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King Abdulaziz University

Faculty of Science - Chemistry Department

Wednesday 21 / 1 / 1434 H

Chem-110, Second Exam

Time: 90 minutes

Name:	Number:	Section:
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•Useful information:

Speed of light,	$C = 3.0 \times 10^8 \text{ m/s}$
Planck's const.,	$h = 6.626 \times 10^{-34} \text{ J.s}$
Avogadro's No.,	$N_{av} = 6.022 \times 10^{23} \text{ mol}^{-1}$
Rydberg const. for H atom	$R_H = 2.18 \times 10^{-18} \text{ J}$
Mass of the electron,	$m_e = 9.11 \times 10^{-31} \text{ kg}$
Gas constant,	$R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$

1 H Hydrogen 1	
7 Li Lithium 3	9 Be Beryllium 4
23 Na Sodium 11	24 Mg Magnesium 12

PERIODIC TABLE

12
C
Carbon
6

Key

Relative atomic mass to nearest whole number

Symbol

Atomic number

4 He Helium 2
20 Ne Neon 10
40 Ar Argon 18

11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
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									

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 Which of the following pressure units has the largest value?

a) $\frac{765 \text{ torr}}{760}$

b) 1.00 atm

c) $\frac{595 \text{ mmHg}}{760}$

d) 167 Pa

A-2 A sample of oxygen occupies 6.33 liters under a pressure of 1240 mmHg at 25°C. What volume would it occupy at 25°C if the pressure was decreased to 0.960 atm?

a) 23.6 L

b) 12.7 L

c) 32.1 L

d) 10.76 L

A-3 What is the pressure of 3.45×10^{-3} mol gas in a 0.1 L flask at 21.2°C?

a) 0.99 atm

b) 0.83 atm

c) 0.197 atm

d) 0.5 atm

A-4 What is the mass of nitrogen gas ($M=28 \text{ g/mol}$) in 500 mL flask at STP?

a) 0.625 g

b) 0.750 g

c) 0.875 g

d) 1.125 g

A-5 What is the density of oxygen gas ($M=32 \text{ g/mol}$) at STP?

a) 1.64 g/L

b) 2.91 g/L

c) 1.43 g/L

d) 1.15 g/L

A-6 A mixture of gases contains 6.0 mol of H_2 gas and 2.5 mol of He gas. If the total pressure is 1.15 atm, calculate the partial pressure of the H_2 gas.

a) 1.06 atm

b) 0.812 atm

c) 2.12 atm

d) 1.41 atm

A-7 A mixture of 3 mol N_2 gas and 4 mol O_2 are in 2 L flask at 300 K, what is the total pressure?

a) 57.4 atm

b) 86.1 atm

c) 43.05 atm

d) 34.44 atm

$X_{\text{N}_2} = \frac{3}{7} =$
 $X_{\text{O}_2} = \frac{4}{7} =$

$P_{\text{N}_2} \times 2 = 3 \times 0.0821 \times 300 = 36.945$

$P_{\text{O}_2} \times 2 = 4 \times 0.0821 \times 300 = 49.26$

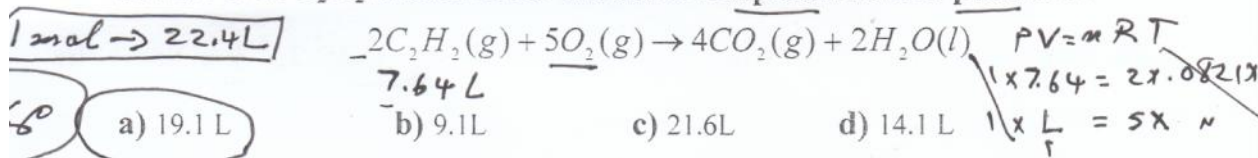
$$E = \frac{hc}{\lambda} = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1 \times 10^{-14}} = 1.989 \times 10^{-11} \text{ m}$$

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A-8 What is the wavelength (λ) of radiation that has a frequency (ν) of $1.0 \times 10^{14} \text{ Hz}$?

- a) $5 \times 10^{-3} \text{ cm}$ b) $1 \times 10^{-4} \text{ cm}$ c) $3 \times 10^{-4} \text{ cm}$ d) $1 \times 10^{-6} \text{ cm}$

A-9 Calculate the volume of O_2 (in L) required for the complete combustion of 7.64 L of C_2H_2 measured at the same temperature and pressure?



A-10 If the frequency (ν) of radiation is $1.00 \times 10^8 \text{ Hz}$, what is the energy (E) of this radiation?

- a) $6.63 \times 10^{-26} \text{ J}$ b) $6.63 \times 10^{-34} \text{ J}$ c) $6.63 \times 10^{-42} \text{ J}$ d) 6.63 kJ

A-11 What is the energy of radiation after transition of an electron from $n=3$ to $n=2$ in the hydrogen atom? (The Rydberg constant for H atom = $2.18 \times 10^{-18} \text{ J}$)

- a) $3.03 \times 10^{-17} \text{ J}$ b) $3.03 \times 10^{-18} \text{ J}$ c) $3.03 \times 10^{-19} \text{ J}$ d) $2.18 \times 10^{-15} \text{ J}$

A-12 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 $n=6$

$$\frac{1}{4} - \frac{1}{16} = -0.75$$

$$\frac{1}{36} - \frac{1}{1} = -0.97$$

A-13 Calculate the wavelength associated with a beam of neutrons moving at $7.0 \times 10^2 \text{ m/s}$? (The mass of a neutron is $1.675 \times 10^{-27} \text{ kg}$).

- a) 0.565 nm b) 1.318 nm c) 0.747 nm d) 0.439 nm

$$\lambda = \frac{6.63 \times 10^{-34}}{1.675 \times 10^{-27} \times 7 \times 10^2} = 5.65 \times 10^{-10} \text{ m} = 0.565 \text{ nm}$$

A-14 The volume of a sample of nitrogen is 7.20 liters at 35°C and 0.970 atm. What volume will it occupy at STP?

- a) 8.17 L b) 5.16 L c) 4.30 L d) 6.19 L

$$V = \frac{0.97 \times 7.2}{308} = 2.27$$

$$V = \frac{0.97 \times 7.2 \times 273}{308} = 6.19 \text{ L}$$

A

A-15 Give the values of the quantum numbers (n , l and m_l) associated with the $2p$ subshell?

a) $n = 2, l = 2, m_l = -2, -1, 0, 1, 2$

b) $n = 2, l = 1, m_l = 0$

c) $n = 2, l = 1, m_l = 1$

d) $n = 2, l = 1, m_l = -1, 0, 1$

A-16 The electron configuration of a neutral atom is $1s^2 2s^2 2p^6 3s^2$. Name the element?

a) Si

b) Na

c) Mg

d) Al

A-17 A ground-state atom of zinc (Zn) has 0 unpaired electrons and is di.

a) 0, paramagnetic

b) 1, paramagnetic

c) 2, paramagnetic

d) 0, diamagnetic

A-18 The elements having ns^1 configuration in their outermost shell are:

a) Noble gases

b) Halogens

c) Alkali metals

d) Alkaline earth metals

A-19 O^{2-} is isoelectronic with :

a) F^-

b) K^+

c) Cl^-

d) Ar

A-20 Electron affinity is highest for :

a) Cl

b) I

c) S

d) Br

A-21 The electron configuration of V is:

a) $[Ar]4s^2 4p^3$

b) $[Kr]4s^2 3d^3$

c) $[Ar] 4s^2 3d^3$

d) $[Kr]4s^2 4p^3$

A-22 Which of the following will form an ionic bond?

- a) Mg and F b) Si and O c) C and O d) Cl and O

A-23 Pick out the correct statement from the following:

- a) Alkali metals have the lowest ionization energy
 b) Alkali metals have the highest ionization energy
 c) Halogens have the lowest ionization energy
 d) Inert gases have the lowest ionization energy

A-24 According to Lewis's theory, a covalent bond is formed by the:

- a) Transfer of electrons b) Sharing of electrons
 c) partial transfer of electrons d) Donation of electrons

A-25 How many total valance electrons are available in CO_2 ?

- a) 10 b) 18 c) 16 d) 24

A-26 How many lone pairs of electrons are in CO_2 ?

- a) 1 b) 4 c) 2 d) 0

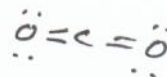
A-27 How many resonance structures are there in CO_2 ?

- a) 3 b) 2 c) 1 d) 0

A-28 The formal charge on the carbon atom in CO_2 ?

- a) +1 b) 0 c) -1 d) +2

$$\begin{aligned} 3 \times 8 &= 24 \\ 4 + 2 \times 6 &= 16 \\ \hline 8 &= 4 \\ \text{Fe's} &= 24 - 8 \end{aligned}$$



ASubshell

A-29 What is the total number of sub-orbital associated with the principal quantum number $n = 3$?

a) 3

b) 16

c) 9

d) 2

A-30 Order the following according to increasing atomic radius.

N Be Mg C O B

a) $N > O > Mg > Be > C > B$ c) $Mg < Be < B < C < N < O$ b) $O < N < C < B < Be < Mg$ d) $Be > Mg > B > C > N > O$