Science Olympiad
Bio-Process Lab Test
Lexington Invitational Tournament

Team Name: _____

Team Number: _____

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Directions:

- This test was made to be long and difficult. Make sure you have a calculator, as it will be needed for some questions.

- The test will be split into sections concerning various important topics in biology.

- You are only allowed what the rules manual permits for this event regarding notes and resources

- Good luck on the test!

For grading use only

Page:	2	3	4	5	6	7	8	9	10	11
Points:	$10\frac{1}{2}$	7	$7\frac{1}{2}$	$3\frac{1}{2}$	$5\frac{1}{2}$	12	6	6	$3\frac{1}{2}$	8
Score:										
Page:	13	14	15	16	17	18	19	20	21	22
Points:	2	11	2	9	2	12	15	7	9	10
Score:										
Page:	23	24	25	26	27	28	29	30		Total
Points:	6	4	12	$10\frac{1}{2}$	9	10	5	12		217
Score:										

Section A: Cell Biology/Biochemistry

1. (1 point) What is the powerhouse of the cell?

    A. Mitochondria

    B. Endoplasmic Reticulum

    C. Nucleus

    D. Lysosome

2. (1 point) What are the two subunits of a ribosome known as?

    _____

3. (1 point) Select all of the following that are functions of the Smooth ER: (select all that apply)

    A. Detoxification

    B. Synthesis of lipids

    C. Storage of divalent ions(Ca^{2+})

    D. Removing hydroxyl groups from poisons

4. (1½ points) In order for a peroxisome to function, it must create Hydrogen Peroxide, however, this Hydrogen peroxide is harmful for the cell. How does the cell circumvent this?

5. (1 point) What is cytoplasmic streaming, and what cytoskeletal elements are utilized?

6. (1 point) What is the pKa of an acid if the Ka(dissociation constant) is .001?

    _____

7. (3 points) What is the H+ concentration of a solution with a pH of a) 3.4 b) 6.2 c) 4.5?

    (a) _____

    (b) _____

    (c) _____

8. (1 point) What is the name of a molecule that contains regions that are polar(or charged) and regions that are nonpolar?

    A. Pluripathic

    B. Omnipathic

    C. Amphipathic

    D. Omnivalent

9. (1 point) What is the name of the effect that clusters nonpolar amino acid residues to the interior of a protein, and polar charged amino acids to the outside of the protein?

     A. Hydrophilic effect

     B. Hydrophobic effect

     C. Omnipathic effect

     D. Amino cluster effect

For the following 2 questions, use the equation provided:

$$pH = pK_a + \log \frac{[conjugate\ base]}{[weak\ acid]}$$

This is the Henderson Hasselbalch equation, and it is useful for analyzing the titration curves of weak acids in addition to analyzing the properties of buffers. Today we will look at one such example with NaH_2PO_4, and Na_2HPO_4, in solution.

10. (1 point) Knowing that an acid donates protons, and a base accepts protons, match each molecule (from the instructions) to either conjugate acid, or conjugate base.

11. (3 points) In this hypothetical solution, the concentration of NaH_2PO_4 is .039 M, and the concentration of Na_2HPO_4 is .06M. What is the pH of this mixture? The pKa will be 6.86. You don't have to show work, but explaining your method may give you partial credit.

12. (1 point) Proteins are polymers of what biomolecule?

13. (1 point) What type of bonds connect these monomers?

14. (2 points) What is the characteristic pH at which the net electric charge is zero?

    A. Net neutral pH

    B. Fixated point

    C. pKa

    D. Isoelectric point

Use the following information for the next 2 questions:

Now lets talk about some experimental techniques used to isolate proteins. The first one is column chromatography. It takes advantage of differences in protein charge, size, binding affinity, and other properties. A porous solid material with appropriate chemical properties is held in a column and a buffered solution migrates through the said column. Proteins are held on top of the column and with the addition of the buffer, move down the column according to its properties. In one type of column chromatography, Ion exchange chromatography, proteins are separated based on their ionic charges. The specific example we will look at is cation exchange chromatography. In this, there are anions bound to the gel that attract/bind cations. Answer the following questions below:

15. (1 point) Which aspect of the chromatography (the column or the solution) is the stationary phase? Which one is the mobile phase?

16. (2 points) Would a protein with a high amount of lysine residues (positive side chain) or aspartic acid residues (negative side chain) travel less in the gel? Support your answer.

17. ($2\frac{1}{2}$ points) **Knowing that the faster a protein travels, the more quickly it is eluted (washed off the gel), answer the following question.**
A biochemist wants to separate two peptides by anion-exchange chromatography. At the pH of the mobile phase to be used on the column, peptide Deez has a net charge of -2.46, and peptide Nux has a net charge of +2.3. Which peptide would elute first and why?

18. (1 point) What is the difference between a multimer and an oligomer?

19. (1 point) **Photosynthesis is one mechanism by which autotrophs can generate their own food. Answer the following questions below about this necessary process:**
    What are the two stages of photosynthesis?

Use the following information for the next question.

If you haven't figured it out by now, light is an important energy provider for photosynthesis. Well how can a plant pick up this light? I don't see any solar panels on the plant! Well, plants have their own unique pigments that absorb the photons from light and this absorption causes a biochemical cascade. Different pigments absorb light of different wavelengths, and those that are absorbed disappear. If a pigment were to be shined under white light, the color we see is the color most reflected or transmitted by the pigment. A spectrophotometer directs beams of light of different wavelengths through a solution of the pigment and measures the fraction of the light transmitted at each wavelength. A graph plotting a pigment's light absorption versus wavelength is called an absorption spectrum. The following diagram shows the absorption spectrum of certain pigment - chlorophyll a.
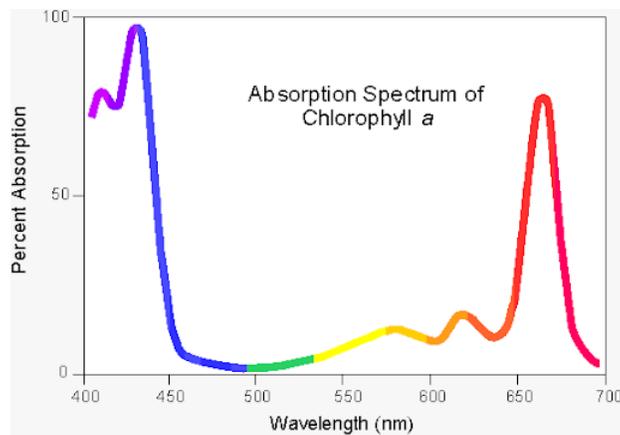
20. (1½ points) Using the background information given, give an approximate wavelength of light that chlorophyll a best transmits.

Use the following information for the next 4 questions.

There is another chart that is needed to study photosynthesis, the action spectrum. This compares the relative wavelengths of light with the overall activity of photosynthesis. To create this chart, Theodore Engelmann used a clever strategy. He had a colony of filamentous algae that would release O2 during photosynthesis. He tested the algae in different wavelengths of light, and measured the O2 release levels through the amount of congregation of specific aerobic bacteria.
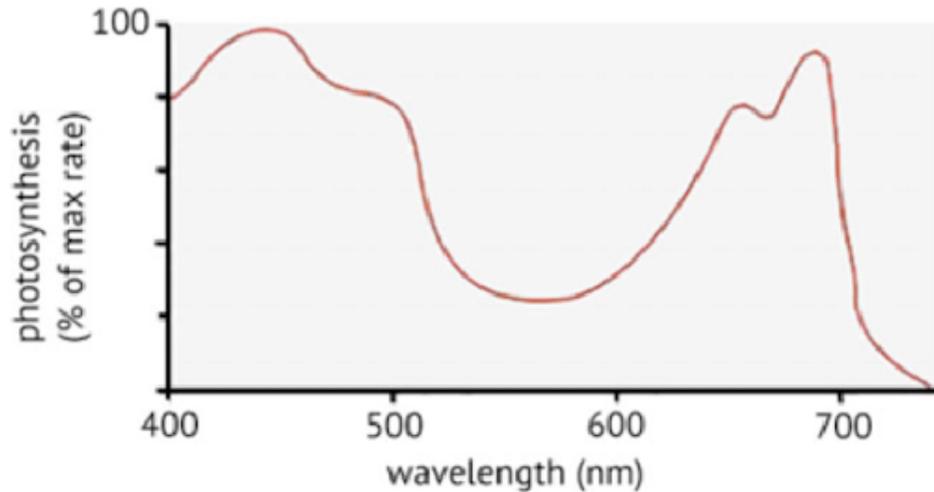
21. (1½ points) Hey! This doesn't look like the absorption spectrum for chlorophyll a. What could explain this?

22. (1½ points) Explain how aerobic bacteria could contribute to this experiment?

23. (1½ points) At what wavelength(s) of light did Engelmann find the most amount of bacteria?

24. (1 point) What was the photosynthesis rate (% of max rate) when the algae were shined under 700 nm wavelength light.

25. (5 points) Describe the difference between noncyclic and cyclic electron flow. Which process produces NADPH?

26. (1 point) The second stage of photosynthesis is most similar to what part of cellular respiration backwards?

      A. Energy Payoff Phase of Glycolysis

      B. Energy Investment Phase of Glycolysis

      C. Citric Acid Cycle

      D. Oxidative phosphorylation

Different types of plants use different methods of photosynthesis, depending mostly on the scarcity of water. One method used by plants to conserve water is crassulacean acid metabolism (CAM) photosynthesis. In CAM photosynthesis, stomata are opened during the night and carbon dioxide is fixed into organic acids inside the plant during the night. This allows the plant to keep its stomata close during the day, conserving water in arid environments.

27. (1 point) Using the information above, what type of plants might use CAM photosynthesis?

28. (2 points) What molecule is produced by the fixation of carbon dioxide during the night? What is the name of the enzyme that catalyzes this reaction?

    (a) _____

    (b) _____

29. (3 points) RuBisCO, the first enzyme in the second part of photosynthesis, can bind to both oxygen and carbon dioxide. What is the name of the process of oxygen binding to RuBisCO? Is this process beneficial or detrimental? Why?

30. (1 point) What phase of cellular respiration is included in both aerobic and anaerobic respiration.

31. (1 point) The immediate energy source that drives ATP synthesis by ATP synthase during oxidative phosphorylation is what?

32. (2 points) What are the two types of fermentation?

33. (1 point) In each of the two types of fermentation mentioned above, what biomolecule do they primarily regenerate?

Use the following information for the next 4 questions

Fluorescence recovery after photobleaching (FRAP) is a method for determining the kinetics of diffusion through tissue or cells. It is capable of quantifying the two dimensional lateral diffusion of a molecularly thin film containing fluorescently labeled probes, or to examine single cells. In the specific experiment below, you want to investigate lipid mobility in the plasma membrane of a rat liver cell. You first isolate a $5\mu m^2$ membrane fraction, and fluorescently label the phospholipids with Nile Red, a dye that shows up red in fluorescence imaging. You then photobleach a portion of the membrane fraction and you record the time it takes for the photobleached portion to fluoresce.

34. (1 point) What part of the phospholipid would be conjugated with Nile Red

      A. Head

      B. Tail

      C. Arms

      D. Legs

The results of your study are below. Answer the following 3 questions below using the data.
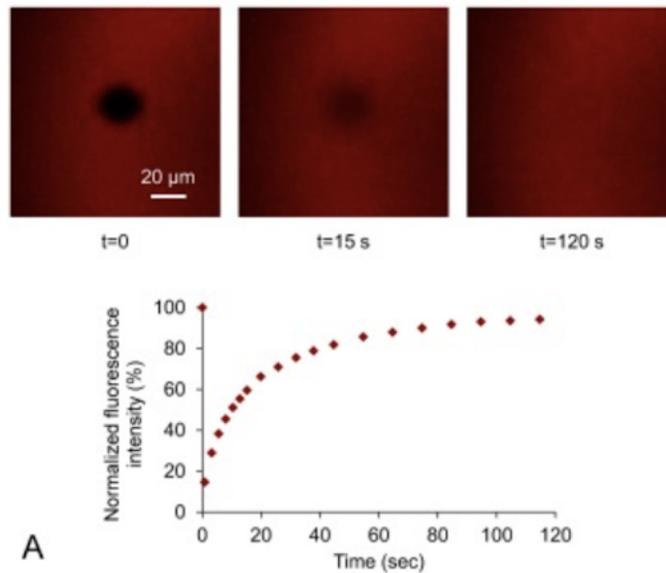
35. (1 point) Approximately 40 seconds after photobleaching, what was the approximate fluorescence intensity in the membrane fraction?

36. (2 points) What type of graph is shown in the figure? What can you infer from its shape?

37. (3 points) The above experiment tests the time it takes for diffusion of lipids in a photobleached area. Would you expect this diffusion to be lateral (i.e. in the lipid bilayer, lipids move only within their "row"/monolayer), or would it be vertical (where lipids in the cytoplasmic monolayer translocate to the outer monolayer), and why?

Don't FRET over these questions

Use the following information to answer the next 4 questions:

Fluorescence resonance energy transfer (FRET) microscopy is a process by which energy is transferred from one fluorophore (a molecule that releases light when hit with light) to a second fluorophore in a nonradiative manner (without releasing a photon of light), rather than being emitted as a photon of light from the donor. This only works when the wavelength of the light one fluorophore releases (the emission) is included in the exciting wavelengths (the wavelengths that cause fluorescence) of the other. This means that when one absorbs light, if close enough, the other will also release light, creating a unique light that can be seen on the microscope. This phenomenon is strongly dependent on the distance between the two fluorophores, occurs most efficiently when they are within 10 nm of each other, and decreases exponentially with increasing distance. Consequently, FRET is usually used to determine interactions between proteins. GPR143 is a gene that is involved in the production of pigment storing bodies called melanosomes and is component of pigmentation in the skin and eyes.
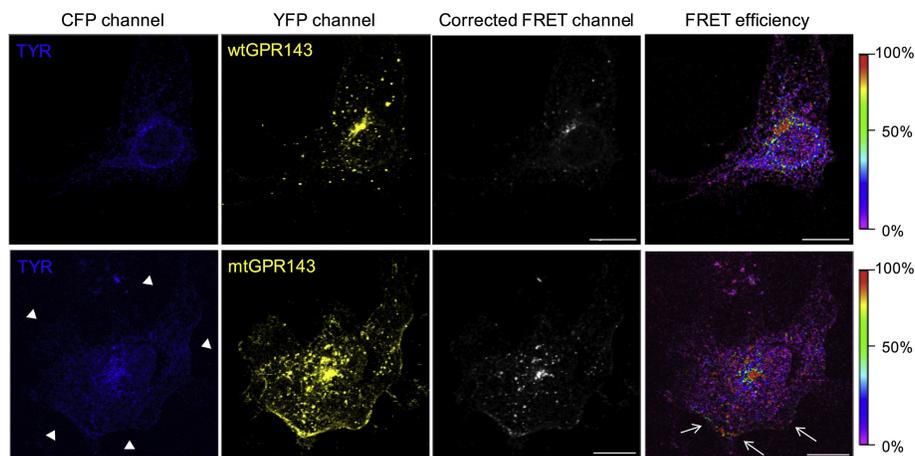

In the following image, FRET is used to observe where in a COS7 cell G-protein–coupled receptor 143 (GPR143) tagged with YFP (Yellow fluorescent protein, the acceptor) is interacting with the melanogenic enzyme tyrosinase (TYR) tagged with CFP (Cyan fluorescent protein, the donor). A wild type (wt) cell is shown in the top row and a mutant (mt) cell is shown in the bottom row. The white arrowheads show the location of the plasma membrane. Scale bar = 20 μm

38. (1 point) Using the scale bar, estimate the size of the cell in the image (in μm)

39. (2½ points) In your own words, briefly explain how G-proteins are activated and how they generate a cellular response.

40. (3 points) In the corrected FRET channel images, what do the white dots represent?
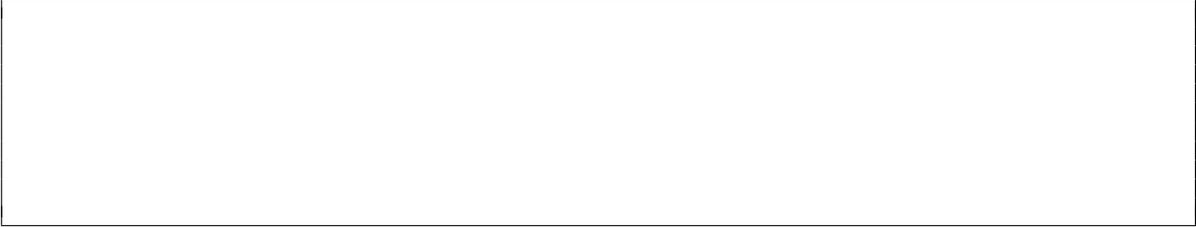
41. (5 points) Using the data provided, provide a guess for how the mutation affects the mutant cells. What might be the effect of this?

Sort this Microarray in O(n log n) time

Use the following information for the next 3 questions.

DNA microarrays consist of tiny amounts of a large number of single stranded DNA strands representing different genes fixed to a glass slide in a tightly spaced matrix of dots. mRNA from cells are converted to complementary DNAs which act as fluorescent probes. DNA microarrays are often used as a tool in the molecular profiling of tumors. The goal is to identify genes whose patterns of expression correlate with each other. In the study, researchers compare cancer cells with normal cells and identify groups of genes that are turned on in the cancer cells and off in the normal cells, and other groups of genes that are turned off in the cancer cells and on in the normaal cells. Furthermore, they can compare the different types of tumors and find out the genes that show differential expression patterns. As a budding oncologists, you wish to study the gene expression pattern of a type of cancer known as diffuse large B-cell lymphoma(DLBCL). The two types of DLBCL are germinal type and activated type. Germinal type cancer cells show similar expression levels for certain genes compared to wild-type germinal cells, and activated type cancer cells show similar expression levels for specific genes compared to wild type activated cells. Your results are below. Unfortunately, your sussy amongus colleague tried to sabotage you, and erased the labels delineating which side of the microarray was for germinal and activated cancer cells. Luckily, you have a chart matching expression levels in normal cell lines of these types.

	Germinal^{WT}	Activated^{WT}
CD21	+	-
Protocadherin-43	+	-
OGG1	+	-
Cyclin D2	-	+
FLIP	-	+
LYSP100	-	+

Table 1: *"+" denotes high levels of expression, "-" indicates low levels of expression. The genes showed in the table are indicated with blue dots on the right hand side of the following figure.*
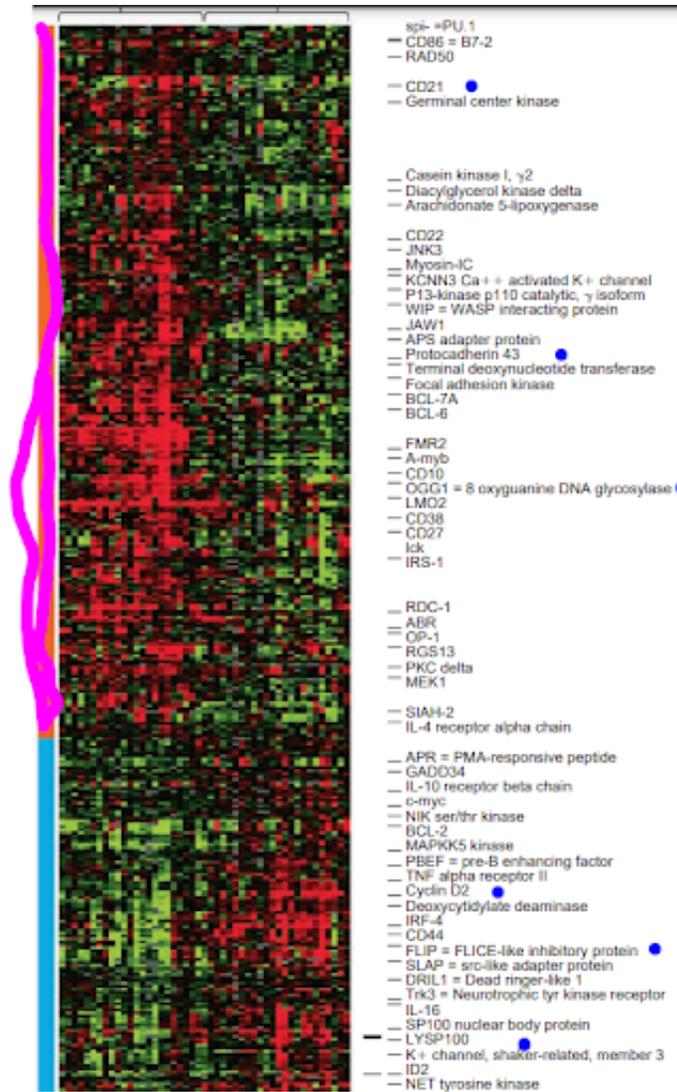
Figure 1: *The rightmost column with all the names is the different genes. Red indicates high levels of expression, green indicates lower levels of expression. Credits: Ash Alizadeh et al. 403:6769*

42. (2 points) First, let's talk about the background of our scenario. We mentioned that you must convert mRNA from the cells you are analyzing into complementary DNA(cDNA). What enzyme is key for this conversion, and what is this process known as.

    (a) _____

    (b) _____

43. (4 points) In your own words, describe how fluorescence could be achieved. Reference the background information given at the beginning of the problem.

44. (6 points) Analyze both the table and the cluster analysis (2nd figure), and figure out which side (left or right) on the second figure matches to germinal type, and which one matches to activated type. Keep in mind, the cancer cells should show similar levels of activation for specific genes are compared to their wild-type. Give reasoning for full credit.

Name that Organelle:

You are a microbiologist at the world famous biotech company, SusCorp, and before you leave to go home, you notice that you lost your labels for all the pics you took of your organelles. Label each picture provided with the correct organelle. SusCorp relies on it!
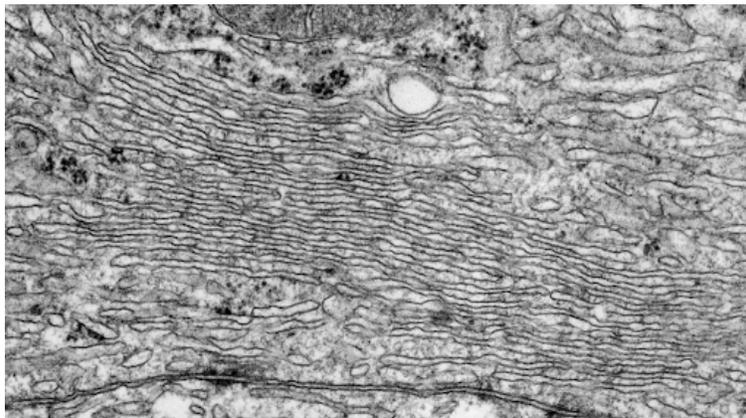
45. (1 point) Identify the organelle shown above:
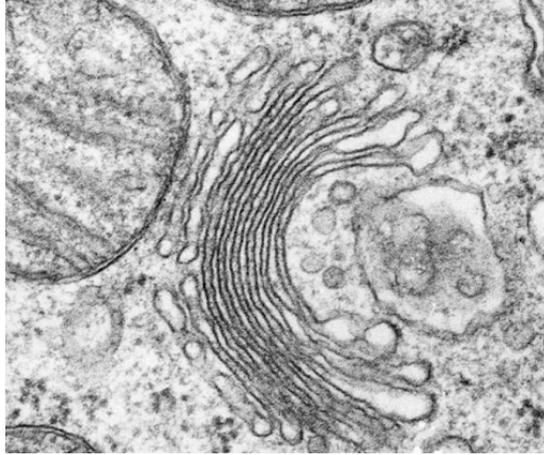
46. (1 point) Identify the organelle shown above:
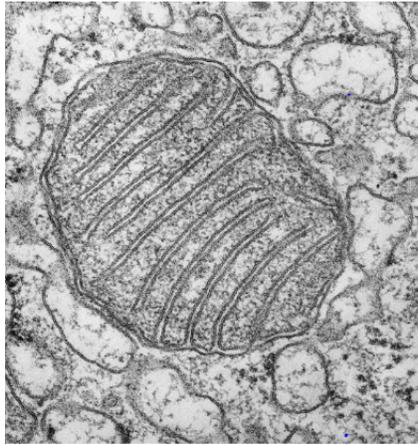
47. (1 point) Identify the organelle shown above:

Michael-Jordan Kinetics

Lineweaver-Burk Plots are a way of analyzing the efficiency of enzymes. The x-axis shows 1/[S], where [S] is the substrate concentration, and the y-axis shows 1/V, where V is the initial velocity (rate) of the reaction. In the following plots, an uninhibited enzyme is shown next to an enzyme with an inhibitor.
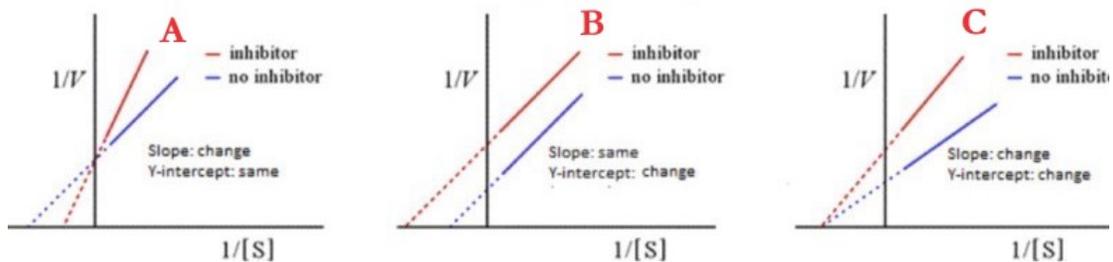
48. (1 point) Where on the enzyme does a competitive inhibitor bind?

_____

49. (6 points) Identify the type of inhibition found in each plot (A, B, and C) and explain its effect on V_{max} and K_m

50. (2 points) A mystery molecule increases the enzyme's affinity for its substrate. Predict what the new plot may look like relative to the uninhibited line.

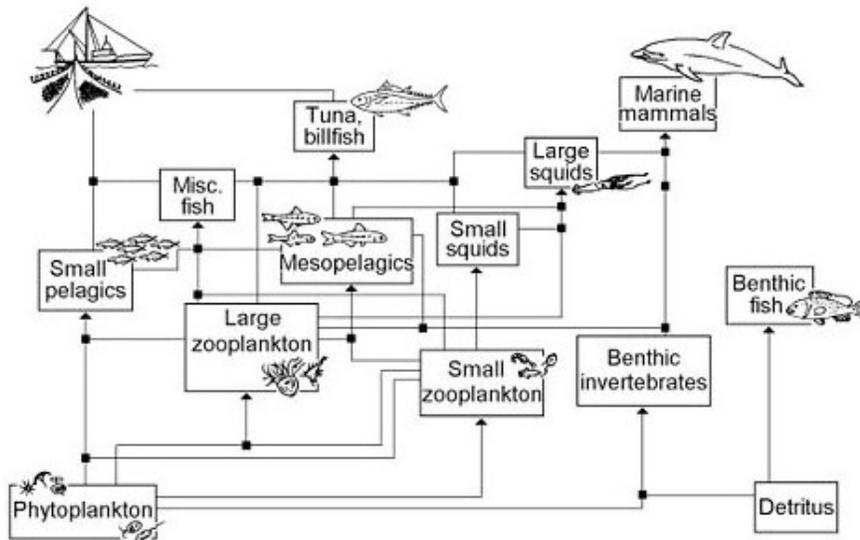

Section B: Ecology

Use the below image for the next question
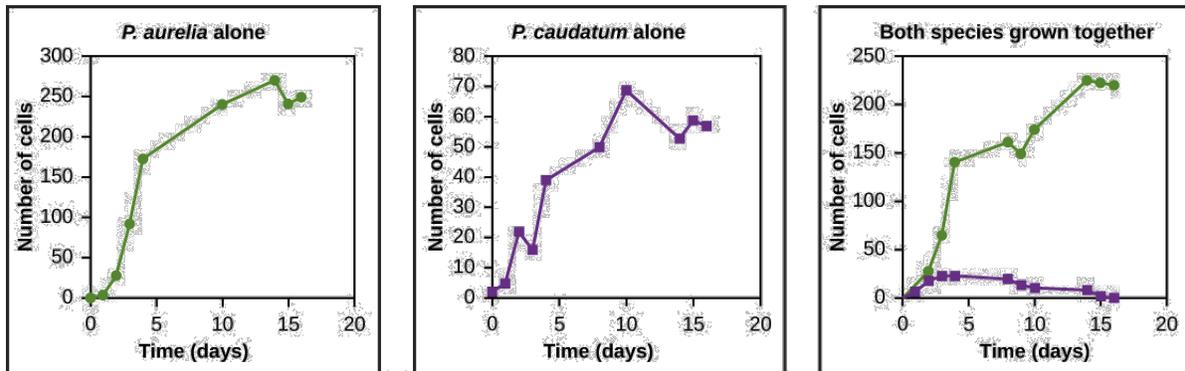
51. (1 point) The picture above shows an example of:

    A. Allen's Rule

    B. Bergmann's Rule

    C. Gloger's Rule

    D. Gause's Law

Use the below image for the next 3 questions

52. (1 point) Which of the following are secondary consumers? (Select all that apply)

    A. Small Pelagics

    B. Tuna Billfish

    C. Marine Mammals

    D. Small Zooplankton

53. (1 point) If the phytoplankton have 400 kilojoules of energy, how much energy would be available to the small squids (in kilojoules)?

    A. 400 kJ

    B. 40 kJ

    C. 4 kJ

    D. 0.4 kJ

54. (2 points) A viral disease spreads through the community, killing all of the tuna billfish. Which of the following effects would be expected? (Select all that apply)

    A. An increase in the small squid population

    B. An increase in the misc. fish population

    C. An increase in the small zooplankton population

    D. An increase in the phytoplankton

55. (1 point) Remoras are a type of fish also known as suckerfish. They are often found attached to large fish such as stingrays and sharks. Attachment is used to help the remoras travel and does not harm the host. What type of symbiosis is this an example of?

    A. Mutualism

    B. Comensalism

    C. Competition

    D. Amensalism

56. (3 points) What is the name for the subcategory of the symbiotic relationship from the previous question, where a symbiont uses the other as transportation? (Hint: it is NOT an answer choice from the previous question)

    _____

57. (2 points) Skuas are a type of bird that attack other birds until they drop their food, allowing the skua to steal it. What type of parasitic relationship is this?

    A. Adelphoparasitism

    B. Kleptoparasitism

    C. Social Parasitism

    D. Brood Parasitism

58. (1 point) A researcher adds a bacterium into a medium with limitless resources. Which of the following best describes the pattern of population growth? (Select all that apply)

    A. Logistic growth

    B. Exponential growth

    C. S-curve

    D. J curve

59. (2 points) Which of the following best describes an oak tree? (Select all that apply)

    A. r-selected

    B. K-selected

    C. Type I Survivorship Curve

    D. Type III Survivorship Curve

60. (1 point) A biome with an average annual temperature of 3°C and 100 cm of average annual rainfall best describes a:

      A. Tundra

      B. Taiga

      C. Temperate Grassland

      D. Woodland

61. (1 point) A population has a growth rate of 1.4%. Approximately how long is the doubling time of this population (in years)?

62. (5 points) In your own words, briefly describe the difference between fundamental and realized niche. Is it possible for the realized niche to be larger than the fundamental niche? If so, how?

63. (3 points) Which of the following are an example of Allen's Rule? (Select all that apply)

      A. A polar bear having large, thick legs

      B. A sea turtle having large, wide flippers

      C. A jackrabbit having broad, thin ears

      D. An arctic fox having small, thin legs

64. (2 points) Which of the following would have the lowest extinction rate?

      A. A large island far away from the mainland

      B. A large island close to the mainland

      C. A small island far away from the mainland

      D. A small island close to the mainland

65. (3 points) A population of moose has 1045 females and 1100 males. However, 60 of the female moose are too old or too young to breed. What is the effective population size (to the nearest whole number) of this population?

Section C: Genetics

66. (1 point) Which of the following is a display of condensed chromosomes arranged in pairs?

    A. Haplotype

    B. Diplotype

    C. Genotype

    D. Karyotype

67. (1 point) Which of Gregor Mendel's laws states that genes assort on their own without external influence during gamete formation, but later ended up being proven not true due to the discovery of recombination

    A. Law of segregation

    B. Law of independent assortment

    C. Law of non recombination

    D. Law of monohybird allele assortment

68. (1 point) Which of the following forms of dominance explains the type AB blood as well as spotted cows?

    A. Codominance

    B. Complete Dominance

    C. Incomplete Dominance

    D. Pleiotropy

69. (1 point) Which of the following is the most accurate model regarding DNA replication?

    A. Conservative

    B. Dispersive

    C. Semiconservative

    D. Liberal

70. (1 point) Muscle cells differ frmo liver cells mainly because they:

    A. Express different genes

    B. Use different genetic codes

    C. Contain different genes

    D. Have unique ribosomes

71. (1 point) What are the sex chromosomes of a female chicken?

    A. ZZ

    B. ZW

    C. Z0

    D. None of the above

72. (1 point) Gene X affects eye color and eye size. This form of inheritance can best be described by:

    A. Polygenic Inheritance

    B. Codominance

    C. Epistasis

    D. Pleiotropy

73. (2 points) The recombination frequency (RF) of genes G and H is 26%. The RF of genes H and F is 38%, while the RF of genes F and I is 7%. The RF of genes I and H is 31%, and the RF of G and F is 12%. Which of the following could be the order of the genes?

    A. FIGH

    B. IFHG

    C. HGFI

    D. IGHF

74. (2 points) A child with a genotype of XYY would most likely have been caused by:

    A. Nondisjunction in meiosis 1 of the mother

    B. Nondisjunction in meiosis 2 of the mother

    C. Nondisjunction in meiosis 1 of the father

    D. Nondisjunction in meiosis 2 of the father

75. (2 points) A man with hemophilia has a child with a woman who does not have hemophilia. The women has a mother who had hemophilia and a father who did not have hemophilia. What is the probability of the child having hemophilia?

76. (2 points) You are studying two types of genomes: A genome from a human cell line, and that of a single stranded DNA virus, bozovirus. In the human cell line, Adenine comprises 30% of the genome, and in the bozovirus, guanine comprises 23% of the genome. If possible, give the proportions for the rest of the nucleotides in the human cell line and the bozovirus cell line.

I need some hair gel

Use the following information for the next 4 questions

Gel electrophoresis is a laboratory method used to separate mixtures of DNA, RNA, or proteins according to molecular size. In gel electrophoresis, the molecules to be separated are pushed by an electrical field through a gel that contains small pores. To analyze DNA, researchers often use a technique known as Southern Blotting. Answer the following questions which relate to the process of gel electrophoresis and southern blotting.

77. (1 point) What is the name of the positive pole and what is the name of the negative pole in gel electrophoresis?
Answer with the name of the positive pole in the first blank and the name of the negative pole in the second.

    (a) _____

    (b) _____

78. (2 points) Which pole is DNA loaded onto and why? Which pole will DNA travel to?

79. (2 points) Do smaller or larger DNA fragments travel farther in the gel? Why?

80. (2 points) Using similar logic as the last question, would supercoiled or linear DNA travel farther in a gel? Explain for full credit.

You decide to analyze the expression of a trait in your family using a certain pedigree.
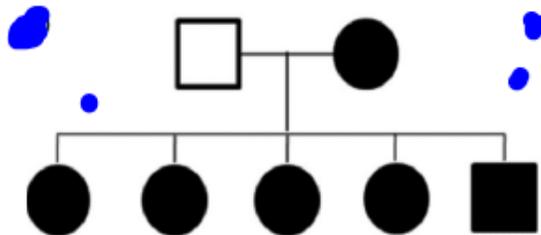
81. (1 point) Name a form of inheritance that can explain this trait. Give the most likely answer.

82. (3 points) Give the phenotypic ratio of a cross between an AaBbCc male with an AaBbCc female:
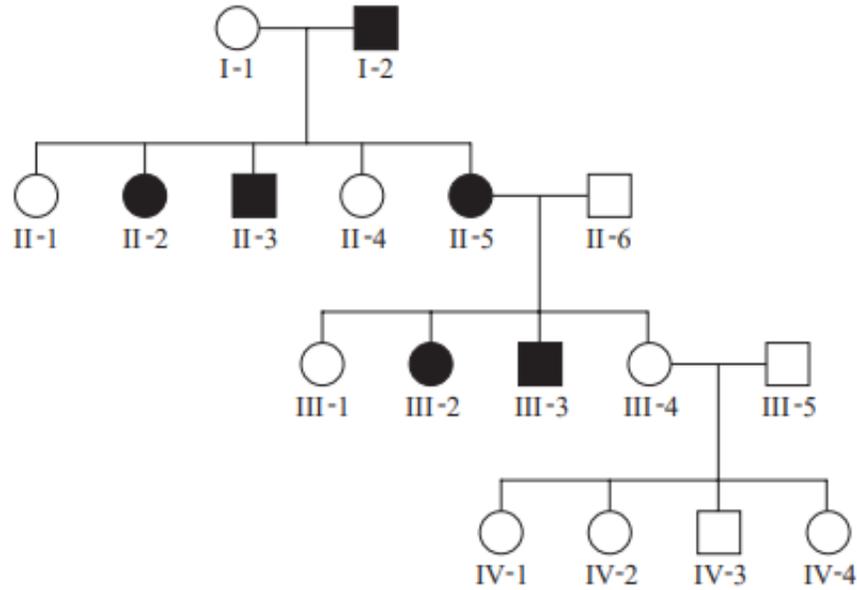
83. (1 point) Give the most likely mode of inheritance for the above pedigree.

84. (1 point) Which of the following disorders could have the form of inheritance from the previous question?

   A. Marfan's Syndrome

   B. Hemophilia

   C. Red-Green Colorblindness

   D. Muscular Dystrophy

85. (2 points) A woman with Bozo Disease (an autosomal dominant condition) and a phenotypically unaffected male have 6 children, all of whom are affected by Bozos. What is the probability of creating this family if the mother is a heterozygote?

Scientists are trying to crack the genetic code. You try to apply your knowledge of the Vigenère cipher, but that doesn't seem to work, so you use a biological approach. You utilize a cell-free translation system, and when radiolabeled amino acids are added to it, the synthesized polypeptides are radiolabeled and easy to detect.

86. (2 points) Firstly, using context clues from the passage, what do you best think is a cell-free translation system.

You want to analyze how certain RNA base sequences can correlate with amino acid output, so you add mRNA molecules of known base composition to your cell-free translation system, and analyze the resultant polypeptides. Before we get into the specifics of your experiment, let's talk about how our mRNA sequences were even made. You require an enzyme known as polynucleotide phosphorylase, which in the presence of excess NDP, will catalyze covalent bonds between nucleotides to create an RNA polymer.

87. (2 points) True or False: Polynucleotide phosphorylase does not require a DNA template, so thus the order of the nucleotides is random.

      A. True

      B. False

Now that you have some background information, let's talk about what happened in your experiment. You add a solution containing 70% Uracil and 30% Adenine to the cell-free translation system.

88. (1 point) What is the relative proportion of codons produced in the resulting RNA polymer that contain the sequence UUA? Round to the nearest percent.

    _____

89. (1 point) If the relative amount of the resulting amino acid, SusPog, is only 3%, what is the likely sequence of it in this genome?

    _____

Section D: Microscopy

Label the parts of the following microscope:
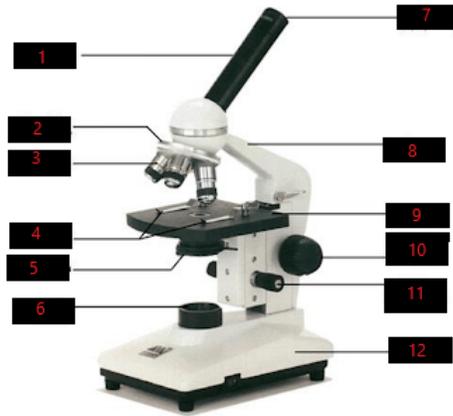
90. (1 point) What does the number 1 represent?

_____

91. (1 point) What does the number 2 represent?

_____

92. (1 point) What does the number 3 represent?

_____

93. (1 point) What does the number 4 represent?

_____

94. (1 point) What does the number 5 represent?

_____

95. (1 point) What does the number 6 represent?

_____

96. (1 point) What does the number 7 represent?

_____

97. (1 point) What does the number 8 represent?

_____

98. (1 point) What does the number 9 represent?

_____

99. (1 point) What does the number 10 represent?

_____

100. (1 point) What does the number 11 represent?

_____

101. (1 point) What does the number 12 represent?

_____

102. (2 points) When labeling intracellular molecules, antibodies are commonly used to show where in the cell the molecules are. Primary antibodies bind to the molecule and secondary antibodies bind to the primary antibodies. Secondary antibodies are modified to contain fluorescent proteins or other molecules that can be seen by a microscope. List 2 reasons why secondary antibodies are commonly used instead of primary antibodies to show positions of molecules.

103. (2 points) Dark field microscopy disregards light that is not scattered. This makes the specimen appear:

104. (2 points) Oil immersion is a technique used to increase the numerical aperture of the microscope. Briefly explain why oil immersion improves the numerical aperture.

105. (2 points) In your own words, briefly describe how confocal microscopy produces images of 3D specimens.

106. ($2\frac{1}{2}$ points) What is the minimum resolution of a light microscope and why is it limited?

107. (1 point) If you tried to visualize a structure smaller than the minimum resolution of a light microscope on a light microscope, how large would the structure appear in the microscope, if it appears at all?

108. (1 point) Why are electron microscopes often not used to analyze living specimens?

109. (2 points) Describe the differences between a transmission electron microscope and a scanning electron microscope. How does a SEM work?

110. (1 point) What is the function of the rheostat?

111. (1 point) Which structure of the microscope controls the amount of light reaching between the condenser and the specimen?

112. (2 points) What materials do you need to prepare a wet mount?

113. (1 point) What is the total magnification of a microscope if the objective lens is set at 40x and the ocular lens is set at 5x?

Section E: Tools and Analysis

114. (2½ points) A student was asked to measure out 1.1565 mL of a liquid. Which tool should she use: a volumetric pipette or a graduated pipette? Why?

115. (1½ points) What is a thistle funnel used for?

116. (2 points) What is the difference between a Florence Flask and a Round-Bottom Flask?

117. (2 points) What does a Retort Flask do, and which tool has replaced them?

118. (2 points) What is the defining feature of Wurtz Flasks?
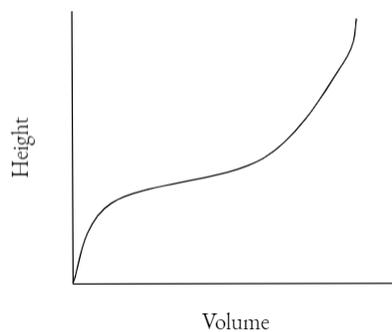
119. (2 points) What is the difference between Class A and Class B graduated cylinders?

120. (1 point) What tool is this?

121. (1 point) What tool is this?

Height

Volume

122. (1 point) A student measured the volume of liquid that a certain flask could fit as a function of its height. Based on the graph created, what type of flask did the student use to make the graph?

123. (1 point) Find the mean of the following integers: 2, 4, 6, 7, 9, 10:

124. (10 points) As a budding plant biologist, you want to study what makes certain bees travel to certain plants? Is it their color? Is it their scent? Is it the height of the plant? All of these questions are valid questions to ask, and it is your duty to find the answer. Obviously, since you cannot study the entirety of plants, you choose to study a plant species, A. Gus, native to Planet Sus. There is a bee species known as C. mate, that is a frequent pollinator of the flowers. Luckily for you, you possess genetic mutant strains of C. mate and A. Gus that allow you to specifically isolate certain factors that may potentially affect pollination. Pick any of the valid questions in this first paragraph, and write how you would go about finding the answer to this question. List out your hypothesis, any materials needed, independent/dependent/controls, etc.

125. (1 point) Find the mode of the following numbers:
1, 1, 2, 3, 4, 5, 7, 2, 4, 7, 19, 24, 19, 19, 4, 7, 8, 2, 3, 6, 4