Chemistry 121
Final Exam

Fall 2005
December 6, 2005

Oregon State University
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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. **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.

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.

$R = 0.0821 \dfrac{L \bullet atm}{mol \bullet K}$	$R = 8.314 \dfrac{kg \bullet m^2}{s^2 \bullet mol \bullet K}$	$\mu_{rms} = \sqrt{\dfrac{3RT}{Molar\ Mass}}$
PV = nRT	760 Torr = 1 atm = 760 mm Hg	K = 273.15 + °C
$N_A = 6.02 \times 10^{23}$	$\dfrac{P_1V_1}{n_1T_1} = \dfrac{P_2V_2}{n_2T_2}$	$q = mc\Delta T$
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 = hv	$\nu = \dfrac{c}{\lambda}$	$h = 6.626 \times 10^{-34}$ J·s

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

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

1 inch = 2.54 cm (exact)

1 mole = 6.02×10^{23}

Substance	J/g·°C
Water	4.184
Methyl Alcohol	2.549
Ice	2.093
Steam	2.009
Benzene	1.750
Wood (typical)	1.674

Substance	J/g·°C
Soil (typical)	1.046
Air	1.046
Aluminum	0.901
Mercury	0.138
Gold	0.130
Lead	0.128

Name	Charge	Formula
Hydroxide	1-	OH^-
Cyanide	1-	CN^-
Nitrate	1-	NO_3^-
Acetate	1-	CH_3COO^-
Carbonate	2-	CO_3^{2-}
Phosphate	3-	PO_4^{3-}
Hydronium	1+	H_3O^+
Ammonium	1+	NH_4^+
Sulfate	2-	SO_4^{2-}

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)

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1. A student measures the volume of a sodium hydroxide solution to be 342.090 mL.

(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.]

zeroes on the right are significant

2. Consider the following operation: 130.304 g + 12.1 g. The correct answer with the proper number of significant figures is:

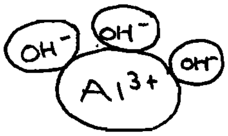
(A) None of the below
(B) 142.404 g
(C) 142.40 g
(D) [✓ 142.4 g]
(E) 142. g

$$\begin{array}{rl} & 130.304\ \text{g} \\ + & 12.1\ \text{g} \\ \hline & 142.4\ \text{g} \end{array}$$

limited to tenths place

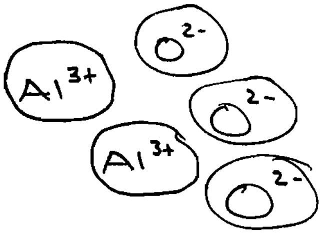
3. Consider $Al(OH)_3$. Each unit contains:

(A) Three aluminum ions, one oxygen ion, and one hydrogen ion.
(B) One aluminum ion, one oxygen ion, and one hydrogen ion.
(C) One aluminum ion, three oxygen ions, and three hydrogen ions.
(D) One aluminum ion, one oxygen ion, and three hydrogen ions.
(E) [✓ One aluminum ion and three hydroxide ions.]



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

(A) [✓ Al_3O_2] → Could be Al_2O_3
(B) BaF_2
(C) K_2CO_3
(D) LiOH
(E) BaS



→ protons + neutrons

5. $^{243}Am^{3+}$ has: neutrons = 243 - 95 = 148

(A) 148 **protons**, 243 **neutrons**, 95 **electrons**
(B) 243 **protons**, 148 **neutrons**, 240 **electrons**
(C) [✓ 95 **protons**, 148 **neutrons**, 92 **electrons**]
(D) 148 **protons**, 95 **neutrons**, 98 **electrons**
(E) 95 **protons**, 148 **neutrons**, 98 **electrons**

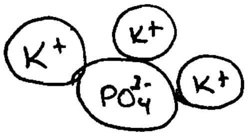
95 ← 95 protons
Am

$e^- = 95 - 3 = 92$

6. The chemical formula of potassium phosphate is:

K^+ PO_4^{3-}
↑
Need 3

(A) KHP
(B) KP
(C) K_3P
(D) [✓ K_3PO_4]
(E) $K_3(PO_4)_3$



7. Which of the following pairs are isotopes?

↘ Same element (same number of protons) with different number of neutrons.

(A) ^{16}N and ^{16}O
(B) ^{15}N and ^{15}O
(C). [✓ ^{14}N and ^{16}N]
(D) $^{20}F^-$ and ^{20}Ne
(E) ^{40}Ar and ^{20}Ne

8. The mass percent composition of carbon in methane, CH_4, is:

↗ ↖ 4 * 1.0079 g/mol
12.011 g/mol

16.0426 g/mol

(A) 20.0 %
(B) 25.0 %
(C) [✓ 74.9 %]
(D) 80.0 %
(E) 1/5 %

Mass percent composition C = $\frac{C}{CH_4} = \frac{12.011\ g/mol}{16.0426\ g/mol} = 74.9\%$

9. The name of $AsCl_5$ is?

(A) [✓ arsenic pentachloride]
(B) arsenic chloride
(C) arsenic carbonate
(D) monoarsenic pentacarbonate
(E) monoarsenic chloride

AsCl5

ide
arsenic pentachlori~~n~~e
⑤

10. The molar mass of octane, C_8H_{18}, is:

$18 * 1.0079$ g/mol
$8 * 12.011$ g/mol
114.23 g/mol

(A) 96.22 g/mol
(B) 1.8975×10^{-22} g/mol
(C) 74.58 g/mol
(D) 6.8766×10^{25} g/mol
(E) [✓ 114.23 g/mol]

11. A student () obtains 139.44 grams of gallium. This is:

(A) 3.01×10^{23} gallium atoms
(B) 2.00 gallium atoms
(C) 9.39×10^{24} gallium atoms
(D) [✓ 1.20×10^{24} gallium atoms]
(E) 9.39×10^{25} gallium atoms

31
Ga
69.72

69.72 g/mol

$$139.44 \text{ g Ga} \left(\frac{1 \text{ mol}}{69.72 \text{ g}}\right)\left(\frac{6.02 \times 10^{23} \text{ atoms}}{1 \text{ mol}}\right) =$$

1.20×10^{24} Ga atoms

12. When the reaction

$$C_{11}H_{24}(l) + \underline{17}\ O_2(g) \rightarrow \underbrace{11\ CO_2(g) + 12\ H_2O(g)}_{22 + 12 = 34 \text{ oxygen atoms}} \text{ is correctly balanced,}$$

(A) 22 O_2 are consumed.
(B) 11 O_2 are consumed.
(C) [✓ 17 O_2 are consumed.]
(D) 19 O_2 are consumed.
(E) 23 O_2 are consumed.

13. A student () places 221.97 grams of $CaCl_2$ (s) into an 8.00-L volumetric flask and fills to the mark with water. The concentration of this solution is:

(A) [✓ 0.250 M $CaCl_2$]
(B) 0.500 M $CaCl_2$
(C) 1.000 M $CaCl_2$
(D) 2.00 M $CaCl_2$
(E) 4.00 M $CaCl_2$

$$M = \frac{mol}{L} = \frac{\left(\frac{221.97\ g}{110.986\ g/mol}\right)}{8.00\ L} = 0.250\ M\ CaCl_2$$

Unit 2 (Material Assessed on Exam 2)

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14. A student dilutes 500.0 mL of 0.7500 M NaOH to a new volume of 2500.0 mL. The concentration of the new solution is:

(A) 6.667 M
(B) 1.667 M
(C) 0.6000 M
(D) [✓ 0.1500 M]
(E) 1.067 M

$$M_{Before}V_{Before} = M_{After}V_{After}$$

$$(0.7500\ M)(500.0\ mL) = (M_{After})(2500.0\ mL)$$

$$M_{After} = 0.1500\ M$$

15. How many grams of H_2O (g) are theoretically produced from 80.213 grams of CH_4 (g), and an excess amount of oxygen?

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

80.213g ↓① 5.000 mol ——②——→ 10.000 mol ↑③ 180.2 g

① $80.213g \left(\frac{1\ mol}{16.043g}\right) = 5.000\ mol\ CH_4$

② $5.000\ mol \left(\frac{2\ mol\ H_2O}{1\ mol\ CH_4}\right) = 10.000\ mol\ H_2O$

③ $10.000\ mol\ H_2O \left(\frac{18.02g}{1\ mol}\right) = 180.2\ g\ H_2O$

(A) 160.426 g H_2O (g) are produced.
(B) 36.04 g H_2O (g) are produced.
(C) 90.10 g H_2O (g) are produced.
(D) [✓ 180.2 g H_2O (g) are produced.]
(E) 198.2 g H_2O (g) are produced.

16. A student mixes an aqueous solution of $Hg(NO_3)_2$ (aq) with an aqueous solution of Na_2S (aq). Which of the following statements is **<u>FALSE</u>**?

(A) NO_3^- is a spectator ion. ✓
(B) Na^+ is a spectator ion. ✓
(C) Hg^{2+} ions will combine with S^{2-} ions will form the insoluble HgS (s). ✓
(D) [✓ Na^+ ions will combine with NO_3^- ions will form the insoluble $NaNO_3$ (s).]

$Hg(NO_3)_2(aq) + Na_2S(aq) \rightarrow 2\,NaNO_3(aq) + HgS(s)$
↑ ↖ solid - Rule 2
Na^+ & NO_3 are spectator ions

17. Consider the mixture of two aqueous solutions: one of lithium carbonate and one of barium nitrate. The net ionic equation for the process that occurs is:

(A) $Ba^{2+}\,(aq) + 2\,NO_3^-\,(aq) \rightarrow Ba(NO_3)_2\,(s)$
(B) $Li^+\,(aq) + NO_3^-\,(aq) \rightarrow LiNO_3\,(s)$
(C) [✓ $Ba^{2+}\,(aq) + CO_3^{2-}\,(aq) \rightarrow BaCO_3\,(s)$]
(D) $2\,Li^+\,(aq) + 2\,NO_3^+\,(aq) \rightarrow 2\,LiNO_3\,(s)$
(E) $Li_2CO_3\,(aq) + Ba(NO_3)_2\,(aq) \rightarrow BaCO_3\,(s) + 2\,LiNO_3\,(aq)$

$\cancel{Li_2}CO_3(aq) + Ba(\cancel{NO_3})_2(aq) \rightarrow 2\,\cancel{Li}\cancel{NO_3}(aq) + BaCO_3(s)$

Spectator Ions are not included in the Net Ionic Equation

18. A student calculates that 190.3 grams of calcium carbonate should theoretically be produced during a process. She actually recovers 103.4 grams of calcium carbonate. What is the percent yield for this process?

(A) 18.40 %
(B) 184.0 %
(C) [✓ 54.34 %]
(D) 84.04 %
(E) 11.90 %

$$\% = \frac{\text{Actual}}{\text{Theoretical}} \cdot 100\% = \frac{103.4\text{ g}}{190.3\text{ g}} \cdot 100\% = 54.34\ \%$$

19. A student obtains a Thermos® bottle at 24.1 °C and 0.989 atm. The student closes the bottle containing air [78% N_2 (g); 21% O_2 (g); 1% other gases]. The student places the bottle over a Bunsen burner so the bottle and the air heat up to 30.5 °C. Which of the following is true?

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

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

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

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

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

20. A student obtains 30.00 mL of NaOH (aq) of unknown concentration. Upon titration, 17.45 mL of 0.1990 M HCl (aq) are required for neutralization. Determine the concentration of the NaOH (aq).

(A) 2.759 M
(B) [✓ 0.1158 M]
(C) 0.3421 M
(D) 0.09221 M
(E) 8.639 M

$M_{Acid}V_{Acid} = M_{Base}V_{Base}$

$(0.1990\ M)(17.45\ mL) = (M_{Base})(30.00\ mL)$

$M_{Base} = 0.1158\ M$

21. A student obtains a 2.50 liter balloon at 280 K. He heats the balloon to 320 K. The volume of the balloon at 320 K is:

(A) [✓ 2.86 L]
(B) 0.350 L
(C) 2.19 L
(D) 0.457 L
(E) 3.19 L

$\frac{\cancel{P_1}V_1}{\cancel{n_1}T_1} = \frac{\cancel{P_2}V_2}{\cancel{n_2}T_2}$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $\frac{2.50\ L}{280\ K} = \frac{V_2}{320 K}$

$V_2 = 2.86\ L$

22. A student obtains a 1.25 liter Thermos bottle at 302 K and 0.955 atm. The bottle is cooled to 270 K. The pressure of the Thermos bottle at 270 K is:

$\frac{P_1\cancel{V_1}}{\cancel{n_1}T_1} = \frac{P_2\cancel{V_2}}{\cancel{n_2}T_2}$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{0.955\ atm}{302 K} = \frac{P_2}{270 K}$

(A) [✓ 0.854 atm]
(B) 1.17 atm
(C) 7.07 atm
(D) 0.141 atm
(E) 1.07 atm

$P_2 = 0.854\ atm$

23. A student places 11.368 g of a diatomic (a molecule having two atoms; such as O_2) gas into a 1.00-L container at 300 K and measures the pressure to be 1.00 atm. This diatomic gas is:

(A) H_2
(B) F_2
(C) Cl_2
(D) [✓ N_2]
(E) O_2

$PV = nRT$ $\quad n = \frac{PV}{RT} = \frac{(1.00\text{ atm})(10.00\text{ L})}{(0.0821\,\frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(300\text{ K})} = \overset{0.4060}{\cancel{0.0406}}\text{ mol}$

Molar Mass: $\text{g/mol} = \frac{11.368\text{ g}}{\cancel{0.0406}\text{ mol}}$ $= 28.0\text{ g/mol}$ $\quad N_2$
0.4060

24. A student places 8.005 grams of He (g) into a 2.000-L flask at 300.0 K. The pressure inside the flask is:

(A) 0.04060 atm.
(B) 0.05339 atm.
(C) 22.4 atm.
(D) 12.662 atm.
(E) [✓ 24.63 atm.]

$PV = nRT$ $\quad P = \frac{nRT}{V} = \frac{\left(\frac{8.005\text{ g}}{4.0026\text{ g/mol}}\right)(0.0821\,\frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(300\text{ K})}{2.000\text{ L}}$

$P = 24.63\text{ atm}$

25. Consider the following five gases: [✓ H_2 (g)] I_2 (g) Ne (g) CH_4 (g) Xe (g)

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

(A) [✓ H_2 (g)] ↖ lightest
(B) I_2 (g)
(C) Ne (g)
(D) CH_4 (g)
(E) Xe (g).

26. Shown below is the balanced equation for the combustion of methane. What is the volume (liters) of H_2O (g) produced at 1.000 atm and 300.0 K from the combustion of 32.085 grams of methane in excess O_2 (g)?

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

$$\begin{tikzcd}
32.085\,g \arrow[d, "①"] & & \underline{\quad}\ L \\
\underline{2.000}\ mol \arrow[rr, "②"] & & \underline{4.000}\ Mol \arrow[u, "③"]
\end{tikzcd}$$

① $32.085 g\ CH_4 \left(\frac{1\ mol}{16.0426 g}\right) = 2.000\ mol\ CH_4$

② $2.000\ mol\ CH_4 \left(\frac{2\ mol\ H_2O}{1\ mol\ CH_4}\right) = 4.000\ mol\ H_2O$

③ $PV = nRT$

$$V = \frac{nRT}{P} = \frac{(4.000\ mol)(0.0821 \frac{L \cdot atm}{mol \cdot K})(300.0 K)}{(1.000\ atm)} = 98.52\ L$$

(A) 6.158 L
(B) 12.32 L
(C) 24.63 L
(D) 49.26 L
(E) [✓ 98.52 L]

27. Which of the following processes is exothermic?

(A) [✓ $2\,C_8H_{18}$ (l) + 25 O_2 (g) → 16 CO_2 (g) + 18 H_2O (g).] Combustion gives off heat
(B) H_2O (s) → H_2O (l).
(C) H_2O (l) → H_2O (g).
(D) NH_4NO_3 (s) → NH_4NO_3 (aq).

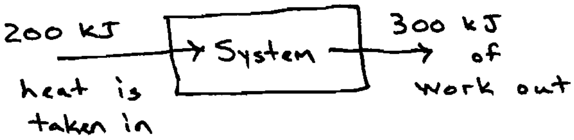
28. How much heat is required to raise the temperature of 300.0 grams of water from 23.0°C to 63.0°C?

$$q = mc\Delta T = (300.0\,g)(4.18\,\tfrac{J}{g\,°C})(63.0°C - 23.0°C)$$
$$= 50,160\,J = 50.2\,kJ$$

(A) 43.6 kJ
(B) 12.9 kJ
(C) 10.4 kJ
(D) 12,000 kJ
(E) [✓ 50.2 kJ]

29. A system takes in 200 kJ of heat and does 300 kJ of work. The change in internal energy is:

(A) + 500 kJ.
(B) - 500 kJ.
(C) + 100 kJ.
(D) [✓ - 100 kJ.]



$$\Delta E = q + w = (+200\,kJ) + (-300\,kJ) = -100\,kJ$$

Unit 3 (Material Discussed After Exam 2)

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30. The frequency of red laser photons having a wavelength of 630 nm is:

$$\nu = \frac{c}{\lambda} = \frac{3.00\times10^{8}\,\frac{m}{s}}{630\times10^{-9}\,m} = 4.76\times10^{14}\,\frac{1}{s}$$

(A) $1.60 \times 10^{-9}\ \frac{1}{s}$.

(B) $1.60 \times 10^{9}\ \frac{1}{s}$.

(C) [✓ $4.76 \times 10^{14}\ \frac{1}{s}$.]

(D) $2.10 \times 10^{14}\ \frac{1}{s}$.

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

31. 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.

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

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

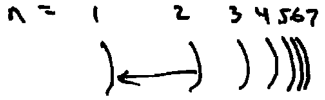
Energy per mole photons $= 4.14 \times 10^{-19} \frac{J}{photon} * \frac{6.02 \times 10^{23}\ photons}{1\ mol} =$

$249{,}303\ J = 249\ kJ$

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

(A) n = 7 to n = 6.
(B) [✓ n = 2 to n = 1.]
(C) n = 1 to n = 2.
(D) n = 5 to n = 4.
(E) n = 3 to n = 4.

⊕

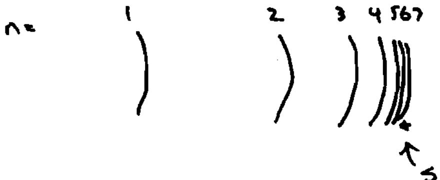


33. Consider the Bohr Model for the Hydrogen Atom. Which of the following electron transitions releases electromagnetic radiation with the **longest** wavelength?

(A) [✓ n = 7 to n = 6.]
(B) n = 2 to n = 1.
(C) n = 1 to n = 2.
(D) n = 5 to n = 4.
(E) n = 3 to n = 4.

⊕

Longest wavelength = Lowest energy



Small energy release
n: 7 → n = 6

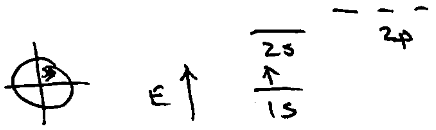
34. Which of the following sets of quantum numbers is not valid?

(A) $n = 1, l = 0, m_l = 0, m_s = +\frac{1}{2}$.
(B) $n = 3, l = 1, m_l = 0, m_s = +\frac{1}{2}$.
(C) $n = 3, l = 2, m_l = -2, m_s = -\frac{1}{2}$.
(D) $n = 2, l = 1, m_l = 0, m_s = +\frac{1}{2}$.
(E) [✓ $n = 1, l = 1, m_l = 1, m_s = +\frac{1}{2}$.]

↖ $n = 1$ l must be 0

35. 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.



36. Blue light is greater in energy than red light. Which of the following statements is **false**?

(A) The frequency of blue light is greater than the frequency of red light. ✓
(B) [✓ The wavelength of blue light is greater than the wavelength of red light.]
(C) Both blue and red light are in the visible region of the electromagnetic spectrum.
(D) One mole of blue photons has a greater energy than one mole of red photons.
(E) Blue and red light travel at the same speed in a vaccuum.

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

← $\ell = 1$ (a p orbital) with other valid quantum numbers

(A) $n = 1, l = 0, m_l = 0, m_s = +½$.
(B) $n = 1, l = 1, m_l = 0, m_s = +½$. ← not a valid set of quantum numbers
(C) [✓ $n = 2, l = 1, m_l = 0, m_s = +½$.]
(D) $n = 2, l = 2, m_l = 0, m_s = +½$.
(E) $n = 3, l = 2, m_l = 1, m_s = +½$.

39. deBroglie's proposition regarding the nature of matter was:

(A) [✓ All matter exhibits a wavelength: $\lambda = h/mv$.]
(B) All photons are in the visible region of the electromagnetic spectrum.
(C) The frequency of electromagnetic radiation is inversely proportional to the energy.
(D) All matter exhibits energy: $E=mc^2$.
(E) Matter that is greater in energy than UV is IR.

40. Because of CH 121...

(A) I dream of molecules and Brad Pitt and/or Angelina Jolie and/or Jennifer Aniston.
(B) my manners have improved.
(C) my manners have deteriorated.
(D) [✓ I use the words "titration, quantum, orbitals, stoichiometric, electromagnetic, molarity" at parties and never leave alone.]
(E) I want to build something really cool; like a device that will assimilate class lectures and cram that knowledge into my brain. This would allow me to nap or play video games or text message during Chem Class.

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 :)