KEY

IZMIR UNIVERSITY OF ECONOMICS

Faculty of Engineering

Term	: 24-25 Fall
Course	: CHEM 100 – General Chemistry
Exam	: Midterm Exam
Date	: 11.11.2024

Full Name : ....

Student ID : ....

GROUP A

1) The correct name for HBrO3 is _____.

a) bromic acid   b) hydrobromic acid   c) bromous acid

d) perbromic acid   e) hypobromic acid

2) What is the molar mass of cobalt (II) sulfate tetrahydrate?

a) 173 g/mol   b) 185 g/mol   c) 227 g/mol

d) 285 g/mol   e) 323 g/mol

3) Aluminum oxide (used as an adsorbent or a catalyst for organic reactions) forms when aluminum reacts with oxygen.

$Al(s) + O_2(g) \rightarrow Al_2O_3(s)$ (not balanced)

A mixture of 50.75 g of aluminum and 92.50 g of oxygen is allowed to react. What mass of aluminum oxide can be formed?

a) 101.6 g   b) 95.9 g   c) 89.3 g   d) 81.7 g   e) 72.5 g

4) What is the atomic weight of an atom whose isotopes are 62.930 amu (abundance: 69.17%) and 64.928 amu (abundance: 30.83%)?

a) 62.782   b) 63.096   c) 63.218

d) 63.546   e) 64.076

5) The compound XF_6 contains 78.05% F by mass. What is the element X?

a) P   b) S   c) I   d) N   e) B

6) What would the result of the following mathematical operation be with appropriate number of significant figures?

$$(0.162 \times 1.0970) + (4.2580 / 2.632001) = ?$$

a) 1.7958   b) 1.796   c) 1.80   d) 1.79549   e) 1.8

7) Lead (II) carbonate decomposes to give lead (II) oxide and carbon dioxide:

$$PbCO_3 \text{ (s)} \rightarrow PbO \text{ (s)} + CO_2 \text{ (g)}$$

If the reaction yield is 95.7%, how many grams of lead (II) oxide will be produced by the decomposition of 2.50 g of lead (II) carbonate?
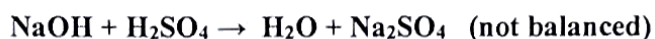
A) 1.04   B) 1.55   C) 2.00

D) 2.18   E) 5.55

8) Select the correct chemical formula for the precipitate that forms when the following reactants are mixed.

$CoSO_4(aq)$ + $(NH_4)_3PO_4(aq)$ →

A) $Co_3(PO_4)_2$ B) $CoPO_4$ C) $Co_3(PO_4)_2$

D) $(NH_4)_2SO_4$ E) $Co(PO_4)_2$

9) Using the following equation:

$$NaOH + H_2SO_4 \rightarrow H_2O + Na_2SO_4 \text{ (not balanced)}$$

How many grams of sodium sulfate will be formed if you start with 200.0 grams of sodium hydroxide and you have an excess of sulfuric acid?

a) 328 g b) 355 g c) 672 g

d) 710 g e) 656 g

10) Select the ionic compound which is insoluble in water.

a) Rb_2CO_3 b) $Co(NO_3)_3$ c) $MgBr_2$

d) $(NH_4)_3PO_4$ e) $Al(OH)_3$

11) How many grams of K_2CrO_4 are required to make 250 ml of 0.20 M K_2CrO_4?

a) 2.78 g b) 4.35 g c) 6.71 g

d) 9.71 g e) 11.6 g

12) Compound X contains 28.38 mass % C, 3.18 mass % H, 55.85 mass % Cl, and 12.60 mass % O. What is its empirical formula?

a) CHClO b) $C_3H_6ClO_2$ c) $C_3H_5Cl_2O_2$

d) $C_3H_4Cl_2O$ e) $C_4H_8Cl_2O$

13) You are preparing 0.525 M $Ca(NO_3)_2$ solution. What is the mass of solute needed to prepare 350 mL solution?

a) 12.45 g b) 21.20 g c) 30.15 g d) 32.4 g e) 36.6 g

14) How many moles of $Al(OH)_3$ contain 2.18×10^{21} oxygen atoms?

a) 1.21×10^{-3} b) 1.81×10^{-3} c) 3.62×10^{-3}

d) 0.28   e) 0.094

15) There are _____ protons, _____ neutrons, and _____ electrons in $^{210}Pb^{2+}$ isotope.

a) 80, 210, 82   b) 82, 128, 80   c) 82, 210, 2

d) 210, 82, 128   e) 80, 80, 2

16) Chromatography is a good way to separate the_____

a) elements in a compound.   b) the components in a mixture.

c) the atoms in an element.   d) the phases of a pure substance.

e) none of the above.

17) Classify each observation as a physical or a chemical property and tally them.

Observation 1: Gallium metal melts at 30 °C.

Observation 2: A dry piece of paper burns.

Observation 3: Chromium is the hardest metal

Observation 4: The density of a iron is 7.874 g/cm³

a) 2 chemical properties and 2 physical properties

b) 3 chemical properties and 1 physical properties.

c) 1 chemical properties and 3 physical properties

d) 4 chemical properties

e) 4 physical properties

18) The dimensions of a rectangular solid are 0.250 cm long, 0.120 cm wide, and 0.300 cm high. If the density of the solid is 10.0 g/cm³, what is its mass?

a) 90 grams

b) 9 grams

c) 9×10^7 grams

d) 0.09 grams ⟵ (circled)

e) 9×10^9 grams

19) How many oxygen atoms are there in 2.50 g of copper (II) chlorite?

a) 0.0125

b) 0.0252

c) 3.79×10^{21}

d) 1.51×10^{22}

e) 3.03×10^{22} ⟵ (circled)

20) Terephthalic acid, used in the production of polyester fibers and films, is composed of carbon, hydrogen, and oxygen. When 0.6943 g of terephthalic acid was subjected to combustion analysis it produced 1.471 g CO_2 and 0.226 g H_2O. If its molar mass is between 158 and 167 g/mol, what is its molecular formula?

a) $C_4H_6O_7$ b) $C_6H_8O_5$ c) $C_7H_{12}O_4$ d) $C_8H_{16}O_3$ e) $C_8H_6O_4$ ⟵ (circled)

21) Of the species below, only _____ is not an electrolyte.

a) HBr

b) $AgNO_3$

c) KOH

d) CCl_4 ⟵ (circled)

e) $CaCl_2$

22) A flask has a mass of 78.23 g when empty and 593.63 g when filled with water. When the same flask is filled with concentrated sulfuric acid, H_2SO_4, its mass is 1026.57 g. What is the density of concentrated sulfuric acid? (Assume water has a density of 1.00 g/cm^3 at the temperature of the measurement.)

a) 1.992 g/cm^3 b) 1.840 g/cm^3 c) 1.729 g/cm^3

d) 1.598 g/cm^3 e) 0.543 g/cm^3

23) What is the molarity of a solution in which 0.057 kg $NiCl_2·6H_2O$ is dissolved in enough water to make 350.0 cm^3 of solution?

a) 0.000685   b) 0.00023   c) 0.685

d) 0.342   e) 0.23

24) What is the mass percentage by mass of oxygen in CH_3COOH?

a) 24.7%   b) 31.8%   c) 40.0%

d) 6.70%   e) 53.3%

25) Which of the formulas below does not represent a compound that actually exists?

a) NaF   b) $Mg(NO_3)_2$ c) $CuSO_4.5H_2O$ d) K_2O_2 e) $Al_2(PO_4)_3$

TABLE 4.1 · Solubility Guidelines for Common Ionic Compounds in Water

Soluble Ionic Compounds		Important Exceptions
Compounds containing	NO_3^-	None
	CH_3COO^-	None
	Cl^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	Br^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	I^-	Compounds of Ag^+, Hg_2^{2+}, and Pb^{2+}
	SO_4^{2-}	Compounds of Sr^{2+}, Ba^{2+}, Hg_2^{2+}, and Pb^{2+}

Insoluble Ionic Compounds		Important Exceptions
Compounds containing	S^{2-}	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}
	CO_3^{2-}	Compounds of NH_4^+ and the alkali metal cations
	PO_4^{3-}	Compounds of NH_4^+ and the alkali metal cations
	OH^-	Compounds of NH_4^+, the alkali metal cations, Ca^{2+}, Sr^{2+}, and Ba^{2+}

Periodic Table of the Elements

Legend:
- Atomic Number
- Symbol
- Name
- Atomic Mass

1 IA / 1A	2 IIA / 2A	3 IIIB / 3B	4 IVB / 4B	5 VB / 5B	6 VIB / 6B	7 VIIB / 7B	8 VIII / 8	9 VIII	10 VIII	11 IB / 1B	12 IIB / 2B	13 IIIA / 3A	14 IVA / 4A	15 VA / 5A	16 VIA / 6A	17 VIIA / 7A	18 VIIIA / 8A
1 H Hydrogen 1.008																	2 He Helium 4.003
3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180
11 Na Sodium 22.990	12 Mg Magnesium 24.305											13 Al Aluminium 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.867	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.798
37 Rb Rubidium 84.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217	78 Pt Platinum 195.085	79 Au Gold 196.967	80 Hg Mercury 200.592	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Fl Flerovium [289]	115 Uup Ununpentium unknown	116 Lv Livermorium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

Lanthanide Series

57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967

Actinide Series

89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]

CHEM100 - General Chemistry   Midterm Key

① $HBrO_3$, bromic acid

② $CoSO_4 \cdot 4H_2O$

$58.933 + 32.065 + 16 \times 4 + 4 \times 18 = 227g/mol$

③ $4Al + 3O_2 \longrightarrow 2Al_2O_3$

$n = \dfrac{50.75}{26.98}$ $n = \dfrac{92.5}{32}$

$= 1.88 mol$ $= 2.89 mol$ (Aluminium is the limited reagent)

$\begin{array}{cc} 4 & 1.88 mol \\ 2 & x \end{array}$

$X = 0.94 mol$ of Al_2O_3

$0.94 mol = \dfrac{M}{101.96 g/mol} \implies M = 95.9 g$

④ $62.930 \times \dfrac{69.17}{100} + 64.928 \times \dfrac{30.83}{100} = 63.546$

⑤ $F = \dfrac{78.09}{18.988} = 4.108 mol$ $X = \dfrac{21.90}{MW}$ $\dfrac{4.108}{6} = 0.689 mol$ of X

$0.689 = \dfrac{21.90}{MW} \implies MW = 32.04 g/mol$
$= S//$

⑥ $0.162 \times 1.0970 = 0.178$
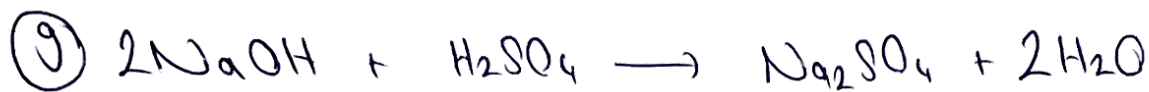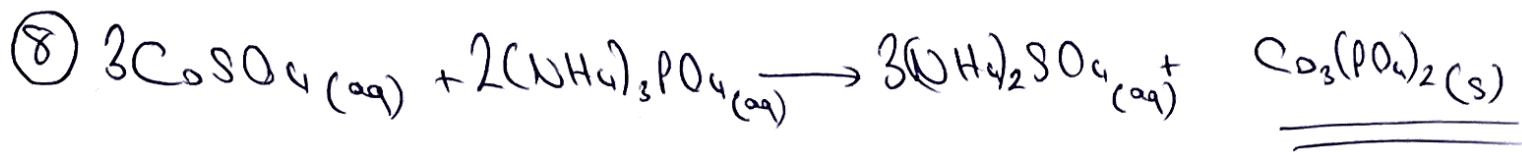$4.2580 / 2.632001 = 1.6178$ $\Big\}$ $0.178 + 1.6178 = 1.796$

⑦ $n_{PbCO_3} = \dfrac{2.50 g}{269.21 g/mol} = 9.35 \times 10^{-3} mol = n_{PbO}$

$9.35 \times 10^{-3} mol = \dfrac{M}{223.2}$

$= 2.08 g \times \dfrac{95.7}{100} = 2.00 g$

⑧ $3CoSO_4 (aq) + 2(NH_4)_3PO_4 (aq) \longrightarrow 3(NH_4)_2SO_4 (aq) + \underline{\underline{Co_3(PO_4)_2 (s)}}$

⑨ $\underline{2NaOH} + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

$n = \dfrac{200g}{40g/mol} = 5 mol$

$2.5 mol = \dfrac{M}{142 g/mol} \implies M = 355 g$

⑩ $Al(OH)_3$

⑪ $0.2 = \dfrac{n}{0.25} \implies n = 0.05 mol$ 　　$0.05 mol = \dfrac{M}{194.2 g/mol} \implies M = 9.71 g$

⑫ $C = \dfrac{28.38}{12} = 2.365 mol \Big/_{0.7875}$ 　$H = \dfrac{3.18}{1} = 3.18 mol \Big/_{0.7875}$

$Cl = \dfrac{55.85}{35.5} = 1.573 mol \Big/_{0.7875}$ 　$O = \dfrac{12.60}{16} = 0.7875 mol \Big/_{0.7875}$ 　$\underline{\underline{C_3H_4Cl_2O}}$
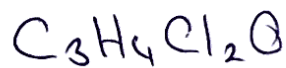
⑬ $0.525 = \dfrac{n}{0.350} \implies n = 0.18375 mol \implies 0.18375 mol = \dfrac{M}{164 g/mol} \implies M = 30.19 g$

⑭ $\dfrac{2.18 \times 10^{21}}{6.02 \times 10^{23}} = 3.62 \times 10^{-3} mol$ of oxygen

$\dfrac{3.62 \times 10^{-3}}{3} = 1.207 \times 10^{-3} mol$ of $Al(OH)_3$

(15) Mass number = 210
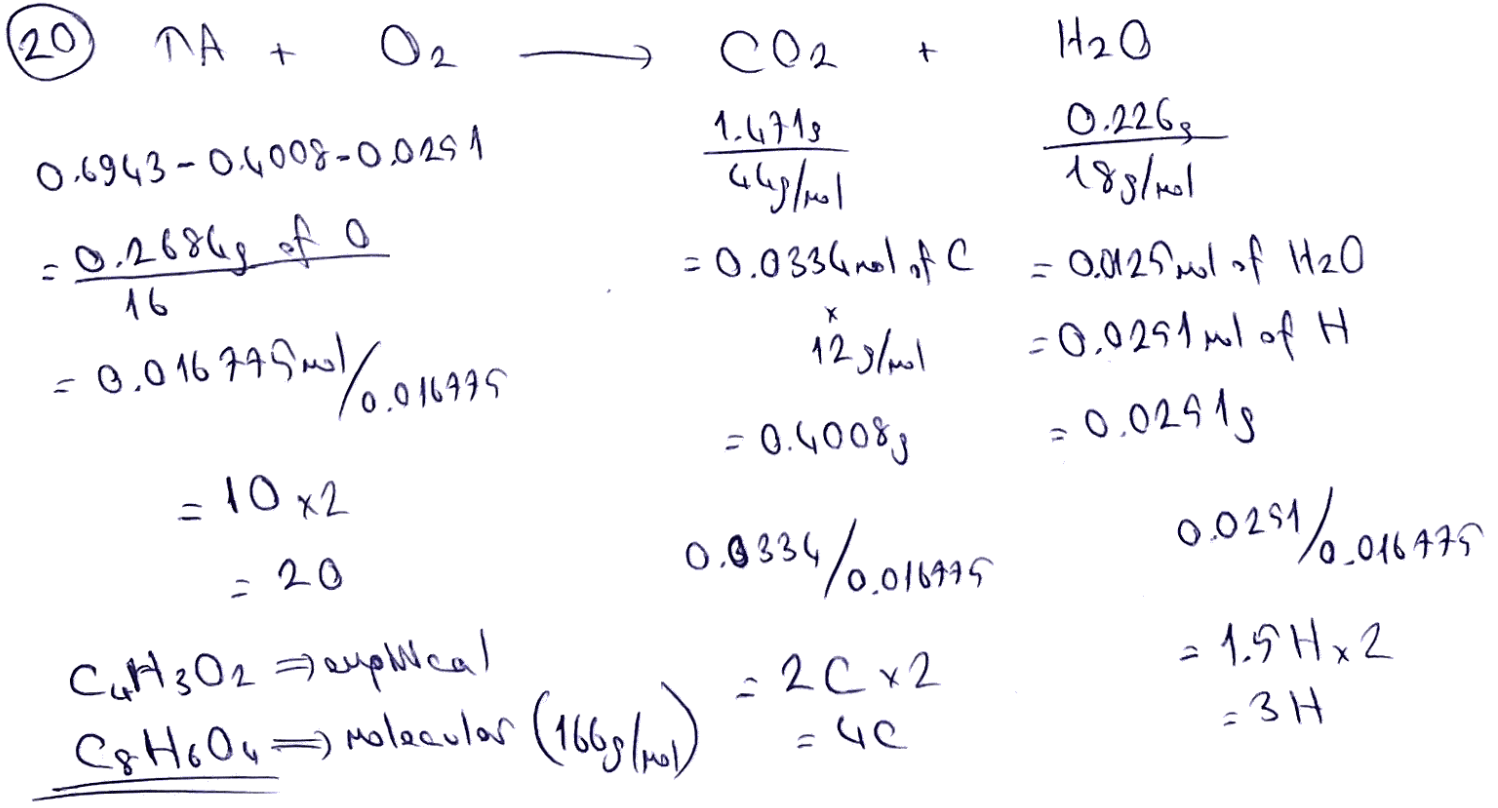proton = 82

$210 - 82 = n = 128$

$82 - e = +2$

$e = 80$

(16) Chromatography is a good way to seperate the components in a mixture.

(17) Observation 1 ⟹ physical   Observation 3 ⟹ physical
Observation 2 ⟹ chemical   Observation 4 ⟹ physical

* 1 chemical properties and 3 physical properties

(18) $V = (0.250) \cdot (0.120) \cdot (0.3) = 9 \times 10^{-3} cm^3$

$d = \dfrac{m}{V} \Rightarrow 10 \, g/cm^3 = \dfrac{M}{9 \times 10^{-3} cm^3} \Rightarrow M = 0.09 \, g$

(19) $Cu(ClO_2)_2$

$n = \dfrac{2.50 \, g}{198.4 \, g/mol} \Rightarrow n = 0.0126 \, mol \times 4 = 0.05 \, mol$ of oxygen

$0.05 \, mol \times 6.02 \times 10^{23} = 3.03 \times 10^{22}$

(20) $\Lambda A + O_2 \longrightarrow CO_2 + H_2O$

$0.6943 - 0.4008 - 0.0291$

$= 0.2686 \, g$ of O

$= \dfrac{0.2686 \, g \text{ of } O}{16}$

$= 0.016749 \, mol / 0.016749$

$= 10 \times 2$

$= 20$

$\dfrac{1.471 \, g}{44 \, g/mol}$

$= 0.0334 \, mol \text{ of } C$

$\times 12 \, g/mol$

$= 0.4008 \, g$

$0.0334 / 0.016749$

$= 2C \times 2$

$= 4C$

$\dfrac{0.226 \, g}{18 \, g/mol}$

$= 0.0125 \, mol \text{ of } H_2O$

$= 0.0251 \, mol \text{ of } H$

$= 0.0291 \, g$

$0.0251 / 0.016749$

$= 1.5 \, H \times 2$

$= 3H$

$C_4H_3O_2 \Rightarrow$ empirical
$C_8H_6O_4 \Rightarrow$ molecular $(166 \, g/mol)$

㉑ $\underline{\underline{CCl_4}}$ is nonpolar molecule.

㉒ mass of water = 593.63 − 78.23 = 515.4 g

$d = \dfrac{M}{V} \implies 1 g/mL = \dfrac{515.4 g}{V} \implies V = 515.4 \, mL$

Mass of H_2SO_4 = 1026.57 − 78.23 = 948.34 g

$d = \dfrac{948.34 g}{515.4} = \underline{\underline{1.84 \, g/cm^3}}$

㉓ $n = \dfrac{57 g}{237.7 g/mol} \implies n = 0.2398 \, mol$ $M = \dfrac{0.2398}{0.350} = \underline{\underline{0.685 \, mol/L}}$

㉔ $\dfrac{32}{60} \times 100\% \implies \underline{\underline{53\%}}$

㉕ $Al_2(PO_4)_3$ ✗

$AlPO_4$ ✓