Chemistry 14A Fall 2007: Quiz 1 Professor : Lavelle

Name: _____ Student ID Number: _____

TA: _____ Discussion Section: _____

Write in Pen. Check your significant figures and units. Good Luck.

Total points: 40 Total time: 40 minutes 2pt for sf 2pt for units

Planck's constant, $h = 6.62608 \times 10^{-34}$ J.s

Avogadro's constant, $N_A = 6.02214 \times 10^{23}$ mol^{-1}

Rydberg constant, $R = 3.28984 \times 10^{15}$ Hz

Boltzmann's constant, $k = 1.38 \times 10^{-23}$ J·K^{-1}

Faraday's constant, $F = 96{,}485$ C·mol^{-1}

Gas constant, $R = 8.314$ J·K^{-1}·mol^{-1} $= 8.206 \times 10^{-2}$ L·atm·K^{-1}·mol^{-1} =

8.314×10^{-2} L·bar·K^{-1}·mol^{-1} $= 62.364$ L·Torr·K^{-1}·mol^{-1}

Mass of electron, $m_e = 9.1095 \times 10^{-31}$ kg

Speed of light, $c = 2.99792 \times 10^{8}$ m.s^{-1}

C_2 = Second radiation constant = 0.0144 K·m

0°C = 273.15 K 1L = 1 dm^3 1 atm = 101.325 kPa $\pi = 3.14$

Water Density = 1g.ml^{-1} $\ln(X) = 2.303 \log_{10}(X)$ 1 kcal = 4.18 kJ

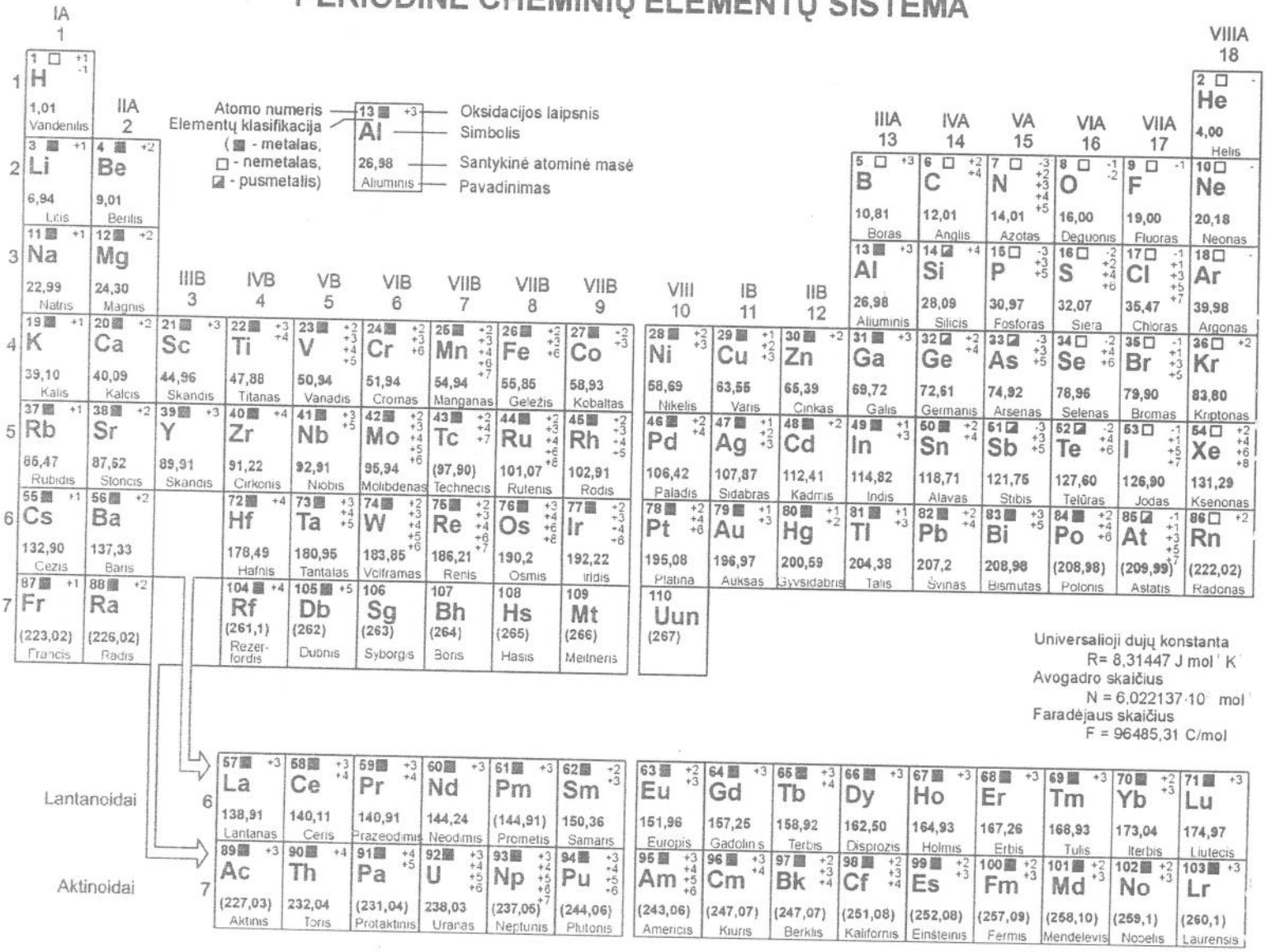
1 eV = 1.602×10^{-19} J

$c = \lambda \nu$ $E = h \nu$ $E = pc$ $p = mv$ $E_n = -\frac{h R}{n^2}$

$\lambda = \frac{h}{p}$ $E = \frac{1}{2} mv^2$ $T \lambda_{MAX} = \frac{1}{5} C_2$ $\Delta p \times \Delta x \geq \frac{h}{4\pi}$ $E_n = \frac{h^2 n^2}{8 m L^2}$

$$E_{TOTAL}\, \psi(x) = E_K\, \psi(x) + V(x)\, \psi(x) = -\frac{h^2}{8\pi^2 m} \frac{d^2\psi(x)}{dx^2} + V(x)\, \psi(x)$$

PERIODINĖ CHEMINIŲ ELEMENTŲ SISTEMA



[1]www.jergym.hiedu.cz/~canovm/vyhledav/varianty/litva.gif

1. Suppose 12.4 g of ethanol, CH_3CH_2OH, are dissolved in water to produce 800. mL of solution. What is the molarity of ethanol molecules in the solution? (3 pts)

Answer .336 M

$M = \frac{\text{mol solute}}{\text{L solution}} = \frac{.269652 \text{ mol}}{.8 \text{ L}} = .336 \text{ M}$

2. You need to prepare 666. mL of 0.150 M $CH_3CH_2CH_2OH(aq)$ using a 0.900 M $CH_3CH_2CH_2OH(aq)$ stock solution. What is the volume of stock solution needed? (3 pts)

Answer → .111 L

3. What is the wavelength of a radio station transmitting at 99.1 MHz? (3 pts)

A. 330 nm
B. 303 nm
C. 0.00303 m
D. 3.03 m
E. 0.330 m

$C = \lambda\nu \rightarrow 3 \times 10^8 = \lambda (99100000)$

$\lambda = 3.03 \text{ m}$

4. A lawyer who received a speeding ticket argues that because of the Heisenberg uncertainty principle the radar reading is uncertain. The judge, who happens to have a science degree, rules against the lawyer. Which of the following statements is true? (3 pts)

A. The judge is incorrect because the uncertainty in position is large.
B. The judge is correct because the car is so massive that the uncertainty in speed is very small.
C. The judge is correct because the uncertainty in momentum is very large.
D. The judge is incorrect because radar has only wave characteristics.
E. The judge is incorrect because $(m\Delta v)(\Delta x) \geq \frac{1}{2}h$.

5. According to the Heisenberg uncertainty principle, if the uncertainty in the speed of an electron is 4.1×10^3 m/s, the uncertainty in its position (in m) is at least: (3 pts)

A. 65 m
B. 19 m
C. 6.6×10^{-8} m
D. 1.4×10^{-8} m

$\Delta p \Delta x \geq \frac{h}{4\pi} \rightarrow \frac{6.626 \times 10^{-34}}{4\pi}$ $\Delta x = 5.79 \times 10^{-5}$

$\rightarrow \Delta x = 1.4 \times 10^{-8}$

$\Delta p = m\Delta v$

$\Delta p = (9.1095 \times 10^{-31})(4.1 \times 10^3) = 3.734895 \times 10^{-27}$

6. The work function for gold is 4.54 eV. What is the wavelength of the lowest frequency radiation needed to eject electrons from gold metal? (3 pts)

A. 1.16×10^{13} nm.
B. 273 nm.
C. 4.87×10^5 nm.
D. 4.16×10^{-26} m.

$\phi = 4.54 \text{ eV} \times \frac{1.602 \times 10^{-19} \text{ J}}{1 \text{ eV}} = 7.273 \times 10^{-19}$

$E = h\nu$

$C = \lambda\nu$ $\lambda = 4.125 \times 10^{-26} \text{ m}$

7. Calculate the velocity of an oxygen molecule, given that it has a de Broglie wavelength of 0.0140 nm. (3 pts)

A. 890. m□s^{-1}
B. 3.00×10^8 m□s^{-1}
C. 1780 m□s^{-1}
D. 445 m□s^{-1}
E. 8.90 m□s^{-1}

$p = mv$, $\lambda = \frac{h}{p}$

8. Which set of quantum numbers could correspond to a 3d-orbital? (3 pts)

A. $n = 3, l = 3, m_l = +2$
B. $n = 3, l = 2, m_l = +3$
C. $n = 3, l = 2, m_l = -2$

s $l = 0$
p $l = 1$
d $l = 2$
f $l = 3$

H5

D. $n = 2, l = 1, m_l = +1$
E. $n = 2, l = 1, m_l = 0$

9. The total number of orbitals in a shell with principal quantum number 5 is (3 pts)
A. 32.
B. 50.
C. 25.
D. 40.
E. 5.

$m\ell = 5$

s 1 orbitals
p 3
d 5
s 7

10. Which of the following statements is true? (3 pts)
A. A 2s orbital has one nodal plane.
B. An electron in a p-orbital has zero probability of being found at the nucleus.
C. A p-orbital has a spherical boundary surface.
D. An s-orbital becomes more dense as the distance from the nucleus increases.
E. An electron in an s-orbital has a zero probability of being found at the nucleus.

11. Below is the mass percentage of each element in a compound:
54.53% C, 9.15% H, and 36.32% O.
Determine the empirical formula of the compound. Show all your work. (5pts)

$54.53\ g\ C \times \frac{1\ mol\ C}{12\ g\ C} = 4.544\ mol\ C$

$9.15\ g\ H \times \frac{1\ mol\ H}{1\ g\ H} = 9.15\ mol\ H$

$36.32\ g\ O \times \frac{1\ mol\ O}{16\ g\ O} = 2.27\ mol\ O$

$\frac{4.544\ mol\ C}{2.27\ mol\ O} \approx 2$

$\frac{9.15\ mol\ H}{2.27\ mol\ O} \approx 4$

emp formula: C_2H_4O

12. Light of wavelength 589 nm is absorbed by a sodium atom in the gas phase. What is the total energy needed to excite 1.50 moles of sodium atoms in the gas phase? Show all your work. (5pts)

$E = h\nu$

$E = \frac{hc}{\lambda}$

$5.32 \times 10^{-17}\ J$

+21/40

+6