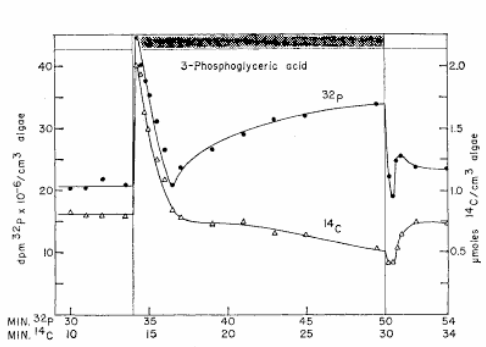
CHEM-643 Intermediary Metabolism Name _____
Monday, 1 October 2007
Group Quiz on Photosynthesis Case Study Problem, Are you what you eat?
Averages: 5.11/12 (individual) 35.6/60 IF*AT (Group)

(To do well on this quiz you should be familiar with photosynthesis, Calvin Cycle, radioisotopic tracers, phase plane plots, light and dark reactions of photosynthesis, and the Bassham experiment.)

Select the best answer.

____ 1. Plants
A. Produce O_2 during the day and consume CO_2 at night.
B. Produce both CO_2 and O_2 in the day, but not at night.
C. Consume CO_2 in the day and consume O_2 at night.
D. Consume both CO_2 and O_2 at night, but not in the day.

____ 2. After ~16 minutes in the dark, approximately what proportion of carbon in 3PGA comes from $^{12}CO_2$ that was fixed before $^{14}CO_2$ was added to the *Chlorella* culture?
A. all
B. ~2/3
C. ~1/3
D. none



____ 3. If CO_2 were suddenly removed from an actively photosynthesizing algal suspension, which of the following would you expect?
A. Activation of the TCA Cycle to replace the missing CO_2.
B. An increased concentration of ribulose 1,5 bisphosphate, RuBP.
C. A rapid decrease in glycolysis.
D. An increased rate in the synthesis of starch.

____ 4. The main purpose of the Bassham experiment was: (Pick the ***best*** answer.)
A. To study the regulation of carbon flux in the Calvin Cycle.
B. To study the incorporation of radioisotopes into Calvin Cycle intermediates.
C. To study the effect of light on 3PGA concentrations.
D. To study the dynamics of ^{32}P and ^{14}C in the dark reactions of photosynthesis.

____ 5. Carbon atoms in bone
A. Are part of the $CaCO_3$ mineral matrix.
B. Reside in protein trapped in the mineral matrix.
C. Have a $\delta^{13}C$ corresponding to that of atmospheric CO_2.
D. All of the above.

____ 6. Ribulose 1,5 bisphosphate carboxylase
A. Functions primarily in the light
B. Is one of the "dark reactions" of photosynthesis
C. Discriminates against $^{13}CO_2$ more than does PEP carboxylyase.
D. All of the above.

____ 7. 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. ~10% B. ~1% C. ~0.1% D. ~0.01%

____ 8. The carbon atoms in nylon
A. Would have a significantly different $\delta^{13}C$ than gasoline.
B. Include essentially no ^{14}C.
C. Are derived directly by chemical synthesis from atmospheric CO_2.
D. Are derived from corn starch and cellulose.

____ 9. The belemnite used as a $\delta^{13}C$ reference standard and also the state fossil of Delaware
A. Is an extinct type of mollusk related to squid and cuttlefish.
B. Has a lower $^{13}C/^{12}C$ ratio than the carbon in either C_3 or C_4 plants.
C. Is composed of hydroxyapatite, $Ca_5(PO_4)_3OH$.
D. Has a $^{14}C/^{12}C$ ratio similar to that in atmospheric CO_2.

____ 10. Ignoring photorespiration, the ratio of ATP:NADPH consumed per each CO_2 fixed by the Calvin Cycle is __ in C_3 plants:
A. 1:1 B. 2:1 C. 3:2 D. 1:2

____ 11. Consider two identical photosynthesizing leaves placed in separate vessels containing atmospheric carbon dioxide. Vessel 1 is sealed so new air cannot come in, while the Vessel 2 remains open to the air. Photosynthesis is allowed to continue until the CO_2 in Vessel 1 is used up. What can you predict about the $\delta^{13}C$ values for newly fixed carbon?
A. $\delta^{13}C$ Vessel 1 > $\delta^{13}C$ Vessel 2
B. $\delta^{13}C$ Vessel 1 < $\delta^{13}C$ Vessel 2
C. $\delta^{13}C$ Vessel 1 = $\delta^{13}C$ Vessel 2
D. $\delta^{13}C$ Vessel 2 = $\delta^{13}C$ atmospheric CO_2.

____ 12. The point on the graph to the right represents the concentrations of 3PGA 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. What would be the expected slope (m = Δ[3PGA]/Δ[RuDP]) of the line connecting ● and the point you plotted?
A. $m \geq 1$
B. $0 < m < 1$
C. $-1 < m < 0$
D. $m \leq -1$