

1) Select the formula of magnesium disulfite:

- a) $\text{Mg}_2\text{S}_2\text{O}_4$ b) MgS_2O_7 c) MgS_2O_6 d) MgS_2O_5
e) no answer is correct

2) Calculate the mass percentage of oxygen in sodium peroxide, $A_r(\text{Na}) = 23$, $A_r(\text{O}) = 16$.

- a) 41.0% b) 30.1% c) 20.5% d) 18.9%
e) no answer is correct

3) Calculate the theoretical volume of water that, upon decomposition, yields one litre of oxygen. Consider the properties of ideal gas, 0 °C and 101.3 kPa. $A_r(\text{H}) = 1$, $A_r(\text{O}) = 16$, density of water = 1.0 g/ml.

- a) 89.7 cm^3 b) 22.4 dm^3 c) 1.6 cm^3 d) 44.8 dm^3
e) no answer is correct

4) Calculate the mass of one selenium atom. $A_r(\text{Se}) = 79$

- a) 1.3×10^{-22} g b) 4.7×10^{-25} g c) 1.5×10^{-20} g d) 3.2×10^{-22} g
e) no answer is correct

5) Radioactive fluorine isotope ^{18}F contains:

- a) 10 protons + 8 neutrons b) 7 protons + 11 neutrons c) 9 protons + 9 neutrons
d) 18 neutrons e) no answer is correct

6) Consider a general equilibrium reaction in gaseous phase $[\text{A}(\text{g}) + 2\text{B}(\text{g}) \rightleftharpoons \text{C}(\text{g}) + \text{heat}]$ and select the correct statement:

- a) removing A supports reaction progress from the left to the right
b) adding B supports reaction progress from the right to the left
c) increasing pressure will support the right-to-left reaction
d) decreasing temperature will drive the left-to-right reaction course
e) no answer is correct

7) Select the compound that can form hydrogen bonds with water molecules:

- a) trichloromethane b) dimethyl sulfide c) ethylamine d) potassium bromide
e) no answer is correct

8) A mouthwash contains 600 ppm of fluoride anion. Calculate the molarity of fluoride.

$A_r(\text{F}) = 19$, density of mouthwash = 1.0 g/ml, ppm = parts per million

- a) 31.6 mmol/l b) 31.6 $\mu\text{mol/l}$ c) 0.32 mmol/l d) 0.03 $\mu\text{mol/l}$
e) no answer is correct

9) A solution of hydrochloric acid (20%, $M = 36.5$ g/mol) has the density 1.1 g/ml. Determine the molarity of HCl.

- a) 6.0 mol/l b) 1.3 mol/l c) 3.0 mol/l d) 12.0 mol/l
e) no answer is correct

10) The solution of sulfuric acid (50 ml; 0.1 mol/l) was added to the NaOH solution (40 ml; 0.1 mol/l). How many per cents of acid was neutralized? Assume an ideal solution and complete dissociation of both electrolytes.

- a) 80% b) 30% c) 45% d) 60%
e) no answer is correct

11) In a sodium phosphate solution, the concentration of cations is 400 mmol/l. Calculate the concentration of anions. Assume complete dissociation and ideal conditions, do not consider the hydrolysis of ions.

- a) 100 mmol/l b) 200 mmol/l c) 400 mmol/l d) 1200 mmol/l
 e) no answer is correct

12) Select a weak electrolyte (R = alkyl):

- a) R-CO-R b) R-NH₂ c) R-NH₃⁺ Cl⁻ d) R-CH₂-R
 e) no answer is correct

13) A solution of nitric acid (*M* = 63 g/mol) has pH = 2.0 (25 °C). Calculate the mass concentration of HNO₃.

- a) 1.8 g/l b) 3.1 g/l c) 2.5 g/l d) 0.63 g/l
 e) no answer is correct

14) Select the salt whose aqueous solution is acidic:

- a) KNO₂ b) MgCl₂ c) Al₂(SO₄)₃ d) NaHCO₃
 e) no answer is correct

15) Select the true statement on alkali metals:

- a) potassium ions (K⁺) are the major cations of intracellular fluid
 b) hydrated sodium ion [Na(H₂O)_n]⁺ exhibits typical properties of a Brønsted acid
 c) rubidium ion (Rb⁺) has very strong reducing properties
 d) natural caesium (Cs) is a radioactive element
 e) no answer is correct

16) Select the poorly soluble salt:

- a) Ca(HCO₃)₂ b) MgCO₃ c) KHSO₄ d) NaClO₃ e) no answer is correct

17) Select the redox reaction:

- a) CaCO₃ → CaO + CO₂
 b) PCl₅ + H₂O → POCl₃ + 2 HCl
 c) 2 CH₃-SH + ½ O₂ → CH₃-S-S-CH₃ + H₂O
 d) [Cu(H₂O)₄]²⁺ + H₂O → [Cu(H₂O)₃OH]⁺ + H₃O⁺
 e) no answer is correct

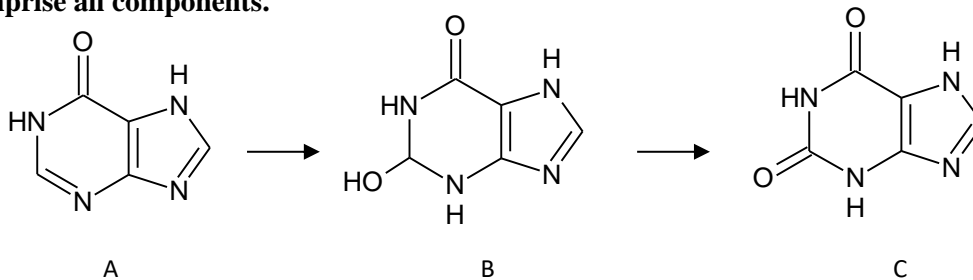
18) Find the acyl of a five-carbon carboxylic acid:

- a) malonyl b) succinyl c) caproyl d) acetoacetyl e) no answer is correct

19) Select the redox pair (A_{red}/A_{ox}) corresponding to dehydrogenation (A_{red} → A_{ox} + 2 H):

- a) acetate/acetaldehyde b) propanal/propanone c) glycerol/glyceraldehyde
 d) asparagine/aspartate e) no answer is correct

20) Determine the reactions during conversion of compounds A → B → C. The scheme is simplified, does not comprise all components.



- a) dehydrogenation of A is followed by hydration of B
 b) the A → B conversion is hydration, the second reaction is isomerization
 c) the first reaction is oxidation, the second conversion is reduction
 d) upon hydration of A, the intermediate B undergoes dehydrogenation
 e) no answer is correct

21) The compound $R-CO-CH_2-CO-NR_2$ ($R = \text{alkyl}$) is formed by the reaction of:

- a) keto acid + amine
- b) ketone + amino acid
- c) diketone + amine
- d) keto acid + amino acid
- e) no answer is correct

22) Select the correct set of general names for $R-CH(OR)OH$, $R-CO-NH-R$, $R-S-S-R$ ($R = \text{alkyl}$):

- a) acetal, dipeptide, disulfane
- b) hemiacetal, amide, disulfide
- c) ester, aldimine, dithiol
- d) ester, azide, disulfate
- e) no answer is correct

23) Select the compound possessing a centre of chirality:

- a) cyclohexylamine
- b) malic acid
- c) diethyl succinate
- d) 2-bromopropane
- e) no answer is correct

24) Select the compound corresponding to molecular formula $C_6H_{14}N_2O_2$:

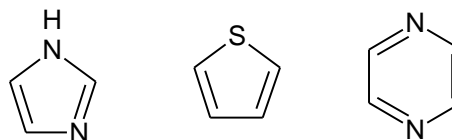
- a) thymine
- b) alanyl-serine
- c) lysine
- d) *N,N*-dimethylbutanamide
- e) no answer is correct

25) Select the monocarboxylic acid:

- a) maleic
- b) glutaric
- c) oxalic
- d) ascorbic
- e) no answer is correct

26) Select the correct set of names for the compounds depicted:

- a) imidazole, thiolane, pyridine
- b) pyrrole, furan, pteridine
- c) pyrrolidine, oxolane, pyrimidine
- d) pyridine, thiophene, purine
- e) no answer is correct

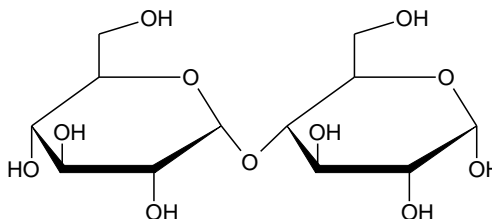


27) Select the compound containing a nitrogen heterocycle:

- a) hydroquinone
- b) aniline
- c) catechol
- d) hydroxyproline
- e) no answer is correct

28) The compound depicted is:

- a) mannose
- b) maltose
- c) sucrose
- d) galactose
- e) no answer is correct



29) Select the isomer of glucose:

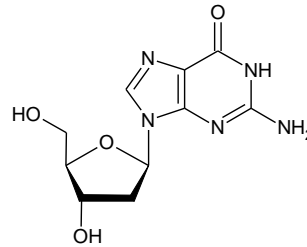
- a) ribose
- b) fructose
- c) maltose
- d) amylose
- e) no answer is correct

30) Select the fatty acid that is essential for humans:

- a) *cis,cis*-octadeca-6,9-dienoic acid
- b) *cis,cis*-octadeca-9,12-dienoic acid
- c) *cis,cis*-octadeca-15,18-dienoic acid
- d) *cis,cis,cis*-octadeca-6,9,12-trienoic acid
- e) no answer is correct

31) Determine the name of the compound depicted:

- a) deoxyadenosine
- b) deoxycytidine
- c) deoxyguanosine
- d) deoxythymidine
- e) no answer is correct

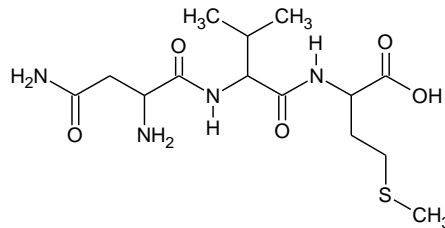


32) In replication, deoxynucleotides are attached to a newly synthesized DNA strand. Select the equation that correctly expresses elongation of the dCdG sequence by dT (P_i = phosphate, PP_i = diphosphate):

- a) $dCdG + dTMP \rightarrow dCdGdT + H_2O$
- b) $dCdG + dTDP \rightarrow dCdGdT + P_i$
- c) $dCdG + dTTP \rightarrow dCdGdT + PP_i$
- d) $dCdG + dTMP + ATP \rightarrow dCdGdT + ADP + P_i$
- e) no answer is correct

33) The compound depicted is formed from:

- a) asparagine, valine, methionine
- b) glutamine, histidine, threonine
- c) lysine, glutamine, isoleucine
- d) glutamine, tyrosine, isoleucine
- e) no answer is correct



34) Which amino acid has the highest number of positive charges under physiological pH (6.8 – 7.4)?

- a) glutamine
- b) tryptophan
- c) lysine
- d) glutamate
- e) cannot decide unambiguously

35) Select the amino acid with the highest number of carbon atoms:

- a) histidine
- b) tyrosine
- c) threonine
- d) arginine
- e) cannot decide unambiguously

36) The conversion of malate to fumarate is catalysed by:

- a) oxidoreductase
- b) hydrolase
- c) transferase
- d) lyase
- e) no answer is correct

37) Select the intermediate of glycolysis that undergoes isomerization:

- a) phosphoenolpyruvate
- b) fructose-1,6-bisP
- c) glyceraldehyde-3-P
- d) glycerol-3-P
- e) no answer is correct

38) $R-CO-CH_2-CO-S-CoA$ is an intermediate of β -oxidation of fatty acids. Its further conversion requires:

- a) H_2O
- b) NAD^+
- c) FAD
- d) $CoA-SH$
- e) no answer is correct

39) Identify the vitamin from the following data: molecular formula $C_{12}H_{17}N_4OS$, water soluble, contained in meat, beans, yeast, whole-meal cereals, derivative of pyrimidine and thiazole, needed for aerobic catabolism of all nutrients, especially glucose. Its deficit is manifested mainly by various neurological problems, e. g. irritability and confusion.

- a) ascorbate
- b) thiamine
- c) phylloquinone
- d) folate
- e) no answer is correct

40) Select the intermediate of citrate cycle that releases carbon dioxide:

- a) 2-oxoglutarate
- b) malate
- c) citrate
- d) succinyl-CoA
- e) no answer is correct