MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) All of the following statements concerning digestion are correct **except** 1) _____
   A) The major physical processes in digestion are mixing, softening and grinding of food.
   B) Different foods are digested by different enzymes.
   C) The major chemical reaction in digestion is enzyme–catalyzed hydrolysis of large molecules.
   D) Digestion can be considered a catabolic process in which bulk food is broken down into individual small molecules.
   E) Digestion begins in the stomach and is completed in the large intestine.

2) All of the following statements concerning digestion are correct **except** 2) _____
   A) The same enzymes are used in the digestion of carbohydrates, lipids, and proteins.
   B) The major physical processes in digestion are mixing, softening, and grinding of food.
   C) The major chemical reaction in digestion is enzyme–catalyzed hydrolysis of large molecules.
   D) Digestion begins in the mouth, continues in the stomach, and is completed in the small intestine.
   E) Digestion can be considered a catabolic process in which bulk food is broken down into individual small molecules.

3) The target molecule(s) for α–amylase is (are) 3) _____
   A) glucose.
   B) starch.
   C) all disaccharides.
   D) starch and glycogen.
   E) sucrose.

4) Which of the following is **not** a product of digestion? 4) _____
   A) fatty acids
   B) glucose
   C) pyruvate
   D) glycerol
   E) amino acids

5) The most important goal of glucose metabolism is 5) _____
   A) production of ATP as an energy source for all cells.
   B) production of acetyl–SCoA for synthesis of lipids.
   C) synthesis of glycogen for later use.
   D) synthesis of oxidized coenzymes.
   E) synthesis of carbon skeletons for amino acid production.

6) The pathway followed by glucose when energy is needed is 6) _____
   A) glycogenesis.
   B) the pentose phosphate pathway.
   C) gluconeogenesis.
   D) glycolysis.
   E) lipogenesis.

7) When a cell's need for NADPH or ribose–6–phosphate exceeds its need for ATP, glucose–6–phosphate is metabolized by 7) _____
A) glycogenesis.
B) glycolysis.
C) the pentose phosphate pathway.
D) glycogenolysis.
E) gluconeogenesis.

8) When energy is needed and adequate oxygen is available, pyruvate is converted to _____. 8) _____
A) glucose
B) ethanol
C) lactate
D) glycogen
E) acetyl–SCoA

9) Which conversion is accomplished during glycolysis? 9) _____
A) glucose to pyruvate
B) glycogen to glucose
C) pyruvate to glucose
D) starch to glucose
E) glucose to glycogen

10) All of the following are reactions in the oxidation of glucose which produce energy **except** 10) _____
A) glycolysis.
B) oxidation of pyruvate to acetyl–SCoA.
C) reaction of reduced coenzymes in the electron transport chain.
D) glycogenolysis.
E) the citric acid cycle.

11) The major function of the pentose phosphate pathway when lipid synthesis is a priority is 11) _____
A) providing intermediates for the citric acid cycle.
B) producing NADPH.
C) providing intermediates for glycogenesis.
D) producing ribose.
E) meeting the need for large amounts of ATP.

12) The major function of the pentose phosphate pathway when nucleic acid synthesis is a priority is 12) _____
A) providing intermediates for the citric acid cycle.
B) providing intermediates for glycogenesis.
C) producing ribose.
D) producing NADPH.
E) meeting the need for large amounts of ATP.

13) All of the chemicals below are associated with the pentose phosphate pathway **except** 13) _____
A) glucose 6–phosphate.
B) NADP.
C) pyruvate.
D) NADPH.
E) ribose.

14) The most important monosaccharide for energy production is? 14) _____

A) galactose B) mannose C) ribose D) fructose E) glucose

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) Classify each pathway of carbohydrate metabolism as anabolic or catabolic. Justify your choice in each case. 15) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) In the first step of glycolysis, the conversion of glucose to glucose 6–phosphate is known as 16) _____

A) phosphorylation.
B) isomerization.
C) dehydration.
D) reduction.
E) oxidation.

17) Which of the following are produced as a net result of glycolysis? 17) _____

I. NADH
II. NAD^+
III. ADP
IV. ATP

A) III and IV B) I and IV C) I and II D) II and III E) I and III

18) The conversion of glucose 6–phosphate to fructose 6–phosphate in the second step of glycolysis is a(an) _____ reaction. 18) _____

A) isomerization
B) dehydration
C) oxidation
D) phosphorylation
E) reduction

19) The chemical resulting from steps 3–5 of glycolysis which is oxidized in step 6 is 19) _____

A) acetyl–SCoA.
B) glyceraldehyde 3–phosphate.
C) citrate.
D) glucose.
E) oxaloacetate.

20) When ATP is produced by direct transfer of a phosphate group instead of from reactions coupled to electron transport, the process is referred to as _____ phosphorylation. 20) _____

A) catabolic
B) reductive
C) substrate–level
D) anabolic
E) oxidative

21) The products of glycolysis important in metabolism are 21) _____

A) pyruvate, ATP, and NADH.
B) acetyl–SCoA and ATP.
C) CO_2, ATP, and NADH.
D) CO_2 and H_2O.
E) pyruvate, ADP, and NAD^+.

22) Steps 1–5 of glycolysis are referred to as the "energy investment" portion of the process because these steps 22) _____

A) produce NADH which is less energy–rich than ATP.
B) generate waste products which cost ATP for disposal.
C) consume ATP instead of producing it.
D) involve several endergonic isomerizations.
E) none of the above

23) The first step of glycolysis involves _____ to form _____. 23) _____

A) esterification, glucose–1–phosphate
B) isomerization, fructose–6–phosphate
C) esterification, glucose–6–phosphate
D) addition, fructose–1, 6–diphosphate
E) oxidation, glucose –6–phosphate

24) Conversion of dihydroxyacetone phosphate to D–glyceraldehyde 3–phosphate is a(n) _____. 24) _____

A) reduction
B) esterification
C) condensation
D) oxidation
E) isomerization

25) Pyruvate is converted to lactate under anaerobic conditions because _____. 25) _____

A) reduction of pyruvate provides NAD^+ which is needed for glycolysis
B) lactate is storage for of pyruvate for use later when more ATP is needed
C) lactate releases oxygen upon conversion to acetyl–CoA
D) reduction of pyruvate provides NADH which is needed for gluconeogenesis
E) none of the above

26) The enzyme that catalyzes cleavage of fructose 1,6–bisphosphate to dihydroxyacetone phosphate and D–glyceraldehyde–3–phosphate is _____. 26) _____

A) aldolase
B) D–glyceraldehyde–3–phosphatase
C) hexokinase
D) phosphofructokinase
E) none of the above

27) Entry of monosaccharides other than glucose into the glycolysis pathway initially involves 27) _____

A) oxidation into acetyl groups.
B) conversion into phosphates.
C) reduction of carbonyl groups.
D) hydrolysis of 2–carbon units.
E) breakdown into pyruvate.

28) Which chemical is produced from pyruvate when it is metabolized in muscle cells under aerobic conditions? 28) _____

A) lactate
B) glucose
C) phosphoenol pyruvate
D) ethanol
E) acetyl–SCoA

29) Which chemical is produced from pyruvate when it is metabolized in muscle cells under anaerobic conditions? 29) _____

A) glucose
B) ethanol
C) phosphoenol pyruvate
D) lactate
E) acetyl–SCoA

30) Which chemical is produced from pyruvate when it is metabolized by yeast cells? 30) _____

A) phosphoenol pyruvate
B) lactate
C) glucose
D) ethanol
E) acetyl–SCoA

31) The action of yeast on pyruvate is a process referred to as 31) _____

A) glycolysis.
B) alcoholic fermentation.
C) substrate–level phosphorylation.
D) aerobic oxidation.
E) anaerobic reduction.

32) The diseases identified as diabetes are primarily associated with a malfunction of the hormone 32) _____

A) cortisone.
B) glucagon.
C) sorbitol.
D) insulin.
E) epinephrine.

33) Which pathway converts glucose to its storage form in animals? 33) _____

A) glycogenesis
B) glycogenolysis
C) lipogenesis
D) glycolysis
E) gluconeogenesis

34) Hormones which regulate glucose metabolism are _____, _____, and _____. 34) _____

A) estrogen; progesterone; testosterone
B) estrogen; glucagon; epinephrine
C) insulin; glucagon; epinephrine
D) insulin; cortisone; thyroxine
E) growth hormone; cortisone; thyroxine

35) Overproduction of insulin causes _____, a state in which the concentration of blood sugar is _____ than normal. 35) _____

A) hypoglycemia; higher
B) hyperglycemia; higher
C) hypoglycemia; lower
D) hyperglycemia; lower
E) none of the above

36) A lack of insulin causes _____, a state in which the concentration of blood sugar is _____ than normal. 36) _____

A) hypoglycemia; lower
B) hypoglycemia; higher
C) hyperglycemia; higher
D) hyperglycemia; lower
E) none of the above

37) In an individual who is starving or fasting, the body meets its need for glucose first by the process of _____, and then by the process of _____. 37) _____

A) gluconeogenesis; glycogenesis
B) lipogenesis; glycogenolysis
C) glycogenolysis; gluconeogenesis
D) glycogenesis; lipogenesis
E) glycolysis; gluconeogenesis

38) When a person is deprived of food, in which order does the body use the following sources to produce glucose? 38) _____

I. protein breakdown to amino acids used for gluconeogenesis
II. conversion of glycogen to glucose
III. catabolism of lipids

A) III, II, I B) I, II, III C) II, I, III D) II, III, I E) III, I, II

39) Gluconeogenesis occurs mainly in the 39) _____

A) mitochondria of all cells.
B) cytosol of all cells.
C) brain.
D) liver.
E) muscle.

40) Which pathway produces glucose from its storage form in animals? 40) _____

A) glycolysis
B) gluconeogenesis
C) glycogenolysis
D) lipogenesis
E) glycogenesis

41) Glycogen is most commonly found in _____ cells and _____ cells. 41) _____

A) red blood; white blood
B) muscle; liver
C) red blood; liver
D) bone; white blood
E) muscle; white blood

42) The process of making glucose from noncarbohydrates is known as 42) _____

A) gluconeogenesis.
B) glycogenesis.
C) lipogenesis
D) glycolysis.
E) glycogenolysis.

43) Glycolysis occurs mainly in the 43) _____

A) brain.
B) cytosol of all cells.
C) muscle.
D) liver.
E) mitochondria of all cells.

44) A high energy phosphate molecule involved in gluconeogenesis is _____. 44) _____

A) UTP B) UDP C) GDP D) GTP E) ADP

MATCHING. Choose the item in column 2 that best matches each item in column 1.

Match the following.

45) gluconeogenesis	A) the production of glucose from noncarbohydrate sources	45) _____
46) glycogenolysis	B) the conversion of glucose into pyruvate	46) _____
47) glycolysis	C) the conversion of glucose into carbohydrate molecules containing phosphate groups and five carbon atoms	47) _____
48) pentose phosphate pathway	D) the conversion of glycogen into glucose	48) _____
49) glycogenesis	E) the conversion of glucose into glycogen	49) _____

1) E
2) A
3) D
4) C
5) A
6) D
7) C
8) E
9) A
10) D
11) B
12) C
13) C
14) E
15) Glycolysis is catabolic, because a large molecule is broken into smaller ones, with a net production of high–energy molecules.
Gluconeogenesis is anabolic because it is a synthesis reaction. It consumes energy as ATP and GTP.
Glycogenolysis is catabolic because it involves breaking larger molecules into smaller ones.
Glycogenesis is anabolic because it consumes energy in the form of UTP in order to build a larger molecule from smaller ones.
16) A
17) B
18) A
19) B
20) C
21) A
22) C
23) C
24) E
25) A
26) A
27) B
28) E
29) D
30) D
31) B
32) D
33) A
34) C
35) C
36) C
37) C
38) C
39) D
40) C
41) B
42) A
43) B
44) D
45) A

46) D
47) B
48) C
49) E