BIOLOGY
Section II
8 Free-Response Questions
Time—80 minutes

Directions: Questions 1 and 2 are long free-response questions that should require about 20 minutes each to answer. Questions 3 through 8 are short free-response questions that should require about 6 minutes each to answer. Read each question carefully and write your response in the space provided following each question. Only material written in this space will be scored. Answers must be written out. Outline form is not acceptable. It is important that you read each question completely before you begin to write.

1. In a certain prairie community, a dominant prairie grass species has recently been infected with a virus that disrupts one of the electron transport proteins in the chloroplasts of infected cells.

   (a) **Describe** the most likely effects on cellular processes (be specific as to which processes and molecules are most likely to be directly affected).

   (b) **Describe** and **explain** the most likely effects on individual infected plants.

   (c) **Predict** the short-term effects (within a year of infection) on the infected plant populations and their communities. **Justify** your prediction.

   (d) **Predict** the long-term effects (years to decades after infection) on the infected plant populations and their communities. **Justify** your prediction.

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2. Plants lose water from their aboveground surfaces in the process of transpiration. Most of this water is lost from stomata, microscopic openings in the leaves. Excess water loss can have a negative effect on the growth, development, and reproduction of a plant. Severe water loss can be fatal. Environmental factors have a major impact on the rate of plant transpiration.

TRANSPIRATION RATE VERSUS TEMPERATURE

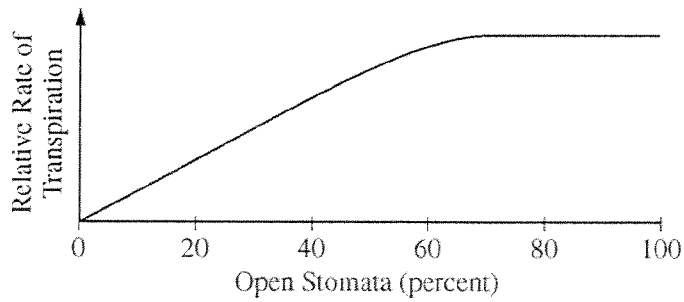
Temperature (°C)	20	23	27	28
Transpiration rate ($mmol/m^2 \cdot sec$)	1.5	3	5	4.5

(a) Using the data above and the axes provided, **draw** a graph showing the effect of temperature change on the rate of transpiration. **Explain** the shape of the curve from 23 degrees to 28 degrees.

(b) Humidity is another environmental factor that affects transpiration rate. Using the axes provided, **draw** a curve that illustrates what you predict would be the rate of transpiration with increasing humidity and constant temperature. **Justify** the shape of the curve based on your prediction.

(c) The curve below illustrates the rate of transpiration related to the percent of open stomata on the leaf of a particular plant. **Explain** why the curve levels off with increasing percentage of open stomata per area of the leaf.

OPEN STOMATA VERSUS RATE OF TRANSPIRATION



(d) The data below show the density of stomata on the leaf surfaces of three different species of plants. **Describe** the environments in which each plant most likely evolved. **Justify** your descriptions.

	Stomata Density (# of stomata/mm^2)	
Plant	In Upper Epidermis	In Lower Epidermis
Anacharis	0	0
Water lily	420	0
Black walnut	0	465

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3. In fruit flies (*Drosophila melanogaster*), straight wing shape is dominant to curly wing shape. A particular population of fruit flies is in Hardy-Weinberg equilibrium with respect to the alleles for wing shape.

The Hardy-Weinberg equation, given below, is useful in understanding population genetics:

$$p^2 + 2pq + q^2 = 1$$

(a) **Explain** what the terms (p^2, $2pq$, and q^2) represent in the population of fruit flies.

(b) **Describe** one condition that is necessary for the population to be in equilibrium.

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4. Populations of a plant species have been found growing in the mountains at altitudes above 2,500 meters. Populations of a plant that appears similar, with slight differences, have been found in the same mountains at altitudes below 2,300 meters.

   (a) **Describe** TWO kinds of data that could be collected to provide a direct answer to the question, do the populations growing above 2,500 meters and the populations growing below 2,300 meters represent a single species?

   (b) **Explain** how the data you suggested in part (a) would provide a direct answer to the question.

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5. In eukaryotic cells, ribosomes are found both free in the cytosol and attached to the endoplasmic reticulum (ER). Proteins produced on the attached ribosomes are delivered to the ER, while proteins produced on free ribosomes are delivered to the cytosol. **Briefly explain** in one or two sentences the two processes in terms of the following:

- ONE ultimate destination of a protein produced on an attached ribosome, and ONE general function of the protein (You do not need to identify the specific protein.)
- ONE ultimate destination of a protein produced on a free ribosome, and ONE general function of the protein (You do not need to identify the specific protein.)

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6. Fruit flies (*Drosophila melanogaster*) with a wild-type phenotype have gray bodies and red eyes. Certain mutations can cause changes to these traits. Mutant flies may have a black body and/or cinnabar eyes. To study the genetics of these traits, a researcher crossed a true-breeding wild-type male fly (with gray body and red eyes) with a true-breeding female fly with a black body and cinnabar eyes. All of the F_1 progeny displayed a wild-type phenotype.

Female flies from the F_1 generation were crossed with true-breeding male flies with black bodies and cinnabar eyes. The table below represents the predicted outcome and the data obtained from the cross. **Explain** the difference between the expected data and the actual numbers observed.

F_2 Generation Phenotypes			
Body Color	Eye Color	Number Predicted	Number Observed
Gray	Red	244	455
Black	Cinnabar	244	432
Gray	Cinnabar	244	42
Black	Red	244	47

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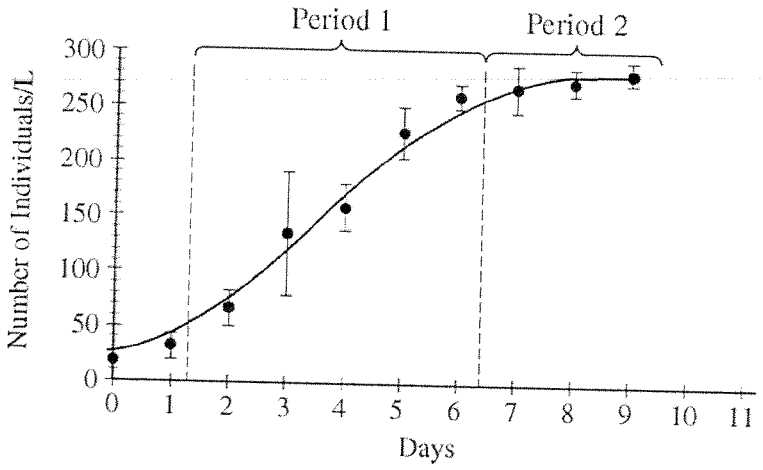
7. A population of microscopic eukaryotic organisms growing in a large flask had the growth pattern shown.



In one paragraph, **explain** the biological factors that determine the shape of the growth pattern shown above in both period 1 and period 2.

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8. Fossils of a microscopic organism are found in rocks determined to be over 3.5 billion years old. **Identify** TWO types of evidence that would help answer the question of whether the organism was photosynthetic.

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