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**VCE Biology  $\frac{3}{4}$**   
**Cellular Respiration and Anaerobic Fermentation [2.2]**  
**Test**

**42 Marks. 1 Minute Reading. 34 Minutes Writing.**

Results:

Test Questions	_____ / 34
Extension	_____ / 8



## Section A: Test Questions (34 Marks)

### Question 1 (5 marks)

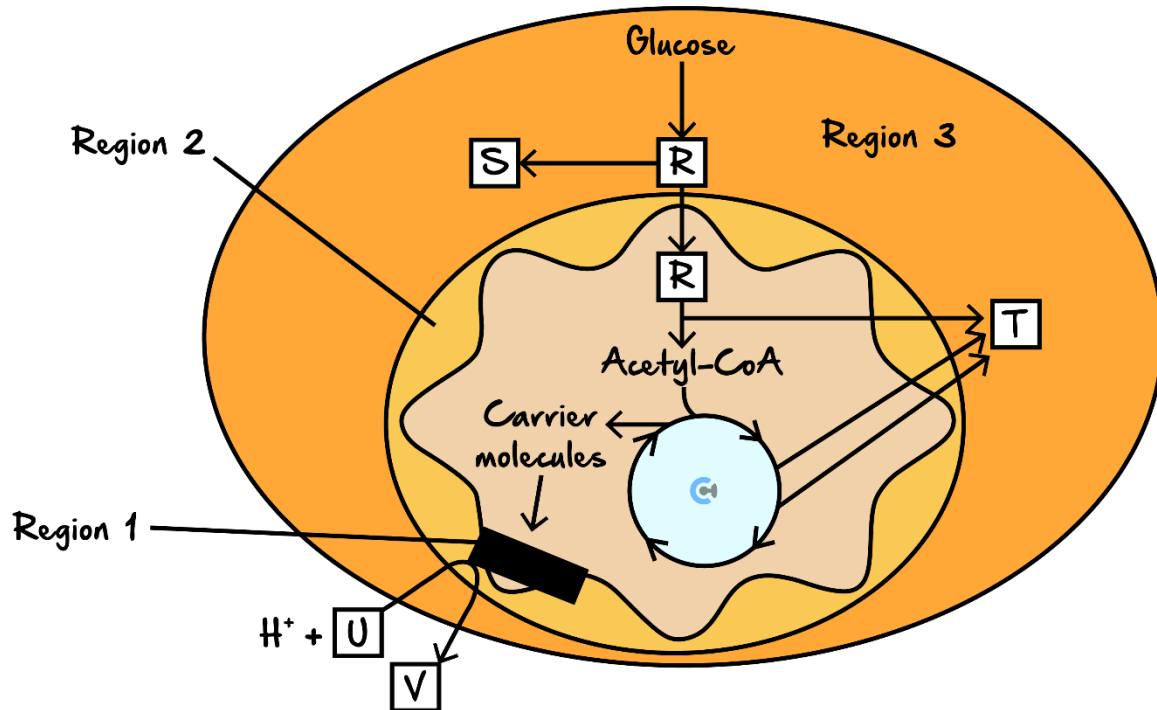
Tick whether the following statements are **True** or **False**.

	True	False
a. The main output of glycolysis is the production of 4 ATP molecules.		
b. The Krebs cycle occurs in the mitochondrial matrix.		
c. Lactic acid fermentation in animals occurs in the mitochondria.		
d. NADH and FADH <sub>2</sub> are electron carriers that donate electrons to the Electron Transport Chain.		
e. Anaerobic fermentation produces more ATP than aerobic cellular respiration.		
f. The cristae of the mitochondria increase the efficiency of ATP production by providing more surface area for the Electron Transport Chain.		
g. In yeast, pyruvate is converted into ethanol and carbon dioxide during anaerobic fermentation.		
h. Oxygen is the final electron acceptor in the Electron Transport Chain during aerobic respiration.		
i. Biofuels are considered non-renewable because they are derived from fossil fuels.		
j. Temperature has no impact on the rate of cellular respiration.		

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The following information applies to the four questions that follow

There are a number of ways in which an animal cell is able to use compounds such as glucose to produce the energy that it needs to be able to function. The diagram below outlines the general metabolic pathways for cellular respiration in an animal cell.



**Question 2** (1 mark)

Which process occurs in **Region 2** of the diagram?

- A. Glycolysis
- B. Krebs cycle
- C. Electron Transport Chain
- D. Alcoholic fermentation

**Question 3** (1 mark)

What is the role of acetyl-CoA as shown in the diagram?

- A. It acts as the final electron acceptor in the Electron Transport Chain.
- B. It is an intermediate product that enters the Krebs cycle.
- C. It is a byproduct of glycolysis in the cytoplasm.
- D. It is a molecule that carries oxygen to the mitochondria.

**Question 4** (1 mark)

What is represented by **Region 1** in the diagram?

- A. Cytoplasm where glycolysis occurs.
- B. Matrix of the mitochondria where the Krebs cycle takes place.
- C. Cristae of the mitochondria where the Electron Transport Chain operates.
- D. Nucleus of the cell where transcription happens.

**Question 5** (1 mark)

Which of the following gives the correct names of compounds **S**, **T**, and **U**, shown in the first diagram above?

	<b>S</b>	<b>T</b>	<b>U</b>
A.	Glucose	NADH	ATP
B.	Glucose	Carbon dioxide	Oxygen
C.	Pyruvate	NADH	Oxygen
D.	Pyruvate	Carbon dioxide	ATP

**Question 6** (1 mark)

Fermentation of grapes is used in agriculture to produce wine. The bottles are tightly sealed and make a noticeable 'pop' when opened, with bubbles forming throughout the liquid. The bubbles are due to:

- A. Oxygen being produced in the electron transport chain.
- B. Carbon dioxide and lactic acid being produced.
- C. Carbon dioxide being produced in the breakdown of glucose.
- D. The splitting of water in the light dependent stage of photosynthesis.

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**Question 7** (1 mark)

The action of ATP synthase decreases when the ATP concentration is high. One consequence in human cells is that the rate of anaerobic respiration increases.

Which one of the following consequences would be expected to occur due to the increase in the rate of anaerobic respiration?

- A. Oxygen intake will increase.
- B. Ethanol concentration in cells will increase.
- C. Lactic acid concentration in cells will increase.
- D. Carbon dioxide concentration in cells will increase.

**Question 8** (1 mark)

E10 fuel, sold at most Victorian service stations, contains:

- A. Alcohol from fermentation of sugar cane mixed with petroleum.
- B. Synthetic petroleum produced by genetically modified *E coli* bacteria.
- C. Transesterified lipids, made by reacting vegetable oils with ethanol.
- D. Petrol which has been modified by an enzyme to reduce the toxicity of exhaust.

**Question 9** (1 mark)

Glycolysis is part of aerobic respiration. Glycolysis:

- A. Is the second stage of aerobic respiration.
- B. Can only occur when mitochondria are present.
- C. Results in the formation of pyruvate.
- D. Releases three molecules of ATP for each glucose molecule used up.

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**Question 10** (1 mark)

Cellular respiration can be summarised in one chemical equation but this is a shorthand way of representing many chemical reactions that occur in a series of stages.

Which statement concerning the stage of electron transport is correct?

- A.** For each glucose molecule that enters the Krebs cycle, five loaded acceptor molecules enter the electron transport reactions.
- B.** Electron transport occurs on the outer membrane of the mitochondria.
- C.** Electrons from the loaded acceptor molecules enable oxygen to combine with hydrogen to form water.
- D.** For each molecule of glucose consumed in glycolysis, 36 ATP molecules are produced in the electron transport reactions.

**Question 11** (1 mark)

Fungal cells produce energy through anaerobic respiration. The products of anaerobic respiration, in this example, include:

- A.** Carbon dioxide, water and ATP.
- B.** Glucose, oxygen and water.
- C.** NADH, carbon dioxide and ATP.
- D.** Ethanol, carbon dioxide and ATP.

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## Sub-Section: Short Answer Questions

### Question 12 (8 marks)

2,4-dinitrophenol is a chemical that is toxic to mitochondria. When added to mitochondria this chemical allows electron transport to occur but prevents the phosphorylation of ADP to ATP. The chemical achieves this by breaking the essential link between electron transport and ATP synthesis. This toxin causes mitochondria to produce heat instead of ATP. The greater the amount of toxin added, the quicker its action.

- a. If mitochondria are poisoned with 2,4-dinitrophenol by what process could a plant cell produce more ATP? (1 mark)

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- b. Where in the mitochondria does electron transport and ATP production occur? (1 mark)

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A researcher wanted to study cellular respiration in insect cells. She cultured some muscle cells from the common field cricket, *Teleogryllus oceanicus*, and then studied the effects of adding 2,4-dinitrophenol to these cells. An agricultural company may want to fund this research.

- c. Give one reason why an agricultural company might want to fund research on the effects of this toxin on field crickets. (1 mark)

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The Experiment is summarised in the table below. Temperature observations in each trial were made at equal time intervals.

Observations made at equal time intervals	Temperature °C		
	Control (no 2,4-dinitrophenol)	Trial 1 (2,4-dinitrophenol added)	Trial 2
1 (start)	28	28	28
2	27	28	29
3	28	29	
4	29	31	
5	28	36	
6	28	23	
7	27	21	

**d.** In terms of energy production, why did the temperature go up in trial 1 and not in the control? (1 mark)

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**e.** Explain why the temperature went down after the fifth observation in trial 1. (1 mark)

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**f.** Trial 2 had twice the concentration of 2,4-dinitrophenol added. Compare the table by writing in temperatures in the spaces provided to predict the trend. (2 marks)

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Another researcher suggested adding pyruvate to the cells to cancel out the effects of this toxin.

- g. Explain what effect adding pyruvate would have on cancelling out the effect of this toxin. (1 mark)

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**Question 13** (3 marks)

- a. Write the word or chemical equation for aerobic cellular respiration. (1 mark)

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- b. Cyanide inactivates metabolic reactions at the cristae of mitochondria. Cyanide poisoning often results in death. Explain why. (2 marks)

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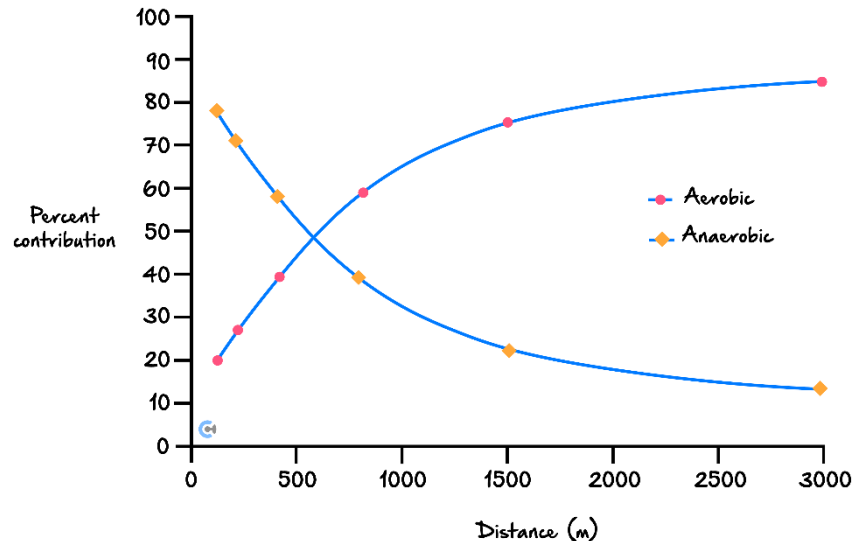
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**Question 14** (8 marks)

Elite runners use both anaerobic and aerobic systems to complete their running events. A series of measurements of the anaerobic and aerobic contributions over distances ranging from 100 m to 3000 m of elite male runners were made. The runners exercised as intensely as possible and the data gained is illustrated in the graph below.



- a.
- What is the balanced chemical equation for aerobic respiration? Include any energy conversions that are part of the reaction. (2 marks)
  - Describe one difference between anaerobic and aerobic respiration. (1 mark)
  - How far would an athlete need to run if he was depending equally on the contribution of aerobic and anaerobic respiration? (1 mark)

- b. Explain which system elite athletes rely on when completing a 3000 *m* race. (2 marks)

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Elite runners are always looking for new training strategies to improve their performance in particular running events. Coaches help to develop training schedules that provide an opportunity for better results.

- c. Describe a training schedule that could be offered to an elite 100 *m* athlete to improve their performance. Use the data gained from the graph to support your answer. (2 marks)

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**Section B: Extension (8 Marks)****Question 15** (8 marks)

Wine is traditionally produced in glass bottles sealed with a cork. When a bottle of wine is opened, the cork is often sniffed to detect whether the wine has 'gone off'. This is usually caused by the cork not sealing the bottle correctly and air getting in. Wine that has 'gone off' will have an unpleasant smell, and will also have little or no alcoholic content.

- a.** Name the process that would normally occur within the wine to produce the alcohol. (1 mark)

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- b.** Explain what occurs when the wine has access to air due to the presence of a poor-quality cork. (2 marks)

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- c.** Write a word equation for the process identified in **part b.** (1 mark)

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- d.** Suggest a reason why the normal process of alcohol production is less likely to occur once air has entered the wine bottle. (3 marks)

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- e. Wine rarely exceeds 14% alcohol content despite there being an excess of natural sugars available and many years of storage. Suggest what occurs during this process that limits the alcohol content. (1 mark)

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