

2019 AP[®] BIOLOGY FREE-RESPONSE QUESTIONS

3. The pyruvate dehydrogenase complex (PDC) catalyzes the conversion of pyruvate to acetyl-CoA, a substrate for the Krebs (citric acid) cycle. The rate of pyruvate conversion is greatly reduced in individuals with PDC deficiency, a rare disorder.
- (a) **Identify** the cellular location where PDC is most active.
 - (b) **Make a claim** about how PDC deficiency affects the amount of NADH produced by glycolysis AND the amount of NADH produced by the Krebs (citric acid) cycle in a cell. **Provide reasoning** to support your claims based on the position of the PDC-catalyzed reaction in the sequence of the cellular respiration pathway.
 - (c) PDC deficiency is caused by mutations in the *PDH1* gene, which is located on the X chromosome. A male with PDC deficiency and a homozygous female with no family history of PDC deficiency have a male offspring. **Calculate** the probability that the male offspring will have PDC deficiency.

AP[®] BIOLOGY
2019 SCORING GUIDELINES

Question 3

The pyruvate dehydrogenase complex (PDC) catalyzes the conversion of pyruvate to acetyl-CoA, a substrate for the Krebs (citric acid) cycle. The rate of pyruvate conversion is greatly reduced in individuals with PDC deficiency, a rare disorder.

(a) **Identify** the cellular location where PDC is most active.

Identification (1 point)

- Mitochondria
- Mitochondrial matrix

(b) **Make a claim** about how PDC deficiency affects the amount of NADH produced by glycolysis AND the amount of NADH produced by the Krebs (citric acid) cycle in a cell. **Provide reasoning** to support your claims based on the position of the PDC-catalyzed reaction in the sequence of the cellular respiration pathway.

(1 point per row; 2 points max.)

	Claim	Reasoning
Glycolysis	No change	<ul style="list-style-type: none">• Glycolysis continues; PDC is not needed.• Glycolysis occurs before conversion of pyruvate to acetyl-CoA.
Krebs cycle	Decrease	<ul style="list-style-type: none">• The Krebs cycle is greatly reduced/slowed down if there is no/less acetyl-CoA.• The Krebs cycle occurs after conversion of pyruvate to acetyl-CoA.

(c) PDC deficiency is caused by mutations in the *PDHA1* gene, which is located on the X chromosome. A male with PDC deficiency and a homozygous female with no family history of PDC deficiency have a male offspring. **Calculate** the probability that the male offspring will have PDC deficiency.

Calculation (1 point)

- The probability of inheritance is 0.
- The offspring cannot/will not have PDC deficiency.