Chemistry 121	Fall 2004	Oregon State University
Final Exam	December 9, 2004	Dr. Richard Nafshun

Test Form 1

Instructions: You should have with you several number two pencils, an eraser, your 3" x 5" note card, a calculator, and your University ID Card. If you have notes with you, place them in a sealed backpack and place the backpack OUT OF SIGHT or place the notes directly on the table at the front of the room.

Fill in the front page of the Scantron answer sheet with your test form number (listed above), last name, first name, middle initial, and student identification number. **Enter the test form number on your Scantron form, but leave the class section number blank.**

This exam consists of 40 multiple-choice questions. Each question has four points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the answer sheet. If you have any questions before the exam, please ask. If you have any questions during the exam, please ask the proctor. Open and start this exam when instructed. When finished, place your Scantron form and note card in the appropriate stacks. You may keep the exam packet, so please show your work and mark the answers you selected on it.

Rule 1: All nitrates, group 1A metal salts and ammonium salts are soluble.
Rule 2: All carbonates, hydroxides, phosphates and sulfides are insoluble.
Rule 3: Rule 1 always takes precedent.

$R = 0.0821 \frac{L \bullet atm}{mol \bullet K}$	$R = 8.314 \frac{kg \bullet m^2}{s^2 \bullet mol \bullet K}$	$\mu_{rms} = \sqrt{\frac{3RT}{Molar\ Mass}}$
PV = nRT	760 Torr = 1 atm = 760 mm Hg	K = 273.15 + °C
$N_A = 6.02 \times 10^{23}$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$	$q = mc\Delta T$
E = q + w	1 foot = 12 inches (exact)	1 inch = 2.54 cm (exact)
1 kg = 2.2 pounds	$R_H = 2.180 \times 10^{-18}$ J/photon	$c = 3.00 \times 10^8$ m/s
E = hν	$\nu = \frac{c}{\lambda}$	$h = 6.626 \times 10^{-34}$ J·s

Energy levels in an H atom: $E_n = \left(\frac{-1312 \frac{kJ}{mol}}{n^2}\right)$ and $E_{high} - E_{low} = \left(\frac{-1312 \frac{kJ}{mol}}{high^2}\right) - \left(\frac{-1312 \frac{kJ}{mol}}{low^2}\right)$

centi	c	1/100
milli	m	1/1000
kilo	k	1000
micro	μ	10^{-6}
nano	n	10^{-9}

Periodic Table of the Elements on the Next Page

Periodic Table of the Elements

Key

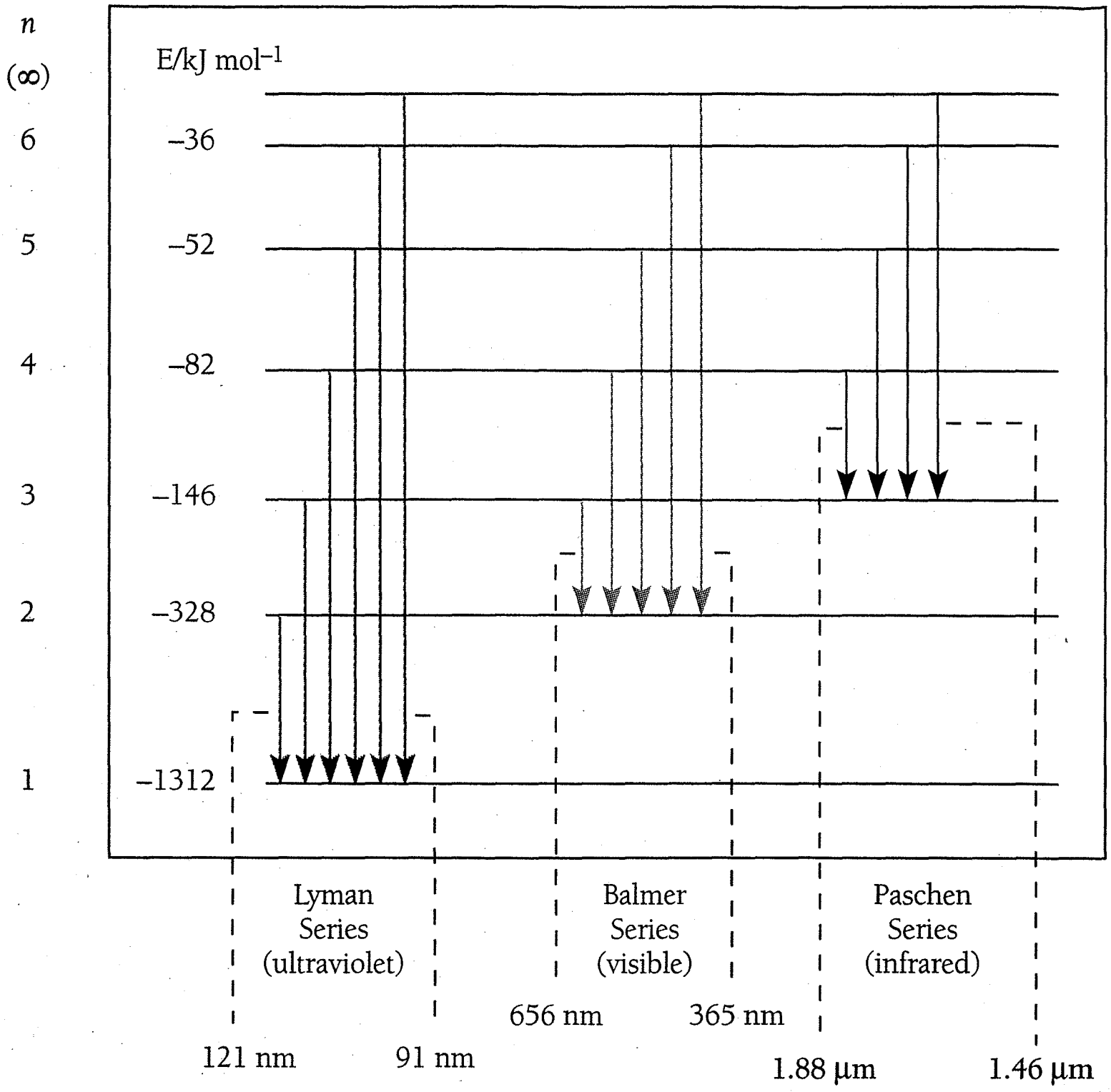
1	Atomic number
H	Symbol
Hydrogen	Name
1.0079	Atomic mass

Periods	Group IA	IIA	IIIB	IVB	VB	VIB	VIIB	VII			1B	IIB	IIIA	IVA	VA	VIA	VIIA	Noble Gases VIIIA
1	1 H Hydrogen 1.0079																	2 He Helium 4.0026
2	3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.179
3	11 Na Sodium 22.98977	12 Mg Magnesium 24.305											13 Al Aluminum 26.9815	14 Si Silicon 28.0855	15 P Phosphorus 30.97376	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
4	19 K Potassium 39.0983	20 Ca Calcium 40.08	21 Sc Scandium 44.9559	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.996	25 Mn Manganese 54.9380	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.70	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
5	37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	40 Zr Zirconium 91.22	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.4	47 Ag Silver 107.868	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.9045	54 Xe Xenon 131.30
6	55 Cs Cesium 132.9054	56 Ba Barium 137.33	57–71 *Rare earths	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
7	87 Fr Francium (223)	88 Ra Radium 226.0254	89–103 †Actinides	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (263)	107 Ns Neilsbohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 ‡ (269)	111 ‡			114				

Stable region?

	57 La Lanthanium 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.9077	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9254	66 Dy Dysprosium 162.50	67 Ho Holmium 164.9304	68 Er Erbium 167.26	69 Tm Thulium 168.9342	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
*Lanthanides 6															
	89 Ac Actinium 227.0278	90 Th Thorium 232.0381	91 Pa Protactinium 231.0359	92 U Uranium 238.029	93 Np Neptunium 237.0482	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium 259	103 Lr Lawrencium 262
†Actinides 7															

Note: The atomic mass value given is for naturally occurring proportions of isotopes. Values in parentheses are mass numbers for the most stable isotope.
‡Reported but not confirmed; no name proposed.


n
(∞)
E/kJ mol⁻¹
6
5
4
3
2
1
–36
–52
–82
–146
–328
–1312
Lyman Series (ultraviolet)
Balmer Series (visible)
Paschen Series (infrared)
121 nm
91 nm
656 nm
365 nm
1.88 μm
1.46 μm

Unit 1 (Material Assessed on Exam 1)

1. A student ( ) measures the mass of a titanium sample to be 0.020300 g.

   (A) There are two significant figures in this measured quantity.
   (B) There are three significant figures in this measured quantity.
   (C) There are four significant figures in this measured quantity.
   (D) There are five significant figures in this measured quantity.
   (E) There are six significant figures in this measured quantity.

2. Consider the following operation: 0.397457 mm * 30.420 mm. The correct answer with the proper number of significant figures is:

   (A) 12.09064 mm^2.
   (B) 12.0906 mm^2.
   (C) 12.091 mm^2.
   (D) 12.09 mm^2.
   (E) 12.1 mm^2.

   Calculator: 12.09064194
   5 sig figs

3. ^{238}U has:

   (A) 238 **protons**, 119 **neutrons**, 119 **electrons**.
   (B) 119 **protons**, 119 **neutrons**, 119 **electrons**.
   (C) 92 **protons**, 146 **neutrons**, 119 **electrons**.
   (D) 92 **protons**, 92 **neutrons**, 119 **electrons**.
   (E) 92 **protons**, 146 **neutrons**, 92 **electrons**.

   92
   U

   92 protons
   238 - 92 = 146 neutrons
   92 electrons

4. The chemical formula of magnesium carbonate is:

   Mg^{2+} CO_3^{2-}

   (A) MgC.
   (B) MgC_2.
   (C) Mg_2C_4.
   (D) $Mg(CO_3)_2$.
   (E) $MgCO_3$.

5. When the equation:

$$C_9H_{20} + 14\ O_2 \rightarrow \underbrace{9\ CO_2 + 10\ H_2O}_{18+10=28 \text{ oxygen atoms}}$$

is correctly balanced,

(A) 10 moles of O_2 are consumed.
(B) 12 moles of O_2 are consumed.
(C) 14 moles of O_2 are consumed.
(D) 16 moles of O_2 are consumed.
(E) 18 moles of O_2 are consumed.

6. Which of the following sets of elements will form an ionic compound?

Metal + Non-metal

(A) Na and Li.
(B) Na and F.
(C) Na and Mg.
(D) He and Na.
(E) C and Cl.

7. Which of the following is heterogeneous?

different throughout

(A) C_8H_{18} (l).
(B) $Mg(NO_3)_2$ (s).
(C) Hexane.
(D) Granite.
(E) Water.

8. The name of CCl_4 is?

Molecule - need prefix on second non-metal (first is mono).

(A) Carbon chloride.
(B) Carbonate.
(C) Carbon carbonate.
(D) Carbon tetrachloride.
(E) Carbon (IV) chloride.

9. The molar mass of acetic acid, CH_3COOH, is:

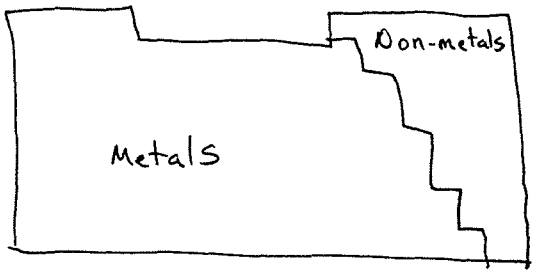
(A) 3.62×10^{25} g/mol.
(B) 48.04 g/mol.
(C) 18.02 g/mol.
(D) 114.23 g/mol.
(E) 60.05 g/mol.

2 C 2 x 12.01 g/mol
2 O 2 x 16 g/mol
4 H 4 x 1.01 g/mol

60.06 g/mol

10. Which of the following is a metal?

(A) Aluminum.
(B) Phosphorous.
(C) Sulfur.
(D) Chlorine.
(E) Bromine.



11. A student obtains 554.9 grams of calcium chloride, $CaCl_2$. How many moles of $CaCl_2$ are present?

40.08
2x 35.45
110.98 g/mol

(A) 6.158×10^4 mol NaCl.
(B) 3.000 mol NaCl.
(C) 5.000 mol NaCl.
(D) 111.0 mol NaCl.
(E) 3.340×10^{26} mol NaCl.

$$554.9\,g\ CaCl_2 \left(\frac{1\ mol}{110.98\ g}\right) = 5.000\ mol\ CaCl_2$$

12. A student obtains 320.85 grams of methane, CH_4. How many hydrogen atoms are present?

1x12.01
4x1.0079
16.0416 g/mol

(A) 20 hydrogen atoms.
(B) 1.204×10^{25} hydrogen atoms.
(C) 4.816×10^{25} hydrogen atoms.
(D) 2.408×10^{26} hydrogen atoms.
(E) 1.932×10^{26} hydrogen atoms.

$$320.85\,g\ CH_4 \left(\frac{1\ mol}{16.0416\ g}\right)\left(\frac{6.02\times10^{23}\ CH_4}{1\ mol\ CH_4}\right)\left(\frac{4\ H\ atoms}{1\ CH_4}\right) = 4.816\times10^{25}\ H\ atoms$$

13. Which of the following statements is **FALSE?**

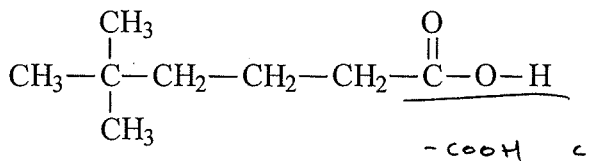
(A) Electrons are located outside of the nucleus.
(B) Protons and neutrons have similar masses.
(C) Electrons carry a negative charge; protons carry a positive charge.
(D) A neutral atom has an equal number of protons and electrons.
(E) Electrons are roughly 2000 times as massive as protons and neutrons; therefore, most of the mass in an atom is located outside the nucleus.

Unit 2 (Material Assessed on Exam 2)

14. Which of the following selections contains only bases?

(A) CH_4, CH_3CH_3, $CH_3CH_2CH_3$, $CH_3CH_2CH_2CH_3$.
(B) HNO_3, $NaNO_3$, HCl, NaCl.
(C) NH_4OH, KOH, NH_3.
(D) HNO_3, HCl, NH_3.
(E) H_2SO_4, HNO_3, HCl, CH_3COOH.

15. Consider the following compound:



-COOH carboxylic acid
weak acid group

The compound is:

(A) a strong acid.
(B) a weak acid.
(C) a strong base.
(D) a weak base.

16. A student places 390.3 grams of sodium sulfide, Na_2S (s) into a 2.000-L volumetric flask and then fills to the mark with water. 78.06 g/mol

(A) The concentration of the solution is 78.06 M.
(B) The concentration of the solution is 3.000 M.
(C) The concentration of the solution is 2.500 M.
(D) The concentration of the solution is 5.000 M.
(E) The concentration of the solution is 6.000 M.

$M = \frac{mol}{L} = \frac{390.3\,g\left(\frac{1\,mol}{78.06\,g}\right)}{2.00\,L} = 2.500\,M$

17. A student calculates that 22.5 grams of water should theoretically be produced from the combustion of octane during a process. 7.80 g of water is actually recovered. What is the percent yield for this process?

(A) 97.4 %.
(B) 94.7 %.
(C) 6.70 %.
(D) 2.88 %.
(E) 34.7 %.

Percent yield $= \frac{actual}{theoretical} \times 100\% = \frac{7.80\,g}{22.5\,g} \times 100\% = 34.7\,\%$

18. How many grams of O_2 (g) are consumed when 401.1 g of methane, CH_4, is combusted?

$$CH_4\ (g) \quad + \quad 2\ O_2\ (g) \quad \rightarrow \quad CO_2\ (g) \quad + \quad 2\ H_2O\ (g)$$

401.1 g $\xrightarrow{①}$ 25.00 mol $\xrightarrow{②}$ 50.00 mol $\xrightarrow{③}$ ____ g

① $401.1\,g\left(\frac{1\ mol}{16.04\ g}\right) = 25.00\ mol\ CH_4$

② $25.00\ mol\ CH_4\left(\frac{2\ mol\ O_2}{1\ mol\ CH_4}\right) = 50.00\ mol\ O_2$

③ $50.00\ mol\ O_2\left(\frac{32.00\ g}{1\ mol}\right) = 1600\ g\ O_2$

(A) 802.2 g O_2 (g) are consumed.
(B) 25.00 g O_2 (g) are consumed.
(C) 800.0 g O_2 (g) are consumed.
(D) 1600.0 g O_2 (g) are consumed.
(E) 1763.8 g O_2 (g) are consumed.

19. A student mixes two solutions: K_3PO_4 (aq) and $Ca(NO_3)_2$ (aq). The solid precipitate formed is:

(A) KNO_3 (s).
(B) $Ca_3(PO_4)_2$ (s).
(C) KOH (s).
(D) CaO (s).
(E) K_3PO_4 (s).

$Ca_3(PO_4)_2(s)$

20. A student obtains 25.00 mL of an HCl solution of unknown concentration. Upon titration, 26.02 mL of 0.08000 M NaOH are required for neutralization. Determine the concentration of the HCl solution.

(A) 12.01 M.
(B) 0.07686 M.
(C) 13.41 M.
(D) 0.08326 M.
(E) 2.082 M.

$M_{HCl}V_{HCl} = M_{NaOH}V_{NaOH}$

$(M_{HCl})(25.00\ mL) = (26.02\ mL)(0.08000\ M)$

$M_{HCl} = 0.08326\ M$

21. A student obtains a 2.00 liter Thermos® bottle at 25.0 °C and 1.00 atm . The bottle is heated to 50.0 °C. The pressure inside the bottle at 50.0 °C is:

(A) 1.00 atm.
(B) 1.08 atm.
(C) 2.00 atm.
(D) 0.923 atm.
(E) 4.00 atm.

$$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

$$\frac{1.00 \text{ atm}}{(273.15+25)\text{K}} = \frac{P_2}{(273.15+50)\text{K}}$$

$P_2 = 1.08$ atm

22. A student places 1.026 g of a diatomic gas into a 5.00-L container at 298 K and measures the pressure to be 2.49 atm. This diatomic gas is:

(A) H_2.
(B) N_2.
(C) O_2.
(D) F_2.
(E) Cl_2.

$$\text{Molar Mass} = \text{g/mol} = \frac{1.026\text{g}}{0.5089 \text{ mol}} = 2.016 \text{ g/mol } H_2$$

$$n = \frac{PV}{RT} = \frac{(2.49 \text{ atm})(5.00 \text{ L})}{(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298\text{K})} = 0.50887 \text{ mol}$$

23. The root-mean-square speed of Cl_2 (g) at 1.20 atm and 350 K is:

(A) 34.9 m/s.
(B) 123 m/s.
(C) 351 m/s.
(D) 1.23×10^6 m/s.
(E) 11.1 m/s.

$$u_{rms} = \sqrt{\frac{3RT}{MM}} = \sqrt{\frac{(3)(8.314 \frac{\text{kg}\cdot\text{m}^2/\text{mol}}{\text{s}^2\cdot\text{K}})(350\text{K})}{70.9 \times 10^{-3} \frac{\text{kg}}{\text{mol}}}}$$

$$= 351 \frac{\text{m}}{\text{s}}$$

24. Consider the following five gases: H_2 (g) He (g) Ne (g) Ar (g) Xe (g)

Of these, the gas molecule with the **slowest** velocity at room temperature is:

heavy!

(A) H_2 (g).
(B) He (g).
(C) Ne (g).
(D) Ar (g).
(E) Xe (g).

25. A system takes in 40 kJ of heat and does 30 kJ of work. The change in the energy of the system is:

$\Delta E = q + w = (+40 \text{ kJ}) + (-30 \text{ kJ}) = +10 \text{ kJ}$

takes in (+) — does work (−)

(A) -70 kJ.
(B) +70 kJ.
(C) -10 kJ.
(D) + 10 kJ.
(E) 1.33 kJ.

26. Determine ΔH° for the reaction $3\ Fe_2O_3\ (s) + CO\ (g) \rightarrow CO_2\ (g) + 2\ Fe_3O_4\ (s)$, using:

3 × $Fe_2O_3\ (s) + 3\ CO\ (g) \rightarrow 2\ Fe\ (s) + 3\ CO_2\ (g)$ ΔH° = -28.0 kJ

2 × $3\ Fe\ (s) + 4\ CO_2\ (g) \rightarrow 4\ CO\ (g) + Fe_3O_4\ (s)$ ΔH° = +12.5 kJ

$3Fe_2O_3 + 9\ CO \rightarrow 6\ Fe + 9\ CO_2$ ΔH = -84.0 kJ

~~$8\ CO + 2\ Fe_3O_4 \rightarrow 6$~~

$6\ Fe + 8\ CO_2 \rightarrow 8\ CO + 2\ Fe_3O_4$ ΔH = +25.0 kJ

$3\ Fe_2O_3 + CO \rightarrow CO_2 + 2Fe_3O_4$ ΔH = -59 kJ

(A) - 105.5 kJ.
(B) - 74.8 kJ.
(C) - 1570 kJ.
(D) - 211.0 kJ.
(E) -59.0 kJ.

27. When the following reaction is carried out in a flask, the flask feels COLD when held in the hands:

System — Heat enters (endo)

$NH_4NO_3\ (s) \rightarrow NH_4NO_3\ (aq)$ [This reaction is the system]

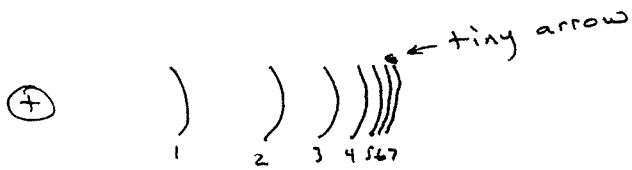
Which of the following is **TRUE**?

(A) Heat is transferred from the flask to the hand; this is an endothermic reaction.
(B) ~~Heat is transferred from the flask to the hand; this is an exothermic reaction.~~
(C) Heat is transferred from the hand to the flask; this is an endothermic reaction.
(D) Heat is transferred from the hand to the flask; this is an exothermic reaction.

Unit 3 (Material Discussed After Exam 2)

28. Consider the Bohr Model for the Hydrogen Atom. Which of the following electron transitions releases the **least** energy?

(A) n = 7 to n = 6.
(B) n = 2 to n = 1.
(C) n = 1 to n = 2.
(D) n = 5 to n = 1.
(E) n = 6 to n = 4.



29. Which of the following sets of quantum numbers is not valid?

(A) n = 1, l = 0, m_l = 0, m_s = +½.
(B) n = 3, l = 1, m_l = 0, m_s = +½.
(C) n = 3, l = 2, m_l = -2, m_s = -½.
(D) n = 2, l = 1, m_l = 0, m_s = +½.
(E) n = 1, l = 1, m_l = 1, m_s = +½. invalid

$l = 0$ when $n = 1$

30. A hydrogen atom with the electron in its ground state has the electron in:

(A) a 1g orbital.
(B) a 1s orbital.
(C) a 2p orbital.
(D) a 2s orbital.
(E) a 1p orbital.

1s

31. X-rays are greater in energy than radio waves. Which of the following statements is **false**?

(A) The frequency of an X-ray is greater than the frequency of a radio wave.
(B) The wavelength of an X-ray is greater than the wavelength of a radio wave.
(C) Dental X-rays penetrate soft tissue. shorter
(D) During X-ray procedures, areas of the patient not being imaged are often Pb (s) shielded.
(E) X-rays and radio waves travel at the same speed.

X-ray | radio

High E
High ν
Short λ

32. The frequency of blue photons having a wavelength of 480 nm is:

(A) $480 \times 10^{-9} \frac{1}{s}$.

(B) $480 \times 10^{9} \frac{1}{s}$.

(C) $3.18 \times 10^{-31} \frac{1}{s}$.

(D) $1.44 \times 10^{2} \frac{1}{s}$.

(E) $6.25 \times 10^{14} \frac{1}{s}$.

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8} \frac{m}{s}}{480 \times 10^{-9} \frac{m}{s}} = 6.25 \times 10^{14} \frac{1}{s}$$

33. The energy of **one mole** of blue photons having a wavelength of 480 nm is:

(A) 249 kJ.
(B) 284 kJ.
(C) 302 kJ.
(D) 604 kJ.
(E) 906 kJ.

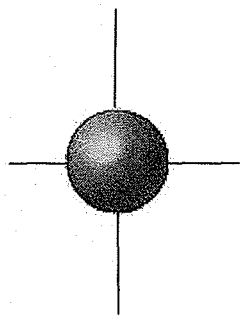
$$E = h\nu = \left(6.626 \times 10^{-34} \frac{J \cdot s}{photon}\right)\left(6.25 \times 10^{14} \frac{1}{s}\right) = 4.14 \times 10^{-19} \frac{J}{photon}$$

$$4.14 \frac{J}{photon}\left(\frac{6.02 \times 10^{23} \text{ photon}}{1 \text{ mol}}\right) = 249{,}303 \text{ J} = 249 \text{ kJ}$$

34. Solutions to the wave equation for the hydrogen atom solved by Schrodinger led to the new concept(s) of the quantization of:

(A) Enthalpy.
(B) Energy and space for the electron.
(C) Molarity.
(D) Isomers.
(E) Gases.

35. Which set of four quantum numbers describes the orbital pictured below?



$l = 0$

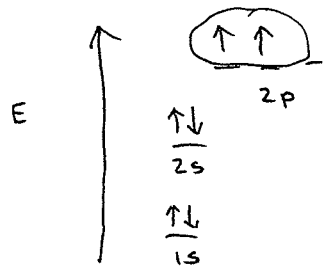
(A) $n = 1, l = 0, m_l = 0, m_s = +½.$
(B) $n = 1, l = 1, m_l = 0, m_s = +½.$
(C) $n = 2, l = 0, m_l = 0, m_s = +½.$
(D) $n = 2, l = 1, m_l = 0, m_s = +½.$
(E) $n = 2, l = 1, m_l = 1, m_s = +½.$

36. There are ___ **unpaired** electrons in a ground-state carbon atom (C).

6
C

6 e⁻

(A) 0.
(B) 1.
(C) 2.
(D) 3.
(E) 4.

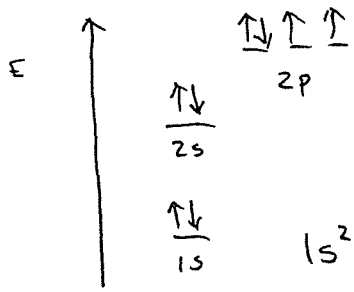


37. The ground-state electron configuration of an oxygen atom is:

8
O

8 e⁻

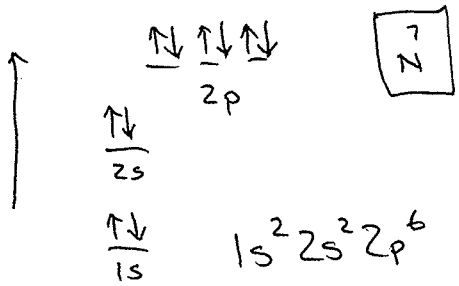
(A) $1s^2 2s^2 3s^4$.
(B) $1s^2 2s^2 3s^2 3p^2$.
(C) $1s^2 2s^2 2p^2 3s^2$.
(D) $1s^2 2s^2 2p^2$.
(E) $1s^2 2s^2 2p^4$.



$1s^2 2s^2 2p^4$

38. The ground-state electron configuration of a nitride ion (N^{3-}) is:

(A) $1s^2 2s^2 3s^6$.
(B) $1s^2 2s^2 2p^2$.
(C) $1s^2 2s^2 2p^6$.
(D) $1s^2 2s^2 2p^3$.
(E) $1s^2 2s^2 2p^6 3s^2 3p^6$.



$\boxed{{}^{7}_{N}}$ $7e^- + 3e^- = 10e^-$

$1s^2 2s^2 2p^6$

39. Consider an electron (mass of 9.10939×10^{-31} kg) traveling at 1/40th the speed of light. Which of the following statements is correct?

(A) The wavelength of the e^- is 5.22 nm and this has practical significance.
(B) The wavelength of the e^- is 5.22 nm and this does not have practical significance.
(C) The wavelength of the e^- is 0.121 nm and this has practical significance.
(D) The wavelength of the e^- is 0.0970 nm and this has practical significance.
(E) The wavelength of the e^- is 0.0970 nm and this does not have practical significance.

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}\ J \cdot s}{9.10939 \times 10^{-31}\ kg \cdot \frac{3.00 \times 10^{8}\ \frac{m}{s}}{40}} = 0.0970\ nm$$ and this matters for an e^-!

40. During Winter Break, I plan on...

(A) Recovering from the full-body-discomfort brought on by Chemistry 121.
(B) Driving hundreds of miles from here to find a sunny day.
(C) Volunteering at the Valley library so I can play with the motorized bookshelves.
(D) Hangin' with friends.
(E) Two words: Doritos and PlayStation.

Questions 1 through 40 each have 4 points attached. Any response to Question 40 will receive full credit (4 Points); even no response.

The point total for this exam is 160 points. See the grade sheet or CH 121 web syllabus for grade computation details.

Final exam keys, scores, and course grades will be posted on the CH 1211 website as they become available.

Have an excellent and safe Winter Break :)