الرجاء عدم تظليل الإجابات في ورقة الأسئلة

A

King Abdulaziz University

Faculty of Science - Chemistry Department

Chem-110, Second Exam
Saturday 14 /03 /1439 H
Time: 90 minutes

Name:	**Number:**	**Section:**

•Useful information:

Speed of light,	$C = 3.0\times10^{8}$ m/s
Planck's const.,	$h = 6.626\times10^{-34}$ J.s
Avogadro's No.,	$N_{av} = 6.022\times10^{23}$ mol^{-1}
Rydberg const. for H atom	$R_H = 2.18\times10^{-18}$ J
Mass of the electron,	$m_e = 9.11\times10^{-31}$ kg
Gas constant,	$R = 0.082$ L atm K^{-1} mol^{-1}

PERIODIC TABLE

1A												3A	4A	5A	6A	7A	8A
1 H Hydrogen 1	2A																4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Flourine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminum 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	63.5 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	72.5 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85.5 Rb Rubidium 37	86 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	(96) Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Cesium 55	137 Ba Barium 56	139 La Lanthanum 57	178.5 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	(210) Po Polonium 84	(210) At Astatine 85	(222) Rn Radon 86
(223) Fr Francium 87	(226) Ra Radium 88	(227) Ac Actinium 89	(261) Rf Rutherfordium 104	(262) Db Dubnium 105	(266) Sg Seaborgium 106	(264) Bh Bohrium 107	(265) Hs Hassium 108	(268) Mt Meitnerium 109									

Key: 12 C Carbon 6 — Relative atomic mass to nearest whole number; Symbol; Atomic number

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162.5 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	244 Pu Plutonium 94	(243) Am Americium 95	(247) Cm Curium 96	(247) Bk Berkelium 97	(251) Cf Californium 98	(252) Es Einsteinium 99	(257) Fm Fermium 100	(258) Md Mendelevium 101	(259) No Nobelium 102	(262) Lr Lawrencium 103

Choose the correct answer

A-1 **If the temperature and pressure are kept constant during the process, how many liters of $TiCl_4$ gas will be produced when 20.0 L of chlorine (Cl_2) react with titanium (Ti) according to the reaction: $Ti(s) + 2\ Cl_2(g) \rightarrow TiCl_4(g)$**

a) 5.0 L b) 10.0 L c) 20.0 L d) 40.0 L

From the equation
2 L of Cl2 produce 1 L of TiCl4
20 L of Cl2 ----------X L of TiCl4
X L of Cl2 = 10 L

A-2 **What is the pressure in atmospheres of a gas mixture that consists of 0.20 moles of nitrogen and 0.30 moles of oxygen in a 1250 mL container at 0 °C?**

a) 0.00895 atm b) 0.963 atm c) 1.63 atm d) 8.95 atm

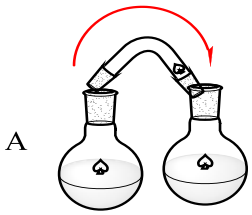
$$P_T = \frac{n\,R\,T}{V}$$

Where $n = n_A + n_B$

N moles of N2 = 0.20 mole
N moles of O2 = 0.30 mole
V = 1250 ml / 1000= 1.25 L
T= 0+ 273 = 273 K

= (0.20 + 0.30) X 0.0821 X 273 / 1.25
= 8.95 atm

A-3 **You have a sample of CO_2 gas in a flask (A) with a volume of 265 mL. At 22.5 °C, the pressure of the gas is 136.5 mmHg. To find the volume of another flask (B), you move the CO_2 to that flask and find that its pressure is now 94.3 mmHg at 24.5 °C. What is the volume of flask B?**



V of A = 256 ml / 1000 = 0.256 L
T of A= 22.5 + 273 = 295.5 K
P of A= 136.5 mmHg / 760 = 0.179 atm

V of B = ?
T of B = 24.5 + 273 = 297.5 K
P of B = 94.3 mmHg / 760 = 0.124 atm

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

A B

P1 V1 T2 = P2 V2 T1

V2 = P1V1T2 / P2 T1

= 386.2 mL

A-4 The pressure of 6.0 L of an ideal gas in a flexible container is decreased to one-third of its original value, and its absolute temperature is decreased by one-half. What is the final volume of the gas?

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

V1 = 6 L

P2 = P1 /3

T2 = T1 /2

V2 = ?

$$V2 = \frac{P1 \;\; V1 \;\; T2}{P2 \;\; T1}$$

$$V2 = \frac{P1 \times 6 \times \frac{T1}{2}}{\frac{P1}{3} \times T1} = \frac{\frac{6}{2}}{\frac{1}{3}} = 9 \text{ L}$$

A-5 The relationship known as Charles Law is valid:

a) at constant temperature and amount of gas.
b) at constant pressure and amount of gas.
c) at constant volume and amount of gas.
d) at constant temperature and volume.

A-6 A fixed quantity of a gas is subjected to a decrease in pressure at constant temperature. The volume of the gas:

a) remains the same b) decreases **c) increases** d) can't be determined

A-7 A student adds 4.00 g of dry ice (solid CO_2) to an empty balloon. What will be the volume of the balloon at STP after all the dry ice sublimes (converts to gaseous CO_2)?

a) 1.67 L b) 2.04 L c) 3.50 L d) 4.20 L

STP conditions means :
T = 0°C = 273.15 K
P = 1 atm.

PV = nRT

$$V = \frac{n\,R\,T}{P}$$

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n = 4 / 44 = 0.0909 mole

$$V = \frac{0.0909 \text{ X } 0.0821 \text{ X } 273.15}{1} = 2.038 \text{ L}$$

OR

At STP 1mole of an ideal gas occupies 22.414L.

V = n X 22.414
= 0.0909 X 22.414 = 2.037 L

A-8 A compound is solid at room temperature, but it boils at 56 °C. Determine the density of the compound at 60 °C and 745 torr (molar mass of the compound = 352 g/mol).

a) 12.64 g/L b) 5.23 g/L c) 21.32 g/L d) 15.85 g/L

$$d = \frac{P\,MM}{R\,T}$$

T = 60 + 273 = 333 K
P = 745 torr / 760 = 0.9802 atm
MM= 352 g / mol

$$d = \frac{0.9802 \text{ X } 352}{0.0821 \text{ X } 333} = 12.64 \text{ g/L}$$

A-9 **A mixture of two gases (A and B) are mixed in the same container. Calculate the mole fraction of gas B if the total pressure is 2 atm and the partial pressure of gas A is 1.5 atm ?**

$P_T = 2$ atom

$P_A = 1.5$ atm

$X_B = ?$

$$X_A = \frac{P_A}{P_T}$$

$$X_A = \frac{1.5}{2} = 0.75$$

$$X_A + X_B = 1$$

$$X_B = 1 - X_A$$

$$X_B = 1 - 0.75 = 0.25$$

$$X_A + X_B = \frac{n_A}{n_B + n_A} + \frac{n_B}{n_A + n_B} = 1$$

A-10 **A certain amount of gas at 25 °C and at a pressure of 0.800 atm is contained in a glass vessel. Suppose that the vessel can withstand a pressure of 2.00 atm. How high can you raise the temperature of the gas without bursting the vessel?**

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$T_1 = 25 + 273 = 298$ K

$P_1 = 0.800$ atm

$P_2 = 2$ atm

We assume that $V_2 = V_1$

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{P_2 T_1}{P_1}$$

$$T2 = \frac{2 \times 298}{0.800} = 745 \text{ K or } 472\ C^0$$

A-11 Give a possible set of four quantum numbers {n, *l*, m_l, m_s } for the starred electron in the following diagram. Select the values of ml by numbering from – *l* to + *l* from left to right. 2p ↑↓ ↑↓* ↑

a) n=1, *l*=1, m_l = 1, m_s = ½
b) n=2, *l*=1, m_l = 2, m_s = ½
c) n=2, *l*=2, m_l = 1, m_s = -½
d) n=2, *l*=1, m_l = 0, m_s = -½

A-12 An electron in the hydrogen atom makes a transition from an energy state of principal quantum numbers n_i to the *n* = 2 state. If the photon emitted has a wavelength of 434 nm, what is the value of n_i?

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

$$\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)$$

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

A-13 An electron in a certain atom is in the $n = 2$ quantum level. List all possible values of l, and m_l, that it can have?

a) $l = 0$, $m_l = 0$; $l = 1$, $m_l = -1, 0, 1$; $l = 2$; $m_l = -2, -1, 0, 1, 2$
b) $l = 0$, $m_l = 0$; $l = 1$, $m_l = -1, 0, 1$
c) $l = 0$, $m_l = -1, 0, 1$
d) $l = 1$, $m_l = -1, 0, 1$

A-14 The electron configuration of S is :

a) **$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$**
b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
c) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6{}_4s^2\ 3d^{10}\ {}_4p^2$
d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3d^6$

A-15 Indicate which of the following sets of quantum numbers (n, l, m_l, m_s) in an atom are unacceptable: (A) (1, 0, ½, ½); (B) (3, 0, 0, +½); (C) (2, 2, 1, +½); (D) (4, 3, –2, +½); (E) (3, 2, 1, 1)?

A-16

a) (A) and (B)
b) (B), (C) and (D)
c) (A), (B), (C) and (E)
d) (A), (C) and (E)

A-17 Oxygen is _____ and has _____ unpaired electrons?

a) Paramagnetic ,0
b) Paramagnetic ,2
c) diamagnetic ,1
d) diamagnetic ,0

A-18 Which of the following elements is a representative element?

a) Li
b) Ni
c) Ag
d) Sc

A-19 A police officer is measuring traffic speed with radar operating at a frequency of 1.0 x 10^9 Hz. What is the wavelength?

a) 0.30 nm
b) 3.30 m
c) 0.30 m
d) 3 x 10^{17} m

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

A-20 An alpha particle of mass 6.645x10^{-27} kg has a velocity of 10.0% of the speed of light. What is its de Broglie wavelength (in m)?

a) 3.50 x 10^{-21} m b) 3.30 x 10^{-18} m c) 3.70 x 10^{-16} m d) 3.32 x 10^{-15} m

$$\lambda = \frac{h}{mu}$$

$$C = 3 \text{ X } 10^{8} \frac{\text{x } 10}{100} = 3 \text{ x } 10^{7} \text{ m}$$

A-21 Which of the following electron transitions would absorb the lowest energy by the hydrogen atom?

a) from n = 1 to n = 4 b) from n = 1 to n = 2 c) from n = 1 to n = 7 d) from n = 1 to n = 6

A-22 Determine the total number of: *s* electrons in Si (*Z* = 14)?

a) 3 b) 2 c) 4 **d) 6**

^{14} **Si** :$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

A-23 The outermost electron configuration $4s^2 4p^3$ can be found in :

a) Se b) Kr **c) As** d) P

A-24 Rank the following five atomic species in order of increasing atomic radius (smallest to largest): Si, Na, K, F, O

a) K, Na, Si, O, F **b) F, O, Si, Na, K** c) O, F, Si, Na, K d) O, F, Na, Si, K

A-25 The Mg^{2+} ion is isoelectronic with which neutral atom?

a) Si b) Na **c) Ne** d) Ar

A-26 Which atom of the following has the largest first ionization energy?

a) N **b) F** c) Na d) Li

A-27 Which of these elements has the greatest attraction for electrons in a covalent bond?

a) Se b) As **c) Br** d) Kr

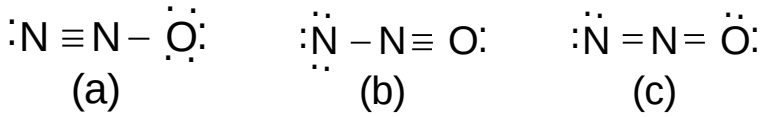
A-28 The ion not having Octet configuration in the outermost shell is _____.

a) Sr^{2+} **b) Fe^{2+}** c) Mg^{2+} d) S^{2-}

A-29 How many lone pair around sulfur atom in SO_2?

a) 2 **b) 1** c) 0 d) 6

A-30 Which of the following resonance structures is more stable ?



(a) (b) (c)

a) (b) b) (c) **c) (a)** d) (a) and (b)

A-31 30-Which of the following combinations of two elements is most likely to produce highly ionic bonds?

a) O – F **b) C – N** c) F – Cl d) Li – Na

الرجاء عدم تظليل الإجابات في ورقة الأسئلة

Absorb	يمتص	lowest	الأقل
according	وفقا	mixture	خليط
alpha particle	جسيمات الفا	molar mass	الكتلة المولية
amount	كميه	molecules	جزيئات
another	مختلف	neutral	متعادل
around	حول	Octet	ثماني
attraction	جذب	one-third	ثلث
boils	يغلي	original value	الكمية الأساسية
bursting	انفجار	outermost	خارجي
certain	محدد	pair	زوج
one-half	النصف	paramagnetic	احادي المغناطيسية
acceptable	مقبول	partial pressure	ضغط جزئي
Consists of	يتكون من	police officer	شرطي مرور
constant	ثابت	possible	ممكن
container	وعاء	process	عمليه
Converts to	يتحول الى	quantum number	اعداد كم
covalent	تساهمي	radar	رادار
density	كثافه	radius	نصف قطر
determined	إيجاد	raise	يرفع
diagram	رسم بياني	Rank	رتب
diamagnetic	ثنائي المغناطيسية	relationship	علاقة
dry	جاف	remains	يبقى
during	خلال	represent	يمثل
electron configuration	توزيع الكتروني	representative elements	عناصر ممثله
electronegativity	سالبيه كهربائية	resonance structures	اشكال رنين
Emission	انبعاث	respectively	على التوالي
emit	يبعث	sample	عينه
empty	خالي	sets	مجموعات
energy	طاقة	smallest	أصغر
Fixed quantity	كمية ثابتة	solid	صلب
Flask	وعاء	species	صنف
Flexible	مرن	stable	مستقر
Found	وجد	starred electron	الإلكترون ذو النجمة
Frequency	تردد	Subjected to	تعرض الى
gaseous	غازي	traffic speed	سرعة السير
greatest	أكبر	transitions	انتقاله
Highest	اعلى	unacceptable	غير مقبول
Ideal gas	غاز مثالي	unpaired	مفرد
Indicate	اوجد	valid	صالح
initial	ابتدائي	velocity	سرعه
isoelectronic	نظير الالكتروني	vessel	وعاء
kept	حافظ	volume	حجم
List	اوجد	wavelength	طول موجي
lone pair	ازواج حره	withstand	يتحمل