

A

King Abdulaziz University

Faculty of Science - Chemistry Department

Thursday 14 /2 /1434 H

Chem-110, Final Exam

Time: 120 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,	$R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$

PERIODIC TABLE																		4 He Helium 2					
1 H Hydrogen 1																							
7 Li Lithium 3	9 Be Beryllium 4	Key 12 C Carbon 6 Relative atomic mass to nearest whole number Symbol Atomic number																11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 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															
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										

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Choose the correct answer :

A-1 The element in group 3A and period 3 is:

- a) Ga b) Be **c) Al** d) Mg

A-2 Which compound has the same empirical formula as $C_3H_{12}O_6$?

- a) $C_{12}H_{20}O_4$ **b) $C_2H_8O_4$** c) $C_6H_3O_6$ d) $C_{12}H_{24}O_{12}$

A-3 What is the number of protons, electrons and neutrons in the atom of



- a) 31 protons, 34 electrons, 15 neutrons b) 16 protons, 16 electrons, 16 neutrons
c) 15 protons, 18 electrons, 16 neutrons d) 18 protons, 15 electrons, 31 neutrons

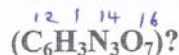
A-4 The correct systematic name for Fe_2O_3 is

- a) Iron (II) oxide. **b) Iron (III) oxide.**
c) Diiron trioxide d) Iron oxide

A-5 A $\frac{0.06}{95}$ 5.691 g sample of $MgCl_2$ is dissolved in enough water to give 750 mL of solution. What is the molarity of this solution?

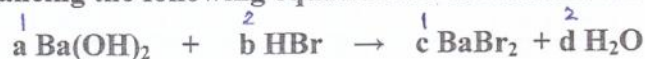
- a) $3.70 \times 10^{-2} M$ b) $1.05 \times 10^{-2} M$ c) $2.58 \times 10^{-2} M$ **d) $7.99 \times 10^{-2} M$**

A-6 Calculate the percent composition by mass of O in picric acid



- a) 1.3 % b) 18.3 % **c) 31.4 %** d) 48.9 %

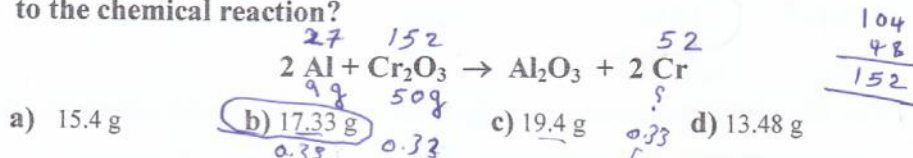
A-7 After balancing the following equation the coefficients are:



- a) a=1, b=2, c=1, d=2** b) a=2, b=2, c=1, d=2
c) a=1, b=3, c=1, d=2 d) a=2, b=1, c=3, d=1

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A-8 What is the theoretical yield of chromium (Cr) that can be produced by the reaction of 50.0 g of Cr_2O_3 with 9.00 g of aluminum (Al) according to the chemical reaction?



A-9 If the actual yield for the experiment in the above question (8) produced 13.0g, what is the percentage yield?

- a) 84.4% **b) 75.0%** c) 67% d) 96.4%

A-10 What is the mass of carbon in 15 g carbon dioxide (CO_2)?

- a) 4.1 g** b) 2.73 g c) 5.45 g d) 6.82 g

A-11 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 $n = 5$
 c) from $n = 3$ to $n = 4$ **d) from $n = 1$ to $n = 6$**

A-12 What mass of helium is required to fill a 2.50 L balloon at STP?

- a) 0.134 g b) 0.267 g **c) 0.447 g** d) 267 g

A-13 The electronic configuration of Fe^{+3} is:

- a) $[\text{Ar}] 4s^2 3d^6$ b) $[\text{Ar}] 4s^1 3d^5$ **c) $[\text{Ar}] 3d^5$** d) $[\text{Ar}] 3d^6$

A-14 If the mass of 0.210 L of gaseous compound was 3.6 g at 35°C with 1.7 atm pressure, the molar mass of the compound is equal to:

- a) 168.37 g/mol **b) 254.68 g/mol** c) 150.6 g/mol d) 100 g/mol

$$1.7 \times 0.21 = \frac{3.6}{mm} \times 0.0821 \times 308$$

$$mm = \frac{3.6 \times 0.0821 \times 308}{1.7 \times 0.21}$$

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A-15 What is the molecular formula of the compound in the above question if you know that it contained 33.0 percent Si and 67.0 percent F by mass?

- a) Si_2F_6 **b) SiF_3** c) Si_3F_9 d) Si_3F

A-16 The element 'X' does not usually form compounds with atoms of other elements. Which one of the following could be the electron configuration of 'X'?

- a) $1s^2 2s^1$ b) $1s^2 2s^2 2p^3$ **c) $1s^2 2s^2 2p^6$** d) $1s^2 2s^2 2p^1$

A-17 "The energy required to remove an electron from a gaseous atom in its ground state" is known as:

- a) Electron affinity. b) Electronegativity.
c) Ionization energy d) Ionic radius.

A-18 If the energy (E) of radiation is 6.63×10^{-24} J, what is the frequency (ν) of this radiation?

- a) **1×10^{10} Hz** b) 1×10^8 Hz c) 1×10^{-34} Hz d) 1×10^{-8} Hz
- $E = h\nu$
 $\nu = \frac{6.63 \times 10^{-24}}{6.63 \times 10^{-34}}$

A-19 How many total valence electrons are available in SO_2 ?

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

A-20 What is the volume of 4.35×10^{-3} mol gas at 21.2°C and 0.83 atm?

- a) 0.13 L** b) 0.2 L c) 0.1 L d) 0.3 L
- $V = \frac{4.35 \times 10^{-3} \times 294.2}{0.83}$

A-21 Calculate the pH of 0.05 M ammonium hydroxide ($K_b = 1.8 \times 10^{-5}$ at 25°C).

- a) 3.02 **b) 10.98** c) 11.55 ~~d) 13~~
- $\text{NH}_4\text{OH}_{(\text{aq})} \rightleftharpoons \text{NH}_4^+_{(\text{aq})} + \text{OH}^-_{(\text{aq})}$

$$\text{pH} = -\log \sqrt{0.05 \times 1.8 \times 10^{-5}} = -\log 9.5 \times 10^{-4} = 3.0$$

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A-22 Calculate pH of final solution after diluting 10 mL of 0.1 M HCl with 90 mL water.

a) 2.0

b) 2.5

c) 3.5

d) 1.0

$$10 \times 0.1 = M \times 100$$

$$M = \frac{10 \times 0.1}{100} = 0.01$$

$$pH = -\log 0.01 = 2$$

A-23 Arrange the following salts according to increasing of solubility: AgCl

($K_{sp} = 1.6 \times 10^{-10}$), AgI ($K_{sp} = 8.3 \times 10^{-17}$), and AgBr ($K_{sp} = 7.7 \times 10^{-13}$).

a) AgCl > AgI > AgBr

b) AgI < AgBr < AgCl

c) AgI > AgBr > AgCl

d) AgCl < AgI < AgBr

$$[S] = \sqrt{\frac{K_{sp}}{25}} = \sqrt{\frac{1.6 \times 10^{-10}}{25}} = \sqrt{6.4 \times 10^{-12}} = 2.5 \times 10^{-6}$$

$$\sqrt{1.6} = 1.26$$

$$\sqrt{9} = 3$$

A-24 If the solubility of $BaSO_4$ is 1.05×10^{-5} M at 25 °C, the K_{sp} of this salt is:

a) 1.1×10^{-10} b) 2.5×10^{-12} c) 1.05×10^{-5} d) 5×10^{-20} 

$$K_{sp} = (1.05 \times 10^{-5})^2$$

A-25 For the reaction at equilibrium; $N_2(g) + 3 H_2(g) \rightleftharpoons 2 NH_3(g)$

If $[N_2] = 0.1$ M, $[H_2] = 0.2$ M and $[NH_3] = 0.2$ M, the equilibrium constant (K_c) is:

a) 10

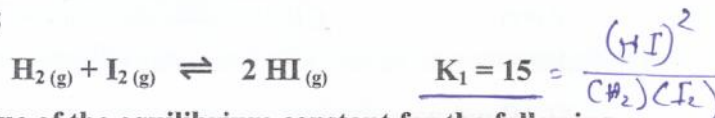
b) 50

c) 112.5

d) 200

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(0.2)^2}{(0.1)(0.2)^3} = \frac{0.04}{0.008} = 5$$

A-26 The equilibrium constant for the following reaction at definite temperature is;



What is the value of the equilibrium constant for the following reaction?



a) 15

b) 6.6×10^{-3} c) 6.6×10^{-2} d) 5×10^{-3}

$$K_2 = \frac{(H_2)(I_2)}{(HI)^2} = \frac{1}{K_1}$$

$$\frac{1}{15}$$

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A-27 At equilibrium, the total gas pressure was found to be 0.033 atm.

Calculate the equilibrium constant K_p for the following decomposition;



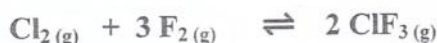
a) 5.32×10^{-6}

b) 5.55×10^{-4}

c) 2.22×10^{-3}

d) 5.0×10^{-3}

A-28 For the reaction at equilibrium;



$K_c = 3.0 \times 10^{-2}$ at 25°C , the K_p of this reaction is:

a) 4.86×10^{-6}

b) 2.28×10^{-6}

c) 5.0×10^{-5}

d) 1.33×10^{-5}

A-29 Which of the following is the correct form of the equilibrium constant

expression for the reaction;



a) $K_c = [\text{Cu}^{2+}] [\text{2Ag}]^2$

c) $K_c = [\text{Cu}] [\text{2Ag}^+] / [\text{Cu}^{2+}] [\text{2Ag}]^2$

b) $K_c = [\text{Ag}]^2 [\text{Cu}^{2+}] / [\text{Cu}] [\text{Ag}]^2$

d) $K_c = [\text{Cu}^{2+}] / [\text{Ag}^+]^2$

A-30 For the following reaction, at equilibrium which choice gives a change that will shift the position of equilibrium to favor formation of NO?



a) Increase the total pressure.

c) Decreasing the temperature.

b) Increasing the temperature.

c) Removing NOBr selectively.

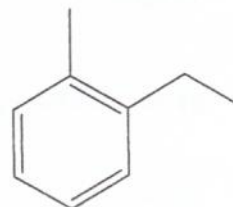
A-31 The correct name for the following compound is :

a) o-methyltoluene

c) o-ethyltoluene

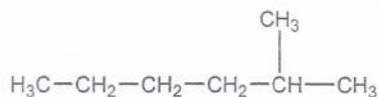
b) m-methyltoluene

d) m-ethyltoluene



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A-32 The right systematic name for the following organic molecule is :



a) 5-methyl-3-hexene

b) 5-methylhexane

c) 2-methylhexane

d) 3-methylhexene

A-33 HF/NaF system is used as buffer solution. What is the pH if it has [HF] =

0.1M and [NaF] = 0.15M? ($K_a = 7.1 \times 10^{-4}$ at 25 °C). $pH = 3.149 + \log \frac{0.15}{0.1} = 3.33$
 $pK_a = -\log 7.1 \times 10^{-4}$
 $\text{HF}_{(aq)} \rightleftharpoons \text{H}^+_{(aq)} + \text{F}^-_{(aq)}$
 $\text{NaF}_{(s)} \rightarrow \text{Na}^+_{(aq)} + \text{F}^-_{(aq)}$

a) 2.12

b) 3.33

c) 0.83

d) 1.4

A-34 The percent ionization of hydrofluoric acid (HF) at the concentrations of

0.50 M ($K_a = 7.1 \times 10^{-4}$) is:
 $x = [H^+] = \sqrt{0.5 \times 7.1 \times 10^{-4}}$
 $\text{HF}_{(aq)} \rightleftharpoons \text{H}^+_{(aq)} + \text{F}^-_{(aq)}$

a) 3.8%

b) 0.6%

c) 0.011%

d) 2.83%

A-35 The general molecular formula of alkynes is:

a) C_nH_{2n}

b) $\text{C}_n\text{H}_{2n-2}$

c) $\text{C}_n\text{H}_{2n+2}$

d) $\text{C}_n\text{H}_{2n+1}$

A-36 The concentration of hydroxide ion $[\text{OH}^-]$ in an aqueous solution is

$3.5 \times 10^{-9} \text{ M}$. What is the concentration of hydrogen ion $[\text{H}^+]$?

a) $2.86 \times 10^{-6} \text{ M}$

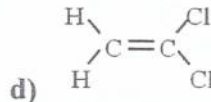
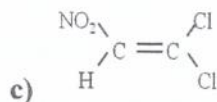
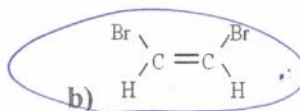
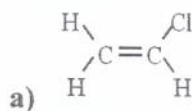
b) $2.86 \times 10^6 \text{ M}$

c) $3.5 \times 10^{-5} \text{ M}$

d) $3.5 \times 10^5 \text{ M}$

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A-37 Which of the following compounds has geometrical isomer?



A-38 The right name for the following molecule is:



a) propyl methyl alcohol

b) 1-methyl-2-propanal

c) 2-pentanone

d) methyl propyl ester

A-39 Calculate the H^+ ion concentration in lemon juice having a $\text{pH} = 2$.

a) 0.01 M

b) $2.5 \times 10^{-4} \text{ M}$

c) 10.0 M

d) 3 M

$$[\text{H}^+] = 10^{-2} = 0.01$$

A-40 Which expression correctly relates K_p to K_c for the reaction;



a) $K_p = K_c(\text{RT})^{-1}$

b) $K_p = K_c(\text{RT})^{-2}$

c) $K_p = K_c(\text{RT})$

d) $K_p = K_c$