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BIOLOGY

ENERGY TRANSFERS IN & BETWEEN ORGANISMS

Level & Board	AQA (A-LEVEL)
TOPIC:	RESPIREATION
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	6
TOTAL MARKS	32

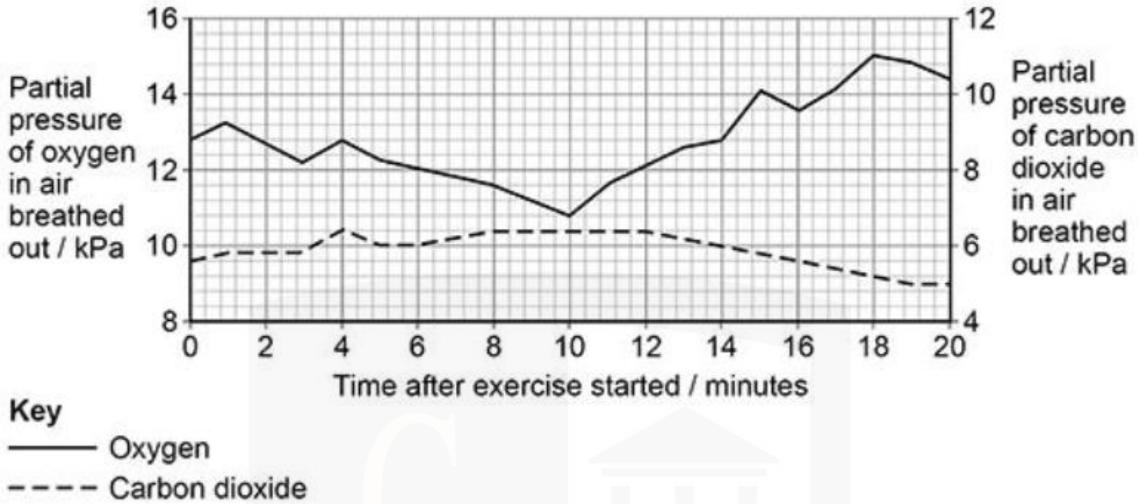
Respiration - 2

1.

(a) What are the benefits of the Bohr effect when engaging in vigorous exercise? **(2)**

(b) A cyclist used an exercise bike to accomplish a fitness test. Every ten seconds, the exercise intensity was raised. When he was unable to complete another cycle, the test was over. Measurements were made of the partial pressures of carbon dioxide (pCO_2) and oxygen (pO_2) in exhaled air.

The cyclist fitness test results are displayed in the graph below.



The moment at which anaerobic respiration becomes more necessary to sustain muscular contraction because aerobic respiration is no longer sufficient is known as the ventilatory threshold, or VT.

(b) When there is an increase in pO_2 exhaled without a corresponding increase in pCO_2, VT can be recognized as the initial point.

Calculate the amount of time the cyclist reached VT after the exercise began using the graph above.

Determine the current breath-out air pO_2 to pCO_2 ratio.

Display your work. **(2)**

Time when the cyclist reached VT = __________ min

Ratio of pO2 to pCO2 at VT = _____ :1

(c) The amount of carbon dioxide produced during exercise increases as exercise intensity does.

The graph above, however, demonstrates that there was not a significant rise in the pCO_2 in the air that was exhaled throughout the activity.

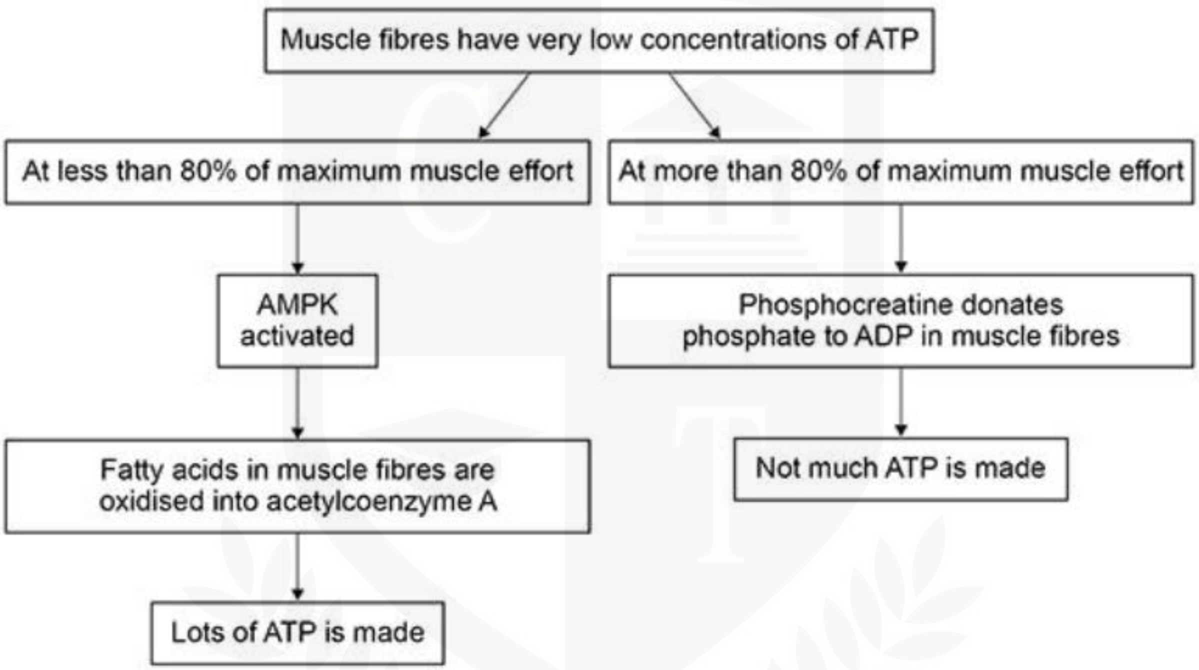
Name one physiological alteration that might lead to this outcome. Describe how the physiological shift would enable the increased amount of carbon dioxide produced to be eliminated. **(2)**

The following are possible sources of ATP for muscle fibers in situations where their ATP concentrations are very low.

• An enzyme called AMPK oxidizes fatty acids.

• In anaerobic environments, phosphocreatine contributes phosphate to ADP.

This chemical mechanism is depicted in the diagram below.



(d) ATP production is time-limited when exerting muscles above 80% of their maximal potential.

Provide one explanation for this using the above diagram**. (1)**

Tick (✓) the correct box.

ATP cannot move into muscle fibres at a fast-enough rate.	☐
Muscle fibres have a limited amount of phosphocreatine.	☐
Muscle fibres produce too much lactate.	☐
Muscle fibres quickly run out of ADP.	☐

2.

(a) Drug GW1516 is used to improve performance. GW1516 generates slow muscle fibers during rest by activating AMPK.

Explain why professional athletes aren't permitted to take GW1516 using the above diagram.

In your response, do not get into specifics of chemiosmotic theory. **(4)**

Another medication that improves performance is EPO. The hematocrit the proportion of red blood cells in blood may rise as a result.

(b) The coronary arteries failure to supply enough glucose and oxygen to the heart muscle results in a heart attack. The risk of a heart attack can rise with excessive EPO use.

Suggest how? **(2)**

3.

(a) For male humans, the typical hematocrit is 47(±5)%. The maximum permissible hemoglobin percentage for male professional riders is 50%.

Professional male cyclists should be permitted to use EPO until their hemoglobin level is 50%, according to a student's suggestion.

Give two arguments against the validity of this proposition. **(2)**

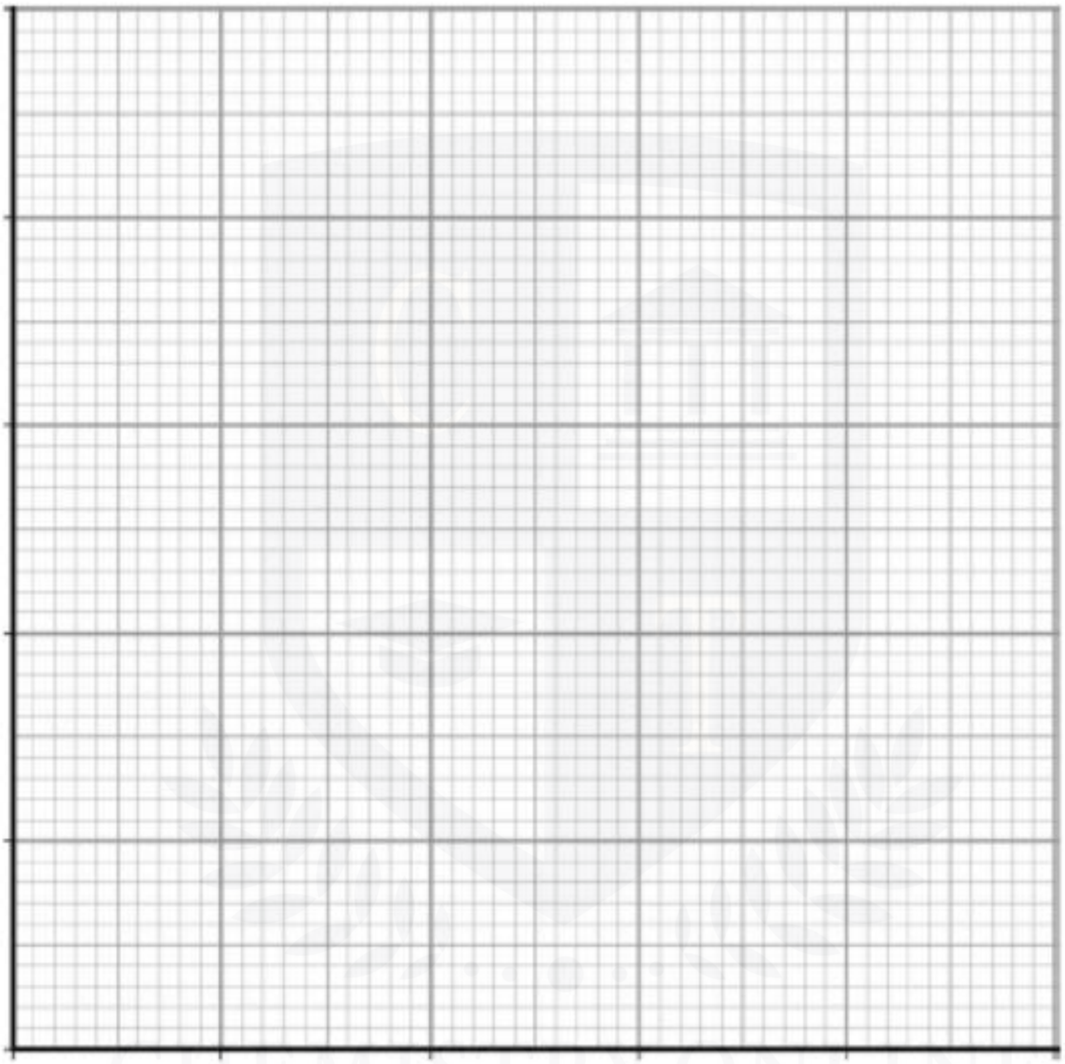
4.

(a) Three groups of the same kind of insects were used to measure the rate at which carbon dioxide was released by scientists at 10 °C, 20 °C, and 30 °C. Additionally, they ascertained the average mass of every insect group.

The table displays the scientist findings.

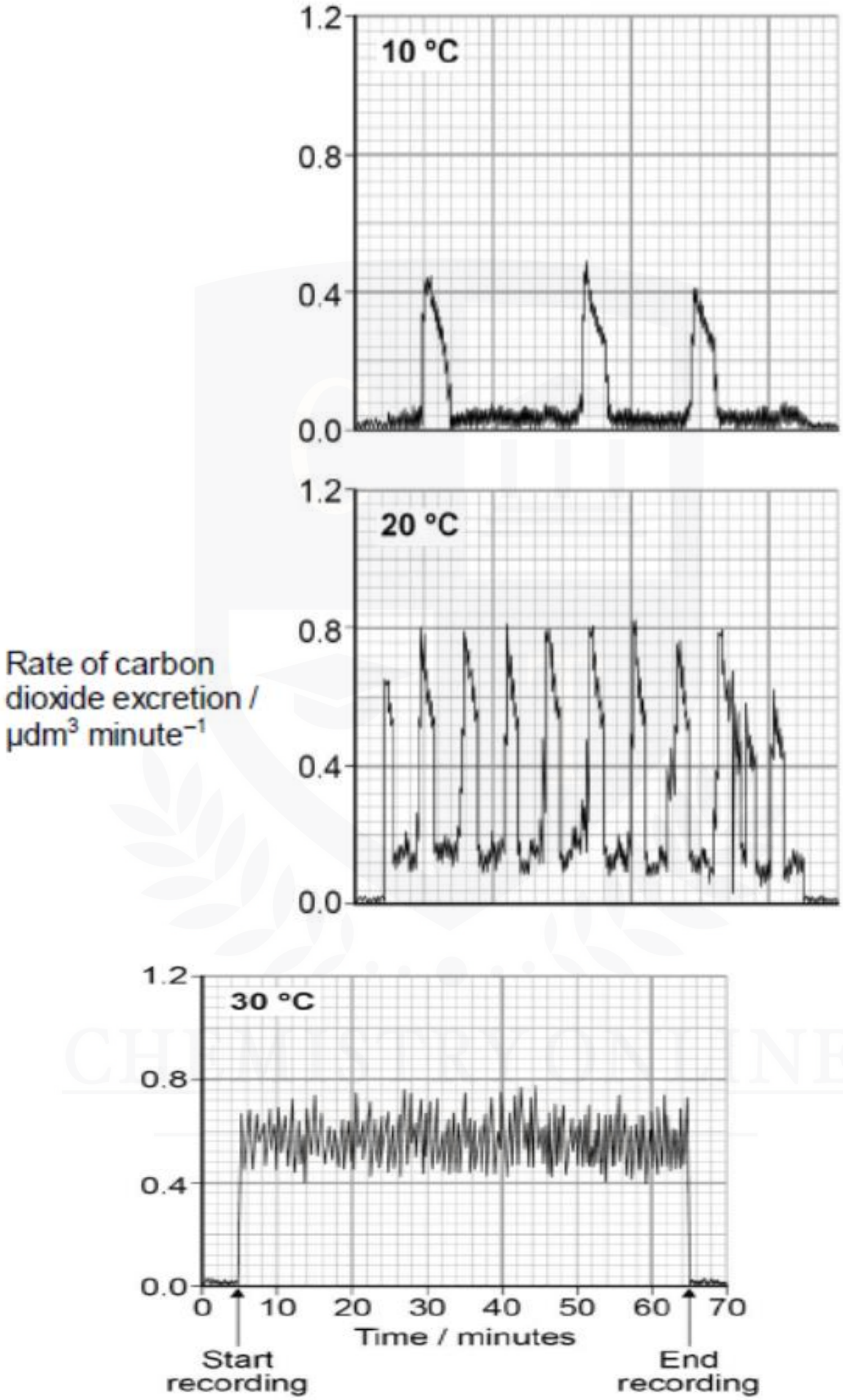
Temperature / °C	Mean mass / g	Rate of carbon dioxide release / µdm³ minute⁻¹	Rate of carbon dioxide release per gram / µdm³ g⁻¹ minute⁻¹
10	0.047	0.12	
20	0.046	0.33	
30	0.048	0.56	

(a) Fill in the above table, then use the graph paper to create a graph showing your computed values against temperature. Make sure you include the right number of significant digits in your estimated rates. **(3)**



The temperature at which the insects were housed had a significant impact on their body temperature. The scientists timed the pace at which individual flies released carbon dioxide at each temperature. The opening or closure of spiracles determines this rate.

Three insects results are displayed in the graphs below.


10 °C
20 °C
30 °C
Rate of carbon dioxide excretion / µdm³ minute⁻¹
1.2
0.8
0.4
0.0
0
10
20
30
40
50
60
70
Time / minutes
Start recording
End recording

(b) Determine the difference in the spiracle opening rate per hour between 10 and 20 degrees Celsius. **(1)**

(c) Describe how you arrived at the total amount of carbon dioxide released at 30 °C during the recording time**. (1)**

(d) Provide a rationale for the relationship between temperature and carbon dioxide emission rate. **(3)**

5.

(a) Explain the formation of acetylcoenzyme A in the link reaction. **(2)**

Six-carbon citrate is created in the Krebs cycle when acetylcoenzyme A interacts with four-carbon oxaloacetate. The enzyme citrate synthase is responsible for catalyzing this reaction.

(b) The first substrate that the enzyme citrate synthase binds to is oxaloacetate. This causes an alteration in the enzyme that permits the binding of acetylcoenzyme A.

Describe the process by which oxaloacetate allows acetylcoenzyme A to attach to the enzyme. **(2)**

(c) One other component of the Krebs cycle is known as succinyl coenzyme A. This material resembles acetylcoenzyme A in form.

Explain how the rate of the reaction that citrate synthase is catalyzing could be regulated by the synthesis of succinyl coenzyme A. **(2)**

6.

During anaerobic respiration, pyruvate is changed into lactate in muscles.

(a) Describe how the process of converting pyruvate to lactate permits anaerobic respiration to continue producing ATP. **(2)**

(b) When muscles receive enough oxygen, part of the lactate is transformed back into pyruvate. Name one benefit that this has. **(1)**

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