5 B I O C H E M I S T R Y E X A M

June 23, 1999

NAME_____

1. The ring structure for a ketohexose having a hemi-ketal structure formed between the 2-keto group and the 'OH' group on the Δ5 carbon atom will be a _____ ring structure and will show _____ oxygen atoms.
A) furanose -- 6 B) pyranose -- 5 C) furanose -- 5 D) furanose -- 4 E) pyranose -- 6

2. Sketch a 2-ketotetrose on your scratch paper and predict the maximum number of stereoisomers one could draw for this carbohydrate.
A) 3 B) 1 C) 2 D) 4 E) 5

3. A disaccharide which produces only glucose upon hydrolysis and has a glycosidic linkage described as α1-α1 will show _____ oxygen atoms in its structure and be a _____ sugar.
A) 12 -- reducing B) 11 -- non-reducing C) 8 -- non-reducing D) 5 -- reducing
E) 6 -- non-reducing

4. 'Starch' is described as a homopolymer of _____, and shows _____ '1-6' branches than glycogen.
A) glucose -- more B) sucrose -- more C) glucose -- fewer D) galactose -- fewer
E) sucrose -- fewer

5. A system of unsaturated fatty acids will have a lower melting point range than a system of saturated fatty acids because the unsaturated system _____. (NOTE: Assume that both the saturated and unsaturated fatty acids have the same number of carbon atoms.)
A) has a 'cis' configuration B) is more reduced C) has a α configuration
D) is more hydrogenated E) is more oxidized

6. Olive oil and lard have in common the fact that they are both _____.
A) hydrogen bonded B) polar lipids C) sphingolipids D) triacylglycerols E) hydrophilic

7. The enzyme(s) which catalyze the hydrolysis of the α 1-6 glycosidic linkages found in starch is(are) synthesized within the _____.
A) intestinal mucosa B) intestinal lumen C) salivary glands D) pancreas E) portal system

8. The large work potential which is available when ATP is hydrolyzed to ADP and P_i is understood to be the result of the enormous energy content of the chemical bond between _____ and _____.
A) H_2O -- $-PO_3^{2-}$ B) ATP -- $-PO_3^{2-}$ C) ADP -- $-PO_3^{2-}$ D) ADP -- ATP E) ADP -- H_2O

9. Complete the reaction: glucose + ATP → _____ + _____.
A) ADP -- H_2O B) G-6-P -- ADP C) G-6-P -- P_i D) H_2O -- G-6-P E) G-1-P -- H_2O

10. In order to produce 300 millimoles of ATP using the glycolytic pathway, one must concomitantly produce _____ millimoles of lactate and consume _____ millimoles of glucose.
A) 150 -- 150 B) 300 -- 300 C) 150 -- 300 D) 300 -- 150 E) 300 -- 75

11. How many millimoles of ATP can be produced by the glycolytic pathway starting with 10 millimoles of F-6-P and ending with lactate?
A) 30 B) 40 C) 25 D) 20 E) 10

12. According to the reactions of the glycolytic pathway, when PFK is allosterically inhibited, the glycolytic component which tends to accumulate in the cellular system is _____.
A) ADP B) F-6-P C) F-1,6-P D) G-6-P E) glucose

13. Which combination of phosphate compound concentrations is not only consistent with intracellular processes, but will also generate a sigmoidal kinetic response curve from the enzyme phosphofructokinase?
A) [AMP]↑ -- [ATP]↓ B) [ATP]↑ -- [ADP]↓ C) [ADP]↑ -- [AMP]↑ D) [ATP]↓ -- [ADP]↑
E) [AMP]↓ -- [ATP]↓

14. If the reaction: 1,3 bisphosphoglycerate + ADP → 3 phosphoglycerate + ATP has a ΔG° = -15 kJ, estimate the value of ΔG° for the hydrolysis of 1,3 bisphosphoglycerate. (NOTE: Remember that the ΔG° for the hydrolysis of ATP is -31 kJ/mol
A) -46 kJ/mol B) -31 kJ/mol C) -50 kJ/mol D) -16 kJ/mol E) +50 kJ/mol

15. When pyruvate is converted into lactate at the end of the glycolytic pathway, the oxidizing agent in this process is the metabolite _____.
A) NADH B) pyruvate C) ATP D) lactate E) NAD^+

16. The oxidation of glucose via the 'shunt' is _____ and generates the product _____, along with a pentose and several reducing agents.
A) aerobic -- ribulose-5-P B) aerobic -- ATP C) anaerobic -- NADPH D) anaerobic -- CO_2
E) anaerobic -- ATP

17. Which of the following is a likely result of the manipulation of the pentose products of the phosphogluconate pathway in order to generate metabolites which are compatible with glycolysis?
A) F-6-P B) pyruvate C) lactate D) glucose E) ATP

18. One turn of the TCA cycle converts all of the carbon atoms in a molecule of _____ into carbon dioxide.
A) pyruvate B) glucose C) acetyl CoA D) succinyl CoA E) citrate

19. Many of the oxidizing agents used in the TCA cycle are supplied by the _____ oxidation of _____.
A) aerobic -- CO_2 B) aerobic -- NADH C) anaerobic -- lactate D) aerobic -- ATP
E) aerobic -- pyruvate

20. The TCA cycle is responsible for the production of about _____ percent of the ATP generated by the catabolism of glucose.
A) 50 B) 67 C) 33 D) 40 E) 95

21. All of the cofactors in the pyruvate dehydrogenase enzyme system are examples of active forms of B-complex vitamins except _____.
A) lipoic acid B) NAD C) FAD D) CoASH E) thiamin pyrophosphate

22. Based on observed types of activity, 'white fibers' (skeletal muscle) would be expected to show a(n) _____ concentration of glycogen when compared to 'red-fibers' and hence one could further predict mainly _____ catabolism of glucose in the white-fibers.
A) lower -- aerobic B) lower -- anaerobic C) higher -- anaerobic D) higher -- aerobic
E) equal -- aerobic

23. Given the following: $[glucose]_{plasma}$ = 5 mM; $[G\text{-}6\text{-}P]_{intracellular}$ = 0.2 mM; K_m (glucokinase) = 10 mM; and K_m (G-6-phosphatase) = 3 mM; one could expect the liver to start exporting significant amounts of glucose when _____.
A) $[G\text{-}6\text{-}P]_{intracellular}$ = 3 mM B) $[glucose]_{plasma}$ = 10 mM C) $[G\text{-}6\text{-}P]_{plasma}$ = 3 mM
D) $[G\text{-}6\text{-}P]_{plasma}$ = 10 mM E) $[glucose]_{plasma}$ = 5 mM

24. The regulation mechanism demonstrated by the pyruvate dehydrogenase enzyme system depends largely on the _____ of the enzyme pyruvate dehydrogenase kinase by _____.
A) activation -- acetyl CoA B) inhibition -- CO_2 C) activation -- NADH D) activation -- ADP
E) inhibition -- ATP

25. If a carbohydrate shows a glycemic index of 65, this means that the carbohydrate in question has a(n) _____. (NOTE: 'AUGTC' means 'Area Under the Glucose Tolerance Curve')
A) higher AUGTC than sucrose B) lower AUGTC than glucose C) lower sweetness index than glucose
D) AUGTC equal to that of fructose E) higher sweetness index than sucrose

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M A T C H I N G

THE ITEMS 26-30 REFER TO THE LIST AT THE RIGHT. THERE IS ONLY ONE CORRECT ANSWER FOR EACH ITEM 26-30, BUT A GIVEN RESPONSE FROM THE LIST AT THE RIGHT MAY BE USED MORE THAN ONCE.

26. This type of carbohydrate is not compatible with any of the carbohydrate pathways we have seen

27. Carbohydrates are always retained within a cellular environment by converting the simple sugar to this type of compound

28. Lipids always display this type of bonding to attach a fatty acid to a molecule of glycerol.

29. The reaction: UTP + G-1-P → UDP-glucose + PP_i is forced to the right as this type of bond is hydrolyzed.

30. Type of bonding found in disaccharides and polysaccharides but not in monosaccharides.

A) Monosaccharide
B) Hemi-acetal structure
C) Phosphate ester
D) Ester linkage
E) Amide linkage
AB) Enol linkage
AC) Phosphate anhydride
AD) Hayworth projection
AE) Glycosidic linkage
BC) α-form
BD) Disaccharide
BE) Mixed anhydride linkage
CD) Aldehyde function

T R U E - - - F A L S E
(A) (B)

31. The TCA cycle is referred to as aerobic because, during its operation, carbon dioxide is produced.

32. Complete hydrolysis of a polar lipid will yield three fatty acids.

33. The digestion of fructose involves the hydrolysis of the sugar to its monosaccharide components.

34. The catabolism of any simple sugar invariably requires at least some of the reactions of the glycolytic pathway.

35. Assuming no 'deoxy sugars' are involved, a disaccharide will have the general formula, $C_n(H_2O)_{2n-1}$.

5
1-A 2-C 3-B 4-C 5-A 6-D 7-A 8-A 9-B 10-D 11-A 12-D 13-B 14-A 15-B 16-D 17-A 18-C 19-B
20-B 21-A 22-C 23-A 24-A 25-B 26-BD 27-C 28-D 29-AC 30-AE 31-B 32-B 33-B 34-A 35-A

5 B I O C H E M I S T R Y E X A M

December 7, 2005

NAME_____

1. Fatty acid biosynthesis tends to be _____ and requires the reagent _____.

A) reductive -- NADPH B) reductive -- NAD^+ C) hydrolytic -- CoASH
D) oxidative -- malonyl CoA E) oxidative -- $NADP^+$

2. Complete the following reaction from the fatty acid biosynthesis mechanism: R-COSACP + malonyl SACP Ø $R\text{-}CH_2CH_2\text{-}COSACP$ + ACPSH + _____.

A) PP_i B) CO_2 C) NADPH D) palmitate E) acetyl CoA

3. How many millimoles of malonyl SACP (a three carbon metabolite) are required to produce a millimole of a C-16 saturated fatty acid, starting with acetyl SCoA?

A) 6 B) 7 C) 8 D) 16 E) Impossible to determine

4. In order to produce the fatty acid 20:1 Δ13 starting with 16:0, the sequence of reactions should be _____.

A) desaturation - elongation - elongation B) elongation - elongation - desaturation
C) elongation - desaturation - elongation D) desaturation - elongation - desaturation
E) desaturation - desaturation - elongation

5. During the execution of the pyruvate citrate cycle, one can note that as one millimole of pyruvate is consumed, _____ carbon(s) are installed in the growing fatty acid and _____ carbon(s) are lost as carbon dioxide.

A) 3 -- 1 B) 1 -- 2 C) 2 -- 1 D) none -- 3 E) 3 -- none

6. The process of achieving the presence of acetyl CoA in a cellular cytoplasm, to allow the synthesis of fatty acids, requires the use of the reagent _____, moving from the mitochondrion to the cytoplasm, as a carrier of the acetyl CoA.

A) malate B) malonyl CoA C) citrate D) pyruvate E) oxaloacetate

7. Which of the following types of molecules are usually regarded as carbon sources for the synthesis of saturated fatty acids?

A) ketogenic amino acids and ketone bodies B) simple sugars and glycogenic amino acids
C) simple sugars and ketone bodies D) simple sugars and ketogenic amino acids
E) unsaturated fatty acids and ketone bodies

8. Cholesterol synthesis takes place in most cells, at least to some extent, but occurs to a significant extent in _____ starting with _____.

A) LDLs -- acetyl CoA B) hepatocytes -- acetyl CoA C) hepatocytes -- glycogenic amino acids
D) adipocytes -- bile salts E) adipocytes -- glucose

9. Cholesterol is lost to the human organism via _____.

A) feces B) urine C) oxidation D) respiration E) catabolism

10. Chylomicrons are formed in the _____ and function by carrying _____ to adipocytes.

A) intestinal mucosa -- exogenous triacylglycerols B) blood plasma -- cholesterol esters
C) intestinal mucosa -- bile salts D) liver -- exogenous triacylglycerols
E) liver -- endogenous triacylglycerols

11. Which of the following lipoproteins supplies apolipoprotein C II, but does not use it?

A) VLDL B) chylomicron C) IDL D) HDL E) LDL

12. If a diet is hypercaloric but low in fat (excess calories are carbohydrates), which plasma component would be expected to show an increase in concentration.

A) FFA B) HDL C) cholesterol D) chylomicron E) VLDL

13. The agent lipoprotein lipase is used to catalyze the reaction that _____.

A) hydrolyzes triacylglycerols within adipocytes B) forms cholesterol esters
C) hydrolyzes triacylglycerols found in lipoproteins D) activates apolipoprotein B-100
E) hydrolyzes cholesterol esters

14. Under normal circumstances, fat mobilization occurs as a result of _____.

A) elevated plasma cAMP B) fasting induced hypoglycemia C) hyperglycemia from a meal
D) elevated plasma concentrations E) a high fat meal

15. The alanine-glucose cycle uses the liver to synthesize _____.

A) glucose and urea B) glucose and alanine C) glutamine and alanine D) glucose and glutamine
E) alanine and urea

16. Methyl group transfer reactions of the type that convert norepinephrine into epinephrine, use the B-complex vitamin _____ and the amino acid _____.

A) niacin -- alanine B) folate -- methionine C) niacin -- glutamine D) cobalamin -- glutamine
E) folate -- alanine

17. Although methionine is regarded as an essential amino acid, humans have a reaction process available to them which allows the preparation of methionine from _____.

A) alanine B) homocysteine C) glycine D) creatine E) glutamine

18. The generalized pathway for pyrimidine synthesis leads to the formation of CTP, UTP, and _____.

A) NAD B) GTP C) PRPP D) ATP E) TTP

19. Hyperuricemia (gout) is identified with a failure of the enzyme phosphoribosylpyrophosphate synthetase to respond to its normal allosteric inhibitor, _____.

A) GTP B) UTP C) TTP D) CTP E) ribose-5-P

20. A study of the metabolism found in adrenergic neurons shows that they routinely synthesize the neurotransmitter acetylcholine from choline and acetyl CoA. The choline is recycled but the acetyl CoA has to be resynthesized, during each cycle, using _____ as a carbon source.

A) ketone bodies B) fatty acids C) simple sugars D) methyl group carriers
E) ketogenic amino acids

21. An insulin dependent diabetic can be expected to have elevated plasma levels of _____ and diminished plasma levels of _____ if his insulin is not being effectively applied.

A) glucose -- urea B) ketone bodies -- bicarbonate ion C) ketone bodies -- glucose
D) bicarbonate ion -- glucose E) hydrogen ion -- ketone bodies

22. The two major storage sites for iron in the human organism are _____.

A) bone marrow and blood plasma B) liver and skeletal muscle C) blood plasma and bone marrow
D) liver and bone marrow E) intestinal mucosa and liver

23. The amount of iron absorbed from the intestinal lumen is predicated on the amount of _____ found in the intestinal mucosal cells.

A) hemosiderin B) apoferritin C) ferritin D) transferrin E) apotransferrin

24. Among other things that occur in the liver as a result of the reaction, due to the hepatic clearance of ethyl alcohol: pyruvate + NADH Ø NAD^+ + lactate; is that the extent of _____ in the liver is reduced and _____ starts to appear in the blood plasma, giving rise to a type of acidosis.

A) oxidative deamination -- glucose B) ketogenesis -- lactate C) ketogenesis -- urea
D) gluconeogenesis -- lactate E) gluconeogenesis -- pyruvate

25. Very little ATP is available to the liver from fatty acid catabolism during hepatic clearance of ethyl alcohol because of a shortage of _____, which limits β-oxidation, and a shortage of _____ which limits the TCA Cycle.

A) NADH -- oxaloacetate B) NAD^+ -- oxaloacetate C) NAD^+ -- lactate D) NAD^+ -- pyruvate
E) NADH -- lactate

M A T C H I N G

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26. The solution called bile includes this agent.

27. Methyl group transfer reactions use this non-peptide amino acid.

28. The activity of LDLs includes the use of this apoliprotein.

29. This amino acid is the precurso for the neurotransmitter dopamine.

30. This niacin containing reducing agent is used in fatty acid biosynthesis.

A) HMG CoA

B) Malate

C) C-II

D) Homocysteine

E) NADPH

AB) Cholesterol

AC) Cholesterol esters

AD) B-100

AE) Methionine

BC) Alanine

BD) Glutamine

BE) $FADH_2$

CD) Glycine

CE) LCAT

DE) Tyrosine

T R U E - - - F A L S E
(A) (B)

31. Fat mobilization tends to be encouraged during periods of low blood sugar and discouraged during periods of high blood sugar.

32. HDLs function to donate cholesterol to peripheral cells.

33. The pathway for pyrimidine biosynthesis leads to the formation of ATP.

34. Hepatic clearance of ethyl alcohol tends to take place at a fixed rate, rather than at a rate which is dependent on the amount of alcohol needing to be cleared.

35. A saturated fatty acid has to be reduced as a double bond is introduced into its structure.

5
1-A 2-B 3-B 4-A 5-C 6-C 7-B 8-B 9-A 10-A 11-D 12-E 13-C 14-B 15-A 16-B 17-B 18-E 19-A
20-C 21-B 22-E 23-B 24-D 25-B 26-AB 27-D 28-AD 29-DE 30-E 31-A 32-B 33-B 34-A 35-B

5 B I O C H E M I S T R Y E X A M

April 4, 2001

NAME_____

1. Anabolic processes almost always have ΔG°'s which are less than zero because the biosynthetic pathways _____.

A) produce ATP B) consume ATP C) are anaerobic D) are aerobic
E) take place in alternative cellular sites

2. Complete the reaction: pyruvate + ATP + CO_2 → ____ + ADP + P_i.

A) citrate B) phosphoenolpyruvate C) AMP D) oxaloacetate E) glucose-6-P

3. If four millimoles of pyruvate, a three carbon metabolite, provide a sufficient number of carbon atoms for the synthesis of two millimoles of G-6-P, how many millimoles of malate, a four carbon metabolite, would be required to synthesize two millimoles of G-6-P.

A) 3 B) 6 C) 2 D) 4 E) 1

4. Carbon atoms derived from the catabolism of glucose cannot be used as starting materials for ketogenesis because _____.

A) there aren't enough carbon atoms B) glucose carbon atoms cannot be made into acetyl CoA
C) pyruvate can be converted to oxaloacetate D) acetoacetate is exported by the liver
E) acetyl CoA is used by the TCA cycle only

5. Consider the substrate cycle: A ⇄ B. When 120 millimoles of 'A' are being made into 120 millimoles of 'B' and 100 millimoles of 'B' are being made into 100 millimoles of 'A', the flux is _____. If the A → B step is increased 25% and the B → A step is decreased 25%, the new flux is _____.

A) 100 -- 120 B) 85 -- 20 C) 20 -- 85 D) 120 -- 100 E) 20 -- 20

6. If a meal is regarded as occurring at 'time = 0 hours', then the ONSET of glycogen hydrolysis starts at about 'time = _____ hours'. Within about _____ hours of ONSET, glycogen hydrolysis provides enough glucose to maintain normal blood sugar levels.

A) 12 -- 16 B) 6 -- 16 C) 2 -- 12 D) 3 -- 2 E) 8 -- 6

7. As a 'fight-or-flight' stimulus is waning and plasma levels of epinephrine are declining, which intracellular metabolite contributes to the cessation of glycogen hydrolysis as its concentration increases?

A) adenyl cyclase B) glycogen synthase (I) C) G-6-P D) cAMP E) glycogen phosphorylase

8. The synthesis of a C-16 saturated fatty acid can be viewed as starting with the two carbon fatty acid, acetyl CoA, and then systematically elongating the fatty acid, in _____ carbon increments, using the three carbon metabolite _____.

A) 3 -- malonyl CoA B) 1 -- carbon dioxide C) 2 -- acetyl CoA D) 2 -- malonyl CoA
E) 3 -- pyruvate

9. If a C-16 unsaturated fatty acid (16:0) undergoes an elongation reaction, followed by a desaturation reaction, and then another elongation reaction, the resulting fatty acid will have the configuration _____. (NOTE: The 'Δ' indicates the position of the double bond)

A) 16:2 Δ9,Δ11 B) 20:1 Δ11 C) 18:1 Δ9 D) 18:1 Δ11 E) 20:1 Δ13

10. Cholesterol can be removed from the human organism via _____.

A) the entero-hepatic cycle B) amination by the urea cycle
C) polymerization with 3,3' dimethylallylpyrophosphate D) oxidation by the TCA Cycle
E) conversion to the more soluble squalene

11. Which of the following requires cholesterol as a precursor?

A) 2-monoacylglycerols B) phosphatides C) non-polar lipids D) bile salts E) sphingolipids

12. The function of VLDL's is to carry triacylglycerols from the _____ to _____ via the blood plasma.

A) liver -- adipocytes B) liver -- HDL's C) small intestine -- skeletal muscle cells
D) chylomicron remnant -- the liver E) small intestine -- adipocytes

13. One of the functions of HDL's is to _____.

A) carry fat soluble vitamins to the liver B) transport triacylglycerols to adipocytes
C) move cholesterol esters to adipocytes D) supply apoliprotein CII to chylomicrons
E) convert LDL's into VLDL's

14. Cholesterol is stored in most cells as _____.

A) LDL's B) apoliproteins C) triacylglycerols D) cholesterol esters E) HMG CoA

15. 'Fat mobilization' is initiated in response to _____.

A) hypocholesteremia B) hypercholesteremia C) hyperglycemia D) hypoglycemia
E) hyperlipoproteinemia

16. As a fasting individual shifts his/her energy sources from carbohydrates to fats, the item which shows the greatest increase in concentration in the blood plasma is _____.

A) 3-hydroxybutyrate B) glucose C) insulin D) alanine E) palmitate

17. As the demand for precursors for hepatic gluconeogenesis increases, skeletal muscles respond by converting the array of amino acids, produced from the hydrolysis of endogenous protein, to the single amino acid _____.

A) asparagine B) alanine C) serine D) glutamate E) aspartate

If the human organism has a shortage of the substance cobalamin, indicate which of the following agents will also show a shortage as a result of the lack of cobalamin. (INDICATE ALL POSSIBILITIES)

A) methionine B) glycine C) norepinephrine D) homocysteine E) folic acid

19. The substance thymine monophosphate (TMP) is a(n) _____ and is formed by adding a methyl group to uracil monophosphate (UMP) using a mechanism involving H$_4$Folate and _____.

A) purine -- glutamate B) pyrimidine -- methionine C) pyrimidine -- adenine
D) pyrimidine -- glutamine E) purine -- homocysteine

0. The neurotransmitter acetylcholine is synthesized in a pre-synaptic neuron from acetyl CoA and choline. The acetyl CoA is formed from a reaction sequence which can be summarized as _____.

A) acetoacetate → acetyl CoA B) fatty acid → acetyl CoA
C) fatty acid → pyruvate → acetoacetyl CoA D) glucose → pyruvate → acetyl CoA
E) any ketogenic amino acid → acetyl CoA

) mechanism proposed for the action of the agent cocaine in the operation of the neurotransmitter amine shows the cocaine reacting with _____, which are then prevented from reacting with dopamine as they should.

A) dopamine oxidizing coenzymes B) the post-synaptic neurons C) dopamine receptors
D) dopamine uptake proteins E) a series of hydrolytic enzymes

2. A known diabetic presents with the following: rapid, shallow breathing; low blood pressure; a rapid pulse; and glucose in his urine. He would be expected to show a(n) _____ blood plasma pH and a _____ than normal concentration of HCO_3^-.

A) normal -- lower B) alkalotic -- lower C) acidotic -- higher D) acidotic -- lower
E) alkalotic -- higher

3. What is the name of the protein which reacts with dietary iron, as the iron is being absorbed?

A) heme B) apoferritin C) myoglobin D) hemosiderin E) transferrin

4. If a person is fasting during the time period in which he is undergoing hepatic clearance of ethanol, he would tend to become hypoglycemic as a result of hepatic conversion of _____ to _____, which is done to provide the oxidizing agents for the alcohol.

A) NAD^+ -- NADH B) malate -- oxaloacetate C) acetaldehyde -- acetate D) pyruvate -- lactate
E) ethanol -- acetaldehyde

5. The 'fatty liver' which results from long term use of ethyl alcohol is caused by the fatty acids which collect in the liver and cannot be oxidized by the β-oxidation pathway because of a shortage of hepatic _____.

A) pyruvate B) acetyl CoA C) lactate D) NADH E) NAD^+

M A T C H I N G

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5. This carbohydrate precursor is also a TCA cycle component.

; ificant concentrations his metabolite discourage gluconeogenesis and encourage glycolysis.

3. The action of cAMP is terminated by a reaction which occurs under the influence of this enzyme.

9. More than 85% of the carbon atoms which eventually end up in a fatty acid during biosynthesis, are first converted into this metabolite.

). This apoliprotein is associated with the peripheral cellular uptake of low density lipoproteins.

A) Pyruvate
B) Succinyl CoA
C) F-2,6-P
D) NAD^+
E) Phosphodiesterase
AB) Glycogen Phosphorylase
AC) Lipoprotein lipase
AD) Lactate
AE) Glucagon
BC) B-100
BD) LCAT
BE) Malonyl CoA
CD) Carbon dioxide
CE) C II
DE) Acyl Carrier Protein

T R U E - - - F A L S E
(A) (B)

1. The more alcohol one ingests, the faster it is oxidized under the influence of the enzyme, alcohol dehydrogenase.

2. A typical starting metabolite for fatty acid biosynthesis in the liver is acetoacetate.

3. The hormone glucagon causes the production of the metabolite cAMP in both hepatocytes and adipocytes.

4. An increase in the urea concentration in the blood plasma of a diabetic is thought to be caused by the ation of ketone bodies.

5. re core of a low density lipoprotein would be more likely to contain cholesterol esters than cholesterol.

;
-B 2-D 3-D 4-C 5-C 6-D 7-C 8-D 9-B 10-A 11-D 12-A 13-D 14-D 15-D 16-A 17-B 18-AE 19-B
)-D 21-D 22-D 23-B 24-D 25-E 26-B 27-C 28-E 29-BE 30-BC 31-B 32-B 33-A 34-B 35-A

July 29, 1999

NAME_____

1. Which of the following is a reasonable source of pyruvate for use as a carbohydrate precursor?
(A) oxidation of lactate B) hydrolysis of PEP C) deamination of glutamate
D) carboxylation of acetyl CoA E) reduction of malate

2. The requirements for the production of 3 millimoles of glucose-6-P are _____ millimoles of pyruvate and _____ millimoles of ATP. (NOTE: Assume that GTP is energetically equivalent to ATP)
A) 3 -- 6 B) 4 -- 12 (C) 6 -- 18 D) 6 -- 6 E) 2 -- 6

3. For the substrate cycle: A <---> B; initially the 'rate' of A ---> B is 100, the 'rate' of B ---> A is 80 and the A to B flux is _____. After the A ---> B 'rate' is increased by 10% and the B ---> A 'rate' is decreased by 10%, the new A to B flux is _____.
A) 31 -- 20 B) 20 -- 31 C) 20 -- 20 (D) 20 -- 38 E) 38 -- 10

4. If half of the lactate processed by the liver during the Cori Cycle was burned to produce ATP and the other half was converted into glucose, estimate the ratio of ATP produced, to glucose consumed, using the Cori Cycle? (As an example, assume that 180 ATP are produced by skeletal muscle)
(A) 12:1 B) 2:1 C) 36:1 D) 18:1 E) 4:1

5. The metabolite fructose 2,6 bisphosphate, F-2,6-P, impacts carbohydrate metabolism by _____ the activity of the enzyme PFK-1 and _____ the activity of the enzyme fructose-2,6-bisphosphatase.
(A) increasing -- decreasing B) increasing -- increasing C) decreasing -- decreasing
D) decreasing -- increasing E) Both 'B' and 'D' are correct

6. The hormone glucagon is: produced in the pancreas; a _____ hormone; and is secreted in response to _____ blood sugar concentrations.
A) catecholamine -- decreasing (B) polypeptide -- decreasing C) steroid -- increasing
D) catecholamine -- increasing E) polypeptide -- increasing

7. The action of epinephrine on a skeletal muscle cell's glycogen supply involves the formation of _____ within the skeletal muscle cell.
A) phosphodiesterase (B) glycogen phosphorylase ('a' form) C) glycogen synthase ('I' form)
D) adenyl cyclase E) cAMP stimulated protein kinase

8. Complete the reaction: acetyl CoA + CO_2 + ATP → ADP + P_i + _____.
(A) malonyl CoA B) pyruvate C) succinyl CoA D) HMG CoA E) phosphoenolpyruvate

9. The reaction: citrate + CoASH + ATP → ADP + P_i + acetyl CoA + oxaloacetate; takes place in the cellular _____ as the cellular environment is preparing to _____.
A) cytoplasm -- synthesize ATP B) cytoplasm -- synthesize fatty acids
C) mitochondrion -- reduce NAD^+ D) mitochondrion -- synthesize ATP
(E) mitochondrion -- synthesize carbohydrates

10. The pyruvate-citrate cycle indicates that when glucose is used a carbon source for the synthesis of a fatty acid, approximately _____ of the glucose carbon atoms end up in the fatty acid with the remaining carbons being made into _____.
(A) 2/3 -- CO_2 B) 5/6 -- citrate C) 1/3 -- CO_2 D) 1/4 -- citrate E) 1/2 -- acetyl CoA

11. The biosynthesis of triacylglycerols requires the three carbon metabolite _____ and three fatty acyl CoA esters.
(A) dihydroxyacetone-P B) malonyl CoA C) lactate D) pyruvate E) malate

12. The entero-hepatic cycle shows the various components of bile being absorbed from the intestinal lumen into either the portal system or the lymphatic system based on the _____ of the bile component.
A) formula weight B) oxidation state C) lipoprotein content D) sterol content
(E) water solubility

13. The synthesis of cholesterol starts with _____ and is inhibited by _____.
(A) glucose -- acetyl CoA B) acetoacetyl CoA -- glucose C) acetyl CoA -- cholesterol
D) a fatty acid -- mevalonate E) acetyl CoA -- HMG CoA

14. A typical lipoprotein would demonstrate _____ in the outer shell of the structure and _____ in the inner 'core' of the molecular complex.
(A) apolipoproteins -- triacylglycerols B) cholesterol -- apoliproteins
C) triacylglycerols -- cholesterol esters D) triacylglycerols -- phospholipids
E) apoliproteins -- cholesterol

15. The lipoproteins called chylomicrons are most similar in function to _____.
A) LDL B) HDL C) LCAT D) IDL (E) VLDL

16. Which of the following is considered to be a function of high density lipoproteins (HDLs)?
(A) source of apolipoprotein C II B) hydrolysis of cholesterol esters to produce cholesterol
C) long term storage of cholesterol esters D) transport of dietary triacylglycerols
E) transport of endogenous triacylglycerols

17. A typical cell limits its own uptake of cholesterol from LDLs using a mechanism in which incumbent intracellular cholesterol _____.
A) catalyzes the hydrolysis of cholesterol esters B) inhibits the formation of HDLs
C) occupies plasma membrane sites D) inhibits its own synthesis
(E) restricts the synthesis of B-100 receptors

18. A study of the mechanism of 'fat mobilization' indicates that the normal hormonal response to fasting induced hypoglycemia causes a(n) _____ in the intracellular concentration of _____ within adipocytes.
A) increase -- adenyl cyclase B) decrease -- ATP (C) decrease -- intracellular lipase (active)
D) increase -- cAMP E) increase -- cholesterol

19. During periods of starvation [illegible] large amounts of ______ as an alternative to ______, which would normally be used as fuel in a fully 'fed' state.

A) ketone bodies -- glucose B) glucose -- triacylglycerols C) fatty acids -- ketone bodies D) ketone bodies -- fatty acids E) glucose -- fatty acids

20. The primary carbon source for hepatic gluconeogenesis is the ______.

A) the amino acid, alanine B) carbohydrate, ribose C) ketone body, acetoacetate D) fatty acid, palmitate E) carbohydrate, sucrose

21. The amino acid glutamine is used to transport ______ from skeletal muscle cells to the renal system in order supply these atoms for systemic regulation of ______.

A) carbon atoms -- CO_2 B) nitrogen atoms -- purine synthesis C) nitrogen atoms -- urea synthesis D) carbon atoms -- fatty acid synthesis E) nitrogen atoms -- acid-base balance

22. One of the problems that occurs when there is a systemic shortage of folic acid is an increase in the human organism's requirement for ______.

A) methionine B) epinephrine C) NADH D) cobalamin E) thiamine

23. The synthesis of the neurotransmitter acetylcholine by specific neurons is dependent upon the reaction which converts ______ into acetyl CoA.

A) ketogenic amino acids B) HMG CoA C) acetoacetate D) pyruvate E) fatty acids

24. Iron absorption from the intestinal lumen is dependent on the amount of the protein ______ in the ______.

A) apoferritin -- intestinal mucosa cells B) apotransferrin -- bone marrow C) apoferritin -- blood plasma D) ferritin -- intestinal lumen E) transferrin -- liver cells

25. As the liver clears large amounts of ethyl alcohol from the blood plasma, there is a tendency for the blood pH to ______ as a result of the production of high concentrations of ______ by the liver during the clearance process.

A) decrease -- acetate ion B) decrease -- fatty acids C) increase -- ketone bodies D) decrease -- lactate E) increase -- glucose

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M A T C H I N G

THE ITEMS 26-30 REFER TO THE LIST AT THE RIGHT. THERE IS ONLY ONE CORRECT ANSWER FOR EACH ITEM 26-30, BUT A GIVEN RESPONSE FROM THE LIST AT THE RIGHT MAY BE USED MORE THAN ONCE.

26. Phosphodiesterase catalyzes the hydrolysis of this substance to AMP.

27. This substance mediates a glucose transport mechanism used to move glucose from the blood plasma to the cytoplasm of skeletal muscle cells.

28. This is the designation used for the format used to move fatty acids from adipocytes to the liver.

29. This is the final product of gluconeogenesis in most non-hepatic cells.

30. The liver is deprived of this substance during periods of alcohol clearance.

A) PFK-2
B) G-6-P
C) Insulin
D) cAMP
E) Lactate
AB) HDL
AC) Glucagon
AD) VLDL
AE) Epinephrine
BC) Glucose
BD) ATP
BE) FFA
CD) Malate
CE) Pyruvate
DE) ADP

T R U E - - - F A L S E
(A) (B)

31. Glycogen hydrolysis is normally encouraged by the hormone insulin.

32. Acetylcholine is absorbed from the synaptic cleft into a presynaptic neuron in order to allow the post-synaptic neuron to repolarize.

33. The TCA Cycle component citrate plays a crucial in the biosynthesis of fatty acids.

34. Cholesterol is classified as a lipid because it can be catabolized to acetyl CoA.

35. Glucose can be synthesized starting with lactate or succinyl CoA, but not starting with acetyl CoA.

1-A 2-C 3-D 4-E 5-A 6-B 7-B 8-A 9-B 10-A 11-A 12-E 13-C 14-A 15-E 16-A 17-E 18-D 19-A 20-A 21-E 22-A 23-D 24-A 25-D 26-D 27-C 28-BE 29-B 30-CE 31-B 32-B 33-A 34-B 35-A

B I O C H E M I S T R Y E X A M

July 30, 1998

NAME_____

(4)

1. Complete the reaction: pyruvate + ATP + CO_2 → _____.

A) lactate + ADP B) phosphoenolpyruvate + ADP C) oxaloacetate + ADP + P_i D) malate + ADP

E) phsophoenolpyruvate + ADP + HCO_3^-

2. At about _____ hours into a fast, a person's liver starts hydrolyzing glycogen in order to _____.

A) 2 -- maintain blood sugar levels (B) 6 -- maintain blood sugar levels

C) 6 -- supply hepatic ATP D) 24 -- maintain blood sugar levels E) 24 -- supply hepatic ATP

3. During the regulation of glycolysis vs gluconeogenesis, the substance fructose 2,6 bisphosphate affects the performance of the enzyme _____.

(A) PFK-1 B) PFK-2(unphosphorylated PFK-2) C) glucokinase D) G-6-phosphatase

E) PFK-2-P(phosphorylated PFK-2)

4. An example of a substrate cycle appearing in the glycolysis/glyconeogenesis pathway is the conversion of _____ into _____ in the liver.

A) PEP -- 2-phsophoglycerate B) F-6-P -- G-6-P C) 3-phsophoglycerate -- glyceraldehyde-3-P

D) F-1,6-P -- F-6-P (E) F-1,6-P -- DHAP and glyceraldehyde-3-P

120
60
30
15
7.5

5. A study of the mechanism of action of epinephrine on the hydrolysis of glycogen shows that this process, the epinephrine induced hydrolysis of glycogen, is impeded as a result of the action of the enzyme _____.

A) phosphodiesterase B) glycogen phosphorylase C) cAMP stimulated protein kinase

D) adenyl cyclase E) hexokinase

6. If a polypeptide hormone has a half-life of 24 minutes and 128 ng of the substance is supplied by the pancreas, how much of the hormone remains in the blood plasma after two hours?

A) 2ng B) 256 ng (C) 4 ng D) 128 ng E) All of the hormone is gone after two hours

7. The elongation process noted as a C-16 saturated fatty is synthesized uses _____ as the reactant which combines with a given fatty acid to produce a new fatty acid which is two carbons longer.

A) citrate B) malate C) pyruvate (D) malonylSACP E) acetylSACP

8. Only _____ of the carbon atoms from glucose end up in the finished fatty acid because the fatty acid which is being synthesized must be more _____ than the carbohydrate from which it is synthesized.

A) 1/2 -- reduced B) 1/6 -- oxidized C) 2/3 -- oxidized D) 1/2 -- oxidized (E) 2/3 -- reduced

9. Cholesterol synthesis is strongly inhibited by _____.

A) malonyl CoA B) acetyl CoA (C) cholesterol D) mevalonic acid E) HMG CoA

10. The entero-hepatic cycle shows that the bile component _____ is absorbed from the intestinal lumen and moved to the _____ via the _____. (NOTE: Cholic acid is a bile 'salt')

A) cholesterol -- gall bladder -- lymphatic system (B) cholesterol -- liver -- hepatic portal vein

C) cholic acid -- gall bladder -- hepatic portal vein

D) cholic acid -- liver -- hepatic portal vein E) cholic acid -- gall bladder -- lymphatic system

11. From the choices listed below, select TWO substances, or types of substances, that would normally be transported by chylomicrons. (NOTE: KEY TWO ANSWERS FOR THIS QUESTION)

(A) dietary triacylglycerols B) endogenous triacylglycerols C) apoliprotein B-100 D) LCAT

(E) fat soluble vitamins

12. Which lipoprotein conversion takes place routinely?

A) HDL → chylomicron B) chylomicron → LDL (C) HDL → LDL D) VLDL → LDL E) VLDL → HDL

13. Which type of substance would tend to collect in the plasma in the event of a genetic defect which causes a failure to produce HDLs containing apoliprotein C II?

A) lecithin (B) chylomicron C) LCAT D) lipoprotein lipase E) HDL

14. Which situation causes the initiation of 'fat mobilization'?

A) decreased plasma [LCAT] B) decreased plasma [ketone bodies]

C) Increased plasma [fatty acids] C) decreased plasma [triacylglycerols]

(E) decreased plasma [glucose]

X 15. The concentration of cholesterol in a given cellular environment is controlled by a mechanism which _____. (NOTE: 'ACAT' refers to the enzyme 'acyl cholesterol acyl transferase' which catalyzes the hydrolysis of cholesterol esters)

A) interferes with the synthesis of 'B-100' receptors B) encourages the catabolism of cholesterol

C) inhibits ACAT D) encourages the action of ACAT

(E) encourages the synthesis of apoliprotein C II receptors

16. During periods of fat mobilization, the fatty acids which leave adipocyte cells and are taken up by _____ cells are then used to produce _____ at those cellular sites.

A) hepatic -- glucose (B) hepatic -- ketone bodies C) central nervous system -- ATP

D) central nervous system -- ketone bodies E) skeletal muscle -- ketone bodies

X 17. Which non-amino acid starting material would probably be used to synthesize the amino acids ala, ser, and cys, all of which contain three carbon atoms.

A) succinate B) α-ketoglutarate C) oxaloacetate D) phenylalanine E) pyruvate

18. During the early stages of starvation, large amounts of alanine move from skeletal muscle to the liver. After 3 or 4 days of starvation, the alanine continues to be moved to the liver but to a lesser extent. This change in the amount of alanine being moved is due to _____.

A) hepatic saturation with alanine (B) increasing hepatic production of ketone bodies

C) diminished fat mobilization D) alanine shortage in the skeletal muscle

E) increasing plasma concentration of insulin

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19. A segment of mRNA generated from a section of DNA, . . .G C T T A C . . ., would have the base sequence _____.

A) C G A A U G B) U G C C G T C) G C T T A C D) G T A A G C E) C A T T C G

20. The amino acid homocysteine is derived from the _____.

A) catabolism of glycine B) demethylation of methionine C) oxidation of alanine
D) oxidation of norepinephrine E) hydrolysis of a protein

21. A deficiency in cobalamin can lead to systemic shortages of the vitamin _____ and the amino acid _____.

A) folic acid -- methionine B) folic acid -- glycine C) niacin -- methionine
D) vitamin B-12 -- methionine E) niacin -- homocysteine

22. When acetylcholine is synthesized in a _____ neuron according to the reaction acetyl CoA + choline → acetylcholine + CoASH, the carbon atoms found in the acetyl CoA must be derived from _____.

A) presynaptic -- carbohydrates B) postsynaptic -- fatty acids C) postsynaptic -- carbohydrates
D) presynaptic -- fatty acids E) presynaptic -- CO_2

23. To be classified as a neurotransmitter, a substance must induce depolarization in a post-synaptic neuron and also _____.

A) allow repolarization of a post-synaptic neuron B) be derived from an amino acid
C) contain a benzene ring D) undergo hydrolysis in the synaptic cleft
E) be synthesized in a pre-synaptic neuron

24. Iron absorption from the intestinal lumen is dependent on the amount of _____ found in the _____.

A) apoferritin -- intestinal mucosa B) transferrin -- intestinal mucosa
C) transferrin -- blood plasma D) ferritin -- blood plasma E) apotransferrin -- liver

25. Ethyl alcohol catabolism interferes with gluconeogenesis by depriving the liver of the metabolite _____ which is needed for carbohydrate synthesis.

A) pyruvate B) malate C) NADH D) lactate E) palmitate

M A T C H I N G

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26. Amino acid used a source of 'ammonia' in the kidneys.

27. Essential amino acid used as a starting material for the synthesis of dopamine and epinephrine.

28. Product of the reaction between carbon dioxide and acetyl CoA.

29. Substance formed when pyruvate is carboxylated.

30. Lipoprotein which converts cholesterol into cholesterol esters.

A) Malonyl CoA
B) Pyruvate
C) Apoliprotein C II
D) Oxaloacetate
E) Succinate
AB) HDL
AC) Palmitate
AD) VLDL
AE) Tyrosine
BC) Acetyl CoA
BD) Glutamine
BE) Homoscysteine
CD) Glutamate
CE) Chylomicron
DE) Methionine
ABC) Alanine
ABD) Valine

T R U E - - - F A L S E
(A) (B)

31. In non-hepatic cells, gluconeogenesis stops at Glucose-6-phosphate and never produces glucose.

32. Bile is one of the catalysts which is involved in the digestion of dietary triacylglycerols.

33. The mechanism of action for epinephrine is that it is taken up by a target cell and encourages the hydrolysis of cAMP within that cell.

34. A normal individual oxidizes ethyl alcohol at a rate which is a function of the amount of alcohol present.

35. As a carbohydrate is being converted into a fatty acid, some of the carbohydrate carbon atoms have to be reduced.

1-C 2-B 3-A 4-D 5-A 6-C 7-D 8-E 9-C 10-D 11-AE 12-D 13-B 14-E 15-A 16-B 17-E 18-B 19-A
20-B 21-A 22-A 23-E 24-A 25-A 26-BD 27-AE 28-A 29-D 30-AB 31-A 32-B 33-B 34-B 35-A

5 B I O C H E M I S T R Y E X A M

December 10, 1998

(4)

NAME_____

1 Complete the reaction: pyruvate + CO_2 + ATP → _____ + ADP + P_i.

A) lactate B) malate C) oxaloacetate D) pyruvate phosphate E) phosphoenolpyruvate

2. From the Cori Cycle, the ratio of ATP formed to glucose used is about 12:1. If the ratio of lactate 'burned' in the liver to lactate used for gluconeogenesis was 1:7 rather than 1:5, estimate the ratio of ATP formed to glucose used.

A) 36:1 B) 6:1 C) 12:1 D) 16:1 E) 8:1

3. As the concentration of F-2,6-P increases, the enzyme _____ undergoes a positive modulation and the pathway called _____ is encouraged.

A) PFK-1 -- glycolysis B) F-1,6-bisphosphatase -- glycolysis C) PFK-1 -- gluconeogenesis
D) PFK-2(ase) -- gluconeogenesis E) PFK-2 -- gluconeogenesis

4. For a substrate cycle, 'A → B' with a forward rate (A to B) of 200 and a reverse rate (B to A) of 160, and having a 'flux' of 40, if the A to B rate is increased by 20% and the B to A rate is decreased by 25%, the flux is _____ by a factor of about _____.

A) increased -- 10 B) decreased -- 5 C) decreased -- 10 D) increased -- 3 E) increased -- 4

5. One of the impacts, on carbohydrate metabolism, of a failure of the enzyme phosphodiesterase to catalyze its assigned reaction is the possibility of a(n) _____.

A) increase in intracellular G-6-P B) decrease in extracellular cAMP
C) increase in intracellular epinephrine D) increase in extracelluar epinephrine
E) decrease in intracellular epinephrine

6. Epinephrine can cause a rapid hydrolysis of skeletal muscle glycogen. When the stimulus which produced the epinephrine has subsided, an _____ in intracelluar _____ seems to cause a cessation in the glycogen hydrolysis and an increase in glycogen synthesis.

A) decrease -- epinephrine B) decrease --cAMP C) increase -- G-6-P D) increase -- cAMP
E) increase -- adenyl cyclase

7. If a meal for a human organism is regarded as time, t = 0, by the time t = 6 hours, most of the carbohydrate used by this organism is supplied from _____, with a significant contribution from _____.

A) glycogen hydrolysis -- exogenous sources B) glycogen hydrolysis -- gluconeogenesis
C) exogenous sources -- glycogen hydrolysis D) gluconeogenesis -- glycogen hydrolysis
E) gluconeogenesis -- exogenous sources

8. Which type of lipid would form when two millimoles of fatty acyl CoA react with one millimole of glycerol phosphate?

A) phosphatide B) sphingolipid C) sterol D) sphingosine E) triacylglycerol

9. If a C-16:1 Δ9 fatty acid undergoes an elongation reaction with malonyl CoA, $^{-}OOCCH_2COCoA$, the result will be a new fatty acid which is _____.

A) C-18:1 Δ11 B) C-18:1 Δ9 C) C-16 D) C-18 E) C-16:1 Δ11

10. If one millimole of glucose is processed by the pyruvate-citrate cycle, half of the carbon atoms from the glucose will have been converted into _____ and the other half converted into _____.

A) acetyl CoA -- citrate B) acetyl CoA -- pyruvate C) pyruvate -- citrate D) pyruvate -- CO_2
E) pyruvate + CO_2 and acetyl CoA

11. The process referred to as 'enterohepatic circulation' reveals that most of the water soluble bile salts leave the intestinal lumen via the _____.

A) lymphatic system B) TCA cycle C) gall bladder D) cyclization of squalene
E) hepatic portal vein

12. Lipoproteins are designed to have a surface which is _____, and substances such as _____ will be found as a component of this surface rather than as a part of the core of the macromolecule.

A) hydrophilic -- triacylglycerols B) hydrophobic -- cholesterol esters
C) hydrophobic -- all types of sterols D) hydrophilic -- cholesterol esters
E) hydrophilic -- apoliproteins

13. Most dietary cholesterol arrives at the liver via the _____ in the form of a(n) _____.

A) blood plasma -- LCAT B) hepatic portal vein -- VLDL C) blood plasma -- chylomicron remnant
D) blood plasma -- HDL E) hepatic portal vein -- fatty acid albumin complex

14. Cholesterol is supplied to extrahepatic cells in the form of _____.

A) VLDLs B) IDLs C) HDLs D) LDLs E) ACATs

15. In order for chylomicrons to react with _____, the chylomicron must receive _____ from HDLs in the blood plasma.

A) ACAT -- LCAT B) LCAT -- apolipoprotein B-100 C) lipoprotein lipase -- apolipoprotein C II
D) lipoprotein lipase -- apolipoprotein B-100 E) hepatic receptors -- apolipoprotein C II

16. During periods of extreme starvation (several weeks), the cells of the central nervous system utilize the following array of fuels (approximately): ___ % carbohydrate; ___ % ketone bodies; and _____ % fatty acids.

A) 25 -- 50 -- 25 B) 50 -- 25 -- 25 C) 50 -- 50 -- < 1 D) 99+ -- < 1 -- < 1
E) 50 -- < 1 -- 50

17. A given cell can limit its uptake of cholesterol (from the blood plasma) in the form of _____ by genetically inhibiting the biosynthesis of _____.

A) HDLs -- HMG CoA reductase B) chylomicrons -- apolipoprotein B-100 receptors
C) VLDLs -- HMG CoA reductase D) LDLs -- apolipoprotein B-100 receptors
E) LDLs -- HMG CoA reductase

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18. Data has shown that the elimination of _____ essential amino acid(s) from an otherwise balanced diet will lead to an immediate _____ nitrogen balance.

A) only one -- negative B) only one -- positive C) only one -- zero
D) at least two or more -- zero E) at least two or more -- positive

19. The nitrogen used by the kidneys for maintaining acid-balance is derived from the amino acid _____ which in turn comes from _____.

A) glutamine -- renal protein sources B) alanine -- skeletal muscle protein
C) citrulline -- hepatic portal vein D) glutamine -- skeletal muscle protein
E) alanine -- renal protein sources

20. During long term starvation, the extent of the 'glucose-alanine cycle' is limited due to the use of _____ as a fuel source.

A) glutamine B) glycogen C) alanine D) ketone bodies E) glucose

21. A systemic shortfall in folic acid levels can lead to an increase in the dietary requirement for _____.

A) cobalamin B) creatine C) glycine D) methionine E) homocysteine

22. The nitrogen atoms found in a purine nucleus are derived from _____.

A) uric acid B) atmospheric nitrogen C) methionine D) non-essential amino acids E) urea

23. Neurons which synthesize the neurotransmitter acetylcholine have to use _____ as the source of the carbon atoms found in the 'acetyl' portion of acetylcholine.

A) fatty acids B) ketone bodies C) ketogenic amino acids D) carbohydrates
E) Either 'A' or 'B' is correct

24. The assimiliation of iron from the intestinal lumen is limited by the availability of _____ within the intestinal mucosal cells.

A) apotransferrin B) ferritin C) apoferritin D) transferrin E) hemosiderin

25. Hepatic oxidation of ethyl alcohol interferes with gluconeogenesis because the alcohol requires large amounts of oxidizing agents which are produced by _____.

A) reducing malate B) reducing NAD+ C) reducing pyruvate D) oxidizing lactate
E) oxidizing acetyl CoA

M A T C H I N G

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26. Enzyme which catalyzes the hydrolysis of cAMP to AMP.

27. Amino acid used as a precursor for the neurotransmitter dopamine.

28. Enzyme used to catalyze the formation of cholesterol esters in HDLs.

29. Triacylglycerol component which could possibly be used as a carbohydrate precursor.

30. Amino acid which combines with a methyl group to become methionine.

A) LCAT
B) Acetoacetate
C) Phosphodiesterase
D) Adenyl cyclase
E) Glycogen phosphorylase 'a'
AB) Glycerol
AC) Palmitate
AD) LPL
AE) ACAT
BC) Glutamine
BD) Homocysteine
BE) Citrulline
CD) Alanine
CE) Tyrosine
DE) Glycine

T R U E - - - F A L S E
(A) (B)

31. Humans do not require p-amino benzoic acid as a nutrient because they don't synthesize folic acid

32. Chylomicrons transport cholesterol from the intestinal lumen to extrahepatic cells for storage.

33. The more ethyl alcohol the liver needs to oxidize, the faster the oxidation occurs.

34. The nitrogen which is left over from the glucose-alanine cycle is stored in the liver for future amino acid synthesis.

35. The same intracellular conditions which encourage gluconeogenesis, simultaneously discourage glycolysis.

5

1-C 2-D 3-A 4-D 5-A 6-C 7-B 8-A 9-A 10-E 11-E 12-E 13-C 14-D 15-C 16-C 17-D 18-A
19-D 20-D 21-D 22-D 23-D 24-C 25-C 26-C 27-CE 28-A 29-AB 30-BD 31-A 32-B 33-B 34-B 35-A

B I O C H E M I S T R Y E X A M

July 8, 1998

NAME_____

(3)

1. The first law of thermodynamics, $\Delta E = \delta q - \delta w$ has a corollary which says that no process can be designed for which _____.

A) $\Delta E = 0$ B) δw equals zero C) $\delta q = 0$ D) $\delta w = \delta q$ E) $\Delta E = \delta q$

2. Which arrangement of six identical coins will require the least amount of work to produce? (NOTE: 'H' denotes the coin in 'heads' position, etc.)

A) HHHTHH B) HTHTHT C) HHHHHH D) TTTTTT E) THTTTT

3. If a reaction system: A → B has an initial [A] = 0.6 M and an initial [B] = 0.45 M, and has an equilibrium [A] = 0.35 M and an equilibrium [B] = 0.7 M, calculate the value of the reaction quotient 'Q' for this system.

A) 0.75 B) 0.5 C) 2 D) 0.27 E) 1.3

4. Estimate the value of ΔG° for the system: A → B if ΔG for this process is 0 when [A] = 0.35 M and [B] = 0.7 M. (NOTE: The value of the term 'RT' when T = 298 K is about 2478 J) $\Delta G = RT \ln K$

A) -1718 J B) -1239 J C) +1239 J D) -2478 J E) +1718 J

5. If the reaction: $X + P_i \rightarrow X\text{-}P + H_2O$ has a ΔG° of +26 kJ, then the reaction ATP + X → X-P + ADP must have a ΔG° of _____.

A) +57 kJ B) -5 kJ C) -57 kJ D) -26 kJ E) +5 kJ

6. Estimate the efficiency of the process: X-P + ADP → ATP + X if the reaction $X\text{-}P + H_2O \rightarrow P_i$ + X has a ΔG° equal to -120 kJ.

A) 90 % B) 31 % C) 10 % D) 25 % E) 42 %

7. Where, in a typical mitonchondrial system, would one expect to find electron transport system components such as non-heme iron proteins?

A) attached to the outer membrane B) on the cytoplasmic side of the inner membrane
C) within the matrix D) attached to the inner membrane E) in the intermembrane space

8. The iron in cytochrome c is in a _____ format and is in the _____ oxidation state when the E.T.S. is not respirating. (NOTE: Consider the term 'not respirating' to indicate that the system is not consuming oxygen.)

A) heme -- 2+ B) non-heme -- 2+ C) non-heme -- 3+ D) heme -- 1+ E) heme -- 3+

9. he addition of an uncoupler to a functioning E. T. S. causes the system to _____ and its efficiency to _____.

A) start consuming oxygen -- increase B) stop producing ATP -- decrease
C) stop consuming oxygen -- increase D) start reducing NAD^+ -- decrease
E) stop oxidizing NADH -- decrease

10. The glycerol phosphate shuttle system provides a mechanism for the oxidation of _____.

A) mitochondrial $FADH_2$ B) mitochondrial NADH C) cytoplasmic FAD D) cytoplasmic $FADH_2$
E) cytoplasmic NADH

11. The observations of the Pasteur Effect show that under aerobic conditions no lactate is produced at the expense of glucose because _____.

A) NADH is formed pyruvate is reduced B) NAD^+ is formed as DHAP is reduced
C) lactate leaves the cellular environment D) no NADH is available
E) there is an excess of pyruvate

12. The Cori Cycle shows the liver demonstrating the ability to convert plasma _____ into plasma _____.

A) glucose -- puruvate B) lactate -- glucose C) pyruvate -- acetyl CoA D) lactate -- ATP
E) glucose -- ATP

13. The malate shuttle moves reducing power to the cellular mitochondrion when there is a(n) _____ ATP in _____ cells.

A) excess of -- skeletal muscle B) excess of -- cardiac muscle C) demand for -- hepatic
D) demand for -- skeletal muscle E) excess of -- hepatic

14. The reaction: _____ can be used by skeletal muscle cells to meet short term demand for ATP.

A) creatine-P + ADP → creatinine + ATP B) creatine-P → creatinine + P_i
C) creatine-P + ADP → ATP + creatine D) creatine-P + H_2O → creatine + P_i
E) creatine + P_i → creatine-P

15. The pathway referred to as β-oxidation produces what product?

A) citrate B) acetyl CoA C) NAD^+ D) pyruvate E) CO_2

16. Approximately what percentage of the ATP produced during the conversion of a C-16 saturated fatty into CO_2 requires the E.T.S. but not the TCA Cycle? (NOTE: Assume that the oxidation of NADH by the E.T.S. produces 3 ATP and the oxidation of $FADH_2$ produces 2 ATP)

A) 100% B) 50% C) 75% D) 25% E) None

17. Estimate the efficiency of the catabolism of a C-18 saturated fatty acid if the ΔG° for the combustion of such an acid is -15,200 kJ/mol.

A) 60% B) 30% C) 40% D) 20% E) 50%

18. When attempting to oxidize a fatty acid having a Δ-13 cis unsaturation, β-oxidation would have to take place _____ times making the unsaturation _____. At this point a special enzyme would have to be used to make the fatty acid compatible with further β-oxidation.

A) 5 -- Δ3 trans B) 4 -- Δ2 cis C) 4 -- Δ2 trans D) 5 -- Δ3 cis E) 6 -- Δ2 cis

19. Ketone body synthesis is a(n) _____ event using _____ as a starting material.

A) hepatic -- acetyl CoA B) skeletal muscle -- 3-hydroxy butyrate
C) skeletal muscle -- acetyl CoA D) hepatic -- 3-hydroxy butyrate E) hepatic -- acetoacetate

20. Ketone body oxidation requires the activity of the enzyme _____ found in _____ cells.
A) β-ketothiolase -- skeletal muscle B) HMG CoA lyase -- hepatic
C) β-oxoacid transferase -- skeletal muscle
D) Δ-3 cis, Δ-2 trans enoyl CoA isomerase -- skeletal muscle E) methylmalonyl mutase -- hepatic

21. The digestion process for dietary proteins carries out which reaction sequence.
A) hydrolysis of peptide linkages B) transamination reactions C) conversion to acetyl CoA
D) emulsification with bile E) oxidative removal of nitrogen

22. An amino acid which is classified as glycogenic will never be converted to _____ during its catabolism.
A) succinyl CoA B) acetyl CoA C) acetoacetate D) malate E) fumarate

23. The catabolism of an amino acid to the three carbon metabolite _____, $CH_3CH_2COSCoA$, is an indication of the _____ nature of the initial amino acid.
A) succinyl CoA -- glycogenic B) acetyl CoA -- glycogenic C) acetoacetyl CoA -- ketogenic
D) HMG CoA -- ketogenic E) propionyl CoA -- glycogenic

24. Which reaction, or reaction sequence, has failed when the condition called PKU evolves?
A) phenylalanine + α-ketoglutarate → glutamate + phenylpyruvate B) phenylalanine → tyrosine
C) tyrosine → phenylalanine D) tyrosine → succinyl CoA
E) tyrosine → fumarate + acetoacetyl CoA

25. Which set of properties, displayed by the substance urea, make it a good choice as a metabolite to be used to regulate nitrogen levels in the human organism? (INDICATE ALL POSSIBILITIES)
A) H_2O insoluble B) contains nitrogen C) toxic D) H_2O soluble E) non-toxic

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M A T C H I N G

THE ITEMS 26-30 REFER TO THE LIST AT THE RIGHT. THERE IS ONLY ONE CORRECT ANSWER FOR EACH ITEM 26-30, BUT A GIVEN RESPONSE FROM THE LIST AT THE RIGHT MAY BE USED MORE THAN ONCE.

26. This metabolite is associated with the oxidation of fatty acids.

27. This variable is regarded as path independent.

28. This metabolite is a non-peptide and a component of the E.T.S.

29. During periods of carbohydrate shortage, this metabolite is synthesized in the liver.

30. This metabolite is produced by the oxidation of odd-carbon fatty acids and branched chain amino acids.

A) CoQ
B) Cyt b
C) Work
D) Creatinine
E) FeS
AB) Creatine
AC) Heat
AD) Bile
AE) Acetoacetate
BC) Carnitine
BD) Phenylalanine hydroxylase
BE) Cholesterol
CD) Propionyl CoA
CE) Gibbs Free Energy
DE) Pyruvate

T R U E - - - F A L S E
(A) (B)

31. The standard free energy change for a process, ΔG°, is proportional to the natural log of the equilibrium constant for that process.

32. Fatty acid digestion takes primarily in the lumen of the small intestine.

33. The ammonia toxicity produced when the condition called

34. The oxidation of an amino acid under anaerobic conditions produces lactate as does a carbohydrate.

35. Since no ATP is produced in the presence of an uncoupler, the value for the ΔG° for the oxidation of NADH is increased under such conditions.

1-C 2-B 3-A 4-A 5-B 6-D 7-D 8-E 9-B 10-E 11-B 12-B 13-C 14-C 15-B 16-D 17-B 18-D
19-A 20-C 21-A 22-C 23-E 24-B 25-BDE 26-BC 27-CE 28-A 29-AE 30-CD 31-A 32-A 33-B 34-B 35-B

5 B I O C H E M I S T R Y E X A M

April 8, 1999

NAME_____

(3)

1. Regardless of the starting material used for glucose synthesis in the human organism, the substance _____ must be made in the cellular mitochondrion in order to initiate the gluconeogenetic pathway.

A) citrate B) pyruvate C) phosphoenolpyruvate D) malate E) acetyl CoA

2. The gluconeogenetic pathway accounts for the observation that carbohydrate carbon atoms cannot be used for ketone body synthesis, even though they can be converted into acetyl CoA, because _____ can be made into _____ which eliminates the need for ketogenesis.

A) acetyl CoA -- citrate B) acetyl CoA -- oxaloacetate C) acetyl Co A -- malate
D) pyruvate -- oxaloacetate E) pyruvate -- lactate

3. The process by which the enzymes PFK-1, PFK-2, PFK-2(ase) and 2,6-bisphosphatase regulate glycolysis and gluconeogenesis, relies on the metabolite F-2,6-P to negatively modulate _____ and encourage _____ during periods of high ATP concentration.

A) PFK-2(ase) -- F-1,6-bisphosphatase B) F-1,6-bisphosphatase -- PFK-1 C) PFK-2(ase) -- PFK-1
D) PFK-1 -- PFK-2 E) PFK-2 -- PFK

4. A skeletal muscle cell will normally require _____ millimoles of glucose to produce 240 millimoles of ATP anaerobically. By imposing the Cori cycle on the system, the same amount of ATP can be produced using _____ millimoles of glucose.

A) 120 -- 20 B) 20 -- 40 C) 36 -- 18 D) 40 -- 200 E) 200 -- 40

5. If the process A <---> B has an initial rate to the right of 120 and a rate to the left of 100, the initial flux is _____. A 20% increase in the rate to the right and a 20% decrease in the rate to the left produces a new flux which is about _____ times the initial flux.

A) 20 -- 3.5 B) 20 -- 5 C) 2.5 -- 20 D) 100 -- 10 E) 100 -- 2.5

6. The onset of gluconeogenesis in man usually occurs about _____ hours after a feeding event but _____ liver glycogen is exhausted.

A) 1 to 2 -- after B) 20 to 24 -- before C) 4 to 8 -- before D) 2 to 4 -- after
E) 24 to 28 -- before

7. The blood plasma concentration of insulin usually _____, while the plasma concentration of glucagon usually _____, as one's blood sugar concentration diminishes.

A) decreases -- decreases B) increases -- decreases C) decreases -- increases
D) increases -- increases E) increases -- remains constant

8. The mechanism of action of epinephrine with respect to a skeletal muscle cell indicates that the specific enzyme affected by plasma epinephrine is _____.

A) glycogen synthase 'I' B) cAMP stim. protein kinase C) phosphodiesterase
D) glycogen phosphorylase 'a' E) adenyl cyclase

9. As the blood concentrations of epinephrine drop due to a lack of 'fight or flight' response, skeletal muscle concentrations of G-6-P tend to _____ while the intracellular concentrations of cAMP tend to _____.

A) decrease -- increase B) remain constant -- increase C) increase -- decrease
D) increase -- increase E) increase -- remain constant

10. A systemic shortage of the hormone insulin, or a problem with the cellular insulin 'receptor sites', can give rise to which set of symptoms or laboratory test results?

A) acidosis and hypoglycemia B) falling blood pressure and hypoventilation (slow respiration)
C) ketosis and glucosuria D) hypoglycemia and alkalosis E) hyperglycemia and alkalosis

11. Which of the following processes can possibly provide acetyl CoA to the cellular cytoplasm in order to generate the starting material for the synthesis of a fatty acid?

A) decarboxylation of pyruvate B) oxidation of malate C) thiolytic cleavage of citrate
D) β-oxidation E) glycolysis

12. The reaction sequence: _____ followed by _____, represents a series of reaction steps which could be used to produce the fatty acid - 18:1 Δ-9 from palmitate (C-16 saturated fatty acid).

A) elongation -- desaturation B) reduction -- elongation C) desaturation -- oxidation
D) oxidation -- desaturation E) desaturation -- elongation

13. Which complement of fatty acids in a triacylglycerol will generate the TAG (triacylglycerol) with the lowest melting point? NOTE: 'S' = 18:0; 'O' = 18:1 Δ-9; 'P' = 16:0)

A) S - O - S B) O - P - S C) P - S - P D) O - P - O E) P - P - P

14. Significant fat mobilization is not likely during the four or so hours after eating a meal because the initial reaction step in the mechanism for hydrolysis of intracellular lipids is inhibited by the substance _____.

A) adenyl cyclase B) intracellular lipase C) insulin D) glucagon
E) cAMP stimulated protein kinase

15. Sterols are excreted from the human organism in the form of _____ via the _____.

A) bile salts -- urine B) acetyl CoA -- feces C) acetyl CoA -- urine D) cholesterol -- urine
E) bile salts -- feces

16. The process by which _____ surrender their triacylglycerol content to adipocytes is catalyzed by the enzyme _____.

A) VLDLs -- lipoprotein lipase B) chylomicrons -- intracellular lipase
C) HDLs -- intracellular lipase D) chylomicrons -- hepatic lipase E) HDLs -- pancreatic lipase

17. A substance like vitamin A, a fat soluble vitamin, moves from the intestinal lumen to the liver via _____.

A) the hepatic portal vein B) a HDL C) a chylomicron D) a VLDL E) a low-density lipoprotein

VLDL

18. A pathway for the movement of endogenous cholesterol, shows the cholesterol moving from _____ to _____ to _____ and being converted to a cholesterol ester during this sequence.

A) blood plasma -- a HDL -- a LDL B) a VLDL -- blood plasma -- LDL
C) a HDL -- a chylomicron -- a VLDL D) a chylomicron -- a HDL -- a VLDL
E) a HDL -- a VLDL -- blood plasma

19. An increasing concentration of cholesterol within a given cell will tend to prevent the uptake of additional cholesterol from plasma LDLs by inhibiting _____.

A) the synthesis of B-100 receptors B) the enzyme HMG CoA reductase C) LDL formation
D) ketone body synthesis E) the enzyme LCAT (Lecithin Cholesterol Acyl Transferase)

20. The amino acid carbon atoms which are used as starting materials for hepatic gluconeogenesis are moved from _____ cells, to the liver, in the form of the amino acid _____.

A) intestinal mucosal -- citrulline B) skeletal muscle -- alanine
C) intestinal mucosal -- glutamine D) skeletal muscle -- methionine E) renal -- glutamine

21. One of the functions of folic acid is to regenerate the amino acid methionine by _____ the amino acid homocysteine.

A) oxidizing B) reducing C) phosphorylating D) hydrolyzing E) methylating

22. The acetyl CoA used by certain neurons to synthesize acetylcholine must be derived from the catabolism of _____, and cannot be prepared from the catabolism of _____.

A) fatty acids -- fatty acids B) fatty acids -- carbohydrates
C) ketogenic amino acids -- fatty acids D) carbohydrates -- fatty acids
E) ketone bodies -- fatty acids

23. As the concentration of dopamine increases in the synaptic cleft, the post-synaptic neuron has more and more difficulty achieving repolarization. To compensate for this situation, the post-synaptic neuron produces _____.

A) hydrolyzed dopamine B) more receptor sites C) fewer receptor sites
D) fewer uptake proteins E) more uptake proteins

24. The extent to which iron is absorbed from the intestinal lumen is controlled by the availability of the protein _____.

A) ferritin B) apoferritin C) transferrin D) hemosiderin E) apotransferrin

25. As ethyl alcohol is cleared by the liver, gluconeogenesis is _____ because of the formation of large amounts of _____ during the clearance process.

A) encouraged -- lactate B) discouraged -- acetate C) encouraged -- acetate
D) discouraged -- lactate E) discouraged -- malate

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26. This amino acid provides the nitrogen which is used by renal cells to regulate systemic acid-base balance.

27. Although it is not a starting material for gluconeogenesis, this reagent is a cofactor for pyruvate carboxylase.

28. This metabolite is used to lengthen a fatty acid during its synthesis.

29. This apoliprotein is identified with the recognition of an LDL by a skeletal muscle cell.

30. This phosphorylated carbohydrate is not a glycolytic component but it is a powerful inhibitor of gluconeogenesis.

A) Malate
B) HMG CoA
C) LCAT
D) B-100
E) 3,3'-dimethylallylpyrophosphate
AB) Acetyl CoA
AC) Methionine
AD) Fructose-2,6-bisphosphate
AE) Oxaloacetate
BC) Lipoprotein lipase
BD) Phosphoenolpyruvate
BE) Alanine
CD) C II
CE) Glutamine
DE) Malonyl-S-ACP

T R U E - - - F A L S E
(A) (B)

31. The reaction which forms cAMP from ATP is not reversible.

32. Chylomicrons direct their triacylglycerol content to adipocytes and their cholesterol content to HDLs.

33. Ketone bodies can be used as carbohydrate precursors.

34. Intracellular cholesterol synthesis is limited when cholesterol inhibits the transcription of the mRNA used to synthesize the enzyme HMG CoA reductase.

35. One of the ways the liver clears ethyl alcohol from one's blood is to convert the alcohol into glucose for metabolism by the central nervous system.

1-D 2-D 3-B 4-A 5-A 6-C 7-C 8-E 9-C 10-C 11-C 12-A 13-D 14-C 15-E 16-A 17-C 18-A 19-A 20-I
21-E 22-D 23-C 24-B 25-D 26-CE 27-AB 28-DE 29-D 30-AD 31-A 32-B 33-B 34-A 35-B

5 B I O C H E M I S T R Y E X A M

December 7, 2000

NAME_____

1. If the reaction: P_i + glucose → G-6-P + H_2O has a ΔG° of +17 kJ, then G-6-P can be prepared, exergonically, using the reaction: ATP + glucose → G-6-P + ADP; which will have a ΔG° of _____.
   A) -17 kJ B) +14 kJ C) +31 kJ D) -14 kJ E) -31 kJ

2. The production (anaerobic) of 300 millimoles of ATP will require 150 millimoles of glucose. The Cori Cycle allows us to recover about 125 millimoles of the glucose from lactate. The ratio of ATP produced to glucose consumed, using the Cori Cycle, is about _____.
   A) 36:1 B) 15:1 C) 2:1 D) 12:1 E) 8:1

3. The gluconeogenetic pathway is encouraged as the cellular concentration of ATP increases and _____ is hydrolyzed to F-6-P.
   A) F-1,6-P B) ATP C) F-2,6-P D) PFK-1 E) cAMP

4. Glucagon is a polypeptide hormone which is produced in the _____ in response to _____.
   A) liver -- decreasing plasma [glucose] B) gonads -- an external stimulus
   C) pancreas -- decreasing plasma [glucose] D) adrenal medulla -- an external stimulus
   E) pancreas -- increasing plasma [glucose]

5. The mechanism for the hydrolysis of liver glycogen, which is triggered by the hormone glucagon, is terminated when the reaction _____ takes place.
   A) glycogen → G-6-P B) G-6-P → G-1-P C) cAMP → AMP D) ATP → cAMP
   E) glycogen phosphorylase 'b' → glycogen phosphorylase 'a'

6. As blood sugar levels increase after a meal, the hormone _____ is supplied by the pancreas and as the plasma levels of this hormone increase, glucose is transported into various types of cells such as skeletal muscle and _____.
   A) epinephrine -- skeletal muscle B) glucagon -- adipocytes C) glucagon -- liver
   D) insulin -- adipocytes E) insulin -- liver

7. The fatty acid synthesis mechanism uses the metabolite _____ to react with the growing fatty acid to elongate it by two carbons.
   A) citrate B) malonyl ACP C) succinyl CoA D) acetyl ACP E) CO_2

8. In order to biosynthesize a fatty acid with the designation 20:1 Δ13, starting with a fatty acid, 16:0, an appropriate reaction sequence would be _____. (NOTE: 'elongation' means lengthening the acid by two carbons; 'desaturation' means the introduction of a carbon-carbon double bond)
   A) elongation - elongation - desaturation B) desaturation - desaturation - elongation
   C) elongation - desaturation - elongation D) desaturation - elongation - desaturation
   E) desaturation - elongation - elongation

9. The 'entero-hepatic cycle' shows that the cholesterol component of bile moves from the _____ to the liver via the _____.
   A) small intestine -- hepatic portal vein B) small intestine -- bile duct
   C) small intestine -- lymphatic system D) gall bladder -- lymphatic system
   E) gall bladder -- hepatic portal vein

10. Which of the following would be found in the hydrophobic inner core of a generic lipoprotein?
    A) phosphatides B) cholesterol esters C) apolipoproteins D) lipoprotein lipase
    E) cholesterol

11. The remains of a VLDL (what's left after triacylglycerols are donated to adipocytes) develop into _____ which then carry _____ to peripheral sites such as skeletal muscle.
    A) LDLs -- cholesterol esters B) HDLs -- cholesterol C) chylomicrons -- cholesterol esters
    D) LDLs -- triacylglycerols E) HDLs -- cholesterol esters

12. Which of the following sets of lipoproteins receives apoliprotein C II from high density lipoproteins?
    A) LDLs and HDLs B) chylomicrons and LDLs C) VLDLs and LDLs D) VLDLs and HDLs
    E) VLDLs and chylomicrons

13. Which type of lipoprotein would increase in the blood plasma as a result of a failure of a peripheral cell to synthesize apoliprotein B-100 receptors?
    A) LDLs B) VLDLs C) HDLs D) IDLs E) chylomicrons

14. Under normal circumstances, the process of 'fat mobilization' is initiated by _____ blood sugar levels and intracellular formation of cAMP under the influence of the hormone _____.
    A) decreasing -- glucagon B) increasing -- epinephrine C) increasing -- insulin
    D) decreasing -- insulin E) increasing -- glucagon

15. During 'fat mobilization', fatty acids which arrive at the liver undergo a series of reactions converting them into _____.
    A) glucose B) triacylglycerols C) ketone bodies D) ATP E) VLDLs

16. The hormone insulin is regarded as 'antilipolytic' because it _____ the activity of the enzyme _____.
    A) discourages -- adenyl cyclase B) encourages -- phosphodiesterase
    C) encourages -- lipoprotein lipase D) encourages -- intracellular lipase
    E) discourages -- lipoprotein lipase

17. During periods of starvation, large amounts of the amino acid alanine are seen to be moving to the liver, which converts the alanine into _____ and _____.
    A) glutamine -- NH_4^+ B) glucose -- ATP C) glucose -- urea D) ATP -- urea
    E) glutamine -- glucose

The ammonium ion, NH_4^+, excreted by the kidneys to regulate systemic acid-base balance, is supplied to the renal system by the nitrogen containing compound _____.
A) urea B) glutamine C) ornithine D) aspartate E) alanine

A93

19. The catbolism of the _____ called adenine leads to the formation of _____.
A) purine -- urea B) purine -- ammonium ion C) pyrimidine -- urea D) pyrimidine -- uric acid
E) purine -- uric acid

20. Intracellular synthesis of acetylcholine requires acetyl CoA specifically produced from _____.
A) a ketone body B) a fatty acid C) glucose D) palmitate E) the oxidation of oxaloacetate

21. The animation you saw in class showed that the neurotransmitter dopamine is cleared from the synaptic cleft by _____.
A) oxidation to CO_2 B) a carboxylation reaction C) reaction with a post-synaptic receptor
D) reaction with an uptake protein E) hydrolysis to acetyl CoA

22. A diabetic displaying a blood pH of 7.1 and abnormally high levels of plasma ketone bodies will also show abnormally _____ concentration in his/her blood plasma.
A) low sodium ion B) low potassium ion C) low glucose D) high bicarbonate ion E) high urea

23. Which of the following anatomical sites stores iron in the form of ferritin?
A) adipocytes B) intestinal mucosa C) blood plasma D) kidneys E) skeletal muscle

24. The hepatic clearance of ethyl alcohol creates large amounts of the metabolite _____ which must be disposed of, but not metabolized, by the liver.
A) lactate B) malate C) pyruvate D) glucose E) NAD^+

25. Fat deposits appear in the liver as a result of continuous alcohol usage because lipids are mobilized due to falling blood sugar and when the fatty acids arrive at the liver, they cannot be metabolized due to an hepatic shortage of _____.
A) NAD^+ B) NADH C) oxaloacetate D) lactate E) palmitate

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26. Without cobalamin, the human requirement for this amino acid would increase.

27. The cells of the intestinal mucosa have a limited supply of this protein.

28. The intracellular synthesis of this protein is inhibited by cholesterol.

29. This metabolite regulates both gluconeogenesis and glycolysis.

30. Name given to the molecule which carries acetyl CoA to the cytoplasm during fatty acid synthesis.

A) F-2,6-P
B) Pyruvate carboxylase
C) Citrate
D) Alanine
E) Glutamine
AB) Lipoprotein lipase
AC) Intracellular lipase
AD) Malonyl CoA
AE) Chylomicron remnant
BC) B-100 receptor site
BD) Malate
BE) Methionine
CD) LCAT
CE) Apoliprotein C II
DE) Apoferritin

T R U E - - - F A L S E
(A) (B)

31. In humans, carbohydrate precursors have at least three carbon atoms in their structure.

32. As amino acids are used to make glucose in the liver, the ammonia from the amino acids is transported to the kidneys to become the urinary component, ammonium ion.

33. HDLs are referred to as 'good cholesterol', at least in part, because they react with free cholesterol found in the blood plasma and convert the sterol into a fatty acid ester.

34. Fatty acids can be synthesized from carbohydrates and carbohydrates can be synthesized from fatty acids.

35. After hydrolysis in the synaptic cleft, the 'choline' portion of the neurotransmitter acetylcholine is absorbed by the post-synaptic neuron.

5
1-D 2-D 3-C 4-C 5-C 6-D 7-B 8-E 9-C 10-B 11-A 12-E 13-A 14-A 15-C 16-A 17-C 18-B 19-E 20-C
21-D 22-E 23-B 24-A 25-A 26-BE 27-DE 28-BC 29-A 30-C 31-A 32-B 33-A 34-B 35-B

B I O C H E M I S T R Y E X A M

July 26, 2001

NAME_____

. The substance acetyl CoA is not regarded as a viable carbohydrate precursor because it _____.

A) is a CoA ester B) cannot be made into malate C) is not a TCA Cycle component
D) can be made from a fatty acid E) has only two carbon atoms

. plete the following reaction from the gluconeogenetic pathway: F-1,6-P + _____ → F-6-P + _____.

A) ADP -- ATP B) H_2O -- P_i C) H_2O -- G-6-P D) ATP -- P_i E) ATP -- ADP

. The metabolite F-2,6-P impacts carbohydrate metabolism by favoring glycolysis via the kinetic enhancement of the enzyme _____ and the inhibition of the enzyme _____. (NOTE: THE IMPACT OF F-2,6-P OCCURS AT THE F-6-P → F-1,6-P STEP IN GLYCOLYSIS)

A) PFK-1 -- PFK-2 B) hexokinase -- pyruvate kinase C) PFK-1 -- hexokinase
D) PFK-1 -- F-1,6-bisphosphatase E) pyruvate carboxylase -- G-6-phosphatase

. The hormone glucagon is a _____ hormone which is provided by the pancreas in response to _____ blood sugar levels.

A) catecholamine -- falling B) polypeptide -- falling C) steroid -- falling
D) polypeptide -- rising E) catecholamine -- rising

. The 'mediated cascade' mechanism for the hydrolysis of liver glycogen is terminated when intracellular levels of cAMP diminish as a result of: 1) the lack of stimulation, by glucagon, of the enzyme _____; and 2) the ongoing action of the intracellular enzyme _____.

A) glycogen phosphorylase -- glycogen synthase B) adenyl cyclase -- glycogen phosphorylase
C) phosphodiesterase -- cAMP stimulated protein kinase D) adenyl kinase -- phosphodiesterase
E) glycogen synthase -- glycogen phosphorylase

. For the period of 12 hrs to 24 hrs after a feeding event, the carbohydrate supply for a typical human organism is derived from _____ to an increasing extent during the period, and _____ to a decreasing extent over the period.

A) exogenous sources -- gluconeogenesis B) glycogen hydrolysis -- exogenous sources
C) gluconeogenesis -- glycogen hydrolysis D) gluconeogenesis -- exogenous sources
E) exogenous sources -- glycogen hydrolysis

. Acetyl CoA, derived from the decarboxylation of pyruvate (designated acetyl CoA_{carb}) is not a ketone body precursor, whereas acetyl CoA derived from β-oxidation (designated acetyl CoA_{fa}) is a ketone body precursor, because _____.

A) acetyl CoA_{carb} is different from acetyl Co A_{fa}
B) fatty acids can be converted to oxaloacetate
C) $acetyl_{carb}$ is more oxidized than acetyl CoA_{fa}
D) ketone bodies can be converted to oxaloacetate E) pyruvate can be converted to oxaloacetate

. The carbon atoms used as substrates for the synthesis of fatty acids are usually derived from _____ and move from the mitochondrion to the cytoplasm in the form of the metabolite _____.

A) glucose -- citrate B) glucose -- pyruvate C) glucose -- acetyl CoA D) pyruvate -- citrate
E) fatty acids -- acetyl CoA

. As soon as two carbon atoms are added to a growing fatty acid, the candidate fatty acid is _____ before an additional two carbons are added.

A) reduced -- dehydrated -- reduced B) oxidized -- hydrated -- oxidized
C) oxidized -- dehydrated -- reduced D) reduced -- hydrated -- oxidized
E) reduced -- dehydrated -- oxidized

. If two fatty acids are esterified to glycerol phosphate, the resultant lipid is best referred to as a _____ and would be used as a component of _____.

A) neutral fat -- depot fat B) phosphatide -- depot fat
C) triacylglycerol -- a mitochondrial membrane D) triacylglycerol -- a plasma membrane
E) polar lipid -- a plasma membrane

. Exogenous lipids are transported to adipocytes for storage in the form of _____.

A) cholesterol esters B) chylomicrons C) apolipoproteins D) LCAT E) low density lipoproteins

. One of the functions of HDLs is to supply _____ to chylomicrons and VLDLs.

A) cholesterol B) cholesterol esters C) LCAT D) lipoprotein lipase E) apoliprotein C II

. Intracellular cholesterol limits the uptake of additional cholesterol from the blood plasma by inhibiting the synthesis of _____.

A) apoliprotein B-100 receptors B) apoliprotein B-100 C) cholesterol esters
D) HMG CoA reductase E) cholesterol

. The phenomenon of fat mobilization is normally instigated by _____.

A) low blood sugar B) low levels of 'FFAs' in the blood C) elevated blood sugar
D) high levels of 'FFAs' in the blood E) hyperlipoproteinemia

. The increase in ketone body concentration in the blood noted during starvation is attributed to the ___.

) increase in hepatic lipogenesis B) effects of the hormone insulin
increased extent of fatty acids being processed by the liver
D) increased rate of hydrolysis of liver glycogen E) decreased pH of the blood plasma

. For a starvation period of several weeks, the central nervous system tends to use fewer _____ and more _____. (NOTE: For this question, 'carbohydrates' refers to glucose)

A) fatty acids -- carbohydrates B) carbohydrates -- ketone bodies
C) ketone bodies -- fatty acids D) carbohydrates -- fatty acids
E) ketone bodies -- carbohydrates

. In order to supply a carbon source to the liver for the support of hepatic gluconeogenesis, skeletal

. The renal system requires the amino acid glutamine as a source of _____ which is then used to form _____.

A) carbon -- glucose B) nitrogen -- ammonium ion C) carbon -- methyl groups
D) nitrogen -- urea E) nitrogen -- alanine

. The agent SAM is used as a source of _____ for a variety of reactions including the conversion of norepinephrine to epinephrine and the conversion of guanidoacetate to creatine.

) methyl groups B) homocysteine C) creatine D) cobalamin E) amine groups

. If there is a problem with either a dietary availability of cobalamin, or its absorption, the system will quickly produce a shortage of the amino acid _____.

A) methionine B) homocysteine C) alanine D) glutamine E) norepinephrine

.. The enzyme phophoribosyl pyrophosphate synthetase, used to catalyze one of the early reactions in the synthesis of purines, is normally inhibited by _____. Failure of this inhibitory mechanism can lead to the condition called 'gout'.

A) ATP B) UTP C) CTP D) uric acid E) urea

. In a system which uses dopamine as a neurotransmitter, the depolarization of the post-synaptic neuron is stopped when the dopamine is _____.

A) returned to the pre-synaptic neuron B) hydrolyzed to acetate and L-dopa
C) reduced to phenylalanine D) absorbed by the post-synaptic neuron E) oxidized to tyrosine

. The assimilation of iron by the human organism is accomplished when the iron from the intestinal lumen is able to react with the protein _____, which is found in the _____.

A) apotransferrin -- liver B) transferrin -- blood plasma C) apoferritin -- intestinal mucosa
D) apoferritin -- blood plasma E) ferritin -- liver

. The mechanism by which the liver 'clears' ethyl alcohol can produce a _____ state as a result of the hepatic production of _____, which consumes the glucose precursor, pyruvate.

A) hypoglycemic -- NADH B) hypoglycemic -- acetate C) hyperglycemic -- NADH
D) hypoglycemic -- lactate E) hyperglycemic -- NAD^+

. If a person can oxidize ethyl alcohol in his/her liver at the rate of 100 mg alcohol/hr/kg, it will take about _____ hours for a 70 kg man to clear the alcohol found in a bottle of wine (750 ml). (NOTE: Assume the wine is about 12% alcohol by volume and 1 ml of alcohol has a mass of 0.8 g).

A) 2 B) 4 C) 10 D) 16 E) 6

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6. This pathway often supplies carbohydrate precursors.

7. Falling blood sugar usually causes this hormone to be supplied.

8. Glycolysis is kinetically enhanced, and gluconeogenesis is inhibited, by this metabolite.

9. The term 'good cholesterol' is a reference to this agent.

0. Methyl group transfers are facilitated by this B-complex vitamin.

A) Citric acid cycle
B) Pyruvate
C) Acetyl CoA
D) β-oxidation
E) Insulin
AB) F-2,6-P
AC) Chylomicron
AD) Epinephrine
AE) Cholesterol esters
BC) Glycolysis
BD) Biotin
BE) Glucagon
CD) Folic acid
CE) HDL
DE) Pantothenate

T R U E - - - F A L S E
(A) (B)

1. During starvation, the neurons of the central nervous system substitute fatty acids ,as a fuel, for approximately half of the glucose they would normally use.

2 ...oth VLDLs and chylomicrons use the agent 'apolipoprotein C II'.

...ducing power must be supplied to the cytoplasm in order for gluconeogenesis to occur.

4. Phosphodiesterase is activated by the hormone insulin.

5. The more alcohol a person ingests, the faster his/her liver will oxidize it.

5

5.4

1-B 2-B 3-D 4-B 5-D 6-C 7-E 8-A 9-A 10-E 11-B 12-E 13-A 14-A 15-C 16-B 17-E 18-B 19-A
20-A 21-A 22-A 23-C 24-D 25-C 26-A 27-BE 28-AB 29-CE 30-CD 31-B 32-A 33-A 34-B 35-B