Instructor Name: ......د. الفقد يوسف......

Section: ...2 – 3...

أ، ب، ج

33 ب

Useful data: $N_A = 6.02 \times 10^{23}$/mol; $T(K) = T(°C) + 273$;

$R = 8.315$ J/mol.K = 0.0821 L.atm/mol.K; $u_{rms} = \sqrt{(3RT/M)}$

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

Q1) In the following reaction, which atom is oxidized?

$$8NaI + 5H_2SO_4 \rightarrow 4I_2 + H_2S + 4Na_2SO_4 + 4H_2O$$

a) Na b) H c) O d) I e) S

Q2) What mass of solute, in g, is contained in 356 mL of a 0.895 M ammonium chloride, NH_4Cl, solution? (Molar mass of NH_4Cl = 53.5 g/mol)

a) 12.3 b) 26.6 c) 17.0 d) 30.5 e) 21.8

Q3) A 51.24-g sample of Ba(OH)2 is dissolved in enough water to make 1.20 L of solution. How many mL of this solution must be diluted with water in order to make 1.00 L of 0.120 M Ba(OH)2? (Molar mass of Ba(OH)2 = 171.3 g/mol)

a) 643 b) 482 c) 278 d) 562 e) 401

Q4) Calculate the mass in g of cadmium sulfide, CdS, precipitated when 250.0 mL of 0.15 M $(NH_4)_2S$ solution is mixed with 120.0 mL of 0.063 M $CdSO_4$. Molar mass of CdS = 144.4 g/mol. The balanced equation for the reaction is:

$$(NH_4)_2S(aq) + CdSO_4(aq) \rightarrow CdS(s) + (NH_4)_2SO_4(aq)$$

a) 1.7 b) 1.3 c) 0.92 d) 1.5 e) 1.1

Q5) A 0.207-g sample of an unknown monoprotic acid is titrated to the end point using 35.2 mL of 0.106 M NaOH. Calculate the molar mass, in g/mol, of the acid.

a) 82.3 b) 136 c) 55.5 d) 151 e) 109

Q6) Calculate the number of moles of an ideal gas contained in a cylinder with volume of 1.81 L at a pressure of 177 atm and temperature of 25°C. → 25 + 273

a) 13.1 b) 16.5 c) 10.9 d) 14.6 e) 18.3

Q7) Calculate the density, in g/L, of CO_2 gas at 27 °C (T) and 0.70 atm (P) pressure. Molar mass of CO_2 = 44.01 g/mol.

a) 1.3 b) 0.21 c) 1.6 d) 0.89 e) 0.54

Q8) Which of the following statement about Kinetic Molecular Theory of gases is correct?

a) At a given temperature, molecules with a greater molar mass will have a higher average kinetic energy.
b) As the temperature of a gas increases, the average kinetic energy decreases.
c) The average kinetic energy of a gas is dependent on temperature, molar mass, and speed.
d) Molecules with a greater molar mass will have a higher speed.
e) The most probable speed increases as temperature increases.

$$\frac{r_1}{2r_2} = \sqrt{\frac{M_1}{M_2}}$$

Q9) What is the molar mass, in g/mol, of a gas that effuses through a small hole twice faster the rate of chlorine gas, Cl_2, at the same temperature? Molar mass of Cl_2 = 70.9 g/mol.

a) 38.5 b) 17.7 c) 14.2 d) 24.6 e) 64.0

Q10) Calculate the root-mean-squared speed, u_{rms}, of oxygen, O_2, molecules in a sample at 25°C. Molar mass of O_2 = 32.00 g/mol.

a) 442 m s^{-1} b) 681 m s^{-1} c) 515m s^{-1} d) 482 m s^{-1} c) 593 m s^{-1}

$\sqrt{3RT}$

Q11) Which one of the following statements is *false*?

a) The change in internal energy, ΔU, for a process is equal to the amount of heat absorbed at constant volume, q_v.
b) The change in enthalpy, ΔH, for a process is equal to the amount of heat absorbed at constant pressure, q_p.
c) If q_p for a process is negative, the process is exothermic.
d) The freezing of water is an example of an exothermic process.
e) Work is a state function.

Q12) Calculate the work, in (L . atm), associated with the expansion of a gas from 152.0 L to 189.0 L at a constant pressure of 16.0 atm.

a) -666 b) -518 c) -444 d) -592 e) -359

Q13) A 140.0-g sample of water at 25.0°C is mixed with 80.0 g of a certain metal at 100.0°C. After thermal equilibrium is established, the final temperature of the mixture is 29.6°C. What is the specific heat of the metal? Specific heat of water = 4.184 J/g°C.

a) 0.38 J/g°C b) 0.77 J/g°C c) 0.48 J/g°C d) 0.89 J/g°C e) 0.55 J/g°C

$q_1 = -q_2$

$m s \Delta t = -m s \Delta t$

$140 \times (29.6 - 25) = -80 \times 4.184 \times (29.6 - 100)$

Q14) The ΔH value for the reaction $(1/2)O_2(g) + Hg(l) \rightarrow HgO(s)$ is –90.8 kJ/mol. How much heat is released when 22.5 g Hg is reacted with excess oxygen? Molar mass of Hg = 200.6 g/mol.

a) -23.8 kJ b) -10.2 kJ c) -30.2 kJ d) -19.2 kJ e) -14.7 kJ

Q15) Determine the standard enthalpy change $\Delta H°_{rxn}$, in kJ/mol, for the reaction of of Fe_2O_3 with aluminum metal according to the equation:

$$Fe_2O_3(s) + 2Al(s) \rightarrow Al_2O_3(s) + 2Fe(l)$$

Given the following::

Substance	$\Delta H_f°$ kJ/mol
$Fe_2O_3(s)$	-825.5
$Al_2O_3(s)$	-1675.7
$Fe(l)$	12.4

a) -931.8 b) -657.1 c) -825.4 d) -460.0 e) -754.0

Q16) calculate the standard enthalpy change, $\Delta H°_{rxn}$, in kJ/mol, for the the following reaction:

$$2NO(g) + O_2(g) \rightarrow N_2O_4(g)$$

Using the following thermochemical data:

$$\tfrac{1}{2}\, N_2(g) + \tfrac{1}{2} O_2(g) \rightarrow NO(g) \qquad \Delta H° = 90.4 \text{ kJ/mol}$$
$$\tfrac{1}{2}\, N_2(g) + O_2(g) \rightarrow NO_2(g) \qquad \Delta H° = 33.8 \text{ kJ/mol}$$
$$2NO_2(g) \rightarrow N_2O_4(g) \qquad \Delta H° = -58.0 \text{ kJ/mol}$$

a) 171.2 b) –114.6 c) 114.6 d) -171.2 e) 88.6

كل الشكر للطالبه

انيسه ابو ارشيد

على حل الاسئله

Q1 :-

(d) I

Q2 :-

$$0.895 \frac{mol}{L} * 35.6L * \frac{53.5g}{mol}$$

(c) 17.0 g

Q3 :-

$M_i V_i = M_f \cdot V_f$

⇓

??

$$51.24g * \frac{mol}{171.3g} = 2991 \text{ (No. of mols of Solute)}$$

$$M_i = \frac{.2991}{1.20} = .249 \ mol/L$$

$$M_i V_i = M_f \cdot V_f \Rightarrow V_i = \frac{.249}{.120}$$

$$.249 \times V_i = .120 \times 1$$

$$= .481L \times 10^{+3} \frac{mL}{L}$$

(b) 482

Q4:-

$0.063 \frac{mol}{L} * ,120L * 144.4 \frac{g}{mol}$

(e) 1.1 g

Q5:-

$0106 \frac{mol}{L} * ,0352L = ,00373$ mol of NaOH which = No. of mols of acid

molar mass $= \frac{0.207}{,00373}$

(c) 55.5

Q6:-

$PV = nRT$

$(177)(1.81) = n\ (0.0821)(25+273)$

(a) 13.1

Q7 :-

$P * \text{molar mass} = d * R * T$

$(0.70)(44.01) = d\,(0.0821)(27+273)$

(a) 1.3

Q8 :-

(e)

Q9 :-

Supose that ⟹ Unknown gas has r_1

Cl_2 gas has r_2

From question $r_1 = 2r_2$.

$$\frac{r_1}{r_2} = \sqrt{\frac{\text{molar mass 2}}{\text{molar mass 1}}} \implies \frac{2r_2}{r_2} = \sqrt{\frac{\text{molar mass 2}}{\text{molar mass 1}}}$$

$4(\text{Molar mass}_1) = \text{Molar mass 2}$

$= 70.9$

$$\text{molar mass 1} = \frac{70.9}{4}$$

(b) 17.7 .

Q_{10} :-

(d) 482

$$\overline{U}_{rms} = \sqrt{\frac{3RT}{M}}$$

$$= \sqrt{\frac{3 * (0.0821) * (25 + 273)}{.032 \times 10^{-3}}}$$

Q_{11} :-

(e)

Q_{12} :-

$$W = -P\Delta U$$

$$W = -(16.0)(189.0 - 152.0)$$

(d) -592

Q13 :-

$$ms\Delta T = -ms\Delta T$$

$$80(s)(29.6-100) = -[140.0(4.184)(29.6-25.0)]$$

(c) $0.49\ J/g.^{\circ}C$

Q14 :-

$$22.5g * \frac{mol}{200.6g} = ,112\ mol$$

$$-90.8\ \frac{kJ}{mol} * ,112\ mol$$

(b) $-10.2\ kJ$

Q15 :-

$$\Delta H^{\circ}_{rex} = n\Delta H^{\circ}_{F}(Products) - m\Delta H^{\circ}_{f}(Reactant)$$

$$= 2(12.4) + (-167.7) - [-825.5]$$

(c) -825.4

Q16:-

		ΔH°
*-2	$[\frac{1}{2} N_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow NO_{(g)}$	90.4]
*2	$[\frac{1}{2} N_{2(g)} + O_{2(g)} \rightarrow NO_{2(g)}$	33.8]
	$2NO_{2(g)} \rightarrow N_2O_{4(g)}$	-58.0
	$2NO_{(g)} \rightarrow N_{2(g)} + O_{2(g)}$	-180.8
	$N_{2(g)} + 2O_{2(g)} \rightarrow 2NO_2$	67.6
	$2NO_{2(g)} \rightarrow N_2O_{4(g)}$	-58.0

$2NO_{(g)} + O_{2(g)} \rightarrow N_2O_{4g}$

(d) -171.2

12

CHEMISTRY 101 **Second EXAM** **DEPARTMENT OF CHEMISTRY**

70 MIN December 6 , 2014

NAME ابيه احمد محمود رزق SECTION ..... REGISTRATION No. 0139762

1)	a	b	c	**X**	e	f	14)	a	b	**X**	d	e	f
2)	a	**X**	c	d	e	f	15)	a	b	c	d	**X**	f
3)	**X**	b	c	d	e	f	16)	a	b	c	d	e	**X**
4)	a	b	**X**	d	e	f	17)	a	b	c	d	**X**	f
5)	a	**X**	c	d	e	f	18)	a	**X**	c	d	e	f
6)	a	b	c	d	**X**	f	19)	a	b	**X**	d	e	f
7)	a	b	c	**X**	e	f	20)	**X**	b	c	d	e	f
8)	**X**	b	c	d	e	f	21)	a	b	c	**X**	e	f
9)	a	b	c	d	e	**X**	22)	a	b	**X**	d	e	f
10)	a	b	c	**X**	e	f	23)	a	b	c	**X**	e	f
11)	a	b	**X**	d	e	f	24)	a	**X**	c	d	e	f
12)	a	b	c	**X**	e	f	25)	a	b	c	**X**	e	f
13)	**X**	b	c	d	e	f	26)	a	b	c	**X**	e	f

Answer each of the following questions and put X on the correct choice on the front page:

1) Calculate the molarity of a solution of 7.57 g of methanol (CH_3OH, Molar mass = 32.0 g/mol) in 1.50×10^2 mL of solution.

a) 0.952 b) 1.16 c) 1.37 (d) 1.58 e) 1.79 f) 1.99

$$M = \frac{m/\mu_m}{V} = \frac{7.57/32.0}{1.50 \times 10^2 \times 10^{-3}} = 1.58$$

2) Calculate the volume (in mL) of 5.0 M solution H_2SO_4 that are required to prepare 453 mL 0.32 M H_2SO_4 solution

a) 27 (b) 29 c) 31 d) 33 e) 35 f) 37

$M_1 = 5.0$ $V_1 = 45.0$ ml M_2 $M_1V_1 = M_2V_2$ $5.0 \times 45 = 0.32 \times V_2$

$$V_2 = \frac{5.0 \times 453 \times 10^{-3}}{0.32} \quad \frac{0.32 \times 453}{5.0} = 28.9$$

3) Calculate the concentration (in M) of 50.0 mL of H_2SO_4 solution which is needed to neutralize 39.12 mL of 0.1510 M NaOH solution

$$H_2SO_4(aq) + 2\,NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2\,H_2O(aq)$$

$M_{H_2SO_4}$ $V = 50.0$ $M_{NaOH} =$

(a) 0.0476 b) 0.0500 c) 0.0523 d) 0.0550 e) 0.0571 f) 0.0591

$M \times \frac{n}{V} = n = MV = 0.1510 \times 39.12 = 5.91$ $n = 12$ $\frac{12}{50.0 \times 10^{-3}} = 11.8$ $M = \frac{12}{50.0} = 0.024$

4) A sample of 0.676 g of a solution containing Ba^{2+} ions is treated with an excess Na_2SO_4 to produce 0.3605 g $BaSO_4$ precipitate. What is the percent by mass (%) of Ba^{2+} in the original sample?

(Molar mass of Ba = 137.3 g/mol and for $BaSO_4$ = 233.4 g/mol)

a) 23.5 b) 27.0 (c) 31.4 d) 35.7 e) 40.1 f) 44.4

Ba % = $\frac{137.3}{233.4} \times 100\% = 58.8\%$

mass Ba = $58.8 + 0.3605 = 59.2$ 21.1

mass % = $\frac{59.2}{0.676} \times 100\%$

5) When the reaction $Fe^{2+}_{(aq)} + H^+_{(aq)} + MnO_4^-{}_{(aq)} \rightarrow Fe^{3+}_{(aq)} + Mn^{2+}_{(aq)} + H_2O_{(l)}$ is balanced in acidic solution, the coefficient of Mn^{2+} is $Fe^{2+} + H^+ \rightarrow Fe^{3+}$

a) 1 (b) 2 c) 3 d) 4 e) 5 f) 8

$MnO_4^- \rightarrow Mn^{2+} + H_2O$

$0 = 2 +$ 10

6) Which of the following statements is correct about Boyle's law?

a) $\frac{V}{T}$ = constant b) $\frac{P}{V}$ = constant c) $\frac{V}{P}$ = constant

d) $\frac{V}{n}$ = constant (e) PV = constant f) $\frac{T}{V}$ = constant

Boyles

Which of the following is **not** an assumption of the kinetic molecular theory of gases:

a) The collisions between molecules are elastic.
b) The gas molecules are in constant motion.
c) The volumes of the gas molecules are negligible compared with the volume of the container.
d) The gas molecules are in rapid motion.
e) There are neither attractions nor repulsions between gas molecules.
f) At a constant temperature, all the molecules have the same speed.

) The standard temperature and pressure (STP) refers to

a) 273 K and 1 atm b) 298 K and 1 atm c) 298 K and 1 mmHg
d) 273 K and 1 pascal e) 273 K and 1 mmHg f) 273 F and 1 atm

) How many moles of gas are there in a 45.0 L container at 25.0 °C and 590. mmHg? (760. mmHg = 1.00 atm, R = 0.0821 L·atm·mol^{-1}·K^{-1}, T(K) = T(C) +273)

a) 1.21 b) 1.28 c) 1.33 d) 1.38 e) 1.43 f) 1.48

) Calculate the density of NO_2 gas (g/L) in a tank at 1.5 atm and 5.0 °C (molar mass of NO_2 = 46.0 g/mol, R = 0.0821 L atm mol^{-1} K^{-1})

a) 1.8 b) 2.2 c) 2.6 d) 3.0 e) 3.4 f) 3.8

) Which of the following gases will have the greatest rate of effusion at a given temperature? Molar mass: NH_3 = 17, CH_4 = 16, Ar = 40., HBr = 81.0, HCl = 36.5, N_2 = 28.0 g/ mol

a) NH_3 b) CH_4 c) Ar d) HBr e) HCl f) N_2

) Calculate the root-mean-square speed (u_{rms}) of CO in (m/s) at 25°C (Molar mass of CO = 28.0 g/mol, R = 8.314 J mol^{-1} K^{-1}, $u_{rms} = \sqrt{\frac{3RT}{\mathcal{M}}}$)

a) 682 b) 612 c) 515 d) 482 e) 442 f) 411

13) C_2F_4 (Molar mass = 100.0 g/mol), effuses through a small opening at a rate of 4.6×10^{-6} mol/h. An unknown gas effuses at a rate of 5.8×10^{-6} mol/h under the same conditions. What is the molar mass of the unknown gas (in g/mol)?

$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$

a) 63 b) 53 c) 40. d) 35 e) 27 f) 22

$0.62 = \frac{100.0}{M_2}$

$M_2 = \frac{100}{0.62}$ 1.6.

$\left(\frac{4.6 \times 10^{-6}}{5.8 \times 10^{-6}}\right)^2 = \left(\sqrt{\frac{100.0}{1000}}\right)^2$

14) Which of the following conditions will give lowest deviation from ideal gas behavior?

a) 100.0°C and 40. atm b) 0.0°C and 20. atm c) 100.0°C and 1.0 atm
d) -100.0°C and 40. atm e) -100.0°C and 20. atm f) -100.0°C and 1.0 atm

15) Which one of the following conditions would always result in an **increase** of the internal energy of a system?

$E = q + w$

a) The system loses heat and does work on the surrounding
b) The system gains heat and does work on the surrounding
c) The system loses heat and work is done by the surrounding on the system
d) The system loses heat without doing any work
e) The system gains heat and work is done by the surrounding on the system
f) The system does work on the surrounding

16) For which one of the following reactions will ΔH equal to ΔU?

Solid — L

a) $H_2O(l) \longrightarrow H_2O(g)$
b) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$
c) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$
d) $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$
e) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$
f) $H_2O(s) \longrightarrow H_2O(g)$

) Calculate the enthalpy change (in kJ/mol) for the reaction

$$NO(g) + O(g) \longrightarrow NO_2(g)$$

from the following data:

$NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$ $\Delta H = -198.9$ kJ

$O_3(g) \longrightarrow 1.5O_2(g)$ $\Delta H = -142.3$ kJ

$O_2(g) \longrightarrow 2O(g)$ $\Delta H = 495.0$ kJ

NO

$\Delta H = -198.9 - (-495)$

$2O(g) \longrightarrow O_2 = -495$

a) -324.1 b) -304.1 c) -284.1 d) -264.1 e) -294.1 f) -309.1

296.1

306.1

18) Calculate the $\Delta H°_{rxn}$ (in kJ/mol) for the following reaction.

-1003.2 -905.8

$\Delta H =$ ☐ − ☐

$SiO_2(s) + 4HCl(g) \longrightarrow SiCl_4(g) + 2H_2O(g)$

1909.

97.4

$\Delta H°_f [SiO_2(s)] = -910.9$ kJ/mol; $\Delta H°_f [SiCl_4(g)] = -657.0$ kJ/mol;

$\Delta H°_f [HCl(g)] = -92.3$ kJ/mol; $\Delta H°_f [H_2O(g)] = -248.8$ kJ/mol

161.5 b) 179.5 c) 147.5 d) 155.5 e) 139.5 f) 125.5

19) Calculate the heat of neutralization (kJ/mol) when 50.0 mL of 0.500 *M* HCl at 25.0°C is added to 50.0 mL of 0.500 *M* NaOH at 25.0°C in a coffee cup calorimeter, the temperature of the mixture rises to 28.7°C. Assume that the mixture has a specific heat of 4.18 J/g·°C, the density of the reaction solution is 1.00 g/mL, and the calorimeter has negligible heat capacity.

$M_1 V_1 T$

a) -41.8 b) -43.5 c) -51.8 d) -55.2 e) -61.9 f) -65.2

$M V, T$

t, d

20) Which of the following is **not** state function?

a) enthalpy b) heat c) temperature d) volume e) energy f) pressure

21) Calculate the heat (in kJ) released from the reaction of 75.0 g of Cl_2 (Molar mass of Cl_2 = 70.9 g/mol) with enough amount of H_2 according to the following reaction:

$H_{2(g)} + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$ $\Delta H = -372$ kJ/mol

a) 131 b) 184 c) 236 d) 288 e) 341 f) 394

-372

ΔH

m molar

$n = \frac{75.0}{70.9}$

1.03

22) What is the wavelength (in nm) of radiation that has a frequency of $6.11 \times 10^{14}\ s^{-1}$?
($C = \lambda v = 3.00 \times 10^8$ m/s) $\lambda = \frac{c}{v} = \frac{3.00 \times 10^8}{}$ $\lambda =$

a) 434 b) 461 c) 491 d) 516 e) 554 f) 587

23) What is the energy (in J) of one photon of microwave radiation with a wavelength 0.211 m?
($h = 6.63 \times 10^{-34}$ J s, $E = h\nu$, $c = 3.00 \times 10^8$ m/s, $c = \lambda\nu$) $E = h\nu$ $c = \lambda\nu$ $\nu =$

a) 1.09×10^{-24} b) 1.31×10^{-24} c) 1.63×10^{-24}
d) 9.43×10^{-25} e) 8.25×10^{-25} f) 7.62×10^{-25}

$\frac{3.00 \times 10^8}{0.211}$

24) Atoms emit visible and ultraviolet light when

$6.63 \times 10^{-34} \times 1.5 \times 10^{8}$ (V) 1.5×10^{8}

99.4×10^{-26}

a) electrons drop from higher energy levels to lower levels.
b) electrons jump from lower energy levels to higher levels.
c) the atoms condense from a gas to a liquid.
d) they are heated and the solid melts to form a liquid.
e) the electrons move about the atom within an orbit.
f) the electrons move around the nucleus of an atom.

25) Calculate the energy (in J) of the photon accompanied by moving an electron in a hydrogen atom from the n = 6 to the n = 3 principal energy levels. ($E_n = -2.18 \times 10^{-18}$ J$(1/n^2)$)

a) -2.08×10^{-19} b) -1.55×10^{-19} c) -1.82×10^{-19}
d) -1.02×10^{-19} e) -4.84×10^{-19} f) -5.01×10^{-19}

$= \frac{-2.18}{36 - 9}$

-1.02

26) In the hydrogen atom, which of the following transitions will result in the emission of the lowest energy photon?

a) n = 4 → n = 1 b) n = 5 → n = 1 c) n = 3 → n = 1
d) n = 2 → n = 1 e) n = 7 → n = 1 f) n = 6 → n = 1

H_1^1 ZERO

2 → 1

Q1: Molarity $M = \frac{n \text{ mols solute}}{\text{L solution}}$

$n = \frac{2.53}{320} = 0.2366$ mols

$L = 150$ ml

$M = \frac{0.2366}{150 \times 10^{-3}}$

$= 1.58$ which is d

Q2: $M_1 V_1 = M_2 V_2$

$V_1 = \frac{M_2 V_2}{M_1} \Rightarrow \frac{0.32 \times 453}{5} \approx 29$ which is b

---

Q3: mols $NaOH = 0.151 \times 3912 \times 10^{-3} = 591 \times 10^{-3}$

$\frac{1}{2} = \frac{\text{mol } H_2SO_4}{\text{mol } NaOH} \Rightarrow$ mols $H_2SO_4 = 2.95 \times 10^{-3}$

$M = \frac{2.95 \times 10^{-3}}{50 \times 10^{-3}} = 0.0591$ which is f

---

Q4 ~~Ba %~~ $= \frac{137.3}{233.4}$ ~~55.8%~~

mol $Ba^{+2} = \frac{\text{mass}}{Mm} = \frac{0.3609}{233.4} = 0.095$

mass $Ba^{+2} = 0.095 \times 137.3 = 0.2059$

mass percentage $= \frac{0.2059}{0.676} \times 100\% = 31.9$

Q5 $MnO_4^- \rightarrow Mn^{+2} + 4H_2O$ | $Fe^{+2} + H^+ \rightarrow Fe^{+3}$

$O = 2+$ "

hence solution is b) 2

Q6: solution is e) PV = constant.

Q7: solution is d) The gas molecules are in prabid motion

Q8) the solution is a) 273 K and 1 atm

Q9) $T = 25 + 273 = 298$, $P = \frac{590}{760} = 0.776$ atm

$PV = nRT \Rightarrow n = \frac{PV}{RT} = \frac{0.776 \times 45}{0.0821 \times 298} = 1.43$

Q10: $T = 5 + 273 = 278K$, $P = 1.5$, $M_m = 46$

$M_m = \frac{dRT}{P} \Rightarrow d = \frac{M_m P}{RT} = 3$

Q11: greatest rate of effusion is always for the molecule with smallest molar mass

which is CH_4

Q12:

$$U_{rms} = \sqrt{\frac{3RT}{M_m}} = \sqrt{\frac{3 \times R \times 298}{28 \times 10^{-3}}} = 515$$

which is c

$T = 25 + 273 = 298$

$M_m = 28$

Q13: $\frac{4.6 \times 10^{-6}}{5.8 \times 10^{-6}} = \frac{\sqrt{x}}{\sqrt{100}}$

$\sqrt{x} = \sqrt{100} \times 0.793$

$x = 63$

Q14: • solution is c) 100. C and 1.0 atm

Q15: the solution is ~~e) None~~

e) the system gains heat heat and work is done by the surrounding on the system

Q16: A solution is f) $H_2O_{(s)} \rightarrow H_2O_{(g)}$

Q17:

$NO_{(g)} + O_{3(g)} \rightarrow NO_{2(g)} + O_{2(g)}$

$O_{3(g)} \rightarrow 1.5\, O_{2(g)}$

$O_{2(g)} \rightarrow 2O_{(g)}$

$2O_{(g)} \rightarrow O_2 = -495$

$\Delta H = -198.2 - (-495) = 294.1 \rightarrow -294.1$

which is e

Q18: ~~$\Delta H_f = -1003.2 - (-905.8) = 97.4$~~

$\Delta \Sigma H_f$ products $= -657 + -248.8 \times 2$

ΣH_f reactants $= 4 \times -92.3 + 910.9$

$\Delta H_{rxn} = \Delta \Sigma H_f$ products $- \Sigma H_f$ reactants

$= 125.5\ kJ/mol$ which is f

Q19: e) -0.9

Q 20: solution is b) heat

Q 21:

$$75\,g \times \frac{1\,mol}{70.9\,g} \propto \frac{-372\,KJ}{1\,mol} = -394\,KJ$$

which means 394 KJ released which is f

Q 22: $c = \lambda \nu \Rightarrow 3\times10^{8} = \lambda \times 6.11\times10^{14}$

$$\lambda = \frac{3\times10^{8}}{6.11\times10^{14}} = 491\times10^{-9}$$

which is c

Q 23: $\lambda = 0.211$, $h = 663\times10^{-34}$, $c = 3\times10^{8}$

$\lambda \nu = c \Rightarrow \nu = \frac{c}{\nu}$

$E = h\nu \Rightarrow \frac{hc}{\nu} = \frac{6.63\times10^{-34}\times3\times10^{8}}{0.211} = 9.43\times10^{-25}$

which is d

Q24: solution is

a) electrons drop from higher energy levels to lower levels

Q25) $E_{energy} = \frac{E_0}{n_2^2 - n_1^2} = \frac{2.18 \times 10^{-18}}{36-9} = -8.084 \times 10^{-}$

$E_{energy} = E_n \left(\frac{1}{n_2^2} - \frac{1}{n_1^2}\right) = 2.18 \times 10^{-18} \times \left(\frac{1}{36} - \frac{1}{5}\right) = 9.82 \times 10^{-20}$

which is $\leq$

Q26: d) $n=2 \rightarrow n=1$

General Chem. 101 ***Second Exam*** **11/12/2011** **60 min.**

Name: ..... Reg. No.: .....

Instructor and time..... Seat No. .....

Ideal gas equation: $PV = nRT$; $E_{photon} = h\nu$; $N = 6.022 \times 10^{23}\ mol^{-1}$;
R(gas constant) = 0.08206 atm.L / mol.K ; h(Planck's constant) = 6.63×10^{-34} J.s
c(speed of light) = 3.00×10^{8} m/s ; E (for H atom) = $-(2.18 \times 10^{-18}/n^2)$ J ;
One nm = 10^{-9} m. ; $\lambda = h/mv$; $c = \nu\lambda$. atm.L =101.3 J

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. The volume of a certain amount of a gas is 8.80 L at 127 °C and at pressure of 2.00 atm, calculate its volume at 27 °C and 6.00 atm.

a) 6.60 L b) 4.40 L c) 3.30 L d) 2.64 L e) 2.20 L

2. Calculate the density of CO_2 gas (in g/ L) at 25°C and 1.60 atm. Molar mass of CO_2 is 44.0 g/mol.

a) 2.52 b) 2.70 c) 2.88 d) 2.10 e) 2.34

3. A sample of 1.40 g of a vapor occupies 0.559 L at 97°C and 0.967 atm. Calculate the molar mass of the compound.

a) 98.3 b) 78.6 c) 124 d) 144 e) 112

4. A mixture of 0.260 moles O_2 and 0.540 moles N_2 has a total pressure of 4.00 atm. Calculate the partial pressure of O_2 in the mixture.

a) 1.30 atm b) 2.60 atm c) 3.25 atm d) 0.980 atm e) 1.95 atm

5. For the following gases (given molar masses):

$F_2(38)$, $Cl_2(71)$, $O_2(32)$ and $CO_2(44)$

The order of increasing rate of effusion is:

a) $F_2 < Cl_2 < CO_2 < Cl_2$ b) $Cl_2 < F_2 < CO_2 < O_2$

c) $Cl_2 < O_2 < F_2 < CO_2$ d) $CO_2 < O_2 < F_2 < Cl_2$

e) $Cl_2 < CO_2 < F_2 < O_2$

6. According to kinetic molecular theory, which of the following statements is **correct**?

a) At same temperature gases with larger molar masses have lower average kinetic energies.
b) The volume occupied by an ideal gas particles cannot be neglected.
c) The pressure of the gas is due to the collisions of the gas particles with the walls of the container.
d) Ideal gas particles repel each other, but do not attract each another.
e) All above statements are wrong.

7. A gas is allowed to expanded from an initial volume of 2.00 L to a final volume of 11.00 L under a constant external pressure of 5.00 atm. The value of work, w , is;

a) -1.82×10^3 J b) -5.79×10^3 J c) -2.74×10^3

d) -3.65×10^3 J e) -4.56×10^3 J

8. Which one of the following reactions has ΔH equals to ΔE?

a) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
b) $H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$
c) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
d) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
e) $H_2O(l) \rightarrow H_2O(g)$

9. 50.0 mL of 0.500 M HCl at 25.0°C is added to 50.0 mL of 0.500 M NaOH at 25.0°C in a coffee cup calorimeter, the temperature of the mixture rises to 28.2°C. What is ΔH of neutralization per mole H_2O produced? Assume the mixture has a specific heat of 4.18 J/g·°C and a density of 1.00 g/mL . Assume the calorimeter to have zero heat capacity.

a) −54 kJ/mol b) −57 kJ/mol c) − 52 kJ/mol
d) − 55 kJ/mol e) − 59 kJ/mol

10. Given the following thermochemical equations:

$NO(g) + O_3(g) \rightarrow NO_2(g) + O_2(g)$, $\Delta H = -198.9$ kJ/ mol
$O_3(g) \rightarrow 1.5O_2(g)$, $\Delta H = -140.3$ kJ /mol
$O_2(g) \rightarrow 2O(g)$ $\Delta H = +495.0$ kJ /mol

Calculate the enthalpy change for the reaction: $NO(g) + O(g) \rightarrow NO_2(g)$

a) −302.1 kJ/mol b) −304.1 kJ/mol c) −308.1 kJ/mol
d) −306.1 kJ/mol e) −300.1 kJ/mol

11. Use the following data to calculate the standard enthalpy of formation, $\Delta H°_f$, of manganese(IV) oxide, MnO_2 (*s*), in kJ/mol.

$2MnO_2(s) \rightarrow 2MnO(s) + O_2(g)$ $\Delta H = +264$ kJ/mol
$MnO_2(s) + Mn(s) \rightarrow 2MnO(s)$ $\Delta H = -248$KJ/mol

a) −505 b) −512 c) −508 d) −516 e) −527

12. What is the wavelength of a photon of electromagnetic radiation whose frequency is 4.20×10^{15} Hz.

a) 71.4 nm b) 32.6 nm c) 98.4 nm d) 51.7 nm e) 41.7 nm

13. Calculate the wavelength of the wave associated with a proton (mass $= 1.67 \times 10^{-24}$ g.) moving at a speed of 1.90×10^3 m/s

a) 0.426 nm b) 0.209 nm c) 0.153 nm d) 0.137 nm e) 0.180 nm

14. Calculate the frequency (in Hz) of the electromagnetic radiation emitted by the hydrogen atom in undergoing a transition from the $n = 5$ level to the $n = 3$ level.

a) 2.74×10^{14} b) 7.64×10^{14} c) 1.60×10^{14} d) 2.34×10^{14} e) 2.98×10^{14}

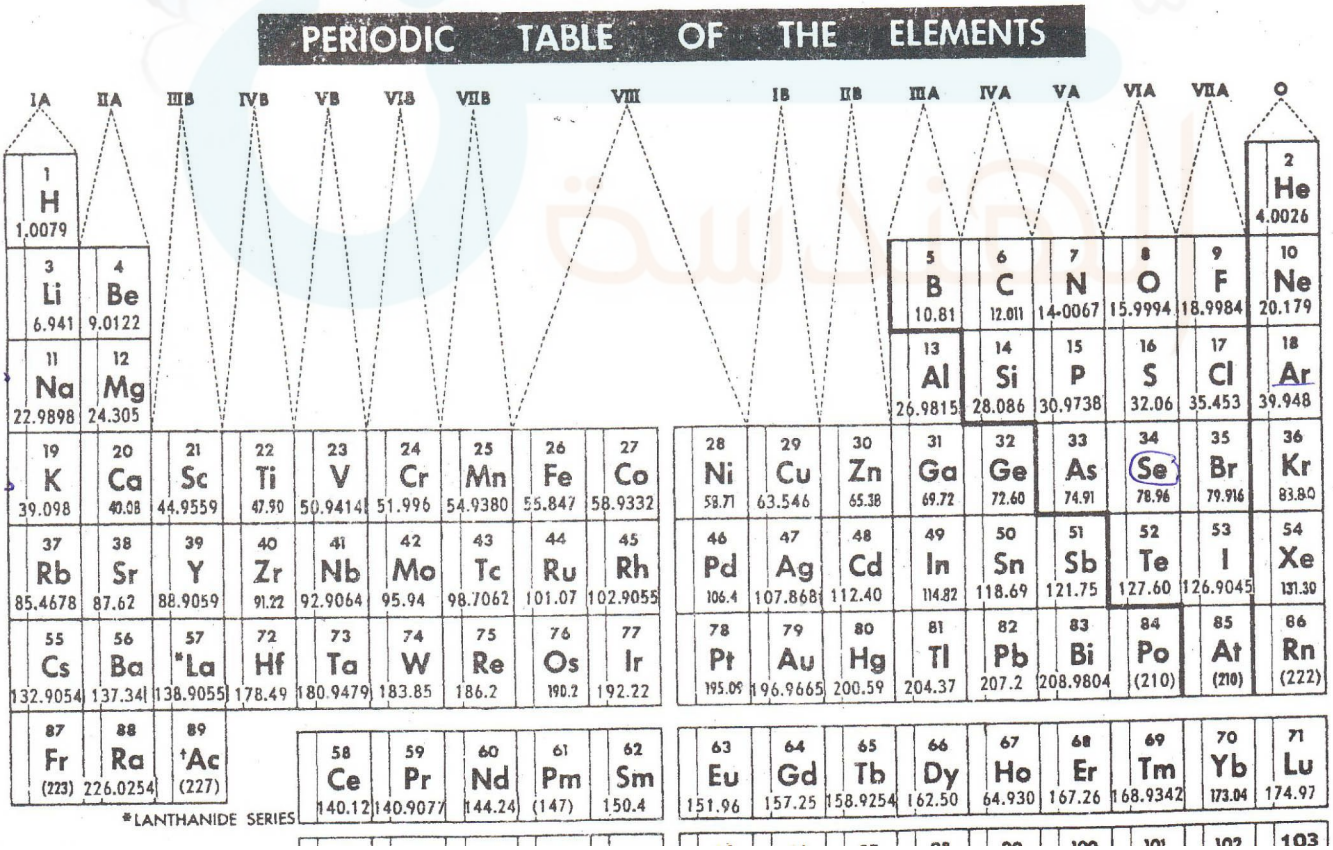
15. Which one of the following sets of quantum numbers is **not acceptable**?

a) $n=4,\ l=3,\ m_l=-3,\ m_s=+1/2$
b) $n=4,\ l=2,\ m_l=+2,\ m_s=-1/2$
c) $n=4,\ l=4,\ m_l=+2,\ m_s=+1/2$
d) $n=4,\ l=0,\ m_l=0,\ m_s=-1/2$
e) $n=4,\ l=1,\ m_l=0,\ m_s=+1/2$

16. Which of the following is the correct electronic configuration of Se(Z=34)?

a) $[Ar]\ 3d^{10}\ 4p^6$ b) $[Kr]\ 4s^2\ 3d^{10}\ 4p^4$ c) $[Ar]\ 4s^2\ 4p^4\ 4d^{10}$

d) $[Ar]\ 4s^2\ 3d^{10}\ 4p^4$ e) $[Ne]\ 4s^2\ 3d^{10}\ 4p^4$



Solution:

1. $P_1 = 2atm$, $P_2 = 6atm$

$T_1 = 127+273 = 400 K^\circ$

$T_2 = 27+273 = 300 K^\circ$

$V_1 = 8.80L$, $V_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \boxed{V_2 = 2.20L}$$ (e)

2. $T = 25+273 = 298 K^\circ$

$$d = \frac{M_w P}{RT} = \frac{44*1.6}{0.0821*298} = \boxed{2.878}$$ (c)

3. $$M_w = \frac{mRT}{PV} = \frac{1.4*0.0821(47+273)}{0.067*0.559}$$

$$= \boxed{78.6}$$ (b)

4. $$X_{O_2} = \frac{n_{O_2}}{n_{O_2}+n_{N_2}} = 0.8$$

$$P_{O_2} = X_{O_2} + P_{total} = \boxed{1.3\ atm}$$ (a)

5. M_w (كلما كبيرة كلما) effusion

$Cl_2 < CO_2 < F_2 < O_2$ (e)

6. (c)

7. $V_1 = 2l$, $V_2 = 11L$, $P = 5atm$

$$W = -P\Delta V = -5(11-2)$$

$$= -45\ atm\cdot L = -4.56*10^3 J$$ (e)

8. تفاعل احتراق $\Rightarrow CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (c)

9. $HCl + NaOH \rightarrow NaCl + H_2O$

$V_1 = 50ml = 0.05L$, $V_2 = 50ml = 0.05L$

$M = 0.5$, $M = 0.5$

$\Delta T = (28.2-25) = 3.2^\circ$, $\Delta H = ??$

$C = 0$, $SP = 4.18$

$$\Delta H = (SP*m*\Delta T) + (C*\Delta T) = 4.18*100*3.2$$

$$= 1.337 kJ = -1.337 KJ$$ (exothermic)

$m = d * V_{total} = 1*(50+50) = 100g$

* HCl & NaOH L.R (حد حاجز).

$n_{H_2O} = n_{HCl} = M*V = 0.5*0.05 = 25*10^{-3} mol$

$25*10^{-3} mol \rightarrow 1.337 kJ$

$1 mol \rightarrow X\ kJ \Rightarrow X = -54 kJ$ (a)

10. $NO + O_3 \rightarrow NO_2 + O_2$, $\Delta H = -198.9$

$O_3 \rightarrow 1.5 O_2$, $\Delta H = -1403$

$O_2 \rightarrow 2O$, $\Delta H = 495$

$NO + O_3 \rightarrow NO_2 + O_2$, $\Delta H = -198.9$

$1.5 O_2 \rightarrow O_3$ عكسنا المعادلة $\Delta H = +140.3$

$O \rightarrow 0.5 O_2$ ضربنا ½ وعكسنا المعادلة. $\Delta H = -247.5$

$$\Delta H_{total} = -198.9 + 140.3 - 147.5$$

$$= -306.1 kJ/mol$$ (d)

11. $-512 = \Delta H_f^\circ$ (b)

12. $C = \lambda * V = 3*10^8$, $\lambda = \frac{c}{V} = \frac{3*10^8}{4.2*10^{15}}$

$= 71.4 nm$ (a)

13. $$\Delta E = A\left[\frac{1}{n_f^2} - \frac{1}{n_i^2}\right] = 2.178*10^{-8}\left[\frac{1}{5^2} - \frac{1}{3^2}\right]$$

$$V = \frac{\Delta E}{h} = \frac{-1.5*10^{-9}}{6.626*10^{-34}} = -2.33*10^{24}$$

13. $V = 1.9 \times 10^{3}$, $m = 1.67 \times 10^{-27}$ kg

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{1.67 \times 1.9 \times 10^{3}} = 2.08 \times 10^{-10} \text{ m}$$

15 $n = 4$, $L = 4$, $m_l = 2$, $m_s = +\frac{1}{2}$

ⓒ

{لا يمكن ان تكون قيمة (L) مساوية لقيمة (n)}

16

ⓓ

$$\{[Ar]^{18}\ 4s^2\ 3d^{10}\ 4p^4\}$$

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 = 0.082057L.atm/(K.mol) = 8.314J/(K.mol), L.atm = 101.3J, $N_A = 6.022\times10^{23}$, $h = 6.63\times10^{-34}$ J.s, $R_H = 2.18\times10^{-18}$ J,

$c = 3\times10^8$ m/s, $PV = nRT$, $u_{rms} = \sqrt{\overline{u^2}} = \sqrt{\frac{3RT}{M}}$, $KE = \frac{3}{2}RT = N_A(\frac{1}{2}m\overline{u^2})$, $\Delta E = \Delta H - P\Delta V$

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

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℃ 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℃ is 118 *mmHg*. (*Molar mass of* H_2=2.016 *g/mol*)

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

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℃ 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*) 4.14×10^{-24} *kJ* *c*) 2.5×10^{-1} *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

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*:

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

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*

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.

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

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

10] When 3.50 *g* of sucrose undergoes combustion in a *constant-volume* 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*.

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

a) -5.07×10^{3} *b*) -1.45×10^{3} *c*) $+1.45\times10^{3}$ *d*) -1.48×10^{1} *e*) $+1.48\times10^{1}$

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*

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

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

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) $1.20\times10^{9}\ J$ *b*) $1.99\times10^{-24}\ J$ *c*) $1.99\times10^{-15}\ J$ *d*) $3.30\times10^{-39}\ J$ *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) $1.4\times10^{12}\ s^{-1}$ *b*) $4.3\times10^{19}\ s^{-1}$ *c*) $4.3\times10^{16}\ s^{-1}$ *d*) $4.3\times10^{14}\ s^{-1}$ *e*) $1.4\times10^{9}\ s^{-1}$

Q1 T = 273K P = 1 atm, V = 0.4L

$PV = nRT \Rightarrow n = \frac{PV}{RT} = 1.785 \times 10^{-2}$

$M = \frac{m}{n} = \frac{1.55}{1.785 \times 10^{-2}} = 86.6\ g/m$

Q2: $P_{tot} = P_{H_2O} + P_{H_2}$

$988 = 118 + P_{H_2} \Rightarrow P_{H_2} = 870\ mmHg = 1.145\ atm$

$PV = nRT \Rightarrow n = \frac{PV}{RT} = 0.024$

$mass = n \times m = 0.024 \times 2.016 = 0.0488$

Q3 $Ca + H_2SO_4 \rightarrow CaSO_4 + H_2$

1 mol Ca → 1 mol H_2SO_4

$P = \frac{720}{760}$

$T = 20 + 273$

$V = 0.5$

$mols\ Ca = \frac{PV}{RT} = 0.0210\ mols$

$grams\ of\ Ca = 0.020 \times 40.08 = 0.84\ g$

Q4: $KE = \frac{3}{2} RT = \frac{3}{2} \times 200 \times 8.314 = 249\ kJ$

Q9) b) CO_2(44g/m) effuses faster than N_2(g) (28g/m) at STP

Q5: $T = 10 + 273 = 274$, $R = 8.314$

$$V_{rms} = \sqrt{\frac{3RT}{M_m}} = 12.5$$

Q7: q = heat absorbed = 350

$$W = -P\Delta V = -1.1 \times (8-3) = 1.1 \times (5) = -5.5 \text{ L-atm}$$

$$= -5.5 \times 101 = -555.5$$

$$\Delta E = q + W = -207$$

Q8: mols C_8H_{18} $n = \frac{105}{114} = 0.921$

2 mols $\rightarrow$ 10930 KJ

0.921 mols $\rightarrow$ x KJ

$$\frac{2}{0.921} = \frac{10930}{x} \Rightarrow$$

$$x = \frac{0.921}{2} \times 10930 \text{ KJ}$$

$$x = 5.03 \times 10^3 \text{ KJ}$$

Q10: $q_{rxn} = C\Delta t = -3.7 \times (29-225) = +14.8$

$\Delta H = \frac{1\ mol}{} \times \frac{342.3\ g}{1\ mol} \times \frac{+14.8\ KJ}{3.5\ g} = -1.45 \times 10^{-3}\ KJ/mol$

Q11: equations become:-

$2C + 2H_2O \rightarrow 2CO + 2H_2 \quad \Delta H = +262\ KJ$

$CO + H_2O \rightarrow CO_2 + H_2 : \Delta H = -41\ KJ$

$CO + 3H_2 \rightarrow CH_4 + H_2O : \Delta H = -206\ KJ$

↓

$2C + 2H_2O \rightarrow CH_4 + CO_2 : \Delta H = +15\ KJ$

Q12: $(PbO - 110.5) - (0 - 393.5) = +131.4$

$\Delta H_f\ PbO = -151.6\ KJ$

Q 13: $\Delta H = (2 \times -1118.1 + 3 \times -393.5) - (3 \times -824.2 - 110.5)$

$= -12.3\ kJ$

$M_m Fe_2O_3 = 55.85 \times 2 + 16 \times 3 = 159.7$

result $= \frac{-47.2 \times 10^3}{159.7 \times 3} = -98.51\ J/g$

* multiply M_m by 3 because there are 3 mols in the equation

Q 14: $E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{10 \times 10^{-2} \times 10^{-9}} =$

Energy of mol $= E \times 6.02 \times 10^{23} = 1.2 \times 10^3$

Q 15: $\Delta E = -2.18 \times 10^{-18} \left(\frac{1}{1} - \frac{1}{4}\right) = -1.635 \times 10^{-18}$

$|E| = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{|E|} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1.635 \times 10^{-18}} = 122\ nm$

Q 16: $E = \frac{1}{2} m v^2 = 4.51 \times 10^{-25}$

$E = hc/\lambda$ ~~$\rightarrow \lambda$~~ $E = hf$

$f = h/E$ $f =$

$E = hf \Rightarrow f = \frac{E}{h} =$

General Chem. 101

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

Student's Name: | Reg. No:

Section No. | Seat No.

##@@@@@@@@@@@@@@@@@@@

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; $E_n = -(2.18 \times 10^{-18}/n^2)$ 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, $[P + a(n/V)^2](V - nb) = nRT$

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

@@@@@@@@@@@@@@@@@@@@@@@@@@@@######################################

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

$C_3H_{8(g)} + 5\,O_{2(g)} \rightarrow 3\,CO_{2(g)} + 4\,H_2O_{(l)} \quad \Delta H = -2220$ 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°_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:

$HCl_{aq} + NH_{3aq} \rightarrow NH_4Cl_{aq}$

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 1.2×10^{-14} J

a) 1.7×10^{-12} b) 17 c) 1.7×10^{-1} d) 1.7×10^{-3} e) 1.7×10^{-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 1.0×10^5 m/s, given that the molar mass is 19.992 g/mol.

a-1.0×10^{-12} b- 2.0×10^{-13} c- 1.0×10^{-14} d) 9.7×10^{-13} e- 2.0×10^{-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

General Chem. 101
Second Exam

Date: 3/5/2008
Time: 60 min.

Name: …….. Reg. No.: ……...
Instructor Name: …… Seat No.: ……..

$PV=nRT$, $\Delta U=q+w$, $R = 0.0821$ atm L/mol. K , $h=6.63\times10^{-34}$ J.sec
$1m=10^{9}$ nm $= 10^{12}$ pm , $N = 6.022\times10^{23}$, $R= 8.314$ J/mol.K,

$U = \sqrt{\frac{3RT}{M}}$, $E= h\nu$, $\frac{1}{\lambda}= 1.097\times10^{7}\ m^{-1}\left(\frac{1}{n_f^2}-\frac{1}{n_i^2}\right)$, $C = 3.0\times10^{8}\frac{m}{sec}$

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. Calculate the number of grams of $KMnO_4$ (MW = 158.0) in 3.00 liters of a 0.250 M solution

   a) 191 b) 75.0 c) 119 d) 139 e) 169

2. A 0.6025 g-sample of a chloride salt was dissolved in water and the chloride precipitated by adding excess silver nitrate (MW=169.87). The precipitate of silver chloride (MW = 143.32) was filtered, washed, dried, and found to have a mass of 0.7134 g. Calculate the mass percentage of chloride (A.W = 35.45) in the sample.

   a) 20.89 b) 22.81 c) 24.73 d) 29.29 e) 31.57

3. How many degrees of temperature rise (in ^oC) will occur when a 25.0 g block of aluminum absorbs 0.338 kJ of heat? The specific heat of Al is 0.900 J/g. ^oC

   a) 22.2 b) 3.60 c) 15.0 d) 5.75 e) 11.4

4. When gasoline burns in a car engine, heat is released and $CO_{2(g)}$ and $H_2O_{(g)}$ are produced. If the resulting gases do 236 J of work on the surrounding, and the system loses 437 J to the surrounding as heat, calculate the change in internal energy, ΔU, of the system.

   a) 673 J b) -673 J c) 201 J d) -201 J e) 776 J

5. Liquid hydrogen peroxide decomposes at constant pressure according to the following thermochemical equation

$2\ H_2O_{2(l)} \rightarrow 2\ H_2O_{(l)} + O_{2(g)} \qquad \Delta H^o = -196.1\ kJ$

How much heat is released when 14.64 g $H_2O_{2(l)}$ (molar mass = 34.0 g/mol) decomposes?

a) 196.1 kJ b) 98.1 kJ c) 21.1 kJ d) 42.2 kJ e) 114.2 kJ

6. Given the following thermochemical equation

$^1/_2\ C_2H_{4(g)} \rightarrow C_{(s)} + H_{2(g)} \qquad \Delta H^o = -\ 6.55\ kJ$

The enthalpy of formation of $C_2H_{4(g)}$ [$\Delta H^o_f\ (C_2H_{4(g)}$] is

a) +13.1 kJ b) -26.2 kJ c) -52.4 kJ d) -13.1 kJ e) +52.4 kJ

7. The following heats of reaction are known

$2\ ClF_{(g)} + O_{2(g)} \rightarrow Cl_2O_{(g)} + F_2O_{(g)} \qquad \Delta H^o = 167.4\ kJ$
$2\ ClF_{3(g)} + 2\ O_{2(g)} \rightarrow Cl_2O_{(g)} + 3\ F_2O_{(g)} \qquad \Delta H^o = 441.4\ kJ$
$2\ F_{2(g)} + O_{2(g)} \rightarrow 2\ F_2O_{(g)} \qquad \Delta H^o = -43.4\ kJ$

Using Hess's law, calculate ΔH^o (in kJ) for the reaction:

$ClF_{(g)} + F_{2(g)} \rightarrow ClF_{3(g)}$

a) -130.2 b) 108.7 c) -217.5 d) 217.5 e) -158.7

8. What is the correct electronic configuration of silver Ag (Z = 47)?

a) [Kr] $5s^2\ 4d^9$
b) [Kr] $5s^2\ 5d^9$
c) [Kr] $4s^1\ 3d^{10}$
d) [Kr] $5s^2\ 4d^{10}$
e) [Kr] $5s^1\ 4d^{10}$

9. Which of the following elements is considered a paramagnetic substance

a) Hg(80) b) Ba(56) c) Ru(44) d) Cd(48) e) Sr(38)

10. A 2.56 g of a colorless liquid was vaporized in a 250 mL flask at 121 ^oC and 786 mmHg. What's the molecular weight of this liquid.

a) $3.2x10^2$ g/mol b) $6.3x10^2$ g/mol c) 125 g/mol
d) $2.0x10^2$ g/mol e) $5.1x10^2$ g/mol

11. In alcohol fermentation, yeast converts glucose to ethanol and carbon dioxide:

$$C_6H_{12}O_{6(s)} \rightarrow 2\ C_2H_5OH_{(l)} + 2\ CO_{2(g)}$$

If 5.97 g of glucose (MW = 180.2) are reacted and 1.44 L of CO_2 gas are produced at 293 K and 0.984 atm, what is the percent yield of the reaction?

a) 60.5% b) 10.2% c) 88.9% d) 95.1% e) 40.4%

12. If 0.10 mole of I_2 (MW = 253.8) vapor can effuse from an opening in a heated vessel in 39 seconds, how long will it take 0.10 mole of H_2 (MW = 2.016) to effuse under the same conditions?

a) 9.5 s b) 3.5 s c) 1.8 s d) 5.3 s e) 15.3 s

13. A mixture of helium and neon gases is collected over water at 28 ^{o}C and 745 mmHg. If partial pressure of helium is 368 mmHg, what is the partial pressure of neon? (vapor pressure of water at 28 ^{o}C = 28.3 mmHg).

a) 349 mmHg b) 214 mmHg c) 504 mmHg
d) 150 mmHg e) 501 mmHg

14. What is the energy in Joules, of one photon of X-ray radiation with wavelength of 0.158 nm.

a) 3.14×10^{-26} J b) 1.48×10^{-24} J c) 3.19×10^{25} J
d) 7.15×10^{40} J e) 1.26×10^{-15} J

15. Calculate the frequency of the light emitted by hydrogen atom during a transition of its electron from the energy level with n=4 to the energy level with n=1.

a) 1.028×10^{7} s^{-1} b) 1.215×10^{-7} s^{-1} c) 2.467×10^{15} s^{-1}
d) 3.083×10^{15} s^{-1} e) 8.228×10^{6} s^{-1}

16. Given the following sets of quantum numbers for (n, l, m_l, m_s), which <u>set is not a possible set</u> of quantum numbers for an electron in an atom?

	n	l	m_l	m_s
a)	4	2	2	-½
b)	3	1	-1	-1
c)	4	3	2	½
d)	4	3	-2	-½
e)	5	2	-2	½

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 أحد... د. ملك القادري Seat No. ......51.......

##@@@@@@@@@@@@@@@@@@@@@@@@

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; $E_n = -(2.18 \times 10^{-18}/n^2)$ 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}, $PV = nRT$, $[P + a(n/V)^2](V - nb) = nRT$

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

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@###################################

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.

T→high

real T→low P→high

Ideal P→low T→high

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

$u_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \cdot 298 \cdot 8.314}{28 \cdot 10^{-3}}}$

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

$M = \frac{dRT}{P}$ $M = \frac{1,801 \cdot 0,082 \cdot 298}{1}$ $M = \frac{dRT}{P}$

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)

,95 atm 298 K. ,03

$P = \frac{m}{M} \frac{RT}{V}$ $m = \frac{PVM}{RT}$,952 − 0,03 (,928)

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

$m = \frac{,928 \cdot 10. \cdot 28}{0,082 \cdot 298}$ $P = \frac{nRT}{V}$ $\frac{m}{M}$

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

$C_3H_{8(g)} + 5\,O_{2(g)} \rightarrow 3\,CO_{2(g)} + 4\,H_2O_{(l)} \quad \Delta H = -2220$ 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°_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:

$HCl_{aq} + NH_{3aq} \rightarrow NH_4Cl_{aq}$

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 1.2×10^{-14} J

a) 1.7×10^{-12} b) 17 c) 1.7×10^{-1} d) 1.7×10^{-3} e) 1.7×10^{-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 1.0×10^5 m/s, given that the molar mass is 19.992 g/mol.

a- 1.0×10^{-12} b- 2.0×10^{-13} c- 1.0×10^{-14} d) 9.7×10^{-13} e- 2.0×10^{-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

11/16

The University of Jordan
Date: 12/12/2010

General Chemistry 101
Second Exam

Chemistry Department
Time: 60 min.

Name: _____ _____. Registration Number ___

Instructor _____. Seat No.____ Day/Time _____

Answer Sheet

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

c =3x10^8 m/s, $PV=nRT$, $u_{rms}=\sqrt{\overline{u^2}}=\sqrt{\frac{3RT}{M}}$, $KE=\frac{3}{2}RT=N_A(\frac{1}{2}m\overline{u^2})$, $\Delta E=\Delta H - P\Delta V$

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

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

$n = \frac{m}{MM}$ $\quad n = 0.018$

$P = \frac{nRT}{V}$ $\quad n = \frac{PV}{RT} = \frac{1 \times 0.401}{0.082057 \times 273.15}$

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*

$Pt = P_{H_2} + P_{H_2O} \rightarrow P_{H_2} = 988 - 118 = 870\ mm\ Hg$

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

$n = \frac{PV}{RT} =$

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*

$P_{H_2} = P_t - P_{H_2O}$

$n = \frac{PV}{RT} = \frac{770 \times 0.500}{0.082057 \times (20 + 273)}$

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

a) 200 *kJ* *b)* 4.14×10^{-24} *kJ* *c)* 2.5×10^{-2} *kJ* *d)* 0.200 *kJ* *e)* 2.49 *kJ*

$\frac{3RT}{MM} = \frac{3 \times 8.315 \times 200}{12.01 + (2 \times 16)} \times 10^{-3}$ $\quad K.E = \frac{1}{2} m v^2$ $\quad \frac{3}{2} R T\ k$

K. mol. L. atm

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

$P_1V_1 = P_2V_2$

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

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

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

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

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

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

$2 \rightarrow -10930$ $\quad \Delta E = q + w$ $\quad \Delta H = mS\Delta T$ $\quad \Delta E = \Delta H - P\Delta V$ $\quad \Delta H = H_f$

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.

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

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

$Ca(NO_3)$ 500 mL 0.400 M + NaF 500 ml 0.8 M $\quad m_{sol} = 1000$ g $\quad S = 4.18$

$20^\circ C$

$q = mS\Delta T \quad 2.395 \times 10^{-3} = \Delta T \quad T_f =$

$11.5 = 1000 \times 4.18 \times (T_f - 20)$

Bomb

10] When 3.50 *g* of sucrose undergoes combustion in a *constant-volume* 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*.

$\Delta H = -$

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

a) -5.07×10^3 *b*) -1.45×10^3 *c*) $+1.45\times10^3$ *d*) -1.48×10^1 *e*) $+1.48\times10^1$

$q = c\Delta T$

$= 3.7 \times (29-25)$

$= 14.8\ kJ$

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

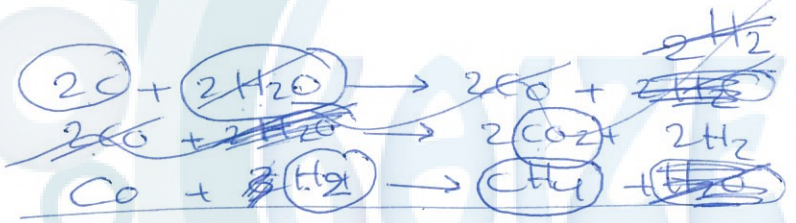
Use the following information to find ΔH for the reaction above.

$CO(g) + H_2(g) \rightarrow C(s) + H_2O(g)$ $\Delta H = -131\ kJ$

$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ $\Delta H = -41\ kJ$

$CO(g) + 3H_2(g) \rightarrow CH_4(g) + H_2O(g)$ $\Delta H = -206\ kJ$

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



$\Delta H = 2(131)$

$\Delta H = 2(-41)$

$\Delta H = -206$

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

$-131.4 = -393.5 + 110.5 -$

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

$2C + 2H_2O \rightarrow 2CO + 2H_2$ $\Delta H = 2(131)$

$2CO + 2H_2O \rightarrow 2CO_2 + 2H_2$ $\Delta H = (-41)2$

$CO + 3H_2 \rightarrow CH_4 + H_2O$ $\Delta H = -206$

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

$2C + 2H_2O \rightarrow 2CO + 2H_2$

$CO + H_2O \rightarrow CO_2 + H_2$

$CO + 3H_2 \rightarrow CH_4 + H_2O$

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) $1.20\times10^{9}\ J$ *b*) $1.99\times10^{-24}\ J$ *c*) $1.99\times10^{-15}\ J$ *d*) $3.30\times10^{-39}\ J$ *e*) $1.20\ J$

$$\Delta E = \frac{hc}{\lambda}$$

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

$$\Delta E = -2.18\times10^{-18}\left(\frac{1}{1^2}-\frac{1}{2^2}\right)$$

$$\Delta E = -1.635\times10^{-18}$$

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) $1.4\times10^{12}\ s^{-1}$ *b*) $4.3\times10^{19}\ s^{-1}$ *c*) $4.3\times10^{16}\ s^{-1}$ *d*) $4.3\times10^{14}\ s^{-1}$ *e*) $1.4\times10^{9}\ s^{-1}$

$$\lambda = \frac{h}{m\upsilon}$$

$$\lambda = 6.978\times10^{-11}$$

$$\Delta E = h\upsilon$$