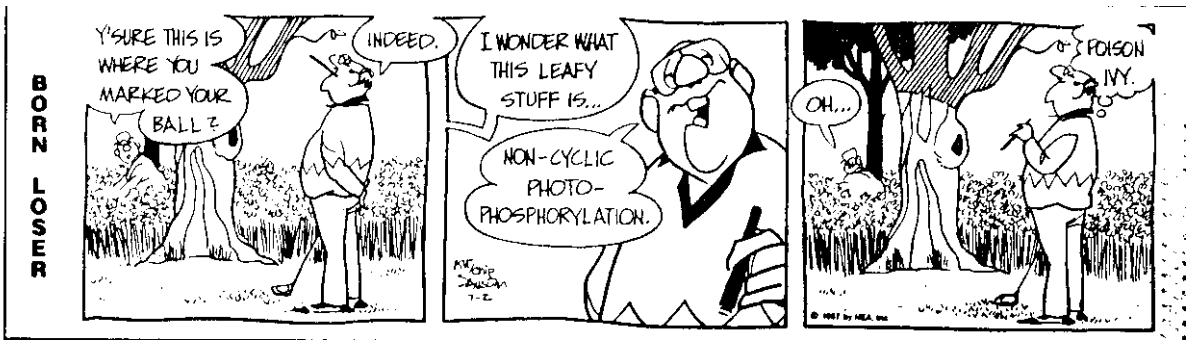
CHEM-643 Intermediary Metabolism
Monday, 5 October 2009
Individual/Group Quiz on Photosynthesis Case Study Problem, Are you what you eat?

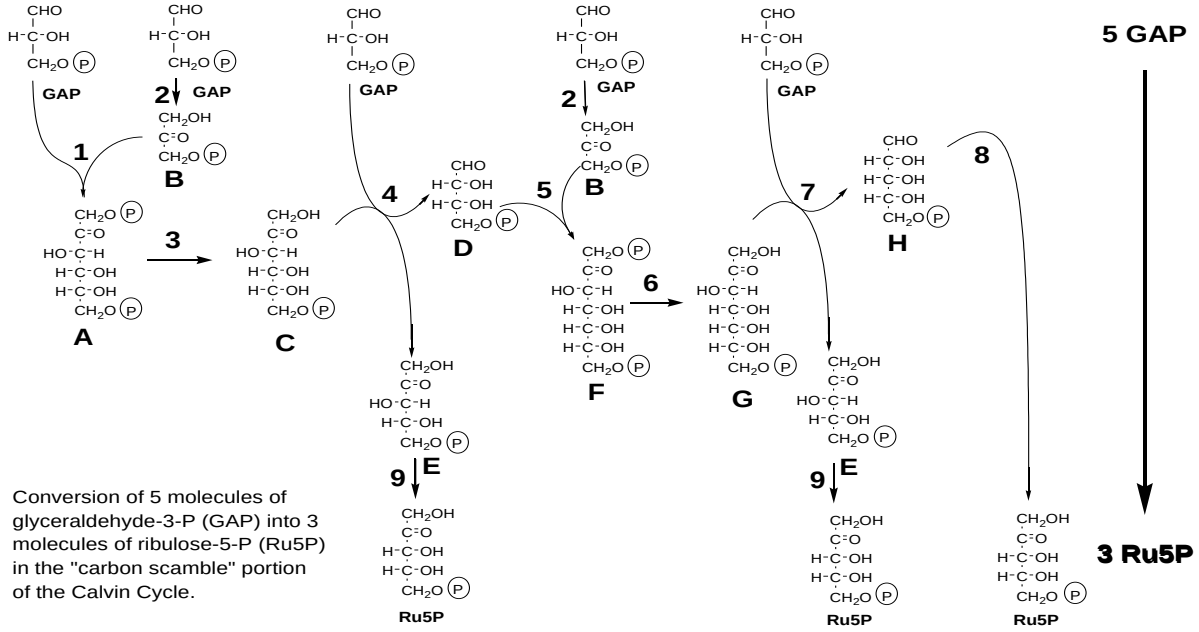
This quiz contains 12 multiple choice questions. To do well you should be familiar with photosynthesis, Calvin Cycle, Hatch-Slack Pathway, radioisotopic tracers, phase plane plots, light and dark reactions of photosynthesis, carbon isotope fractionation, the Bassham experiment, and general principles of metabolism.

First, without discussion with the other members of your group, mark your answer sheet with the letter corresponding to the answer you think is best for each question. If you are unsure of your answer, you may record two letters with the first being your preferred answer for possible partial credit. Do not expose your answers to your neighbors. Your total score will be the sum of the individual and group parts.

When everyone in your group is finished, but no later than 8:20 AM, discuss your answers quietly and come to consensus. Record your group's answer by scratching off the corresponding place on the "lottery ticket" answer sheet. If you do not get the correct answer on the first try, make a second choice. Each question is worth 4 points if you get the correct answer on the first try, 2 points on the second try, and 1 point on the third try. If you think more than one might be correct, pick the best answer.



The following several questions relate to the enzymes and intermediates of the Calvin Cycle.
Select the ***best*** answer.



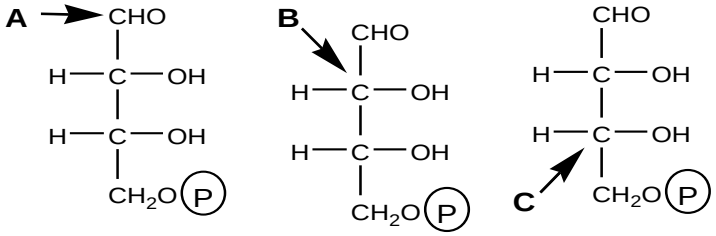
____ 1. The figure above is incomplete because it is missing some reactants, products, and coenzymes. It also is misleading because it suggests that all of the reactions are irreversible, which is not the case. Examine the reactions and decide **which of the following are in fact effectively irreversible**?

A. 1 & 5 B. 3 & 6 C. 2 & 8 D. 4 & 7

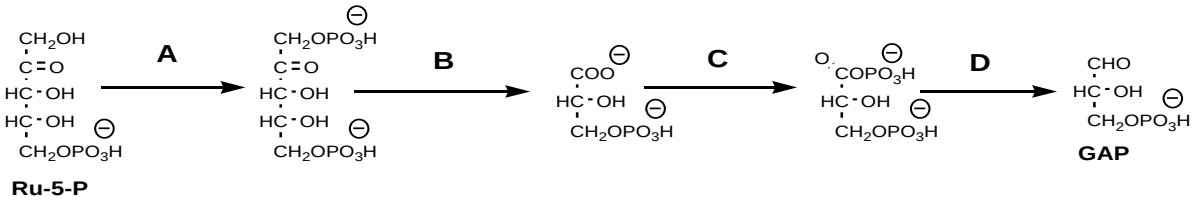
____ 2. Enzyme 5 belongs to which of the following classes of enzymes.

A. Dehydrogenase B. Aldolase C. Isomerase D. Kinase

____ 3. Consider Reaction 4 only [GAP + C → D + E]. If the middle carbon (#2) of GAP were labeled, **where would the label be found in compound D**?



D. The label would not appear in Compound D. It would be in Compound E instead.



____ 4. All but one of the above reactions involved in converting Ru5P to GAP in the Calvin Cycle are driven by products of the photosynthetic light reactions. **Which reaction is not directly dependent on NADPH or ATP**?

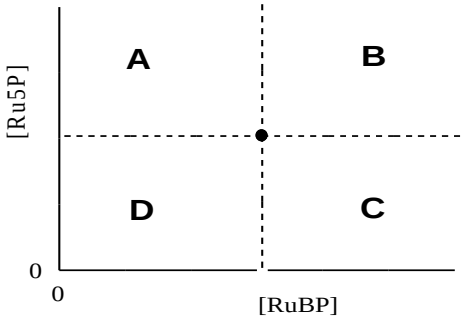
____ 5. Plants

A. Produce both CO_2 and O_2 in the day, but not at night.
B. Consume both CO_2 and O_2 at night, but not in the day.
C. Produce O_2 during the day and consume CO_2 at night.
D. Consume CO_2 in the day and consume O_2 at night.

____ 6. The carbon atoms in nylon

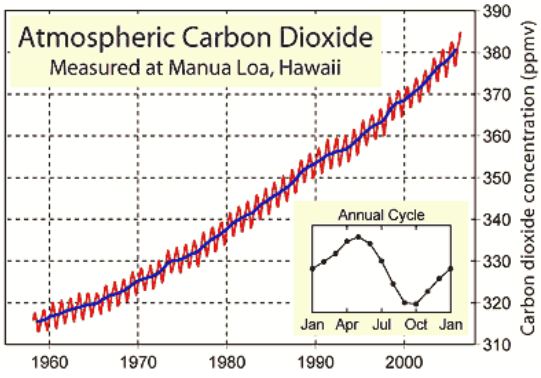
A. Include essentially no ^{14}C.
B. Are derived mostly from corn starch and cellulose.
C. Would have a significantly different $\delta^{13}C$ than gasoline.
D. Are derived directly by chemical synthesis from atmospheric CO_2.

____ 7. The point on the graph to the right represents the concentrations of Ru5P and RuBP at the moment the lights were turned off in Bassham's experiment. Plot the point corresponding to their concentrations about 30 sec later when [3PGA] peaks. In which quadrant would the point be?



____ 8. The "Keeling Curve" (right) tracks atmospheric CO_2 concentrations over time. From the inset curve, one can deduce that photosynthesis is most active in what month?

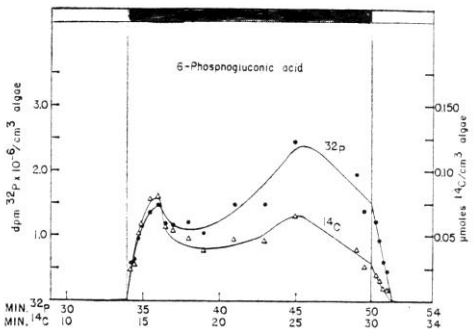
A. January
B. April
C. July
D. October



http://www.globalwarmingart.com/wiki/Carbon_Dioxide_Gallery

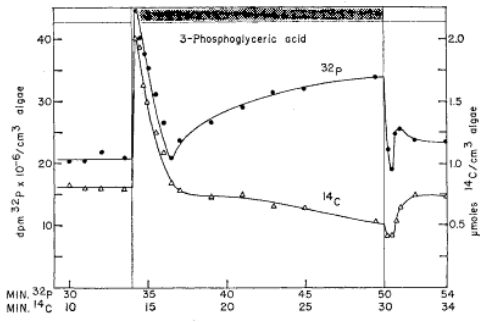
____ 9. The curve at the right displays the amount of ^{14}C and ^{32}P in (PGNA) 6-phospho-gluconate in Bassham's experiment. It shows that:

A. The carbon in PGNA comes predominantly from starch breakdown.
B. The oxidative part of the pentose phosphate pathway operates only in the dark.
C. PGNA is not part of the Calvin Cycle.
D. All of the above.



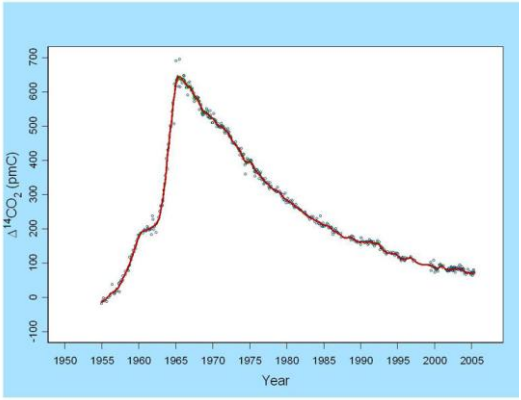
____ 10. After ~16 minutes in the dark, approximately what proportion of carbon in 3PGA comes from $^{12}CO_2$ that that was fixed before $^{14}CO_2$ was added to the *Chlorella* culture?

A. all
B. > 50%
C. < 50%
D. none



____ 11. The curve at the right displays the amount of $^{14}CO_2$ remaining in the atmosphere as the result of atmospheric atomic bomb testing in the 1950s and 60s. Based on these data, estimate the half-life of a CO_2 molecule in the Earth's atmosphere?

A. 40 years
B. 20 years
C. 10 years
D. 5 years



____ 12. The half-life of ^{14}C is about 5700 years. What percent of the ^{14}C originally present in a 57,000 year old fossil would remain today?

A. ~0.1% B. ~0.2% C. ~0.4% D. ~1.0%