PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 3: CLASSIFICATION AND BIODIVERSITY

CLASSIFICATION

SCORE	PERCENTAGE
/70	%

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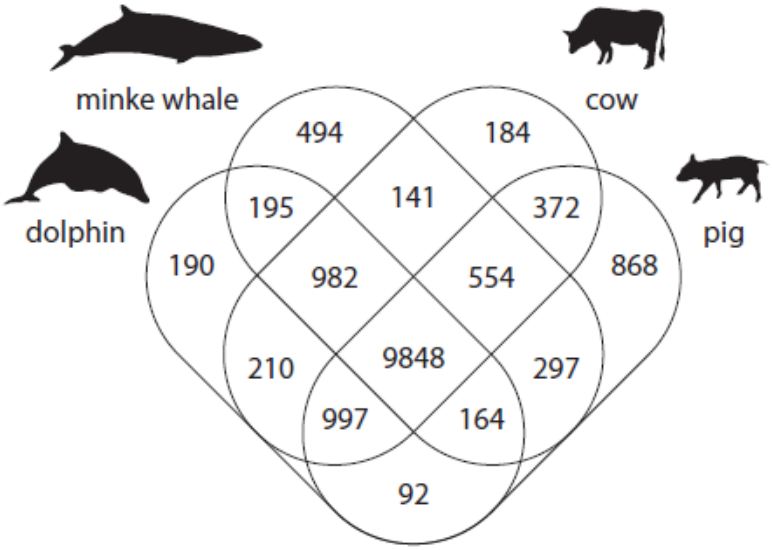
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Q1.

Minke whales, killer whales and dolphins are all cetaceans.

These animals are different species that all belong to the order Cetacea.

The Venn diagram shows unique and shared gene families in the genomes of minke whales, dolphins, pigs and cows.



Calculate the percentage of a dolphin's gene families that are shared with the minke whale.

(2)

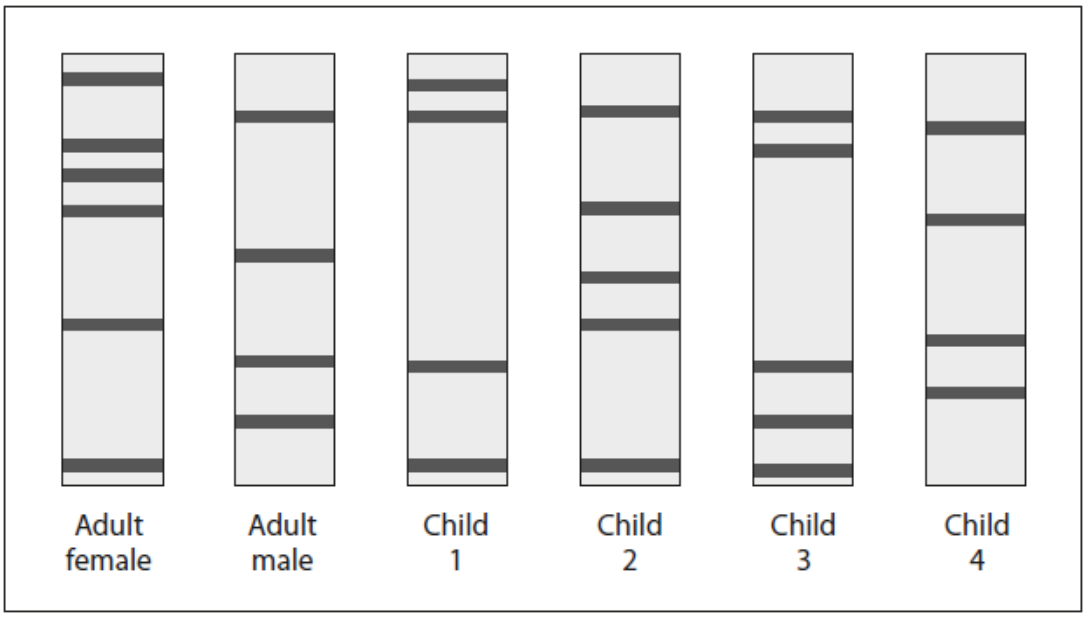
Answer ..... %

(Total for question = 2 marks)

Q2.

The polymerase chain reaction (PCR) and gel electrophoresis are used to produce DNA profiles.

The diagram shows DNA profiles, from an adult female, an adult male and each of four children.



Explain why gel electrophoresis produces individual DNA profiles.

(2)

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(Total for question = 2 marks)

Q3.

The photographs below show three mammals.

Tasmanian wolf (*Thylacinus cynocephalus*)



© The Zoological Society

Grey wolf (*Canis lupus*)



(Source: http://www.animalgalleries.org/Large-Land-Mammals/Wolf/Grey+Wolf+Mexican_Wolf_065+Canis+Lupus.jpg.php)

Dunnart (*Sminthopsis crassicaudata*)



(Source: apscience.org.au)

The evolutionary relationships between these three mammals were investigated.
The DNA base sequence of part of the gene for 12S ribosomal RNA from each mammal was analysed.

Tasmanian wolf	CCTGGCCTTACTGTTAATTCTTATTAGACCTAC
Grey wolf	CCTAGCCTTCCTATTAGTTTTTAGTAGACTTAC
Dunnart	CCTAGCCTTACTGTTAATTTTTATTAGACCTAC

(a) Explain which two of these mammals are most closely related in their evolutionary history.

(2)

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(b) The Tasmanian wolf is a marsupial mammal. In marsupials, the young are born in a tiny, immature form and move into a pouch on the abdomen of the mother to develop further.

The grey wolf is a placental mammal. The fetus develops inside the uterus and the larger young are born in a more mature form.

The ancestors of Tasmanian wolves and grey wolves once shared similar habitats.

Explain why grey wolves and their close relatives are now found in many parts of the world but Tasmanian wolves only survived on isolated islands.

(3)

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(Total for question = 5 marks)

Q4.

Tapirs are nocturnal mammals that are found in South America.

In 2013, the Journal of Mammalogy published an article describing the discovery of a new species of tapir, *Tapirus kabomani*.

Scientists already knew about the animal but thought that it was the same species as *Tapirus terrestris*.



© 20 minutos.es, Creative Commons

(a) Give **one** reason why scientists thought that *Tapirus kabomani* was the same species as *Tapirus terrestris*.

(1)

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(b) These two species of tapir can be distinguished using gene sequencing.

Describe how sufficient amounts of DNA could be obtained in preparation for gene sequencing.

(4)

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(c) Explain how distinguishing *Tapirus kabomani* as a separate species could affect the index of diversity of the area.

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(Total for question = 7 marks)

Q5.

The photograph shows a stonechat, *Saxicola dacotiae*.

The species breeds only on the island of Fuerteventura.



Which of the following is the best definition of a species?

Individuals of the same species can interbreed to produce

(1)

☒ **A** fertile offspring

☒ **B** hybrid offspring

☒ **C** sterile offspring

☒ **D** viable offspring

Q6.

Chester Zoo has 12 000 animals from 400 different species.

Chester Zoo aims "to be a major force in conserving biodiversity worldwide".

Chester Zoo supports an *in-situ* rhinoceros conservation and monitoring project in Chyulu Hills

National Park in Kenya.

It is difficult to find and count the black rhinoceros because they roam freely across a large area.

However, the DNA of a black rhinoceros can be obtained from its dung (faeces).

(i) Devise a method by which black rhinoceros dung could be used to estimate the number of black rhinoceros living in Chyulu Hills National Park.

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(ii) DNA from dung indicated that 14 black rhinoceros were present in the park.

Explain why 14 black rhinoceros could be an underestimate of the population.

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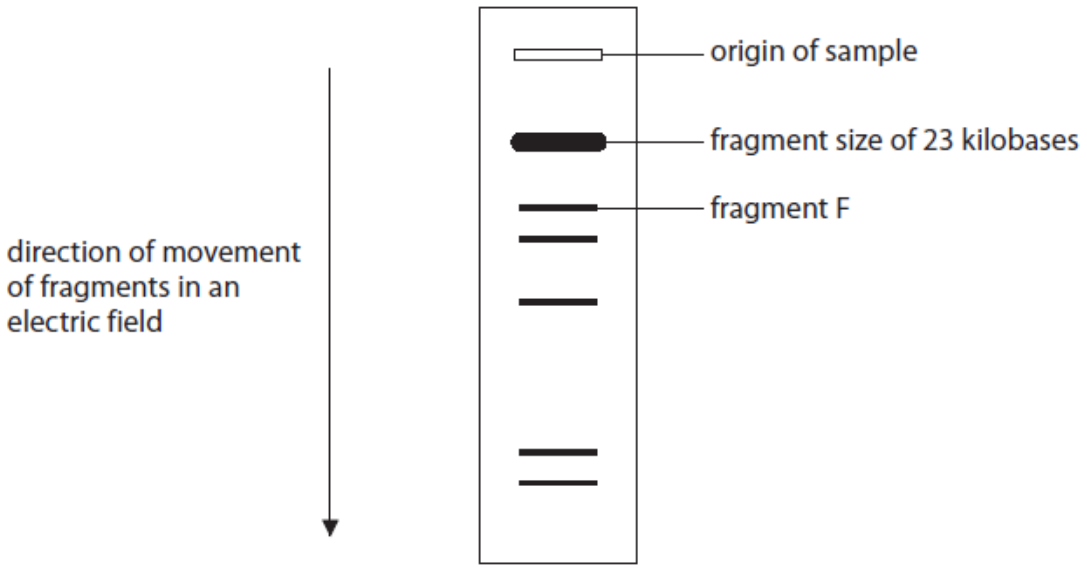
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Q7.

(b) Fragments of DNA can be separated by gel electrophoresis to produce a DNA profile.

The diagram shows an example of a DNA profile.



(i) Explain why fragments of DNA can be separated by gel electrophoresis.

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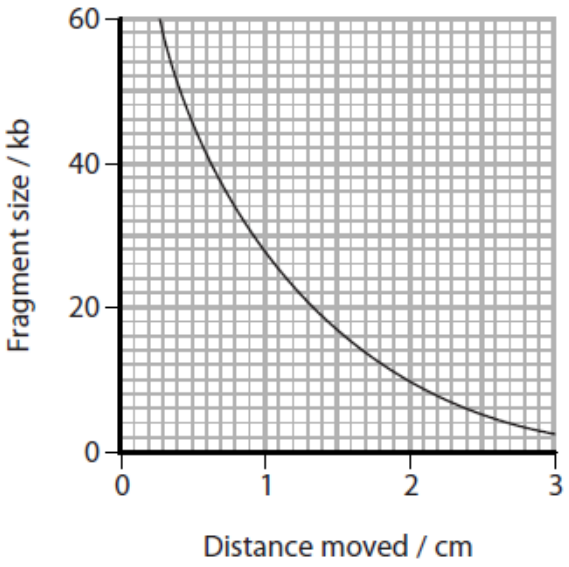
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(ii) The graph shows the relationship between the distance moved in a gel and the fragment size.



Determine the size of fragment F.

(1)

Answer ..... kb

(Total for question = 3 marks)

Q8.

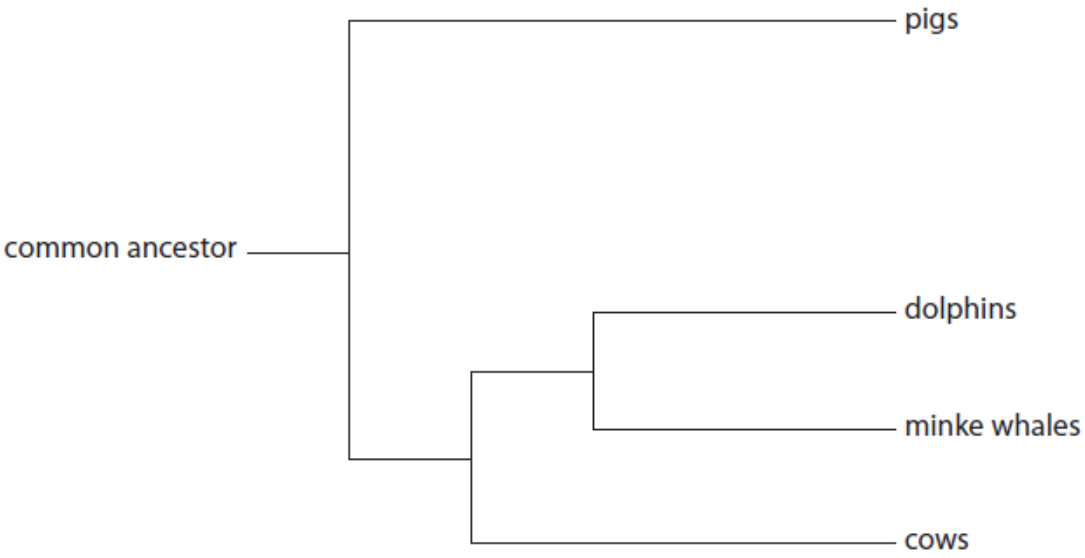
Minke whales, killer whales and dolphins are all cetaceans.

These animals are different species that all belong to the order Cetacea.

Cetaceans evolved between 55 and 60 million years ago.

Their closest living relatives are thought to be pigs and cows.

The diagram shows the evolutionary relationship between minke whales, dolphins, pigs and cows.



Analyse the diagram to explain the evolutionary relationship between these four animals.

(3)

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(Total for question = 3 marks)

Q9.

Fritillaria delavayi is a small plant (height 7 cm), that grows on rocky slopes on mountains in China.

The image shows *Fritillaria delavayi*.



For at least 2 000 years, this plant has been collected and used in Chinese medicine.
It is not known to be eaten by animals.

In less accessible regions, where few humans go, the plants are bright green with bright yellow flowers.

In locations where bulbs are collected in high numbers, most plants have greyish-brown leaves and flowers.

Scientists believe that the greyish-brown plants are the same species as the brightly-coloured plants.

(i) Describe how scientists can use gel electrophoresis to show that these plants belong to the same species.

(4)

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(ii) Explain why the features of the brightly-coloured plants enable them to grow successfully in the areas where they are not collected by humans.

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(Total for question = 6 marks)

Q10.

The photograph shows an adult mayfly.



Rhithrogena germanica is commonly known as the March brown mayfly.

The classification hierarchy for this mayfly is:

Animalia
Arthropoda
Insecta
Ephemeropteroidea
Heptageniidae
Rhithrogena germanica

(i) State the genus of this mayfly.

(1)

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(ii) This mayfly belongs to the phylum Arthropoda.

Which is the order for this mayfly?

(1)

☒ **A** Animalia

☒ **B** Ephemeropteroidea

☒ **C** Heptageniidae

☒ **D** Insecta

(Total for question = 2 marks)

Q11.

Answer the question with a cross in the boxes you think are correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Mosquitoes transmit a number of diseases, including malaria.

The photograph shows a mosquito, *Anopheles gambiae*.

This mosquito transmits malaria.



Source: © Sinclair Stammers / Science photo library

(i) State the genus of this mosquito.

(1)

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(ii) Mosquitoes belong to the class Insecta.

Some of the insects in this class are subdivided into a group called Diptera.

What is the name of the classification group that includes Diptera?

(1)

☒ **A** Family

☒ **B** Genus

☒ **C** Order

☒ **D** Phylum

(iii) Which of the following organisms causes the symptoms of malaria?

(1)

☒ **A** *Anopheles gambiae*

☒ **B** *Plasmodium falciparum*

☒ **C** *Puccinia graminis*

☒ **D** *Salmonella enterica*

(Total for question = 3 marks)

Q12.

Tibetan populations have a recessive allele that helps them to survive at high altitude.

In a village in Tibet, 1950 people out of a population of 2500 people carry two copies of this allele.

(i) Calculate the number of heterozygous people in the village.

Use the Hardy-Weinberg equation

$$p^2 + 2pq + q^2 = 1$$

(3)

Answer .....

(ii) This allele is currently found only in human populations in Tibet.

The allele has also been found in the fossil bones of an extinct form of modern humans called the Denisovans.

Fossils of Denisovans have been found in Tibet.

Explain why scientists think that the Denisovans belonged to the same species as modern humans.

(2)

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(Total for question = 5 marks)

Q13.

Minke whales, killer whales and dolphins are all cetaceans.

These animals are different species that all belong to the order Cetacea.

A wholphin is an extremely rare hybrid animal born from the mating of a female dolphin and a male killer whale.

Kekaimalu was a wholphin born in the United States in 1985. Kekaimalu was mated with a dolphin and on three occasions gave birth to live offspring.

Explain how this case study illustrates the limitations of the definition of a species.

(2)

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(Total for question = 2 marks)

Q14.

Answer the question with a cross in the box you think is correct ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

The photograph shows an insect fossilised in amber resin.



(Source: Bjoern Wylezich. 123rf.com/PAL)

Scientists have classified another fossilised insect found in amber resin as a new species of mosquito, *Priscoculex burmanicus*.

This mosquito is anatomically very similar to modern species of mosquito.

(i) Which of these processes produces new species without geographically separating populations?

(1)

☒ **A** allopatric speciation

☒ **B** genetic speciation

☒ **C** stabilising speciation

☒ **D** sympatric speciation

(ii) *Priscoculex burmanicus* became extinct about 100 million years ago.

State why it was difficult for scientists to decide if this insect belonged to a different species from modern mosquitoes.

(1)

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(iii) State how scientists would have reached agreement on classifying this mosquito.

(1)

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(iv) Complete the classification table for *Priscoculex burmanicus*.

(2)

Taxon	Name
Domain	Eukarya
Kingdom	Animalia
	Arthropoda
	Diptera
Order	Culicidae
Family	Anophelinae
Genus	
Species	

(Total for question = 5 marks)

Q15.

The polar bear, *Ursus maritimus*, preys on seals and fish. Polar bears are adapted to live in cold Arctic regions.



Polar bear
Magnification ×0.04

A recent study has shown that all polar bears are descended from populations that diverged from the Irish brown bear, *Ursus arctos*, approximately 120 000 years ago.

In this study, DNA from modern polar bears, the remains of historic polar bears and the remains of Irish brown bears was analysed.

(a) The first part of the study involved the amplification of DNA to give large enough samples for analysis.

(i) Describe how small samples of DNA can be amplified.

(4)

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(ii) Name **one** technique that could be used to analyse the amplified DNA samples.

(1)

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(b) Suggest how the scientists who conducted the study had their results accepted by other scientists.

(2)

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(c) Suggest how each of the following may have contributed towards the divergence of polar bears and Irish brown bears into two separate species.

(i) Separation of the Arctic and Irish regions by sea

(2)

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(ii) Genetic mutation

(2)

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(Total for question = 11 marks)

Q16.

Scientists are researching new methods of controlling malaria.

One group used a procedure called gene drive.

This procedure resulted in female mosquitoes that could not bite or could not lay eggs.

One of the scientists said:

> 'It will still be at least 5 to 10 years before we consider testing any mosquitoes with gene drive, but now we have some encouraging proof that we're on the right path.'

Explain why this group are sharing the results of their research.

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(Total for question = 2 marks)

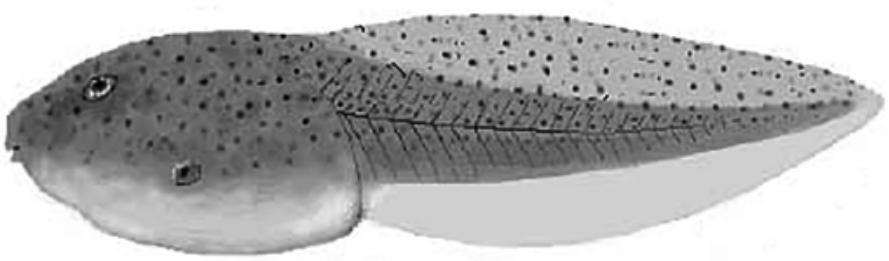
Q17.

The adult American bullfrog, *Rana catesbeiana*, can live in water or on land.

Adult frogs lay eggs in water where they are fertilised.

The fertilised eggs develop into tadpoles that live only in water.

The photograph shows a tadpole.



State the domain to which *Rana catesbeiana* belongs.

(1)

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(Total for question = 1 mark)

Q18.

A student measured the distribution of two plant species at the coast.

The distribution was measured from the high water line to 170 m inland.

State what is meant by the term species.

(1)

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(Total for question = 1 mark)

Q19.

Minke whales, killer whales and dolphins are all cetaceans.

These animals are different species that all belong to the order Cetacea.

The five-kingdom model of classification is hierarchical.

Part of this hierarchy is:

kingdom

phylum

class

family

genus

Where in this hierarchy should the order Cetacea appear?

(1)

☒ **A** between kingdom and phylum

☒ **B** between phylum and class

☒ **C** between class and family

☒ **D** between family and genus

(Total for question = 1 mark)

Q20.

Malaria is a serious and sometimes fatal disease.

Scientists are constantly looking for new ways of controlling this disease.

Which row of the table shows the name of the pathogen that causes malaria, and its classification group?

(1)

	Name of pathogen	Classification group
☒ **A**	*Plasmodium*	genus
☒ **B**	*Plasmodium*	species
☒ **C**	*Puccinia*	genus
☒ **D**	*Puccinia*	species

(Total for question = 1 mark)