CELL BIOLOGY (60 points)

MATCHING (10 points)

1. _____Phospholipase C
2. _____Sphingosine
3. _____*Ras*
4. _____Retinal
5. _____Protein Kinase C
6. _____Nitric oxide
7. _____Separase
8. _____Spectrin
9. _____Ephrins
10. _____Ras-related Nuclear Protein

a) Act through receptor tyrosine kinases
b) Amino alcohol
c) Functions in anaphase
d) Maintains erythrocyte shape
e) Purple color
f) Proto-oncogene
g) Small essential G protein
h) Produces diacylglycerol
i) Activated by diacylglycerol
j) Stimulates guanylyl cyclase

MUTLIPLE CHOICE (20 points)

1. _____ Which of the following structures of a cell would be disrupted by the addition of colchicines?

   A) Phragmoplast
   B) Preprophase band
   C) Mitotic spindle
   D) All of the above

2. _____What is the large family of dimeric proteins that facilitate the elongating of actin filaments?

   A) Profilin
   B) Thymosin

C) Formin
D) Stathmin

3. _____Which vitamin has the role of transferring CO_2 from one molecule to another (decarboxylation)?

A) Biotin
B) Pyridoxine
C) Cobalamin
D) Thiamine

4. _____What group of proteins are upregulated by higher temperatures that maintain the conformation of other proteins?

A) Chaperonin
B) Thermosome
C) Heat shock protein
D) Thermostatic barrels

5. _____What is the indicator that loses its color in the presence of vitamin C?

A) DCPIP
B) Indophenol
C) Methylene blue
D) Wurster's blue

6. _____In the rubber industry, what enzyme is used to generate oxygen from peroxide?

   A) Catalase
   B) Peroxase
   C) Ficin
   D) Trypsin

7. _____What are the name of alleles that are inherited together in clusters without major genetic rearrangement?

   A) Polynucleotide polymorphisms
   B) Haplotype blocks
   C) Tandem genes
   D) Allele map

8. _____Other than through direct signal transduction with the apoptotic proteins like caspase 8, through what organelle can apoptosis function?

   A) Nucleus
   B) Endoplasmic Reticulum
   C) Lysosome
   D) Mitochondria

9. _____What shape is the head of the bacteriophage T_4?

A) Helical
B) Icosahedral
C) Prolate
D) Complex

10. _____During senescence in plants, what plastid dismantles the photosynthetic apparatus?

A) Amyloplast
B) Gerontoplast
C) Chromoplast
D) Etioplast

11. _____What functional group is found in ATP?

A) Phosphoester
B) Phosphoanhydride
C) Phosphoenol
D) Phosphocarboxylate

12. _____What type of fermentation does not produce any gas?

A) Homolactic fermentation
B) Heterolactic fermentation
C) Ethanol fermentation
D) Propanol fermentation

13. _____What happens during fluorescence recovery after photobleaching?

A) Activating an inactive fluorophore with intense light
B) Fluorescence is introduced in a small portion of a sample
C) Analysis is done on how the fluorescence spreads from a small portion over the whole sample
D) Light extinguishes the fluorescence in a certain area

14. _____What is the proper order of the five sequential stages of Prophase I?

A) Zygotene, leptotene, pachytene, diakinesis, diplotene
B) Diplotene, pachytene, zygotene, leptotene, diakinesis
C) Leptotene, zygotene, pachytene, diplotene, diakinesis
D) Diakinesis, pachytene, zygotene, diakinesis, leptotene

15. _____Which of the following statements is NOT a way in which protease action is controlled?

A) There is negative feedback being exerted by protease products
B) The cell secretes its own inhibitors
C) Proteases are abundant but in an inactive form
D) Proteases must be bound to specific receptors to be active

16. _____Which of the following best explains why isoelectric focusing is performed first and then SDS-PAGE in a 2D electrophoresis?

A) Isoelectric focusing requires neutral pH and SDS-PAGE requires acidic pH
B) SDS denatures proteins and establishes an uniform negative charge
C) Isoelectric focusing requires a very fine gel that will be disrupted if SDS-PAGE is performed first
D) SDS-PAGE causes the formation of strong disulfide bonds in order to analyze protein mass

17. _____Which of the following statements is true about histones?

A) They are highly alkalinic
B) There are six major classes of histones
C) A typical nucleosome has four turns of DNA around it
D) They are present in high amounts in euchromatin

18. _____ Which two of the following metabolic pathways produces NADPH?

A) Light-dependent reactions
B) Glyoxylate cycle
C) Pentose phosphate pathway
D) Cori cycle

19. _____ Which of the following statements best explains why diabetes leads to life-threatening acidosis?

    A) Glucose is converted into hydrophobic acids that can be taken up by cells
    B) Glucose sparing leads to the production of ketone bodies
    C) The cotransport of glucose into cells results in the pumping of high amounts of protons out of the cells
    D) Glucose retention in the blood leads to a buildup of acidic metabolites

20. _____ Which two of the following molecules can phosphodiesterase act on?

    A) Phospholipids
    B) Deoxyribonucleic acids
    C) Cyclic AMP
    D) Glyceraldehyde 3 phosphate

SHORT ANSWER (30 points)

1. Describe three differences between plant and animal mitosis. (3 points)

2. What stable structure is found in proteins when two or three alpha helices wrap and twist around each other? What requirement must the helices have to be able to create this structure? (3 points)

3. What are the name of plasma membrane microdomains that contain combinations of glycosphingolipids and protein receptors that organize molecule assembly and trafficking? What are special types of these microdomains called that are small invaginations of the plasma membrane that facilitate endocytosis? (4 points)

4. What common functional group is responsible for the joining of the acetate and Coenzyme A in acetyl CoA? (2 points)

5. What is the function of an enzyme that ends with “isomerase”? In glycolysis, what two enzyme-catalyzed reactions are caused by isomerases? (Name either the enzyme or the reactant/product of the reaction) (4 points)

6. Draw a general graph to express the relationship between temperature and enzyme rate, where the X axis is increasing temperature and the Y axis is the rate of the reaction. (3 points)

7. During photosynthesis, however, the carbon fixation rate drops at a temperature cooler than that which would denature the enzymes. Explain what causes this and how C4 plants solve this issue. (4 points)

8. To what major macromolecule class do lectins bind? Calnexin is a lectin chaperone that is associated with what organelle? (3 points)

9. In a Lineweaver-Burk plot, what are measured by the x-axis and y-axis? What type of inhibition is seen if the y-intercept is changed, but the x-axis stays the same? (4 points)

CELL BIOLOGY (60 points)

MATCHING (10 points)

1. __H__Phospholipase C	a) Act through receptor tyrosine kinases
2. __B__Sphingosine	b) Amino alcohol
3. __F__*Ras*	c) Functions in anaphase
4. __E__Retinal	d) Maintains erythrocyte shape
5. __I__Protein Kinase C	e) Purple color
6. __J__Nitric oxide	f) Proto-oncogene
7. __C__Separase	g) Small essential G protein
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9. __A__Ephrins	i) Activated by diacylglycerol
10. __G__Ras-related Nuclear Protein	j) Stimulates guanylyl cyclase

MUTLIPLE CHOICE (20 points)

1. __D__ Which of the following structures of a cell would be disrupted by the addition of colchicines?

   A) Phragmoplast
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2. __C__What is the large family of dimeric proteins that facilitate the elongating of actin filaments?

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3. __A__ Which vitamin has the role of transferring CO_2 from one molecule to another (decarboxylation)?

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5. __A__ What is the indicator that loses its color in the presence of vitamin C?

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6. __A__In the rubber industry, what enzyme is used to generate oxygen from peroxide?

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7. __B__What are the name of alleles that are inherited together in clusters without major genetic rearrangement?

   A) Polynucleotide polymorphisms
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8. __D__Other than through direct signal transduction with the apoptotic proteins like caspase 8, through what organelle can apoptosis function?

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9. __C__What shape is the head of the bacteriophage T_4?

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10. __B__During senescence in plants, what plastid dismantles the photosynthetic apparatus?

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11. __B__What functional group is found in ATP?

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C) Leptotene, zygotene, pachytene, diplotene, diakinesis
D) Diakinesis, pachytene, zygotene, diakinesis, leptotene

15. __A__Which of the following statements is NOT a way in which protease action is controlled?

A) There is negative feedback being exerted by protease products
B) The cell secretes its own inhibitors
C) Proteases are abundant but in an inactive form
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16. __B__ Which of the following best explains why isoelectric focusing is performed first and then SDS-PAGE in a 2D electrophoresis?

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17. __A__ Which of the following statements is true about histones?

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18. _AC__ Which two of the following metabolic pathways produces NADPH?

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19. __B__ Which of the following statements best explains why diabetes leads to life-threatening acidosis?

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    C) The cotransport of glucose into cells results in the pumping of high amounts of protons out of the cells
    D) Glucose retention in the blood leads to a buildup of acidic metabolites

20. _BC__ Which two of the following molecules can phosphodiesterase act on?

    A) Phospholipids
    B) Deoxyribonucleic acids
    C) Cyclic AMP
    D) Glyceraldehyde 3 phosphate

SHORT ANSWER (30 points)

1. Describe three differences between plant and animal mitosis. (3 points)

   Centriole vs no centriole (1 points)
   Pre-prophase band vs no pre-prophase band (1 points)
   Phragmoplast vs actin ring (1 points)
   Asters vs no asters (1 points)

2. What stable structure is found in proteins when two or three alpha helices wrap and twist around each other? What requirement must the helices have to be able to create this structure? (3 points)

   Coiled-coil (1 point, tiebreaker question)
   Each helix must have a hydrophobic groove (2 points)

3. What are the name of plasma membrane microdomains that contain combinations of glycosphingolipids and protein receptors that organize molecule assembly and trafficking? What are special types of these microdomains called that are small invaginations of the plasma membrane that facilitate endocytosis? (4 points)

   Lipid raft (2 points)
   Caveolae (2 points)

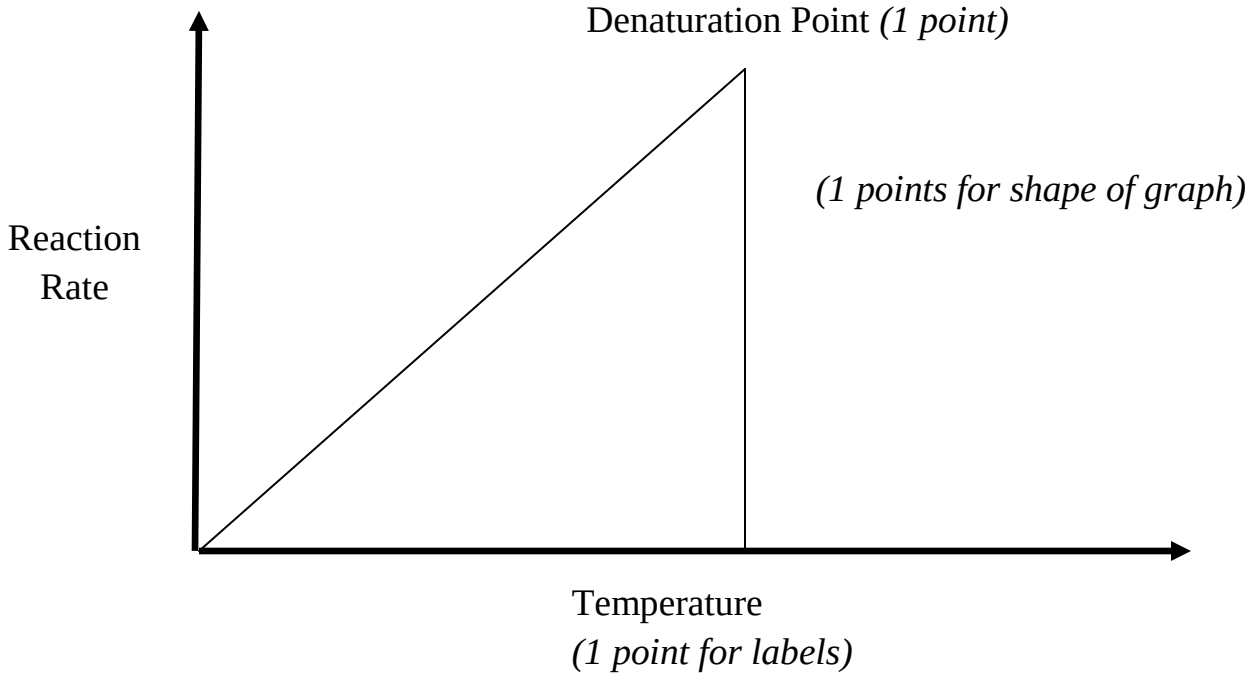
4. What common functional group is responsible for the joining of the acetate and Coenzyme A in acetyl CoA? (2 points)

   Thioester (2 points)

5. What is the function of an enzyme that ends with "isomerase"? In glycolysis, what two enzyme-catalyzed reactions are caused by isomerases? (Name either the enzyme or the reactant/product of the reaction) (4 points)

   Converts from ketone to aldehyde or vice versa (2 points)
   Phosphoglucose isomerase / glucose 6 phosphate / fructose 6 phosphate (1 point)
   Triose-phosphate isomerase / DHAP / G3P (1 point)

6. Draw a general graph to express the relationship between temperature and enzyme rate, where the X axis is increasing temperature and the Y axis is the rate of the reaction. (3 points)



7. During photosynthesis, however, the carbon fixation rate drops at a temperature cooler than that which would denature the enzymes. Explain what causes this and how C4 plants solve this issue. (4 points)

   Photorespiration/As temperature increases more oxygen is fixed (2 points)
   Transporting CO_2 to bundle sheathe cells to reduce presence of oxygen (2 points)

8. To what major macromolecule class do lectins bind? Calnexin is a lectin chaperone that is associated with what organelle? (3 points)

   Carbohydrates (2 points)
   Endoplasmic reticulum (1 point, tiebreaker question)

9. In a Lineweaver-Burk plot, what are measured by the x-axis and y-axis? What type of inhibition is seen if the y-intercept is changed, but the x-axis stays the same? (4 points)

   X-axis: 1/[S]; Y-axis: 1/v (1 point each, tiebreaker question)
   Non-competitive inhibition (2 points)