

**A Level Biology A**  
**H420/02 Biological Diversity**

**Question Set 4**

1 (a)

Two species of chimpanzees, the chimpanzee and the bonobo, are the closest living relatives of humans.

Fig. 19.1 is a diagram representing the current classification of chimpanzees and humans within the Family Hominidae.

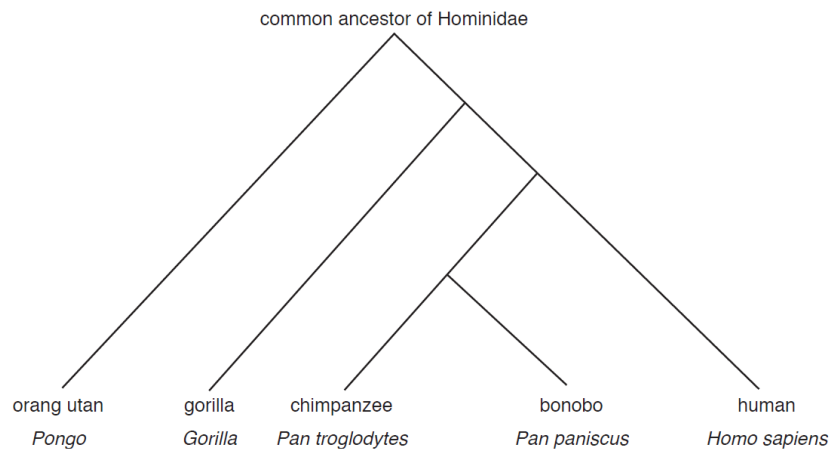


Fig. 19.1

Humans and chimpanzees are currently classified within the same family.

Chimpanzees were once classified separately from humans in the Family Pongidae alongwith gorillas and orang utans.

Fig. 19.2 shows a human hand and a chimpanzee hand.

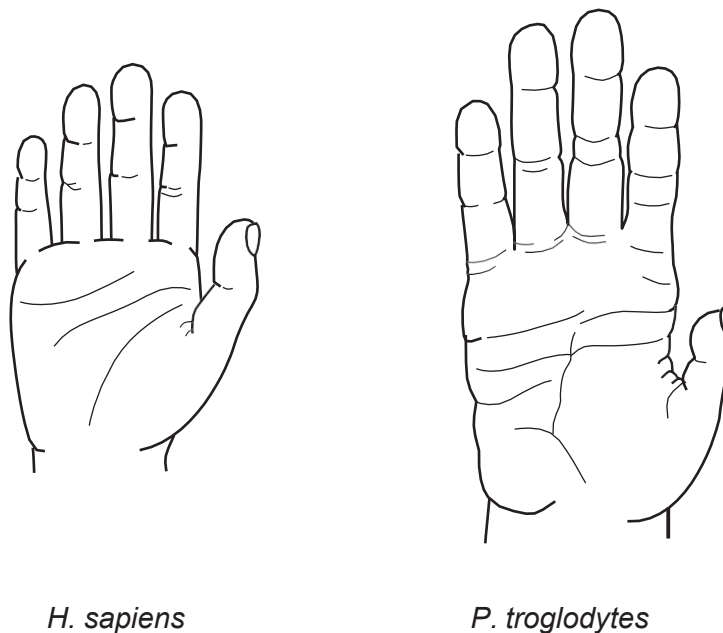


Fig. 19.2

Describe **two** differences between the two images that could have been used to classify humans and chimpanzees in separate families.

[2]

chimpanzee has shorter thumb than humans relatively.  
Chimpanzee has a longer palm than humans relatively.

- 1 (b) (i) Differences between the nucleotide base sequences can be used to estimate the length of time since two species diverged from one another.

The greater the number of differences, the greater the length of time that has elapsed since the two organisms were part of the same species.

Fig. 19.3 shows the line of best fit for the differences in DNA between pairs of primate species plotted against the number of years since the two species diverged from a common ancestor.

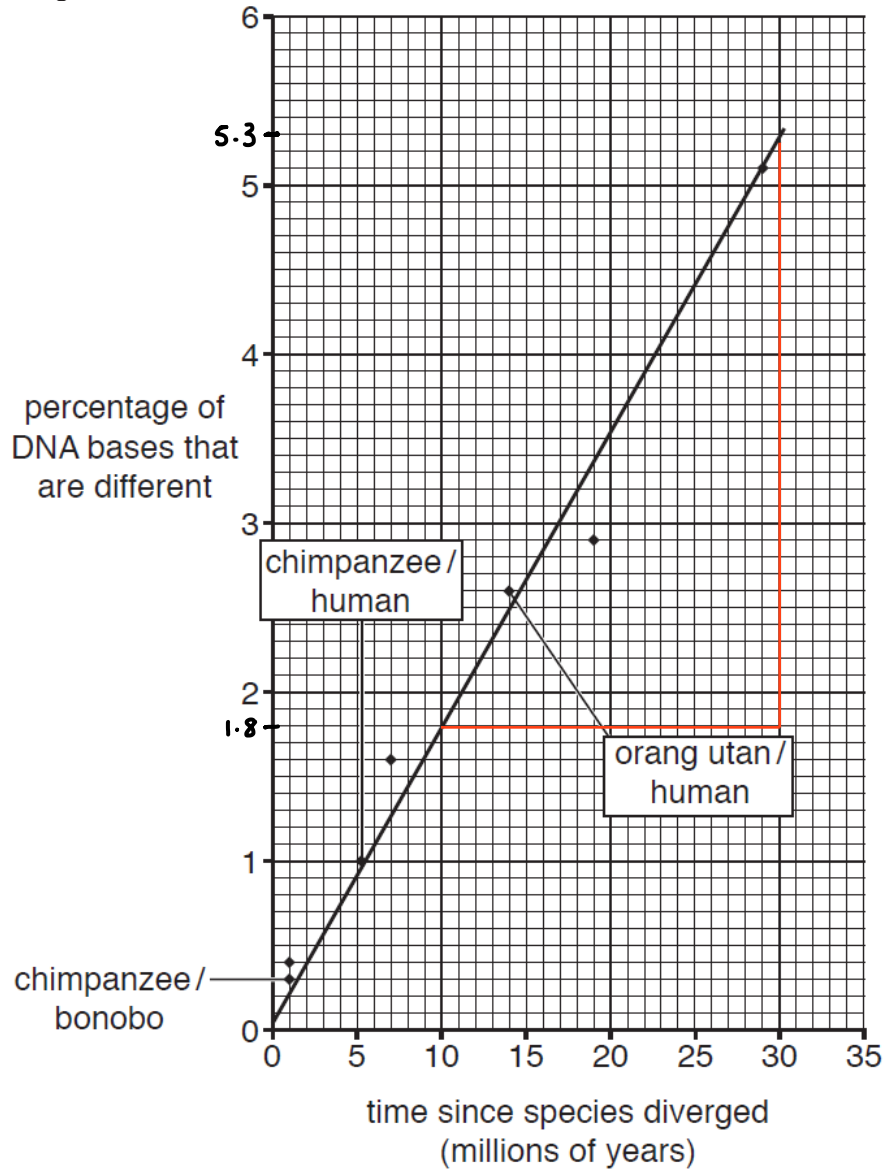


Fig. 19.3

Calculate the rate of DNA change using the data in Fig. 19.3.

Give your answer to **three** significant figures.

$$\text{gradient} = \frac{5.3 - 1.8}{30 - 10}$$

$$\text{Rate} = \dots\dots\dots 0.175 \dots\dots\dots$$

$$= \frac{3.5}{20}$$

$$= 0.175$$

[2]

- (ii) The mutation rate in mammals can vary by as much as 20% between species.

Use Fig. 19.3 to calculate the time since the phylogeny of humans diverged from chimpanzees, and the range over which this estimate may vary.

time since divergence = ..... 5.25 million years

range = ..... 4.2 to 6.3 million years

$$\begin{array}{ccc} \uparrow & & \uparrow \\ 5.25 \times 0.8 & & 5.25 \times 1.2 \end{array}$$

[2]

- (iii) Some scientists have suggested that humans and chimpanzees should be reclassified as belonging to the same genus.

Evaluate their suggestion using evidence from Figs. 19.1 to 19.3 and your own knowledge of the scientific basis for the classification of organisms.

Humans and chimpanzees could be classified to the same genus because the divergence occurred recently. The percentage of DNA bases that are different is low (1%) thus chimpanzees can be considered as being very similar to humans (genetically similar). Also chimpanzees and humans occupy same branch on phylogenetic tree as seen in Fig 19.1. The phylogeny is the basis of classification. Because they diverged relatively recently, they would share similar base sequence thus closely related to each other. Using biochemistry to compare them may be more accurate than comparative anatomy

[6]

However, they shouldn't be classified together as well potentially because the divergence is less recent for chimpanzee compared to bonobo as seen in Fig 19.1. Furthermore, the anatomy of the hand is fairly different between the chimpanzees and humans as shown in Fig 19.2. Original classification is based on the comparative anatomy.

- (iv) One type of gene is known as a homeobox gene.

The base sequences of homeobox genes in humans and chimpanzees are almost identical.

What conclusions about the evolutionary relationship between humans and chimpanzees can be drawn from this piece of evidence?

[1]

Not much can be concluded because homeobox genes are highly conserved within animal kingdom. Hence this only supports that they belong to the same kingdom.

**Total Marks for Question Set 4: 13**

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