2. Consumers in aquatic ecosystems depend on producers for nutrition.

   (a) **Explain** the difference between gross and net primary productivity.

   (b) **Describe** a method to determine net and gross primary productivity in a freshwater pond over a 24-hour period.

   In an experiment, net primary productivity was measured, in the early spring, for water samples taken from different depths of a freshwater pond in a temperate deciduous forest.

NET PRIMARY PRODUCTIVITY IN A FRESHWATER
POND ECOSYSTEM DURING SPRING
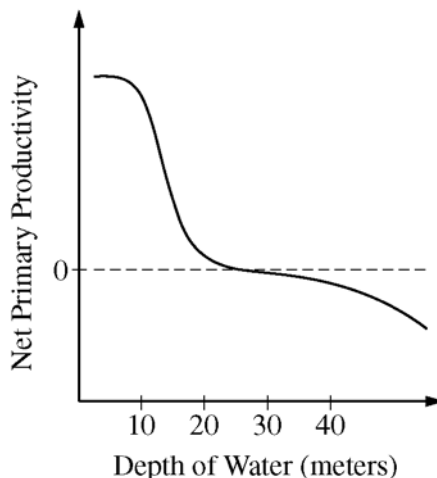
   (c) **Explain** the data presented by the graph, including a description of the relative rates of metabolic processes occurring at different depths of the pond.

   (d) **Describe** how the relationship between net primary productivity and depth would be expected to differ if new data were collected in mid-summer from the same pond. **Explain** your prediction.

Question 2

2. Consumers in aquatic ecosystems depend on producers for nutrition.

(a) **Explain** the difference between gross and net primary productivity. **(2 points)**

- Definition of gross primary productivity **(1 point)**
  - Total energy converted/transformed by photosynthesis
  - Total organic molecules produced or carbon fixed
- Definition of net primary productivity **(1 point)**
  - The biomass or total energy converted minus the amount used by the producers for cell respiration
  - The amount of energy or organic molecules left for the next trophic level
  - The energy that is available to organisms that eat primary producers
  - Gross primary productivity minus respiration

(b) **Describe** a method to determine net and gross primary productivity in a freshwater pond over a 24-hour period. **(1 point for each bullet; 4 points maximum)**

Measurement described
- Dissolved oxygen production or increase in biomass, or carbon dioxide uptake

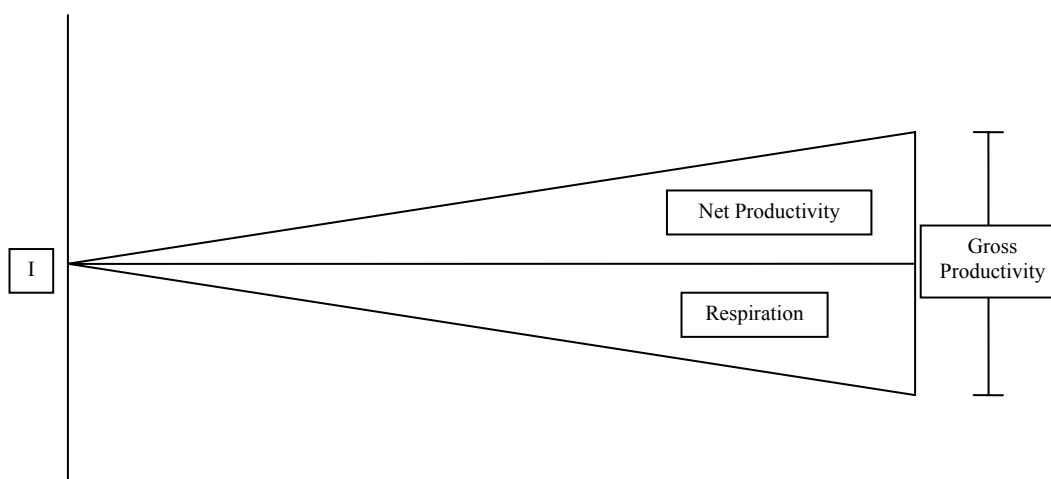Instrument/technique used to collect the data
- Winkler or C^{14} or oxygen probe

Methodology/design described
- Initial/baseline comparison
- Light and dark bottle comparison

Data analysis
- Light minus initial = net productivity
- Initial minus dark = respiration
- Light minus dark = gross productivity

(c) **Explain** the data presented by the graph, including a description of the relative rates of metabolic processes occurring at different depths of the pond. **(1 point for each bullet; 4 points maximum)**

Explanation of data:
- As depth is increased, the net primary productivity decreases because light decreases/lower rates of photosynthesis.

Description of relative rates of metabolic process occurring at specific depths according to the graph (letters added to graph to simplify rubric):

- <u>A</u>: The upper area of the graph is equally productive because light availability is not a limiting factor at the surface/ photosynthesis is not limited.
- <u>B</u>: The rapidly decreasing productivity region is a result of decreasing light available for photosynthesis/photosynthesis is decreasing rapidly.
- <u>C</u>: At 0 (the compensation point) the photosynthetic product is equal to the cell respiration requirements due to light availability/photosynthesis equals cell respiration.
- <u>D</u>: Below 0 the photosynthetic product does not meet the cell respiration requirements due to insufficient light. Photosynthesis less than respiration.

NET PRIMARY PRODUCTIVITY IN A FRESHWATER POND ECOSYSTEM DURING SPRING
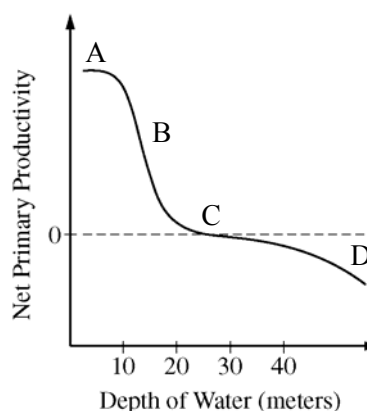
(d) **Describe** how the relationship between net primary productivity and depth would be expected to differ if new data were collected in mid-summer from the same pond. **Explain** your prediction. **(1 point for each bullet; 2 points maximum)**

- Description of a plausible prediction of a change in graph or a change in the relationship between productivity and depth from spring graph to mid-summer graph.
- Explanation of a plausible prediction of a shift in the graph must be tied to a valid or plausible reason.