AP® Biology
2004 Sample Student Responses
Form B

2. In most aquatic environments, primary production is affected by the light available to the community of organisms.

   Using measurements of dissolved oxygen concentration to determine primary productivity, design a controlled experiment to test the hypothesis that primary productivity is affected by either the intensity **or** the wavelength of light. In your answer, be sure to include the following.

   - A statement of the specific hypothesis that you are testing
   - A description of your experimental design (Be sure to include a description of what data you would collect and how you would present and analyze the data using a graph.)
   - A description of results that would support your hypothesis

My hypotesis is that the more intense light is given to photosynthetic organisms, the more photosynthesis and primary production occurs.

~~My control~~ I would ~~be~~ take algae ~~in~~ pond water and put equal amounts in five different bottles. I would ~~My control~~ expose them to different light intensities by using screens, preventing some light penetration.

My control would be the bottle exposed to 100% light, without any screens.

I would put the bottles under 100%, 80%, 50%, 20% and 0% light intensities. The variable would be the percent of light recieved. I would use aluminum foil to complety cover the bottle for 0% light.

I would measure the initial dissolved oxygen with a probe

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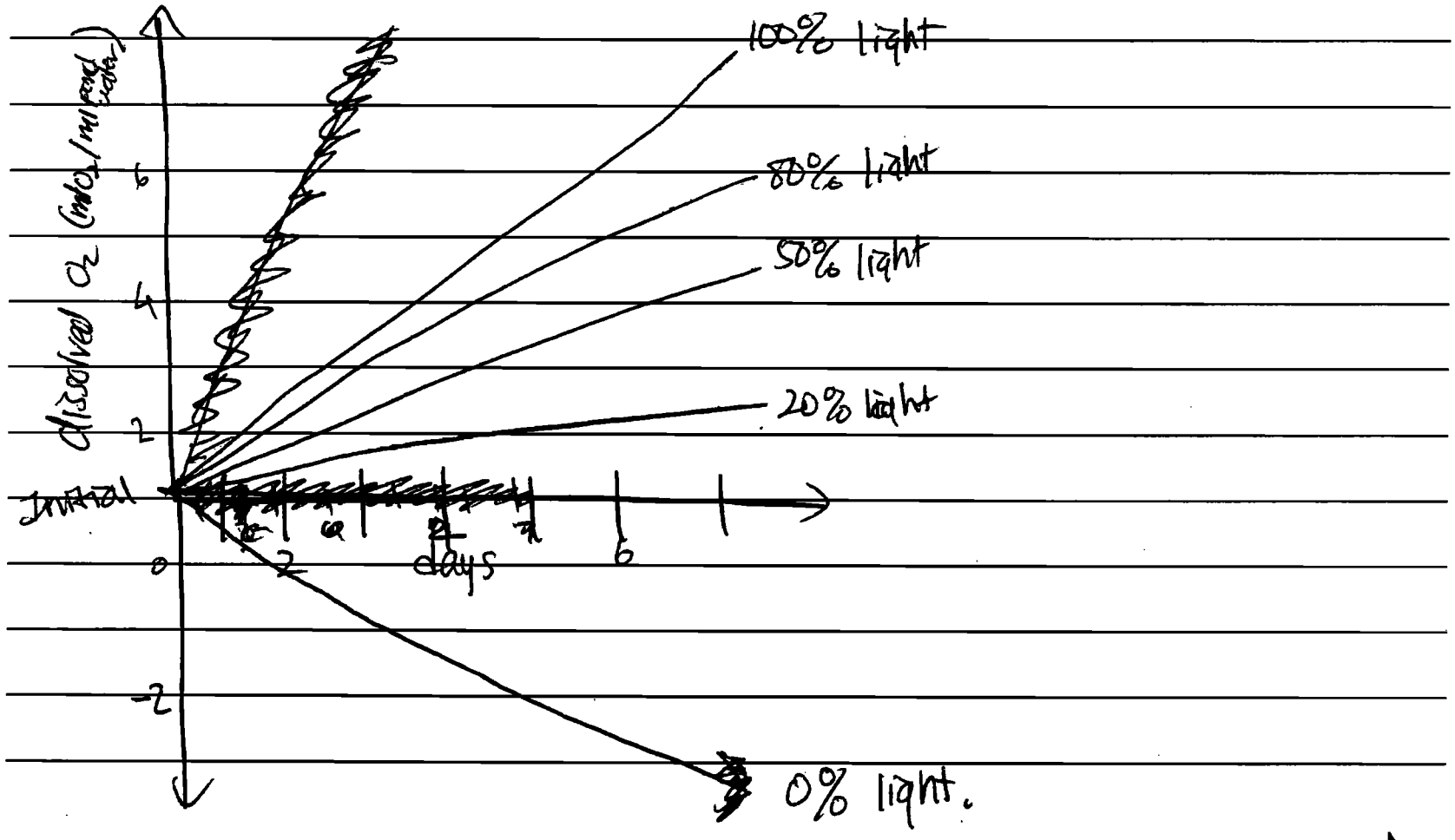
able to measure the amount of oxygen in water. The units used would be mL oxygen per mL pond water.
I would measure the dissolved oxygen in each bottle. After allowing the bottles to be exposed to the different intensities of light for a week, measuring everyday for more accurate results. After the week was over, I would graph the data using days as the x-axis and dissolved oxygen as the y-axis. The graph would look something like this.

Amount of dissolved Oxygen in Pond water under different Intensities of light.



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The bottle under 100% would produce the most dissolved oxygen because there's the most amount of light available for photosynthesis, ~~that shows that the primary production increase~~ which is primary production. The next highest dissolved O_2 ~~was~~ amount is in the 80%, then the 50%. The 0% light has a ~~neg~~ decreasing value because no photosynthesis is occurring due to no light available. Photosynthesis requires light. Thus, what's happening is that only respiration is occuring here, which uses Oxygen, decreasing the amount over time.

The more time the algae is exposed to light, the more photosynthesis can occur and therefore the more O_2 is produced and in the water.

~~The~~ A source of error could be the unequal amount of organisms in the pond water despite the equal volume in each bottle. This could be overcome by repeating the experiment several times.

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a) Primary producers, or plants and photosynthetic protists (algae) are able to undergo photosynthesis underwater, but to a lesser extent than plants on land. With the hypothesis that primary productivity is affected by intensity of light, a predictable result would be that dissolved O_2 concentration in water is greater at greater intensities due to a higher rate of photosynthesis and thus greater amounts of the product O_2 from the equation $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.

b) To perform an experiment, collect 5 equal sized specimens of green algae and place them all in different tubs underwater. The control will be the algae that is placed in regular sunlight intensity, while the other 4 algae can be placed under lamps of 10 watts, 15 watts, 20 watts, and 25 watts. Every 20 minutes, the rate of photosynthesis can be measured by measuring the amounts of dissolved O_2 in each tub.

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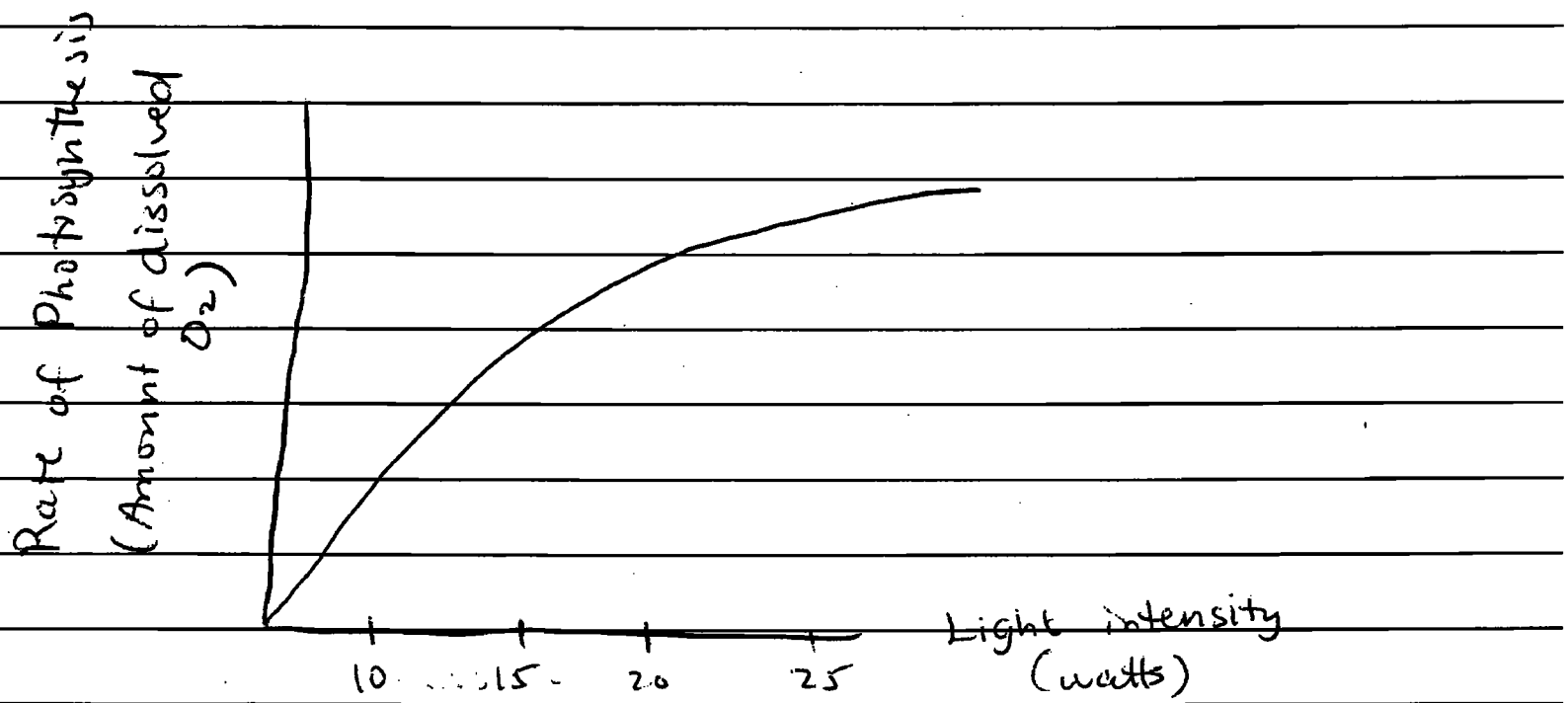
A graph that would be expected would look like:



C) As a result, photosynthesis rates would be much greater as the light intensity increases, meaning that more dissolved O_2 would be present in tubs which were shone with light of higher intensity. This is logical, since greater intensity of light would allow for more sunlight to penetrate deep into the water of aquatic biomes, allowing primary producers to provide food for others around them and for themselves.

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As the intensity of light increases, so does the primary productivity. The materials you need are a tank of water and a light source as well as an aquatic plant. You need to place black paper all around the tank so there is no other places the light can enter the tank except for the top. Place the plant at the bottom of the darkened plant. In intervals of an hour, you can measure the amount of dissolved oxygen concentration to determin primary productivity. However, every hour, you can move the light further and further away from the top of the tank. You start off with the light almost touching the water. After every hour, you need to use a meter to collect the data of the amount of dissolved oxygen in the water. To determin the ~~light~~ intensity, you can measure the number of inches the light is away from the water in the tank. You would present your data using a graph by having the time on the x axis as the independent variable and the ~~x~~ y axis

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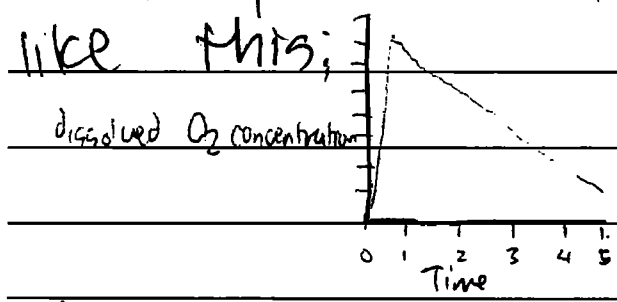
will be the scale of dissolved oxygen concentration. Lets also say that every hour, the light source will be moved back 2 inches. You can then graph your results on the graph and you will come up with a line graph. Since a visual is now established, you can better analyze the data.

The results you would find would be that as the light intensity was higher and closer to the water, the dissolved oxygen concentration was also higher therefore making the primary productivity higher. The graph you would get of that data would look something like this;



You can see that as the intensity of the light decreases, so does the dissolved oxygen concentration. This means that the primary productivity is definetly affected by the light intensity. These results would support the hypothesis stated that the intensity of light increases and so does the primary productivity.

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