**Yr 12 ATAR HUMAN BIOLOGY**

**Evidence for Evolution Test 4**

**Multiple Choice: /8**

**Short Answer: /33**

**Extended Answer: /14**

**Name:** \_\_MARKING KEY

Select the best alternative from the answers given and mark your choice like this

(a) (b) (c) (d)

|  |  |
| --- | --- |
| 1. (a) (b) (c) (d)  2. (a) (b) (c) (d)  3. (a) (b) (c) (d)  4. (a) (b) (c) (d) | 5. (a) (b) (c) (d)  6. (a) (b) (c) (d)  7. (a) (b) (c) (d)  8. (a) (b) (c) (d) |

**Section Two: Short Answers**

Answer in the spaces provided

1. Complete the table below providing an outline and example of the different lines of evidence that support the theory of evolution.

|  |  |  |
| --- | --- | --- |
| **Evidence** | **Support for Evolution** | **Example** |
| Protein Analysis | **comparing ubiquitous protein structures in different species it can be seen that similar species show greater similarity than species that are as closely related (1)** | Cytochrome C/  Beta chain haemoglobin |
| Vestigial organs | **Structures that are reduced in size and appear to have no function (1) believed to have come from a past ancestor** | Nictitating membrane |
| Comparative embryology | The presence of similarities and specific features during early stages of development that are not present in later development suggest a common ancestor. | 1 relevant eg  Gills - humans  Tails - human |

(6 marks)

1. The fossil record can provide evidence for the process of evolution. A complete fossil record exists for some species but not others.
2. What is a fossil?

Preserved remains or trace of a once living thing

(1 mark)

1. Suggest 3 reasons why the fossil record is incomplete for some species

Conditions for fossilisation has not been met (no fossil)

Inaccessible location / buried too deep in the ground

Destroyed by human / geological activity (eg folding, volcanic)

Unable to date fossil as it does not meet limitations

Fossil too fragmented

Scientists disagree with interpretation of fossils

Any 3 for 3 marks)

One method of relative dating scientists use to date fossils is comparative stratigraphy. The diagram below shows the various layers of three core samples taken from different locations.

Diagram, engineering drawing

Description automatically generated

The samples were brought back to the laboratory for analysis.

1. Name three strata that were laid down at the same time.

F, J and N or E, I and M

(1 mark)

1. Which site contains the oldest fossils?

Site 3

(1 mark)

1. What 2 principles suggests this layer is the oldest?

Principle of superposition (1)

Correlation of rock strata (1)

(2 mark)

1. Describe the way in which specimens, such as those shown in the diagram above, might have

become fossilised.

Organism died and was buried by sand / ash / mud / sediment rapidly (1)

Protected from scavengers (1)

In a low energy environment (1)

New minerals replace the organic matter of the organism/petrification (1)

Needed to remain undisturbed for a long period of time (1)

Any 4 for 4 marks

1. A palaeontologist who is completing excavations at an East African dig site unearths a fossil and believes he has discovered a lost primate. To determine where this fossil sits on the evolutionary line they decide to complete a comparative study of DNA.
2. Due to severe degradation of the fossil’s genetic material the lab needs to create more DNA.

Explain the 3 key stages of the PCR process used to create more DNA.

DENATURING

temperatures raised to 90oC (1), DNA separates into 2 strands (1)

ANNEALING

DNA is cooled to 50 – 65oC (1), primers attach/anneal to the complementary sequence (1)

ELONGATION (1)

Temperature is raised to 72oC (1), Taq polymerase adds DNA nucleotides to replicate each of the DNA strands (1)

(6 marks)

1. Describe the process used to determine the DNA sequence after having created the master mix(s) of DNA of varying lengths.

**Gel Electrophoresis**

Sample is then placed into the four different wells [representing the four bases] on an electrophoresis gel (1)

An electric current is passed through the gel (1)

DNA is negatively charged (1)

therefor moves through the gel towards the positive electrode/ away from the negative electrode (1)

larger fragments move slower, shorter fragments move faster [1]

This forms band lines in the gel for each base that can be read for the sequence (1)

**Capillary electrophoresis**

DNA sample is placed at the start of a capillary tube [1]

An electric current is passed through the gel (1)

DNA is negatively charged (1)

therefor moves through the gel towards the positive electrode/ away from the negative electrode (1)

larger fragments move slower, shorter fragments move faster [1]

A laser at the end of the tube excites and reads the fluorescent tags (attached to altered bases) to determine the sequence (1)

(6 marks)

1. Explain how this shows evolutionary relationships between primates and therefore how he can

determine where the fossil sits on the evolutionary line.

More differences in DNA sequences means longer time since they diverged from a common ancestor / vice versa (1)

He would look for primates that shared the most similarities to this species (1)

(2 marks)

1. Mitochondrial DNA can also be used as evidence for evolution. Explain why this data can only be

used to show evolutionary relationships of maternal ancestry.

Mitochondrial DNA is only passed on from the mother

(1 mark)

**Section Three: Extended answer**

1. Bone tools have been discovered very recently in South America and are believed to be 53,000 years old. Identify and explain the type of dating technique used to determine the age of these tools and describe two of its limitations.

|  |  |
| --- | --- |
| Identify dating method: Carbon 14 dating | 1 |
| Explanation:  Carbon 14 is created in the atmosphere from Nitrogen by cosmic radiation  Plants absorb C14 during photosynthesis (as CO2)  Animals eat/ Food chain C14 is passed on  After death C14 ceases to be absorbed so its decay can be measured  C14 is radioactive and decays back into N14  ½ Life of C14 is 5730 years  By establishing the ration between C14 And C12 you can determine how many ½ lives have passed  Knowing the number of half lives we can determine an absolute age of the fossil | 1-7 |
| Limitations:  Can only date fossils up to 60,000 years (as negligible C14 left after this)  Substance being tested must be organic / contain carbon  Technique assumes C14 levels in the past match those of today  Requires a minimum of 3grams (unless using AMS) | 1-2 |
| Total | 10 |

(10 marks)

1. Potassium40 (K40) is another radio-isotope used in dating objects. Given that the half-life of K40 is approx. 1.3 billion years and what you know about this dating method, explain the circumstances under which you would use K40 to estimate the age of fossils and artifacts.

Potassium argon dating dates the rock/volcanic material in which the fossil is found (1)

Around fossil not fossil itself so good for minimal fossil material (1 mark)

Much Longer half-life so can date much older fossils (1)

Allows dating of rock 100 000 years +. (1)

Younger than 200,000 lose precision (1)

Allows dating of non-organic artifacts (1)

(any 4 for 4 marks)