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### Multiple Choice Questions

- Decide which of the choices best completes the statement or answers the question.
  - Locate that question number on the separate answer sheet provided.
  - Use the procedure described by your teacher to answer each question. For example, “fill in the circle that corresponds to your choice” or “make an X over the letter corresponding to your choice.”
1. Cellular respiration refers to
    - a. breathing.
    - b. the production of ATP from energy-rich compounds.
    - c. the diffusion of oxygen into the cells.
    - d. the transfer of O<sub>2</sub> and CO<sub>2</sub> across a cell membrane.
  2. Carbon dioxide is to the Calvin Benson cycle as
    - a. oxaloacetic acid is to the electron transport system.
    - b. acetyl co-enzyme A is to the Krebs cycle.
    - c. ATP is to the electron transport system.
    - d. pyruvic acid is to glycolysis.
  3. Most of the ATP produced in cellular respiration is associated with the
    - a. formation of pyruvic acid.
    - b. production of alcohol.
    - c. Krebs cycle.
    - d. formation of water.
  4. Both NAD and FAD are compounds derived from the B vitamins niacin and flavin. Which of the following would most likely be a symptom of a person whose diet is deficient in these vitamins?
    - a. a lack of energy
    - b. increase production of water
    - c. increase production of carbon dioxide
    - d. decrease oxygen production
  5. Complete this statement: In the process of cellular respiration,
    - a. carbon dioxide is released as water is formed.
    - b. carbon dioxide is oxidized, resulting in the formation of glucose.
    - c. glucose is oxidized, resulting in the formation of ATP, carbon dioxide, and water
    - d. glucose is reduced to carbon dioxide and water.

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6. Adenosine tri-phosphate (ATP), is often referred to as the energy currency of the cell. Which of the following cellular process does NOT require the use of ATP?
- muscle contraction
  - cell division
  - hair growth
  - osmosis

*Use the following information to answer the next question.*

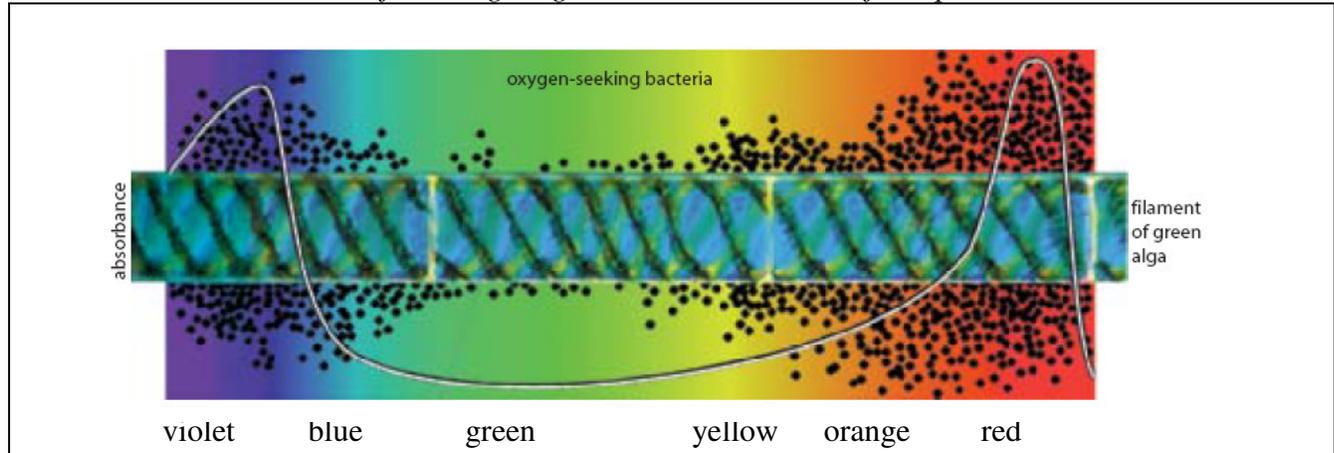
### Yeast Cells

Yeasts are microscopic fungi. They are single-cell organisms that are generally about 5-10 microns in size. They are given Latin names that represent their genus and species (e.g., *Saccharomyces cerevisiae* or *Candida utilis*). The species differ from each other by: where they are found, their cellular morphology or shape, how they metabolize different substrates, and how they reproduce. While there are nearly 50,000 species of fungi, there are only 60 different genera of yeast representing about 500 different species.

Yeasts are “facultative anaerobes,” which means that they can survive and grow with or without oxygen. Yeast propagation is an aerobic process where the yeast converts oxygen and sugar, through oxidative metabolism, into carbon dioxide and usable free energy for efficient yeast cell growth.

7. When yeast cells experience anaerobic conditions, they will use fermentation to obtain energy. The end products of fermentation in these conditions are
- carbon dioxide only.
  - ATP only.
  - ATP, carbon dioxide, and ethyl alcohol.
  - carbon dioxide, ATP, and water.
8. In photosynthesis, the energy released by the excited electrons in the electron transport system is used to move hydrogen ions across the thylakoid membrane against the concentration gradient. The movement of hydrogen ions in this case is an example of
- osmosis
  - diffusion
  - exocytosis
  - active transport

Use the following diagram to answer the next four questions.



An investigator wanted to determine the rate of photosynthesis at different wavelengths of light. Aerobic bacteria were evenly distributed in a test tube of *Spirogyra*, a species of green algae. The *Spirogyra* is exposed to various wavelengths of light as shown on the diagram above. The results show the growth of bacteria (black dots), after one day.

9. The manipulated (independent) variable in this investigation is
- the type of bacteria grown in the test tube.
  - the wavelength of light.
  - the amount of oxygen produced.
  - the intensity of light.
10. Which row below identifies the wavelengths at which the rate of photosynthesis in *Spirogyra* is greatest?

Row	Wavelength	Wavelength
a.	violet	red
b.	green	yellow
c.	violet	green
d.	yellow	red

11. Which of the following statements best completes the statement below?

Statement: "If the intensity of the light was increased, one would expect \_\_\_\_\_"

- bacterial growth to increase at the green and yellow wavelengths only.
  - bacterial growth to decrease at all wavelengths.
  - bacterial growth to increase at the violet and red wavelengths only.
  - bacterial growth to increase at all wavelengths.
12. The process by which bacteria are producing energy in order to reproduce is
- photosynthesis.
  - fermentation.
  - aerobic cellular respiration.
  - anaerobic cellular respiration.

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Use the following information to answer the next two questions.

A student uses the following experimental design to study respiration in yeast cells. She sets up four test tubes with the following contents. After an hour, she uses a spectrophotometer to measure the intensity of the blue colour in each test tube.

NOTE: The intensity of methylene blue decreases as oxygen is consumed.

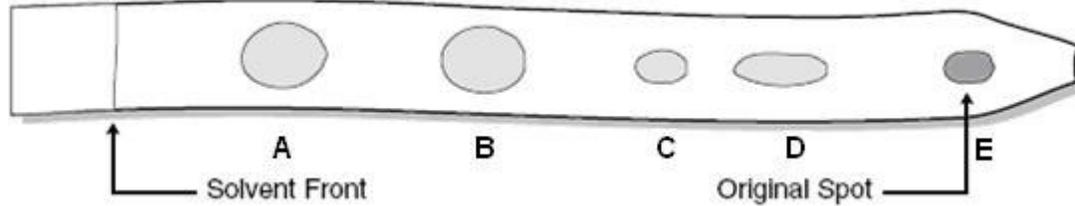
Experimental Design for a Study in the Rate of Respiration in Yeast Cells

Test Tube	Water added (ml)	Methylene Blue Solution (ml)	Yeast Solution (ml)	Glucose solution (ml)	Top of Test Tube
A	4	2	–	2	open
B	2	2	2	2	sealed
C	2	2	2	2	open
D	4	2	2	–	open

13. Carbon dioxide production would be most intense in the test tube labelled
- A
  - B
  - C
  - D
14. The condition in test tube B that would eventually lead to the death of the yeast cells would be
- a lack of oxygen
  - a build-up of carbon dioxide
  - a build-up of alcohol
  - overcrowding
15. In animal cells, a waste product of anaerobic respiration is
- alcohol
  - water
  - carbon dioxide
  - lactic acid
16. The compound produced by the Calvin-Benson cycle that is so important to the maintenance of life on Earth is
- glucose.
  - water.
  - oxygen.
  - carbon dioxide.
17. Oxygen is a waste product of photosynthesis. This oxygen is inhaled into the lungs and delivered to the cells in the human body. The process of cellular respiration converts this oxygen into
- carbon dioxide.
  - glucose.
  - water.
  - ATP.

Use the following information to answer the next two questions.

In an investigation to study the different pigments present in Spruce needles, the pigments were extracted, placed on chromatography paper in position E, and separated using chromatography. The results are shown in the diagram below.



Chromatogram showing the separation of the pigments in a Spruce needle

18. A logical inference based on the results of this diagram is that there are
- 5 pigments in a Spruce needle, some of which did not move in the solvent.
  - 4 pigments in a Spruce needle, with some contamination.
  - 4 pigments in a Spruce needle, each with a different solubility in the solvent.
  - 6 pigments in a Spruce needle.
19. Which row below identifies the pigment with the highest  $R_f$  value and provides the most plausible explanation?

Row	Pigment with highest $R_f$ value	Explanation
a.	A	the least soluble pigment found in the solvent used in this investigation because it travelled the farthest in the solvent
b.	A	the most soluble pigment in the solvent because it travelled the farthest in the solvent
c.	C	this pigment is somewhat soluble in the solvent
d.	D	the most soluble pigment in the solvent because it travelled the shortest distance in the solvent

20. Respiration, whether it is aerobic or anaerobic, occurs in
- plant cells only.
  - animal cells only.
  - organisms only found in the plant and animal kingdoms.
  - all living things.

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21. During photosynthesis, water molecules are split in the
- Calvin-Benson cycle.
  - carbon fixation stage.
  - syntheses reactions.
  - light-dependent reactions.
22. The synthesis of glucose in plants
- occurs in the light-dependent reactions.
  - requires ATP and NADPH.
  - occurs in the citric acid cycle.
  - occurs during photosystems I and II.

*Use the following information to answer the next question.*

A student conducts a series of tests on a plant and discovers that, according to his data, plants absorb carbon dioxide from the atmosphere and release oxygen during the day. At night the student finds the opposite to be true.

23. The best explanation for these results is that
- plants carry out photosynthesis during the day and cellular respiration at night.
  - the carbon dioxide produced by plants during the day is used immediately by the plant during photosynthesis.
  - there must have been numerous experimental errors because these results are wrong.
  - during the day, in plants, cellular respiration occurs at a faster rate than does photosynthesis.
24. In aerobic respiration, electrons move through the electron transport system from
- higher energy levels to lower energy levels.
  - more stable compounds to less stable compounds.
  - weak electron donors to stronger electron donors.
  - lower energy levels to higher energy levels.
25. The stimulus that activates the enzymes that convert pyruvate to lactate during a muscle contraction is
- high levels of oxygen.
  - low levels of oxygen.
  - high levels of ATP.
  - low levels of carbon dioxide.
26. The products of cellular respiration that leave the mitochondrion are:
- carbon dioxide, ATP, and water
  - NAD, FAD, and ATP
  - glucose, carbon dioxide, and water
  - water, ADP, and carbon dioxide

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27. Which of the following bests completes the statement below?

Statement: *When light is absorbed in a green plant*

- a. there is a transfer of electrons that results in the production of CO<sub>2</sub> and H<sub>2</sub>O.
  - b. electrons of chlorophyll are energized, and the energy is released to produce ATP and NADPH.
  - c. ATP is reduced to ADP, releasing energy that will be used in the grana to produce glucose.
  - d. photolysis takes place, eliminating the need for the Calvin-Benson cycle.
28. Aerobic and anaerobic cellular respiration are similar in that they both
- a. release energy from glucose.
  - b. produce O<sub>2</sub> as a waste product.
  - c. take place in the mitochondria.
  - d. result in the accumulation of lactic acid.
29. The word “photosynthesis” presumes a two-part process, one involving light energy, the other, the production of some molecule. A substance associated with each process respectively would be
- a. the formation of glucose; NADPH.
  - b. the formation of ATP; the reduction of carbon dioxide to produce glucose.
  - c. ribulose bisphosphate; rubisco.
  - d. the formation of O<sub>2</sub>; the release of CO<sub>2</sub>.

*Use the following information to answer the next question.*

### Pesticides and Herbicides

Rotenone is a herbicide used to kill parasitic mites on chicken and other fowl. Atrazine, diuron, and paraquat are herbicides that are used to eliminate unwanted plants (weeds). Hydrogen sulfide in small concentrations acts as a vasodilator and helps play a role in the memory of animals but, like cyanide, is deadly in high concentrations. All of these chemicals are lethal because they disrupt the electron transport system.

30. These chemicals directly or indirectly interfere with the ability of the affected organisms to
- a. produce ATP
  - b. utilize oxygen
  - c. utilize or produce carbon dioxide
  - d. all of the above are correct

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### Numerical Response Questions

- Record your answer on the answer sheet provided.
- If an answer is a value between 0 and 1 (e.g., 0.25), be sure to record the 0 before the decimal place.

*Use the following key to answer the next question.*

**KEY:**

- occurs in the chloroplast only
- occurs in the mitochondrion only
- occurs in both the chloroplast and mitochondrion
- occurs in neither the chloroplast nor mitochondrion

- Match the number from the Key above to the processes of chemiosmosis, fermentation, glucose synthesis, and the citric acid cycle. Record your **four-digit** answer in the numerical response section on the answer sheet.

**Number from**

**Key:**

**Process**

\_\_\_\_\_

**chemiosmosis**

\_\_\_\_\_

**fermentation**

\_\_\_\_\_

**glucose  
synthesis**

\_\_\_\_\_

**citric acid  
cycle**

*Use the following information to answer the next question.*

**Chromatography**

In an investigation to identify the pigments found in the leaves of a species of plant, the pigments were extracted and separated using chromatography. The process was carried out for a period of 1 hour, and the solution migrated a total distance of 11.6 cm. The following results were obtained:

**Distance each substance moved**

Substance	Distanced Travelled (cm)	R <sub>f</sub> Value
A	4.9	
B	11.4	
C	1.74	
D	6.8	

**R<sub>f</sub> Values of Certain Plant Pigments**

Pigment Number	Pigment	R <sub>f</sub> Value
1	carotene	0.98
2	chlorophyll a	0.59
3	pheophytin	0.47
4	chlorophyll b	0.42
5	xanthophyll 1	0.28
6	xanthophyll 2	0.15

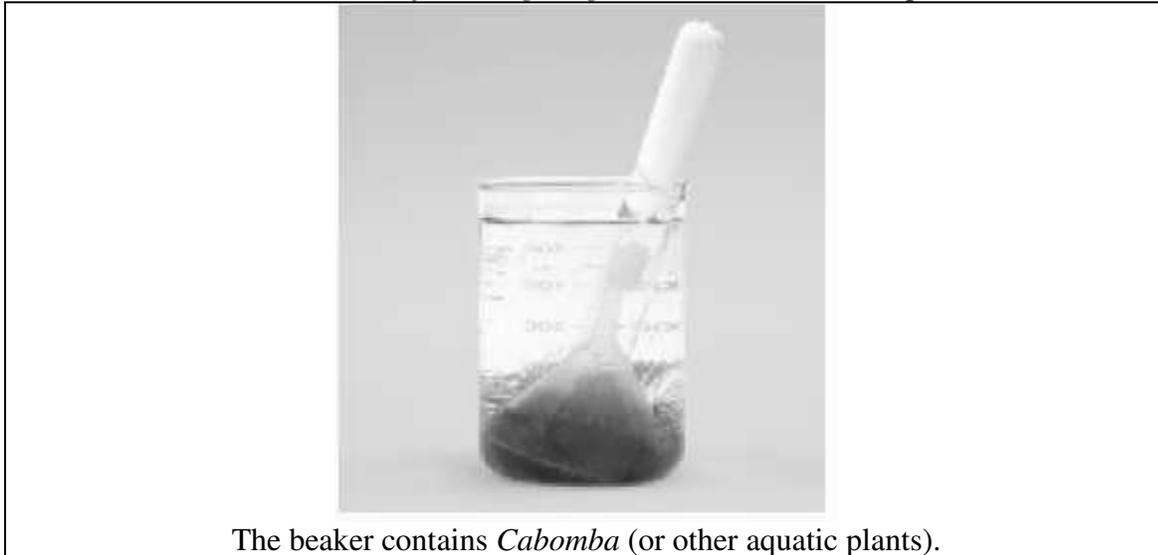
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2. Match the  $R_f$  value of the known pigments to those that you calculated for substances A, B, C, and D. Record your **four-digit** answer in the numerical response section on the answer sheet.

**Pigment #:** \_\_\_\_\_  
**Unknown**  
**Substance:**      **Substance A**      **Substance B**      **Substance C**      **Substance D**

### Written Response

Use the following diagram to answer the next question.



1. Using the apparatus shown above, including a beaker, funnel, and test tube, and any other materials normally found in a high school laboratory, design an investigation that quantitatively shows the effect of light intensity on the rate of photosynthesis in aquatic plants.
- a) Your experimental design should include a **list** of all of the materials that you would need to conduct your investigation as well as a **list** of the safety precautions you would have to follow. (6 marks)

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- e) **Sketch** a graph of the expected results, and **provide** a rationale for your expectations. (5 marks)