IB · HL · Biology

1 hour 12 questions

Structured Questions

Evolution & Speciation

Evolution / Evidence of Evolution / Convergent Evolution / Speciation / Types of Speciation (HL) / Adaptive Radiation (HL) / Speciation in Plants (HL)

Easy (3 questions)	/21
Medium (5 questions)	/25
Hard (4 questions)	/23
Total Marks	**/69**

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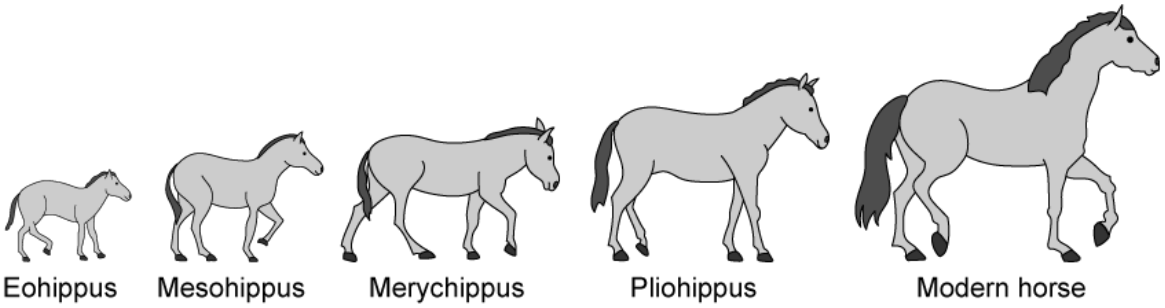
Easy Questions

1 (a) The diagram below shows the evolution of the modern horse (*Equus caballus*).



Define the term 'evolution'.

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(1 mark)

(b) State the name of the mechanism which drives evolution.

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(1 mark)

(c) There are several sources that provide evidence for evolution, such as selective breeding.

List **three** other sources of evidence for evolution.

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(3 marks)

(d) State **two** visible differences between *Eohippus* and modern horses.

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(2 marks)

2 (a) Two populations of cluster pine trees (*Pinus pinaster*) grew on opposite sides of a large mountain range. After many generations, scientists attempted to cross breed individuals from the two populations with each other but could not succeed. The scientists concluded that speciation occurred between the two populations.

Define the term 'speciation'.

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(1 mark)

(b) State **two** reasons why speciation occurred between the two populations of pine trees.

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(2 marks)

(c) Islands will very often contain many species that are endemic to those regions.

Describe a possible reason for this occurrence.

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(2 marks)

3 (a) Selective breeding has played an important role in the domestication of wild plant and animal species.

State **three** examples of selective breeding in agriculture, along with the improved characteristics of each.

(3 marks)

(b) Outline the process of selective breeding.

(6 marks)

Medium Questions

1 (a) The limbs of *Ichthyostega* and of modern tetrapods, taken together with the fins of marine mammals and the wings of birds are also considered to provide evidence for evolution.

Explain how these structures provide evidence for evolution.

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(2 marks)

(b) A key signal for biologists when developing theories of the evolution of animals is to look for evidence of pentadactyl limbs.

Explain the meaning of the term *pentadactyl.*

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(1 mark)

2 (a) The Pyrenean desman (*Galemys pyrenaicus*) is a small, semi-aquatic, globally threatened mammal related to moles and shrews. It lives in the Pyrenees, a mountain range between France and Spain, and can be seen in the image below.

Suggest two adaptive features of the Pyrenean desman.

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(2 marks)

(b) The scientists found that there were two populations of desman living in the Pyrenees; a northern and southern population. Analysis showed that there was variation between the two populations. Some of the variation could be accounted for by environmental factors such as food availability, but some could not.

Outline a source of variation **other** than environmental factors.

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(2 marks)

(c) During a study that lasted many years, scientists found that the number of desman travelling from the northern population to the southern side of the mountain range was extremely low. The scientists suspect that the original desman species may have split into two different species.

Explain how the original desman species may have split into two separate species.

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(3 marks)

3 Explain the importance of heritable variation in evolution.

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(3 marks)

4 (a) Researchers collected fish from a water source inside a cave and from the same water source in the open air.

They measured the diameter of the eyes of each fish as well as the length of its body. From these measurements they calculated the mean values for each site. Their results are shown in the table below.

	Fish in open air	**Fish in cave**
Mean diameter of eye / mm	0.23	0.10
Mean length of body / cm	8.49	5.82

An article published by a researcher several years before this study suggested that animals living in caves had similar adaptations; smaller eyes and a smaller body for decreased energy expenditure.

Evaluate this suggestion in the light of the data in the table above.

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(2 marks)

(b) The researcher decided to continue their investigation and calculate the genetic diversity of the fish. Their results are shown in the table below.

Gene	Allele	Percentage of fish with this allele	
		In the open air	In the cave
PGI	**P**	2.4	1.0
	Q	4.5	0.0
	R	61.8	95.7
	S	6.8	1.0
	T	19.7	0.0
ACO2	**A**	4.7	0.0
	B	100.0	21.3
	C	0.0	100.0

State, with a reason, what can be concluded about the genetic diversity of fish in the open air in comparison to fish in the cave.

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(2 marks)

(c) The percentage of fish with allele **C** in the open is different from the percentage of fish with allele **C** in the cave. Suggest a reason for this difference.

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(3 marks)

(d) Suggest how the researcher could find out if the fish living in the open are still the same species as those living in the cave.

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(1 mark)

5 Explain how polyploidy can lead to the formation of new plant species.

(4 marks)

Hard Questions

1 Explain how isolation can result in the development of a new species.

(4 marks)

2 (a) The apple maggot fly (*Rhagoletis pomonella*) is a species of fruit fly that lays eggs on apples. As a result of this they are often found in apple orchards, where they can cause damage to apple yields.

Scientists studied two populations of apple maggot flies from orchards that were separated by a busy road. They found that flies from the two populations were unable to interbreed when they were kept together in the same container.

Suggest a reason for this observation.

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(3 marks)

(b) The size of one of the orchards that was studied by the scientists had been systematically reduced by the farmer to make way for grazing cattle. The table below shows the size of the apple orchard and the estimated population of apple maggot flies over time.

Year	Orchard size / m^2	Estimated number of apple maggot flies
1995	424	45 000
2000	316	36 000
2005	157	18 000
2010	132	12 000
2015	78	7 000

Calculate the percentage decrease in the population of apple maggot flies from 1995 to 2015.

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(2 marks)

(c) The scientists estimated the apple maggot fly population size in part b) by sampling four trees from five randomly selected areas of the orchard between May and July. They concluded that the reduction in orchard size caused a significant decrease in apple maggot flies between 1995 and 2015.

Using the data from part b) and your own knowledge, evaluate the scientist's conclusion.

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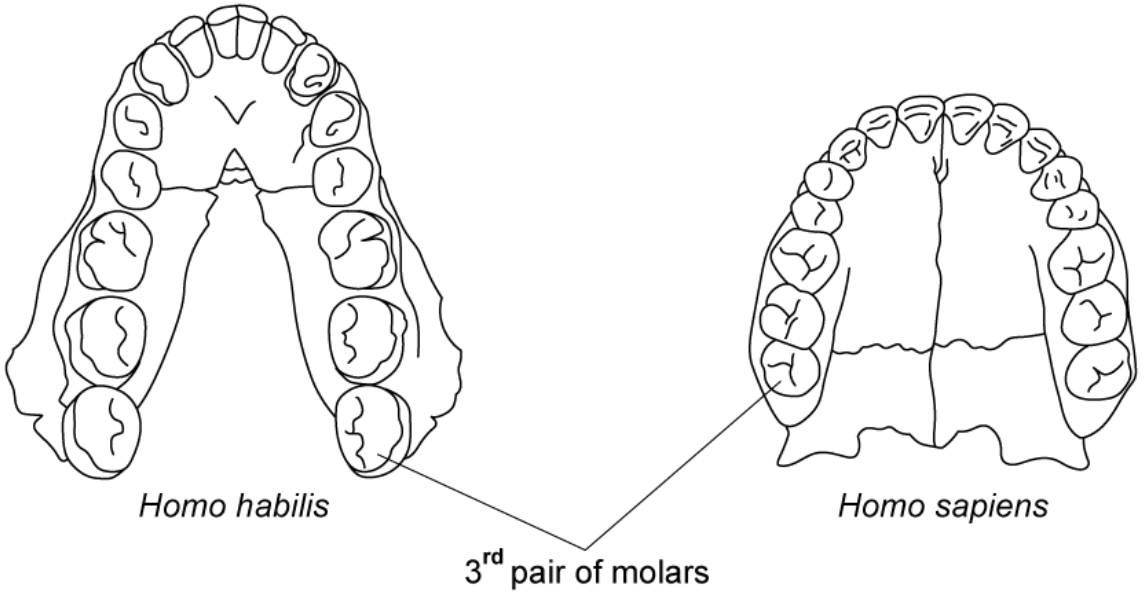
(3 marks)

3 (a) Wisdom teeth are thought to serve very little purpose in modern humans. These teeth are third molars that human ancestors (such as *Homo habilis*) used to grind down large volumes of raw plant material. These early humans had larger jaws that could accommodate a third pair of molars.

The diagram below compares the lower jaw of *Homo habilis* and *Homo sapiens* according to scale.



Suggest why modern humans still have wisdom teeth.

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(2 marks)

(b) Wisdom teeth can cause a range of oral health problems, including gum infections, damage to other teeth and problems with eating due to teeth being pushed out of position as wisdom teeth grow. Some scientists believe that this may affect their persistence in future generations.

Predict, with a reason, the possible fate of wisdom teeth in future human populations, based on this information and your knowledge of natural selection.

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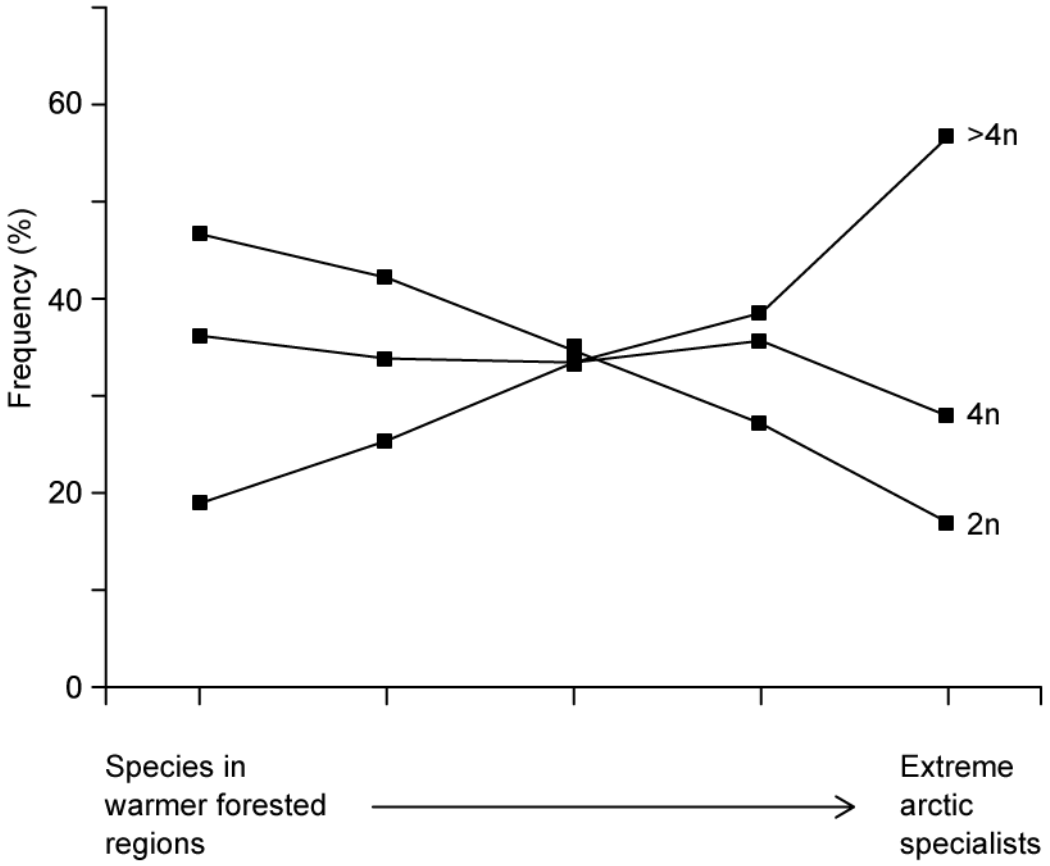
(2 marks)

4 (a) The graph below shows ploidy levels of 1 719 plant species that were studied in different regions of Svalbard in Norway, ranging from warmer forested regions to the northern Arctic desert.



Describe the results shown in the graph.

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(4 marks)

(b) The scientists concluded from this study that polyploidy was more common in species of plants adapted for extreme cold environments because it helps to "buffer against inbreeding".

(i) Suggest why inbreeding is so common with these groups of plants

[1]

(ii) Explain how polyploidy could buffer the effects of inbreeding

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(3 marks)