



Answer by encircling the letter in front of one of the offered answers. Each correct answer is worth 2 points. A wrong answer is penalized by -0.25 points. Unanswered questions do not alter the score. Using a pencil, encircling of two or more answers or drawing over the answer is penalized by -0.25 points. Each problem is worth a total of 5 points.

JURY ONLY

Total points: _____

Checked by: _____

I. MULTIPLE CHOICE TEST WITH A SINGLE CORRECT ANSWER

(Encircle **only one** of the answers A,B, C,DorE)

1. A salt dissolved in water could be separated from the water by

- A. Decantation.
- B. Aspiration.
- C. Distillation.
- D. Filtration.
- E. Coagulation.

2. The relative atomic mass of an atom is the quotient of its mass with 1/12 of the:

- A. Mass of oxygen.
- B. Mass of carbon.
- C. Mass of carbon 13.
- D. Mass of carbon 14.
- E. Mass of carbon 12.

3. During a β radioactive decay of a nuclide, its isobar is obtained. What does it mean?

- A. The product is another compound
- B. It is the same nuclide, but with a larger mass number.
- C. It is the same nuclide, but with a lower mass number.
- D. The nuclide is being destroyed.
- E. It is a nuclide of another element but with the same mass number.

4. The equations $2\text{H}_2 + \text{O}_2 = 2\text{H}_2\text{O}$ and $\text{H}_2 + 1/2\text{O}_2 = \text{H}_2\text{O}$ describe the same reaction. In that case, upon consumption of 2 mols of hydrogen:

- A. The change of the extent of both reactions is equal.
- B. The change of the extent of both reactions is different.
- C. The change of the extent of the first reaction is 1, and of the second is 2.
- D. The change of the extent of both reactions is 2.
- E. The change of the extent of both reactions is 1.

5. The orbitals (by shape) are:

- A. Space directed.
- B. Angle directed.
- C. Spherical.
- D. Cylindrical.
- E. Like the number 8.

6. The fluorine adopts the electron configuration of [He], and the rest of 7 electrons fill the orbitals with $n = 2$. Which configuration is correct?

- A. $[\text{He}]2s^2 2p_1^2 2p_0^2 2p_{-1}^1$

B. $[\text{He}]2s^1 2p_1^2 2p_0^2 2p_{-1}^2$

C. $[\text{He}]2s^2 2p_1^1 2p_0^2 2p_{-1}^2$

D. $[\text{He}]2s^2 2p_1^2 2p_0^1 2p_{-1}^2$

E. $[\text{He}]2s^2 2p_1^2 2p_0^1 2p_{-1}^1$

7. Considering the variation of electronegativity along the period, which molecule – CO or NO – is expected to be more polar?

- A. CO.
- B. NO.
- C. There is no difference.
- D. Molecules are not polar entities.
- E. Both are ionic compounds, therefore they are not molecules.

8. What is the valence of chlorine in CCl_4 :

- A. 4
- B. 7
- C. 1
- D. 8
- E. 0.25

9. The stoichiometric coefficients of the constituents in the reaction described by the equation $\text{HgS} + \text{HCl} + \text{HNO}_3 = \text{HgCl}_2 + \text{NO} + \text{S} + \text{H}_2\text{O}$ are (left to right):

- A. 6, 3, 1, 6, 1, 6, 7
- B. 2, 6, 3, 2, 3, 6, 4
- C. 2, 6, 3, 3, 2, 6, 5
- D. 3, 6, 2, 3, 2, 3, 4
- E. 3, 6, 2, 3, 3, 3, 4

10. Upon heating of CaCO_3 , CaO and CO_2 are obtained. CaO is transferred in a vessel with water, while CO_2 is transferred in another vessel with water. What are the products obtained upon dissolution?

- A. CaO and CO_2 are not water soluble.
- B. CaOH and HCO_3 .
- C. CaHCO_3 and CO .
- D. Crystallohydrates.
- E. $\text{Ca}(\text{OH})_2$ and H_2CO_3 .

11. $\text{Al}(\text{OH})_3$ reacts with aqueous solution of NaOH . In that case:

- A. There is no reaction; both are bases.
- B. The products is $\text{NaAl}(\text{OH})_4$.
- C. The products are $\text{Al}(\text{OH})_4$ and elemental Na .
- D. The products are Na_3AlO_3 and water.
- E. The products are Na_3Al and water.

12. All correct chemical names of: P_2O_5 , $HClO_2$, $Fe(OH)_2$, $AlK(SO_4)_2 \cdot 12H_2O$ are under the letter:
A. Phosphorus(V) oxide, chlorous acid, iron hydroxide, aluminiumpotassium sulfate dodecahydrate.
B. Phosphorus penta oxide, hydrochloric acid, ferrium hydroxide, potassium(I)aluminium(III) sulfate hydrate.
C. Diphosphoruspentaoxide, hypochlorous acid, ferrous hydroxide, aluminiumpotassium sulfate dodecahydrate.
D. Diphosphoruspentaoxide, chlorous acid, ferrous hydroxide, aluminium potassium sulfate dodecahydrate.
E. Diphosphorusfiveoxide, chlorous acid, ferrous hydroxide, potassiumaluminium sulfate dodecahydrate.

13. $Zn(OH)_2$, $Al(OH)_3$ are:
A. Salts.
B. Bases.
C. Amphoteric hydroxides.
D. Acids.
E. Metallic oxides.

14. A crystal is powdered. The substance, in that case, is:
A. Amorphous, consisting of tiny crystals.
B. Crystalline, consisting of tiny crystals.
C. Amorphous, consisting of tiny amorphous phases.
D. Crystalline, consisting of tiny amorphous phases.
E. An amorphous crystal.

15. If a K atom is heavier than a Na one, but lighter than a Rb one, then:
A. The ionization energy of K is higher than that of Na.
B. The ionization energy of K is lower than that of Na.
C. The ionization energy of Rb is higher than that of K.
D. The ionization energy of Na is lower than that of Rb.
E. The ionization energy of Rb is higher than that of Na.

Write the procedure and the result in the rectangle under each problem and only the written in the rectangles will be checked. You may freely use the other side of the paper, but that will not be checked nor will points be assigned, unless written as advised.

II. PROBLEMS

1. Pehblenda is a uranium ore in which the mass fraction of U_3O_8 equals 75 %. Determine the mass of uranium present in 1 t of the ore. $M(\text{U}) = 238.03 \text{ g mol}^{-1}$; $M(\text{O}) = 15.999 \text{ g mol}^{-1}$.

Solution:

2. What is the yield in the reaction given by the equation $\text{Fe} + \text{Cl}_2 = \text{FeCl}_3$ (balance the equation first!) if the initial masses of Fe and Cl_2 are 6 g and 15 g, respectively, while the mass of the product FeCl_3 is 16 g. $A_r(\text{Fe}) = 55.845$; $A_r(\text{Cl}) = 35.45$.

Solution:

3. The extent of the reaction (ξ) is a quantity showing “the point reached by the chemical reaction”. It is defined as a change of the quantity of any reaction constituent, i.e. $(n-n_0)$, divided by the corresponding stoichiometric coefficient ν . The sign of the latter is negative for reactants and positive for products. The extent of the reaction of saponification using ester ethyl acetate (given by the equation $\text{CH}_3\text{COOC}_2\text{H}_5 + \text{NaOH} = \text{CH}_3\text{COONa} + \text{C}_2\text{H}_5\text{OH}$ – check whether it is balanced) is $2 \cdot 10^{-3}$ mol, while the initial quantity of ethyl acetate is $5 \cdot 10^{-3}$ mol. What is the mass of the acetate ions, CH_3COO^- ? $A_r(\text{H}) = 1.008$; $A_r(\text{O}) = 15.999$; $A_r(\text{C}) = 12.011$.

Solution:

4. 5 g of some compound are dissolved in water and some lemon was squeezed in it, too. The compound reacts with water (further aided by the lemon present), giving rise to an equal quantity of glucose ($\text{C}_6\text{H}_{12}\text{O}_6$), with mass of 2.6316 g. The fractions of carbon and of hydrogen in the compound are $w(\text{C}) = 42.11\%$, $w(\text{H}) = 6.48\%$, the rest being oxygen. What is the true formula of the compound? $A_r(\text{H}) = 1.008$; $A_r(\text{O}) = 15.999$; $A_r(\text{C}) = 12.011$.

Solution:

