

Eastern Mediterranean University

Department of Chemistry

CHEM103 GENERAL CHEMISTRY

2019-2020 Fall MIDTERM EXAM

19 November 2019 | 14:30-16:00 (90 minutes)

Name and surname: KEY TO MID_EXAM	Student No
Signature:	Group: <i>(Lose 1 mark if incorrect)</i>

INSTRUCTIONS:

- Write your name, surname and group no. on the question booklet. If group number is incorrect you **will lose 1 point**.
- The exam consists of 6 questions worth 100 points. To get full marks, answer all questions. **Show all steps in answering the questions. Use dimensional analysis and give your answers to correct significant figures.**
- The Periodic Table provided may be necessary to answer some of the questions.
- Use of mobile phones, exchange of calculators or rubbers is not allowed.
- You can see your papers in the first 10 days after the announcement of the results!*

Periodic Table of Elements

1 H 1.008	2 He 4.003	3 Li 6.94	4 Be 9.01	5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18	11 Na 22.99	12 Mg 24.30	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95														
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.54	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80														
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.42	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.71	51 Sb 121.75	52 Te 127.6	53 I 126.90	54 Xe 131.29														
55 Cs 132.91	56 Ba 137.33	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.97	80 Hg 200.59	81 Tl 204.38	82 Pb 207.2	83 Bi 208.98	84 Po 208.98	85 At 209.99	86 Rn 222.02
87 Fr 223.02	88 Ra 226.03	103 Lr 260.11																													

Lanthanides	57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.36	63 Eu 151.97	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
Actinides	89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu 244.06	95 Am 243.06	96 Cm 247.07	97 Bk 247.07	98 Cf 251.08	99 Es 252.08	100 Fm 257.10	101 Md 258.10	102 No 259.10

USEFUL CONSTANTS and RELATIONSHIPS

$$N_A = \frac{6.022 \times 10^{23}}{\text{mol}}, R = 0.0821 \frac{\text{L.atm}}{\text{K.mol}} = 8.314 \frac{\text{J}}{\text{mol.K}}, T(\text{K}) = T(^{\circ}\text{C}) + 273.15$$

Leave blank! For instructor's use	Q1 (10 points)	Q2 (20 points)	Q3 (20 points)	Q4 (20 points)	Q5 (20 points)	Q6 (10 points)	TOTAL (100 points)

Question 1

MULTIPLE CHOICE QUESTIONS

I. Which of the following observations is/are examples of **physical change**?

1. Iron (Fe) rusts, forming Fe_2O_3 .
2. Boiling water
3. Digesting food
4. Burning of wood.

- a. All
- b. 2 only
- c. 3 only
- d. 2 and 4
- e. 2 and 3

II. How many protons, neutrons, and electrons are in a sulfur ion (S^{2-}) with a **mass number of 32**?

- a. 16 protons, 16 neutrons, 18 electrons
- b. 18 protons, 16 neutrons, 17 electrons
- c. 32 protons, 18 neutrons, 18 electrons
- d. 16 protons, 18 neutrons, 17 electrons
- e. 17 protons, 16 neutrons, 32 electrons

III. Which is the correct conversion of 10.6 kg/m^3

- a. 0.0204 g/cm^3
- b. $0.106 \text{ cm}^3/\text{g}$
- c. 0.0106 g/cm^3
- d. 10.6 kg/cm^3
- e. 0.0204 kg/cm^3

IV. How many **non-metallic** elements are there in **group 18**?

- a. 0
- b. 1
- c. 2
- d. 3
- e. 6

V. Which of the following is homogeneous mixture?

- a. Chicken noodle soup
- b. Turkish kebab
- c. A bottle of vodka
- d. Blood
- e. Olive oil water

Question 2

2-1- Calculate number of **Rb atoms** in 25.55 g *Rb*?

2-2- How many moles of N are there in 5.60×10^{14} N molecules?

2-3- How many *grams* of **H** are there in 2.75 mol C_6H_5OH ?

2-4- Calculate *fluorine* percentage in CCl_2F_2 .

SOLUTION

2-1-

$$25.55 \text{ g Rb} \times \frac{1 \text{ mol Rb}}{85.47 \text{ g Rb}} \times \frac{6.022 \times 10^{23} \text{ Rb atoms}}{1 \text{ mol Rb}} = 1.8 \times 10^{23} \text{ Rb atoms}$$

2-2-

$$5.60 \times 10^{14} \text{ N molecules} \times \frac{1 \text{ mol N}}{6.022 \times 10^{23} \text{ N molecules}} = 9.2 \times 10^{-10} \text{ mol N}$$

2-3-

$$2.75 \text{ mol } C_6H_5OH \times \frac{6 \text{ mol H}}{1 \text{ mol } C_6H_5OH} \times \frac{1.008 \text{ g H}}{1 \text{ mol H}} = 16.6 \text{ g H}$$

2-4-

$$\% \text{ composition} = \frac{n \times \text{molar mass of element}}{\text{molar mass of compound}} \times 100\% \Rightarrow \%F = \frac{2 \times 19 \text{ g}}{120.91 \text{ g}} \times 100\% = 31.43\%$$

Question 3

3-1- Analysis of *Allicin* found in garlic gives the following composition by mass: C: 44.4%, H: 6.21%, S:39.5%, O:9.86%. What is its molecular formula if its molar mass is about 162g?

SOLUTION

If we have 100 g of *Allicin*, then each percentage can be converted directly to grams.

$$n_{\text{C}} = 44.4 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 3.697 \text{ mol C}$$

$$n_{\text{H}} = 6.21 \text{ g H} \times \frac{1 \text{ mol H}}{1.008 \text{ g H}} = 6.161 \text{ mol H}$$

$$n_{\text{S}} = 39.5 \text{ g S} \times \frac{1 \text{ mol S}}{32.07 \text{ g S}} = 1.232 \text{ mol S}$$

$$n_{\text{O}} = 9.86 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 0.6163 \text{ mol O}$$

$$\text{C}_{3.697}\text{H}_{6.161}\text{S}_{1.232}\text{O}_{0.6163} \Rightarrow \text{C} : \frac{3.697}{0.6163} \approx 6 \quad \text{H} : \frac{6.161}{0.6163} \approx 10 \quad \text{S} : \frac{1.232}{0.6163} \approx 2 \quad \text{O} : \frac{0.6163}{0.6163} = 1$$

Hence, the empirical formula is $\text{C}_6\text{H}_{10}\text{S}_2\text{O}$

$$\text{empirical molar mass} = 6(12.01 \text{ g}) + 10(1.008 \text{ g}) + 2(32.07 \text{ g}) + 16.00 \text{ g} = 162 \text{ g}$$

$$\frac{\text{molar mass}}{\text{empirical molar mass}} = \frac{162 \text{ g}}{162 \text{ g}} = 1, \text{ therefore the molecular formula is } \mathbf{C_6H_{10}S_2O}$$

Question 4

4-1- Fill in the blanks to complete the table

Symbol	Charge	No. of Electrons	No. of Protons	No. of Neutrons	Atomic number	Mass number
${}_{26}^{54}\text{Fe}^{2+}$	+2	24	26	28	26	54
${}_{16}^{32}\text{S}^{2-}$	-2	18	16	16	16	32
${}_{38}^{87}\text{Sr}$	0	38	38	49	38	87

4-2- Gallium has only two naturally occurring isotopes, Ga-69 and Ga-71. Use the following table to calculate the missing data.

Isotope	Mass (amu)	Abundance (%)
Ga-69	68.9256	60.11
Ga-71	70.9171	39.89

SOLUTION

Total abundance of isotopes = 100%

$$\text{Ga-71 (\%)} = 100 - 60.11 = 39.89\%$$

$$69.72 \text{ amu} = (0.6011) \times 68.9256 \text{ amu} + (0.3989) \times x \text{ amu}$$

$$0.3989x = 69.72 - 41.43 \Rightarrow x = \frac{28.29}{0.3989}$$

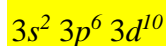
$$x = 70.92 \text{ amu (atomic mass of Ga-71)}$$

Question 5

5-1- What is the total number of orbitals and maximum number of electrons associated with the principal quantum number $n=3$?

SOLUTION

$s=1$ orbital, $p=3$ orbitals and $d=5$ orbitals, **total orbital =9**



Maximum *electrons* = 18

5-2- Write the electron configuration for Fe^{3+} .

SOLUTION

$\text{Fe}^{3+} = 23 e^-$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^3$

5-3- Write the *abbreviated* (short) electron configuration for I.

SOLUTION

$[\text{Kr}] 5s^2 4d^{10} 5p^6$

5-4- Write the orbital diagram for **In**.

SOLUTION

In = 49 electrons

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^1$

Orbital diagram:







MULTIPLE CHOICE QUESTIONS

Question 6

VI. Which of the following correctly arranges the given subshells in order of increasing energy (lowest to highest)?

- a. $2s < 3d < 4s$
b. $4s < 3p < 3s$
c. $2s < 3d < 4p$
d. $4p < 4f < 5s$

VII. Which of the following is the correct valence electron configuration of phosphorus?

- a.  b. 
c.  d. 

b

VIII. Which of the following has the largest atomic size?

1. Li
2. Be
3. Na
4. Mg

IX. How many unpaired electrons does selenium (#34) have?

1. 1
2. 2
3. 3
4. 4

X. What is the molecular weight of SO_3 ?

1. 48.07 amu
2. 48.07 g
3. 80.07 amu
4. 80.07 g