Chemistry 141 Name key

Dr. Cary Willard

Double Quiz A – Quantum (42 points) November 2, 2010

1. (15 points) The threshold frequency of titanium is 1.05 x 1015/sec. Answer the following questions regarding titanium
	1. What is the minimum wavelength required to ionize an atom of titanium?

$$λ=\frac{c}{ν}=\frac{3.00×10^{8}m/sec}{{1.05×10^{15}}/{sec}}=2.85×10^{-7} m or 285 nm$$

* 1. What is the minimum energy required to ionize an atom of titanium?

$$E=hν=\left(6.626×10^{-34} J sec\right)\left({1.05×10^{15}}/{sec}\right)=6.96×10^{-19}J$$

* 1. How many photons would be required to ionize 4.25 grams of titanium?

$$?photons=4.25 g Ti×\frac{1 mol Ti}{47.88 g Ti}×\frac{6.022×10^{23}atom Ti}{1 mol Ti}×\frac{1 photon}{1 atom Ti}=5.34×10^{22}photons$$

* 1. What is the ionization energy in kJ/mol for titanium?

$$\frac{6.96×10^{-19} J}{e^{-1}}×\frac{6.022×10^{23}e^{-1}}{1 mol e^{-1}}×\frac{1 kJ}{1000 J}=\frac{419 kJ}{1 mol e^{-1}}$$

* 1. If a sample of titanium was exposed to light with a wavelength of 215 nm, calculate the kinetic energy of the electrons emitted.

$$E=\frac{hc}{λ}=\frac{\left(6.626×10^{-34} J sec\right)\left(3.00×10^{8}m/sec\right)}{\left(215 nm\right)}×\frac{10^{9}nm}{1 m}=9.25×10^{-19}J$$

$$kinetic energy= E\_{insident}-E\_{ionization}=9.25×10^{-19}J-6.96×10^{-19}J=2.29×10^{-19}J$$

1. (3 points) Ultraviolet radiation causes skin damage that may lead to cancer, but exposure to infrared radiation does not seem to cause skin cancer. Why do you think this is so?

Infrared radiation is lower in energy than ultraviolet radiation so is is less likely to ionized molecules in the skin which might lead to mutations that might cause cancer.

1. (3 points) Explain the difference between a ground-state H atom and an excited-state H atom.

A ground state hydrogen atom has an electron in the 1s orbital. An excited state atom has the electron in a higher energy level.

1. (9 points) The shorthand configuration for an atom of tellurium is [Kr] 5s2 4d10 5p4?
	1. How many valence electrons are there in an atom of Te?

6

* 1. Draw an orbital diagram for an atom of Te showing all of the electrons beyond Kr. (You know the one, shows all of the little boxes representing orbitals with arrows representing the electrons.)

 5s 4d 5p

* 1. Give possible quantum numbers for the 5p electrons in Te.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | n | l | ml | ms |
| Electron 1 | 5 | 1 | 1 | ½  |
| Electron 2 | 5 | 1 | 1 | - ½  |
| Electron 3 | 5 | 1 | 0 | ½  |
| Electron 4 | 5 | 1 | -1 | ½  |

1. (3 points) How many quantum numbers are needed to identify an electron in an atom?

4

1. (3 points) Explain why so many transition metals form ions with a +2 charge.

Almost all transition metals have 2 valence electrons which when lost will give a charge of +2.

1. (3 points) Write the complete electron configuration for an atom of P.

S 1s2 2s2 2p6 3s2 3p3

1. (3 points) Write the shorthand electronic configuration for an atom of europium as predicted from the periodic table.

Eu [Xe] 6s2 5d1 4f6

Formulas

|  |  |  |
| --- | --- | --- |
| Kinetic energy = ½ mv2w = -PΔVΔG = ΔH - TΔSw=dxF C = q/ΔT ΔGo = -nFEoΔG = - RTlnK E = mc2E = IR  | PV = nRTPtotal = P1+P2+P3+…P1=X1\*Ptotal Ba(Na)2 = fruitPtotal = P1 + P2 + P3 + …M = mol/Lm = mol/kg solventXi = moli/ moltotalu = (3RT/MW)½Rate ∝ (MW)-½ | HΨ=EΨAmp = C/secπ= iMRTE = hν = hc/λE = nhν = nhc/λM1V1 = M2V2Psoln = (Psolv)(Xsolv)ΔTf = i(kf)(m)ΔTb = i(kb)(m) |



Constants

|  |  |
| --- | --- |
| F = 9.65 x 104 Ch = 6.626 x 10-34 J secc= 2.9979 x 108 m/sece = 1.602 x 10-19 CNA = 6.022 x 1023/molk = 1.381 x 10-23 J/K1 kcal = 4.184 kJ K = oC + 273.16Kw = 1.0 x 10-14M2 | mass electron = 9.109 x 10-31 kgStandard Temperature and Pressure = 0oC and 1 atmR = 0.0821 L atm/mol K= 8.314 J/K mol= 1.987 cal.mol K = 62.4 L torr/mol K760 torr = 760 mm Hg = 1.00 atm = 101 kPa = 14.6 psi = 30 in Hg |

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Double Quiz B – Quantum (42 points) November 2, 2010

1. (15 points) The threshold frequency of silicon is 1.97 x 1015/sec. Answer the following questions regarding silicon
	1. What is the minimum wavelength required to ionize an atom of silicon?

$$λ=\frac{c}{ν}=\frac{3.00×10^{8}m/sec}{{1.97×10^{15}}/{sec}}=1.52×10^{-7} m or 152 nm$$

* 1. What is the minimum energy required to ionize an atom of silicon?

$$E=hν=\left(6.626×10^{-34} J sec\right)\left({1.97×10^{15}}/{sec}\right)=1.31×10^{-18}J$$

* 1. How many photons would be required to ionize 4.25 grams of silicon?

$$?photons=4.25 g Si×\frac{1 mol Si}{28.09 g Si}×\frac{6.022×10^{23}atom Si}{1 mol Si}×\frac{1 photon}{1 atom Si}=9.11×10^{22}photons$$

* 1. What is the ionization energy in kJ/mol forsilicon?

$$\frac{1.31×10^{-18} J}{e^{-1}}×\frac{6.022×10^{23}e^{-1}}{1 mol e^{-1}}×\frac{1 kJ}{1000 J}=\frac{786 kJ}{1 mol e^{-1}}$$

* 1. If a sample of silicon was exposed to light with a wavelength of 115 nm, calculate the kinetic energy of the electrons emitted.

$$E=\frac{hc}{λ}=\frac{\left(6.626×10^{-34} J sec\right)\left(3.00×10^{8}m/sec\right)}{\left(115 nm\right)}×\frac{10^{9}nm}{1 m}=1.73×10^{-18}J$$

$$kinetic energy= E\_{insident}-E\_{ionization}=1.73×10^{-18}J-1.31×10^{-18}J=4.2×10^{-19}J$$

1. (3 points) Ultraviolet radiation causes skin damage that may lead to cancer, but exposure to infrared radiation does not seem to cause skin cancer. Why do you think this is so?

Infrared radiation is lower in energy than ultraviolet radiation so is is less likely to ionized molecules in the skin which might lead to mutations that might cause cancer.

1. (3 points) Explain the difference between a ground-state H atom and an excited-state H atom.

A ground state hydrogen atom has an electron in the 1s orbital. An excited state atom has the electron in a higher energy level.

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* 1. Give possible quantum numbers for the 5p electrons in Te.

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1. (3 points) Write the complete electron configuration for an atom of Al.

S 1s2 2s2 2p6 3s2 3p1

1. (3 points) Write the shorthand electronic configuration for an atom of gadolinium as predicted from the periodic table.

Gd [Xe] 6s2 5d1 4f7

Formulas

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