



Give the answer by marking only one from the 5 offered options. Every correct answer brings 2 points. Every wrong answer brings negative 0.25 points. Not answered question brings 0 points. Negative 0.25 points will be also given for answering with a pencil, for marking two or more answers and for striking through the answer.

JURY ONLY

Total points: \_\_\_\_\_

Checked by: \_\_\_\_\_

MULTIPLE CHOICE TEST WITH A SINGLE CORRECT ANSWER  
(Encircle **only one** of the offered answers under A, B, C, D or E)

- A compound represents:
  - a pure substance
  - a simple substance
  - a homogeneous mixture
  - a heterogeneous mixture
  - an element
- The total mass of the constituents in an ordinary chemical reaction:
  - never changes
  - changes if the test-tube is not sealed
  - changes in every reaction
  - changes if a metal burns in air
  - does not change, if one considers Einsteins law
- In  $\text{Al}_2(\text{SO}_4)_3$  the mole ratio of the elements Al, S, O equals:
  - 2:1:4
  - 2:3:3
  - 1:1:4
  - 2:3:12
  - 2:3:4
- The chemical equation  $\text{FeCl}_3 + \text{K}_2[\text{Fe}(\text{CN})_6] = \text{Fe}_2[\text{Fe}(\text{CN})_6]_3 + \text{KCl}$  is balanced with the following left-to-right set of stoichiometry coefficients in front of the chemical formulae:
  - 1:2:3:4
  - 3:2:1:2
  - 2:3:1:6
  - 3:1:1:3
  - 3:3:2:6
- What is the rate of the reaction represented by  $8\text{HCl} + 2\text{KMnO}_4 = 2\text{MnO}_2 + 2\text{KCl} + 3\text{Cl}_2 + 4\text{H}_2\text{O}$ , if 5 mols of  $\text{KMnO}_4$  are consumed:
  - 2.5 mol
  - 2/5 mol
  - 2.5
  - 2 mol
  - 2
- Which statement is true?
  - Protium and deuterium are isobars
  - $^{138}_{56}\text{Ba}$  and  $^{138}_{58}\text{Ce}$  are isotopes
  - $^{40}\text{K}$  and  $^{39}\text{K}$  are isotopes
  - $^{40}\text{K}$  and  $^{39}\text{K}$  are isobars
  - $^{138}_{56}\text{Ba}$  and  $^{138}_{58}\text{Ce}$  contain the same nuclides
- The Heisenberg principle states that:
  - electrons in atoms or molecules cannot have arbitrary energy
  - atoms exist in precisely determined trajectories
  - an atomic orbital is a part in space with a maximum probability of finding the electron
  - the exact position and velocity of an electron cannot be simultaneously determined
  - the fundamental particles are the basic building blocks of matter
- The oxygen atom has eight electrons. Which scheme is correct?
  - |                      |                      |  |  |
|----------------------|----------------------|--|--|
| $\uparrow\downarrow$ | $\uparrow\downarrow$ | $\uparrow\downarrow\uparrow\downarrow$ |  |
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1s    2s                  2p
- Which orbitals start to fill in period VI?
  - 4f orbitals
  - 6f orbitals
  - 3d orbitals
  - 3g orbitals
  - 5p orbitals

10. With increasing atomic number, the atomic radius:
- increases within a single period.
  - decreases within a single period.
  - does not vary within one group.
  - does not vary within the period.
  - decreases within one group.
11. With increasing atomic number, the ionization energy:
- decreases within a single period.
  - does not vary within one group.
  - increases within a single period.
  - does not vary within the period.
  - Increases within one group.
12. Which statement is true?
- $p$  orbitals can form a  $\sigma$  bond.
  - $p$  orbitals participate only in  $\pi$  bonding.
  - $s$  orbitals can form a  $\pi$  bond.
  - $s$  orbitals do not form  $\sigma$  bond.
  - $s$  and  $p$  orbitals do not form a bond.
13. Large difference in electronegativities between the atoms is at the origin of:
- a covalent bond
  - an ionic bond
  - a polar covalent bond
  - a hybrid covalent bond
  - a hydrogen bond
14. Which  $s$  elements possess a second ionization potential?
- The alkali elements.
  - The alkaline earths.
  - The Group 1 elements.
  - The elements of Group 8.
  - The elements belonging to groups 13–18.
15. Hybrid  $sp^3$  orbitals form by “mixing” of:
- One  $s$  and one  $p$  orbital.
  - One  $s$  and one  $p$  orbitals.
  - Two  $s$  and one  $p$  orbital.
  - Two  $s$  and three  $p$  orbitals.
  - One  $s$  and three  $p$  orbitals.
16. What is the difference in the bonding between NaCl and HCl?
- No difference, both are ionic.
  - The bond in NaCl is ionic, whilst the one in HCl is non-polar covalent.
  - No difference, both are covalent.
  - The bond in NaCl is ionic, whilst the one in HCl is polar covalent.
  - Both are compounds with hydrogen bond.
17. Solid state substances are arranged in regular pattern.
- Yes, all of them.
  - No.
  - Only the crystalline.
  - Only the amorphous.
  - Only the ionic.
18. Where is the number of formula units larger: in 1 g NaCl or in 1 g KCl? By how many?  $A_r(\text{Na}) = 22,990$ ;  $A_r(\text{K}) = 39,098$ ;  $A_r(\text{Cl}) = 35,45$
- KCl; 2,3658
  - NaCl; 1,2756
  - KCl; 1,2756
  - NaCl; 2,3658
  - The numbers are equal.
19. In an organic acid with a single  $-\text{COOH}$  group, the mass ratio of oxygen is 26,20 %. What is the relative molecular mass of the acid?  $A_r(\text{H}) = 1,008$ ;  $A_r(\text{C}) = 12,011$ ;  $A_r(\text{O}) = 16,00$
- 567,4
  - 256,2
  - 122,1
  - 98,5
  - 40,7
20. What is the molecular formula of a compound with a relative molecular mass of 46,069, while the mass ratios of C, H и O are 52,14 %, 13,13 % и 34,73 %, respectively.  $A_r(\text{H}) = 1,008$ ;  $A_r(\text{C}) = 12,011$ ;  $A_r(\text{O}) = 16,00$
- $\text{C}_2\text{H}_6\text{O}$
  - $\text{C}_3\text{H}_6\text{O}_2$
  - $\text{CH}_4\text{O}$
  - $\text{C}_6\text{H}_{12}\text{O}_6$
  - $\text{C}_4\text{H}_{10}\text{O}$

21. What mass of H<sub>2</sub>O is generated by pyrolysis of 10 g of (NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub>. The unbalanced equation of the reaction is:  
(NH<sub>4</sub>)<sub>2</sub>CO<sub>3</sub> → NH<sub>3</sub> + CO<sub>2</sub> + H<sub>2</sub>O  
 $A_r(\text{H}) = 1,008$ ;  $A_r(\text{C}) = 12,011$ ;  $A_r(\text{O}) = 16,00$ ;  
 $A_r(\text{N}) = 14,007$

- A. 1,875 g
- B. 3,062 g
- C. 0,210 g
- D. 0,346 g
- E. 1,000 g

22. An average relative atomic mass is introduced:

- A. by convention.
- B. because isotopes exist of the chemical elements.
- C. because isobars exist of the chemical elements.
- D. in order to determine the position of the element in the periodic table.
- E. in order to introduce the unified mass unit

23. 1 pmol equals:

- A. 10<sup>-12</sup> mol
- B. 10<sup>12</sup> mol
- C. 10<sup>9</sup> mol
- D. 10<sup>-9</sup> mol
- E. 10<sup>-6</sup> mol

24. The principal  $n$ ; orbital  $l$ ; and magnetic quantum number  $m_l$  take on the values:

- A. 0, 1, 2...; 1...  $n$ ; 0...  $l$
- B. 1, 2, 3...; 1...  $n-1$ ; 0...  $l$
- C. 0, 1, 2...;  $n-1$ ...  $n+1$ ; 0...  $l$
- D. 1, 2, 3...; 0...  $n-1$ ;  $-l$ ... $l$
- E. 1, 2...; 1...  $n$ ;  $-l$ ... $l$

25. The valence electrons:

- A. are those with the lowest energy.
- B. are those with the highest energy.
- C. exist only for  $s$  elements.
- D. exist only for  $p$  elements.
- E. belong to the inner atomic shells.