**Question 41. (20 marks)**

(a) A recent hominin skeletal find has contributed to our understanding of the theory of evolution in two ways: through fossil evidence and comparative anatomy. Discuss how these two pieces of evidence support the theory of evolution. (10 marks)

***Fossil evidence*** *(Any 4 points, 1 mark each)*

Structure change over time allows us to see the development of the species (1)

*Similarities between fossils of organisms and modern organisms may suggest a common ancestor.(1)*

*The further back in time, the simpler the (organisms)fossil remains(1)*

*Some fossils are completely unlike any species alive today (1)*

*Many present day forms are not preserved in the fossil record and so presumably did not exist in the past (1)*

*When similarity exists between fossils and today’s species, the changing structure over time allows us to see the development of the species (1)*

***Comparative anatomy*** *(Any 6 points, 1 mark each)*

*Involves comparing the structural similarity of related organisms to ascertain the degree of similarity between them (1)*

*The closer the relationship between the organisms being studied, the more similar they are (1)*

*This supports the idea of descent from a common ancestor (1)*

*Homologous structures are those that have a high degree of structural similarity although they may*

*perform different functions (1)*

*Eg: the vertebrate limb (1)*

*Vestigial structures are those that are believed to have been functional in our ancestors but have been retained in a rudimentary form (often reduced in size), and have no obvious function (1)*

*Eg: appendix, wisdom teeth, nictitating membrane, nipples in males, coccyx (1)*

(b) Muscle contraction is believed to occur due to a sliding filament model. Describe the sliding filament model of muscle contraction. Use a correctly labelled diagram.

Around each muscle cell is a special membrane called the sarcolemma.

(1 mark)

Each cell is full of many long thread like fibres called myofibrils.

Each myofibril is made up of myofilaments.

(1 mark)

The myofilaments are made up of two proteins: myosin and actin.

(1 mark)

Diagram(total possible 4 marks)

Two separate Diagrams of relaxed and contracted and headed as such.

Diagram should have actin and myosin labelled, sarcomere(1mark)

Diagram must look like the diagrams taught(1mark)

Cross bridges “bent backwards labelled(1 mark)

Movement of sodium ions into the muscle cells causes calcium to move into the myofilaments(or into the sarcoplasm).

(1 mark)

ATP breaks down to ADP to give energy.

(1 mark)

This causes the ends of the myosin threads “bend” backwards and drags the actin filaments closer together.

(1 mark)

This draws the two z lines together and reduces the length of the sarcomere.

(1 mark)

The actin and myosin molecules stay the same size, they just slide over each other.

(1mark)

**Question 42. (20 marks)**

(a) With the extreme cold temperatures seen in some parts of Europe recently, regulation of body temperature can become a matter of life and death, especially for the aged. Explain how human bodies typically act to maintain core body temperature under cold conditions, both physiologically and behaviourally.

(12 marks)

Stimulus – decreased core body temperature (1)

Receptor – core thermoreceptors in the hypothalamus (1) and Spinal cord(1) and abdominal organs(1)

Modulator – hypothalamus (1)

Which releases TSHrf (1)

Which causes the anterior pituitary to release TSH (1)

Which causes the thyroid to produce thyroxine (1)

Effector – all body cells (1)

Blood vessels near skin/ Smooth muscle of arterioles (1)

Skeletal muscle cells (1)

Response –

Increased metabolic rate/ rate of cell respiration (1)

Shivering (1)

vasoconstriction (1)

Feedback – increased core body temperature (1)

Behavioural mechanisms – put on clothing / consume hot food or drink / put on a heater / reduce surface area by curling into a ball (1 mark each)

(b) In 1775, a typhoon reduced the population of Pingelap, an island in Micronesia from 2000 to 20. Among the survivors was a person heterozygous for achromatopsia, an inherited form of total colour blindness. Describe how and why the gene pool of this population would have been affected by this event over time if this is an isolated population. (4 marks)

(Any 4 points, 1 mark each)

Genetic bottle neck would have occurred as the population is now much smaller.(1) here a large number of the populations are killed(1)

New resultant population may not be genetically representative of the original population of the island (1)

Random genetic drift will have more of an impact as the population is small. (1)

As the population is small and the population is descended form the survivor group the achromatopsia allele becomes more common(frequent) (1)

A lack of immigration means that the population could only breed within this group (1) as a result of this:

less new alleles brought into the population(1)

more chance of allele occurring in the homozygous genotype(1)

(c) Describe how mature osteocytes are supplied with their requirements.

(4 marks)

Any 4 points, 1 mark each)

Bone cells are supplied with oxygen / glucose / their requirements by blood vessels in the Haversian systems (1)

Osteocytesa are interconnected by canaliculi (1) which are outpushing of the cell membrane(1mark).

The osteocytes exchange materials via the canaliculi(1mark)

**Question 43. (20 marks)**

1. A recent fossil find showed that some hominins hafted their tools – they attached wooden handles to some of the bone hand axes they utilised for a variety of tasks. Fluorine dating was utilised in an attempt to date that tool and others found at the same site. Briefly explain how fluorine dating is carried out and identify any limitations it may have.

(7 marks)

**How**

Fluoride ions are present in the water found in soil (1)

Over time, bone absorbs the fluorine from the water in the soil in which it sits (1)

The more fluorine a specimen has the older it is (1)

**Limitations**

Can only be used on bone (1)

Can only be used on samples from the same site (1)

As fluorine levels can vary in the soil from place to place (1)

And in one place over time (1)

Can only provide a relative date (1)

(b) Give three advantages of the use of Recombinant DNA technology in the treatment of Classic haemophilia brought about by a lack of factor VIII.

(3 marks)

Human donors not needed.(1)

Less chance of disease transmission.(1)

Less chance of immune response as no other materials from human blood present.(1)

1. Humans are classified as both primates and hominins. Describe the features that place us in each of these groups.

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| --- | --- |
| **Primate** characteristics  (Any 5 points, 1 mark each) | **Hominin** characteristics  (Any 5 points, 1 mark each) |
| large cerebral cortex | larger cerebral cortex |
| reduction in olfactory capabilities | bipedal |
| increase in optical capabilities / stereoscopic  vision / colour vision | reduction in prognathism |
| increase in gestation time | parabolic dentition / teeth similar in size and shape |
| increase in parental care | S shaped spine |
| increased mobility of the digits /greater  opposability of the thumb / friction ridges / nails instead of claws | pelvis broad and bowl shaped |
| teeth shape now a 4 cusp or Y5 pattern | Longitudinal and transverse arches in the foot |
| reduced number of teeth |  |
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