Scoring Guidelines

Scoring Guidelines for Free-Response Question 1

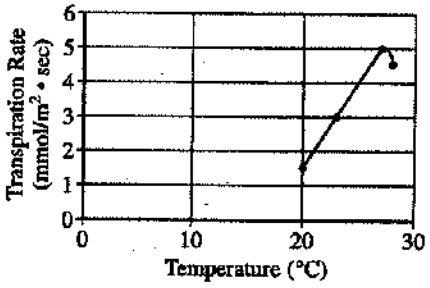
10 points maximum; students must earn points in each part of the question to receive all 10 points.

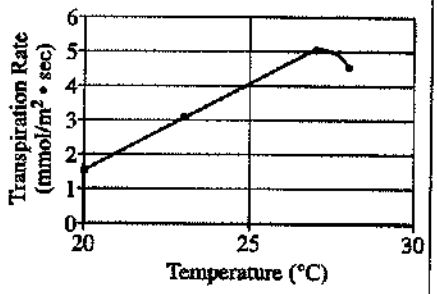
(Part a) Up to 3 points for a properly drawn graph.

One point for each of the following:

- Axes properly labeled and scaled
- Points properly plotted
- Correctly drawing either the curve with connected points or the best-fit line

NOTE: The student may use full scale (0–30), limited scale (20–30), or other legitimate scaling of the x-axis. Two examples are shown. The solid lines indicate the curve with connected points, and the dashed lines indicate the best-fit line.





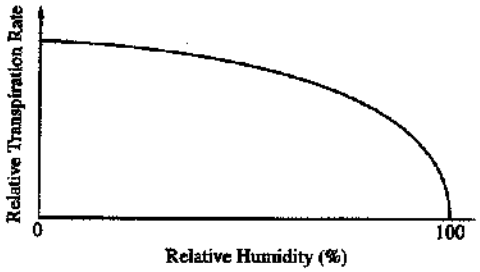
1 point for an appropriate description of the shape of the curve:

- Drawn curve shows increasing rate of transpiration from 20 to 27 degrees and reduction in transpiration rate from 27 to 28 degrees; or
- Best-fit curve shows steady increase in transpiration correlated to increase in temperature.

1 point for appropriate explanation of the change:

- Rate of water evaporation increases with increasing temperature.
- As temperature increases there are more open stomata.
- At the higher temperature stomata begin to close.
- Plants open and close stomata in response to environmental conditions.

(Part b) 1 point for a properly drawn curve, as shown, with correct axes and labels. The curve must have some indication of humidity measure, e.g., 0–100.



1 point for a correct explanation:

- Increasing humidity leads to reduced evaporation rates due to decreased difference in water vapor pressure (water potential) between leaf and atmosphere.

(Part c) 1 point for a correct explanation of the increase in transpiration rate from 0 to 60 percent of open stomata:

- From 0 to 60 percent open stomata, there is an increase in gas exchange with more stomata open.
- There is higher rate of diffusion between the leaf interior and the environment with more stomata open.

1 point for a correct explanation of the flattening of the curve when more than 60 percent of stomata are open:

- When more than 60 percent of the stomata are open, another factor becomes limiting.
- Rate of water movement is now limiting,
- Transpiration is now limited by humidity.

(Part d) Up to 3 points for a reasonable description of each environment, with an appropriate justification.

Descriptions may include:

- Anacharis is adapted to an environment where transpiration does not occur, such as underwater or in 100 percent humidity. There is no need for water vapor *or* it cannot occur via transpiration.
- Water lilies are adapted to an environment where only the upper side of the leaf is exposed to air; thus, only one surface can exchange water vapor with the environment. The large number of stomata is not a disadvantage because the plant has easy access to water.
- Black walnut is adapted to an environment where the upper surface is exposed to strong sunlight and higher temperatures and/or where water is more limited compared to a watery environment. Stomata located on lower epidermis of leaves are shaded from exposure to direct sunlight and higher temperatures, mitigating excessive water loss.

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Scoring Guidelines for Free-Response Question 2

4 points maximum.

Description of the appropriate kind of data and the appropriately linked explanation of its selection may include:

Description of kind of data (1 point each)	**Explanation (1 point each)**
Ability to produce viable seeds/ offspring in nature	Consistent with definition of biological species
Ability to cross-pollinate	Consistent with definition of biological species
Production of fertile offspring	Consistent with definition of biological species
Comparison of sequence of DNA or structures of other conserved molecules	Sufficient similarity supports single species
Comparison of chromosome number and/or structure	Similarity supports single species
Fertile hybrid populations found living between the two other populations of plants	Consistent with definition of biological species

Scoring Guidelines for Free-Response Question 3

4 points maximum.

Student explanations include the following:

- Prediction of a 1:1:1:1 ratio with correct phenotypes based on independent assortment.
- Support for prediction with a diagram of the cross of *BbEe* x *bbee*.
- Correct application of chi-square analysis to show that observed results do not conform to expected Mendelian frequencies.
- Identification of body color and eye color as linked genes/loci.
- Use of ratios to show linkage and independent assortment of wing type versus linked traits.
- Identification of the bottom two phenotypes as products of crossing over (recombinant chromosome).
- Mentioning that crossover rate is approximately 9–10 percent.

Scoring Guidelines for Free-Response Question 4

3 points maximum. 1 point for each correct explanation of the pattern or relationship between the environmental factor and the biological system.
Possible explanations include the following: • Recognition of exponential growth due to lack of limiting factors; reproductive/growth rate far exceeds death rate. • Slowing of reproductive/growth rate due to the influence of density-dependent limiting factors. • Death rate beginning to approach reproductive/growth rate in transition from period 1 to period 2. • Accumulation of toxic wastes increases death rate and decreases reproductive rate. • Population at carrying capacity stabilizes as the reproductive rate equals the death rate.

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