

- 1 Osteocalcin is a structural protein found in the bones of mammals. The sequence of the amino acids in osteocalcin can be determined using mass spectrometry.

The sequences of the first 20 amino acids in the primary structure of osteocalcin from the bones of humans and some apes are shown in the table below. Each amino acid is represented by a capital letter.

Mammal	Amino acid number																			
	1				5					10					15					20
Human	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Chimpanzee	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	R	R
Orang utan	Y	L	Y	Q	W	L	G	A	P	V	P	Y	P	D	P	L	E	P	K	R
Gorilla		L	Y	Q	W	L	G	A	O	V	P	Y	P	D	P	L	E	P	K	R

- (a) Place a cross ☒ next to the most appropriate answer that completes each of the following statements about these sequences of amino acids.

(i) The number of nucleotides in the gene for osteocalcin production used for each of these sequences is

(1)

- A 20
- B 40
- C 60
- D 80

(ii) The type of bond that links the amino acids in the primary structure of osteocalcin is

(1)

- A disulphide
- B hydrogen
- C ionic
- D peptide

(iii) The structure in which the amino acids in the primary structure of osteocalcin would be linked together is a

(1)

- A centriole
- B lysosome
- C nucleolus
- D ribosome

(b) (i) Using the data in the table, suggest with reasons what conclusions scientists might make about the ancestral relationships of humans and apes.

(4)

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(ii) Suggest how DNA analysis could give further evidence for their conclusions.

(2)

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(iii) Describe how gel electrophoresis can be used to analyse DNA.

(3)

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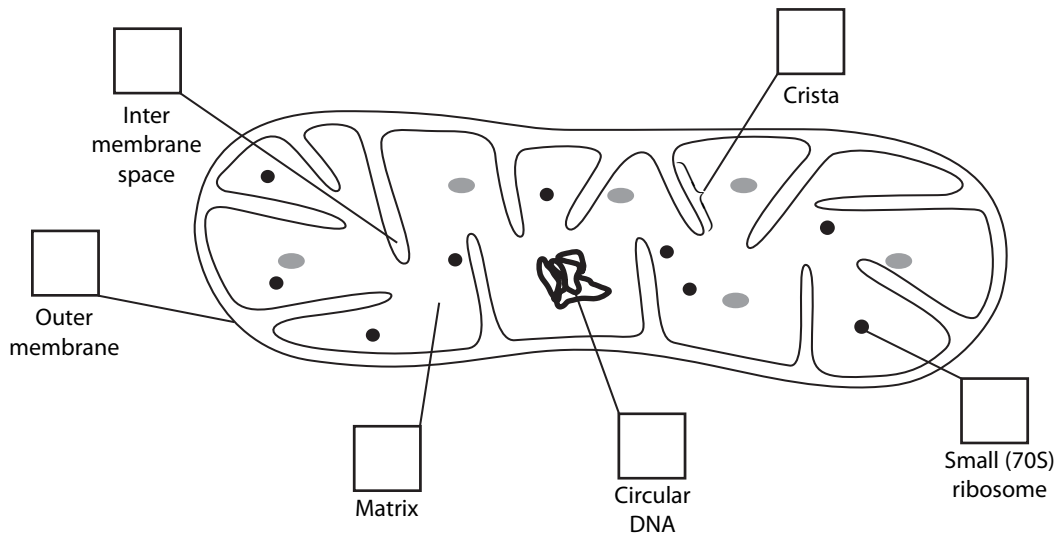
**(Total for Question 1 = 12 marks)**

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2 Prokaryotes, mitochondria and chloroplasts have many features in common.

(a) (i) The diagram below shows a mitochondrion. Two of the features labelled are typical of prokaryotes. Place a tick (✓) in each of the **two** boxes that correctly identify these features.

(2)



(ii) The table below shows some features of mitochondria. If the feature is also present in chloroplasts, place a tick (✓) in the box to the right of that feature and if it is absent, place a cross (✗) in the box.

(3)

Features present in mitochondria	Feature present (✓) or absent (✗) in chloroplasts
Surrounded by a double membrane	
Crista present	
Circular DNA	
Matrix	
Glycogen granule	
Stalked particles	

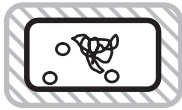
(b) Bacteria can be identified and classified by looking for certain features. Using the information in the passage below, label the five bacteria with the correct letter.

Bacterium P has a single flagellum to enable it to move whilst bacterium Q has several flagella.

Only bacterium R has visible plasmids and bacterium S has an infolding of its cell surface membrane.

Bacterium T has a slime capsule.

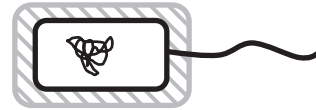
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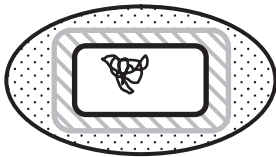
Bacterium .....



Bacterium .....



Bacterium .....



Bacterium .....



Bacterium .....

**(Total for Question 2 = 9 marks)**