

**1. Oxidation is an important reaction type in the human metabolism. Which of the following chemical conversions is an example of oxidation?**

- A)  $\text{CH}_3\text{-CHO} \rightarrow \text{CH}_3\text{-CH}_2\text{-OH}$
- B)  $\text{CH}_3\text{-CH(OH)-CH}_2\text{-COOH} \rightarrow \text{CH}_3\text{-CO-CH}_2\text{-COOH}$
- C)  $\text{CH}_3\text{-COOH} \rightarrow \text{CH}_3\text{-COO}^- + \text{H}^+$
- D)  $\text{CH}_3\text{-(CH}_2\text{)}_7\text{-CH=CH-(CH}_2\text{)}_7\text{-COOH} \rightarrow \text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-COOH}$

**2. Molecules that are poorly soluble in water require carrier proteins for their transport in blood. Choose an example of such a molecule:**

- A) lactic acid
- B) glucose
- C) acetone
- D) stearic acid

**3. In cells, carbohydrates are first "activated" before they enter metabolic conversions. The "activated" forms of carbohydrates are often esters of phosphoric acid. Select the structure describing a phosphorylated carbohydrate (drawing the structure in full can help you):**

- A)  $(\text{HO})_2\text{-PO-O-CH}_2\text{-CH(OH)-CHO}$
- B)  $\text{HO-CH}_2\text{-CH(OH)-CO-O-PO-(OH)}_2$
- C)  $(\text{HO})_2\text{-PO-O-PO-(OH)}_2$
- D)  $\text{HO-CH}_2\text{-CH(OH)-CH}_2\text{-O-PO-(OH)}_2$

**4. Common unsaturated fatty acids occurring in the human body have an even number of carbons and one or more cis double bond(s). Which of the following molecules is an example of fatty acid that can exist in the cis configuration?**

- A) butanoic acid
- B) butanedioic acid
- C) octadecenoic acid
- D) hexadecanoic acid

**5. The chemical conversion of ethanol to ethanal can be described as**

- A) addition of water
- B) elimination of water
- C) addition of two hydrogen atoms
- D) elimination of two hydrogen atoms

**6. Some nitrogen-containing organic compounds behave as bases. Which of the following molecules is an example of such a compound?**

- A) isoprene
- B) 2-aminoethanol
- C) tetramethyl ammonium
- D) phenol

**7. All amino acids occurring in proteins contain at least four different chemical elements. Which of these elements DOES NOT occur in triacylglycerols?**

- A) hydrogen
- B) carbon
- C) oxygen
- D) nitrogen

**8. Which of the following compounds present in the diet brings sulfur to the human body?**

- A) methionine
- B) serine
- C) glycine
- D) aspartic acid

**9. Purine nucleotides are broken down to uric acid in the human body. The accumulation of this acid in blood leads to a painful inflammation of joints called gout. Which of the following molecules breaks down to uric acid?**

- A) cytosine
- B) uracil
- C) guanine
- D) thymine

**10. Which of the following molecules can be classified as a sulfur analog of an ether?**

- A) methanesulfonic acid
- B) ethyl methyl sulfide
- C) diethyl disulfide
- D) propanethiol

**11. Aromatic signaling molecules are synthesized from aromatic amino acids taken in the diet because the aromatic ring is rarely synthesized in the body. What is typical for aromatic compounds? They all**

- A) form cis / trans isomers labelled ortho-, meta- or para-
- B) have only saturated bonds in the whole molecule
- C) consist of at least one cyclohexane ring
- D) contain a planar cycle with delocalized electrons

**12. Macromolecules containing monomers connected by O-glycosidic bonds include:**

- A) starch
- B) albumin
- C) RNA
- D) galactose

**13. Choose the chemical reaction in which one of reactants is water:**

- A) hydrogenation of unsaturated fatty acids
- B) neutralization of acetic acid
- C) conversion of ethene to ethanol
- D) formation of an amide

**14. Which of the following substances contains more than one functional group?**

- A) acetaldehyde
- B) glycerol
- C) dimethyl ether
- D) ethyl propyl amine

**15. What is the correct systematic name of  $\text{HO-CH}_2\text{-CH(NH}_2\text{)-COOH}$ ?**

- A) 1-hydroxy-2-aminopropanoic acid
- B) 2-amino-3-carboxypropanol
- C) 1-hydroxy-2-carboxylicpropane amine
- D) 2-amino-3-hydroxypropanoic acid

**16. The most abundant ion of blood plasma is a sodium ion. For the full neutralization of its charge, it must form an ionic bond with**

- A) two chloride ions
- B) one chloride ion
- C) two potassium ions
- D) one calcium ion

**17. The common form of iron in hemoglobin is the ferrous ion. Under some conditions it can be changed to the ferric ion by**

- A) oxidation
- B) reduction
- C) dissociation
- D) hydrogenation

**18. What is the concentration of  $\text{H}_2\text{SO}_4$  if for the neutralization of 10 ml of this acid 5 ml of 0.2 M NaOH is needed?**

- A) 0.05 M
- B) 0.1 M
- C) 0.5 M
- D) 0.01 M

**19. Ammonia, which is toxic to the human body, forms ammonium cation in aqueous solutions of body fluids. It follows from this that ammonia behaves like**

- A) an acid
- B) a base
- C) an oxidizing agent
- D) an amphoteric substance

**20. The pH of blood is 7.4, which corresponds to a concentration of 40 nmol/l hydroxonium ions. The concentration of hydroxonium ions expressed in mol/l is:**

- A)  $40 \times 10^{-15}$
- B)  $40 \times 10^{-12}$
- C)  $40 \times 10^{-9}$
- D)  $40 \times 10^{-6}$

**21. How many times does the concentration of hydroxonium ions increase if pH decreases from 5 to pH = 3?**

- A) 2x
- B) 10x
- C) 20x
- D) 100x

**22. Synthetic reactions in our metabolism use free energy, often in the form of ATP. Therefore, from the point of thermodynamics they can be classified as**

- A) endergonic
- B) exergonic
- C) found at equilibrium
- D) oxidative phosphorylations

**23. Gastric juice contains**

- A) chloric acid
- B) hydrochloric acid
- C) hypochlorous acid
- D) hyperchloric acid

**24. For a detection of polysaccharides in histology microscopic slides the staining called PAS reaction is used. One of the chemicals used in this test is periodic acid whose formula is**

- A)  $\text{HIO}_4$
- B)  $\text{HIO}_2$
- C)  $\text{HIO}$
- D)  $\text{HI}$

**25. Body fluids differ in their pH values: pH of the cytosol is around 7, pH of blood is 7.4, pH of urine is around 5 and pH in the stomach is around 1.5. By comparing these values one can conclude that the lowest concentration of hydroxonium ions is found in the**

- A) stomach
- B) urine
- C) cytosol
- D) blood

**26. The acidity of chemicals is described by the acidity constant, often expressed as  $\text{pK}_a$  value. For example, the values of phosphoric acid are:  $\text{pK}_{a1} = 2.1$ ,  $\text{pK}_{a2} = 7.2$ ,  $\text{pK}_{a3} = 12.4$ . It follows from this that the phosphoric acid is**

- A) a strong acid that completely dissociates in water to phosphate and  $3 \text{H}^+$
- B) a very weak acid that is unable dissociate in water
- C) an acid whose third dissociation step is the weakest
- D) an acid whose third dissociation step is the strongest

**27. After mixing 600 ml of water with 200 ml of 8% glucose solution the concentration of glucose**

- A) does not change
- B) decreases 4x
- C) increases 6x
- D) decreases 8x

**28. Calculate the molar concentration of sodium hydroxide solution whose mass / mass percentage concentration is 0.4 % and density = 1 g/ml. Molar mass of NaOH = 40 g/mol.**

- A) 0.1 mol/l
- B) 0.4 mol/l
- C) 0.01 mol/l
- D) 1.6 mol/l

**29. In the lungs, this chemical reaction proceeds within red blood cells found in the blood:  $\text{HCO}_3^- + \text{H}^+ \rightleftharpoons \text{H}_2\text{CO}_3 \rightleftharpoons \text{H}_2\text{O} + \text{CO}_2$ . If  $\text{CO}_2$  is subsequently exhaled, the reaction will**

- A) acidify the cell more
- B) form more  $\text{HCO}_3^- + \text{H}^+$
- C) convert more  $\text{HCO}_3^- + \text{H}^+$  to  $\text{H}_2\text{O} + \text{CO}_2$
- D) stop in the form of the molecule  $\text{H}_2\text{CO}_3$

**30. The most abundant inorganic ions of human blood plasma are derived from sodium, chlorine, carbon, potassium, calcium, magnesium and phosphorus. These ions are**

- A) all metals
- B) all cations
- C) all nonmetals
- D) both metals and nonmetals