1.   DNA barcodes are genetic sequences that allow organisms to be identified. The DNA sequence of cytochrome c oxidase I is a common DNA barcode.

Which property of cytochrome c oxidase I makes it suitable for use as a DNA barcode?

A   location on mitochondrial DNA

B   slow mutation rate

C   short DNA sequence

D   long DNA sequence

Your answer ☐

[1]

2.   The genetic diversity of four species was studied by analysing a number of genes. Data from the studies are shown in **Table 9.1** below.

Species	Common name	Genome size (picograms)	Number of gene loci studied	Number of monomorphic gene loci	Number of polymorphic gene loci
A	Humans	3.50	71	51	20
B	House sparrow	1.57	15	10	5
C	American toad	6.35	14	10	4
D	Atlantic horseshoe crab	2.80	25	19	6

Table 9.1

Which species has the greatest genetic diversity?

Your answer ☐

[1]

3. Which of the following statements about fossil evidence does **not** support the conclusion that hominids were bipedal?

    A Hominids have a large cranial capacity.

    B Hominid vertebral columns have a double curve.

    C Hominid feet are arched.

    D Hominid thigh bones slope inward from hip to knee.

Your answer ☐

[1]

4. Organisms can be classified into taxa by analysing and comparing some of their molecules.

    The molecules below are all involved in respiration.

    Which would be the most appropriate molecule to study in order to classify organisms into taxa?

    A ATP synthase
    B Acetyl coenzyme A
    C NAD
    D FAD

    Your answer [ ]

                                                                                                    [1]

5. Tardigrades, or 'water bears', are a group of animals that live in extreme conditions.

    In 2014, a new species of tardigrade called *Mopsechiniscus franciscae* was discovered in Antarctica. The taxonomic classification of this new species is shown below.

Domain	Kingdom	1	Class	2	3	Genus	Species
Eukaryote	Animalia	Tardigrada	Heterotardigrada	Echiniscoidea	Echiniscidae	4	*franciscae*

    Which of the options, **A** to **D**, completes the table above for the correct classification of the new tardigrade?

    A   **1** Phylum   **2** Family   **3** Order   **4** *Mopsechiniscus*
    B   **1** Phylum   **2** Order   **3** Family   **4** *Mopsechiniscus*
    C   **1** Tardigrade   **2** Family   **3** Order   **4** *Mopsechiniscus*
    D   **1** Phylum   **2** Order   **3** Family   **4** *Tardigrade*

    Your answer [ ]

                                                                                                    [1]

6. An ecologist investigated the distribution of wildflowers in four fields, **A** to **D**. The data collected was used to calculate Simpson's Index of Diversity.

The results are shown below.

	Field A	Field B	Field C	Field D
Simpson's Index of Diversity	0.0163	0.6254	0.163	1.451

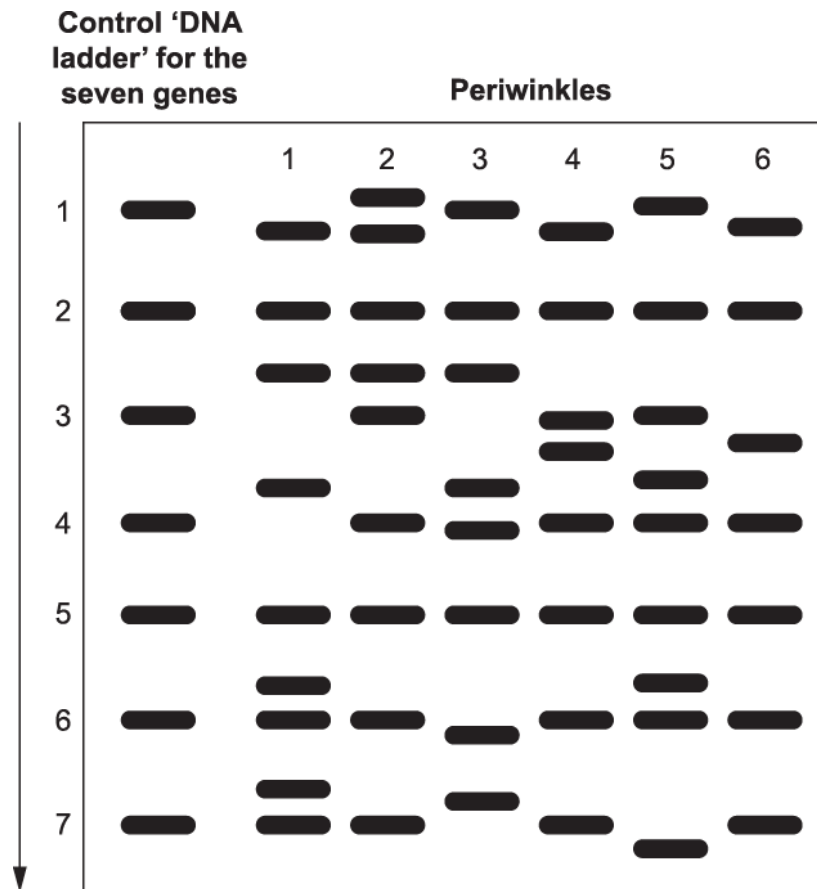Which of the fields, **A** to **D**, is most likely to be able to withstand environmental change?

A field A

B field B

C field C

D field D

Your answer [   ]

[1]

7. Researchers were studying genetic diversity in the common periwinkle, *Littorina littorea*. Seven genes from six periwinkles were analysed using gel electrophoresis.

The results are shown below.

Some of the periwinkle genes were polymorphic and the researchers calculated the proportion of polymorphic genes shown above using the following equation:
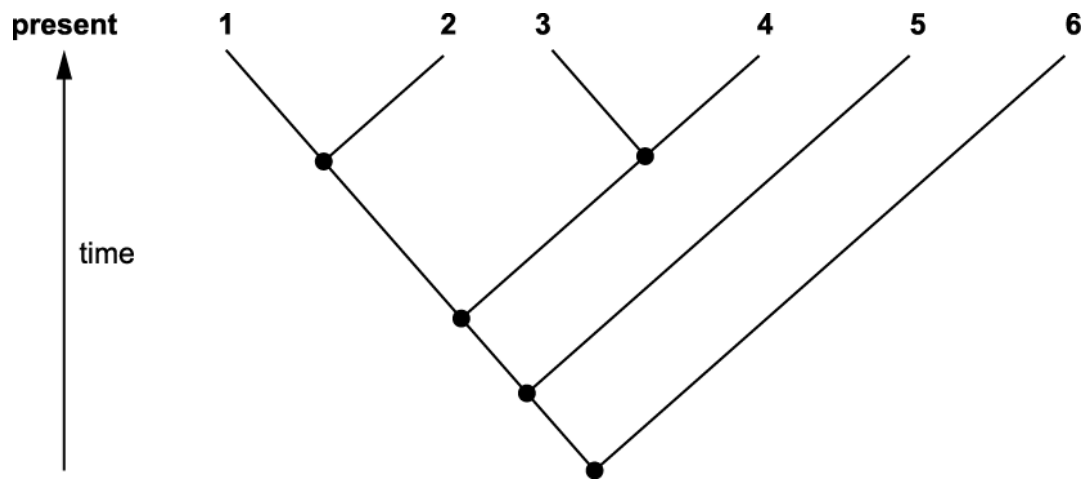
$$\text{Proportion of polymorphic genes} = \frac{\text{number of polymorphic genes}}{\text{total number of genes}}$$

Which of the options, **A** to **D**, shows the correctly calculated proportion of polymorphic genes expressed as a percentage?

A 28.6%

B 36.7%

C 71.4%

D 140.0%

Your answer [   ]

8. A phylogenetic tree is shown below. Six species are labelled **1** to **6**.

Which of the options, **A** to **D**, is a statement that is **not** true of this phylogenetic tree?

A   Branching of the tree is due to random mutations and selection pressures.
B   In genetic terms, species **2**, **3** and **4** are equally close to species **1**.
C   Species **2** and **5** evolved at different times.
D   The tree could have been constructed using fossil records or DNA evidence.

Your answer ☐

[1]

9. DNA barcodes are sequences of DNA that can be used for identifying species.

Which of the statements, **A** to **D**, is a property of a DNA barcode that makes it ideal for identifying species?

A shows a large amount of variation between species
B shows a large amount of variation within a species
C is long, so quick to analyse
D is found in the mitochondria of most taxa

Your answer ☐

[1]

10. Scientists can identify an unknown species as follows:

- extract DNA from tissue, e.g. skin or hair
- amplify a length of DNA, known as a barcode, using the polymerase chain reaction (PCR)
- read the base sequence of the DNA.

The strip below represents a length of extracted DNA before PCR. Lines **1** to **4** represent primers.

Key:
white = same DNA sequence in all species
black = variable DNA sequence between species

Which of the options, **A** to **D**, gives the pair of primers that could be used to amplify DNA from all species?
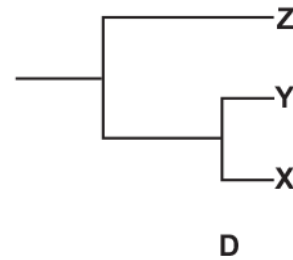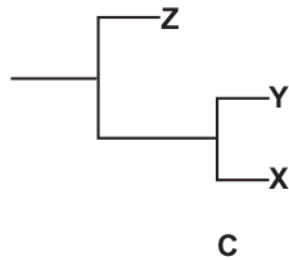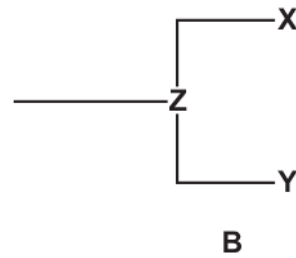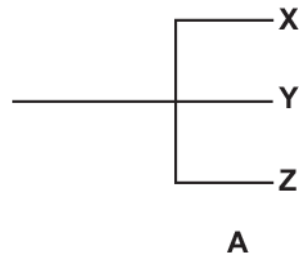
A   1 and 3
B   1 and 4
C   2 and 3
D   2 and 4

Your answer   [1]

11. Three species, **X**, **Y** and **Z**, all evolved from a common ancestor. Species **X** and **Y** were the most closely related and species **Z** was extinct.

Which of the phylogenetic trees, **A** to **D**, represents the evolution of species X, Y and Z?

Your answer ☐ [1]

12. Here are three statements about the evolution of language:

   1   Sequencing the genome of extinct human ancestors helps to indicate the origins of language.

   2   The evolution of language will have been influenced by reproductive (mating) preferences.

   3   The 'gossip' hypothesis relies on trust between animals for the acceptance of unfamiliar sounds.

Which of the statements is/are correct?

A   1, 2 and 3 are correct

B   Only 1 and 2 are correct

C   Only 2 and 3 are correct

D   Only 1 is correct

Your answer ☐ [1]

13. The genetic diversity of monkey populations in a forest ecosystem was studied. The data for one population are shown in the table below.

Total genes studied	Genes with one allele	Genes with two alleles	Genes with more than two alleles
49	33	5	11

Which of the options, **A** to **D**, is the proportion of polymorphic genes in the monkey population?

A   0.11

B   0.33

C   0.67

D   0.78

Your answer [____] [1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			C	1	
			Total	1	
2			B	1	
			Total	1	
3			A	1	
			Total	1	
4			A	1	
			Total	1	
5			B	1	**Examiner's Comments** The majority of candidates were aware of the correct sequence for taxonomic classification and could apply this correctly to the new situation. It was answered correctly by a high proportion of candidates.
			Total	1	
6			B	1	**Examiner's Comments** For candidates that understood that a high value for Simpson's Biodiversity Index would be the most appropriate choice for the question asked, they then had to the choose the highest value between 0 and 1, option **B** being the correct response. The majority of candidates incorrectly offered option **D** as their response to this question. It is likely that this distractor highlighted a misunderstanding of the fact that it had to be a value between 0 and 1.
			Total	1	

Question			Answer/Indicative content	Marks	Guidance
7			C	1	**Examiner's Comments** Another question where there was a lot of information for candidates to process, which then also required a calculation. Despite the calculation being fairly straightforward, extracting the required information from the diagram, not surprisingly, proved challenging.
			Total	1	
8			B ✓	1	
			Total	1	
9			A	1	**Examiner's Comments** This question was straightforward recall and the majority of candidates chose the correct response.
			Total	1	
10			A ✓	1	**Examiner's Comments** Candidates scored highly on this question, most correctly identifying the pair of primers that could be used to amplify DNA from all species.
			Total	1	
11			C	1	
			Total	1	
12			B	1	**Examiner's Comments** Many candidates selected option A or C for this question. However, statement 3 here relates to the mother tongues theory of language evolution.
			Total	1	
13			B	1	
			Total	1	