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**October 2019 Cellular Respiration & Photosynthesis Semi-Cumulative Exam**

B

1. What property of water makes it suitable as a coolant?

- A. It takes a lot of energy to increase the temperature of water.
- B It takes a lot of energy for water to evaporate.
- C. Water molecules are cohesive and stick to the skin.
- D. Water is a good solvent so it can transport heat from the body.

A

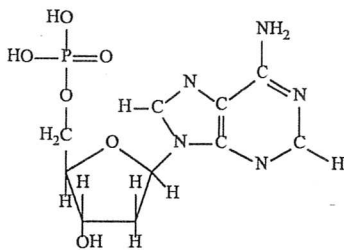
2. Which describes the role of amino acids in the channels of membrane proteins used for facilitated diffusion?

- A Polar amino acids create a channel through which hydrophilic molecules can pass.
- B. Polar amino acids create a channel through which hydrophobic molecules can pass.
- C. Non-polar amino acids create a channel through which hydrophilic molecules can pass.
- D. Non-polar amino acids create a channel through which hydrophobic molecules can pass.

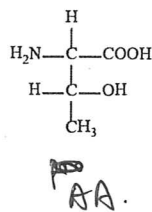
D

3. Which molecules show a monosaccharide and a fatty acid?

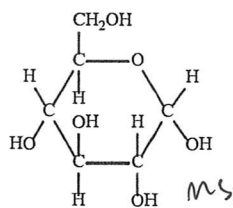
Molecule 1



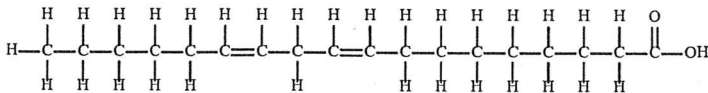
Molecule 2



Molecule 3

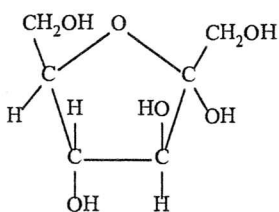


Molecule 4

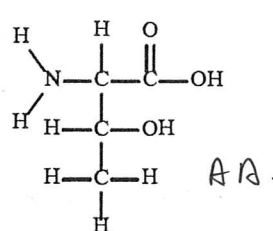


	Monosaccharide	Fatty acid
A.	1, 3 and 5 only	2, 4 and 6 only
B.	1 only	2 and 6 only
C.	3 only	2 and 6 only
<u>D.</u>	3 and 5 only	4 only

Molecule 5



Molecule 6



C

4. What is the function of DNA polymerase I?

- A. It forms Okazaki fragments
- B. It initiates replication on the lagging strand of DNA
- C. It adds nucleotides in the 5' to 3' direction → DNA PII.
- D. It excises RNA primers and replaces them with DNA → DNA PI.

$$\frac{17}{20} + \frac{22}{23} = \frac{39}{43}$$

Link. 2 → 4 ATP. 2 NADH. 2 CO<sub>2</sub>.  
 Kreb. 6 NADH. 2 P<sub>ADH</sub>. 2 ATP. 4 CO<sub>2</sub>.  
 ETC.

C

5. The table below shows the codons that determine different amino acids in protein translation.

What is the sequence of the amino acids that is being translated from the following mRNA sequence?

5'AUGGGUGCUUAUUGGUAAG3'

A. Met-Pro-Arg-Ile-Thr

B. Met-Cys-Ser-Tyr-Trp

C. Met-Gly-Ala-Tyr-Trp

D. Met-Gly-Tyr-Ala-Thr

D. K. P. C. O. F. G. S.

C

6. In classification, which statement is true?

A. If two organisms belong to the same order, then they are in the same genus. x

B. If two organisms are in different orders, then they cannot be in the same class. x

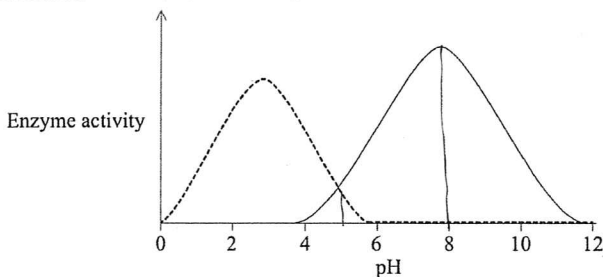
C. If two organisms are in the same class, then they must be in the same phylum. ✓

D. If organisms have the same genus name, they must also have the same species name x

First base in codon	Second base in codon				Third base in codon
	U	C	A	G	
U	Phe	Ser	Tyr	Cys	U
	Phe	Ser	Tyr	Cys	C
	Leu	Ser	—	—	A
	Leu	Ser	—	Trp	G
C	Leu	Pro	His	Arg	U
	Leu	Pro	His	Arg	C
	Leu	Pro	Gln	Arg	A
	Leu	Pro	Gln	Arg	G
A	Ile	Thr	Asn	Ser	U
	Ile	Thr	Asn	Ser	C
	Ile	Thr	Lys	Arg	A
	Met	Thr	Lys	Arg	G
G	Val	Ala	Asp	Gly	U
	Val	Ala	Asp	Gly	C
	Val	Ala	Glu	Gly	A
	Val	Ala	Glu	Gly	G

C

7. Enzyme activity has been measured for two enzymes at different pH values.



At which pH is one enzyme optimal and the other enzyme denatured?

A. pH=5

B. pH=6

C. pH=8

D. pH=10

B

8. How does DNA replicate?

A. The deoxyribose of a free nucleotide is linked to the phosphate of the last nucleotide in the chain.

B. The phosphate of a free nucleotide is linked to the deoxyribose of the last nucleotide in the chain.

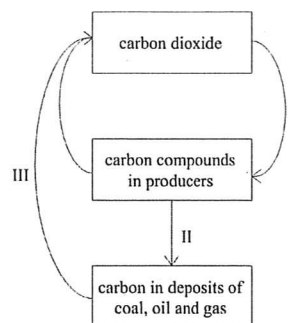
C. Nucleotides are linked in a 3' to 5' direction and the new strands are anti-parallel to the template strands. in respect to the template strand x

D. Nucleotides are linked in a 5' to 3' direction and the new strands are parallel to the template strands. x

✓ A 9. The diagram below shows some of the links in the carbon cycle.

What processes are taking place at I, II and III?

	I	II	III
A.	photosynthesis	fossilization	combustion
B.	cell respiration ✗	fossilization	greenhouse effect
C.	photosynthesis	decomposition ✗	combustion
D.	cell respiration ✗	decomposition ✗	greenhouse effect



✓ C 10. Which process is a reduction reaction?

- A. FADH changing to FAD ✗  
 B. ATP changing to ADP  
 C. NAD changing to NADH ✓  
 D. NADP changing to NAD ?✗

✓ B 11. How can the rate of photosynthesis be measured?

- I. By the amount of oxygen produced ✓  
 II. By the increase in biomass ✓  
 III. By the amount of carbon dioxide produced ✗

- A. I only  
 (B.) I and II only  
 C. I and III only  
 D. I, II and III

✓ C 12. What process occurs during the light-independent reactions of photosynthesis?

- A. Oxygen is released into the atmosphere. ✗  
 B. Protons are pumped from the thylakoid space to the stroma. ✗  
 (C) RuBP is carboxylated then regenerated in the Calvin cycle. ✓  
 D. Triose phosphate is converted to glycerate 3-phosphate.

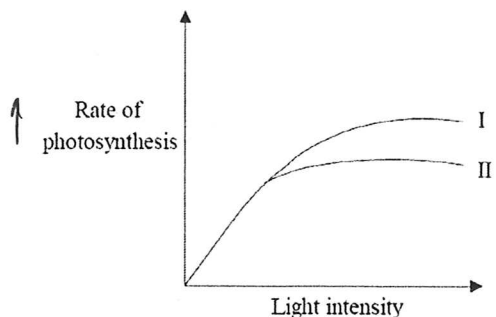
✓ A 13. What happens during glycolysis for one mole of glucose?

- (A) Two pyruvates are formed ✓  
 B. There is a net gain of two NADPH + H<sup>+</sup> ✗  
 C. There is a net loss of two ATP ✗  
 D. Two acetyl CoA are formed ✗

✓ B 14. What is reduced by Photosystem I?

- A. ADP  
 (B.) NADP  
 C. NAD  
 D. FAD

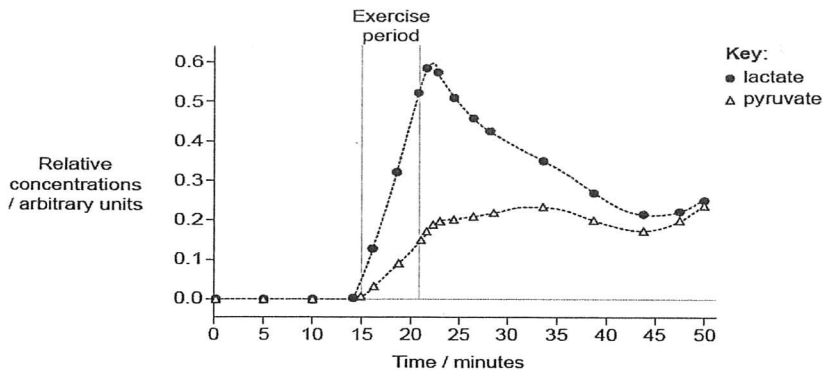
D A 15. What changes in carbon dioxide levels and temperature will most likely produce curve I instead of curve II?



	Carbon dioxide levels	Temperature
(A.)	increase	decrease
B.	decrease	increase
C.	decrease	decrease
D.	increase	increase

increase rate of  
chemical reactions.  
↑ CO<sub>2</sub>.

B. 16. The graph shows the changes in lactate and pyruvate measured in an athlete's blood during and following a mild exercise period as compared to the period before the exercise.

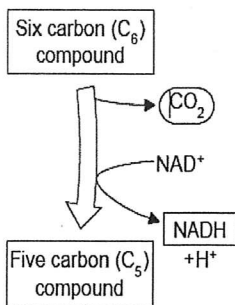


[Source: W. E. Huckabee (1958) *The Journal of Clinical Investigation*, 37 (2), page 257.]

What do these curves suggest?

- A. Before the exercise, there was no pyruvate produced because there was no cell respiration. ✗
- B. During the exercise, there was not enough oxygen available for cell respiration, so the process was partly anaerobic. ✓
- C. During the exercise, the level of lactate increased due to aerobic respiration. ✗
- D. After the exercise, the level of lactate decreased because there was enough pyruvate to be used for anaerobic cell respiration. ✗

B. 17. This reaction occurs in mitochondria.



What explains that this reaction enables energy to be converted into a usable form?

- A. The oxidized  $\text{NAD}^+$  will transfer the energy from the  $\text{C}_6$  compound to ATP. ✗
- B. The chemical energy stored in the  $\text{C}_6$  compound is used to reduce  $\text{NAD}^+$  allowing ATP production. ✓
- C. Energy stored in the  $\text{CO}_2$  molecule will generate an electron gradient. ✗
- D. The  $\text{C}_6$  compound is reduced and the energy resulting from the removal of one carbon is used to oxidize  $\text{NAD}^+$ . ✗

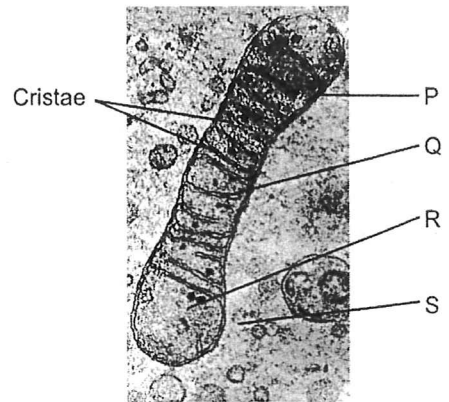
D. 18. What is the source of the oxygen released into the atmosphere in photosynthesis?

- A. Glucose
- B. Carbon dioxide
- C. Chlorophyll
- D. Water

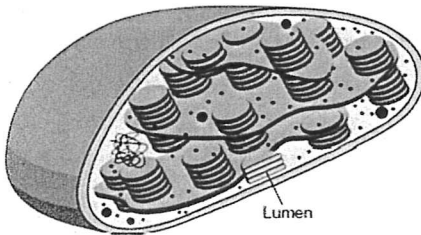
D 19. The image shows a portion of a cell containing a mitochondrion.

Where do glycolysis and electron transport occur?

	Glycolysis	Electron transport
A.	P	R
B.	R	Q
C.	R	R
<u>D.</u>	S	Q



A 20. The image shows a chloroplast.



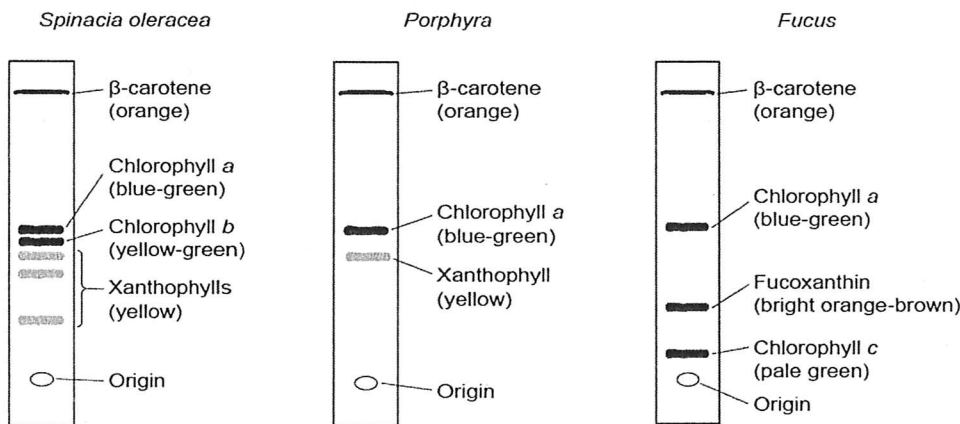
[Source: adapted from <http://evolutionaryroutes.files.wordpress.com>]

During photosynthesis, what happens in the chloroplast at the location labelled lumen?

- A. Protons accumulate. ✓
- B. Pyruvate undergoes decarboxylation. ✗
- C. NADH is oxidized. ✗
- D. Oxygen is produced. ✗

## PART B: Extended Response

21. Chromatography is a technique used to separate the components of a mixture. The photosynthetic pigments from three organisms were separated by thin layer chromatography: spinach (*Spinacia oleracea*), a red alga (*Porphyra*) and a brown alga (*Fucus*).



[Source: Adapted from "Diversity of Photosynthetic Pigments" by Alexander F. Mollen in *Tested Studies for Laboratory Teaching*, Volume 16 of the Association for Biology Laboratory Education and used by permission of the author]

A) Identify a pigment found in all three organisms. [1]

Chlorophyll a.

b) Compare and contrast absorption spectra and action spectra. [2]

- They both talk about how plants can efficiently utilize light of different wavelengths. Their general trend / shape are similar. ✓
- Action spectra shows the rate of photosynthesis at different wavelengths for AN ENTIRE (Algae) PLANT; while absorption spectra shows absorption of light at different wavelengths for different pigments present in a plant. ✓

c. *Porphyra* also contains phycoerythrin, which is a red pigment. Suggest a reason for phycoerythrin being absent from the *Porphyra* chromatogram. [2]

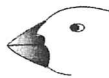
- it's too polar so it hasn't really move or it's too non polar that it runs off of scope.
- it's not so abundant or its polarity is so similar to another pigment that it doesn't show its own stripe.
- the extraction solvent used failed to dissolve and extract phycoerythrin. good - insoluble in solvent

22.

The following shows a dichotomous key.



Bird W



Bird X



Bird Y



Bird Z

Dichotomous key to represent birds

1. a. The beak is relatively long and slender ..... *Certhidea* ✓  
b. The beak is relatively stout and heavy ..... go to 2
2. a. The bottom surface of the lower beak is flat and straight ..... *Geospiza* ✓  
b. The bottom surface of the lower beak is curved ..... go to 3
3. a. The lower edge of the upper beak has a distinct bend ..... *Camarthynchus* ✓  
b. The lower edge of the upper beak is mostly flat ..... *Platyspiza* ✗

(b) Identify, with a reason, which bird could best eat insects that live in small cracks in trees. [1]

*Certhidea*, since its <sup>long and thin</sup> beak enables it to reach insects deep inside the cracks. ✓

t/

- (c) The environment where these four birds live has changed and there are now fewer trees producing nuts and fruit but more insects available for food. Describe how natural selection in this situation could lead to evolution. [3]

Birds with stout & heavy beaks are good at cracking nuts while birds with long & slender beaks are good at catching insects when they're hidden in cracks. When the environment is changed, birds that are better at catching insect will be able to attain food and survive; while birds that rely on nuts will have a hard time finding food and die in hunger. Over time, the bird population will be more filled with birds that are good at catching insect. They can survive well and reproduce, while the other type of bird can't. This advantage gradually makes the population better adapted to the new environment.

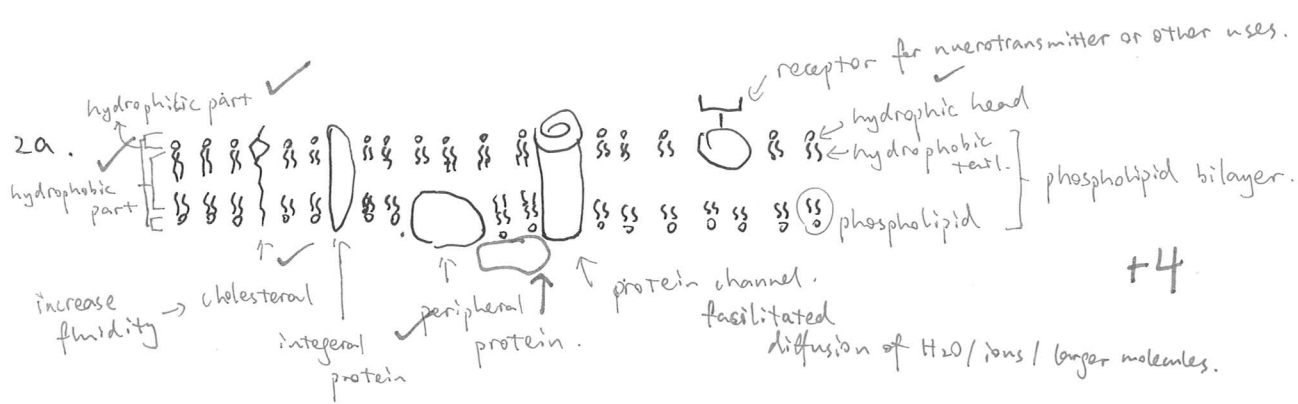
+3

pass on heritable traits.

**PART C: CHOOSE ONE of THREE to ANSWER (Each 15 pts +1 for clarity & communication)**

- 1a. Oxygen is needed to complete aerobic cell respiration. Explain how chemical energy for use in the cell is generated by electron transport and chemiosmosis. [8]
- 1b. Outline **four** different functions of membrane proteins. [4 marks]
- 1c. Describe briefly the endosymbiotic theory. [3]
- 2a. Draw a labelled diagram to show the structure of the plasma membrane. [4 marks] 4
- 2b. The light-dependent reactions in photosynthesis take place on the thylakoid membranes. Explain the light-dependent reactions. [8 marks] 8
- 2c. Outline two factors that affect the rate of photosynthesis. [3 marks] 2
- 3a. Outline the effect of temperature and substrate concentration on the activity of enzymes. [3]
- 3b. Describe how detritivores obtain nutrition and the effects they have in ecosystems. [4]
- 3c. Explain how plants capture and use light in photosynthesis. [8]

1+ CC 15  
16

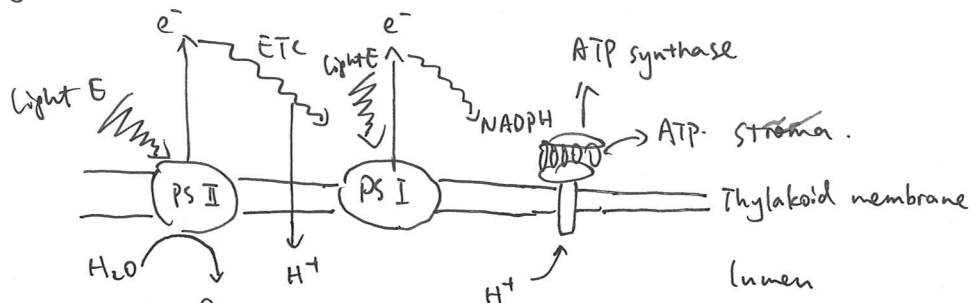


2b. Light-dependent reaction requires high energy to run the reaction.

The reaction takes place in the thylakoid membrane where there're photosystems and ATP synthases.

There're pigments in photosystems so that light energy can be absorbed and used to excite electrons. The electrons come from the photolysis of water, where  $H_2O$  is broken into  $2e^-$ ,  $2H^+$  and  $O_2$ . This is where  $O_2$  is released as a by-product.

At photosystem II (PS II),  $e^-$  can be activated with light at 680 nm wavelength.



The activated  $e^-$  can bring protons through the membrane by electron transport chain in order to create proton gradient. Then  $e^-$  is passed on to PS I.

At PS I,  $e^-$  can be activated again with light at 700 nm wavelength.

The activated  $e^-$  reduce  $NADP^+$  to electron carrier NADPH. NADPH will be used later in light-independent reaction. (through another series of ETC)

Now the accumulated proton gradient pass through ATP synthase and triggers photophosphorylation by proton-motive force. ATP produced will also be used in the light-independent reaction.

- 2c.
- high  $CO_2$  level can provide reactant for the light-independent reaction and increase the rate of photosynthesis.
  - stronger intensity of light can provide greater energy to run the light-dependent reaction so the rate can also increase. ~~until~~ it plateau
  - lower temperature can slow down transpiration of water from leaves so that sufficient electrons from  $H_2O$  can be provided. Rate can also increase.
- but levels off