Chemistry 121	Fall 2006	Oregon State University
Final Exam	December 6, 2006	Dr. Richard Nafshun

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.

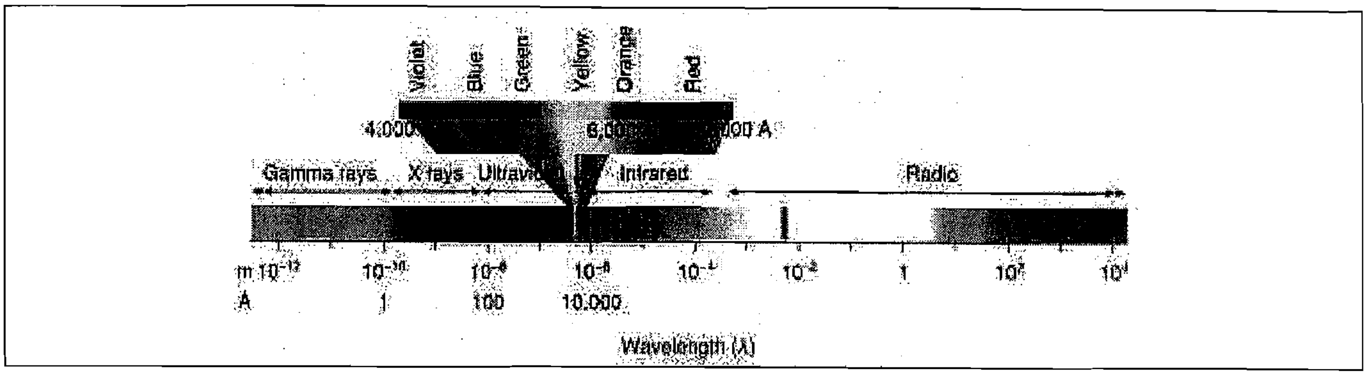
Fill in the front page of the Scantron answer sheet with your test form number (listed above), last name, first name, middle initial, and student identification number. **Leave the class section number and the test form number blank.**

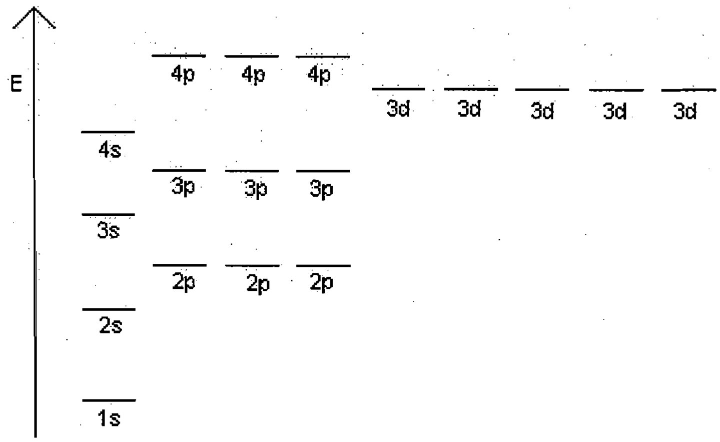
This exam consists of 40 multiple-choice questions. Each question has four points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the answer sheet. If you have any questions before the exam, please ask. If you have any questions during 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.

centi (c) = 1/100	milli (m) = 1/000	kilo (k) = 1000
micro (μ) = 10^{-6}	nano (n) = 10^{-9}	1 mole = 6.022 x 10^{23}
1 inch = 2.54 cm (exact)	1 kg = 2.2 pounds	1 foot = 12 inches (exact)
K = 273.15 + °C	1 atm = 760 mm Hg = 760 Torr	
Hydroxide OH^-	Cyanide CN^-	Nitrate NO_3^-
Acetate CH_3COO^-	Carbonate CO_3^{2-}	Phosphate PO_4^{3-}
Hydronium H_3O^+	Ammonium NH_4^+	Sulfate SO_4^{2-}
Abbreviated Solubility Rules: 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.		
$M_1V_1 = M_2V_2$	$M_{acid}V_{acid} = M_{base}V_{base}$	$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$
$R = 0.0821 \frac{L \bullet atm}{mol \bullet K}$	$\mu_{rms} = \sqrt{\frac{3RT}{Molar\ Mass}}$	$R = 8.314 \frac{kg \bullet m^2}{s^2 \bullet mol \bullet K}$
PV = nRT	$q = mc\Delta T$	$q = m\Delta H$
E = q + w	R_H = 2.180 x 10^{-18} J/photon	c = 3.00 x 10^8 m/s
h = 6.626 x 10^{-34} J·s	$\nu = \frac{c}{\lambda}$	$E = h\nu$

Substance	FM (g/mol)	MP (°C)	Heat (f) (J/g)	BP (°C)	Heat (v) (J/g)	Specific Heat (J/g°C)* Solid	Liquid	Gas
acetone	58.1	-95.1	96.7	56.1	520	2.26	2.20	1.46
benzene	78.1	5.41	126	80.1	394	1.20	1.90	1.17
ethanol	46.1	-112	100	78.3	852	0.96	2.10	1.71
n-octane	114	-57.0	182	126	339	1.30	2.40	1.30
water	18.0	0.00	334	100	2260	2.09	4.18	1.38

* Values are estimated based on averages over the temperature range





1 H Hydrogen 1.0079																	2 He Helium 4.0026
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
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
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
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
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)
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
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

Unit 1 (Material Assessed on Exam 1)

1. A student measures the mass of a sample of calcium carbonate to be 21.720 grams.

(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. A student measures a rectangle to be 20.2 cm by 5.533 cm. The area of the table (with the proper number of significant figures) is:

(A) 1.1×10^2 cm^2
(B) 112. cm^2
(C) 111.8 cm^2
(D) 111.77cm^2
(E) 111.767 cm^2

$20.2 \text{ cm} * 5.533 \text{ cm} = \underbrace{111.7666}_{} \text{ cm}^2$

must report 3 sig figs

112. cm^2

3. Which of the following chemical formulae is **incorrect**?

(A) $Mg_3(PO_4)_2$ Mg^{2+} PO_4^{3-}
(B) $Ca(NO_3)_2$ Ca^{2+} NO_3^-
(C) $BaCO_3$ Ba^{2+} CO_3^{2-}
(D) Li_2O Li^+ O^{2-}
(E) AlN_3

AlN is okay $\boxed{Al^{3+} \quad N^{3-}}$

4. $^{99}Tc^{2+}$ has:
(A) 43 **protons**, 99 **neutrons**, 43 **electrons**
(B) 99 **protons**, 43 **neutrons**, 41 **electrons**
(C) 43 **protons**, 56 **neutrons**, 41 **electrons**
(D) 43 **protons**, 56 **neutrons**, 45 **electrons**
(E) 99 **protons**, 99 **neutrons**, 45 **electrons**

43 ← 43p
Tc 99 - 43 = 56 n
43 e⁻ - 2e⁻ = 41 e⁻

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

(A) When combined with a metal, oxygen will tend to gain two electrons. – True – Group 16
(B) When combined with a metal, neon will tend to gain one electron. – FALSE – Inert Gas
(C) When combined with a non-metal, sodium will tend to loose one electron. – True – Group 1
(D) When combined with a non-metal, calcium will tend to loose two electrons. – True – Group 2
(E) When combined with a non-metal, aluminum will tend to loose three electrons. – True – Group 3

6. The mass percent composition of lithium in $LiNO_3$ is:

(A) 20.00 %
(B) 18.78 %
(C) 33.33 %
(D) 6.941 %
(E) 10.07 %

$\% Li = \frac{6.941}{68.95} \times 100\%$

$= 10.07\%$

Li N O_3

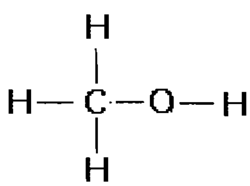
6.941 14.01 $3 * 16.00 = 48.00$

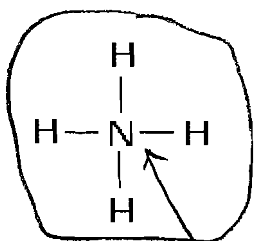
$\underbrace{6.941 \quad 14.01 \quad 48.00}_{68.95\ g/mol}$

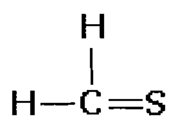
7. Which of the following pairs are isotopes?

(A) ^{2}H and ^{1}H ← Same element (same number of protons) Different number of neutrons
(B) ^{14}C and ^{14}N
(C) ^{14}C and ^{14}N
(D) ^{235}U and ^{238}Pu
(E) ^{14}C and ^{28}Si

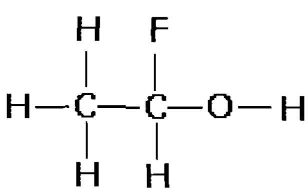
8. Which of the following compounds contains an element with the incorrect number of bonds?

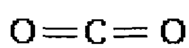

(A)


(B)


(C)

N has 3 bonds in molecules (neutral species)


(D)


(E)

9. The chemical formula of calcium phosphate is:

Ca^{2+} PO_4^{3-}

(A) $Ca_3(PO_4)_2$
(B) $Ca_2(PO_4)_3$
(C) $CaPO_8$
(D) Ca_3P_2
(E) Ca_2P_3

$Ca_3(PO_4)_2$

10. The names of $Al_2(CO_3)_3$ and SF_6 are:

aluminum carbonate and sulfur hexafluoride

No prefixes in ion compounds (metal / non-metal)

use prefixes in molecules (non-metals)

(A) aluminum carbide and sulfur fluoride
(B) aluminum tricarbonate and sulfur hexafluoride
(C) dialuminum tricarbonate and monosulfur fluoride
(D) dialuminum tricarbonate and monosulfur hexafluoride
(E) aluminum carbonate and sulfur hexafluoride

11. Sunbowlium has two naturally occurring isotopes. ^{278}Su has a mass of 278.012 g/mol and is 73.44 % abundant. ^{280}Su has a mass of 280.014 g/mol and is 26.56 % abundant. What is the average atomic mass of Sunbowlium?

(A) 279.01 g/mol
(B) 278.54 g/mol
(C) 279.48 g/mol
(D) 558.03 g/mol
(E) 6.022×10^{23} g/mol

$(278.012 \text{ g/mol})(0.7344) + (280.014 \text{ g/mol})(0.2656) =$
278.54 g/mol

12. When the reaction $C_9H_{20}\ (l) + 14\ O_2\ (g) \rightarrow \underbrace{9\ CO_2\ (g) + 10\ H_2O\ (g)}_{18+10=28 \text{ oxygen atoms}}$ is correctly balanced,

(A) 9 O_2 molecules are consumed
(B) 11 O_2 molecules are consumed
(C) 14 O_2 molecules are consumed
(D) 17 O_2 molecules are consumed
(E) 19 O_2 molecules are consumed

13. A student obtains 342.67 grams of octane, C_8H_{18} (l). How many octane molecules are present?

(A) 7.226×10^{24} octane molecules
(B) 2.408×10^{24} octane molecules
(C) 3.601×10^{24} octane molecules
(D) 1.807×10^{24} octane molecules
(E) 1.204×10^{24} octane molecules

$(8 * 12.01) + (18 * 1.01) = 114.3\ g/mol$

$342.67\,g\ C_8H_{18}\left(\frac{1\ mol}{114.3\ g}\right)\left(\frac{6.022 \times 10^{23}\ C_8H_{18}\ molecules}{1\ mol}\right) =$

$1.807 \times 10^{24}\ C_8H_{18}$ molecules

14. A student places 275.8 grams of $LiNO_3$ (s) into a 5.000-L volumetric flask and then fills to the mark with water. What is the concentration of the solution?

(A) 55.16 M
(B) 0.2000 M
(C) 0.8000 M
(D) 0.01813 M
(E) 1.812 M

68.95 g/mol

$275.8\,g\left(\frac{1\ mol}{68.95\ g}\right) = 4.000\ mol$

$M = \frac{mol}{L} = \frac{4.000\ mol}{5.000\ L} = 0.8000\ M$

Unit 2 (Material Assessed on Exam 2)

15. 3.00 L of 0.725 M NH_4Cl (aq) is diluted to 8.00 L. What is the molarity of the resulting solution?

(A) 0.272 M
(B) 3.68 M
(C) 1.93 M
(D) 0.800 M
(E) 1.25 M

$M_1V_1 = M_2V_2$

$(3.00\,L)(0.725\,M) = (M_2)(8.00\,L)$

$M_2 = 0.272\ M$

16. A student obtains two acid solutions. One is 1.00 L of 0.100 M HCl (aq).
The other is 1.00 L of 0.100 M CH_3CH_2COOH (aq).
Which solution contains the most H^+ ions?

(A) 1.00 L of 0.100 M HCl (aq) $HCl \xrightarrow{100\%} H^+ + Cl^-$ (HCl is a strong acid)
(B) 1.00 L of 0.100 M CH_3CH_2COOH (aq)

a lot

$CH_3CH_2COOH \xrightarrow{\sim 0.2\%} CH_3CH_2COO^- + H^+$

-COOH is a weak acid

a little

17. A student obtains a 15.00 mL sample of HCl (aq). She titrates it with 0.1023 M NaOH (aq) and finds 41.65 mL are required to reach the equivalence point. The concentration of HCl (aq) is:

(A) 63.91 M
(B) 27.14 M
(C) 0.03684 M
(D) 3.521 M
(E) 0.2841 M

$M_{acid}V_{acid} = M_{Base}V_{Base}$

$(M_{acid})(15.00\ mL) = (0.1023\ M)(41.65\ mL)$

$M_{acid} = 0.2841\ M$

18. In an excess amount of oxygen, how many grams of H_2O (g) are theoretically produced from the combustion of 322.5 g of ethanol [CH_3CH_2OH (l), molar mass of 46.07 g/mol]?

$$CH_3CH_2OH\,(l) \quad + \quad 3\,O_2\,(g) \quad \rightarrow \quad 2\,CO_2\,(g) \quad + \quad 3\,H_2O\,(g)$$

322.5 g ↓ ① 7.000 mol ——②——→ 21.00 mol ↑ ③ ___ g

① $322.5\,g \left(\frac{1\ mol}{46.07\ g}\right) = 7.000\ mol$

② $7.000\ mol\ CH_3CH_2OH \left(\frac{3\ mol\ H_2O}{1\ mol\ CH_3CH_2OH}\right) = 21.00\ mol\ H_2O$

③ $21.00\ mol\ H_2O \left(\frac{18.02\,g}{1\ mol}\right) = 378.42\ g/mol$

H_2O

(A) 126.1 g $\cancel{CO_2}$ (g) are produced
(B) 21.00 g $\cancel{CO_2}$ (g) are produced
(C) 967.5 g $\cancel{CO_2}$ (g) are produced
(D) 378.4 g $\cancel{CO_2}$ (g) are produced
(E) ~~42.05 g CO_2 (g) are produced~~

typo not corrected in time for printing. To avoid confusion, full credit is granted for any answer.

19 A student calculates that 167.5 grams of lithium chloride should theoretically be produced during a process. She actually recovers 138.7 grams of lithium chloride. What is the percent yield for this process?

(A) 120.8 %
(B) 82.81 %
(C) ~~17.19 %~~
(D) 28.80 %
(E) 12.08 %

$\% \text{ yield} = \frac{\text{actual}}{\text{theoretical}} \cdot 100\% = \frac{138.7 \text{ g}}{167.5 \text{ g}} \cdot 100\% = 82.81\%$

20. A student obtains a 5.00-L BBQ gas cylinder that contains 1.14 moles of propane gas, $CH_3CH_2CH_3$, at 303 K. The pressure inside the cylinder is:

(A) ~~143 atm~~
(B) 5.67 atm
(C) ~~7.05×10^{-3}~~ atm
(D) 4.98 atm
(E) 0.201 atm

$PV = nRT$

$P = \frac{nRT}{V} = \frac{(1.14 \text{ mol})(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(303 \text{ K})}{5.00 \text{ L}}$

$= 5.67 \text{ atm}$

21. A student places 3.36 g of a gas into a 10.0-L container at 298 K and measures the pressure to be 2.053 atm. This gas is:

(A) O_2 (g)
(B) N_2 (g)
(C) Cl_2 (g)
(D) ~~H_2 (g)~~
(E) He (g)

$n = \frac{PV}{RT} = \frac{(2.053 \text{ atm})(10.0 \text{ L})}{(0.0821 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298 \text{ K})} = 0.8391 \text{ mol}$

Molar Mass = $\text{g/mol} = \frac{3.36 \text{g}}{0.8391 \text{ mol}} = 4.00 \text{ g/mol} = \text{He}$

22. A student obtains a Thermos® bottle at 22.3 °C and 1.031 atm. The student closes the bottle containing air [78% N_2 (g); 21% O_2 (g); 1% other gases]. The student places the bottle in the refrigerator so the air inside the bottle cools to 6.2 °C. Which of the following is true?

(A) The gases inside the bottle are traveling faster at the lower temperature than at the higher temperature; the pressure inside the bottle at the lower temperature is lower than at the higher temperature; the number of moles of gas present inside the bottle at the lower temperature is the same as at the higher temperature.

(B) The gases inside the bottle are traveling slower at the lower temperature than at the higher temperature; the pressure inside the bottle at the lower temperature is the same as at the higher temperature; the number of moles of gas present inside the bottle at the lower temperature is the same as at the higher temperature.

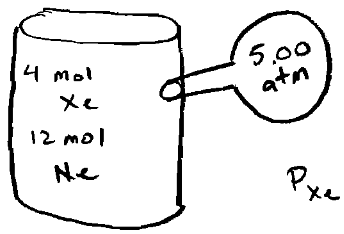
(C) The gases inside the bottle are traveling the same velocity at the lower temperature as the higher temperature; the pressure inside the bottle at the lower temperature is lower than at the higher temperature; the number of moles of gas present inside the bottle at the lower temperature is the same as at the higher temperature.

(D) The gases inside the bottle are traveling slower at the lower temperature than at the higher temperature; the pressure inside the bottle at the lower temperature is lower than at the higher temperature; the number of moles of gas present inside the bottle at the lower temperature is the same as at the higher temperature.

(E) The gases inside the bottle are traveling slower at the lower temperature than at the higher temperature; the pressure inside the bottle at the lower temperature is higher than at the higher temperature; the number of moles of gas present inside the bottle at the lower temperature is the same as at the higher temperature.

23. A student places 4.00 moles of Xe (g) and 12.00 moles of Ne (g) into a flask at 298 K and measures the pressure to be 5.00 atm. The pressure due to Xe (g) is:

(A) 1.25 atm
(B) 1.67 atm
(C) 0.800 atm
(D) 0.333 atm
(E) 2.00 atm



$$P_{Xe} = \frac{4 \text{ mol Xe}}{16 \text{ total moles}} \cdot 5 \text{ atm} = 1.25 \text{ atm}$$

24. Consider the following five gases: F_2 (g) I_2 (g) He (g) H_2 (g) Ne (g)

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

most massive

(A) F_2 (g)
(B) I_2 (g)
(C) He (g)
(D) H_2 (g)
(E) Ne (g).

25. Which of the following processes is exothermic?

(A) $2\ C_8H_{18}\ (l) + 25\ O_2\ (g) \rightarrow 16\ CO_2\ (g) + 18\ H_2O\ (g)$ Combustion
(B) $H_2O\ (s) \rightarrow H_2O\ (l)$
(C) $H_2O\ (l) \rightarrow H_2O\ (g)$
(D) $NH_4NO_3\ (s) \rightarrow NH_4NO_3\ (aq)$
(E) $CO_2\ (s) \rightarrow CO_2\ (g)$

26. How much heat is required to raise the temperature of 5500 grams of water from 80.0°C to 95.0°C?

$$q = mc\Delta T = (5500\text{ g})(4.18\ \text{J/g}\cdot{}^\circ\text{C})(95.0^\circ\text{C} - 80.0^\circ\text{C})$$
$$= 344{,}025\ \text{J or } 344\ \text{kJ}$$

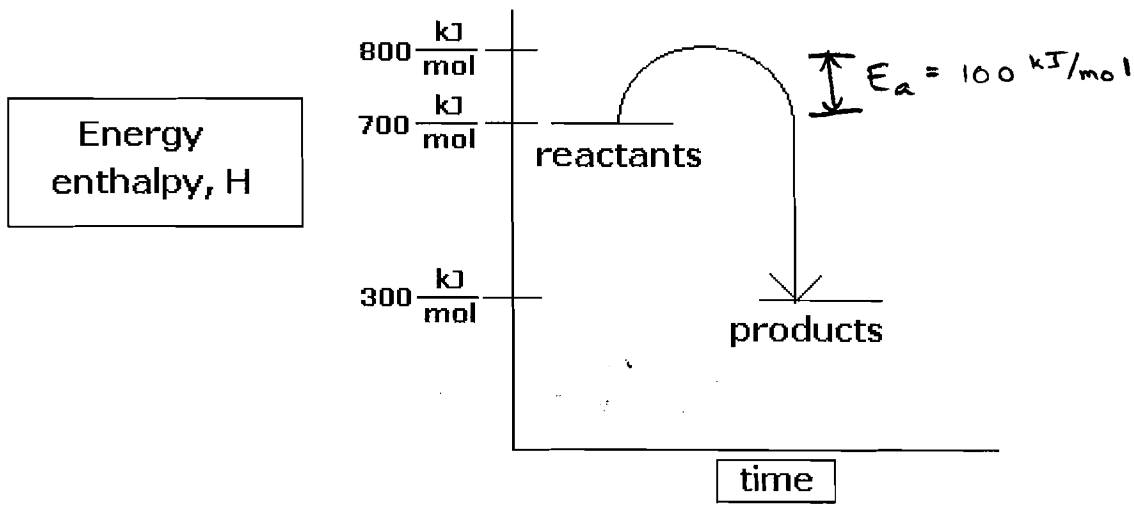
(A) 82500 kJ
(B) 344 kJ
(C) 82.5 kJ
(D) 440 kJ
(E) 150 kJ

27. A system **gives off** 2350 kJ of heat and **does** 1500 kJ of work. The change in the internal energy of the system is:

(A) + 3850 kJ
(B) - 3850 kJ
(C) - 850 kJ
(D) + 850 kJ
(E) + 3.525 x 10^7 kJ

$$\Delta E = q + w = (\underbrace{-2350 \text{ kJ}}_{\text{heat given off}}) + (\underbrace{-1500 \text{ kJ}}_{\text{does work}})$$
$$= -3850 \text{ kJ}$$

28. Consider the reaction profile:



The activation energy (E_a) for the process is:
(A) 100 kJ/mol
(B) 300 kJ/mol
(C) 400 kJ/mol
(D) 500 kJ/mol
(E) 600 kJ/mol

29. Consider:

$$C_{12}H_{22}O_{11}\ (s) + 12\ O_2\ (g) \rightarrow 12\ CO_2\ (g) + 11\ H_2O\ (g) \qquad \Delta H^\circ_{reaction} = -5644 \text{ kJ}$$

How much energy is **released** when 6 moles of sucrose, table sugar, $C_{12}H_{22}O_{11}$ (s) is combusted?

(A) 22576 kJ
(B) 33864 kJ
(C) 67728 kJ
(D) 135456 kJ
(E) 11288 kJ

$$\frac{-5644 \text{ kJ}}{1 \text{ mol } C_{12}H_{22}O_{11}} \cdot 6 \text{ mol } C_{12}H_{22}O_{11} = -33{,}864 \text{ kJ}$$

energy is released

30. The frequency of violet laser photons having a wavelength of 410 nm is:

(A) $1.37 \times 10^{-9}\ \frac{1}{s}$

(B) $1.37 \times 10^{14}\ \frac{1}{s}$

(C) $7.32 \times 10^{14}\ \frac{1}{s}$

(D) $7.68 \times 10^{14}\ \frac{1}{s}$

(E) $8.91 \times 10^{14}\ \frac{1}{s}$

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}\ \frac{m}{s}}{410 \times 10^{-9}\ m} = 7.32 \times 10^{14}\ \frac{1}{s}$$

31. The energy of **one mole** of yellow photons having a wavelength of 580 nm is:

(A) 0.580 kJ
(B) 3.49×10^{26} kJ
(C) ~~302 kJ~~
(D) 206 kJ
(E) ~~485 kJ~~

$$\nu = \frac{c}{\lambda} = \frac{3.00 \times 10^{8}\ \frac{m}{s}}{580 \times 10^{-9}\ m} = 5.17 \times 10^{14}\ \frac{1}{s}$$

$$E = h\nu = \left(6.626 \times 10^{-34}\ \frac{J \cdot s}{photon}\right)\left(5.17 \times 10^{14}\ \frac{1}{s}\right) =$$

$$3.43 \times 10^{-19}\ J/photon$$

↓

energy for one mole

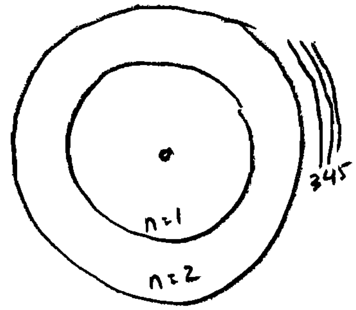
$$E = 3.43 \times 10^{-19}\ J/photon \cdot \frac{6.022 \times 10^{23}\ photons}{1\ mol} = 206{,}388\ J/mol$$

or

206 kJ/mol

32. Consider the Bohr Model for the Hydrogen Atom. Which of the following electron transitions releases the __least__ energy?

(A) n = 7 to n = 6 ← smallest
(B) n = 6 to n = 5
(C) n = 5 to n = 4
(D) n = 4 to n = 3
(E) n = 3 to n = 2



33. Consider the Bohr Model for the Hydrogen Atom. Which of the following electron transitions releases electromagnetic radiation with the **longest** wavelength?

Smallest energy = longest wavelength

(A) n = 7 to n = 6
(B) n = 6 to n = 5
(C) n = 5 to n = 4
(D) n = 4 to n = 3
(E) n = 3 to n = 2

34. 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 = 2, m_l = -1, m_s = +½.
(C) n = 1, l = 1, m_l = -1, m_s = -½. when n=1 l=0
(D) n = 2, l = 1, m_l = 0, m_s = +½.
(E) n = 5, l = 1, m_l = 1, m_s = +½.

35. Consider the set of quantum numbers n = 4, l = 1, m_l = -1, and m_s = -½. What orbital does this set correspond to?

4 p

(A) a 4s orbital
(B) a 4p orbital
(C) a 4d orbital
(D) a 1s orbital
(E) n = 4, l = 1, m_l = -1, and m_s = -½ is not a valid set of quantum numbers.

36. X-rays are greater in energy than visible light. Which of the following statements is **false**?

(A) The frequency of x-rays is lower than the frequency of visible light. $E = h\nu$
(B) The wavelength of x-rays is smaller than the wavelength of visible light.
(C) Both x-rays and visible light are forms of electromagnetic radiation.
(D) One mole of x-ray photons has greater energy than one mole of visible photons.
(E) Blue and red light travel at the same speed in a vacuum.

X-Ray Vis EM

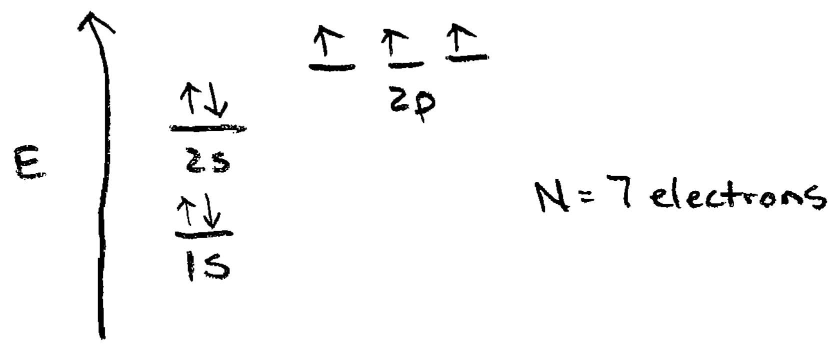
High Energy	Low Energy
High Frequency	Low Frequency
Short Wavelength	Long Wavelength

37. 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

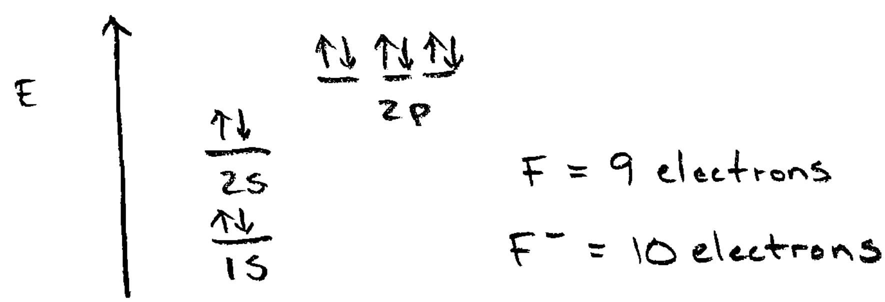
38. The ground-state electron configuration of a nitrogen atom is:

(A) $1s^2 2s^2 3s^2 3p^1$
(B) $1s^2 2s^2 3s^1$
(C) $1s^2 2s^2 2p^5$
(D) $1s^2 2s^2 2p^3$
(E) $1s^2 2s^2 3s^3$



39. The ground-state electron configuration of a fluoride ion (F^-) is:

(A) $1s^2 2s^2 3s^2 3p^2$
(B) $1s^2 2s^2 3s^1$
(C) $1s^2 2s^2 2p^6$
(D) $1s^2 2s^2 2p^6 3s^2 3p^2$
(E) $1s^2 2s^2 2p^4$



40. Because of CH 121...

(A) My pick-up lines now include the words *titrate, heat, enthalpy, dragonflies, and orbitals.*
(B) I have become a social butterfly.
(C) I have brushed off several clumsy passes by the Nobel Prize Committee.
(D) I have laughed more times in the past ten weeks than I have in the previous ten years.
(E) I have switched to a dandruff shampoo.

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 ☺