DSE M.C. Questions - Evolution
(sort by difficulty)

Challenging
/

Average

2013 Q.19 (59%)

Directions: Question 19 and 20 refer to the nucleotide sequence of a certain functional gene segment found in four different species of organisms P, Q, R and S:

A A C G T C G A A A	(organism P)
A A C C T C G A A A	(organism Q)
A G G C T A G A A A	(organism R)
A G G C T A G T A A	(organism S)

The differences in the sequences shown above are most probably caused by

A. crossing over.
B. gene mutation.
C. random fertilization.
D. Chromosomal mutation.

2013 Q.22 (60%)

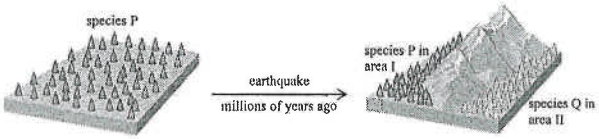
Which of the following observations is not related to the process of evolution?

A. Some variations are not inheritable.
B. Organisms compete for resources to survive.
C. Environmental changes give stress to organisms.
D. Variations exist among different individuals of the same species.

Average

2017 Q.10 (58%)

Directions: Questions 10 and 11 refer to the diagram below. A high mountain resulting from an earthquake millions of years ago has led to the separation of areas I and II. A new tree species Q is found in area II.



Which of the following processes were likely to have been involved in the formation of new species Q?

(1) mutation
(2) isolation
(3) natural selection

A. (1) and (2) only B. (1) and (3) only C. (2) and (3) only D. (1), (2) and (3)

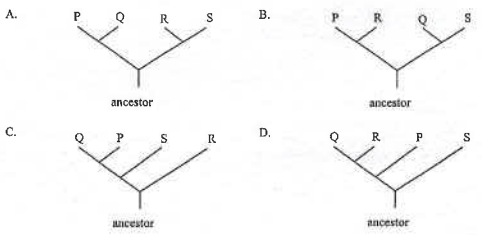
Easy

2013 Q.20 (78%)

Directions: Question 19 and 20 refer to the nucleotide sequence of a certain functional gene segment found in four different species of organisms P, Q, R and S:

A A C G T C G A A A	(organism P)
A A C C T C G A A A	(organism Q)
A G G C T A G A A A	(organism R)
A G G C T A G T A A	(organism S)

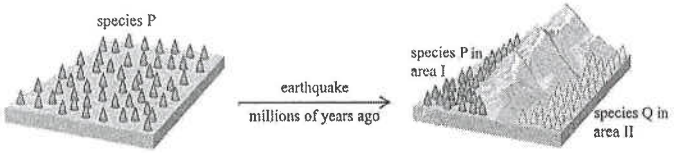
Based on the above information, which of the following diagrams best represents the evolutionary tree of organisms P, Q, R and S.



Easy

2017 Q.11 (81%)

Directions: Questions 10 and 11 refer to the diagram below. A high mountain resulting from an earthquake millions of years ago has led to the separation of areas I and II. A new tree species Q is found in area II.



Which of the following descriptions of the above incident is most likely to be correct?

A. Q is more adaptive than P.
B. P grows equally well in areas I and II.
C. Areas I and II have similar environmental conditions.
D. P and Q belong to the same Family in the classification system.

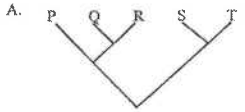
2020.Q15

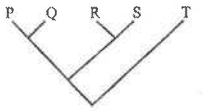
15. The table below shows the presence or absence of some traits in five species:

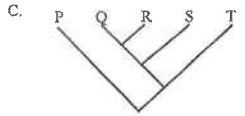
	Trait				
Species	1	2	3	4	5
P	+	+	−	+	−
Q	+	+	−	−	−
R	+	−	−	−	+
S	+	−	+	−	+
T	−	−	−	−	−

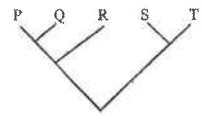
Key:
\+ presence of trait
− absence of trait

Which of the following evolutionary trees best illustrates the phylogenetic relationship of the five species?

A. 

B. 

C. 

D. 

Answers

Challenging

Average

2013	2017
19 [B]	10 [D]
22 [A]	

Easy

2013	2017	2020
20 [A]	11 [D]	15[B]

Past Papers – Evolution

CE - 2005

10. (b) Peter moved to a small island ten years ago. He found that there were a lot of mosquitoes, so he sprayed the area around his house with a certain kind of insecticides. The mosquito population dropped rapidly, but rose again after several months. He then sprayed the same insecticide to kill the mosquitoes and this was repeated whenever there was a rise in the mosquito population. However, Peter has found the insecticide has become less and less effective in recent years.

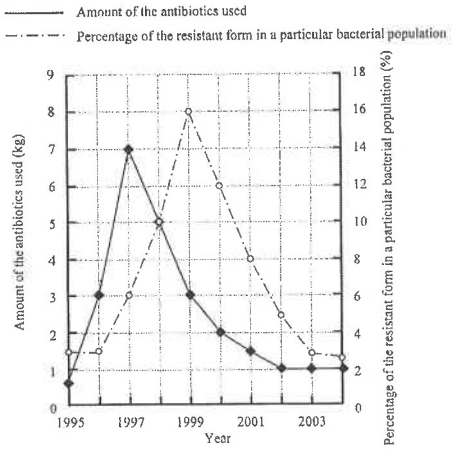
(i) Explain why the mosquito population rose again after a large number of them were killed by the insecticide. (2)

(ii) In the same population, the mosquitoes may show different degrees of resistance to the insecticide. Explain two genetic causes that may lead to this variation among the mosquitoes. (4)

(iii) Using the theory of natural selection, explain why the insecticide, explain why the insecticide has become less and less effects in killing the mosquitoes. (4)

CE – 2007

7. (b) Antibiotic is a drug commonly used to treat bacterial infections. In recent years, there have been more reported cases of resistant forms of bacteria strains found in hospitals. The graph below shows the percentage of the resistant form in a particular bacterial population and the amount of antibiotics used in one particular hospital each year from 1995 to 2004:



(i) Explain why the increased amount of antibiotics used will lead to the rise in the percentage of the resistant form in the bacterial population. (4 marks)

(ii) Some patient in hospitals will have a higher death rate if infected with resistant forms of bacteria. Suggest one group of these patients and give an explanation. (2 marks)

(iii) If you were a doctor, suggest two practices that you could adopt to slow down the rise of the resistant forms of bacteria. (2 marks)

AL - 2006 1A

8. (a) Suggest *two* ways in which scientists can make use of fossil records in their study of the evolutionary relationship of organisms. (2)
   (b) Suggest *two* limitations of using fossil records as evidence of evolution. (2)

AL - 2007 2A

2. To explain the diversity of life forms on Earth. Darwin proposed a theory that different species arose by gradual changes from ancestral stocks. It would be possible to identify the evolutionary relationships of different species by examining the similarities and differences between them and comparing them with pre-existing life forms. Evidence of evolution can be drawn from a wide range of sources, e.g. fossils, comparative anatomy, and comparative biochemistry.

   (a) (i) What are fossils? (2)
   (ii) Discuss how the study of fossils can provide evidence for evolution. What are the limitations of using fossils as evidence for evolution? (5)
   (b) In comparative anatomy, the pentadactyl limb is considered as a homologous structure found in tetrapods. List ***three*** criteria that the limbs of different tetrapods have to satisfy for them to be considered as homologous structures. (3)
   (c) In comparative biochemistry, one can study the structures of the same type of protein, such as haemoglobin, produced by different organisms. The table below shows the differences between the amino acid sequences in the polypeptide chains of haemoglobin of four primate species:

Primate species	Number of amino acids in the polypeptide chain different from that of humans		
	α-chain (141 amino acids)	β-chain (146 amino acids)	γ-chain (146 amino acids)
Human	0	0	0
Chimpanzee	0	0	1
Gibbon	3	3	2
Gorilla	1	1	1

   (i) Based on the above information, construct an evolutionary tree of the four primate species, assuming that they arose from the same ancestor. (2)
   (ii) What is the assumption made when constructing the evolutionary tree of organisms based on the information in the above table? Explain the biological principle underlying your assumption. (4)

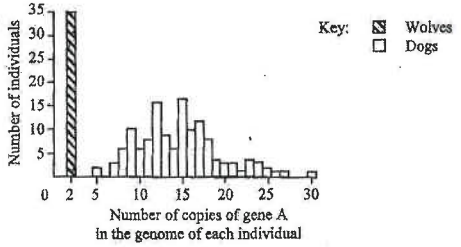
   (d) A modern classification system can reflect the evolutionary relationships of organisms.
   (i) Explain how the taxonomic hierarchy in the modern classification system reflects the evolutionary relationships of organisms. (3)
   (ii) Why is it impossible for two species of organisms grouped under the same family to be put in different classes? (1)

AL - 2010 2B

4. (c) Hair length in a kind of artic dog exhibits continues variation. With reference to the concept of natural selection, suggest the long term effect of global warming on the mean hair length of the arctic dog. (4 marks)

DSE - 2014 1B

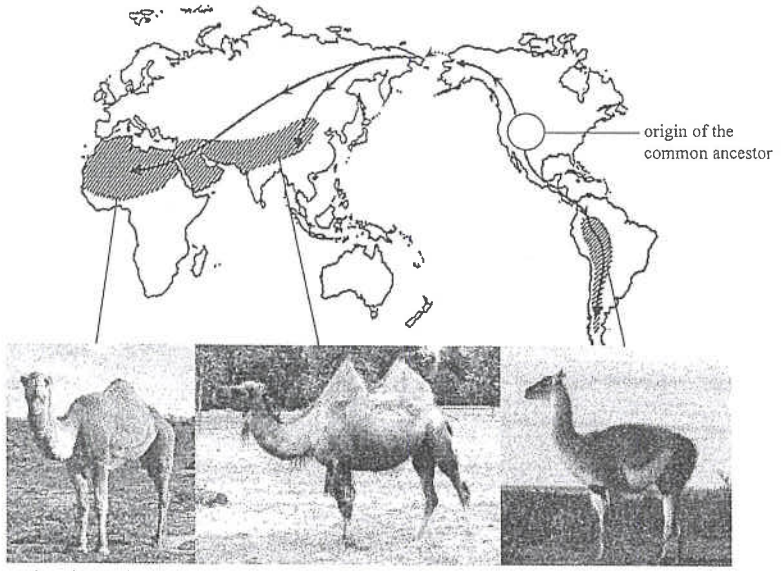
6. It is generally believed that domestic dogs evolved from ancient wolves. A recent study comparing the genomes of wolves and dogs suggests that genes with key roles in starch digestion were selected during the domestication of wolves into dogs. One of these genes was gene A, which codes for amylase. This gene may exist in many copies in a genome. The following graph shows the number of individuals having different numbers of copies of gene A in 35 wolves and 136 dogs:



   (a) Based on the data above and the gene expression processes, explain why the amylase activity in dogs is generally higher than that in wolves. (3 marks)
   (b) It is hypothesized that in ancient times, wolves might have been attracted to waste dumps near early human settlements and consumed human food waste. Suggest how the domestication of wolves would have led to the selection of multiple copies of gene A. (5 marks)

DSE – 2015 1B

10. Fossil records suggest that camels in Africa and Asia and llamas in South America evolved from a common ancestor 6 million years ago. The diagram below shows the possible migration routes of the common ancestor at the time before the continents were separated and the location (shaded areas) where the camels and llamas are found at present:



Camel in Africa Camel in Asia Llama in South America

(a) Based on the information given, draw a diagram to show the evolutionary tree of the three animals. (2 marks)

Evolutionary tree of camels in Africa and Asia and llamas in South America

(b) Explain how the common ancestor might have given rise to the two different animal species (camels and llamas) in the above case. (4 marks)

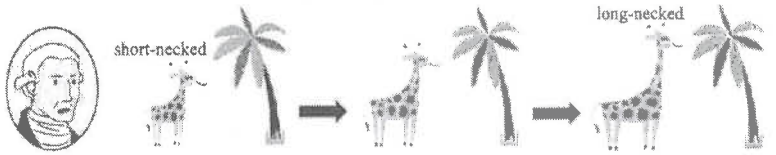
(c) Suggest another way to establish the evolutionary relationship among the above animals. (1 mark)

(d) Give ***two*** limitations of fossil records as evidence for evolution. (2 marks)

DSE – 2018 1B

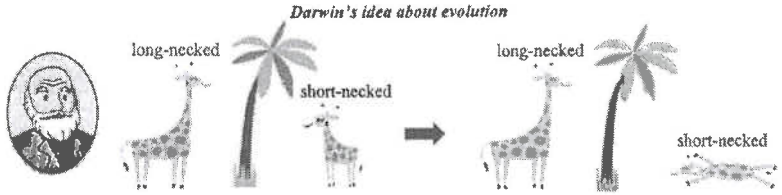
10. Both Lamarck and Darwin contributed greatly to the understanding of evolution. They proposed different explanations for the evolution of long necks in giraffes, as shown below:

Lamarck's idea about evolution



Long necks evolved as generations of giraffes stretched their necks to feed on leaves at high level above the ground

Darwin's idea about evolution



Giraffes with long necks were born by chance and had more offspring due to their competitive advantage over those with short necks

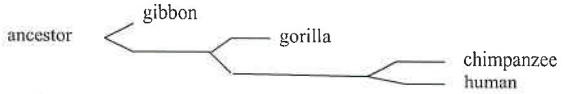
(a) Put a '✓' in the appropriate box to indicate whether the ideas listed were proposed by the scientists. You may put more than one '✓' for each idea. (2 marks)

	Lamarck	Darwin
Characters acquired during life time can be passed on to the next generation		
Organisms become more adaptive to the environment over the generations		

(b) Based on the current understanding of evolution, elaborate on the view of Darwin on the evolution of giraffe's long neck. (4 marks)

(c) In Darwin's era, his idea caused intense debates. The concept of humans evolving from common ancestors along with other species was unacceptable to many people due to their religious belief. What does this tell us about the nature of science? (1 mark)

(c) (i)



(ii) Assumption:
- the fewer the number of different amino acids, the closer the evolutionary relationship of the organisms (1)

Underlying biological principle
- each amino acid in a polypeptide is coded by a codon in the DNA (1)
- mutation in a codon would result in a different amino acid being incorporated in the polypeptide (1)
- organisms with closer evolutionary relationship would have fewer mutation (1) / more similar genetic code

(d) (i)
- the modern classification system is based on the phylogenetic relationship of organisms (1)
- organisms with some fundamental similarities are put into the same group (1)
- each group is then subdivided into smaller groups with organisms sharing more similarities going into the same subgroup, the lower the hierarchy, the closer they are linked in evolution (1)

(ii) - because class is a higher hierarchy than family (1)
/ same family, more similarities / same class, less similarities

AL -2010 2B

4. (c)
- when there is an increase in global temperature, arctic dogs with shorter hair length are at a selective advantage than those with longer hair length (1) / there is a higher selection pressure against those with longer hair length
- because those arctic dogs having longer hair length have a higher chance of being overheated (1) / arctic dogs having shorter hair length have a lower chance of being overheated
- over the generations, arctic dogs with shorter hair length have a higher chance of survival and reproduce (1)
- therefore, the mean hair length of the arctic dog population would decrease over time (1)

(4)

DSE - 2014

6. (a)
- dogs have many more copies of gene A in the genome than wolves (1)
- these genes will be transcribed into mRNA (1)
- which, in turn, translated into amylase, i.e. more amylase will be produced in dogs (1), resulting in higher amylase activity

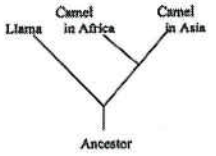
(3)

(b)
- (humans are omnivores,) the human food wastes usually contain carbohydrates such as starch (1)
- variations in copy number of gene A may exist in an ancient wolf population (1)
- those with higher gene copy numbers could produce more amylase and were more adapted to a starch-rich diet of human food waste (1)
- as wolves got used to feeding on human food wastes and gradually domesticated, they could then grow better & reproduce more than those with smaller gene copy number (1)
- their genes, including multiple copies of gene A could be passed to the **next generation (1),** resulting in the selection of multiple copies in the dogs' genome

(5)

HKDSE – 2015 1B

10. (a) Labeling (1)
Correct tree (1) 2



(b) separation of the continents resulted in isolation of the two groups of ancestors (1)
each isolated group was subjected to a different set of environmental conditions (1)
as a result, they evolved differently from each other due to natural selection (1) / adaptive traits specific to those particular environmental conditions were selected by natural selection
until their genetic compositions were so different that they could not interbreed again (1) 4

(c) compare their genetic compositions / biochemical compositions of essential proteins 1

(d) Any *two* of the following:
- not all organisms could be fossilized (1)
- Some fossils are incomplete / damaged (1) / the fossil may contain only part of the body rather than the whole organism
- some fossils are found in inaccessible areas (1)
- there are missing links in the fossil records (1) 2

HKDSE – 2018 1B

10. (a)

	Lamarck	Darwin
Characters developed during life time can be passed on to the ...	✓	
Organisms become more adaptive to the environment over generations	✓	✓

(2)

(b)
- genetic variation existed in the giraffe population, some with longer necks and others with shorter necks (1)
- individuals with longer necks has better ability to obtain food / could get more food than those with shorter necks (1)
- they have greater chance to survive and reproduce (1) (4)
- thus the population of the subsequent generations would have a greater proportion of giraffes with longer neck (1)

(c) - science is culturally embedded / influenced by social and cultural factors (1) (1)

6 marks

HKDSE – 2019 1B

8. (a) (i) • sight is not the sense used by bats when they avoid obstacles (1) (1)

(ii) Any *two*:

Nature of Science	Elaboration
Science is based on evidence from experiment	Spallanzani and Jurine could not provide sufficient evidence to show how bats navigated / scientists did not accept that ats use hearing for navigation until Griffin showed that bats could emit ultrasounds (1)
Scientists build on the work of other scientists	Griffin used Pierce's apparatus to show bats emitted ultrasounds / Griffin built on Spallanzani and Jurine's work, and showed that bats emitted ultrasounds, providing important evidence for the navigation (1)
Technology has impact on the development of science	Griffin could not have proved that bats emitted ultrasounds without Pierce's apparatus (1)

(2)

(accept other reasonable answers)

(b) (i) • the procedures of cutting & gluing back the wing tail itself did not affect the rate of successful escape (1)
• this shows that the results of C / D were related to the length of the wing tail and not related to the manipulation procedures (1) (2)

(ii)

Pair of treatments	Conclusion
A&C	• Removing / shortening the wing tail reduced the rate of successful escape (1)
A&D	• Elongating the wing tail enhanced the rate of successful escape (1)

(2)

(iii) • the data show that the longer the wing tail, the higher the rate of successful escape (1) (1)

(c) • within the moth population, there were genetic variations with some individuals having long wing tails and others having short wing tails (1)
• individuals with long wing tails had a higher chance of escape from the attacks of bats than individuals with short wing tails (1)
• therefore, individuals with long wing tails had a higher chance of survival and reproduced more offspring (1)
• after many generations, offspring which inherited the allele for long wing tails became the majority in the population (1) (4)

12 marks