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KAIZEN

TEAM

chemistry 1

second exams

عندما تطمح في شيء وتسعى جادا في الحصول
عليه ..فإن العالم بأسره يكون في صفك
باولو كويلو

13

General Chem. 101

Time: 60 min. Second Exam Date: 19/12/2009

Student's Name: .... Reg. No: ....

Section No. ٤٤٣ يوم أحمد د. ملك القادري Seat No. ......51.......

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Physical constants and useful relations:

1 atm = 101.3 kPa = 1.013×10^5 Pa = 760. Torr; Planck's constant = 6.63×10^{-34} J.s,

Speed of light = 3.00×10^8 m/s; $E_n = -(2.18\times10^{-18}/n^2)$ J; $E = hc/\lambda$

R = 0.08206 L. atm/mol. K = 8.314 J / mol.K ; 1L. atm = 101.3 J; $\lambda = h/mu$

Av. No. = 6.022×10^{23} mol^{-1}, PV = n RT , $[P + a(n/V)^2](V - nb) = nRT$

$u_{rms} = (3RT/M)^{1/2}$; $\Delta E = q + w$, $\Delta H = \Delta E + P \times \Delta V$, $w = -P \times \Delta V$

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ANSWER SHEET

1.	a	b	c	d	e	9.	a	b	c	d	e
2.	a	b	c	d	e	10.	a	b	c	d	e
3.	a	b	c	d	e	11.	a	b	c	d	e
4.	a	b	c	d	e	12.	a	b	c	d	e
5.	a	b	c	d	e	13.	a	b	c	d	e
6.	a	b	c	d	e	14.	a	b	c	d	e
7.	a	b	c	d	e	15.	a	b	c	d	e
8.	a	b	c	d	e	16.	a	b	c	d	e

1. Which of the following statements concerning gases is ***correct***?

a) All gases behave ideally at high P and/or low T.
b) No gases behave ideally at low P and/or high T.
c) No gases behave ideally at high P and/or high T.
d) All gases behave ideally at low P and/or high T
e) Both *van der Waals* constants (a & b) are *the same* for all gases.

2. Which of the following statements concerning *ideal* gases is *incorrect* (***not correct***)?

a) At constant n and T, $P_1 V_1 = P_2 V_2$.
b) The average molecular speed is higher for H_2 gas than for N_2 gas at same T.
c) The average kinetic energy is higher for H_2 gas than for N_2 gas at same T.
d) At constant n, $P_1 V_1 / T_1 = P_2 V_2 / T_2$.
e) At constant n and V, $P_1 / T_1 = P_2 / T_2$.

3. According to Kinetic Molecular Theory of gases, the root-mean square speed (u_{rms}) of N_2 gas (M = 28.0 g/mol) at 25°C is equal to

a) 411 m/s b) 515 m/s c) 610. m/s d) 682 m/s e) 742 m/s

4. Given that the density for an ideal gas (d= 1.801 g/L) at 1.00 atm and 25°C, the molar mass (M in g/mol) of the gas is equal to

a) 44.0 g/mol b) 30.0 g/mol c) 610. g/mol d) 58.0 g/mol e) 72.0 g/mol

5. The nitrogen (N_2) gas obtained from the decopmposition of sodium azide (NaN_3) according to the chemical reaction: $2\ NaN_{3(S)} \rightarrow 2\ Na_{(S)} + 3\ N_{2(g)}$ was collected over liquid water at a *total pressure* of 724 *torr* and 25°C where the vapor pressure of water was 24.0 torr. If the volume of the N_2 gas was 10.0 L, then the mass of N_2 gas is equal to.... (Molar mass of N_2 = 28.0 g/mole)

a) 5.27 g b) 15.8. g c) 10.5 g d) 21.1 g e) 38.7 g

6. Given that 4.00 g of CH_4 gas (M = 16.0 g/mol) and 22.0 g of C_3H_8 gas (M = 44.0 g/mol) were placed in a 25.0 L container at 25°C, then the total pressure (P in kPa) of the gas mixture would be equal to

a) 92.9 kPa b) 61.9 kPa c) 74.3 kPa d) 53.1 kPa e) 40.8 kPa

7- The combustion (oxidation) of propane (M = 44.0 g/mole) is described by the balanced equation

$C_3H_{8(g)}$ + $5\ O_{2(g)}$ → $3\ CO_{2(g)}$ + $4\ H_2O_{(l)}$ ΔH = - 2220 kJ

Calaculate the mass of propane (in gram) must be burned to produce 175.5 kJ of heat.

a- 6.96 b- 13.9 c- 20.9 d- 3.48 e- 4.40

8- Given the following data:

	$2C_6H_{6(l)}$	+	$15O_{2(g)}$	→	$12CO_{2(g)}$	+	$6H_2O_{(l)}$
ΔH^o_f (kJ/mol)	+49				-393.51		-285.83

Calculate the standard enthalpy of combustion of benzene in (kJ/mole benzene)

a) -3135.5 b) 6535.2 c) -6270.9 d) -3267.6 e) –6535.2

9- A gas is allawed to expand, at constant temperature, from a volume of 1.0 L to 10.1 L against an external pressure of 0.50 atm. If the gas absorbs 250 J of heat from the surroundings, what is the value of q, w, and ΔE?

	q	w	ΔE
a)	250 J	-4.55 J	245 J
b)	-250 J	-460 J	-710 J
c)	250 J	460 J	710 J
d)	-250 J	460 J	210 J
e)	250 J	-460 J	-210 J

10- A 100.0 ml of 0.200 M aqueous hydrochloric acid, is added to 100.0 ml of 0.200 M aqueous ammonia (NH_3) in a constant pressure calorimeter of negligible heat capacity. The initial temperature of both solutions is the same at 25.00 °C. The final temperature after mixing is 26.20 °C. Assuming the density of the solution = 1.00 g/ml and its specefic heat = 4.18 J/g.°C, calculate ΔH per mole of the reaction:

HCl_{aq} + NH_{3aq} → NH_4Cl_{aq}

A) -58.6 kJ b) -54.3 kJ c) -50.2kJ d) -42.2 kJ e) -46.0 kJ

11- given the following data

					ΔH(kJ)
$N_{2(g)}$	+	$3/2\ O_{2(g)}$	→	N_2O_3	83.7
$N_{2(g)}$	+	$O_{2(g)}$	→	$2\ NO_{(g)}$	180.4
$½\ N_{2(g)}$	+	$O_{2(g)}$	→	$NO_{2(g)}$	33.2

Find ΔH(kJ) for the reaction

$NO_{2\ (g)}$ + $NO_{(g)}$ → N_2O_3

a) - 19.7 b) - 59.7 c) 49.7 d) - 29.7 e) - 39.7

12 What is the wavelength (λ in nm) of a photon whose energy is $1.2\text{x}10^{-14}$ J

a) $1.7\text{x}10^{-12}$ b) 17 c) $1.7\text{x}10^{-1}$ d) $1.7\text{x}10^{-3}$ e) $1.7\text{x}10^{-2}$

13- An electron transition of hydrogen atoms is accompanied with emission of light at 2165 nm. If the value of n_f for lower level involved in this emission is 4, what is the value of n_i for the higher level from which the electron falls back?

a) 5 b) 7 c) 3 d) 6 e) 4

14- For the electron configuration ($1s^2\ 2s^2\ 2p^4 3s^1$), how many electrons have the angular momentum quantum number (l) = 1?

a) 4 b) 1 c) 3 d) 2 e) 5

15- Calculate the wavelength (λ in meters) associated with an atom moving at a velocity of $1.0\ \text{x}10^5$ m/s, given that the molar mass is 19.992 g/mol.

a-1.0 $\text{x}10^{-12}$ b- 2.0 $\text{x}10^{-13}$ c- 1.0 $\text{x}10^{-14}$ d) 9.7 $\text{x}10^{-13}$ e- 2.0 $\text{x}10^{-14}$

16- An atom with 23 electrons in its ground state will have..... unpaired electrons and is .....

a- 0, diamagnetic b- 2, diamagnetic c- 3, paramagnetic
d- 5, paramagnetic e- 7, paramagnetic

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The University of Jordan	**General Chemistry 101**	**Chemistry Department**
Date: 12/12/2010	Second Exam	Time: 60 min.

Name: ______________ . Registration Number ____

Instructor ________________________. Seat No.____ Day/Time ________________

Answer Sheet

K = °C+273, 1atm = 760mmHg, $R = 0.082057$L.atm/(K.mol) = 8.314J/(K.mol), L.atm = 101.3J, $N_A = 6.022\text{x}10^{23}$, h=6.63x10^{-34} J.s, R_H=2.18x10^{-18} J,

$c = 3\text{x}10^8\ m/s$, $PV = nRT$, $u_{rms} = \sqrt{\overline{u^2}} = \sqrt{\frac{3RT}{M}}$, $KE = \frac{3}{2}RT = N_A(\frac{1}{2}m\overline{u^2})$, $\Delta E = \Delta H - P\Delta V$

$\Delta E = q + w$, $c = \lambda v$, $E = hv$, $E_n = -R_H(1/n^2)$, $\lambda = h/(mu)$,

1.	*a*	*b*	*c*	*d*	*e*	**9.**	*a*	*b*	*c*	*d*	*e*
2.	*a*	*b*	*c*	*d*	*e*	**10.**	*a*	*b*	*c*	*d*	*e*
3.	*a*	*b*	*c*	*d*	*e*	**11.**	*a*	*b*	*c*	*d*	*e*
4.	*a*	*b*	*c*	*d*	*e*	**12.**	*a*	*b*	*c*	*d*	*e*
5.	*a*	*b*	*c*	*d*	*e*	**13.**	*a*	*b*	*c*	*d*	*e*
6.	*a*	*b*	*c*	*d*	*e*	**14.**	*a*	*b*	*c*	*d*	*e*
7.	*a*	*b*	*c*	*d*	*e*	**15.**	*a*	*b*	*c*	*d*	*e*
8.	*a*	*b*	*c*	*d*	*e*	**16.**	*a*	*b*	*c*	*d*	*e*

1] Determine the molar mass of a gas if 0.401 *L* weighs 1.55g at STP?

a) 69.3 g/mol *b)* 94.5 *g/mol* *c)* 86.6 *g/mol* *d)* 53.3 *g/mol* *e)* 43.3 *g/mol*

2] In a reaction of calcium metal with water, the volume of hydrogen gas collected at 50°C and pressure of 988 *mmHg* is 441 *mL*. What is the mass (*in grams*) of the hydrogen gas obtained? The vapor pressure of water at 50°C is 118 *mmHg*. (*Molar mass of* H_2=2.016 *g/mol*)

a) 0.0436g *b)* 0.0384g *c)* 0.0190g *d)* 0.0242g *e)* 0.0488g

3] Calculate the mass of calcium (in *g*) that must be dissolved in sulfuric acid in order to obtain 500*ml* of hydrogen gas at 20°C and 770 *mmHg*? (*Molar mass* of Ca = 40.08 *g/mol*)

$$Ca(s) + H_2SO_4(aq) \rightarrow CaSO_4(s) + H_2(g)$$

a) 1.38 g *b)* 0.0425 g *c)* 1.24 g *d)* 0.84 g *e)* 1.18 g

4] What is the kinetic energy of a *mole* of CO_2 at 200K (in *kJ*)?

a) 200 *kJ* *b)* 4.14x10^{-24} *kJ* *c)* 2.5x10^{-2} *kJ* *d)* 0.200 *kJ* *e)* 2.49 *kJ*

5] Which of the following is a wrong statement?

a) H_2 gas behaves more ideally than CO_2 gas

b) CO_2 (44 *g/mol*) effuses faster than N_2(g) (28 *g/mol*) at STP

c) At the same temperature molecules of a gas with low molar mass have higher average velocity than heavier molecules

d) Average kinetic energy depends only on temperature

e) Real gases behaves as ideal gases at low pressure and high temperature

$$u_{rms} = \sqrt{\frac{3RT}{MM}} = \sqrt{\ }$$

6] Calculate the root mean square velocity (u_{rms}) in (m/s) of CO_2 molecules in a sample of CO_2 gas at 1.0 °C [*molar mass* of CO_2 = 44.0 *g/mol*]

a) 394   *b*) 44.0   *c*) 1.24   *d*) 39.2   *e*) 12.5

7] A gas is allowed to expand, at constant temperature, from a volume of 3.0 L to 8.0 L against external pressure of 1.10 *atm*. If the gas absorbs 350 *J* of heat from the surroundings, then *ΔE* in *J*:

$q = +350\,J$

a) -345   *b*) +207   *c*) -907   *d*) +345   *e*) -207

$\Delta E = \Delta H - P\Delta V$

$\Delta E = q + w$ -5.5 $w = -P\Delta V$ $w = -1.10 \times (8-3)$ $\Delta V > 0$ $w = -$

8] Consider the combustion of isooctane C_8H_{18} (*Molar mass* = 114 *g/mol*):

$2\,C_8H_{18(l)} + 25\,O_2 \rightarrow 16CO_2 + 18H_2O_{(l)}$ $\Delta H = -10930$ kJ

Calculate the energy released when 105 g of isooctane are combusted in excess oxygen?

a) 2.19×10^4 *kJ* *b*) 1.01×10^4 *kJ* *c*) 5.03×10^3 *kJ* *d*) 2.52×10^3 *kJ* *e*) 2.01×10^4 *kJ*

$2 \rightarrow -10930$ $\Delta E = q + w$ $\Delta E = \Delta H - P\Delta V$ $\Delta H = H_p$

9] When 500.0 *mL* of 0.400 *M* $Ca(NO_3)_2$ is added to 500.0 *mL* of 0.800 *M* NaF, CaF_2 precipitates, as shown in the net ionic equation below. The initial temperature of both solutions is 20.00 *°C*. Assuming that the resulting solution has a mass of 1000.00 g and a specific heat of 4.18 *J/(g.°C)* calculate the final temperature of the solution.

$Ca^{2+}(aq) + 2F^-(aq) \rightarrow CaF_2(s)$ $\Delta H° = -11.5$ *kJ*

a) 18.90 *°C*   *b*) 20.00 *°C*   *c*) 19.45 *°C*   *d*) 20.55 *°C*   *e*) 21.10 *°C*

$Ca(NO_3)$ + NaF

500 mL   500 ml $m_{sol} = 1000$ g

0.400M   0.8 M   S = 4.18

20 °C

$q = ms\Delta T$ $2.395\times10^{-3} = \Delta T$ Tf =

$11.5 = 1000 \times 4.8 \times (T_f - 20)$

10] When 3.50 *g* of sucrose undergoes combustion in a *constant-volume* (Bomb) calorimeter, the temperature rises from 25.00 *°C* to 29.00 *°C*. Calculate *ΔH* for the combustion of sucrose in (*kJ/mol*) sucrose. The heat capacity of the calorimeter is 3.7 *kJ/°C*. The molar mass of sucrose is 342.3 *g/mol*.

$$C_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12CO_2(g) + 11H_2O(l)$$

ΔH = −

a) -5.07×10^3 (*b)*) -1.45×10^3 *c)* $+1.45 \times 10^3$ *d)* -1.48×10^1 *e)* $+1.48 \times 10^1$

$q = C\Delta T$
$= 3.7 \times (29 - 25)$
$= 14.8$ kJ

11] For the following reaction: $2C(s) + 2H_2O(g) \rightarrow CH_4(g) + CO_2(g)$ $\Delta H = ?$

Use the following information to find ΔH for the reaction above.

$CO(g) + H_2(g) \rightarrow C(s) + H_2O(g)$ $\Delta H = -131\ kJ$
$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ $\Delta H = -41\ kJ$
$CO(g) + 3H_2(g) \rightarrow CH_4(g) + H_2O(g)$ $\Delta H = -206\ kJ$

a) -378 *kJ* *b)* 116 *kJ* (*c)*) 15 *kJ* *d)* -116 *kJ* *e)* -372 *kJ*

$2C + 2H_2O \rightarrow 2CO + 2H_2$ $\Delta H = 2(131)$
$2CO + 2H_2O \rightarrow 2CO_2 + 2H_2$ $\Delta H = 2(-41)$
$CO + 3H_2 \rightarrow CH_4 + H_2O$ $\Delta H = -206$

12] Using the information below, calculate ΔH_f° for PbO(s) in kJ/mol.

$$PbO(s) + CO(g) \rightarrow Pb(s) + CO_2(g),\ \Delta H_{rxn}^\circ = -131.4\ kJ/mol$$

Molecules	ΔH°_f (*kJ/mol*)
CO(g)	-110.5
CO_2(g)	-393.5

$\Delta H^\circ_{rxn} = 1 \times \Delta H^\circ_f(CO_2) - \Delta H^\circ_f(CO) - \Delta H^\circ_f$ PbO
$-131.4 = -393.5 + 110.5 - \Delta H^\circ_f$ PbO

a) -413.9 *kJ* (*b)*) -151.6 *kJ* *c)* +372.1 *kJ* *d)* +413.9 *kJ* *e)* -372.1 *kJ*

$2C + 2H_2O \rightarrow 2CO + 2H_2$ $\Delta H = 2(131)$
$2CO + 2H_2O \rightarrow 2CO_2 + 2H_2$ $\Delta H = (-41)2$
$CO + 3H_2 \rightarrow CH_4 + H_2O$ $\Delta H = -206$

$2C + 2H_2O \rightarrow CH_4 + CO_2 + H_2$

$2C + 2H_2O \rightarrow 2CO + 2H_2$
$CO + H_2O \rightarrow CO_2 + H_2$
$CO + 3H_2 \rightarrow CH_4 + H_2O$

13] Use the given standard enthalpies of formation to calculate the *heat released per gram* $Fe_2O_3(s)$. *(molar mass of O=16.00 and Fe=55.85g/mol)*

$$3Fe_2O_3(s)+CO(g)\rightarrow 2Fe_3O_4(s)+CO_2(g)$$

Molecules	ΔH°_f *(kJ/mol)*
$Fe_2O_3(s)$	-824.2
$Fe_3O_4(s)$	-1118.4
$CO(g)$	-110.5
$CO_2(g)$	-393.5

a) -98.5 *kJ/g* *b)* 98.5 *kJ/mol* *c)* -101.9 *J/g* *d)* -98.5 *J/g* *e)* +101.9 *J/g*

14] Calculate the energy (in joules) of 1 mole of photons with a wavelength of 10.00×10^{-2} nm (X ray region).

a) 1.20×10^{9} *J* *b)* 1.99×10^{-24} *J* *c)* 1.99×10^{-15} *J* *d)* 3.30×10^{-39} *J* *e)* 1.20 *J*

15] Calculate the wavelength (λ) of the light emitted by a hydrogen atom during a transition of its electron from the energy level with $n = 2$ to the level with $n = 1$.

a) 1.0×10^{-9} nm *b)* 95.0 nm *c)* 122 nm *d)* 97.3 nm *e)* 103 nm

16] Calculate the frequency of a particle with mass = 1.00×10^{-26} *g* that is moving with a speed of 9.5×10^{2} *cm/s*.

a) 1.4×10^{12} s^{-1} *b)* 4.3×10^{19} s^{-1} *c)* 4.3×10^{16} s^{-1} *d)* 4.3×10^{14} s^{-1} *e)* 1.4×10^{9} s^{-1}