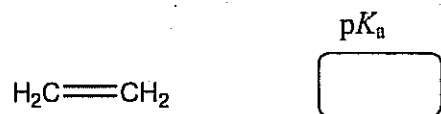
11.

- a. Give the structural formulae of all possible monobromination products for the following reaction. Circle the major product. (3 pts)

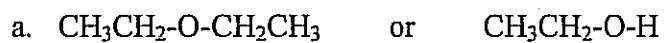


- b. Draw a mechanism for the production of the 2° alkyl halide. (4 pts)

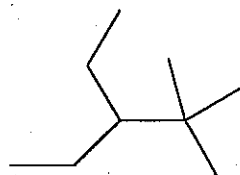
12. The compounds below have the pK_a values 4.7, 16, 45, and 62. Insert the correct pK_a value in the box for each compound. (4 pts)



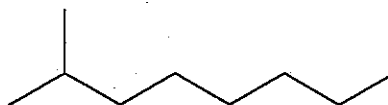
13. Which of the two compounds has a higher boiling point? Explain. (4 pts)



b.

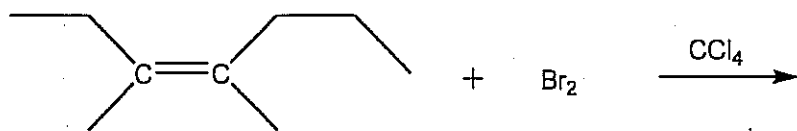


or



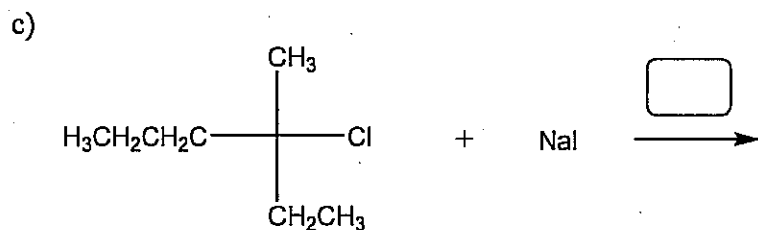
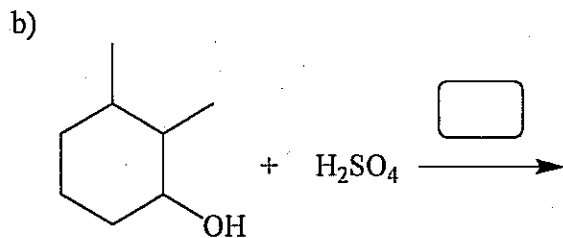
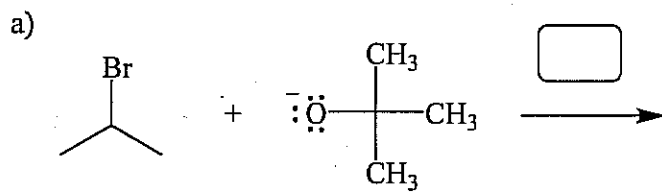
14.

a. Draw the 3D formulae of the products of the following reaction. (4 pts)



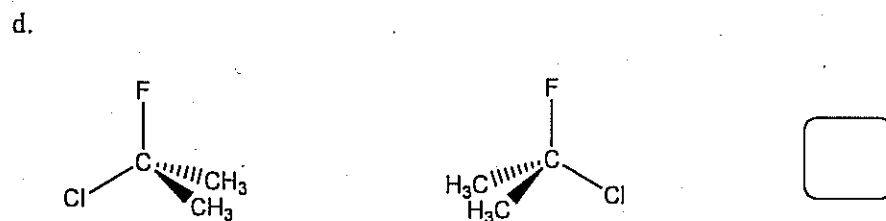
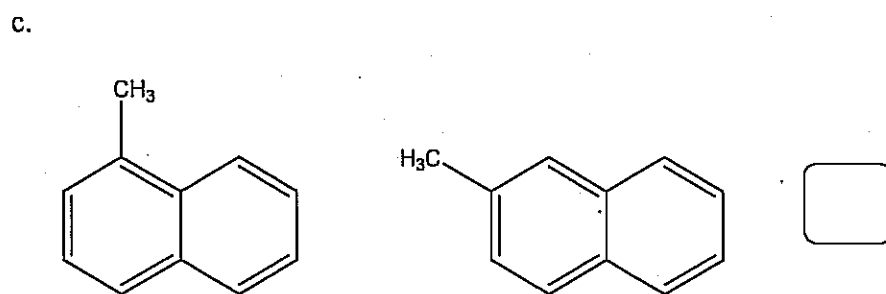
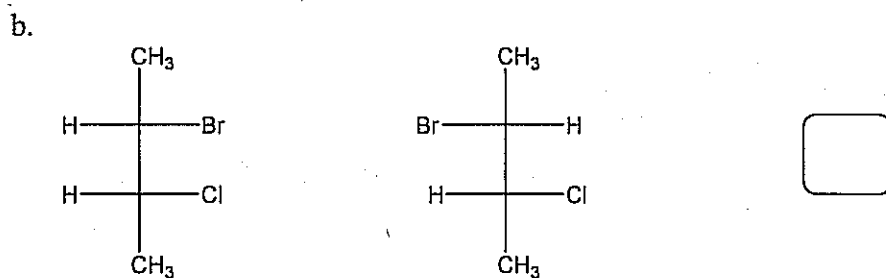
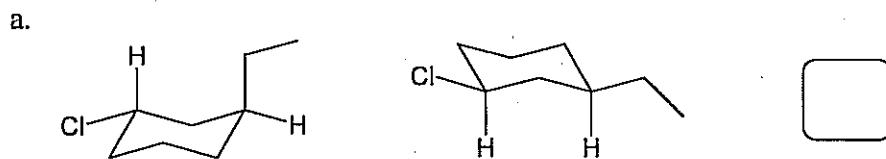
b. Will the final solution be optically active? (1 pt)

15. Give the structures of significant organic products. For each reaction, indicate in the box whether the major mechanism is S_N1 , S_N2 , E1, or E2. (2 pts each, total 6 pts)



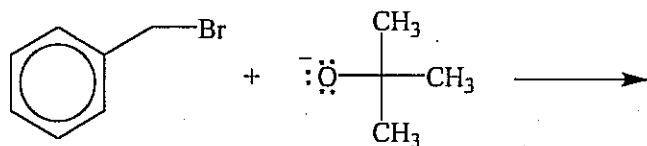
16. What is the relationship between the following molecules? Place your answer in the box. (4 pts)

- i. enantiomers
- ii. diastereomers
- iii. constitutional isomers
- iv. same molecule
- v. none of the above

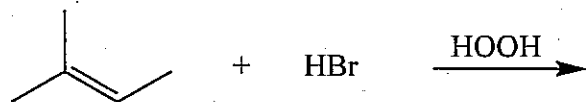


17. Give the structural formulas of the significant organic products for the following reactions. For the reactions with more than one significant organic product, circle the major product. Include stereochemistry where applicable. (2 pts each, total 10 pts)

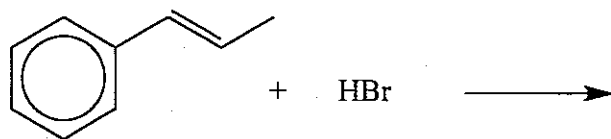
a)



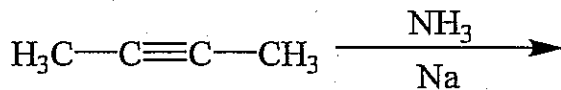
b)



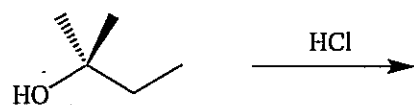
c)



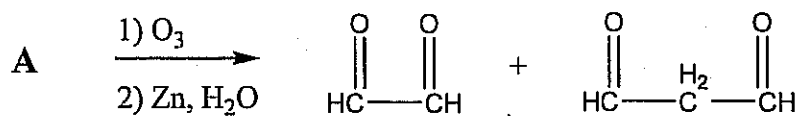
d)



e)



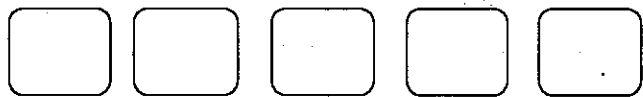
18. When subjected to ozonolysis, followed by treatment with zinc and water, compound A (C_5H_6) gives the following products: (2 pts)



What is the structure of compound A?

19. List the following in order of increasing stability. (4 pts)

- 1-octene
- 1,2-dimethylcyclohexene
- 3-methylpent-2-ene
- (*E*)-2-heptene
- (*Z*)-2-heptene



Least

Highest

Which of the above compounds will release the most energy upon hydrogenation?

PERIODIC TABLE OF THE ELEMENTS

Main Groups s block elements		Main Groups p block elements										Transition Metals d block elements										f block elements	
1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIII	9 VIII	10 VIII	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA						
1 H Hydrogen 1.0079	2 He Helium 4.0026	3 Li Lithium 6.941	4 Be Beryllium 9.0122	5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180	11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948						
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.409	31 Ga Gallium 69.723	32 Ge Germanium 72.64	33 As Arsenic 74.922	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.798						
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.91	46 Pd Palladium 106.42	47 Ag Silver 107.87	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.71	51 Sb Antimony 121.76	52 Te Tellurium 127.60	53 I Iodine 126.90	54 Xe Xenon 131.29						
55 Cs Cesium 132.91	56 Ba Barium 137.33	57 *La Lanthanum 138.91	58 Ce Cerium 140.12	59 Pr Praseodymium 140.91	60 Nd Neodymium 144.24	61 Pm Promethium (145)	62 Sm Samarium 150.36	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.93	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93	68 Er Erbium 167.26	69 Tm Thulium 168.93	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.97							
87 Fr Francium (223)	88 Ra Radium (226)	89 *Ac Actinium (227)	90 Th Thorium 232.04	91 Pa Protactinium 231.04	92 U Uranium 238.03	93 Np Neptunium (237)	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (252)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium (259)	103 Lr Lawrencium (262)							
81 Tl Thallium 204.38	82 Pb Lead 207.2	83 Bi Bismuth 208.98	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)	114 Uuq (289)	111 Uuu (272)	110 Uun (261)	109 Uut (261)	108 Hs Hassium (277)	107 Bh Bohrium (264)	106 Sg Seaborgium (266)	105 Db Dubnium (262)	104 Rf Rutherfordium (261)	103 Nh Nihonium (286)	102 Fl Flerovium (289)							

* Main-Group elements are also called *Representative Elements*.