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BIOLOGY

ORGANISMS RESPOND TO CHANGES IN ENVIRONMENTS

Level & Board	AQA (A-LEVEL)
TOPIC:	SKELETAL MUSCLES
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	6
TOTAL MARKS	26

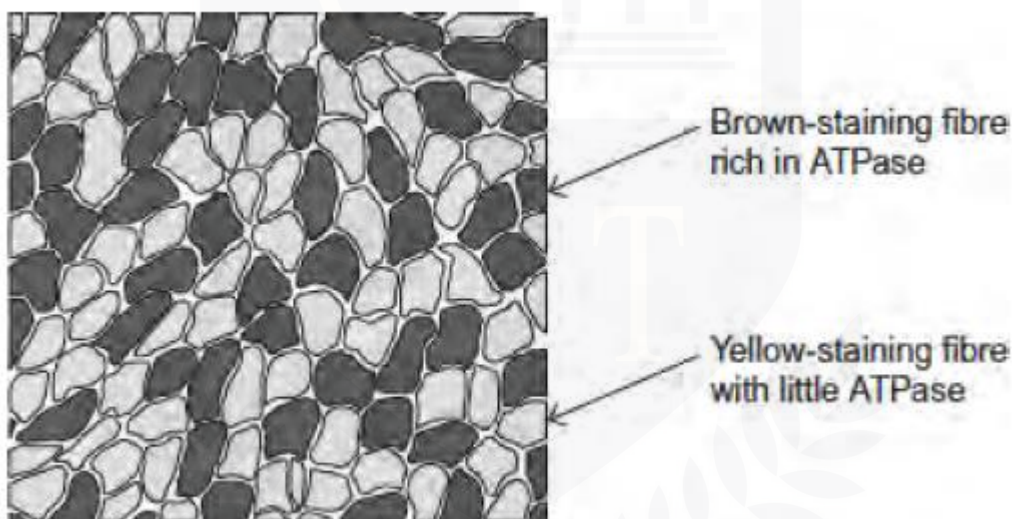
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Skeletal Muscles - 2

1.

Although in differing amounts, slow and rapid muscle fibers are present in both types of skeletal muscles. Under a microscope, muscle sections that have been stained can be used to determine the percentage. An ATPase enzyme is reacted with by the dye employed. Muscle fibers rich in this ATPase have a brown stain. Fibers with low ATPase content show yellow staining.

Muscle fibers stained with a dye are displayed in a portion of the muscle in the diagram.



(a) ATPase is present in both slow and rapid muscle fibers.

Describe your reasoning. (2)

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(b) The muscle tissue depicted in the diagram had a significant percentage of fibers that stained brown. Was it slow or rapid skeletal muscle from which the tissue was removed?

Give an explanation for your response. **(1)**

(c) In the diagram, the muscle tissue had been dyed such that a microscope could observe it.

What proof exists that it was dyed such that an optical (light) microscope could observe it? Give an explanation for your response. **(2)**

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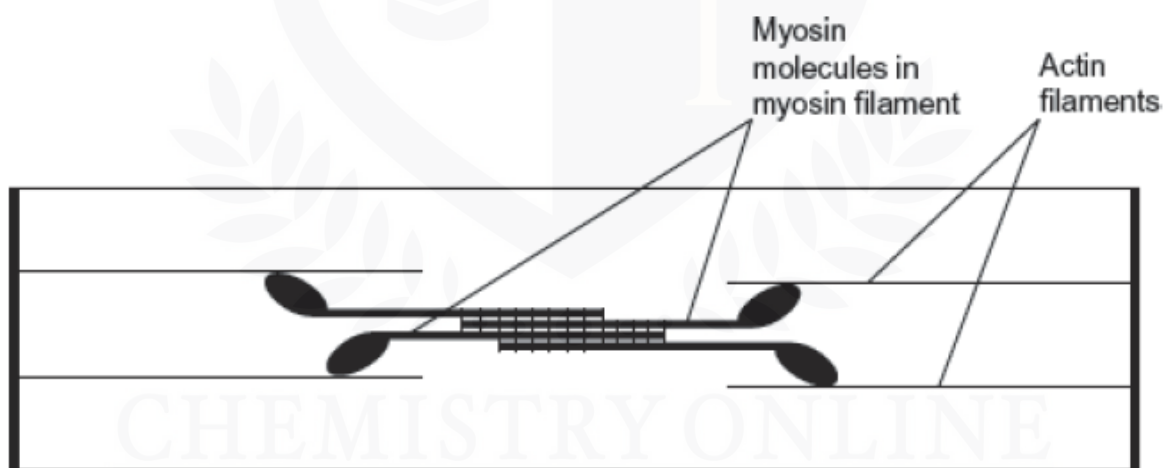
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Several molecules make comprise a sarcomere.

Name the molecule that performs the specified function to complete the table. **(3)**

Function	Name
Attaches to Z line at the end of the sarcomere	
Breaks down ATP	
Covers binding site on actin in relaxed myofibril	

(b) The actin and myosin arrangements within a sarcomere are depicted in the diagram.



A mutant gene allele is the cause of one type of muscle illness. As a result, myosin molecules that cannot attach to other myosin molecules are produced.

Muscle contraction is impeded if myosin molecules are unable to attach to one another. Make suggestions for why using the diagram and your understanding of how muscles contract. **(3)**

3.

(a) Researchers looked at whether aging affects the blood flow to the fast and slow muscle fibers of an organism. They made use of *Mesocricetus auratus*, or hamster, diaphragms. Breathing requires continuous activation of the diaphragm. They removed the diaphragms from hamsters that were young, elderly, and adult.

Each animal's diaphragm was removed, and a sample of muscle tissue was collected. They used an optical (light) microscope to study it. They arbitrarily chose many fields of view for every sample. They then counted the number of capillaries connected to each kind of muscle fiber in each field of view.

This made it possible for the researchers to determine the average number of capillaries in each age group for every kind of muscle fiber.

The standard deviation (SD) of the researchers' findings is displayed in the table below.

Hamster age group	Number of hamsters in group	Mean number of capillaries associated with each type of muscle fiber	
		Slow fibres (\pm SD)	Fast fibres (\pm SD)
Young	9	3.4 (\pm 0.8)	4.0 (\pm 0.8)
Adult	10	4.7 (\pm 0.2)	6.3 (\pm 0.4)
Old	8	4.6 (\pm 0.9)	6.8 (\pm 0.6)

(a) Describe the four safety measures the researchers implemented to ensure the accuracy of their mean capillary number per fiber estimations. **(4)**

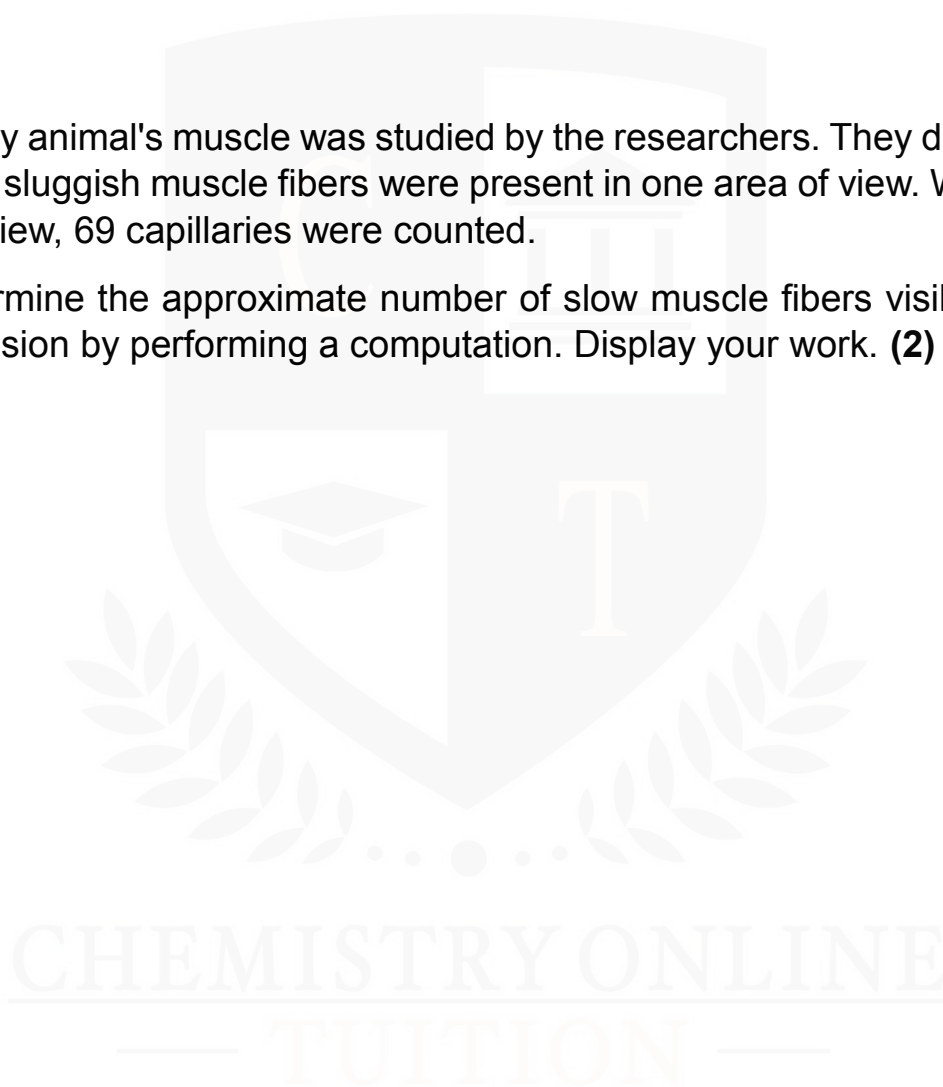
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4.

An elderly animal's muscle was studied by the researchers. They discovered that only sluggish muscle fibers were present in one area of view. Within this area of view, 69 capillaries were counted.

(a) Determine the approximate number of slow muscle fibers visible in this field of vision by performing a computation. Display your work. **(2)**



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(b) The number you computed in question (a) did not match the actual number of slow muscle fibers in the field of view.

Give a single explanation for this. **(1)**

5.

The investigation report by the researchers was read by a student. Despite her belief that the probe was immoral, she believed that a conclusion could still be reached.

(a) Explain her reasoning for believing the probe to be unethical. **(1)**

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(b) She came to the conclusion that the mean number of capillaries per fiber was significantly influenced by age.

Consider this conclusion. **(4)**



6.

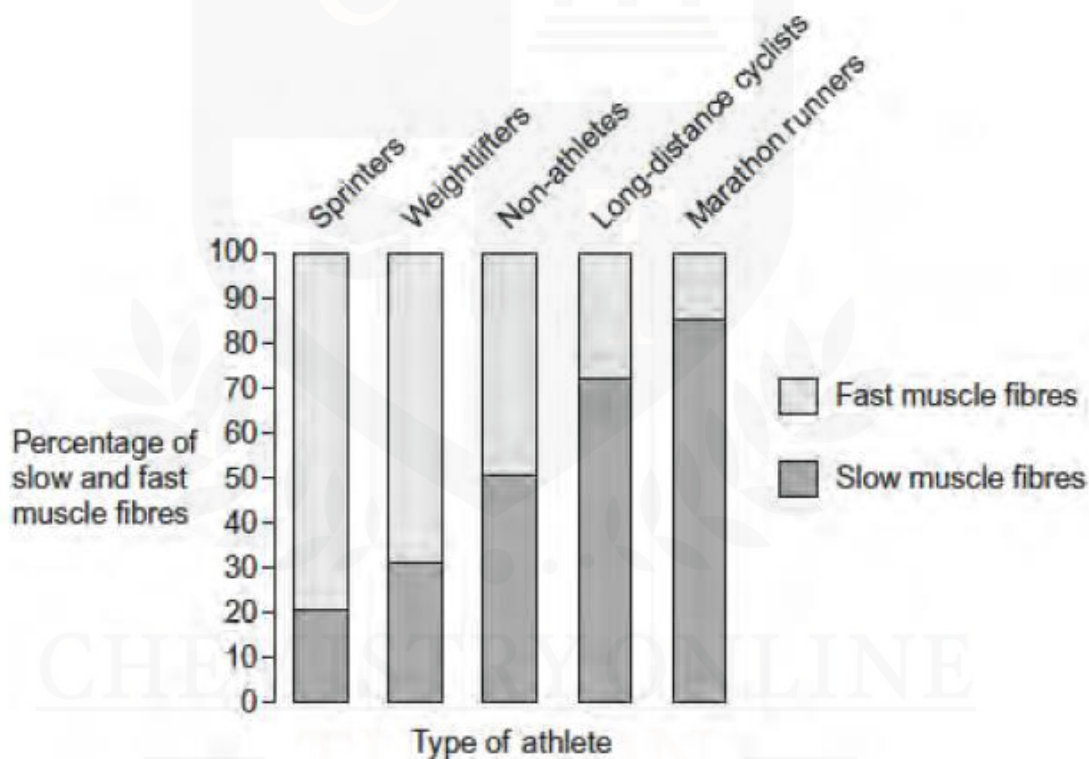
It is thought that each person's skeletal muscles have a specific proportion of fast and slow muscle fibers from birth. The majority of people have 50% fast fibers and 50% slow fibers.

A sports scientist questioned whether these percentages would vary over time based on the kind of sport a person participated in. From earlier studies, he was aware that:

- the number of mitochondria in a fiber can vary;
- a fiber's diameter can vary; and
- the total number of muscle fibers in a skeletal muscle doesn't change over time.

He calculated the average proportions of fast and slow fibers in the skeletal muscles of various sportsmen.

The graph that follows displays his findings in the format that he provided.



(a) Which kind of athlete would the sports scientist anticipate having the most mitochondria in their muscle fibers? **(1)**

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(b) Explain the reason for your choice of athlete. (2)



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