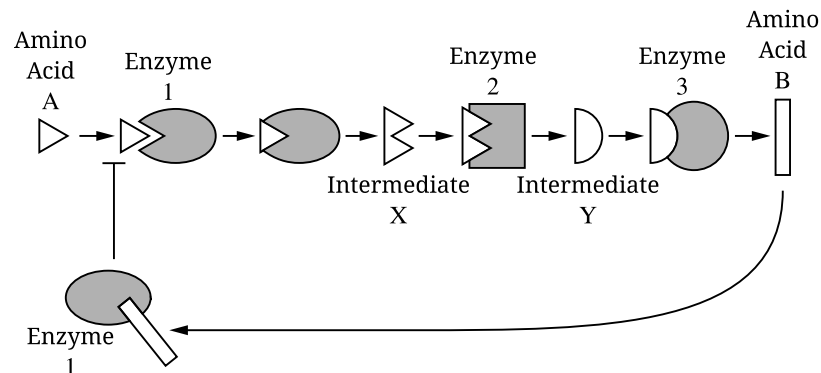


5. Figure 1 shows the reactions of the metabolic pathway used to synthesize amino acid B from amino acid A in cells.

Figure 1. Synthesis of amino acid B from amino acid A



- A. Describe** a characteristic of an enzyme's active site that allows it to catalyze a specific chemical reaction.
- B. Based on Figure 1, explain** how the binding of amino acid A to enzyme 1 is regulated by amino acid B.
- C. Using the information in Figure 1, identify** the product of the reaction catalyzed by enzyme 2: intermediate X, intermediate Y, or amino acid B.
- D. Based on Figure 1, explain** how a change in pH could affect enzyme 3 in such a way that amino acid B cannot be produced.

2. To investigate how increases in environmental temperatures affect the metabolism of certain organisms, researchers incubated liver cells from toads at different temperatures and measured two markers of metabolic activity (Table 1): the rate of oxygen consumption and the rate of ATP synthesis.

(a) **Describe** the role of water in the hydrolysis of ATP.

TABLE 1. RATE OF OXYGEN CONSUMPTION AND ATP SYNTHESIS AT DIFFERENT TEMPERATURES

Metabolic Marker	20°C	25°C	30°C
Rate of Oxygen Consumption (nmol / min / mg of mitochondrial protein $\pm 2 \text{ SE}_{\bar{x}}$)	12.8 ± 2.2	16.5 ± 2.0	22.1 ± 0.7
Rate of ATP Synthesis (nmol / min / mg of mitochondrial protein $\pm 2 \text{ SE}_{\bar{x}}$)	12.6 ± 1.6	16.8 ± 2.0	21.07 ± 0.8

- (b)
- Using the template in the space provided for your response, **construct** a bar graph that represents the data shown in Table 1. Your graph should be appropriately plotted and labeled.
 - Based on the data provided, **determine** the temperature in °C at which the rate of oxygen consumption is different from the rate of oxygen consumption at 25°C.
- (c)
- Based on the data in Table 1, **describe** the effect of temperature on the rate of ATP synthesis in liver cells from toads.
 - Based on the data in Table 1, **calculate** the average amount of oxygen consumed, in nmol, for 10 mg of mitochondrial protein after 10 minutes at 25°C.
- (d)
- Oligomycin is a compound that can block the channel protein function of ATP synthase. **Predict** the effects of using oligomycin on the proton gradient across the inner mitochondrial membrane.
 - Justify** your prediction.

Write your responses to this question only on the designated pages in the separate Free Response booklet.

If there are multiple parts to this question, write the part letter with your response.

4. Noncyclic electron flow and cyclic electron flow are two major pathways of the light-dependent reactions of photosynthesis. In noncyclic electron flow, electrons pass through photosystem II, then components of a chloroplast electron transport chain, and then photosystem I before finally reducing NADP^+ to NADPH. In cyclic electron flow, electrons cycle through photosystem I and some components of the electron transport chain (Figure 1).

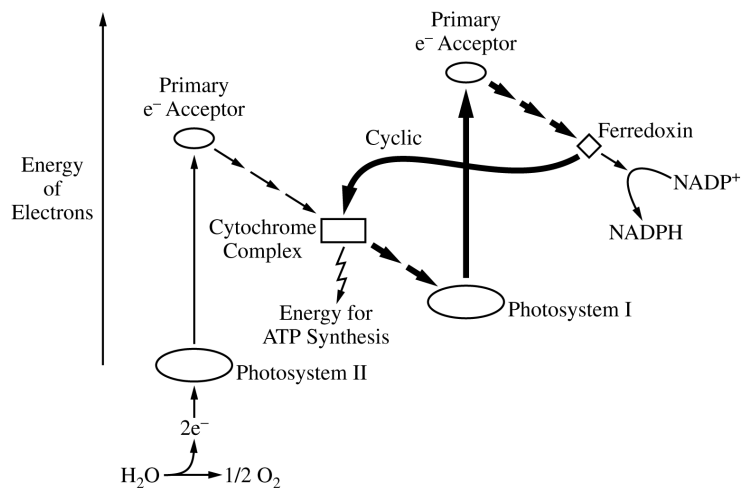


Figure 1. The pathways of noncyclic and cyclic (heavy arrows) electron flow. The cytochrome complex is a component of the electron transport chain between the two photosystems.

- (a) **Describe** the role of chlorophyll in the photosystems of plant cells.
- (b) Based on Figure 1, **explain** why an increase in the ratio of NADPH to NADP^+ will cause an increase in the flow of electrons through the cyclic pathway.
- (c) Using rice plants, scientists examined the effect of a mutation that results in the loss of the protein CRR6. CRR6 is a part of the photosystem I complex, and its absence reduces the activity of photosystem I. **Predict** the effect of the mutation on the rate of biomass (dry weight) accumulation.
- (d) **Justify** your prediction in part (c).

Write your responses to this question only on the designated pages in the separate Free Response booklet.