Grade = 100 − 3(#wrong) 3 points per question

Chem 1110 Rybolt Exam 3 FALL 2011 Name KEY

Numerical constants may be listed below. Other needed information is given in the problem or written on the board or found in the Periodic Tables you will use during exam. For numerical problems, be sure to **show your work**, include units and circle your final answer. If several choices are given, **circle the correct answer**. Your written answers should be brief and to the point. You can use your own calculator on the exam, but no notes, books, external information, or other electronic devices are to be used. No cell phone is to be used in Exam room.

1.000 g = 6.022×10^{23} amu 1mol = 6.022×10^{23} K = °C + 273 °C = (°F − 32)/1.8

$c = 3.00 \times 10^{8}$ m/s $h = 6.63 \times 10^{-34}$ Js

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1) Most touch screen displays such as those found in the iPhone and iPad are made of indium tin oxide (ITO). This material is suitable because it is both transparent to visible light and electrically conducting. However, there is a limited supply of indium in the world and almost all know supplies are in China so other options are being explored for future display screens. Complete the abbreviated electron configuration of In

[Kr] $5s^2 4d^{10} 5p^1$

2) Use arrow notation to show how the two outermost p electrons in tin (Sn) would be distributed among possible 5p orbitals where each line represents a different 5p orbital

↑ ↑ ___

3) Copper is a widely used conducting material. Write the full electron configuration for copper

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

4) Write the full electron configuration for Cu^+

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ the single 4s e is lost

5) A UTC student is looking at the image of a beach resort on an iPad and sees a beautiful blue sky. The electromagnetic radiation representing the blue sky is caused by photons of light with a wavelength of 450 nm. (Recall that nano is 10^{-9}) What is the frequency of this light?

$\lambda\nu = c$

$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}\ m/s}{450 \times 10^{-9}\ m} = 6.67 \times 10^{14}\ s^{-1}$

6) And what is the energy of one single photon of this 450nm light

$E = h\nu$

$= (6.63 \times 10^{-34}\ Js)(6.67 \times 10^{14}\ s^{-1})$

$= 4.42 \times 10^{-19}\ J$

7) A month later while sitting on the beach listening to the radio and celebrating her graduation as a chemistry major from UTC and her acceptance into pharmacy school, the student realizes that the energy of the electromagnetic radiation that she sees (visible), feels from the sun's heat (infrared), and that the radio is receiving (radio waves) are in order from longest to shortest wavelength as

a) radio infrared visible
b) infrared visible radio
c) infrared radio visible
d) visible radio infrared

8) According to the DeBroglie equation $\lambda = h/p$ where $p=mv$ an electron with a mass of 9.11×10^{-31} kg traveling at a speed of 3.00×10^{6} m/s should have wave properties and have a wavelength in nanometers (nm) equal to

$\lambda = h/p$

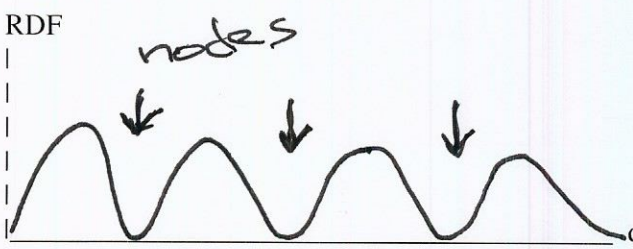
$= (6.63 \times 10^{-34}\ J\,s)/(9.11 \times 10^{-31}\ kg)(3.00 \times 10^{6}\ m/s)$

$= 2.43 \times 10^{-10}\ m \left(\frac{nm}{10^{-9}\ m}\right)$ $\qquad \frac{J\,s}{kg\,m\,s^{-1}} = m$

$= 0.243\ nm$

9) Draw a picture of a radial distribution function of a 4s orbital showing the appropriate number of radial nodes

1s - 0
2s - 1
3s - 2
4s - 3



10) If the principal (main level) quantum number is n=3 what are all the possible values of the secondary (sublevel) quantum number l=

max $l = n-1$

$l = 0$ $l = 1$ $l = 2$ which are 3s 3p 3d

11) If the secondary (sublevel) quantum number is l=2 then what are the possible values of the magnetic orbital quantum number m_l=

min $-l$ .... max l

$m_l = -2 \quad -1 \quad 0 \quad 1 \quad 2$

which are 5 different d orbitals

12) Which of the following would you expect to have the largest size

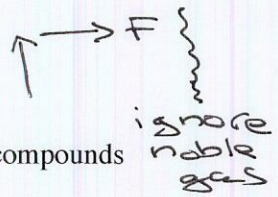
In Sn Sb Te I Xe

13) Which of the following atoms would have the highest ionization energy and thus be most difficult to remove an electron from?

In Sn Sb Te I Xe

14) Which of the following atoms would have the highest electronegativity?

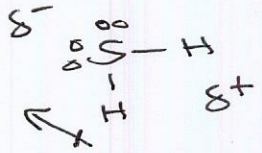
In Sn Sb Te (I) Xe



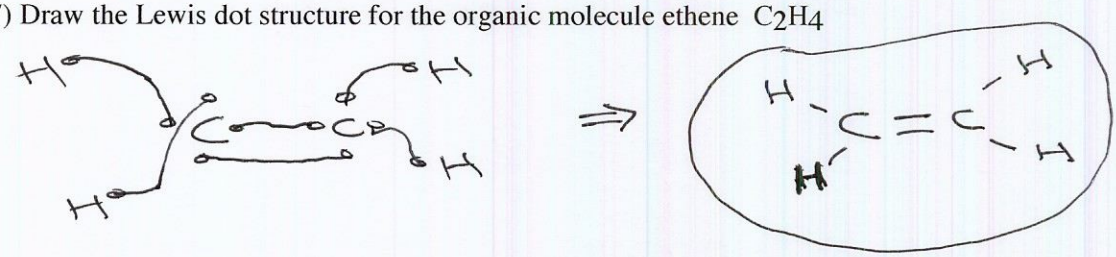
15) Write the type of bonding (metallic, ionic, covalent) found in each of the following compounds

CaI_2 ionic NH_3 covalent

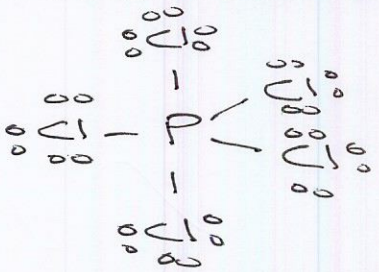
16) Draw the Lewis structure of H_2S and using your knowledge of the Pauli electronegativity scale indicate the negative ∂^- and positive ∂^+ side of the molecule



17) Draw the Lewis dot structure for the organic molecule ethene C_2H_4



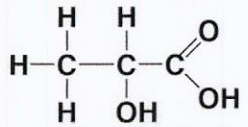
18) Draw the Lewis dot structure for phosphorus pentachloride



19) What is the hybridization of the orbitals on the phosphorus atom in PCl_5

5 e pairs (sp³d) so five sp³d orbitals in trigonal bipyramidal

20) When you need a burst of energy your muscles may utilize glucose metabolism with a shortage or lack of oxygen (anaerobically as opposed to aerobic exercise) and this process can produce lactic acid that builds up in your muscles and causes them to burn or hurt after exercise. Below is the structure of lactic acid - how many pi bonds are found in lactic acid?

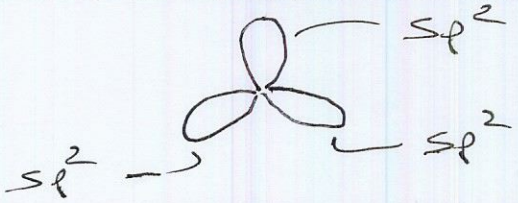


double is σ and π

so (1 π bond)

and 11 σ bonds including 2 O-H

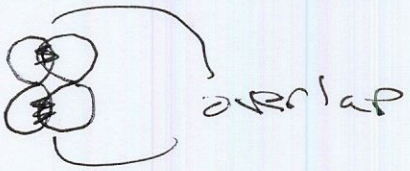
21) You will notice that the rightmost carbon in the Lewis drawing of lactic acid has sp^2 hybridization – draw a picture that shows the appearance and orientation of the three sp^2 hybrid orbitals that are present on this carbon



22) What would the bond angle between neighboring pairs of **sp** hybrid orbitals

180°

23) Draw a picture showing how a pi bond may be formed from two p orbitals



24) Hyrdogen sulfide is colorless, poisonous gas with the characteristic foul odor of rotten eggs. It can be formed in the bacterial breakdown of organic materials where there is a lack of oxygen. H_2S may be formed in swamps and in sewer systems and is sometimes called swamp gas or sewer gas. What is the electron pair geometry of the molecule H_2S. Although the actual situation is more complicated assume that the H_2S forms sp3 hybridization like H_2O then the electron pair geometry would be

linear trigonal planar square planar (tetrahedral) pyramidal

25) And the molecular geometry (considering the atom locations) of the molecule H_2S is

linear trigonal planar tetrahedral pyramidal (bent)

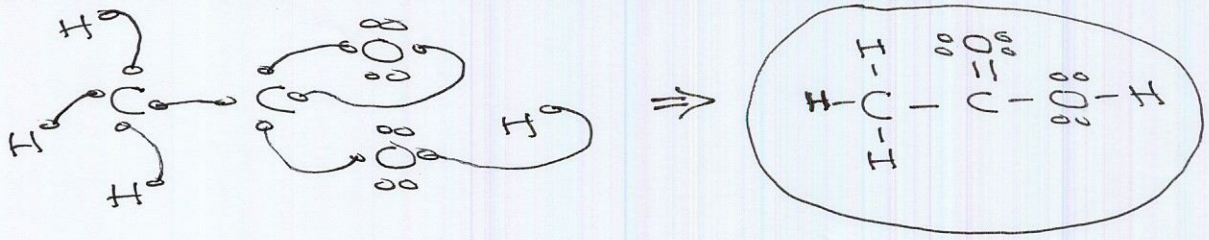
26) According the VSEPR model, the largest bond angle between two hydrogens and a central atom would be observed in

(CH4) NH3 H2S others are pushed closer

27) How much of the weak acid acetic acid exist in the unionized, molecular form ($HC_2H_3O_2$) when it is placed in water 100% (99%) 1% 0%

28) How much of the strong acid hydrochloric acid exist in the unionized, molecular form (HCl) when it is placed in water 100% 99% 1% (0%)

29) keeping in mind that acetic acid has one carbon with two oxygen atoms bonded to it and one oxygen has a bonded hydrogen O- H draw a Lewis structure for acetic acid $C_2H_3O_2H$



30) Unpaired electrons in which of the following to be paramagnetic

K^+ Ca^{2+} (Cr) Br^- Kr

unpaired electrons

Cr [Ar] 4s² 3d⁴ → [Ar] 4s¹ 3d⁵

more stable