Name _____ Test 1 (10/1)
CHEM 0211 (Adv. Inorganic) Fall 2025

1. a. (2 pts.) According to current theories on the universe, subatomic particles and most of the hydrogen nuclei and helium nuclei were formed shortly after what event?

   b. (4 pts.) Where and by what nuclear process (fusion, fission, neutron capture, alpha particle capture, etc.) are hydrogen and helium nuclei converted to nuclei larger than Li.

   c. (4 pts.) Nuclei heavier the iron nucleus are not made by the process used in part b. How and where are nuclei heavier than iron formed.

2. (4 pts.) If two carbon atoms are fused, what element would result?

3. (10 pts.) Rutherford's gold foil experiment established what fact about atomic structure, briefly explain.

4. (8 pts.) Bohr's model of the atom treated the electron as a particle that orbited the nucleus. Quantum Mechanics models the electron as what?

5. (8 pts.) The first molar ionization energy for Be is 899 kJ/mol, whereas it is 800 kJ/mol for B. This seems odd since B has a more positive nucleus. How can you rationalize the observation that removing an electron from B is more favorable (easier to do) than the removing one from Be.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____

6. (10 pts.) List the possible n, l, and m_l values for an electron in each of the following orbitals. If more than one set of quantum numbers can be used to describe the electron, list them all.

a. an electron in a 4s orbital

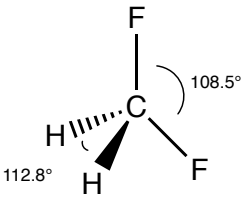
b. an electron in a 3d orbital

7. (16 pts.) Draw Lewis structures for the following molecules/polyatomic ions. The central atom is drawn first.

a. NI_3

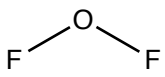
b. $[NO_2]^-$

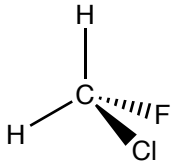
8. (8 pts.) The ideal bond angle for a tetrahedral C atom, in CH_4 for example, is 109.5°. But in CH_2F_2, drawn below, the F-C-F bond angle is less than 109.5°. Briefly explain why this happens.



9. a. (6 pts.) Draw dipole arrows on the bonds on the molecules drawn below.

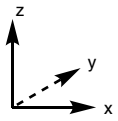
b. (6 pts.) Predict the direction of the molecular dipole. If a prediction cannot be confidently made, write "cannot predict".

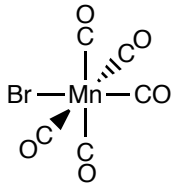


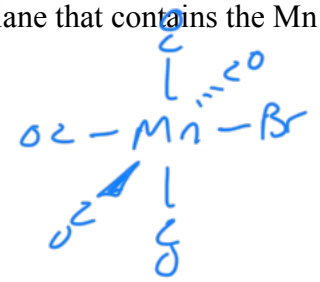


10. (12 pts.) Perform the indicated operations on the following molecules, and draw a 3D representation, using wedge and dash notation where appropriate, for the resulting view.

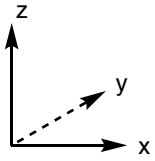
a. Perform a refection through the yz plane that contains the Mn atom.

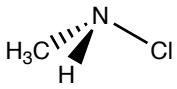


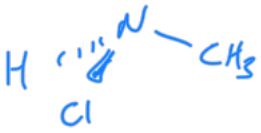




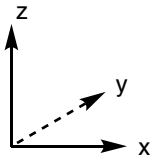
b. Perform a C_3 around the z axis through the N atom

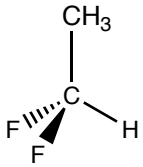


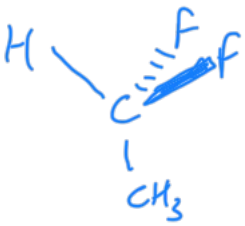




c. Perform an inversion through the central C atom.

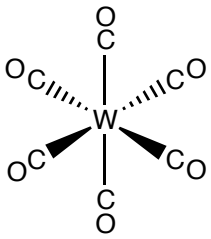






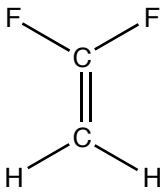
11. (12 pts.) Determine the point group for each of the following molecules. Wedge and dashed 3D representations have been provided.

a.



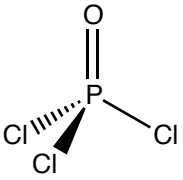
Oh

b.



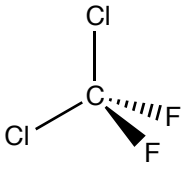
C_{2v}

c.

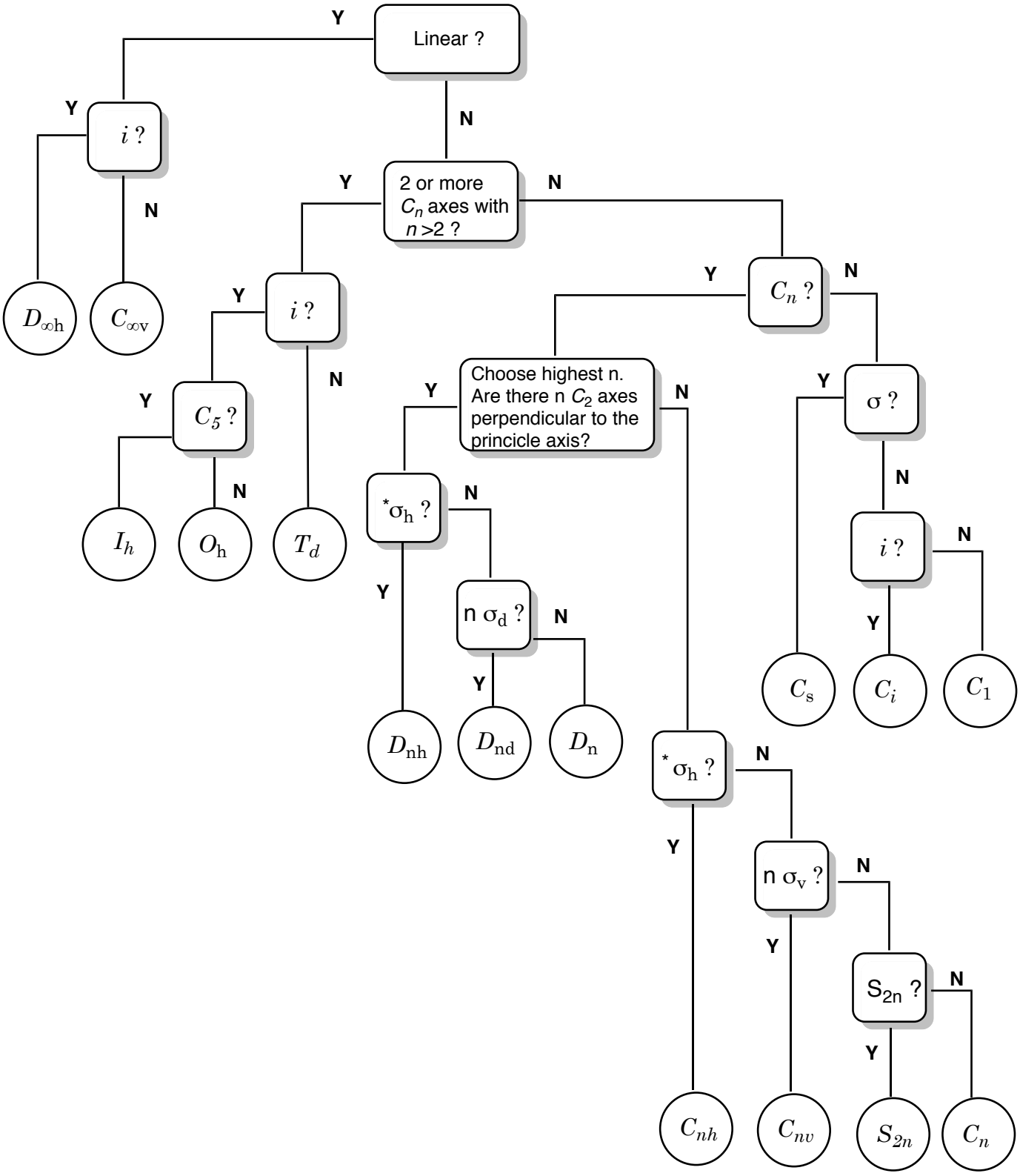


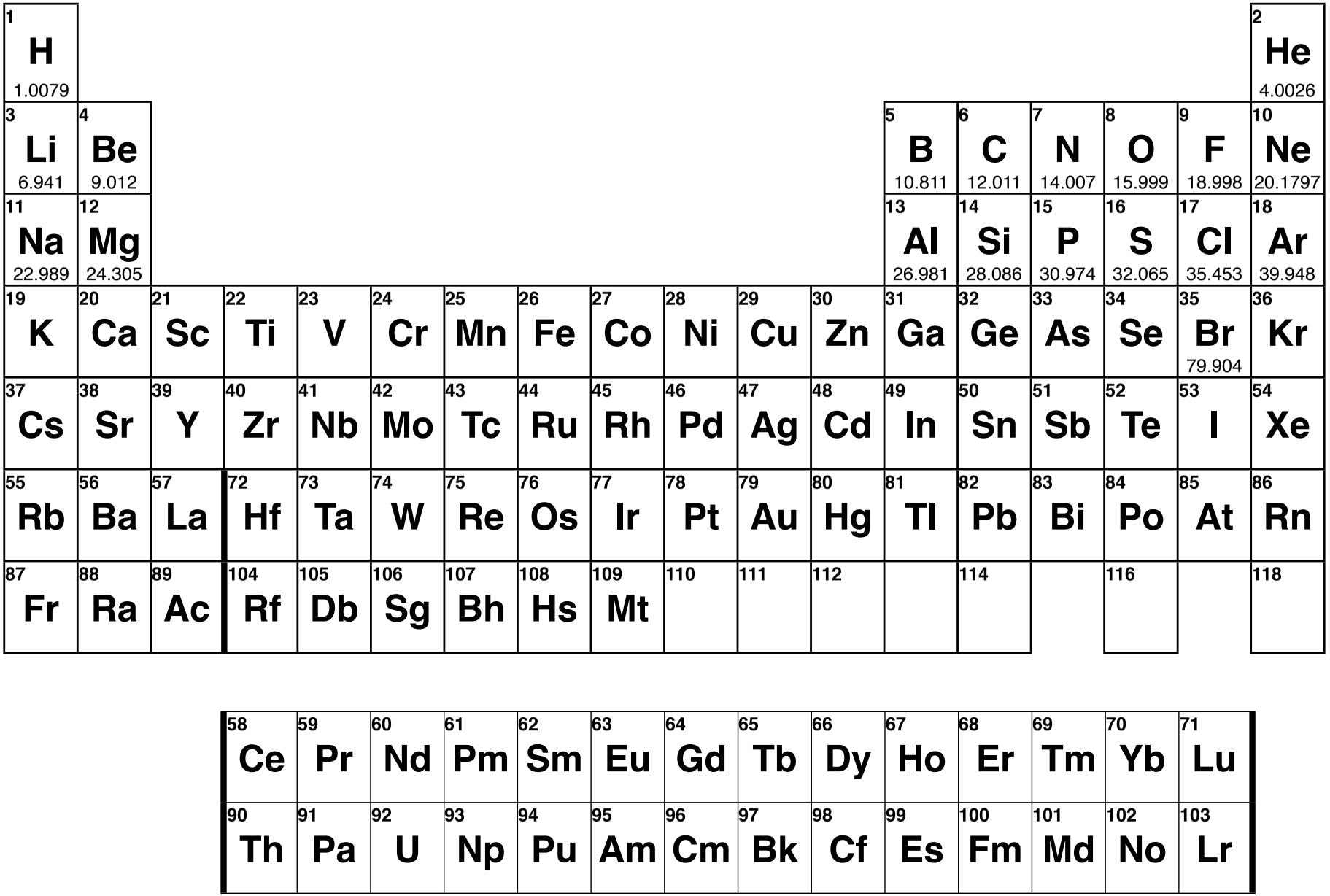
C_{3v}

d.



C_{2v}


Linear ?
Y
N
i ?
Y
N
$D_{\infty h}$
$C_{\infty v}$
2 or more C_n axes with $n>2$?
Y
N
i ?
Y
N
C_5 ?
Y
N
I_h
O_h
T_d
C_n ?
Y
N
Choose highest n. Are there n C_2 axes perpendicular to the princicle axis?
Y
N
$^*\sigma_h$?
Y
N
D_{nh}
n σ_d ?
Y
N
D_{nd}
D_n
σ ?
Y
N
C_s
i ?
Y
N
C_i
C_1
$^*\sigma_h$?
Y
N
C_{nh}
n σ_v ?
Y
N
C_{nv}
S_{2n} ?
Y
N
S_{2n}
C_n


1 H 1.0079
2 He 4.0026
3 Li 6.941
4 Be 9.012
5 B 10.811
6 C 12.011
7 N 14.007
8 O 15.999
9 F 18.998
10 Ne 20.1797
11 Na 22.989
12 Mg 24.305
13 Al 26.981
14 Si 28.086
15 P 30.974
16 S 32.065
17 Cl 35.453
18 Ar 39.948
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br 79.904
36 Kr
37 Cs
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Rb
56 Ba
57 La
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 Ac
104 Rf
105 Db
106 Sg
107 Bh
108 Hs
109 Mt
110
111
112
114
116
118
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
71 Lu
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
103 Lr