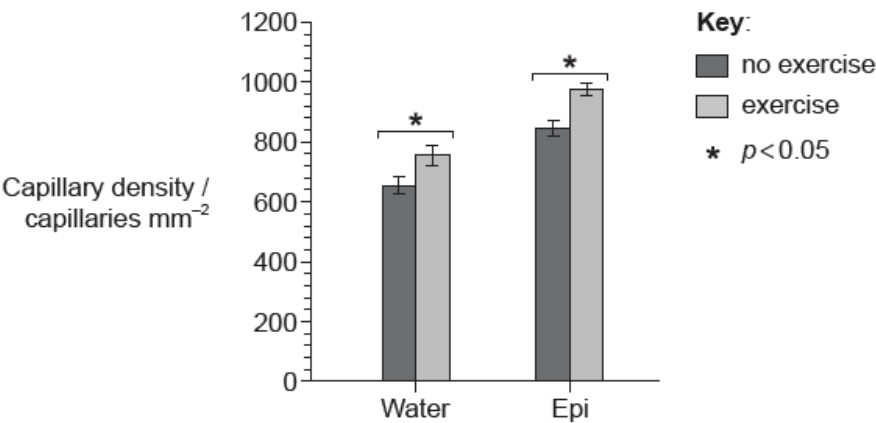


Exam Prep various command terms 2 [72 marks]

Consumption of dark chocolate has been shown to have health benefits. A study was undertaken to see the effects of epicatechin (Epi), a substance in dark chocolate, on the aerobic capacity of leg muscles of mice.

A group of adult mice was used to measure the effects of a low dose of Epi given over 15 days. The mice were divided into four groups and given either water or Epi and were either kept idle (no exercise) or made to exercise on a treadmill.

After 15 days, the results were analysed. The blood capillary density in leg muscle was measured under the light microscope.



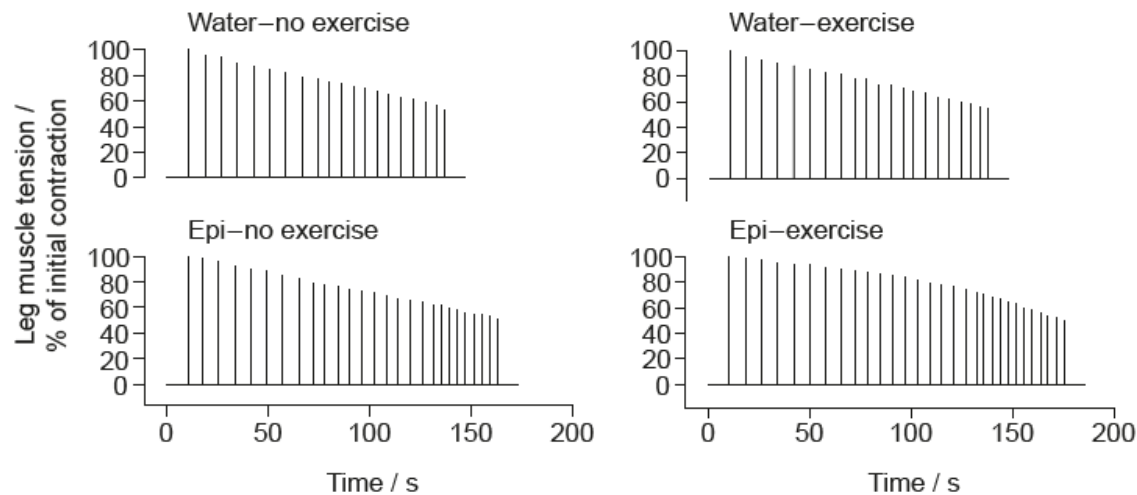
[Source: adapted from L Nogueira, et al., (2011), *The Journal of Physiology*, 589 (part 18), Wiley, pages 4615–4631]

1a. State the significance of the statement: $p < 0.05$. [1 mark]

1b. Outline the trends in capillary density in the results of this experiment. [2 marks]

1c. Describe how increased capillary density could affect the aerobic capacity of muscle. [2 marks]

Leg muscle tension was measured over time during a treadmill exercise in all four groups. The muscle is considered to reach a point of fatigue when there is a decrease in tension to 50 % of the initial tension.



[Source: adapted from L Nogueira, et al., (2011), *The Journal of Physiology*, **589** (part 18), Wiley, pages 4615–4631]

- 1d. State the time when the point of fatigue occurred in the Epi-exercise group. [1 mark]

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- 1e. Compare and contrast the results for the water-no exercise group and the Epi-no exercise group. [3 marks]

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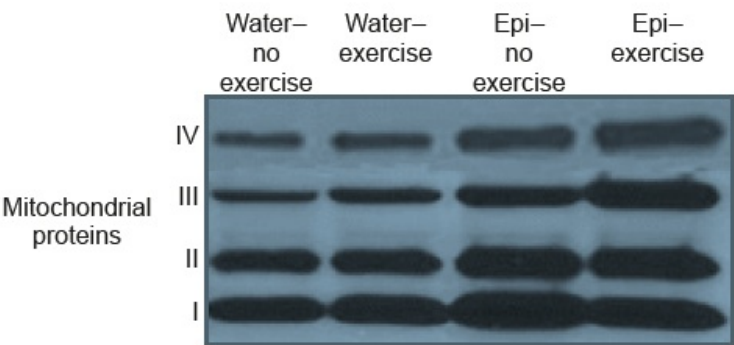
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1f. Discuss the effect of exercise on the results of the experiment. [2 marks]

The scientists tested the expression of four different mitochondrial proteins. The protein samples were taken from leg muscles. The technique that was used to quantify the amount of protein expressed was Western blotting. In this procedure the thickness of the band is an indicator of the amount of protein.



[Source: adapted from L Nogueira, et al., (2011), *The Journal of Physiology*, 589 (part 18), Wiley, pages 4615–4631]

1g. Analyse the effect of exercise on the presence of the mitochondrial proteins in the leg muscle. [2 marks]

1h. Mitochondria are essential for aerobic respiration. Suggest **one** possible [1 mark]
role of the proteins that were studied.

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1i. The scientists concluded that Epi significantly increased aerobic capacity [3 marks]
in leg muscle.

Evaluate the strength of the evidence provided by all of the data for dark
chocolate improving the aerobic capacity of athletes.

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2a. Glands are organs that secrete and release particular chemical substances. Melatonin is an important hormone secreted in the pineal gland in the brain. Describe its role in mammals. [2 marks]

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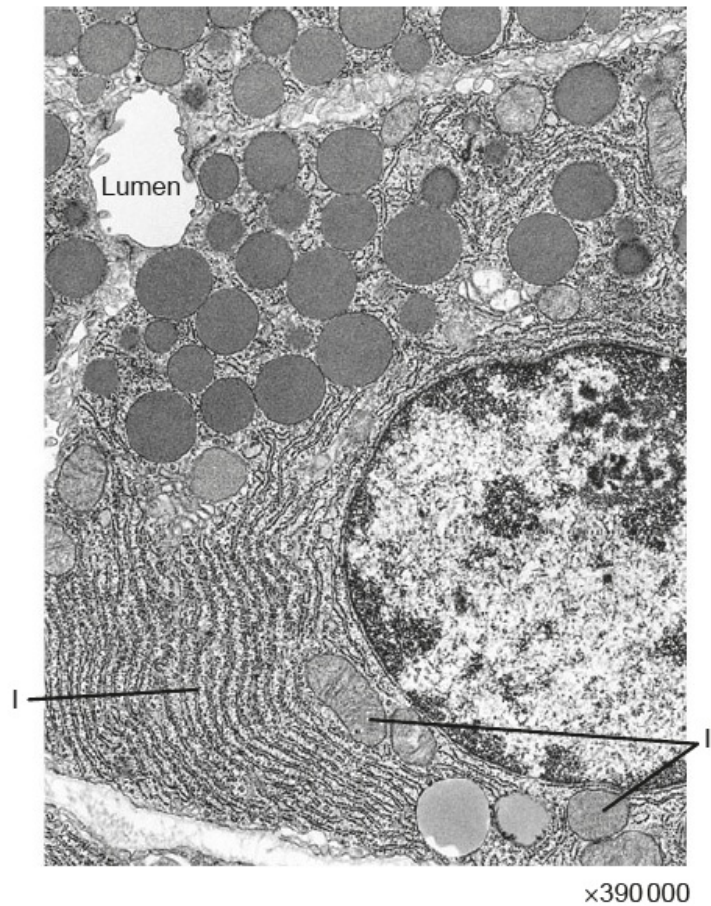
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The electron micrograph shows the structures in an exocrine gland cell of the pancreas.



[Source: Meschner AL, *Junqueira's Basic Histology: Text and Atlas*, 12th edition. Copyright McGrawHill Education.]

2b. State the principal product of this cell.

[1 mark]

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2c. Using the table, identify the organelles labelled I and II on the electron micrograph with their principal role. [2 marks]

Organelle	Name	Principal role
I		
II		

3a. Draw a molecular diagram of an amino acid to show its general structure. [3 marks]

3b. Outline the role of ribosomes in translation.

[4 marks]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

[illegible]

Beavers are large rodents that live in waterways throughout the northern hemisphere. Dams made by beavers change the temperature of the streams and affect the mayfly, *Baetis bicaudatus*. In the summer of 2008, beaver ponds in West Brush Creek and Cement Creek, Colorado, were studied to evaluate their impacts on mayflies. The study sites included streams flowing into (upstream) and out of (downstream) each beaver pond.



[Source: adapted from https://upload.wikimedia.org/wikipedia/commons/thumb/d/d4/Beaver_lodge.jpg/330px-Beaver_lodge.jpg]

Mayflies, including the species *B. bicaudatus*, are aquatic insects that hatch and spend their larval stages in water emerging from the water as adults. Larger females produce an increased number of better quality eggs.

The table shows the mean temperature differences (downstream – upstream) and mean dry mass for female and male mayflies.

	Beaver pond	Relative height of dam	Mean temperature differences / °C	Mean dry mass / mg					
				Female			Male		
				Up-stream	Down-stream	Difference	Up-stream	Down-stream	Difference
West Brush Creek	1	low	+0.1	1.97	1.83	−0.14	1.39	1.37	−0.02
	2	high	−0.3	1.43	1.51	+0.08	1.15	1.18	+0.03
	3	high	−0.2	1.55	1.67	+0.12	1.19	1.23	+0.04
	4	low	+0.4	2.27	2.15	−0.12	1.53	1.51	−0.02
Cement Creek	5	low	0.0	2.12	2.07	−0.05	1.39	1.33	−0.06
	6	high	−0.1	1.79	1.76	−0.03	1.34	1.31	−0.03
	7	high	−0.2	2.10	2.14	+0.04	1.53	1.49	−0.04
	8	low	+0.2	2.14	2.10	−0.04	1.49	1.53	+0.04
	9	high	−0.3	2.05	2.09	... I ...	1.57	1.45	... II ...

[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x
© 2011 Blackwell Publishing Ltd]

4a. Calculate the difference in the mean dry mass of mayflies upstream and downstream of Cement Creek pond 9 for female and male mayflies. [1 mark]

I. Female:mg

II. Male:mg

4b. Describe the effect dams have on water temperature.

[2 marks]

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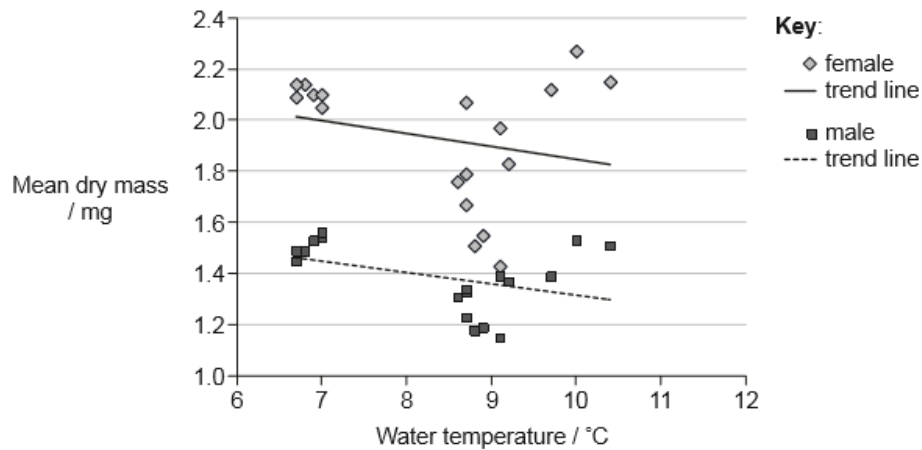
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[2 marks]



[Source: Fuller, M. R. and Peckarsky, B. L. (2011), Ecosystem engineering by beavers affects mayfly life histories. *Freshwater Biology*, 56: 969–979. doi:10.1111/j.1365-2427.2010.02548.x
© 2011 Blackwell Publishing Ltd]

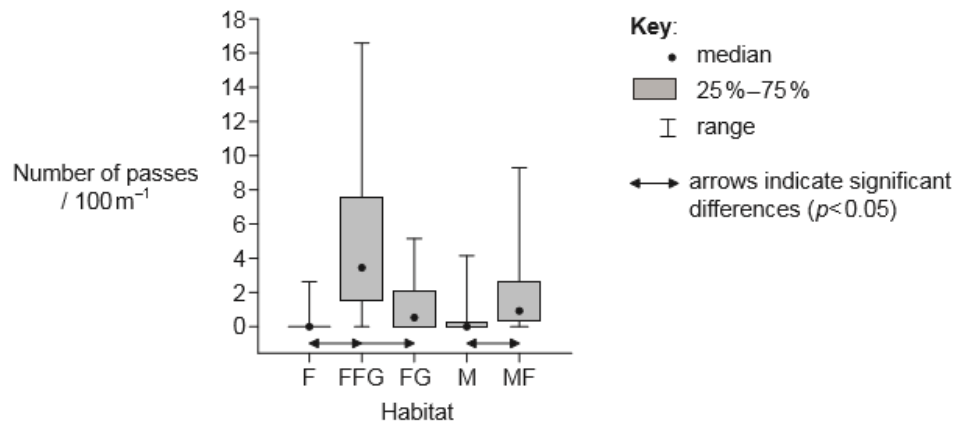
Using the graph, discuss evidence for the hypothesis that mayflies grow to greater dry mass in cooler water.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins or other markings on the paper.

The bat, *Pipistrellus nathusii*, feeds on insects including mayflies. A study was undertaken in Poland to see the effect of European beavers (*Castor fiber*) on the activity of bats. Beaver activity can affect forests that are covered by trees and meadows that are covered by grasses and have no trees. The following habitats were studied:

- forest (F)
- flooded forest with canopy gaps created by beavers and flooding due to the presence of beaver dams (FFG)
- forest with canopy gaps created by beavers but no flooding (FG)
- meadow (M)
- meadow with flooding due to the presence of beaver dams (MF).

As bats feed they fly through the air catching insects. The number of feeding passes made by bats was counted. The graph shows differences in the bat activity between particular habitats.



[Source: adapted from Ciechanowski, M., Kubic, W., Rynkiewicz, A. et al. (2011), "Reintroduction of beavers *Castor fiber* may improve habitat quality for vespertilionid bats foraging in small river valleys". *European Journal of Wildlife Research*, Volume 57, Number 4, Page 737.]

4d. Analyse the data to find the effect of flooding and tree felling by beavers [2 marks] on the activity of bats.

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4e. The trout, *Oncorhynchus mykiss*, that live in West Brush Creek and Cement Creek also feed on the mayflies. Fishermen come to Colorado to catch and eat trout. Draw a diagram of part of a food web for the creeks in Colorado, including mayflies, humans, trout and bats. [2 marks]



4f. Identify an example of competition between organisms in this food web. [1 mark]

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4g. The North American beaver (*Castor canadensis*) was introduced to islands adjacent to Argentina and Chile where they have become an invasive species. Discuss **one** ecological criterion (a basis for deciding) whether beavers are harmful **or** helpful to the ecosystems there. [2 marks]

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5a. Define metabolism. [1 mark]

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5b. Identify the following processes as **either** anabolism **or** catabolism by placing a tick (✓) in the correct box. [2 marks]

Process	Anabolism	Catabolism
Photosynthesis	<input type="checkbox"/>	<input type="checkbox"/>
Glycolysis	<input type="checkbox"/>	<input type="checkbox"/>

5c. Describe cell respiration in terms of metabolism.

[2 marks]

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The diploid number of chromosomes in horses (*Equus ferus*) is 64 and the diploid number in donkeys (*Equus africanus*) is 62. When a male donkey and a female horse are mated, the result is a mule which has 63 chromosomes.

6a. State the haploid number for horses.

[1 mark]

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6b. Explain reasons that mules cannot reproduce.

[2 marks]

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6c. Discuss whether or not horses and donkeys should be placed in the same species.[2 marks]

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6d. A mule was born at the University of Idaho in the USA with 64 chromosomes. Suggest a mechanism by which this could happen.[1 mark]

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7a. Living organisms have been placed in three domains: archaea, eubacteria and eukaryote. Distinguish archaea from eubacteria.[3 marks]

Archaea	Eubacteria

7b. List **two** types of evidence used to determine which species belong in the same clade. [2 marks]

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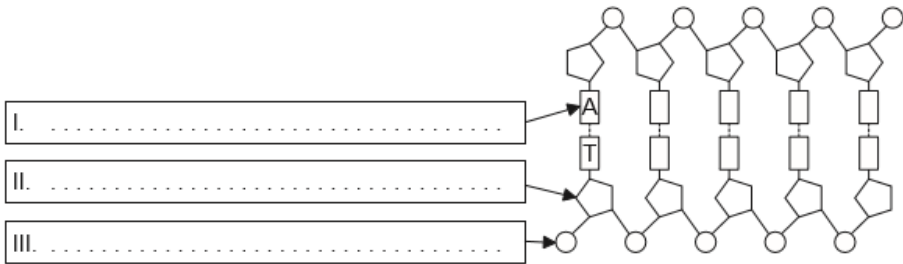
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8a. Label the parts of two paired nucleotides in the polynucleotide of DNA. [3 marks]

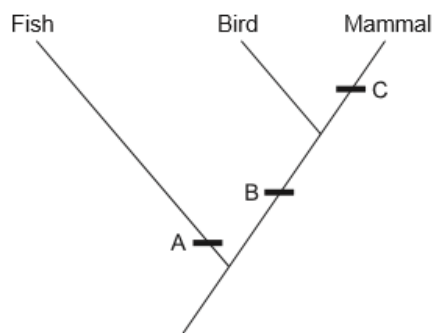


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The image shows part of a cladogram.



8b. Using the cladogram, identify **one** diagnostic feature that characterizes the given groups of vertebrates at A, B and C. [3 marks]

A:
B:
C:

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8c. State the name of the domain to which these organisms belong. [1 mark]

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