Multiple Choice Questions

01. An unknown element X reacts with bromine to form ionic compound XBr. If X^+ has 10 electrons, identify the element:
a) Mg b) Be c) Li d) Na e) Al

02. How many molecules are present in 0.250 mL of propanol, $CH_3CH_2CH_2OH$?
(Density = 0.803 g/mL, Molar mass = 60.11 g/mol)
a) 6.33×10^{21} b) 2.01×10^{21} c) 8.04×10^{21} d) 1.32×10^{21} e) 4.02×10^{21}

03. What is the sum of the coefficients of the reactants after balancing the equation:
$CH_4 + O_2 \rightarrow CO_2 + H_2O$

a) 6 b) 7 c) 11 d) 13 e) 19

04. In one experiment, 4.00 g of $H_2(g)$ reacts with 4.00 g of $O_2(g)$. If 1.94 g of $H_2O(l)$ is formed, what is the percentage yield of the reaction?
a) 97.1% b) 22.0% c) 35.0% d) 86.0% e) 43.1%

05. A compound contains 38.7% K, 13.9% N, and 47.4% O by mass. What is the empirical formula of the compound?
a) KNO
b) KNO_2
c) KNO_3
d) KNO_4
e) KN

06. Molality of an aqueous solution of a solute is 2.1 m. The mole fraction of the solute in the solution is:
a) 0.036 b) 0.070 c) 0.084 d) 0.096 e) 0.051

07. At 25 °C, 0.0404 g O_2 dissolves in one litre of water at 1.00 atm. What is the solubility when the pressure is 359 mmHg?
a) 3.42×10^{-4} mol/L
b) 2.64×10^{-4} mol/L
c) 5.96×10^{-4} mol/L
d) 9.29×10^{-4} mol/L
e) 7.37×10^{-4} mol/L

08. Arrange the following aqueous solutions in order of increasing boiling points:
1.10 m $Mg(NO_3)_2$, 1.10 m Ethanol, 1.10 m NaCl
a) $Mg(NO_3)_2$ < Ethanol < NaCl
b) Ethanol < NaCl < $Mg(NO_3)_2$
c) Ethanol < $Mg(NO_3)_2$ < NaCl
d) NaCl < Ethanol < $Mg(NO_3)_2$
e) $Mg(NO_3)_2$ < NaCl < Ethanol

09. Which one of the following salts is insoluble in water?
a) NH_4Cl b) $Ca(NO_3)_2$ c) $BaCO_3$ d) Na_2S e) $Zn(CH_3COO)_2$

10. Calculate the freezing point of a 0.700 m aqueous solution of $Al_2(SO_4)_3$
(Kf for water = 1.86 °C/m)
a) –2.79 °C b) –4.65 °C c) –6.51 °C d) –1.86 °C e) –8.37 °C

11. A 0.500 g protein sample in 50.0 mL aqueous solution shows osmotic pressure of 8.92 mmHg at 27.0 °C. Estimate the molar mass of the protein.
a) 1.51×10^4 g/mol b) 2.89×10^4 g/mol
c) 2.10×10^4 g/mol d) 3.53×10^4 g/mol e) 2.26×10^4 g/mol

12. A sample of helium has a volume of 1.98×10^{-3} L at 0.998 atm and 31 °C. What is the volume at 0.753 atm and –25 °C?
a) 2.53×10^{-3} L b) 2.79×10^{-3} L
c) 2.30×10^{-3} L d) 3.50×10^{-3} L e) 2.12×10^{-3} L

13. In which series is the lower energy level n = 3 in hydrogen atom?
a) Lyman b) Balmer c) Paschen
d) Brackett e) None of the above

14. Which of the following sets of quantum numbers is not possible?
a) (1,0,0,+½) b) (1,0,1,–½)
c) (3,2,–2,+½) d) (3,2,1,–½) e) (4,2,0,+½)

15. An ion (X^{2+}) with the electron configuration [Ar] $3d^5$ is:
a) V b) Mn c) Co d) Cr e) Fe

16. Which of the following describes the energy for this process:
$Li(g) \rightarrow Li^+(g) + e^-$

a) Electron affinity b) Binding energy
c) Ionization energy d) Electronegativity e) None of these

17. The correct Lewis structure for nitrogen trichloride (NCl_3) has:
a) 3 N–Cl bonds and 6 lone pairs of electrons
b) 1 N–Cl bond, 2 N–Cl bonds and 7 lone pairs
c) 2 N–Cl bonds, 1 N–Cl bond and 8 lone pairs
d) 3 N–Cl bonds and 10 lone pairs of electrons
e) 3 N–Cl bonds and 9 lone pairs of electrons

True or False (T/F)

1. The boiling point of a 0.5 m glucose aqueous solution is lower than that of a 0.5 m sodium chloride solution. (T / F)
2. O^{2-}, F^-, and Ne all are isoelectronic species. (T / F)
3. The density of a gas is constant as long as its temperature remains constant. (T / F)
4. Formal charge on nitrogen in NO_3^- is +1. (T / F)
5. PCl_5 molecule does not obey the octet rule. (T / F)
6. Solutions of weak acids always have lower concentrations of H^+ than solutions of strong acids. (T / F)

University of Bahrain, Department of Chemistry

General Chemistry I (Chemy 101)

Second Semester 2013-2014, Third Hour Examination

June 1st, 2014 **Time**: 70 min

Examiners: Profs. Al-Arab, Akhter, Drs. Saeed, Jameela, Ameera, Saad, Layla, Suad, Ali.

$R = 0.0821$ L·atm/(mol·K)	1 atm = 760 mmHg	$T(\text{K}) = t(^\circ\text{C})+273.15$
$R_H = 2.180\times10^{-18}$ J	$h = 6.626\times10^{-34}$ J·s	$c = 2.998\times10^{8}$ m/s

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Q1. (1 mark)

Which of the following statements regarding the colligative properties are true?

I. The vapor pressure of water over an aqueous solution of glucose is less than the vapor pressure of pure water.

II. The boiling point of an aqueous solution of glucose is less than the boiling point of pure water.

III. The freezing point of an aqueous solution of NaCl is less than the freezing point of pure water.

IV. The osmotic pressure of 0.1M aqueous solution of NaCl is more than that of 0.1M aqueous solution of sugar, both at 25°C.

a) I , III b) I , II , IV c) I , IV d) I , III , IV e) III , IV

Q2. (3 marks)

0.100 g of a compound is dissolved in enough water to make 125 mL solution. The solution has an osmotic pressure of 2.5 mmHg at 25°C. What is the molar mass of the compound? *Show your work*.

Q3. (2 marks)

Estimate the normal boiling point of 0.45 m aqueous solution of $FeCl_3$. k_b of water = 0.52°C/m. *Show your work*.

Q4. (2 marks)

A sample of air is originally at 35°C. If pressure and number of moles are kept constant, to what temperature (in °C) must the air be cooled to decrease its volume to 45% of its original value? *Show your work*.

Q5. (1 mark)

By what factor does the density of a gas changes if its pressure is tripled while its absolute temperature is doubled?

a) 6 b) 3/2 c) 4 d) 2/3 e) 1

Q6. (1 mark)

Consider the reaction $N_2O_5\,(g) + H_2O \rightarrow 2H^+\,(aq) + 2NO_3^-\,(aq)$.

How many moles of H^+ are produced when 1.50 L of N_2O_5 at 25°C and 1.00 atm is bubbled into water?

a) 0.147 b) 0.0306 c) 0.204 d) 0.0510 e) 0.123

Q7. (3 marks)

5.3 g of Ar, 0.30 moles of He, and 650 mL of Ne at 0.80 atm and 25°C were introduced in a 5.0 L flask at a total pressure of 1.5 atm. What is the partial pressure of Ar? *Show your work*.

Q8. (1 mark)

Calculate λ (in nm) for the emission of light from n = 6 in the Balmer series.

a) 94.89 b) 1282 c) 1094 d) 410.3 e) 434.2

Q9. (1 mark)

What are the possible values of m_ℓ for the d sublevel?

a) 0,+1+,2,+3 b) 0,+1,+2 c) +1,0,−1

d) +3,+2,+1,0,−1,−2,−3 e) +2,+1,0,−1,−2

Q10. (1 mark)

What type of electron orbital is designated by n = 6 , ℓ = 3 , m_ℓ = 2 ?

a) 6f b) 5f c) 6d d) 3p e) 3s

Q11. (1 mark)

Give the number of orbitals in a 4p sublevel.

a) 2 b) 5 c) 4 d) 7 e) 3

Q12. (1 mark)

How many electrons in an atom can have the following quantum number designation?

$n = 3 , \ell = 1 , m_\ell = -1 , m_s = +1/2$

a) 1 b) 2 c) 3 d) 4 e) 6

Q13. (1 mark)

Which of the following set of quantum numbers (n , ℓ , m_ℓ , m_s) are incorrect?

I. (5, 4, 0, −½) II. (6, 6, 5, +½) III. (3, 2, 0, −1)
IV. (2, 1, 0, +½) V. (4, 3, −4, −½)

a) I, II, IV b) II, III, V c) III, IV, V d) II, III e) I, IV

Q1. The **name** of ICl_3 is

a) iodine chloride
b) iodine(III) chloride
c) iodide chloride
d) iodine trichloride
e) iodine chlorine

Q.2 The **name** of $Co(ClO_3)_3$ is :

a. Cobalt Chlorite
b. Cobalt (III) Chlorite
c. Cobalt (III) hypochlorite
d. Cobalt (III) Chloride
e. Cobalt (III) Chlorate

Q.3 Consider the following reaction :

$$\mathbf{6\ Li(s) + N_2(g) \rightarrow 2\ Li_3N(s)}$$

Determine the **limiting reactant and the number of moles of the excess reactant remaining** when 3 moles of each reactant react.

a. $N_{2(g)}$ and 0.5 moles $Li_{(s)}$ remaining
b. $Li_{(s)}$ and 0.5 moles $N_{2(g)}$ remaining
c. $N_{2(g)}$ and 3.0 moles $Li_{(s)}$ remaining
d. $Li_{(s)}$ and 1.0 moles $N_{2\ (g)}$ remaining
e. $Li_{(s)}$ and 2.5 moles $N_{2\ (g)}$ remaining

Q.4. All the following compounds are **soluble** in water except

(a) $Fe(NO_3)_3$ (b) Na_2SO_4 (c) $Ba(OH)_2$ (d) d) $NiCl_2$ (e) $Fe(OH)_2$

Q.5 The **number of moles** H_2SO_4 that has 2.4×10^{22} atoms of oxygen is :

a. 0.05 moles
b. 1.23 moles
c. 0.014 moles
d. 4.42 moles
e. 0.01 moles

Q.6. The density of ethanol (C_2H_5OH) is 0.789 g/mL. How many **carbons atoms** are present in 450 mL of this liquid?

a) 9.3×10^{22}
b) 9.3×10^{23}
c) 9.3×10^{24}
d) 7.9×10^{20}
e) 6.4×10^{17}

Q.7. Which of the following molecules or ions has the **same Lewis structure as N_2**?

a) O_2
b) CN^-
c) CO
d) Answers a and c are correct
e) Answers b and c are correct

Q.8. A 1.00 gram sample of a compound containing the elements: C, H, O is burned completely and converted to 2.379 g CO_2 and 1.216 g H_2O. What is its **empirical (simplest) formula**?

(a) C_2H_6O (b) C_2H_5O (c) C_3H_8O (d) $C_2H_2O_4$ (e) $C_4H_{10}O$

Q.9 The number of **unpaired** electrons in (Co^{3+}, Co^{2+}, Co^{4+}) is :

a. (5,4,3) b. (3,4,5) c. (4,5,3) d. (4,3,5) e. (5,3,4)

Q.10 **How many millilitres** of 1.15 M $Ca(OH)_2$ solution are needed to neutralize completely 25.0 ml of 0.800 M H_3PO_4 solution?

$$\mathbf{3Ca(OH)_2 + 2H_3PO_4 \longrightarrow Ca_3(PO_4)_2 + 6H_2O}$$

a) 39.2 mL b) 26.1 mL c) 15.9 mL d) 58.8 mL e) 13.1 mL

Q.11 Which of the following is **not isoelectronic** with Ne ?

a) F^- b) O^{2-} c) Na^+

d) K^+ e) Mg^{2+}

Q.12 The sum of coefficients of **reactants** after balancing the equation

$ClO_3^- + Cl^- \rightarrow Cl_2 + ClO_2$ (acidic solution)

a) 4 b) 5 c) 8 d) 9 e) 13

Q.13 How many **grams of nitrogen gas** must be added to a 6.0 L cylinder containing 6.65 gram of oxygen gas at 20°C to get a total pressure of 4.5 atm?

a) 25.6 g b) 11.2 g c) 6.40 g d) 22.5 g e) 12.8 g

Q.14 **At what temperature** does 1 atm of $N_{2(g)}$ has the **same density** as 1 atm of the $He_{(g)}$ at 30°C?

a) 425 K b) 1981 K c) 2086 K d) 2121 K e) 430 K

Q.15 A line in the **Balmer series** occurs at 410.18 nm. Calculate $\mathbf{n_{hi}}$ for the transition associated with this line.

a) 5 b) 4 c) 3 d) 6 e) 7

Q.16 Which one of the following set of quantum ... orbitals?

a) (3, 0, 0, + ½) b) (3, 1, -1, + ½) c) (3, 2, 1, + ½)

d) (3, 3, -2, + ½) e) (3, 2, 3, + ½)

Q.17 The formal charge(s) on O atoms in NO_3^- is/are

a) 0 b) +1 c) 0 and +1 d) 0 and –1 e) +1 and –1

Q.18 The **electron** configuration for Cu^{+1} is :

a. $[Ar]3d^1$ b. $[Ar]4s^13d^9$ c. $[Ar]4s^23d^9$

d. $[Ar]3d^{10}$ e. $[Ar]4s^23d^8$

Q.19 Calculate the **percentage by mass** of an aqueous solution of Na_2CO_3 whose molarity is 4.8 M and its density is 1.24 g/ml?

a) 20.5% b) 41.0 % c) 10.25% d) 54.9% e) 8.7 %

Q.20 Calculate the **molality** of an aqueous solution of NaCl with mole fraction of NaCl equal 0.12?

a) 14.8 m b) 65.67 m c) 45.87 m d) 26.14 m e) 7.6 m

Q.21 The % by mass of NaOH in a sloution is 40 %. What is its **molarity** (Density of solution = 1.35 g/ml)?

a) 6.75 M b) 13.50 M c) 15.98 M d) 19.72 M e) 22.65 M

Q.22 **At what temperature** will a mixture of 2.00 g of $CaCl_2$ and 25.0 g of water freeze ? (K_f (H_2O) = 1.86 °C/m).

a. - 0.149°C b. - 1.34°C c. - 2.01°C d. - 4.02°C e. - 8.04°C

Q.23 A solution is prepard by dissolving 5.00 g of unknown molecular solid in water to make 1.00 L of solution. The osmotic pressure of the solution is 1.61 atm at 25 °C. What is the molar mass of the solute?

a. 6.37 g/mol b. 228.0 g/mol c. 76.0 g/mol d. 102 g/mol e. 152.0 g/mol

Q.24 The oxidation number of **P** in PO_4^{3-} is

a) + 4 b) + 5 c) + 8 d) – 4 e) – 8

Q.4. ***(1.0 point)***

Place the following elements in order of increasing electronegativity.

Sr, N, P, F

Lowest	Lower	Higher	Highest

Q.5. ***(1.0 point)***

Choose four isoelectronic to K^+ from the following,

Mg^{2+}, Ca^{2+}, Sr^{2+}, Br^-, S^{2-}, Na^+, Cl^-, As^{3+}, Ar

Q.6. ***(1.0 point)***

A ground-state of Fe^{3+} ion has_____ unpaired electrons and is _____ (paramagnetic/diamagnetic)

Q.7. ***(1.0 point)***

The correct orbital diagram for Cr^{3+} is

Q.8–Q.15, Multiple choice questions are worth one point each. Please circle one correct answer for the following questions. ***(1 point each)***

Q.8.

A mixture of 0.225 moles of CO, 0.350 moles of H_2 and 0.640 moles of He has a total pressure of 2.95 atm. What is the partial pressure of H_2?

a) 0.969 atm b) 1.554 atm c) 0.546 atm d) 0.649 atm e) 0.850 atm

Q.9.
A gas mixture consists of N_2, O_2, and Ne, where the mole fraction of N_2 is 0.55 and the mole fraction of Ne is 0.25. If the mixture is at STP in a 5.0 L container, how many molecules of O_2 are present?

a) 1.1×10^{23} molecules O_2 b) 8.1×10^{22} molecules O_2 c) 2.7×10^{22} molecules O_2

d) 5.4×10^{22} molecules O_2 e) 9.3×10^{24} molecules O_2

Q.10.
What volume of N_2O gas, collected over water, at a total pressure of 826 mm Hg and 25°C, can be produced from the decomposition of 2.6 g NH_4NO_3? (The vapour pressure of water at 25°C is 23.8 mm Hg)

$$NH_4NO_3(s) \rightarrow N_2O(g) + 2H_2O(l)$$

a) 753 mL b) 635 mL c) 1332 mL d) 936 mL e) 1912 mL

Q.11.
A line in Lyman series occurs at a wavelength of 94.95 nm. What is the higher energy level (n_{hi}) that is associated with this emission?

a) 3 b) 4 c) 5 d) 6 e) 7

Q.12.
Which of the following sets of quantum numbers is impossible?

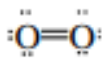
a) $n = 2, l = 1, m_l = -1, m_s = -½$
b) $n = 4, l = 2, m_l = 0\ m_s = ½$
c) $n = 3, l = 0, m_l = 0, m_s = -½$
d) $n = 1, l = 0, m_l = 0, m_s = -½$
e) $n = 3, l = 3, m_l = -2, m_s = ½$

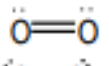
Q.13.
What is the ground state electron configuration for Co^{2+}?

a) [Ar] $4s^2 3d^7$ b)[Ar] $4s^1 3d^5$ c)[Ar] $3d^7$ d)[Ar] $4s^1 3d^{10}$ e)[Ar] $3d^5$

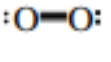
Q.14.
Which of the following is a correct Lewis structure for oxygen gas?

a. O=O

b. 

c. 

d. 

e. 

Q.15.

What is the total number of bonding and nonbonding electrons in the Lewis structure of sulfur trioxide SO_3, respectively?

a. 6 and 18 e^- b. 8 and 16 e^- c. 10 and 14 e^- d. 4 and 20 e^- e. 12 and 12 e^-

Q.4. Which one of the following pure gases has the **greatest** density at STP?

a) H_2 b) $CClF_3$ c) CO_2 d) C_2H_6 e) CF_4

Q.5. Formic acid, $HCHO_2$, decomposes to give CO gas.

$$HCHO_2(l) \rightarrow H_2O(l) + CO(g)$$

If 3.85 L of carbon monoxide, CO, was collected over water at 25 °C and 689 mm Hg, how many **grams of formic acid** were consumed?
(Vapour pressure of water at 25°C is 23.8 mm Hg)

a) 3.65 g b) 5.43 g c) 6.35 g d) 7.75 g e) 9.62 g

Q.6. **How many liters of oxygen gas** at 153°C and 0.820 atm can be produced by the decomposition of 22.4 g of solid $KClO_3$?

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

a) 23.3 L b) 0.085 L c) 46.8 L d) 7.79 L e) 11.7 L

Q.7. 502 mL of Ne at 18°C and 1.04 atm are mixed with 364 mL of SF_6 at 18°C and 0.85 atm in a 250 mL flask at the same temperature. Calculate the **partial pressure of Ne.**

a) 1.24 atm b) 1.89 atm c) 2.09 atm d) 2.89 atm e) 3.56 atm

Q.8. Place the following regions of the electromagnetic spectrum in order from **longest to shortest wavelenght.**

a) radio waves > microwaves > visible > ultraviolet > gamma ray
b) gamma ray > microwaves > radio waves > visible > ultraviolet
c) radio waves > ultraviolet > gamma ray > microwaves > visible
d) microwaves > visible > ultraviolet > gamma ray > radio waves
e) microwaves > radio waves > ultraviolet > visible > gamma ray

Q.9. A helium-neon laser emits light at 632.8 nm. What is the **energy per one mole of photons** from this laser?

a) 1.890×10^{5} J/mole b) 3.139×10^{-19} J/mole c) 4.235×10^{5} J/mole
d) 3.139×10^{5} J/mole e) 2.111×10^{-15} J/mole

Q.10. A line in Balmer series occurs at a wavelength of 434.05 nm. What is the **higher energy level (n_{hi})** that is associated with this emission?

a) 3 b) 4 c) 5 d) 6 e) 7

Q.11. All of the following sets of quantum numbers, (n, ℓ, m_ℓ, m_s) respectively, are allowed (possible) **EXCEPT**

a) (1,0,1,-½) b) (2,1,0,+½) c) (3,1,-1,-½) d) (4,3,-1,-½) e) (6,3,-3,+½)

Q.12. All the following statements are correct for **p orbitals EXCEPT**

a) The shapes of p orbitals consist of two lobes along an axis (x,y, or z).
b) There are three p orbitals available.
c) All p orbitals have spherical shapes.
d) The third quantum number, m_ℓ, for p orbitals are, $m_\ell = 1,0,-1$.
e) Only six electrons, as a maximum number, can be occupied in p orbitals.