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TUTOR STEM

PRACTICE MCAT

BIOCHEMISTRY QUESTIONS

MCAT Section: Biological and Biochemical Foundations of Living Systems

MCAT Biochemistry Question 1

Which of the following amino acids is likely to be found at the active site of an enzyme that performs acid-base catalysis?

- A) Glycine
- B) Glutamic acid
- C) Valine
- D) Phenylalanine

Correct Answer: B) Glutamic acid

Reasoning: Glutamic acid is frequently found at the active sites of enzymes that perform acid-base catalysis due to its side chain, which contains a carboxyl group with a pK_a around 4.1. This carboxyl group can either donate a proton (acting as a Brønsted acid) or accept a proton (acting as a Brønsted base) depending on the local pH and the environment within the enzyme's active site. The ability to switch between protonated and deprotonated forms allows glutamic acid to facilitate the transfer of protons during the catalytic process, stabilizing transition states and intermediates. The precise positioning of the glutamic acid side chain within the active site, often aided by the enzyme's tertiary structure, ensures optimal interaction with substrate molecules. This spatial arrangement maximizes the efficiency of catalysis by aligning the carboxyl group for effective proton exchange. Therefore, the versatility and reactivity of the glutamic acid side chain make it indispensable for enzymes that rely on acid-base mechanisms to catalyze a wide array of biochemical reactions.

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MCAT Biochemistry Question 2

Which of the following coenzymes is directly involved in the decarboxylation of pyruvate to acetyl-CoA in the pyruvate dehydrogenase complex?

- A) NAD⁺
- B) FAD
- C) Thiamine pyrophosphate (TPP)
- D) Coenzyme Q

Correct Answer: C) Thiamine pyrophosphate (TPP)

Reasoning: Thiamine pyrophosphate (TPP) is an essential coenzyme for the enzyme pyruvate dehydrogenase, which plays a critical role in cellular respiration by converting pyruvate into acetyl-CoA, a key molecule for the citric acid cycle. TPP functions by facilitating the decarboxylation of pyruvate, a process that involves the removal of a carbon dioxide (CO₂) molecule. This decarboxylation is crucial because it transforms pyruvate, a three-carbon molecule, into a two-carbon hydroxyethyl group that is temporarily bonded to TPP, forming a hydroxyethyl-TPP intermediate. The structure of TPP, which includes a thiazolium ring, provides the necessary electrophilic center to stabilize the carbanion intermediate that forms during the decarboxylation reaction. Once this intermediate is formed, it is transferred to the lipoamide arm of the pyruvate dehydrogenase complex. This transfer occurs via a swinging arm mechanism, where the hydroxyethyl group is oxidized to an acetyl group, simultaneously reducing the lipoamide. The acetyl group is then transferred to Coenzyme A (CoA), forming acetyl-CoA, which enters the citric acid cycle for further energy production. This entire process is tightly regulated and ensures that the energy from glucose metabolism is efficiently harnessed and utilized. Without TPP, the pyruvate dehydrogenase complex would be unable to carry out these critical reactions, underscoring the importance of TPP in metabolic pathways and energy production.

MCAT Biochemistry Question 3

Which of the following best describes the role of cytochrome c in the electron transport chain?

- A) It transports electrons from Complex I to Complex II.
- B) It transports electrons from Complex III to Complex IV.
- C) It generates ATP directly.
- D) It acts as the final electron acceptor.

Website : www.tutorSTEM.caMCAT Page : www.tutorSTEM.ca/mcatPhone Number for Tutor STEM's Medical School MCAT Department : [416-795-5000](tel:416-795-5000)**Correct Answer: B) It transports electrons from Complex III to Complex IV.**

Reasoning: Cytochrome c is a small heme protein that shuttles electrons between Complex III (cytochrome bc₁ complex) and Complex IV (cytochrome c oxidase) in the mitochondrial electron transport chain. This transfer is crucial for maintaining the flow of electrons, which ultimately drives the production of ATP via oxidative phosphorylation.

MCAT Biochemistry Question 4

Which of the following best describes the primary role of NADPH in the cell?

- A) It serves as a carrier of electrons for ATP production.
- B) It participates in oxidative phosphorylation.
- C) It acts as a reducing agent in biosynthetic reactions.
- D) It is involved in glycolysis.

Correct Answer: C) It acts as a reducing agent in biosynthetic reactions.

Reasoning: NADPH is primarily involved in anabolic (biosynthetic) pathways, where it donates electrons and protons to reduce substrates. This includes fatty acid synthesis, cholesterol synthesis, and the maintenance of reduced glutathione for protection against oxidative damage. NADPH is generated in the pentose phosphate pathway.

MCAT Biochemistry Question 5

Which of the following processes occurs in the mitochondrial matrix?

- A) Glycolysis
- B) Fatty acid oxidation
- C) Electron transport chain
- D) Gluconeogenesis

Correct Answer: B) Fatty acid oxidation

Reasoning: Fatty acid oxidation (β -oxidation) occurs in the mitochondrial matrix, where fatty acids are broken down into acetyl-CoA units. These acetyl-CoA molecules can then enter the citric acid cycle for further oxidation and ATP production. This process also generates NADH and FADH₂, which feed into the electron transport chain.

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MCAT Biochemistry Question 6

Which of the following molecules acts as a competitive inhibitor of succinate dehydrogenase in the citric acid cycle?

- A) Malonate
- B) Fumarate
- C) Oxaloacetate
- D) Citrate

Correct Answer: A) Malonate

Reasoning: Malonate is a structural analog of succinate and acts as a competitive inhibitor of succinate dehydrogenase. It binds to the active site of the enzyme, preventing succinate from binding and being converted to fumarate, thereby inhibiting the citric acid cycle.

MCAT Biochemistry Question 7

Which of the following enzymes is responsible for the conversion of fructose-6-phosphate to fructose-1,6-bisphosphate in glycolysis?

- A) Hexokinase
- B) Phosphofructokinase-1 (PFK-1)
- C) Aldolase
- D) Triose phosphate isomerase

Correct Answer: B) Phosphofructokinase-1 (PFK-1)

Reasoning: Phosphofructokinase-1 (PFK-1) is the enzyme that catalyzes the rate-limiting step of glycolysis, the phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate. This step is highly regulated and is crucial for controlling the flow of glucose through the glycolytic pathway.

MCAT Biochemistry Question 8

Which of the following amino acids is a precursor for the neurotransmitter serotonin?

- A) Tyrosine
- B) Tryptophan

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- C) Phenylalanine
- D) Glutamine

Correct Answer: B) Tryptophan

Reasoning: Tryptophan is the amino acid precursor for the synthesis of serotonin. The conversion involves two main steps: hydroxylation of tryptophan to 5-hydroxytryptophan (5-HTP) by tryptophan hydroxylase, followed by decarboxylation of 5-HTP to serotonin by aromatic L-amino acid decarboxylase.

MCAT Biochemistry Question 9

Which of the following lipoproteins is primarily responsible for the transport of dietary triglycerides and cholesterol from the intestines to peripheral tissues?

- A) Chylomicrons
- B) VLDL
- C) LDL
- D) HDL

Correct Answer: A) Chylomicrons

Reasoning: Chylomicrons are large lipoprotein particles that transport dietary triglycerides and cholesterol from the intestines to peripheral tissues. After a meal, chylomicrons are synthesized in the intestinal mucosa and released into the lymphatic system before entering the bloodstream.

MCAT Biochemistry Question 10

Which of the following enzymes is directly involved in the urea cycle, converting ornithine and carbamoyl phosphate into citrulline?

- A) Arginase
- B) Ornithine transcarbamylase
- C) Argininosuccinate lyase
- D) Carbamoyl phosphate synthetase I

Correct Answer: B) Ornithine transcarbamylase

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Reasoning: Ornithine transcarbamylase catalyzes the reaction between ornithine and carbamoyl phosphate to form citrulline in the urea cycle. This step occurs in the mitochondrial matrix and is essential for the detoxification of ammonia into urea.

MCAT Biochemistry Question 11

Which of the following best describes the role of the enzyme ribulose-1,5-bisphosphate carboxylase/oxygenase (RuBisCO) in photosynthesis?

- A) It captures light energy and converts it into chemical energy.
- B) It synthesizes ATP and NADPH in the chloroplast.
- C) It catalyzes the fixation of carbon dioxide into organic molecules during the Calvin cycle.
- D) It transports electrons in the electron transport chain of the chloroplast.

Correct Answer: C) It catalyzes the fixation of carbon dioxide into organic molecules during the Calvin cycle.

Reasoning: RuBisCO is the enzyme responsible for catalyzing the first step of carbon fixation in the Calvin cycle, incorporating carbon dioxide into ribulose-1,5-bisphosphate to form 3-phosphoglycerate. This reaction is crucial for converting inorganic carbon into organic forms that can be used by the plant for growth and energy storage.

MCAT Biochemistry Question 12

Which of the following describes the primary function of the enzyme adenylyl cyclase?

- A) It degrades cAMP into AMP.
- B) It synthesizes cAMP from ATP.
- C) It phosphorylates proteins in response to cAMP.
- D) It dephosphorylates proteins in response to cAMP.

Correct Answer: B) It synthesizes cAMP from ATP.

Reasoning: Adenylyl cyclase is an enzyme that catalyzes the conversion of ATP to cyclic AMP (cAMP) in response to extracellular signals, such as hormones binding to G protein-coupled receptors. cAMP acts as a second messenger, activating protein kinase A and leading to various cellular responses.

MCAT Biochemistry Question 13

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Which of the following molecules is the final electron acceptor in the mitochondrial electron transport chain?

- A) NAD⁺
- B) FAD
- C) Oxygen
- D) Water

Correct Answer: C) Oxygen

Reasoning: Oxygen is the final electron acceptor in the mitochondrial electron transport chain. It accepts electrons from cytochrome c oxidase (Complex IV) and combines with protons to form water. This reaction is essential for maintaining the flow of electrons through the chain and for the generation of the proton gradient used to produce ATP.

MCAT Biochemistry Question 14

Which of the following best describes the function of the enzyme hexokinase in glycolysis?

- A) It converts glucose to glucose-6-phosphate.
- B) It converts pyruvate to lactate.
- C) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.
- D) It converts glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate.

Correct Answer: A) It converts glucose to glucose-6-phosphate.

Reasoning: Hexokinase catalyzes the phosphorylation of glucose to form glucose-6-phosphate, the first step in glycolysis. This phosphorylation traps glucose within the cell and prepares it for further metabolism in the glycolytic pathway.

MCAT Biochemistry Question 15

Which of the following amino acids is the primary donor of nitrogen for the synthesis of urea in the urea cycle?

- A) Alanine
- B) Glutamine

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- C) Glutamate
- D) Aspartate

Correct Answer: D) Aspartate

Reasoning: Aspartate donates an amino group to form argininosuccinate in the urea cycle. This reaction is catalyzed by argininosuccinate synthetase and is a crucial step in incorporating nitrogen into urea, which is then excreted from the body.

MCAT Biochemistry Question 16

Which of the following molecules is an intermediate in both the glycolysis and gluconeogenesis pathways?

- A) Glucose-6-phosphate
- B) Fructose-1,6-bisphosphate
- C) Phosphoenolpyruvate
- D) Oxaloacetate

Correct Answer: C) Phosphoenolpyruvate

Reasoning: Phosphoenolpyruvate (PEP) is an intermediate in both glycolysis and gluconeogenesis. In glycolysis, PEP is converted to pyruvate by pyruvate kinase. In gluconeogenesis, PEP is generated from oxaloacetate by PEP carboxykinase.

MCAT Biochemistry Question 17

Which of the following enzymes is involved in the conversion of dihydroxyacetone phosphate (DHAP) to glyceraldehyde-3-phosphate (G3P) in glycolysis?

- A) Aldolase
- B) Triose phosphate isomerase
- C) Enolase
- D) Pyruvate kinase

Correct Answer: B) Triose phosphate isomerase

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Reasoning: Triose phosphate isomerase catalyzes the reversible conversion of dihydroxyacetone phosphate (DHAP) to glyceraldehyde-3-phosphate (G3P). This step ensures that both molecules produced from the cleavage of fructose-1,6-bisphosphate can continue through glycolysis.

MCAT Biochemistry Question 18

Which of the following amino acids can be directly deaminated to produce pyruvate?

- A) Glutamate
- B) Aspartate
- C) Alanine
- D) Arginine

Correct Answer: C) Alanine

Reasoning: Alanine can be directly deaminated by alanine transaminase (ALT) to produce pyruvate and glutamate. This reaction is part of the alanine cycle, which transports amino groups from muscles to the liver for urea production and gluconeogenesis.

MCAT Biochemistry Question 19

Which of the following enzymes is responsible for the hydrolysis of triglycerides in adipose tissue?

- A) Lipoprotein lipase
- B) Hormone-sensitive lipase
- C) Pancreatic lipase
- D) Phospholipase A2

Correct Answer: B) Hormone-sensitive lipase

Reasoning: Hormone-sensitive lipase is activated in response to hormonal signals such as adrenaline and glucagon, leading to the hydrolysis of stored triglycerides into free fatty acids and glycerol in adipose tissue. These free fatty acids can then be used for energy production.

MCAT Biochemistry Question 20

Which of the following cofactors is required for the proper function of pyruvate dehydrogenase complex?

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- A) Biotin
- B) Thiamine pyrophosphate (TPP)
- C) Pyridoxal phosphate (PLP)
- D) Cobalamin

Correct Answer: B) Thiamine pyrophosphate (TPP)

Reasoning: Thiamine pyrophosphate (TPP) is an essential cofactor for the pyruvate dehydrogenase complex. TPP binds to pyruvate dehydrogenase and helps catalyze the decarboxylation of pyruvate, leading to the formation of acetyl-CoA, which then enters the citric acid cycle.

MCAT Biochemistry Question 21

Which of the following best describes the role of carnitine in fatty acid metabolism?

- A) It is involved in the synthesis of fatty acids.
- B) It transports fatty acids into the mitochondria for β -oxidation.
- C) It acts as an electron carrier in the electron transport chain.
- D) It catalyzes the conversion of acetyl-CoA to malonyl-CoA.

Correct Answer: B) It transports fatty acids into the mitochondria for β -oxidation.

Reasoning: Carnitine facilitates the transport of long-chain fatty acids across the mitochondrial membrane by forming acyl-carnitine, which can then be translocated into the mitochondrial matrix where β -oxidation occurs.

MCAT Biochemistry Question 22

Which of the following vitamins is a precursor of the coenzyme NAD⁺?

- A) Vitamin B1 (thiamine)
- B) Vitamin B2 (riboflavin)
- C) Vitamin B3 (niacin)
- D) Vitamin B6 (pyridoxine)

Correct Answer: C) Vitamin B3 (niacin)

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Reasoning: Vitamin B3 (niacin) is a precursor for NAD⁺ (nicotinamide adenine dinucleotide). Niacin is converted into nicotinamide, which is then incorporated into NAD⁺, an essential coenzyme involved in redox reactions.

MCAT Biochemistry Question 23

Which of the following is the primary function of the enzyme carbonic anhydrase?

- A) It catalyzes the hydration of carbon dioxide to form carbonic acid.
- B) It degrades hydrogen peroxide into water and oxygen.
- C) It synthesizes bicarbonate ions from pyruvate.
- D) It facilitates the reduction of molecular oxygen.

Correct Answer: A) It catalyzes the hydration of carbon dioxide to form carbonic acid.

Reasoning: Carbonic anhydrase catalyzes the reversible hydration of carbon dioxide to form carbonic acid, which quickly dissociates into bicarbonate and hydrogen ions. This reaction is crucial in maintaining acid-base balance and facilitating CO₂ transport in blood.

MCAT Biochemistry Question 24

Which of the following enzymes is responsible for the conversion of ribose-5-phosphate to ribulose-5-phosphate in the pentose phosphate pathway?

- A) Glucose-6-phosphate dehydrogenase
- B) Transketolase
- C) Phosphogluconate dehydrogenase
- D) Ribose-5-phosphate isomerase

Correct Answer: D) Ribose-5-phosphate isomerase

Reasoning: Ribose-5-phosphate isomerase catalyzes the interconversion between ribose-5-phosphate and ribulose-5-phosphate in the pentose phosphate pathway, which is important for nucleotide biosynthesis and the production of NADPH.

MCAT Biochemistry Question 25

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Which of the following molecules is the main energy currency in cells and is produced during cellular respiration?

- A) ATP
- B) NADH
- C) FADH₂
- D) GTP

Correct Answer: A) ATP

Reasoning: Adenosine triphosphate (ATP) is the primary energy carrier in cells. It is produced during cellular respiration through glycolysis, the citric acid cycle, and oxidative phosphorylation, and is used to power various cellular processes.

MCAT Biochemistry Question 26

Which of the following enzymes is involved in the irreversible conversion of pyruvate to phosphoenolpyruvate in gluconeogenesis?

- A) Pyruvate carboxylase and PEP carboxykinase
- B) Pyruvate dehydrogenase and PEP carboxykinase
- C) Pyruvate kinase and hexokinase
- D) Phosphofructokinase and aldolase

Correct Answer: A) Pyruvate carboxylase and PEP carboxykinase

Reasoning: The conversion of pyruvate to phosphoenolpyruvate in gluconeogenesis involves two steps: pyruvate carboxylase converts pyruvate to oxaloacetate, and PEP carboxykinase (PEPCK) converts oxaloacetate to phosphoenolpyruvate. This bypasses the irreversible pyruvate kinase step in glycolysis.

MCAT Biochemistry Question 27

Which of the following molecules is the primary storage form of glucose in animal cells?

- A) Starch
- B) Cellulose

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- C) Glycogen
- D) Amylose

Correct Answer: C) Glycogen

Reasoning: Glycogen is the primary storage form of glucose in animal cells, particularly in liver and muscle tissues. It is a highly branched polymer of glucose that can be rapidly mobilized to release glucose when needed for energy.

MCAT Biochemistry Question 28

Which of the following enzymes catalyzes the rate-limiting step of cholesterol biosynthesis?

- A) HMG-CoA reductase
- B) Squalene synthase
- C) Mevalonate kinase
- D) Farnesyl pyrophosphate synthase

Correct Answer: A) HMG-CoA reductase

Reasoning: HMG-CoA reductase catalyzes the conversion of HMG-CoA to mevalonate, which is the rate-limiting and highly regulated step in cholesterol biosynthesis. Statins, a class of cholesterol-lowering drugs, inhibit this enzyme.

MCAT Biochemistry Question 29

Which of the following processes is primarily regulated by the enzyme glycogen phosphorylase?

- A) Glycogenesis
- B) Glycogenolysis
- C) Gluconeogenesis
- D) Glycolysis

Correct Answer: B) Glycogenolysis

Reasoning: Glycogen phosphorylase is the enzyme that catalyzes the breakdown of glycogen into glucose-1-phosphate during glycogenolysis. This process releases glucose units from glycogen stores to maintain blood glucose levels during fasting or increased energy demand.

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MCAT Biochemistry Question 30

Which of the following amino acids can be converted into a ketone body?

- A) Leucine
- B) Serine
- C) Glutamate
- D) Asparagine

Correct Answer: A) Leucine

Reasoning: Leucine is a ketogenic amino acid, meaning it can be degraded to acetyl-CoA, which is a precursor for ketone body synthesis. Ketogenic amino acids provide an alternative energy source during prolonged fasting or carbohydrate restriction.

MCAT Biochemistry Question 31

Which of the following enzymes is responsible for the conversion of citrate to isocitrate in the citric acid cycle?

- A) Citrate synthase
- B) Isocitrate dehydrogenase
- C) Aconitase
- D) Fumarase

Correct Answer: C) Aconitase

Reasoning: Aconitase catalyzes the isomerization of citrate to isocitrate via cis-aconitate in the citric acid cycle. This reaction is crucial for the subsequent oxidative decarboxylation steps that produce NADH and FADH₂.

MCAT Biochemistry Question 32

Which of the following molecules is an intermediate in both the urea cycle and the citric acid cycle?

- A) Citrulline
- B) Ornithine

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- C) Arginine
- D) Fumarate

Correct Answer: D) Fumarate

Reasoning: Fumarate is an intermediate in both the urea cycle and the citric acid cycle. In the urea cycle, fumarate is produced from argininosuccinate, and it can enter the citric acid cycle for further metabolism.

MCAT Biochemistry Question 33

Which of the following best describes the role of ATP in muscle contraction?

- A) ATP is required for the binding of myosin to actin.
- B) ATP hydrolysis provides the energy for the power stroke of myosin heads.
- C) ATP is responsible for the reuptake of calcium ions into the sarcoplasmic reticulum.
- D) ATP is required for the release of acetylcholine at the neuromuscular junction.

Correct Answer: B) ATP hydrolysis provides the energy for the power stroke of myosin heads.

Reasoning: ATP hydrolysis by myosin heads provides the energy necessary for the power stroke, which pulls actin filaments towards the center of the sarcomere, resulting in muscle contraction. The subsequent release of ADP and Pi resets the myosin head for another cycle.

MCAT Biochemistry Question 34

Which of the following best describes the primary function of the enzyme glucose-6-phosphatase?

- A) It converts glucose-6-phosphate to fructose-6-phosphate.
- B) It converts glucose-6-phosphate to glucose.
- C) It converts glucose to glucose-6-phosphate.
- D) It converts glucose-6-phosphate to 6-phosphogluconolactone.

Correct Answer: B) It converts glucose-6-phosphate to glucose.

Reasoning: Glucose-6-phosphatase catalyzes the hydrolysis of glucose-6-phosphate to glucose and inorganic phosphate. This reaction occurs in the liver and kidney and is crucial for maintaining blood glucose levels during fasting by releasing free glucose into the bloodstream.

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MCAT Biochemistry Question 35

Which of the following molecules is a precursor for the synthesis of heme?

- A) Succinyl-CoA
- B) Citrate
- C) Oxaloacetate
- D) Pyruvate

Correct Answer: A) Succinyl-CoA

Reasoning: Succinyl-CoA, along with glycine, is a precursor for the synthesis of heme. The first step in heme synthesis involves the condensation of succinyl-CoA and glycine to form δ -aminolevulinic acid (ALA) by the enzyme ALA synthase.

MCAT Biochemistry Question 36

Which of the following processes is directly affected by a deficiency in biotin?

- A) DNA replication
- B) Fatty acid synthesis
- C) Carboxylation reactions
- D) Protein phosphorylation

Correct Answer: C) Carboxylation reactions

Reasoning: Biotin is a coenzyme for carboxylase enzymes, which are involved in carboxylation reactions such as the conversion of pyruvate to oxaloacetate by pyruvate carboxylase and the synthesis of malonyl-CoA from acetyl-CoA by acetyl-CoA carboxylase. Biotin deficiency affects these critical metabolic processes.

MCAT Biochemistry Question 37

Which of the following best describes the function of the enzyme farnesyl pyrophosphate synthase?

- A) It synthesizes cholesterol from squalene.
- B) It catalyzes the formation of farnesyl pyrophosphate from isopentenyl pyrophosphate and dimethylallyl pyrophosphate.

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- C) It converts acetyl-CoA to HMG-CoA.
D) It catalyzes the conversion of mevalonate to isopentenyl pyrophosphate.

Correct Answer: B) It catalyzes the formation of farnesyl pyrophosphate from isopentenyl pyrophosphate and dimethylallyl pyrophosphate.

Reasoning: Farnesyl pyrophosphate synthase catalyzes the condensation of isopentenyl pyrophosphate and dimethylallyl pyrophosphate to form farnesyl pyrophosphate, an important intermediate in the biosynthesis of cholesterol, ubiquinones, and other isoprenoids.

MCAT Biochemistry Question 38

Which of the following best explains the role of thiamine pyrophosphate (TPP) in enzymatic reactions?

- A) It acts as an electron carrier.
B) It serves as a methyl group donor.
C) It stabilizes carbanion intermediates in decarboxylation reactions.
D) It is involved in the transfer of acyl groups.

Correct Answer: C) It stabilizes carbanion intermediates in decarboxylation reactions.

Reasoning: Thiamine pyrophosphate (TPP) stabilizes carbanion intermediates in decarboxylation reactions, such as those catalyzed by pyruvate dehydrogenase and α -ketoglutarate dehydrogenase. This stabilization is critical for the proper functioning of these metabolic enzymes.

MCAT Biochemistry Question 39

Which of the following molecules serves as a precursor for the biosynthesis of purine nucleotides?

- A) Aspartate
B) Ribose-5-phosphate
C) Alanine
D) Acetyl-CoA

Correct Answer: B) Ribose-5-phosphate

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Reasoning: Ribose-5-phosphate, derived from the pentose phosphate pathway, serves as the sugar backbone for the biosynthesis of purine nucleotides. The first committed step in purine biosynthesis involves the formation of 5-phosphoribosylamine from ribose-5-phosphate and glutamine.

MCAT Biochemistry Question 40

Which of the following enzymes is directly involved in the degradation of glycogen to glucose-1-phosphate?

- A) Glycogen synthase
- B) Glucose-6-phosphatase
- C) Glycogen phosphorylase
- D) Phosphoglucomutase

Correct Answer: C) Glycogen phosphorylase

Reasoning: Glycogen phosphorylase catalyzes the phosphorolytic cleavage of glycogen to release glucose-1-phosphate. This enzyme is activated during glycogenolysis to provide glucose for energy production during fasting or exercise.

MCAT Biochemistry Question 41

Which of the following is the main function of the enzyme DNA ligase?

- A) It synthesizes RNA primers during DNA replication.
- B) It joins Okazaki fragments during DNA replication.
- C) It unwinds the DNA double helix.
- D) It degrades mismatched nucleotides during DNA repair.

Correct Answer: B) It joins Okazaki fragments during DNA replication.

Reasoning: DNA ligase catalyzes the formation of phosphodiester bonds between Okazaki fragments on the lagging strand during DNA replication. This enzyme is essential for sealing nicks and completing the synthesis of the lagging strand.

MCAT Biochemistry Question 42

Which of the following molecules is the primary source of reducing power for fatty acid synthesis?

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- A) NADH
- B) FADH₂
- C) NADPH
- D) ATP

Correct Answer: C) NADPH

Reasoning: NADPH provides the reducing power for fatty acid synthesis. It is used by the enzyme fatty acid synthase to reduce acetyl groups and elongate the fatty acid chain. NADPH is generated in the pentose phosphate pathway and by malic enzyme.

MCAT Biochemistry Question 43

Which of the following processes is directly inhibited by the drug methotrexate?

- A) Purine synthesis
- B) Glycolysis
- C) Fatty acid oxidation
- D) DNA replication

Correct Answer: A) Purine synthesis

Reasoning: Methotrexate inhibits dihydrofolate reductase, an enzyme involved in the regeneration of tetrahydrofolate (THF), which is necessary for the synthesis of purines and thymidylate. By inhibiting this enzyme, methotrexate disrupts DNA and RNA synthesis, making it an effective chemotherapeutic agent.

MCAT Biochemistry Question 44

Which of the following enzymes catalyzes the first step of glycolysis?

- A) Hexokinase
- B) Phosphofructokinase
- C) Aldolase
- D) Pyruvate kinase

Correct Answer: A) Hexokinase

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Reasoning: Hexokinase catalyzes the phosphorylation of glucose to form glucose-6-phosphate, the first step of glycolysis. This reaction traps glucose within the cell and primes it for further metabolism.

MCAT Biochemistry Question 45

Which of the following molecules is a substrate for the enzyme glutamine synthetase?

- A) Glutamate
- B) Aspartate
- C) Alanine
- D) Serine

Correct Answer: A) Glutamate

Reasoning: Glutamine synthetase catalyzes the ATP-dependent conversion of glutamate and ammonia to glutamine. This reaction is important for nitrogen metabolism and the detoxification of ammonia in cells.

MCAT Biochemistry Question 46

Which of the following best describes the function of the enzyme ribonucleotide reductase?

- A) It synthesizes RNA from a DNA template.
- B) It converts ribonucleotides to deoxyribonucleotides.
- C) It degrades RNA molecules.
- D) It ligates RNA fragments together.

Correct Answer: B) It converts ribonucleotides to deoxyribonucleotides.

Reasoning: Ribonucleotide reductase catalyzes the reduction of ribonucleotides to deoxyribonucleotides, providing the building blocks for DNA synthesis and repair. This enzyme is tightly regulated to ensure a balanced supply of deoxyribonucleotides.

MCAT Biochemistry Question 47

Which of the following best describes the role of the enzyme pyruvate kinase in glycolysis?

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- A) It catalyzes the conversion of pyruvate to lactate.
- B) It catalyzes the phosphorylation of glucose to glucose-6-phosphate.
- C) It catalyzes the dephosphorylation of phosphoenolpyruvate to pyruvate.
- D) It catalyzes the formation of fructose-1,6-bisphosphate from fructose-6-phosphate.

Correct Answer: C) It catalyzes the dephosphorylation of phosphoenolpyruvate to pyruvate.

Reasoning: Pyruvate kinase catalyzes the final step of glycolysis, in which phosphoenolpyruvate (PEP) is dephosphorylated to form pyruvate and generate one molecule of ATP. This reaction is a key regulatory step in glycolysis.

MCAT Biochemistry Question 48

Which of the following vitamins is essential for the carboxylation reactions catalyzed by pyruvate carboxylase and acetyl-CoA carboxylase?

- A) Vitamin B1 (thiamine)
- B) Vitamin B7 (biotin)
- C) Vitamin B12 (cobalamin)
- D) Vitamin C (ascorbic acid)

Correct Answer: B) Vitamin B7 (biotin)

Reasoning: Biotin is a coenzyme for carboxylase enzymes, such as pyruvate carboxylase and acetyl-CoA carboxylase. It is essential for carboxylation reactions, which are crucial in gluconeogenesis and fatty acid synthesis.

MCAT Biochemistry Question 49

Which of the following molecules is the primary electron donor in the Calvin cycle?

- A) NADH
- B) FADH₂
- C) NADPH
- D) ATP

Correct Answer: C) NADPH

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Reasoning: NADPH provides the reducing power for the Calvin cycle, which is used to reduce 3-phosphoglycerate to glyceraldehyde-3-phosphate. NADPH is generated during the light-dependent reactions of photosynthesis.

MCAT Biochemistry Question 50

Which of the following molecules is an essential cofactor for the enzyme pyruvate dehydrogenase?

- A) Biotin
- B) Pyridoxal phosphate
- C) Thiamine pyrophosphate
- D) Cobalamin

Correct Answer: C) Thiamine pyrophosphate

Reasoning: Thiamine pyrophosphate (TPP) is an essential cofactor for pyruvate dehydrogenase. TPP assists in the decarboxylation of pyruvate to form acetyl-CoA, a critical step linking glycolysis to the citric acid cycle.

MCAT Biochemistry Question 51

Which of the following enzymes catalyzes the conversion of glucose-6-phosphate to 6-phosphogluconolactone in the pentose phosphate pathway?

- A) Glucose-6-phosphate dehydrogenase
- B) Phosphoglucomutase
- C) Ribose-5-phosphate isomerase
- D) Transaldolase

Correct Answer: A) Glucose-6-phosphate dehydrogenase

Reasoning: Glucose-6-phosphate dehydrogenase catalyzes the oxidation of glucose-6-phosphate to 6-phosphogluconolactone, the first step of the oxidative branch of the pentose phosphate pathway. This reaction also produces NADPH, which is important for reductive biosynthesis and antioxidant defense.

MCAT Biochemistry Question 52

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Which of the following best describes the role of lipoic acid in the pyruvate dehydrogenase complex?

- A) It acts as an electron carrier.
- B) It transfers acyl groups between enzyme subunits.
- C) It stabilizes carbanion intermediates.
- D) It donates phosphate groups to substrates.

Correct Answer: B) It transfers acyl groups between enzyme subunits.

Reasoning: Lipoic acid acts as a cofactor in the pyruvate dehydrogenase complex, where it serves as a swinging arm that transfers acyl groups between the active sites of the enzyme subunits, facilitating the conversion of pyruvate to acetyl-CoA.

MCAT Biochemistry Question 53

Which of the following molecules is a direct precursor of both adenine and guanine nucleotides?

- A) Hypoxanthine
- B) Uracil
- C) Thymine
- D) Cytosine

Correct Answer: A) Hypoxanthine

Reasoning: Hypoxanthine is a direct precursor of both adenine and guanine nucleotides. Inosine monophosphate (IMP) contains hypoxanthine and serves as a common intermediate in the biosynthesis of AMP and GMP.

MCAT Biochemistry Question 54

Which of the following enzymes is involved in the interconversion of ribose-5-phosphate and ribulose-5-phosphate?

- A) Transketolase
- B) Ribose-5-phosphate isomerase
- C) Phosphoglucomutase
- D) Transaldolase

Website : www.tutorSTEM.caMCAT Page : www.tutorSTEM.ca/mcatPhone Number for Tutor STEM's Medical School MCAT Department : [416-795-5000](tel:416-795-5000)**Correct Answer: B) Ribose-5-phosphate isomerase**

Reasoning: Ribose-5-phosphate isomerase catalyzes the reversible interconversion of ribose-5-phosphate and ribulose-5-phosphate, an important step in the non-oxidative branch of the pentose phosphate pathway.

MCAT Biochemistry Question 55

Which of the following best describes the function of the enzyme dihydrofolate reductase?

- A) It converts folic acid to tetrahydrofolate.
- B) It synthesizes folic acid from para-aminobenzoic acid.
- C) It degrades folic acid into inactive metabolites.
- D) It phosphorylates folic acid.

Correct Answer: A) It converts folic acid to tetrahydrofolate.

Reasoning: Dihydrofolate reductase catalyzes the reduction of dihydrofolate to tetrahydrofolate (THF), a key step in the folate cycle. THF is essential for the synthesis of purines and thymidylate, making dihydrofolate reductase a critical enzyme for DNA synthesis and cell division.

MCAT Biochemistry Question 56

Which of the following best describes the role of the enzyme ribonuclease H in DNA replication?

- A) It synthesizes RNA primers.
- B) It removes RNA primers from the lagging strand.
- C) It synthesizes DNA from an RNA template.
- D) It degrades DNA during replication.

Correct Answer: B) It removes RNA primers from the lagging strand.

Reasoning: Ribonuclease H (RNase H) degrades the RNA primers used to initiate DNA synthesis on the lagging strand during DNA replication. This enzyme allows the RNA primers to be replaced with DNA, ensuring the completion of the newly synthesized DNA strand.

MCAT Biochemistry Question 57

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Which of the following best describes the primary function of the enzyme transketolase in the pentose phosphate pathway?

- A) It transfers two-carbon units between sugar phosphates.
- B) It catalyzes the oxidation of glucose-6-phosphate.
- C) It converts ribose-5-phosphate to ribulose-5-phosphate.
- D) It synthesizes NADPH from NADP+.

Correct Answer: A) It transfers two-carbon units between sugar phosphates.

Reasoning: Transketolase transfers two-carbon units from a ketose donor to an aldose acceptor in the non-oxidative branch of the pentose phosphate pathway. This enzyme plays a crucial role in the interconversion of sugar phosphates, which is important for nucleotide synthesis and metabolic flexibility.

MCAT Biochemistry Question 58

Which of the following best describes the role of the enzyme phosphofructokinase-1 (PFK-1) in glycolysis?

- A) It phosphorylates glucose to form glucose-6-phosphate.
- B) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.
- C) It cleaves fructose-1,6-bisphosphate into two triose phosphates.
- D) It converts phosphoenolpyruvate to pyruvate.

Correct Answer: B) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.

Reasoning: Phosphofructokinase-1 (PFK-1) catalyzes the phosphorylation of fructose-6-phosphate to form fructose-1,6-bisphosphate, a key regulatory step in glycolysis. This enzyme is allosterically regulated and plays a critical role in controlling the rate of glycolysis in response to cellular energy levels.

MCAT Biochemistry Question 59

Which of the following molecules is the primary product of the enzyme glutamine synthetase?

- A) Glutamate
- B) Glutamine

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- C) α -Ketoglutarate
- D) Aspartate

Correct Answer: B) Glutamine

Reasoning: Glutamine synthetase catalyzes the ATP-dependent conversion of glutamate and ammonia to glutamine. This reaction is important for nitrogen metabolism and the detoxification of ammonia in cells.

MCAT Biochemistry Question 60

Which of the following best describes the role of the enzyme isocitrate dehydrogenase in the citric acid cycle?

- A) It converts isocitrate to α -ketoglutarate.
- B) It converts citrate to isocitrate.
- C) It converts α -ketoglutarate to succinyl-CoA.
- D) It converts succinate to fumarate.

Correct Answer: A) It converts isocitrate to α -ketoglutarate.

Reasoning: Isocitrate dehydrogenase catalyzes the oxidative decarboxylation of isocitrate to α -ketoglutarate, producing NADH and CO₂ in the process. This reaction is a key regulatory step in the citric acid cycle and contributes to the production of reducing equivalents for ATP synthesis.

MCAT Biochemistry Question 61

Which of the following best describes the function of the enzyme malate dehydrogenase in the citric acid cycle?

- A) It converts oxaloacetate to citrate.
- B) It converts fumarate to malate.
- C) It converts malate to oxaloacetate.
- D) It converts succinyl-CoA to succinate.

Correct Answer: C) It converts malate to oxaloacetate.

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Reasoning: Malate dehydrogenase catalyzes the oxidation of malate to oxaloacetate, producing NADH in the process. This reaction regenerates oxaloacetate for the next round of the citric acid cycle and contributes to the production of reducing equivalents for the electron transport chain.

MCAT Biochemistry Question 62

Which of the following molecules is the primary carrier of acyl groups in the β -oxidation of fatty acids?

- A) Coenzyme A
- B) Carnitine
- C) Acyl carrier protein
- D) Biotin

Correct Answer: A) Coenzyme A

Reasoning: Coenzyme A (CoA) is the primary carrier of acyl groups in the β -oxidation of fatty acids. Fatty acids are activated to form acyl-CoA derivatives, which then undergo β -oxidation to produce acetyl-CoA, NADH, and FADH₂.

MCAT Biochemistry Question 63

Which of the following best describes the role of the enzyme aldolase in glycolysis?

- A) It phosphorylates glucose to form glucose-6-phosphate.
- B) It converts fructose-1,6-bisphosphate to glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.
- C) It oxidizes glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate.
- D) It converts phosphoenolpyruvate to pyruvate.

Correct Answer: B) It converts fructose-1,6-bisphosphate to glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.

Reasoning: Aldolase catalyzes the cleavage of fructose-1,6-bisphosphate into two triose phosphates: glyceraldehyde-3-phosphate (G3P) and dihydroxyacetone phosphate (DHAP). This reaction is a crucial step in glycolysis, allowing the subsequent steps to proceed.

MCAT Biochemistry Question 64

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Which of the following best describes the function of the enzyme succinate dehydrogenase in the citric acid cycle?

- A) It converts succinate to fumarate.
- B) It converts fumarate to malate.
- C) It converts malate to oxaloacetate.
- D) It converts α -ketoglutarate to succinyl-CoA.

Correct Answer: A) It converts succinate to fumarate.

Reasoning: Succinate dehydrogenase catalyzes the oxidation of succinate to fumarate, producing FADH_2 in the process. This enzyme is unique as it is part of both the citric acid cycle and the electron transport chain, where it functions as Complex II.

MCAT Biochemistry Question 65

Which of the following molecules is a key intermediate in both the citric acid cycle and gluconeogenesis?

- A) Citrate
- B) Oxaloacetate
- C) Malate
- D) Fumarate

Correct Answer: B) Oxaloacetate

Reasoning: Oxaloacetate is a key intermediate in both the citric acid cycle and gluconeogenesis. In the citric acid cycle, it condenses with acetyl-CoA to form citrate. In gluconeogenesis, it is converted to phosphoenolpyruvate (PEP) by PEP carboxykinase.

MCAT Biochemistry Question 66

Which of the following best describes the role of the enzyme pyruvate dehydrogenase kinase?

- A) It activates pyruvate dehydrogenase by phosphorylation.
- B) It inhibits pyruvate dehydrogenase by phosphorylation.
- C) It converts pyruvate to acetyl-CoA.
- D) It converts acetyl-CoA to pyruvate.

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Website : www.tutorSTEM.caMCAT Page : www.tutorSTEM.ca/mcatPhone Number for Tutor STEM's Medical School MCAT Department : [416-795-5000](tel:416-795-5000)**Correct Answer: B) It inhibits pyruvate dehydrogenase by phosphorylation.**

Reasoning: Pyruvate dehydrogenase kinase phosphorylates and inactivates pyruvate dehydrogenase, thereby inhibiting the conversion of pyruvate to acetyl-CoA. This regulation helps control the entry of pyruvate into the citric acid cycle based on the cell's energy needs.

MCAT Biochemistry Question 67

Which of the following enzymes catalyzes the first committed step in glycolysis?

- A) Hexokinase
- B) Phosphofructokinase-1
- C) Aldolase
- D) Pyruvate kinase

Correct Answer: B) Phosphofructokinase-1

Reasoning: Phosphofructokinase-1 (PFK-1) catalyzes the phosphorylation of fructose-6-phosphate to fructose-1,6-bisphosphate, the first committed step in glycolysis. This enzyme is highly regulated and acts as a key control point for glycolytic flux.

MCAT Biochemistry Question 68

Which of the following molecules is a direct product of the enzyme pyruvate carboxylase?

- A) Oxaloacetate
- B) Acetyl-CoA
- C) Phosphoenolpyruvate
- D) Lactate

Correct Answer: A) Oxaloacetate

Reasoning: Pyruvate carboxylase catalyzes the ATP-dependent carboxylation of pyruvate to form oxaloacetate. This reaction is important for replenishing citric acid cycle intermediates and for gluconeogenesis.

MCAT Biochemistry Question 69

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Which of the following best describes the function of the enzyme enolase in glycolysis?

- A) It phosphorylates glucose to form glucose-6-phosphate.
- B) It converts phosphoenolpyruvate to pyruvate.
- C) It converts 2-phosphoglycerate to phosphoenolpyruvate.
- D) It cleaves fructose-1,6-bisphosphate into two triose phosphates.

Correct Answer: C) It converts 2-phosphoglycerate to phosphoenolpyruvate.

Reasoning: Enolase catalyzes the dehydration of 2-phosphoglycerate to form phosphoenolpyruvate (PEP), a high-energy intermediate in glycolysis. This reaction is a critical step leading to the final production of pyruvate and ATP.

MCAT Biochemistry Question 70

Which of the following molecules is an essential cofactor for the enzyme acetyl-CoA carboxylase?

- A) Biotin
- B) Thiamine pyrophosphate
- C) Pyridoxal phosphate
- D) FAD

Correct Answer: A) Biotin

Reasoning: Biotin is a cofactor for acetyl-CoA carboxylase, the enzyme that catalyzes the carboxylation of acetyl-CoA to form malonyl-CoA. This reaction is the first committed step in fatty acid biosynthesis.

MCAT Biochemistry Question 71

Which of the following best describes the role of the enzyme glucose-6-phosphate dehydrogenase in the pentose phosphate pathway?

- A) It converts glucose-6-phosphate to fructose-6-phosphate.
- B) It oxidizes glucose-6-phosphate to 6-phosphogluconolactone.
- C) It converts ribose-5-phosphate to ribulose-5-phosphate.
- D) It transfers two-carbon units between sugar phosphates.

Website : www.tutorSTEM.caMCAT Page : www.tutorSTEM.ca/mcatPhone Number for Tutor STEM's Medical School MCAT Department : [416-795-5000](tel:416-795-5000)**Correct Answer: B) It oxidizes glucose-6-phosphate to 6-phosphogluconolactone.**

Reasoning: Glucose-6-phosphate dehydrogenase catalyzes the first step of the oxidative branch of the pentose phosphate pathway, oxidizing glucose-6-phosphate to 6-phosphogluconolactone and producing NADPH in the process. NADPH is crucial for reductive biosynthesis and antioxidant defense.

MCAT Biochemistry Question 72

Which of the following best describes the function of the enzyme β -ketoacyl-ACP synthase in fatty acid synthesis?

- A) It activates fatty acids by converting them to acyl-CoA.
- B) It transfers acetyl groups to malonyl-ACP.
- C) It catalyzes the condensation of acetyl-ACP and malonyl-ACP.
- D) It reduces β -ketoacyl-ACP to β -hydroxyacyl-ACP.

Correct Answer: C) It catalyzes the condensation of acetyl-ACP and malonyl-ACP.

Reasoning: β -Ketoacyl-ACP synthase (also known as KS) catalyzes the condensation reaction between acetyl-ACP and malonyl-ACP, forming β -ketoacyl-ACP. This step is essential for the elongation of the fatty acid chain in the fatty acid synthesis pathway.

MCAT Biochemistry Question 73

Which of the following molecules is a substrate for the enzyme thymidylate synthase?

- A) Uridine monophosphate (UMP)
- B) Cytidine monophosphate (CMP)
- C) Deoxyuridine monophosphate (dUMP)
- D) Adenosine monophosphate (AMP)

Correct Answer: C) Deoxyuridine monophosphate (dUMP)

Reasoning: Thymidylate synthase catalyzes the conversion of deoxyuridine monophosphate (dUMP) to deoxythymidine monophosphate (dTMP) by adding a methyl group, which is donated by 5,10-methylenetetrahydrofolate. This reaction is crucial for DNA synthesis and repair.

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MCAT Biochemistry Question 74

Which of the following best describes the role of the enzyme phosphoglucomutase in glycogen metabolism?

- A) It converts glucose-1-phosphate to glucose-6-phosphate.
- B) It hydrolyzes glycogen to release glucose.
- C) It converts glucose-6-phosphate to glucose.
- D) It phosphorylates glucose to form glucose-1-phosphate.

Correct Answer: A) It converts glucose-1-phosphate to glucose-6-phosphate.

Reasoning: Phosphoglucomutase catalyzes the reversible conversion of glucose-1-phosphate to glucose-6-phosphate. This enzyme plays a key role in glycogenolysis, allowing glucose-1-phosphate, produced from glycogen breakdown, to enter glycolysis or gluconeogenesis.

MCAT Biochemistry Question 75

Which of the following best describes the function of the enzyme acetyl-CoA carboxylase in fatty acid metabolism?

- A) It oxidizes fatty acids to produce acetyl-CoA.
- B) It converts acetyl-CoA to malonyl-CoA.
- C) It synthesizes fatty acids from acetyl-CoA.
- D) It hydrolyzes triglycerides to release fatty acids.

Correct Answer: B) It converts acetyl-CoA to malonyl-CoA.

Reasoning: Acetyl-CoA carboxylase catalyzes the ATP-dependent carboxylation of acetyl-CoA to form malonyl-CoA, the first committed step in fatty acid biosynthesis. This enzyme is a key regulatory point in fatty acid metabolism.

MCAT Biochemistry Question 76

Which of the following best describes the role of the enzyme pyruvate dehydrogenase in cellular metabolism?

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- A) It converts pyruvate to lactate.
- B) It converts pyruvate to acetyl-CoA.
- C) It converts pyruvate to oxaloacetate.
- D) It converts pyruvate to phosphoenolpyruvate.

Correct Answer: B) It converts pyruvate to acetyl-CoA.

Reasoning: Pyruvate dehydrogenase catalyzes the oxidative decarboxylation of pyruvate to form acetyl-CoA, NADH, and CO₂. This reaction links glycolysis to the citric acid cycle and is crucial for aerobic energy production.

MCAT Biochemistry Question 77

Which of the following molecules is an intermediate in both the citric acid cycle and amino acid metabolism?

- A) Citrate
- B) α -Ketoglutarate
- C) Succinyl-CoA
- D) Fumarate

Correct Answer: B) α -Ketoglutarate

Reasoning: α -Ketoglutarate is an intermediate in the citric acid cycle and also plays a central role in amino acid metabolism. It is involved in transamination reactions, where it can accept an amino group to form glutamate.

MCAT Biochemistry Question 78

Which of the following best describes the role of the enzyme ATP synthase in cellular respiration?

- A) It transfers electrons from NADH to oxygen.
- B) It synthesizes ATP using the proton gradient generated by the electron transport chain.
- C) It oxidizes glucose to produce ATP.
- D) It converts ADP to ATP using substrate-level phosphorylation.

Correct Answer: B) It synthesizes ATP using the proton gradient generated by the electron transport chain.

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Reasoning: ATP synthase uses the proton gradient generated by the electron transport chain across the inner mitochondrial membrane to drive the synthesis of ATP from ADP and inorganic phosphate. This process, known as oxidative phosphorylation, is the primary method of ATP production in aerobic organisms.

MCAT Biochemistry Question 79

Which of the following molecules is the main precursor for the synthesis of ketone bodies?

- A) Glucose
- B) Acetyl-CoA
- C) Pyruvate
- D) Oxaloacetate

Correct Answer: B) Acetyl-CoA

Reasoning: Acetyl-CoA is the main precursor for the synthesis of ketone bodies. During periods of fasting or low carbohydrate intake, excess acetyl-CoA from fatty acid oxidation is converted into ketone bodies (acetoacetate, β -hydroxybutyrate, and acetone) in the liver, which can be used as alternative energy sources.

MCAT Biochemistry Question 80

Which of the following best describes the function of the enzyme phosphoenolpyruvate carboxykinase (PEPCK) in gluconeogenesis?

- A) It converts oxaloacetate to phosphoenolpyruvate.
- B) It converts pyruvate to oxaloacetate.
- C) It converts glucose-6-phosphate to glucose.
- D) It converts fructose-1,6-bisphosphate to fructose-6-phosphate.

Correct Answer: A) It converts oxaloacetate to phosphoenolpyruvate.

Reasoning: Phosphoenolpyruvate carboxykinase (PEPCK) catalyzes the conversion of oxaloacetate to phosphoenolpyruvate (PEP) in gluconeogenesis. This reaction is a key step in bypassing the irreversible pyruvate kinase reaction of glycolysis.

MCAT Biochemistry Question 81

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Which of the following molecules is the primary electron acceptor in the light-dependent reactions of photosynthesis?

- A) NADP+
- B) FAD
- C) Coenzyme Q
- D) Oxygen

Correct Answer: A) NADP+

Reasoning: NADP+ is the primary electron acceptor in the light-dependent reactions of photosynthesis. It is reduced to NADPH by the photosystem I complex, providing the reducing power needed for the Calvin cycle.

MCAT Biochemistry Question 82

Which of the following best describes the role of the enzyme citrate synthase in the citric acid cycle?

- A) It converts citrate to isocitrate.
- B) It converts oxaloacetate and acetyl-CoA to citrate.
- C) It converts succinate to fumarate.
- D) It converts α -ketoglutarate to succinyl-CoA.

Correct Answer: B) It converts oxaloacetate and acetyl-CoA to citrate.

Reasoning: Citrate synthase catalyzes the condensation of oxaloacetate and acetyl-CoA to form citrate. This is the first step of the citric acid cycle and is crucial for the continuation of the cycle.

MCAT Biochemistry Question 83

Which of the following molecules is a product of the oxidative branch of the pentose phosphate pathway?

- A) NADPH
- B) ATP
- C) FADH₂
- D) Acetyl-CoA

Website : www.tutorSTEM.caMCAT Page : www.tutorSTEM.ca/mcatPhone Number for Tutor STEM's Medical School MCAT Department : [416-795-5000](tel:416-795-5000)**Correct Answer: A) NADPH**

Reasoning: NADPH is a product of the oxidative branch of the pentose phosphate pathway. This pathway generates NADPH, which is essential for reductive biosynthesis and antioxidant defense, and ribose-5-phosphate, which is used in nucleotide synthesis.

MCAT Biochemistry Question 84

Which of the following best describes the function of the enzyme enoyl-CoA hydratase in fatty acid oxidation?

- A) It activates fatty acids by converting them to acyl-CoA.
- B) It converts acyl-CoA to acetyl-CoA.
- C) It hydrates trans- Δ^2 -enoyl-CoA to L-3-hydroxyacyl-CoA.
- D) It reduces β -ketoacyl-CoA to β -hydroxyacyl-CoA.

Correct Answer: C) It hydrates trans- Δ^2 -enoyl-CoA to L-3-hydroxyacyl-CoA.

Reasoning: Enoyl-CoA hydratase catalyzes the hydration of trans- Δ^2 -enoyl-CoA to form L-3-hydroxyacyl-CoA during the β -oxidation of fatty acids. This reaction is an essential step in the breakdown of fatty acids to produce acetyl-CoA.

MCAT Biochemistry Question 85

Which of the following best describes the role of the enzyme glutamate dehydrogenase in amino acid metabolism?

- A) It transaminates glutamate to form α -ketoglutarate.
- B) It oxidatively deaminates glutamate to form α -ketoglutarate and ammonia.
- C) It synthesizes glutamate from glutamine.
- D) It converts glutamate to glutamine.

Correct Answer: B) It oxidatively deaminates glutamate to form α -ketoglutarate and ammonia.

Reasoning: Glutamate dehydrogenase catalyzes the oxidative deamination of glutamate to produce α -ketoglutarate and ammonia. This reaction plays a key role in the catabolism of amino acids and the regulation of nitrogen balance.

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MCAT Biochemistry Question 86

Which of the following molecules is the primary product of the enzyme glycogen synthase?

- A) Glucose-1-phosphate
- B) Glucose-6-phosphate
- C) Glycogen
- D) Maltose

Correct Answer: C) Glycogen

Reasoning: Glycogen synthase catalyzes the addition of glucose units from UDP-glucose to a growing glycogen chain. This enzyme is crucial for glycogen synthesis, storing glucose in a readily accessible form in liver and muscle tissues.

MCAT Biochemistry Question 87

Which of the following best describes the role of the enzyme ribonucleotide reductase in DNA synthesis?

- A) It synthesizes RNA from a DNA template.
- B) It converts ribonucleotides to deoxyribonucleotides.
- C) It degrades RNA primers during DNA replication.
- D) It ligates Okazaki fragments during DNA replication.

Correct Answer: B) It converts ribonucleotides to deoxyribonucleotides.

Reasoning: Ribonucleotide reductase catalyzes the reduction of ribonucleotides to deoxyribonucleotides, providing the building blocks for DNA synthesis and repair. This enzyme is tightly regulated to ensure a balanced supply of deoxyribonucleotides.

MCAT Biochemistry Question 88

Which of the following best describes the role of the enzyme carbamoyl phosphate synthetase I in the urea cycle?

- A) It synthesizes urea from arginine.
- B) It converts citrulline to argininosuccinate.

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- C) It synthesizes carbamoyl phosphate from ammonia and bicarbonate.
D) It converts ornithine to citrulline.

Correct Answer: C) It synthesizes carbamoyl phosphate from ammonia and bicarbonate.

Reasoning: Carbamoyl phosphate synthetase I catalyzes the ATP-dependent synthesis of carbamoyl phosphate from ammonia and bicarbonate. This reaction is the first step of the urea cycle and is crucial for the detoxification of ammonia.

MCAT Biochemistry Question 89

Which of the following best describes the function of the enzyme UDP-glucose pyrophosphorylase in glycogen synthesis?

- A) It phosphorylates glucose to form glucose-1-phosphate.
B) It converts glucose-1-phosphate to UDP-glucose.
C) It adds glucose units to a growing glycogen chain.
D) It degrades glycogen to release glucose-1-phosphate.

Correct Answer: B) It converts glucose-1-phosphate to UDP-glucose.

Reasoning: UDP-glucose pyrophosphorylase catalyzes the conversion of glucose-1-phosphate to UDP-glucose, which is the activated form of glucose used by glycogen synthase to elongate the glycogen chain.

MCAT Biochemistry Question 90

Which of the following best describes the role of the enzyme succinyl-CoA synthetase in the citric acid cycle?

- A) It converts succinate to fumarate.
B) It converts fumarate to malate.
C) It converts succinyl-CoA to succinate.
D) It converts α -ketoglutarate to succinyl-CoA.

Correct Answer: C) It converts succinyl-CoA to succinate.

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Reasoning: Succinyl-CoA synthetase catalyzes the conversion of succinyl-CoA to succinate, coupled with the generation of GTP (or ATP) from GDP (or ADP) and inorganic phosphate. This reaction is part of the citric acid cycle.

MCAT Biochemistry Question 91

Which of the following best describes the role of the enzyme adenylate cyclase in signal transduction?

- A) It degrades cAMP to AMP.
- B) It synthesizes cAMP from ATP.
- C) It phosphorylates proteins in response to cAMP.
- D) It dephosphorylates proteins in response to cAMP.

Correct Answer: B) It synthesizes cAMP from ATP.

Reasoning: Adenylate cyclase catalyzes the conversion of ATP to cyclic AMP (cAMP) in response to extracellular signals, such as hormones binding to G protein-coupled receptors. cAMP acts as a second messenger, activating protein kinase A and leading to various cellular responses.

MCAT Biochemistry Question 92

Which of the following best describes the role of the enzyme hexokinase in glycolysis?

- A) It converts glucose to glucose-6-phosphate.
- B) It converts glucose-6-phosphate to fructose-6-phosphate.
- C) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.
- D) It converts pyruvate to lactate.

Correct Answer: A) It converts glucose to glucose-6-phosphate.

Reasoning: Hexokinase catalyzes the phosphorylation of glucose to form glucose-6-phosphate, the first step in glycolysis. This reaction traps glucose within the cell and primes it for further metabolism in the glycolytic pathway.

MCAT Biochemistry Question 93

Which of the following best describes the role of the enzyme argininosuccinate lyase in the urea cycle?

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- A) It converts arginine to urea and ornithine.
- B) It converts citrulline to argininosuccinate.
- C) It converts argininosuccinate to arginine and fumarate.
- D) It converts ornithine to citrulline.

Correct Answer: C) It converts argininosuccinate to arginine and fumarate.

Reasoning: Argininosuccinate lyase catalyzes the cleavage of argininosuccinate to form arginine and fumarate. This reaction is an essential step in the urea cycle, which detoxifies ammonia by converting it to urea for excretion.

MCAT Biochemistry Question 94

Which of the following molecules is the primary energy carrier in cells and is produced during cellular respiration?

- A) ATP
- B) NADH
- C) FADH₂
- D) GTP

Correct Answer: A) ATP

Reasoning: Adenosine triphosphate (ATP) is the primary energy carrier in cells. It is produced during cellular respiration through glycolysis, the citric acid cycle, and oxidative phosphorylation, and is used to power various cellular processes.

MCAT Biochemistry Question 95

Which of the following enzymes is involved in the interconversion of ribose-5-phosphate and ribulose-5-phosphate?

- A) Transketolase
- B) Ribose-5-phosphate isomerase
- C) Phosphoglucomutase
- D) Transaldolase

Correct Answer: B) Ribose-5-phosphate isomerase

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Reasoning: Ribose-5-phosphate isomerase catalyzes the reversible interconversion of ribose-5-phosphate and ribulose-5-phosphate, an important step in the non-oxidative branch of the pentose phosphate pathway.

MCAT Biochemistry Question 96

Which of the following best describes the role of the enzyme dihydrofolate reductase in nucleotide biosynthesis?

- A) It converts folic acid to tetrahydrofolate.
- B) It synthesizes folic acid from para-aminobenzoic acid.
- C) It degrades folic acid into inactive metabolites.
- D) It phosphorylates folic acid.

Correct Answer: A) It converts folic acid to tetrahydrofolate.

Reasoning: Dihydrofolate reductase catalyzes the reduction of dihydrofolate to tetrahydrofolate (THF), a key step in the folate cycle. THF is essential for the synthesis of purines and thymidylate, making dihydrofolate reductase a critical enzyme for DNA synthesis and cell division.

MCAT Biochemistry Question 97

Which of the following best describes the role of the enzyme phosphoglucomutase in glycogen metabolism?

- A) It converts glucose-1-phosphate to glucose-6-phosphate.
- B) It hydrolyzes glycogen to release glucose.
- C) It converts glucose-6-phosphate to glucose.
- D) It phosphorylates glucose to form glucose-1-phosphate.

Correct Answer: A) It converts glucose-1-phosphate to glucose-6-phosphate.

Reasoning: Phosphoglucomutase catalyzes the reversible conversion of glucose-1-phosphate to glucose-6-phosphate. This enzyme plays a key role in glycogenolysis, allowing glucose-1-phosphate, produced from glycogen breakdown, to enter glycolysis or gluconeogenesis.

MCAT Biochemistry Question 98

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Which of the following best describes the function of the enzyme acetyl-CoA carboxylase in fatty acid metabolism?

- A) It oxidizes fatty acids to produce acetyl-CoA.
- B) It converts acetyl-CoA to malonyl-CoA.
- C) It synthesizes fatty acids from acetyl-CoA.
- D) It hydrolyzes triglycerides to release fatty acids.

Correct Answer: B) It converts acetyl-CoA to malonyl-CoA.

Reasoning: Acetyl-CoA carboxylase (ACC) plays a pivotal role in fatty acid metabolism by catalyzing the ATP-dependent carboxylation of acetyl-CoA to form malonyl-CoA. This reaction is the first committed step in the biosynthesis of fatty acids. The enzyme functions as a biotin-dependent carboxylase, involving two main stages: carboxylation of biotin with bicarbonate in an ATP-dependent manner and subsequent transfer of the carboxyl group from biotin to acetyl-CoA, producing malonyl-CoA. Malonyl-CoA serves as a crucial building block for the elongation of fatty acid chains by fatty acid synthase. Hormonal regulation also plays a role, with insulin promoting dephosphorylation and activation of ACC, while glucagon and epinephrine induce phosphorylation and inactivation through AMP-activated protein kinase (AMPK). This regulation ensures that fatty acid synthesis is tightly coordinated with the cell's overall energy status and availability of substrates, making ACC a critical control point in lipid metabolism and homeostasis.

MCAT Biochemistry Question 99

Which of the following best describes the role of the enzyme pyruvate dehydrogenase in cellular metabolism?

- A) It converts pyruvate to lactate.
- B) It converts pyruvate to acetyl-CoA.
- C) It converts pyruvate to oxaloacetate.
- D) It converts pyruvate to phosphoenolpyruvate.

Correct Answer: B) It converts pyruvate to acetyl-CoA.

Reasoning: Pyruvate dehydrogenase catalyzes the oxidative decarboxylation of pyruvate to form acetyl-CoA, NADH, and CO₂. This reaction links glycolysis to the citric acid cycle and is crucial for aerobic energy production.

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MCAT Biochemistry Question 100

Which of the following best describes the role of the enzyme glucose-6-phosphatase in glucose metabolism?

- A) It converts glucose-6-phosphate to glucose.
- B) It converts glucose to glucose-6-phosphate.
- C) It converts fructose-6-phosphate to fructose-1,6-bisphosphate.
- D) It converts pyruvate to glucose-6-phosphate.

Correct Answer: A) It converts glucose-6-phosphate to glucose.

Reasoning: Glucose-6-phosphatase catalyzes the hydrolysis of glucose-6-phosphate to glucose and inorganic phosphate. This reaction occurs in the liver and kidney and is crucial for maintaining blood glucose levels during fasting by releasing free glucose into the bloodstream.

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