Quiz 1A

CHEM **1141**

Fall 2012

Name: _____KEY_____

Q1. [0.5 pt. ea.] Fill in the blanks:

Quantity	Name of Unit	Symbol of Unit
mass	Kilogram	Kg
time	second	s
electrical current	Ampère	A

Q2. [0.5 pt. ea.] Fill in the blanks:

Element Name	Element Symbol
lead	Pb
carbon	C
mercury	Hg
tin	Sn

Q3. [1 pt. ea.] Fill in the blanks:

SI Prefix	Meaning
n	x10⁻⁹
c	$\times 10^{-2}$
m	$\times 10^{-3}$

Q4. [2 pts.] What volume of mercury has a mass of 1.91 g?
The density of mercury is 13.6 g/mL. **SHOW ALL WORK.**

$$d = m/v$$

$$\Rightarrow V = m/d$$

$$\Rightarrow V = \frac{1.91 g}{13.6 \, g/mL} = \boxed{0.140 \, mL}$$

Quiz 2A
Chemistry 1141
Fall 2012

Name: KEY

Q1. [1 pt. ea.] Compute the following to the correct number of significant figures/decimal places:

a) $3.50 \times 12.00 =$ 42.0 (3 s.f.)

b) $12.920 - 11.420 =$ 1.500 (3 d.p.)

Q2. [2 pts.] Using the conversion-factor method, convert an area of 3.4 in² to cm².
Note: 1 in = 2.54 cm (exactly). *Show ALL work!*

$$3.4 \, in^2 \times \left(\frac{2.54 \, cm}{1 \, in}\right)^2 = 22 \, cm^2 \quad (2 \, s.f.)$$

Q3. [2 pts.] What are the horizontal rows on the periodic table called?

periods

Q4. [2 pts.] Name the following ionic compounds:

a) K_3N potassium nitride

b) CuBr   copper (1) bromide

Q5. [0.5 pts. ea.] Write out the formulas of the following ions:

a) sulfate SO_4^{2-}
b) ferric Fe^{2+}
c) nitrate NO_3^-
d) oxide O^{2-}

Quiz 3A
Chemistry 1141
Fall 2012

Name: _KEY_   9/17/2012

Q1. [1 pt. ea.] Name the following molecular compounds:

a) N_4Cl_{10} tetranitrogen   decachloride

b) P_3Br_5 triphosphorus   pentabromide

Q2. [1 pt.] Give the systematic name the following compound:

$CaSO_4 \cdot 2H_2O$ calcium sulfate   dihydrate

Q3. [1 pt.] How is the **atomic mass unit** defined?

1 amu = $\frac{1}{12}$ mass of $^{12}_6C$ atom.

Q4. [3 pts.] How many moles of CCl_4 are there in a 21.0 g sample?
Show ALL work. You must use the conversion-factor method to receive credit.

CCl_4

$1 \times C = 1 \times 12.01$
$4 \times Cl = 4 \times 35.45$
_____
153.81

$21.0 g \ CCl_4 \times \dfrac{1 \ mol \ CCl_4}{153.81 g \ CCl_4} = 0.137 \ mol \ CCl_4 \ (3s.f.)$

Q5. [3 pts.] Element X is composed of two isotopes: X-76 and X-79. Using the data in the table below, calculate its (average) atomic mass. *Show ALL work.*

Isotope	Mass / u	Relative Abundance / %
X-76	75.904	82.1
X-79	78.890	17.9

Average Atomic Mass = $75.904u \times \dfrac{82.1}{100} + 78.890 \times \dfrac{17.9}{100}$

$= 62.3u \ (3sf.) + 14.1u \ (3sf.)$

$= \boxed{76.4u} \ (1d.p.)$

Quiz 4A
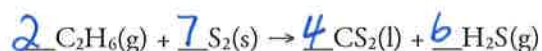# Chemistry 1141
Fall 2012

Name: KEY   9/24/2012

Q1. [2 pts.] Balance the following chemical equation using the lowest set of whole number coefficients:

$$\underline{2}\ C_2H_6(g) + \underline{7}\ S_2(s) \rightarrow \underline{4}\ CS_2(l) + \underline{6}\ H_2S(g)$$

Q2. [6 pts.] Using the balanced chemical equation from Q1, what mass of CS_2 can be formed from the reaction between 10.0 g of C_2H_6 and 10.0 g of S_2?

$\underline{C_2H_6}$

$2 \times C = 2 + 12.01$
$6 \times H = 6 + 1.01$
$\underline{\qquad}$
30.08

(xS)

$$\frac{10.0g\ C_2H_6}{} \left| \frac{1\ mol\ C_2H_6}{30.08g\ C_2H_6} \right| \frac{4\ mol\ CS_2}{2\ mol\ C_2H_6} \left| \frac{76.15g\ CS_2}{1\ mol\ CS_2} \right| = 50.6g\ CS_2$$

$\underline{S_2}$

$2 \times S = 2 \times 32.07$
$\underline{\qquad}$
64.14

(LR)

$$\frac{10.0g\ S_2}{} \left| \frac{1\ mol\ S_2}{64.14g\ S_2} \right| \frac{4\ mol\ CS_2}{7\ mol\ S_2} \left| \frac{76.15g\ CS_2}{1\ mol\ CS_2} \right| = \boxed{6.78g\ CS_2}$$

Theoretical mass

$\underline{CS_2}$

$1 \times C = 12.01$
$2 \times S = 2 + 32.07$
$\underline{\qquad}$
76.15

Q3. [2 pts.] What is the percent yield of this reaction if 2.40 g of CS_2 was formed?

$$\%\ yield = \frac{Actual}{Theoretical} \times 100 = \frac{2.40g}{6.78g} \times 100 = \boxed{35.4\%}$$

"IT WAS INEVITABLE. THEY WERE CHEMISTRY PARTNERS."

Quiz 5A
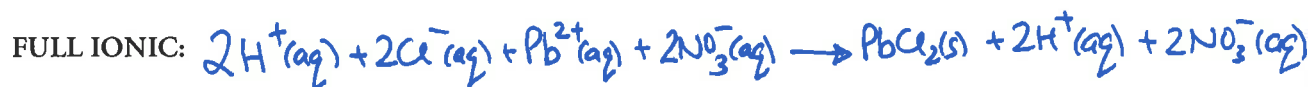# Chemistry 1141
Fall 2012

Name: _KEY_ 10/1/2012

Q1. [2 pts.] What is the Arrhenius definition of an acid?

forms H^+ ions when dissolved in water

Q2. [2 pts.] Predict whether the following compounds will be **soluble** or **insoluble** in water:

a) NH_4NO_3 SOLUBLE

b) Fe_2S_3 INSOLUBLE

c) $Pb(OH)_2$ INSOLUBLE

d) $AgBr$ INSOLUBLE

Q3. [2 pts.] Write out the full-ionic equation given the following molecular equation:

MOLECULAR: $2HCl(aq) + Pb(NO_3)_2(aq) \rightarrow PbCl_2(s) + 2HNO_3(aq)$

FULL IONIC: $2H^+(aq) + 2Cl^-(aq) + Pb^{2+}(aq) + 2NO_3^-(aq) \rightarrow PbCl_2(s) + 2H^+(aq) + 2NO_3^-(aq)$

Q4. [2 pts.] What does the term "**triprotic acid**" mean?

Can release $3H^+$/molecule.

Q5. [2 pts.] What does it mean when a substance is **oxidized**?
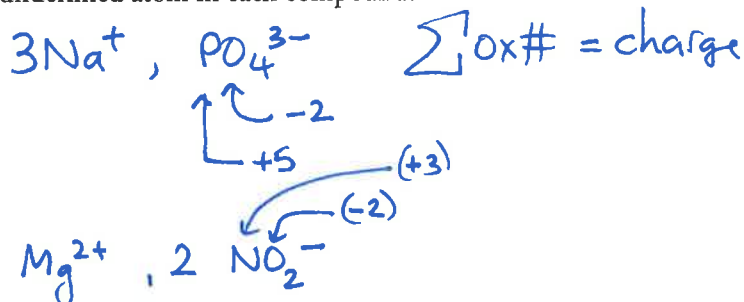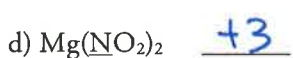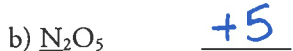
It contains an atom that has $\boxed{lost\ electrons}$

Quiz 6A
Chemistry 1141
Fall 2012

Name: KEY   10/8/2012

Q1. [2 pts.] Assign an oxidation number to the underlined atom in each compound:

N_2O_5

↑↰ (-2)
↳ (+5)

SO_3

↑↰ (-2)
↳ (+6)

a) $Na_3\underline{P}O_4$ +5 $3Na^+$, PO_4^{3-} $\sum ox\# = charge$

b) $\underline{N}_2O_5$ +5   ↑↰ -2
                                                      ↳ +5   (+3)

c) $\underline{S}O_3$ +6   (-2)

d) $Mg(\underline{N}O_2)_2$ +3 Mg^{2+}, $2\ NO_2^-$

Q2. [2 pts] How many moles of $CaCl_2$ are in 25.00 mL of 3.400 M $CaCl_2$(aq)?
Show all work. You must use the conversion-factor method to receive credit.

$$\dfrac{25.00\,mL}{} \left|\dfrac{1\,L}{1000\,mL}\right|\dfrac{3.400\,mol\ CaCl_2}{1\,L} = 0.08500\,mol\ CaCl_2\ (4sf.)$$

V_1 M_1

Q3. [4 pts.] 35.0 mL of water is added to 25.0 mL of 15.0 M HNO_3(aq). Assuming the volumes are additive, what is the final concentration of the HNO_3?

$V_2 = 25.0\,mL + 35.0\,mL = 60.0\,mL$
$M_2 = ?$

$M_1V_1 = M_2V_2$

$\Rightarrow M_2 = \dfrac{M_1V_1}{V_2} = \dfrac{15.0\,M \times 25.0\,mL}{60.0\,mL} = \boxed{6.25\,M}$

Q4. [2 pts.] Circle the elements that are gases at 25 °C and 1 atm:

a) hydrogen ⃝   b) lithium   c) nitrogen ⃝   d) calcium
e) bromine   f) chlorine ⃝   g) neon ⃝   h) iodine

Quiz 7A
Chemistry 1141
Fall 2012

Name: _____KEY_____   10/15/2012

Q1. [3 pts.] 34.0 mL of helium gas at a pressure of 311 mmHg is compressed until its volume becomes 21.4 mL. What will its pressure become? Assume the temperature does not change.

Boyle's Law

$$P_1 V_1 = P_2 V_2 \implies P_2 = \frac{P_1 V_1}{V_2} = \frac{311\,\text{mmHg} \times 34.0\,\text{mL}}{21.4\,\text{mL}} = \boxed{494\,\text{mmHg}}$$

Q2. [3 pts.] 34.0 mL of helium gas at a temperature of 15 °C is cooled down to −15 °C. What is its new volume? Assume the pressure does not change.

Charles' Law

$$T_1 = 15 + 273.15 = 288\,K$$
$$T_2 = -15 + 273.15 = 258\,K$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\implies V_2 = \frac{V_1 \times T_2}{T_1} = \frac{34.0\,\text{mL} \times 258\,K}{288\,K} = \boxed{30.5\,\text{mL}}$$

Q3. [4 pts.] What pressure will 4.00 g of helium gas exert if its temperature is 145 °C when it is confined to a volume of 902 mL?

ideal gas law
$$PV = nRT$$

$$\implies P = \frac{nRT}{V}$$

$$\frac{4.00\,\text{g He}}{} \left| \frac{1\,\text{mol He}}{4.00\,\text{g He}} \right| = 1.00\,\text{mol He} \quad \textcircled{n}$$

$$145 + 273.15 = 418\,K \quad \textcircled{T}$$

$$902\,\text{mL} \left| \frac{1\,L}{1000\,\text{mL}} \right| = 0.902\,L \quad \textcircled{V}$$

$$R = 0.08206 \frac{L \cdot \text{atm}}{\text{mol} \cdot K}$$

$$\implies P = \frac{1.00\,\text{mol} \times 0.08206 \frac{L \cdot \text{atm}}{\text{mol} \cdot K} \times 418\,K}{0.902\,L} = \boxed{38.0\,\text{atm}}$$

Quiz 8A
Chemistry 1141
Fall 2012

Name: _____KEY_____   10/22/2012

Show ALL work to receive credit!

t_i (copper)

t_f (copper)

Q1. [3 pts.] 10.0 g of copper at a temperature of 143.0 °C is dropped into an insulated container of water at an initial temperature of 24.4 °C. If the final temperature of the system is 38.2 °C then calculate the amount of heat lost by the copper.

$$q = m \cdot s \cdot \Delta t = 10.0g \times 0.385\frac{J}{g \cdot °c} \times (38.2°c - 143.0°c)$$

$$= \boxed{-403 J}$$

copper <u>LOST</u> 403 J of heat energy.

Q2. [3 pts.] How much heat was gained by the water?

1st Law: conservation of energy! $q_{H_2O} + q_{Cu} = 0$ $\Rightarrow$ $q_{H_2O} = -q_{Cu} = \boxed{+403 J}$

→ water <u>gained</u> 403 J of heat energy.

Q3. [4 pts.] What mass of water must have been in the container?

$$q_{H_2O} = M_{H_2O} \times S_{H_2O} \times \Delta t_{H_2O}$$

$$M_{H_2O} = \frac{q_{H_2O}}{S_{H_2O} \times \Delta t_{H_2O}} = \frac{+403 J}{\left(4.184 \frac{J}{g \cdot °c}\right)\left(38.2°c - 24.4°c\right)}$$

t_F water t_I water

$$\Rightarrow M_{H_2O} = \boxed{6.98 g}$$

Quiz 9A
Chemistry 1141
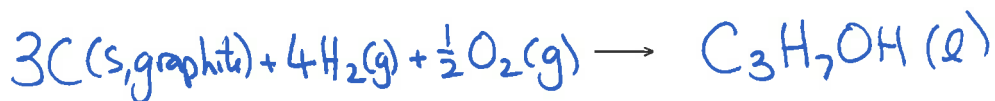# Fall 2012

Name: _____KEY_____   10/29/2012
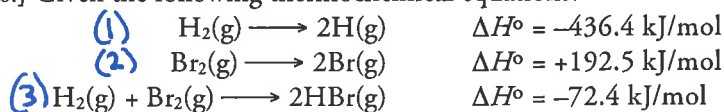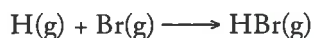
Show ALL work to receive credit!

Q1. [3 pts.] Write the thermochemical equation corresponding to $\Delta H_f^o(C_3H_7OH(l))$

$$3C(s, graphite) + 4H_2(g) + \tfrac{1}{2}O_2(g) \longrightarrow C_3H_7OH(l)$$

Q2. [4 pts.] Given the following thermochemical equations:

    (1) $H_2(g) \longrightarrow 2H(g)$ $\Delta H^o = -436.4$ kJ/mol

    (2) $Br_2(g) \longrightarrow 2Br(g)$ $\Delta H^o = +192.5$ kJ/mol

(3)$H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$ $\Delta H^o = -72.4$ kJ/mol

Determine ΔH^o for the reaction

$$H(g) + Br(g) \longrightarrow HBr(g)$$

reverse and $\tfrac{1}{2}$ (1) $H(g) \longrightarrow \tfrac{1}{2}H_2(g)$; $\Delta H^o = -\tfrac{1}{2} \times -436.4 \tfrac{KJ}{mol} = +218.2 \, ^{KJ}/_{mol}$

reverse and $\tfrac{1}{2}$ (2) $Br(g) \longrightarrow \tfrac{1}{2}Br_2(g)$; $\Delta H^o = -\tfrac{1}{2} \times +192.5 \tfrac{KJ}{mol} = -96.25 \, ^{KJ}/_{mol}$

$\tfrac{1}{2}$ (3) $\tfrac{1}{2}H_2(g) + \tfrac{1}{2}Br_2(g) \rightarrow HBr(g)$; $\Delta H^o = \tfrac{1}{2} \times -72.4 \, ^{KJ}/_{mol} = -36.2 \, ^{KJ}/_{mol}$

(SUM) $H(g) + Br(g) \rightarrow HBr(g)$; $\Delta H^o = +85.8 \, ^{KJ}/_{mol}$

Q3. [3 pts.] Calculate the energy of a photon of green light, with a wavelength of 532 nm.

$$E = h\nu = \frac{hc}{\lambda} = \frac{6.626 \times 10^{-34} \, J \cdot s \times 3.00 \times 10^8 \, m/s}{532 \times 10^{-9} \, m}$$

$$= \boxed{3.74 \times 10^{-19} \, J}$$

Quiz 10A
Chemistry 1141
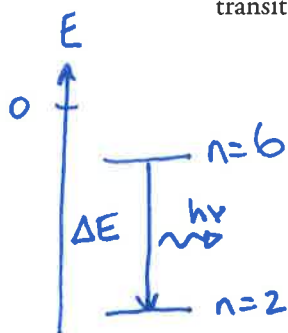# Fall 2012

Name: _KEY_   11/5/2012

Show ALL work to receive credit!

Q1. [6 pts.] Calculate the *wavelength* of light (in nm) emitted from a hydrogen atom undergoing a transition from $n = 6$ to $n = 2$.

$$\Delta E = E_2 - E_6 = -R_H\left(\frac{1}{2^2}\right) \ominus - R_H\left(\frac{1}{6^2}\right)$$

$$= -R_H\left(\frac{1}{2^2} - \frac{1}{6^2}\right) = -2.18\times10^{-18}J\left(\frac{1}{4} - \frac{1}{36}\right)$$

$$\Rightarrow \Delta E = -4.8\underline{44}\times10^{-19}J$$

$\Delta E = -ve \Rightarrow$ atom __loses__ energy
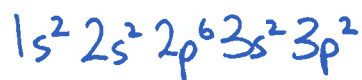
$\Rightarrow$ emit a photon with energy of $+4.8\underline{44}\times10^{-19}J$

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.626\times10^{-34}J\cdot s \times 3.00\times10^{8}m/s}{4.8\underline{44}\times10^{-19}J}$$

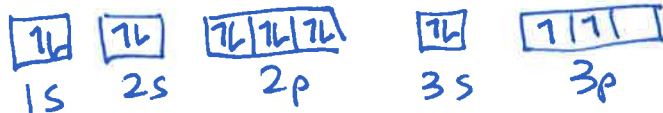$$= 4.10\times10^{-7}m\left|\frac{nm}{10^{-9}m}\right| = \boxed{410.\,nm}$$

VIOLET

Q2. [4 pts.] Write out the *full* electron configuration and the *orbital diagram* for an atom of silicon.

$_{14}Si$ $1s^2\,2s^2\,2p^6\,3s^2\,3p^2$ electron configuration

[↑↓] [↑↓] [↑↓|↑↓|↑↓]   [↑↓] [↑|↑|]   orbital diagram.
1s   2s   2p   3s   3p

Quiz 11A
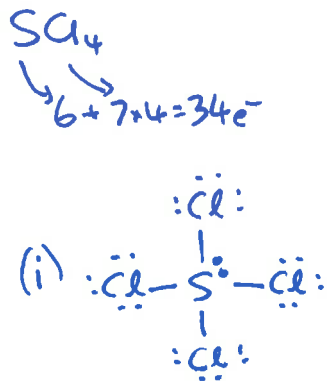# Chemistry 1141
Fall 2012

**Name:** KEY   12/3/2012

Show ALL work to receive credit!

Q1. [6 pts.] Predict the molecular geometry of SCl_4. Your answer should include:
(i) A valid Lewis structure, (ii) A sketch of the molecular geometry using line, dash, and wedge notation, (iii) Approximate bond angles written out, and (iv) the name of the molecular geometry.

SCl_4

$\rightarrow 6 + 7 \cdot 4 = 34 e^-$

$:\ddot{C}l:$

(i) $:\ddot{C}l - \overset{\cdot\cdot}{\underset{|}{S}} - \ddot{C}l:$

$:\ddot{C}l:$

$\begin{array}{r}34\\ -8 \text{(bonds)}\\ \hline 26\\ -24 \text{ (lp on Cl)}\\ \hline 2\\ -2 \text{ (lp on S)}\\ \hline 0\end{array}$

(ii) 5 repulsions around central atom = trigonal bipyramidal.   (e⁻ geom)

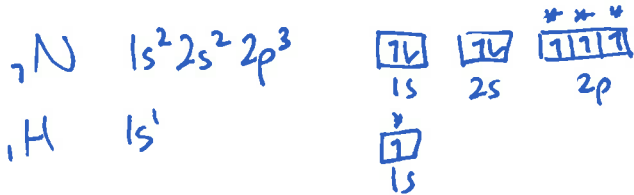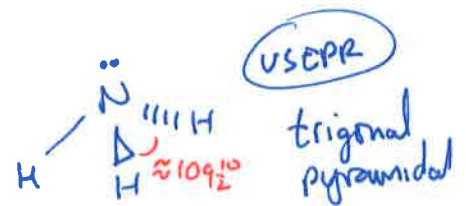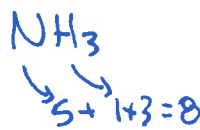[structure sketch with Cl, 90°, 120°, S, Cl, Cl, Cl]
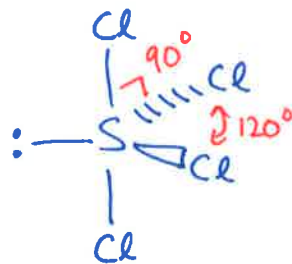
lp goes equatorial
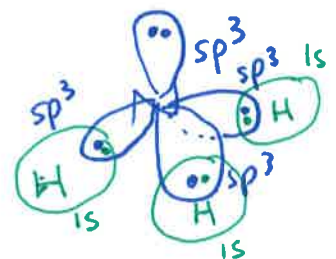(gives 2× lp-bp @ 90°)

(iv) molecular geometry = see-saw

[structure: Cl — S̈ — Cl with Cl and Cl below]

Q2. [4 pts.] Using valence-bond theory, explain the bonding in NH_3.

NH_3

$\rightarrow 5 + 1 \cdot 3 = 8$

$H - \ddot{N} - H$ (Lewis)
      $|$
      H

[structure sketch] VSEPR
trigonal pyramidal
$\approx 109\frac{1}{2}°$

$_7N \quad 1s^2 2s^2 2p^3$ [orbital diagram: 1s ⇅, 2s ⇅, 2p ↑↑↑]

$_1H \quad 1s^1$ [orbital diagram: 1s ↑]
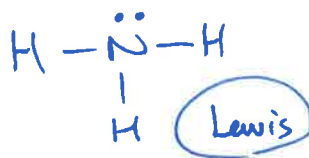
if angles are $109\frac{1}{2}°$, need sp^3 hybridization on N!

$\Rightarrow N:$ [orbital diagram: 1s ⇅, sp^3 ⇅↑↑↑]

[orbital overlap diagram with sp^3 orbitals, H, 1s]

overlap of sp^3 on N
w/ 1s on H makes a σ-bond!