

Introduction to Metabolism, Study Guide

Matching Or Fill In

Choose the correct answer from the list. Not all the answers will be used.

- | | |
|--|---|
| 1) _____ Prokaryotes that are able to synthesize all of their cellular components from simple molecules such as CO ₂ , H ₂ O, NH ₃ , and H ₂ S are called _____. | A) anabolic
B) adenylate kinase
C) ϵ°
D) catabolic
E) NAD ⁺
F) obligate aerobes
G) acyl phosphate
H) proteomics
I) NADPH
J) pyrophosphatase
K) autotrophs
L) oxidation
M) ΔG° |
| 2) _____ Organisms that require oxygen are called _____. | |
| 3) _____ Biomolecules are synthesized from simpler components in _____ pathways. | |
| 4) _____ 1,3-Bisphosphoglycerate is a type of _____. | |
| 5) _____ The enzyme _____ catalyzes the reaction, $PP_i \rightarrow 2 P_i$. | |
| 6) _____ The enzyme _____ catalyzes the transfer of a phosphoryl group from ATP to AMP. | |
| 7) _____ A loss of electrons from a substance is known as _____. | |
| 8) _____ The oxidized form of NADH is _____. | |
| 9) _____ The standard reduction potential at the biochemical standard state is symbolized as _____. | |
| 10) _____ The study of the complete set of proteins synthesized in the cell is called _____. | |

Fill In Questions

- 11) The rate of flow of metabolites through a metabolic pathway is referred to as _____.
- 12) _____ is the process by which nutrients are degraded in order to salvage their components and/or to generate energy.
- 13) The reactants, intermediates, and products of metabolism are all referred to as _____.

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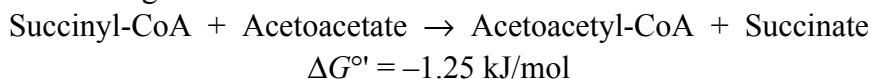
- 14) A bond whose hydrolysis proceeds with large negative value of ΔG° is often referred to as a _____ bond.
- 15) ATP contains one phosphoester bond and two _____ bonds.
- 16) The process by which ATP is formed by the direct transfer of a phosphoryl group to ADP from a “high-energy” compound is referred to as _____ phosphorylation.
- 19) The reduction of NAD^+ involves _____ ion transfer.
- 20) Two widely used electron carriers in metabolism are NAD^+ and _____.

Multiple Choice Questions

- 21) Organisms that are poisoned by oxygen are :
- A) obligate aerobes
 - B) facultative anaerobes
 - C) autotrophs
 - D) chemolithotrophs
 - E) obligate anaerobes
- 22) Which of the following is at a higher level of oxidation than CH_3CHO ?
- A) $\text{CH}_3\text{CH}_2\text{OH}$
 - B) CH_3CH_3
 - C) $\text{CH}_2=\text{CH}_2$
 - D) $\text{CH}_3\text{CO}_2\text{H}$
 - E) none of the above
- 23) Consider the following metabolic reaction:
 $\text{Succinyl-CoA} + \text{Acetoacetate} \rightarrow \text{Acetoacetyl-CoA} + \text{Succinate}$ $\Delta G^{\circ} = -1.25 \text{ kJ/mol}$
What is the K_{eq} for this reaction at 25°C ?
- A) 1.66
 - B) 0.602
 - C) 1.00
 - D) 4.22×10^2
 - E) 03.21
- 24) Consider the following metabolic reaction:
 $\text{Succinyl-CoA} + \text{Acetoacetate} \rightarrow \text{Acetoacetyl-CoA} + \text{Succinate}$
 $\Delta G^{\circ} = -1.25 \text{ kJ/mol}$
The ΔG° for the hydrolysis of Succinyl-CoA is -33.9 kJ/mol . What is the ΔG° for the hydrolysis of Acetoacetyl-CoA:
 $\text{Acetoacetyl-CoA} \rightarrow \text{Acetoacetate} + \text{CoA}$
- A) -35.2 kJ/mol
 - B) -32.7 kJ/mol
 - C) $+32.7 \text{ kJ/mol}$
 - D) $+35.2 \text{ kJ/mole}$
 - E) none of the above

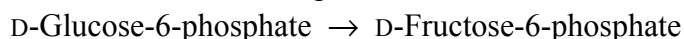
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- 25) Consider the following metabolic reaction:



This reaction is:

- A) favorable under standard conditions.
B) not favorable under standard conditions.
C) always exergonic and can never proceed in the opposite direction.
D) spontaneous as written when [succinate] and [acetoacetyl-CoA] are high.
E) None of the above
- 26) The K_{eq} is 0.503 at 25°C for the following reaction. What is the ΔG° for this reaction?



- A) -1,700 J/mol
B) -2,870 J/mol
C) +143 J/mol
D) +1.70 kJ/mol
E) none of the above
- 27) Consider the following metabolic reaction:



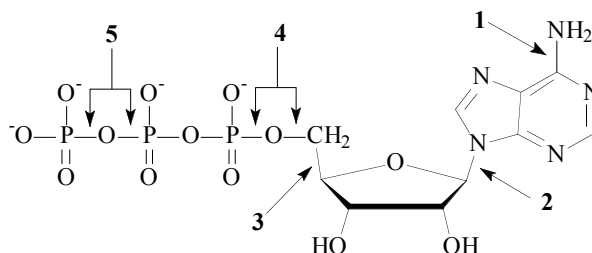
What can be said about this reaction when the concentration of 2-phosphoglycerate is 0.490 mM and the concentration of 3-phosphoglycerate is 2.90 mM at 25°C?

- A) This reaction is endergonic under these conditions.
B) This reaction is exergonic under these conditions.
C) This reaction is at equilibrium under these conditions.
D) This reaction is not favorable under standard conditions.
E) 40 kJ of work can be done by this reaction under these conditions.
- 28) Consider the following metabolic reaction:



What is the ΔG for this reaction when the concentration of 2-phosphoglycerate is 0.290 mM and the concentration of 3-phosphoglycerate is 2.90 mM at 37°C?

- A) +10.3 kJ/mol
B) -1.54 kJ/mol
C) -1.30 kJ/mol
D) -5.93 kJ/mol
E) -4.40 kJ/mol
- 29) Which of the numbered arrows in the figure to the right points toward a “high-energy” phosphoanhydride bond?



- A) 1
B) 2
C) 3

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- D) 4
- E) 5

- 30) Given that the standard reduction potential of oxaloacetate is -0.166 V and the standard reduction potential of NAD^+ is -0.315 V . What is the $\Delta\mathcal{E}^\circ$ for the oxidation of malate by NAD^+ : $\text{Malate} + \text{NAD}^+ \rightarrow \text{Oxaloacetate} + \text{NADH} + \text{H}^+$
- A) -4.81 V
 - B) $+4.81\text{ V}$
 - C) -0.149 V
 - D) $+0.149\text{ V}$
 - E) $+0.0523\text{ V}$

Short Answer Questions

Write your answer in the space provided or on a separate sheet of paper.

- 31) What reaction rates describe the flux of an intermediate in a metabolic pathway?
- 32) List four ways by which cells control or regulate the flux through metabolic pathways.
- 33) What are two factors that contribute to the large negative standard free energy change for the reaction $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$?
- 34) What is meant by the term “substrate-level phosphorylation?”
- 35) What are isozymes?
- 36) Briefly explain how a reaction that has a positive value of ΔG° can be exergonic and hence proceed as written from left to right.
- 37) What is the importance of ATP’s intermediate phosphoryl group-transfer potential to energy metabolism in a cell?
- 38) Why are the vitamins niacin and riboflavin necessary for metabolism?
- 39) What is the relationship between the electromotive force and the ΔG of a reaction?
- 40) Briefly describe how isotopic labeling techniques have revolutionized the study of metabolism.
- 41) What is the advantage of “pyrophosphate cleavage” of ATP?
- 42) What is the role of Acetyl-CoA in catabolism?

Answer: Acetyl-CoA is the common product of the degradation of proteins, carbohydrates, and fats. Acetyl-CoA then enters the citric acid cycle for further catabolism .

Section: 1

Level of Difficulty: moderate

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- 43) Why are two different electron carriers, NAD^+ and FAD, involved in metabolism?
- 44) What are the terminal electron acceptors in aerobic and anaerobic organisms?.
- 45) What differentiates “high-energy” compounds and “low-energy” compounds? Provide examples.