1. What is the key activator of glycolysis in liver?

a. ATP
b. Glucose 6-phosphate
c. Ca+
d. Acetyl CoA
e. Fructose 2.6 bisphosphate

2. Which of the following conversions occurring in the citric acid cycle is coupled to a substrate-level phosphorylation reaction?

a. Acetyl-CoA + oxaloacetate → citrate + CoA
b. Alpha-ketoglutarate + CoA → succinyl-CoA + carbon dioxide
c. Isocitrate → alpha-ketoglutarate + carbon dioxide
d. Succinate → fumarate
e. Succinyl-CoA → succinate + CoA

3. Which of the following is the role of Coenzyme Q (ubiquinone) in the respiratory chain?

a. It links flavoproteins to cytochrome b and c
b. It links NAD-dependent dehydrogenases to cytochrome b and c
c. It is the first step in the respiratory chain
d. It links each of the cytochromes in the respiratory chain to one another

4. Which of the following best describes the biochemical role of coenzyme A?

a. It activates acyl groups for group transfer.
b. It assists in the transport of metabolic intermediates across membranes.
c. It shuttles electrons within the electron transport chain.
d. It introduces adenine nucleotides into metabolic products.
e. It introduces thiol groups into metabolic products.

(1) glycolysis regulation

(2) Flavoproteins

(3) Cori cycle

(4) Brown fat.

5. Which statement is true about the Cori cycle?

a. It involves the transfer of alanine from liver to muscle for gluconeogenesis.
b. It involves the transfer of alanine from the muscle to the liver for gluconeogenesis.
c. It involves the transfer of alanine from the liver to the brain.
d. none of the above

6. The steps of glycolysis between glyceraldehydes 3-phosphate and 3-phosphoglycerate involve all of the following except

a. ATP synthesis
b. use of Pi
c. oxidation of NADH to NAD+
d. formation of 1,3-bisphosphoglycerate
e. catalysis by phosphoglycerate kinase

7. All of the following use coenzyme Q as either substrate or product except

a. Complex I
b. Complex II
c. Complex II'
d. Complex III
e. Complex IV

8. Mitochondria in brown fat of human infants and hibernating animals regulate heat generation by controlling the rate of electron transport. Increased heat output results from an increased rate of electron transport due to

a. inhibition of the ADP-ATP antiporter
b. inhibition of the F1-Fo ATP synthase
c. blockage of NADH reoxidation
d. increased permeability of the inner mitochondrial membrane
e. decreased rate of O2 consumption.

9. The equation for the reduction of cytochrome a by cytochrome c is:

Cyt a (+3) + Cyt c (+2) → Cyt a (+2) + Cyt c (+3)

where: Cyt a (+3) + e^- → Cyt a (+2): $E'_o = +0.27$ V

Cyt c (+3) + e^- → Cyt c (+2): $E'_o = +0.22$ V

What is the $\Delta G_o'$ value for the reduction of cytochrome a by cytochrome c? (Faraday's Constant F is 96.49 kJ/V mol)

a. +2.41 kJ/mol
b. -2.41 kJ/mol
c. +4.82 kJ/mol
d. -4.82 kJ/mol
e. 48.2 kJ/mol

10. A 14-carbon fatty acid undergoes complete beta-oxidation. How many beta-oxidation cycles are completed and how many acetyl-CoA molecules are formed?

a. 6 beta-oxidation cycles and 6 acetyl-CoA molecules formed
b. 7 beta-oxidation cycles and 6 acetyl-CoA molecules formed
c. 6 beta-oxidation cycles and 7 acetyl-CoA molecules formed
d. 7 beta-oxidation cycles and 7 acetyl-CoA molecules formed
e. 7 beta-oxidation cycles and 14 acetyl-CoA molecules formed.

11. Which of the following enzymes in gluconeogenesis bypasses an irreversible reaction in glycolysis?

a. Malate dehydrogenase
b. Citrate synthase
c. Phosphoglucomutase
d. Fructose 1,6 bisphosphatase
e. Pyruvate dehydrogenase

12. In mammalian tissues, isocitrate dehydrogenase is stimulated by

a. low ADP/ATP and low NAD+/NADH ratio
b. high ADP/ATP and high NAD+/NADH ratios
c. high ADP/ATP and low NAD+/NADH ratios
d. low ADP/ATP and high NAD+/NADH ratios
e. it is not controlled by ADP levels

13. The active portion of lipoamide is:

a. a reversibly bound phosphate group.
b. a reducible disulfide bond.
c. an amide.
d. a Cu ion.
e. a Fe_2S_2 cluster.

14. A comatose laboratory technician is rushed into the emergency room. Her most dramatic symptom is that her body is literally hot to your touch, indicating an extremely high fever. You learn that her lab has been working on drugs that influence metabolism and that there is a high likelihood that she accidentally ingested one. Which one of the following is the most likely responsible?

a. Dichloroacetate
b. Rotenone
c. Dinitrophenol
d. Cyanide
e. α-amanitin.

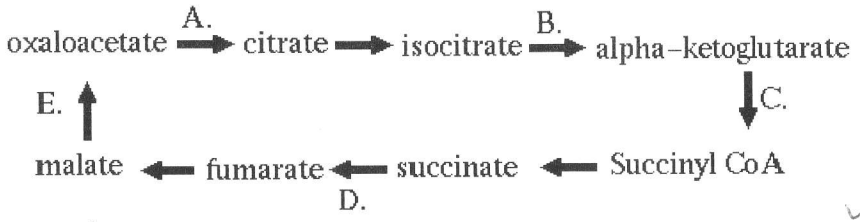
15. All of the following characteristics are features of catabolism EXCEPT:

a. Usually an exergonic reaction
b. Breaks down complex molecules to simpler molecules.
c. An oxidative process
d. Energy producing
e. Oxidizes NADPH

16. Complex I contains all of these components EXCEPT:

a. [FMN]
b. Fe_2S_2 clusters
c. Fe_4S_4 clusters
d. cytochrome c
e. proton pump

17. The enzyme of which reaction directly transfers electrons to Complex II of the mitochondrial electron transport chain?



a. A
b. B
c. C
d. D
e. E

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

a. It accepts electrons from FADH2 to regenerate the FAD reduced during fatty acid oxidation.
b. It acts as a carrier of fatty acids across the inner mitochondrial membrane.
c. It acts as a direct source of malonyl groups for fatty acid synthesis
d. It is decarboxylated to provide a thermodynamic driving force for fatty acid synthesis.
e. It solvates the elongating hydrophobic chain produced during fatty acid synthesis.

Answers Midterm 2 2007

1. b)
2. d)
3. c)
4. a)
5. d)
6. d)
7. d)
8. a)
9. b)
10. b)
11. a)
12. d)
13. a)
14. b)
15. b)
16. c)
17. e)
18. d)
19. d)
20. b)
21. c)
22. d)
23. a)
24. c)
25. a)
26. e)
27. d)
28. b)
29. c)
30. a)
31. d)
32. a)
33. b)
34. c)
35. b)

1. The linkage between monomeric nucleotide units is a:

a) peptide linkage.
b) phosphodiester bond.
c) amide bond.
d) all of the above.
e) none of the above

2. The DNA helix is stabilized by:

a) hydrogen bonds between the bases; A:T and G:C base-pairing.
b) hydrophobic and van der Waals interactions between the stacked bases.
c) hydrogen bonding between the phosphodiester backbones.
d) a and b
e) a, b and c

3. Which of the following is not a feature of B-DNA?

a) The strands of DNA run in antiparallel fashion.
b) B-DNA has a major and a minor groove extending along the entire helix.
c) There are approximately 13 base pairs per turn.
d) The pitch of each base pair is 0.34 nm
e) The diameter is approximately 2 nm.

4. Proteins that change the topology of DNA include the _____, which play a role interconverting supercoiled and relaxed DNA.

a) topisomerases
b) polymerases
c) replicases
d) endonucleases
e) none of the above

5. In the laboratory, some *E.coli* cells have been grown with transcription inhibitors so that only replication could occur. You break open the cells, purify the DNA and then treat the intact DNA with radioactively labeled antibodies that bind to DNA ligase and DNA polymerase I, to indicate where these two enzymes are located. Where do you expect to see the highest concentration of these antibodies?

a) On the leading strand, in one direction from the point of origin.
b) On the leading strands, in both directions from the point of origin.
c) On the lagging strands, in one direction from the point of origin.
d) On the lagging strands, in both directions from the point of origin.
e) On all parts of the DNA molecule equally.

6. Single stranded DNA associates with _____, and these protect the strands and prevent the separated DNA strands from reannealling at the replication fork.

a) helicases
b) topoisomerases
c) gyrases
d) single-stranded binding proteins
e) none of the above

7. Which of the following contains a potential palindromic restriction enzyme cleavage site of at least 4 bases?

a) GCAATTGG
b) ACGTACGT
c) AAAATTT
d) all of the above
e) none of the above

8. Which amino acids are likely to be important in proteins that bind to DNA?

a) Lys. Arg
b) Glu, Asp
c) Gln, Asn
d) Gly, Val
e) Ser, Thr

9. If DNA synthesis initiates at the indicated origin of replication, which segments single-stranded DNA are templates for synthesis of Okazaki fragments?

a) A and C
b) B and D
c) A and D
d) B and C
e) A and B

10. RNA polymerase I transcribes the genes for

a) mRNA precursors
b) 18S, 5.8S and 28S rRNA
c) most tRNA
d) all of the above
e) none of the above

11. The chemical reaction(s) in RNA splicing include

a) two transesterifications
b) one transesterifications
c) one transesterification and an oxidation
d) all of the above
e) none of the above

12. Spontaneous mutations are usually caused by:

a) incorporation of the wrong bases during replication (mismatching).
b) base modification caused by chemical and hydrolytic reactions.
c) incorporation of ribose sugars instead of deoxyribose sugars into the backbone.
d) a and b
e) a, b and c

13. The general steps in DNA repair include:

a) endonuclease cleavage, exonuclease removal of the mononucleotide, polymerase filling of the gap and ligase action to close the gap.
b) deamination reversal of the damaged base, polymerase filling of the gap and telomerase action to seal the gap.
c) exonuclease removal of the mononucleotide, glycoside action to replace the mononucleotide.
d) cleavage across both strands in overlapping cuts, followed by polymerase and ligase action.
e) none of the above

14. Ionizing radiation can cause DNA damage by:

a) causing dimerization of guanine nucleotides.
b) forming hydroxy radicals that react with DNA, forming a reactive DNA radical.
c) deaminating uracil.
d) all of the above
e) none of the above

15. Which of the following statements about DNA ligase is incorrect?

a) It requires ATP to provide energy to form the phosphodiester bond.
b) It forms a phosphodiester bond between a 5'-hydroxyl and a 3'-phosphate in duplex DNA.
c) It is involved in DNA replication, repair and recombination.
d) all of the above.
e) none of the above.

16. Which of the following is true about a circular double-stranded DNA genome that is determined by chemical means to be 21 percent adenosine?

a) The genome is 10.5 % guanosine
b) The genome is 21 % guanosine
c) The genome is 29 % guanosine
d) The genome is 58 % guanosine
e) The base percent composition of guanosine in the genome cannot be determined from the information given.

17. An E.coli strain lacking DNA polymerase I would be deficient in DNA

a) transcription
b) methylation
c) degradation
d) splicing
e) repair

18. Aminoacyl-tRNA synthetases:

a) attach the amino acid to tRNA via an amide bond
b) attach the amino acid to tRNA via a phosphoanhydride bond.
c) join the amino acid to the 5'-end of tRNA
d) catalyze a two-step reaction in which the aminoacyl-adenylate intermediate is produced
e) use GTP hydrolysis to drive synthesis of aminoacyl-tRNA.

19. Regarding the following statement about eukaryotic mRNAs:

I. They are derived from larger RNA precursors.

II. They result from extensive processing of their primary transcripts before serving as translation components.

III. They usually have poly(A) tails at their 5'end.

IV. They have a cap at their 3' ends.

V. They are often encoded by noncontiguous segments of template DNA.

Choose the following if:

a) I and II are correct.
b) III and IV are correct.
c) III, IV and V are correct.
d) I, II, and V are correct.
e) if all are correct.

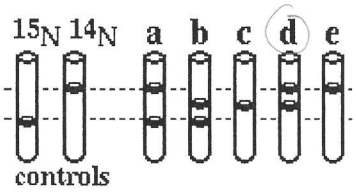
20. Which of the following best describes the TATA box?

a) It is a sequence in chromosomes that marks replication origins.
b) It is a sequence in the promoter region of genes that marks transcription start sites.
c) It is a sequence in primary transcripts that marks cleavage and polyadenylation sites.
d) It is a sequence in primary transcripts that marks splice sites.
e) It is a sequence in mRNAs that marks translation start sites

21. Which of the following best characterizes the function of enhancers in gene regulation?

a) They are DNA sequences that directly bind RNA polymerase and regulate transcriptional initiation.
b) They are DNA sequences that directly bind TFIID, and regulate transcriptional initiation.
c) They are DNA sequences that directly bind transcription factors and regulate transcriptional initiation.
d) They are DNA sequences that directly bind transcription factors and regulate transcriptional elongation.
e) They are mRNA sequences that directly bind initiation factors and regulate translational initiation.

22. The DNA in a bacterium is uniformly labeled by growth for several generations on a medium containing $^{15}NH_4Cl$ as the sole nitrogen source. DNA isolated from these cells bands with a higher density than DNA from cells grown on $^{14}NH_4Cl$ (see controls below). If the cells grown in $^{15}NH_4Cl$ are switched to $^{14}NH_4Cl$ -containing medium for two generations and the DNA is banded on a density gradient, what is the pattern of DNA bands expected by the mechanism responsible for DNA replication?



23. In a eukaryotic ribosome, the subunit particles are _____, and combine to make a particle of _____.

a) 60S and 40S, 80S
b) 23S and 5S, 60S
c) 23S and 50S, 70S
d) 18S and 23S, 80 S
e) none of the above

24. Increasing the concentration of which of the following would most effectively antagonize the inhibition of protein synthesis by puromycin?

a) ATP
b) GTP
c) aminoacyl-tRNAs
d) peptidyl-tRNAs
e) Initiation Factor (IF)

25. What are the primary steps for successful PCR amplification?

a) denaturation, hybridization, and DNA synthesis
b) denaturation, hybridization, and DNA digestion
c) renaturation, hybridization, and DNA synthesis
d) renaturation, hybridization, and DNA digestion
e) none of the above

26. Regarding the following statements about translation:

I. Amino acids are added to the carboxy terminus of the growing polypeptide chain.

II. Termination involves the binding of a terminator tRNA to a stop codon on the mRNA.

III. A specific initiator tRNA along with specific sequences of the mRNA ensures that translation begins at the correct codon.

IV. Amino acids are activated by attachment to tRNA molecules.

V. Peptide bonds form between an aminoacyl-tRNA and a peptidyl-tRNA positioned in the A and P sites, respectively, of the ribosome.

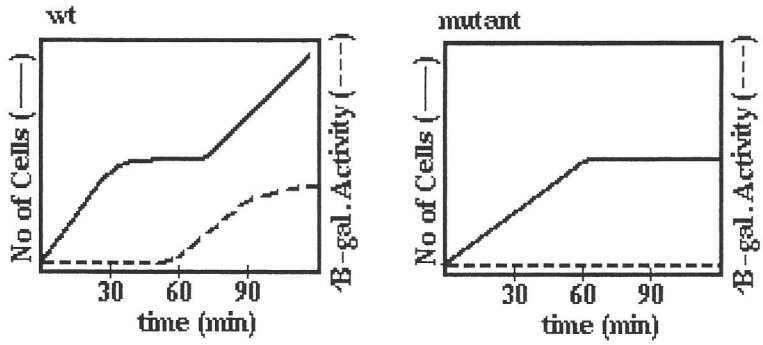
Choose the following if:

a) I, II, and III are correct.
b) III, IV, and V are correct.
c) III and V are correct.
d) II, III, IV, and V are correct.
e) I, III, IV, and V are correct.

27. Which of the following statements is (are) true about restriction endonucleases?

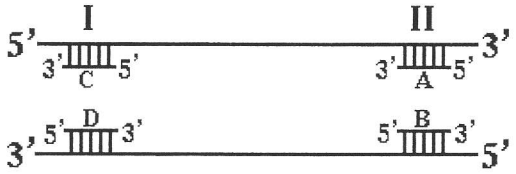
a) They typically recognize and cleave palindromic sequences.
b) Their natural function in bacteria is to cleave foreign DNA.
c) They reproducibly digest large pieces of DNA into discrete fragments.
d) all of the above
e) none of the above

28. *E. coli* cells are grown in medium containing both glucose and lactose. The cell density (——) and the levels of beta-galactosidase (- - - - -) are measured at the indicated times. The mutant strain most likely has a mutation in...



a) the CAP protein that allows it to bind DNA even without bound cAMP.
b) the lac repressor protein that eliminates lactose binding.
c) RNA polymerase that inactivates the enzyme.
d) sigma factor that prevents promoter recognition.
e) the lac operator site that prevents repressor binding

29. To amplify a DNA fragment between position I and II by the PCR method (polymerase chain reaction), which primer set should be used?



a) A and B.
b) B and C
c) A and D
d) B and D
e) A and C

30. Some eukaryotic cells have a specialized mismatch repair system that recognizes G-T mismatches and changes them to G-C (never to A-T) regardless of which nucleotide is in the parental strand. This system safeguards against:

a) methylated cytosines that deaminate to thymine
b) methylated guanines that deaminate to adenine
c) the inability of the generalized repair system to recognize G-T mismatches
d) mismatches that remain after it is too late to discriminate between the parental and daughter strand
e) formation of thymine dimers.

31. Which of these nucleotide sequences in the template strand of a gene encodes this tetrapeptide?

NH_2-Leu-Tyr-Pro-Gly-CO_2H

First letter of Codon (5' end)	Second Letter of Codon: U	C	A	G
U	UUU Phe UUC Phe UUA Leu UUG Leu	UUC Ser UCC Ser UCA Ser UCG Ser	UAU Tyr UAC Tyr UAA Stop UAG Stop	UGU Cys UGC Cys UGA Stop UGG Trp
C	CUU Leu CUC Leu CUA Leu CUG Leu	CCU Pro CCC Pro CCA Pro CUG Pro	CAU His CAC His CAA Gln CAG Gln	CGU Arg CGC Arg CGA Arg CGG Arg
A	AUU Ile AUC Ile AUA Ile AUG Met	ACU Thr ACC Thr ACA Thr ACG Thr	AAU Asn AAC Asn AAA Lys AAG Lys	AGU ser AGC ser AGA Arg AGG Arg
G	GUU Val GUC Val GUA Val GUG Val	GCU Ala GCC Ala GCA Ala GCG Ala	GAU Asp GAC Asp GAA Glu GAG Glu	GGU Gly GCG Gly GGA Gly GGG Gly

a) 5'- AGGTCCTATTTC -3'
b) 5'- CTTTATCCTGGA -3'
c) 5'- GAAATAGGACCT -3'
d) 5'- TCCAGGATAAAG -3'
e) 5'- TAGTAAATGTAG -3'

5' 3'
mRNA: CU_ UA_ CC_ GG_
3' GA_ AT_ GG_ CC 5'

32. Most of the DNA in the eukaryotic nucleus is packaged in nucleosomes with

a) histones
b) ribonuclear proteins
c) ribosomal proteins
d) topoisomerases
e) none of the above

33. Eukaryotic mRNAs differ from prokaryotic mRNAs in that:

I. eukaryotic mRNAs are capped whereas prokaryotic mRNAs are not capped.

II. a poly(A) tail is added to prokaryotic mRNAs but is not added to eukaryotic mRNAs.

III. prokaryotic mRNAs generally have shorter half-lives than eukaryotic mRNAs.

IV. introns occur more frequently in prokaryotic mRNAs than in eukaryotic mRNAs.

Select the correct combination of I, II, III and/or IV:

a) if I, II and III are correct
b) if I and III are correct
c) if II and IV are correct
d) if only I is correct
e) if all are correct

Questions 34 and 35: Retroviruses, like HIV which causes AIDS, have their genetic information in the form of RNA. Reverse transcriptase synthesizes a DNA copy of the viral genome. One drug used in treating AIDS is AZT, an analog of deoxythymidine, which has an azido group at the 3' position of the sugar. It can be phosphorylated and competes with dTTP for incorporation into the reverse transcript. Once incorporated, its presence terminates chain elongation.

34. The growing chain is terminated because:

a) the analog can not hydrogen bond with RNA
b) the presence of AZT inhibits the proofreading ability of the reverse transcriptase
c) AZT does not have a free 3'-OH
d) the analog causes distortion of the growing chain inhibiting reverse transcriptase.
e) dTTP can no longer be added to the growing chain

35. There is a window in which the effect is primarily on viral replication since AZT is much less effective at competing with dTTP for incorporation by cellular DNA polymerases because of the proofreading ability of the DNA polymerases. Proofreading activity to maintain the fidelity of DNA synthesis:

a) occurs after the synthesis has been completed
b) is a function of 3' to 5' exonuclease activity intrinsic to or associated with DNA polymerases
c) requires the presence of an enzyme separate from the DNA polymerases
d) occurs in prokaryotes but not eukaryotes
e) is independent of the polymerase activity in prokaryotes.