NAME: _____SECTION #: _____
Chemistry 111 EXAM 3-Fall 2013 11/20/2013/12:00PM/Odago

Fill in your A# numbers correctly on the scantrons. Attempt all the questions and fill in the bubbles using pencils with your answers.

1. The change in energy for which of the following processes corresponds to the second ionization energy of calcium?
   a) $Ca(g) \rightarrow Ca^{+}(g) + e^{-}$
   b) $Ca(g) + e^{-} \rightarrow Ca^{-}(g)$
   c) $Ca^{+}(g) \rightarrow Ca^{2+}(g) + e^{-}$
   d) $Ca^{-}(g) \rightarrow Ca(g) + e^{-}$
   e) $Ca(g) \rightarrow Ca^{2+}(g) + 2e^{-}$

2. An atom of which of the following elements has the largest first ionization energy?
   a) N
   b) Bi
   c) P
   d) Sb
   e) As

3. The change in energy for which of the following processes corresponds to the electron affinity of iodine?
   a) $I(g) + e^{-} \rightarrow I^{-}(g)$
   b) $I_2(g) \rightarrow 2I(g)$
   c) $I(g) \rightarrow I^{+}(g) + e^{-}$
   d) $I^{-}(g) \rightarrow I(g) + e^{-}$
   e) $I^{+}(g) + I^{-}(g) \rightarrow I_2(s)$

4. All of the following have ground-state noble-gas electron configurations <u>except</u>
   a) Cl^{-}
   b) N^{3-}
   c) Mg^{2+}
   d) P^{3+}
   e) Ar

5. The ground-state electron configuration of the Mg^{2+} ion is
   a) $1s^2 2s^2 2p^6$
   b) $1s^2 2s^2 2p^6 3s^2$
   c) $1s^2 2s^2 2p^6 3s^2 3p^2$
   d) $1s^2 2s^2 2p^3$
   e) $1s^2 2s^2 2p^1$

6. Which set of ions are isoelectronic in their ground-state electron configurations?
   a) $Na^{+}, K^{+}, Rb^{+}, Cs^{+}$
   b) $Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}$
   c) N, O, F, Ne
   d) $F^{-}, Cl^{-}, Br^{-}, I^{-}$
   e) $N^{3-}, O^{2-}, Mg^{2+}, Al^{3+}$

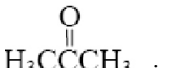
7. Rank the following ions in order of decreasing ionic radius: $S^{2-}, O^{2-}, F^{-}, Na^{+}, Mg^{2+}$.
   a) $S^{2-}, O^{2-}, F^{-}, Na^{+}, Mg^{2+}$
   b) $O^{2-}, F^{-}, Na^{+}, Mg^{2+}, S^{2-}$
   c) $Mg^{2+}, Na^{+}, F^{-}, O^{2-}, S^{2-}$
   d) $Mg^{2+}, S^{2-}, Na^{+}, F^{-}, O^{2-}$
   e) $O^{2-}, S^{2-}, F^{-}, Na^{+}, Mg^{2+}$

8. Which of the following atoms is the most electronegative?
    a) B
    b) Na
    c) N
    d) Cs
    e) Al

9. The Lewis formula for phosphine, PH_3, has
    a) four bonding pairs.
    b) two bonding pairs and two lone pairs.
    c) three bonding pairs and one lone pair.
    d) one bonding pair and three lone pairs.
    e) four lone pairs.

10. What is the total number of valence electrons in the monohydrogen phosphate ion, HPO_4^{2-}?
    a) 28
    b) 30
    c) 32
    d) 34
    e) 36

11. In the Lewis formula for ClF_3, how many lone pairs are around the central atom?
    a) 0
    b) 1
    c) 2
    d) 3
    e) 4

12. The approximate C-C-O angle in acetone,  , is
    a) 60°
    b) 90°
    c) 109°
    d) 120°
    e) 180°

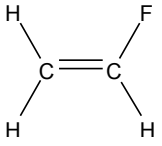
13. What is the predicted H—N—H bond angle in the ammonium ion (NH_4^+)?
    a) 180°
    b) 120°
    c) 90°
    d) 109.5°
    e) 45°

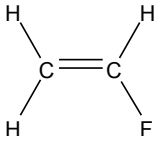
14. What is the H—O—H bond angle in water?
    a) 180°
    b) 120°
    c) 90°
    d) 109°
    e) Slightly less than 109°

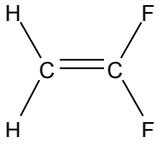
15. In the ICl_4^- ion, how many electron groups surround the central iodine atom?
    a) 2
    b) 3
    c) 4
    d) 5
    e) 6

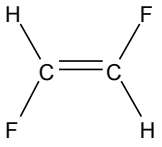
16. What is the molecular geometry of the ICl_4^- ion?
    a) square planar
    b) tetrahedral
    c) octahedral
    d) rectangular
    e) pentagonal

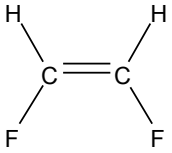
17. Which of the following molecules is nonpolar?

a) 

b) 

c) 

d) 

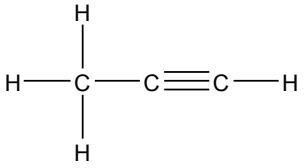
e) 

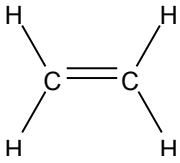
18. When a carbon atom has sp^3 hybridization, it has
    a) four π bonds
    b) three π bonds and one σ bond
    c) two π bonds and two σ bonds
    d) one π bond and three σ bonds
    e) four σ bonds

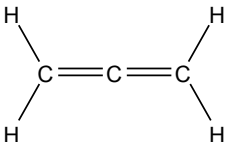
19. What is the hybridization of I in IF_4^-?
    a) sp
    b) sp^2
    c) sp^3d
    d) sp^3
    e) sp^3d^2

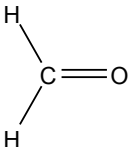
20. According to valence-bond theory, the bonding in ketene, $H_2C=C=O$, is best described as
    a) five σ bonds
    b) four σ bonds and two π bonds
    c) five π bonds
    d) four σ bonds and one π bond
    e) three σ bonds and two π bonds

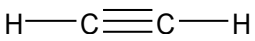
21. Which of the following molecules contains an sp^3-hybridized carbon atom?

a) 

b) 

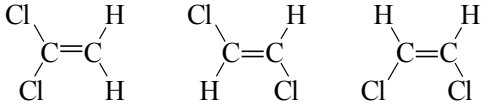
c) 

d) 

e) 

22. Which of these statements about benzene is true?
    a) All carbon atoms in benzene are sp^3 hybridized
    b) Benzene contains only π bonds between C atoms
    c) The bond order of each C—C bond in benzene is 1.5
    d) Benzene is an example of a molecule that displays ionic bonding
    e) All of these statements are false

23. Three possible structures of $C_2H_2Cl_2$ are shown below. Which of these molecules are polar?

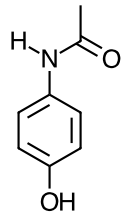


(1) (2) (3)

a) 1 only
b) 2 only
c) 3 only
d) 1 and 3
e) 2 and 3

24. Which of the following statements is <u>incorrect</u> regarding the water molecule?
    a) The molecule is polar
    b) The hybridization of oxygen is sp^3
    c) There are two lone pairs and two bonding pairs on the central atom
    d) The molecular geometry is bent
    e) The hybridization of hydrogen is sp

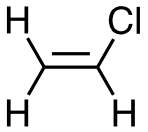
25. Acetaminophen is the active compound in many over-the counter pain relieving medications such as Tylenol. Use the structure of acetaminophen shown below to answer the following questions (24 & 25). What is the hybridization, number of lone pair(s) of electron(s), and molecular geometry around the N-atom? (*Non-bonding electron pairs are not indicated, but you should consider them*)



a) sp^2 hybridized, no lone pair, trigonal planar
b) sp^3 hybridized, no lone pair, trigonal pyramidal
c) sp^3 hybridized, one lone pair, trigonal pyramidal
d) sp^2 hybridized, one lone pair, trigonal planar
e) sp^3 hybridized, one lone pair, tetrahedral

26. What is the hybridization of the oxygen that is doubly bonded to carbon in acetaminophen (*refer to the structure given above*)?
a) sp
b) sp^2
c) sp^3
d) sp^3d
e) sp^3d^2

27. Vinyl chloride is used greatly as monomers in the synthesis of polyvinyl chloride (PVC). Using the structure of vinyl chloride below. Answer the following questions.

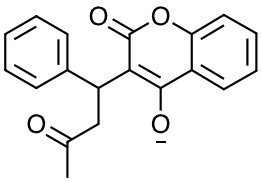


Which orbitals overlap to form the sigma bond between the two carbon atoms?
a) sp^3 and sp^3
b) sp^2 and sp
c) sp^2 and 1s
d) sp^2 and sp^2
e) sp and sp

28. Which orbitals form the pi-bond between the two carbon atoms?
a) sp^2 and 2p
b) $2p_z$ and $2p_z$
c) $2p_x$ and sp^2
d) $2p_x$ and $2p_y$
e) sp^2 and $2p_x$

29. Which of the following bonds would be the strongest?
a) C-Br
b) C-F
c) C-Cl
d) C-I
e) C-As

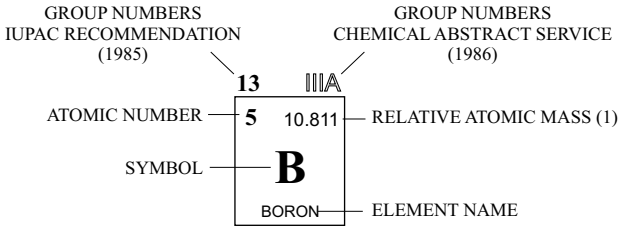
30. Coumadin is a commonly used blood thinner, which is taken by patients to avoid blood clots. How many pi-bonds are in the structure of Coumadin?



a) 7
b) 18
c) 9
d) 3
e) 6

PERIODIC TABLE OF THE ELEMENTS

http://www.ktf-split.hr/periodni/en/



PERIOD	GROUP 1 IA	2 IIA	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8	9 VIIIB	10	11 IB	12 IIB	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1	1 1.0079 **H** HYDROGEN																	2 4.0026 **He** HELIUM
2	3 6.941 **Li** LITHIUM	4 9.0122 **Be** BERYLLIUM											5 10.811 **B** BORON	6 12.011 **C** CARBON	7 14.007 **N** NITROGEN	8 15.999 **O** OXYGEN	9 18.998 **F** FLUORINE	10 20.180 **Ne** NEON
3	11 22.990 **Na** SODIUM	12 24.305 **Mg** MAGNESIUM											13 26.982 **Al** ALUMINIUM	14 28.086 **Si** SILICON	15 30.974 **P** PHOSPHORUS	16 32.065 **S** SULPHUR	17 35.453 **Cl** CHLORINE	18 39.948 **Ar** ARGON
4	19 39.098 **K** POTASSIUM	20 40.078 **Ca** CALCIUM	21 44.956 **Sc** SCANDIUM	22 47.867 **Ti** TITANIUM	23 50.942 **V** VANADIUM	24 51.996 **Cr** CHROMIUM	25 54.938 **Mn** MANGANESE	26 55.845 **Fe** IRON	27 58.933 **Co** COBALT	28 58.693 **Ni** NICKEL	29 63.546 **Cu** COPPER	30 65.39 **Zn** ZINC	31 69.723 **Ga** GALLIUM	32 72.64 **Ge** GERMANIUM	33 74.922 **As** ARSENIC	34 78.96 **Se** SELENIUM	35 79.904 **Br** BROMINE	36 83.80 **Kr** KRYPTON
5	37 85.468 **Rb** RUBIDIUM	38 87.62 **Sr** STRONTIUM	39 88.906 **Y** YTTRIUM	40 91.224 **Zr** ZIRCONIUM	41 92.906 **Nb** NIOBIUM	42 95.94 **Mo** MOLYBDENUM	43 (98) **Tc** TECHNETIUM	44 101.07 **Ru** RUTHENIUM	45 102.91 **Rh** RHODIUM	46 106.42 **Pd** PALLADIUM	47 107.87 **Ag** SILVER	48 112.41 **Cd** CADMIUM	49 114.82 **In** INDIUM	50 118.71 **Sn** TIN	51 121.76 **Sb** ANTIMONY	52 127.60 **Te** TELLURIUM	53 126.90 **I** IODINE	54 131.29 **Xe** XENON
6	55 132.91 **Cs** CAESIUM	56 137.33 **Ba** BARIUM	57-71 **La-Lu** Lanthanide	72 178.49 **Hf** HAFNIUM	73 180.95 **Ta** TANTALUM	74 183.84 **W** TUNGSTEN	75 186.21 **Re** RHENIUM	76 190.23 **Os** OSMIUM	77 192.22 **Ir** IRIDIUM	78 195.08 **Pt** PLATINUM	79 196.97 **Au** GOLD	80 200.59 **Hg** MERCURY	81 204.38 **Tl** THALLIUM	82 207.2 **Pb** LEAD	83 208.98 **Bi** BISMUTH	84 (209) **Po** POLONIUM	85 (210) **At** ASTATINE	86 (222) **Rn** RADON
7	87 (223) **Fr** FRANCIUM	88 (226) **Ra** RADIUM	89-103 **Ac-Lr** Actinide	104 (261) **Rf** RUTHERFORDIUM	105 (262) **Db** DUBNIUM	106 (266) **Sg** SEABORGIUM	107 (264) **Bh** BOHRIUM	108 (277) **Hs** HASSIUM	109 (268) **Mt** MEITNERIUM	110 (281) **Uun** UNUNNILIUM	111 (272) **Uuu** UNUNUNIUM	112 (285) **Uub** UNUNBIUM		114 (289) **Uuq** UNUNQUADIUM				

LANTHANIDE

57 138.91 **La** LANTHANUM	58 140.12 **Ce** CERIUM	59 140.91 **Pr** PRASEODYMIUM	60 144.24 **Nd** NEODYMIUM	61 (145) **Pm** PROMETHIUM	62 150.36 **Sm** SAMARIUM	63 151.96 **Eu** EUROPIUM	64 157.25 **Gd** GADOLINIUM	65 158.93 **Tb** TERBIUM	66 162.50 **Dy** DYSPROSIUM	67 164.93 **Ho** HOLMIUM	68 167.26 **Er** ERBIUM	69 168.93 **Tm** THULIUM	70 173.04 **Yb** YTTERBIUM	71 174.97 **Lu** LUTETIUM

ACTINIDE

89 (227) **Ac** ACTINIUM	90 232.04 **Th** THORIUM	91 231.04 **Pa** PROTACTINIUM	92 238.03 **U** URANIUM	93 (237) **Np** NEPTUNIUM	94 (244) **Pu** PLUTONIUM	95 (243) **Am** AMERICIUM	96 (247) **Cm** CURIUM	97 (247) **Bk** BERKELIUM	98 (251) **Cf** CALIFORNIUM	99 (252) **Es** EINSTEINIUM	100 (257) **Fm** FERMIUM	101 (258) **Md** MENDELEVIUM	102 (259) **No** NOBELIUM	103 (262) **Lr** LAWRENCIUM

(1) Pure Appl. Chem., **73**, No. 4, 667-683 (2001)

Relative atomic mass is shown with five significant figures. For elements have no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.

However three such elements (Th, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

Editor: Aditya Vardhan (adivar@nettlinx.com)