Additional Assessment Materials Summer 2021

Pearson Edexcel GCE (Biology A)

Resource Set Topic 5: Run for your Life

Question Paper

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

2 A spirometer can be used to study the performance of an athlete.

snabbiology.wordpress.com

The trace produced by a spirometer can be used to determine the respiratory minute ventilation and the oxygen consumption of an individual.

(a) Describe how a spirometer trace can be used to calculate the respiratory minute ventilation and the oxygen consumption per minute.

(4)

respiratory minute ventilation

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oxygen consumption per minute

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(b) A student compared the spirometer trace for a pair of healthy, genetically identical twins.

State two variables that would have to be controlled to make this a valid comparison.

(2)

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(Total for Question 2 = 6 marks)

4 A moderate amount of exercise is considered good for the human body.

(a) A student carried out 20 minutes of physical exercise. During this time, her heart rate and level of sweating increased.

Shortly after completing the exercise, the student noted that her heart rate and level of sweating decreased.

(i) Explain the role of the brain in reducing the student's heart rate after the exercise.

(2)

(ii) Describe how the brain reduces the activity of the sweat glands after the exercise.

(2)

(b) Explain why too much exercise could be harmful to the human body.

(3)

(Total for Question 4 = 7 marks)

5 Muscle fibres contain a number of proteins, including actin, myosin and collagen.

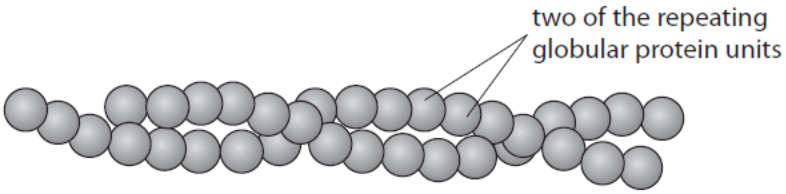
(a) The myosin binding site is found on

(1)

- ☒ **A** actin
- ☒ **B** sarcoplasmic reticulum
- ☒ **C** tropomyosin
- ☒ **D** troponin

(b) Actin and collagen are both proteins.

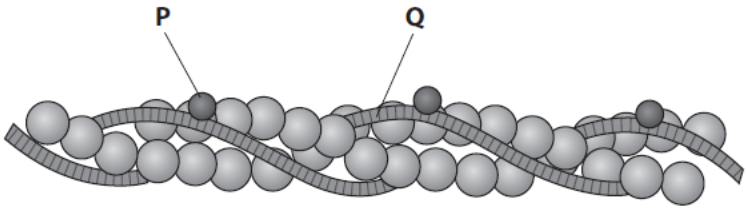
The diagram shows two filaments of actin from a muscle fibre. Each filament is a polymer of repeating globular protein units.



Compare and contrast the structures of an actin filament and collagen.

(3)

(c) The diagram shows actin and other components (P and Q) of a thin filament in a myofibril.



(i) Describe the interaction between P and Q that allows muscle contraction.

(2)

(ii) The thick filament in a myofibril contains myosin. The myosin head contains the enzyme ATPase.

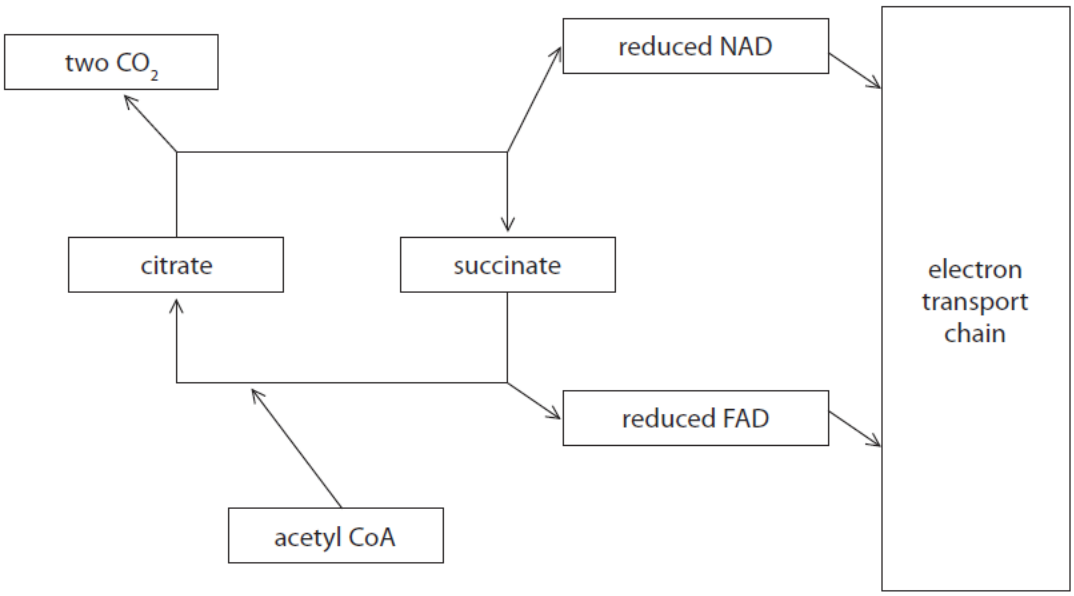
Explain the importance of the primary structure for the functioning of this enzyme.

(3)

(Total for Question 5 = 9 marks)

10 Respiration occurs in all healthy living cells.

(a) The diagram shows part of the Krebs cycle and the electron transport chain.



(i) Which row shows the number of carbon atoms in citrate and succinate?

(1)

		Number of carbon atoms in	
		citrate	**succinate**
☒	**A**	2	4
☒	**B**	5	4
☒	**C**	6	4
☒	**D**	6	8

(ii) Which of the following is transferred to a molecule of FAD to form reduced FAD?

(1)

☒ **A** two oxygen atoms

☒ **B** two hydrogen atoms

☒ **C** one oxygen atom and one hydrogen atom

☒ **D** one water molecule

(iii) Explain the need for reduced NAD to be oxidised in a mitochondrion.

(2)

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(iv) A mutation in the gene that codes for the enzyme succinate dehydrogenase stops the conversion of succinate into citrate.

Which row states the change in concentration of citrate and reduced FAD as a result of this mutation?

(1)

	Concentration of citrate	Concentration of reduced FAD
☒ **A**	decreases	decreases
☒ **B**	decreases	increases
☒ **C**	increases	decreases
☒ **D**	increases	increases

(Total for Question 10 = 5 marks)

5 Athletic competitions often take place during the summer months when ambient temperatures are high.

High ambient temperatures affect marathon runners.

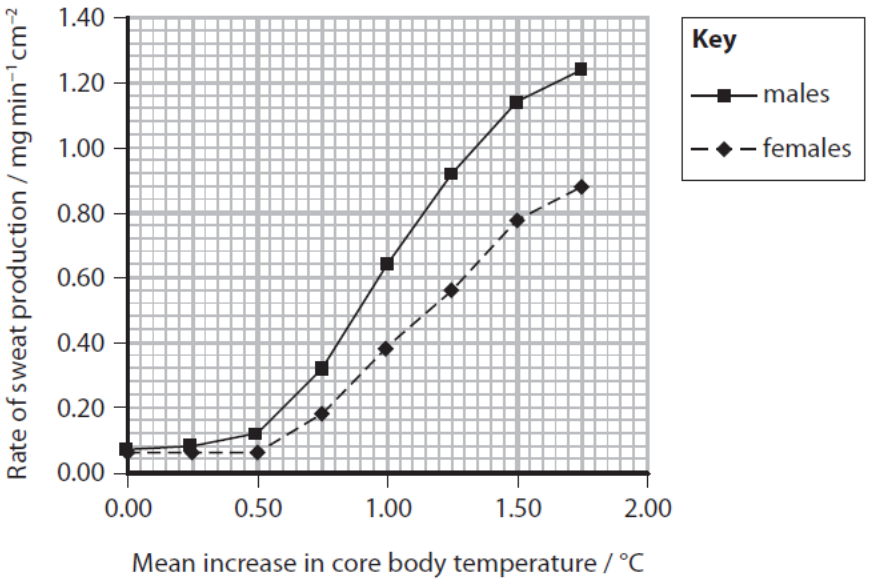
Heat stress occurs when the core body temperature rises above 40 °C.

(a) Describe how thermoregulatory mechanisms are controlled to help marathon runners avoid heat stress.

(4)

(b) Physical and physiological differences between males and females affect thermoregulation.

The graph shows the effect of a mean increase in body temperature on the rate of sweat production by males and females.



Female marathon runners have smaller bodies, with a larger ratio of skin surface to body mass than males.

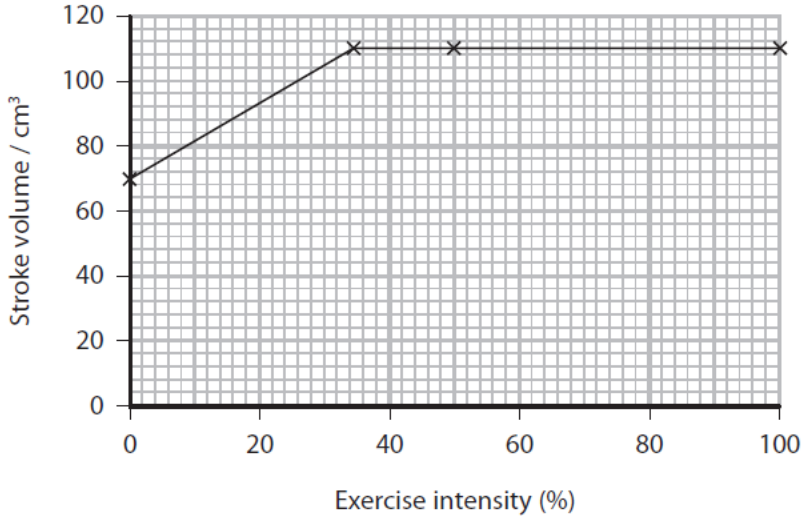
Male marathon runners have less body fat than females: 5 –11% compared with 10 –15%.

Comment on how gender could affect thermoregulation in marathon runners.

(4)

(c) When running a marathon, both heart rate and stroke volume increase.

The graph shows the effect of exercise intensity on stroke volume for marathon runners.



(i) Cardiac output is the product of stroke volume and heart rate.

During a race, a marathon runner's exercise intensity increased from 0 to 100%. The table shows the effect on the runner's heart rate.

Exercise intensity (%)	Heart rate / bpm
0	55
100	160

Calculate the increase in cardiac output for a marathon runner during a race.

Give your answer in $dm^3 min^{-1}$.

(2)

..... $dm^3 min^{-1}$

(ii) Explain why it is necessary for the cardiac output of marathon runners to increase during a race.

(2)

(Total for Question 5 = 12 marks)

7 The arctic ground squirrel (*Spermophilus parryii*) lives in Alaska. It has small ears, a cylindrical body and a shorter tail than other species of ground squirrel.

The arctic ground squirrel can survive cold winters by hibernating for up to eight months per year. When hibernating, arctic ground squirrels use stored fat supplies as an energy source.

www.sciencephoto.com

(a) Which combination of adaptations shown by the arctic ground squirrel have been described?

(1)

☐ **A** anatomical and behavioural only

☐ **B** anatomical and physiological only

☐ **C** anatomical, behavioural and physiological

☐ **D** behavioural and physiological only

(b) During hibernation, the core body temperature of an arctic ground squirrel can fall from 37 °C to −3 °C.

The table shows the effect of air temperature on the metabolic rate in the arctic ground squirrel.

Air temperature / °C	Metabolic rate / cm^3 oxygen g^{-1} $hour^{-1}$
−16	0.18
−8	0.08
−4	0.04
0	0.02
4	0.02
8	0.02
12	0.02

(i) Calculate the change in metabolic rate for an arctic ground squirrel, with a body mass of 850g, as the air temperature increases from −16 °C to 4 °C.

Give your answer in dm^3 oxygen day^{-1}.

(3)

..... dm^3 oxygen day^{-1}

(ii) When the air temperature was –4 °C, the respiratory quotient (RQ) for the arctic ground squirrel was calculated as 0.77.

The RQ value can indicate the respiratory substrate as shown in the table.

RQ value	Respiratory substrate
1.0	Carbohydrate
0.9	Protein
0.7	Lipid

Intermediate values indicate a mixture of respiratory substrates.

Which of the following respiratory substrates were used by the arctic ground squirrel when the air temperature was –4 °C?

(1)

☒ **A** carbohydrate and protein

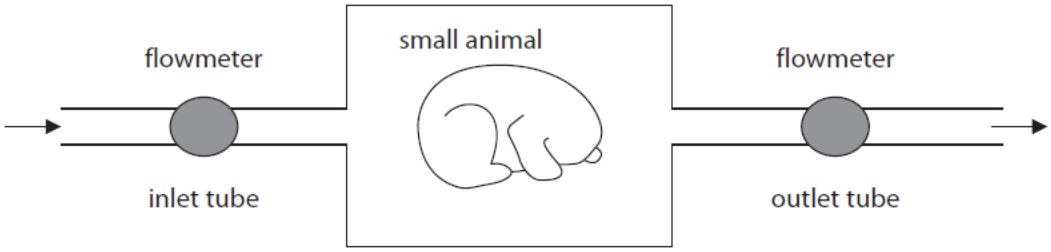
☒ **B** lipid only

☒ **C** lipid and protein

☒ **D** protein only

(iii) The data for calculating metabolic rate are collected using a respirometer.

The rate of respiration for small mammals can be measured using a continuous flow respirometer. A continuous flow respirometer circulates air through a chamber containing the animal. The rate of air flow can be measured using flowmeters on the inlet and outlet tubes.



Devise a procedure using a continuous flow respirometer to collect the data required to calculate the metabolic rate of an arctic ground squirrel.

(4)

(Total for Question 7 = 9 marks)

TOTAL FOR TEST = 48 MARKS