Cellular and Molecular Physiology

A. Multiple Choice

Key/ Page	No.	
e 25	1.	Which of the following is an organic molecule? a. naturally grown hemp b. oxygen c. phosphate d. sodium e. octane
a 26	2.	Which of the following is NOT a lipid? a. glycogen b. trigylceride c. phosphotidylserine d. cholesterol e. fatty acids
c 26	3.	Which of the following is a protein? a. creatine b. muscle c. insulin d. creatine phosphate
d 27	4.	Which of the following is the monomeric, building block of nucleic acids? a. ribose b. phosphate c. nitrogenous base (A, G, C, T, U) d. nucleotide e. amino acid
e 27	5.	Which of the following bases is unique to RNA? a. adenine b. cytosine c. guanine d. thymine e. uracil

d 6. Which of the following bases is unique to DNA?
27
a. adenine
b. cytosine
c. guanine
d. thymine
e. uracil

a 7. Which of the following pairs have NO Relationship?
28
a. ribosomes and membranous organelles
b. inclusions and excess nutrients
c. peroxisomes and detoxification
d. mitochondria and rod or oval shapes
e. vaults and octagonal barrels

d 8 The _____ is unique to eukaryotes.
27
a. plasma membrane
b. cytoplasm
c. ribosomes
d. nucleus
e. genetic material

b 9. Prokaryotes are different from eukaryotes in that the former lack
27
a. cell walls.
b. nuclei.
c. DNA.
d. membrane transport proteins.
e. none of these.

e 10. Protein function and activity can be modified by
27
a. allosteric regulators.
b. changes in electric fields.
c. phosphorylation.
d. physical deformation.
e. all of these.

c 11. The proteins with which DNA associates to form chromosomes are called
30
a. histamines.
b. histidines.
c. histones.
d. ribosomes.
e. nuclear lamins.

e 31 12. Which DNA sequence must be bound by proteins to form a basal transcription complex which recognizes the promoter code and then activates RNA polymerase to make pre-mRNA?

a. AAGG
b. TAGC
c. GCTA
d. GCGC
e. TATA

d 33 13. Which of the following has been shown to be associated with how long an animal might be expected to live (lifespan)?

a. the amount of RNAi in cells
b. the number of pseudogenes
c. the amount of junk DNA
d. the length telemeres
e. none of these has been found to have any effect on the lifespan of an organism.

d 31 14. Your muscle cells are able to express a different complement of proteins from your brain cells because

a. they contain different genes.
b. muscles and brains are the vestiges of different symbiotic organisms present in our ancestors.
c. you inherit the genes for your muscles from your father and the genes for your brain from your mother.
d. the expression of muscle-specific genes is regulated by transcription factors not present in brain cells and *vice versa*.

d 34 15. A researcher identified an uncharacterized mouse gene and the protein it encoded. The researcher prepared antibodies to the purified protein. To determine the specificity of the antibody the researcher incubated tissue sections from a knock-out mouse with the new antibody. If the antibody were specific for the protein under study, would you expect to see labeling in these tissue sections?

a. Yes, because antibody binding does not involve gene products.
b. Yes, because the protein is a mouse protein.
c. Yes, because the gene was knocked out, not the protein.
d. No, because the protein cannot be expressed if the gene is absent.
e. No, because proteins are too small to visualize under a light microscope.

e 35 16. Gene chips

a. are individual segments of DNA.
b. are arrays of genomic DNA adhered to a substrate.
c. bind cDNA.
d. are bound to microtiter plates prior to analysis.
e. Two answers are correct.

b 17. Ribosomes function in the process of
38
a. transcription.
b. translation.
c. transversion.
d. transformation.
e. transition.

e 18. Which of the following is NOT a component of the secretory pathway in cells?
38-41
a. rough endoplasmic reticulum
b. smooth endoplasmic reticulum
c. Golgi complex
d. granules
e. peroxisome

c 19. The presence of abundant smooth endoplasmic reticulum in vertebrate liver cells is
41 related to its function in
a. steroid hormone production.
b. enzyme secretion.
c. detoxification of harmful substances.
d. protein synthesis.
e. calcium storage.

a 20. The sarcoplasmic reticulum is another name for
41
a. the smooth endoplasmic reticulum of muscle cells.
b. the rough endoplasmic reticulum of muscle cells.
c. the secretory complex of muscle cells.
d. the endocytic pathway of muscle cells.
e. none of these.

e 21. Which of the following is NOT true of the Golgi complex?
41, 42
a. The Golgi complex consists of cisternae.
b. The majority of newly synthesized proteins leave the smooth ER and travel to the Golgi.
c. The vesicles leaving the Golgi have docking markers.
d. The nematocysts found in cnidarians originate in the Golgi.
e. All of these are true statements about the Golgi complex.

d 22. Which of the following statements is NOT true?
37
a. Cellular division is one example of cloning.
b. Cloning may involve nuclear transplantation.
c. In whole animal cloning the cells need to revert to the pluripotent state
d. All of these are true.
e. None of these are true.

c
45, 46

23. The genetically programmed process of cell death that occurs normally during development and aging is called
    a. proteoloysis.
    b. pneumatosis.
    c. apoptosis.
    d. ptosis.
    e. necrosis.

e
56

24. Which of the following is a product of anaerobic metabolism?
    a. ethanol
    b. tauropine
    c. alanine
    d. alanopine
    e. all of these

c
464

25. Catalase is an enzyme used to
    a. break beef down into its component amino acids.
    b. break prions down into their component amino acids.
    c. break hydrogen peroxide down to form water and oxygen.
    d. break carbonic acid down to form water and carbon dioxide.
    e. break down a variety of metabolites.

a
46

26. The major product generated in the peroxisome is
    a. hydrogen peroxide.
    b. ethanol.
    c. perchloric acid.
    d. amino acids.

a
47

27. Which of the following tissues has the highest mitochondrial density (is the most oxygen-dependent)?
    a. nervous tissue
    b. muscle tissue
    c. blood tissue
    d. respiratory epithelial tissue
    e. Mitochondrial density is consistent between tissues.

d
57, 59

28. Which of the following do NOT have a relationship?
    a. microtubules and largest cytoskeletal elements
    b. molecular motors and intracellular transport
    c. anoxic animals and hydrogenosomes
    d. *Clostridium* and protozoa
    e. all pairs have a relationship

d 47 29. In animal cells, the electron transport chain used in energy conversion is located in the
a. plasma membrane.
b. cytoplasm.
c. outer mitochondrial membrane.
d. inner mitochondrial membrane.
e. mitochondrial matrix.

a 47 30. The physiological significance of mitochondrial cristae is they
a. provide more surface area across which electrons can be transported.
b. provide a histological cue to enable organelle identification.
c. decrease the volume of the matrix, thereby increasing the concentration of its components.
d. decrease the volume of the matrix, allowing cells to economize on the production of its components.
e. None of these.

b 48 31 The process of glycolysis occurs in the
a. plasma membrane.
b. cytoplasm.
c. outer mitochondrial membrane.
d. inner mitochondrial membrane.
e. mitochondrial matrix.

d 48 32. Which of the following is a potential substrate a cell can use to produce ATP?
a. its own intracellular nutrient stores
b. nutrients stored in other, specialized storage cells
c. recently ingested (and digested) food
d. all of these
e. none of these

c 26, 48 33. Which of the following statements about glycogen is NOT true?
a. Glycogen is stored in glia.
b. Glycogen is an energy source in short term as opposed to long term periods of strenuous activity.
c. Glycogen is a major energy source for migrating salmon.
d. Glycogen is stored in the fat-body of insects.
e. Aerobic metabolism of glycogen can yield at least 30 molecules of ATP.

b 49 34. The end-product of glycolysis is
a. glucose.
b. pyruvic acid.
c. lactic acid.
d. ethanol.
e. carbon dioxide.

e 35. The citric acid cycle occurs in the
49
a. plasma membrane.
b. cytoplasm.
c. outer mitochondrial membrane.
d. inner mitochondrial membrane.
e. mitochondrial matrix.

c 36 Most of the ATP generated as a consequence of oxidative breakdown of glucose comes
51, 53 from
a. substrate-level phosphorylation associated with glycolysis.
b. substrate-level phosphorylation associated with the citric acid cycle.
c. oxidative phosphorylation associated with the electron transport chain.
d. none of the above

e 37 Which statement about oxygen is true?
(b, d) a. Oxygen is required for the synthesis of ATP..
51 b. Oxygen becomes negatively charged during ATP synthesis in the mitochondria.
c. Oxygen is bound to water forming peroxide during the final step of ATP synthesis in the mitochondria.
d. In the electron transport chain, oxygen receives an electron initially released from NADH.
e. Two of these statements are true.

d 38. The electron transport chain is involved in
51-53 a. the oxidation of cofactors (NADH and $FADH_2$) reduced during oxidation of citric acid cycle intermediates.
b. the transport of hydrogen ions from the mitochondrial matrix to the intermembrane space.
c. generating water.
d. all of these
e. none of these

b 39. During ATP synthesis by oxidative phosphorylation,
F 2-20 a. hydrogen ions pass from the mitochondrial matrix to the intermembrane space, activating ATP synthase.
b. hydrogen ions pass from the intermembrane space to the mitochondrial matrix, activating ATP synthase.
c. water passes from the mitochondrial matrix to the intermembrane space, activating ATP synthase.
d. water passes from the intermembrane space to the mitochondrial matrix, activating ATP synthase.

d 53 40 Which of the following IS NOT an enzyme involved in scavenging reactive oxygen species?

a. superoxide dismutase.
b. catalase.
c. glutathione peroxidase.
d. ascorbate.

B. True or False

True 54 1. Concentrations of ATP remain fairly constant in any particular tissue.

False 55 2. Lactate accumulation in tissues causes the pH to rise.

True 57 3. Facultative anaerobes utilize a molecule other than oxygen as the final electron acceptor in ATP synthesis.

True 57 4. Cells contain organelles called vaults which are thought to transport molecules synthesized in the nucleus such as mRNAs.

False 60 5. Microtubules are the dominant structural component of cilia whereas microfilaments are the dominant structure in flagella.

True 65 6. Many cells making up tissues are held together primarily by factors in the extracellular matrix rather than by contacts made with neighboring cells.

True 28 7. The intermediate filaments found in the cytoplasm of cells help to resist mechanical stress.

False 33 8. RNAi inhibits protein synthesis by binding to tRNA and blocking translation.

False 40 9. Lysosomes arise from the endoplasmic reticulum.

False 46 10. Ubiquitin-tagged proteins are destined for lysosomal degradation.

C. Matching (correct answers are aligned with each number; e.g., #1 matches with letter a)

1.	Simple sugar	a.	Monosaccharide
2.	Glycogen	b.	Polysaccharide
3.	Ribosome	c.	Protein synthesis
4.	Rough endoplasmic reticulum	d.	Glycosylation
5.	Smooth endoplasmic reticulum	e.	Protein packaging
6.	Golgi	f.	Protein sorting
7.	Alternative splicing	g.	RNA-protein complex
8.	Proteosome	h.	Protein degradation
9.	Apoptosis	i.	Programmed cell death
10.	Mitochondria	j.	Endosymbiotic

D. Essay

Page	No.	
35	1.	Describe the experimental details outlining how you would use microarray technology to determine which gene is responsible for draught resistance in a species of tree such as the white oak?
33	2.	What is the difference between genomics and proteomics? Would you expect the genome for a cell to be larger or smaller than its proteome? Explain.
34, 35	3.	With respect to knock-out technology, it has been said "If a protein's function is important, its knock-out will result in lethality. On the other hand, if it's very important its function will be duplicated by another protein, and there will be no obvious phenotype for the knock-out." Please explain this statement in your own words.
34, 35	4.	How would you use knock-out and knock-in methodology to show that two genes have an added effect on a cellular process as opposed to the process being regulated by only one of them individually?
46-53	5.	Would you expect the number of peroxisomes to be positively or negatively correlated with the number of mitochondria? Justify your answer in terms of the function of each or in the context of overall cellular functions.