

<p>(b) During cell division</p> <p>One mark for each point – must have at least one but no more than two examples – (max. 7 marks)</p>	<ul style="list-style-type: none"> When homologous chromosomes fail to separate during the anaphase of cell division. If this occurs in either of the two meiotic divisions, some resulting gametes have extra chromosomes, some fewer chromosomes than the normal haploid number. If non disjunction occurs in a mitotic division some somatic cells will have an extra chromosome and some will be missing a chromosome. 	<ul style="list-style-type: none"> Extra DNA in cells may interfere with the normal function of other DNA such that protein synthesis is abnormal. Missing segments of chromosomes may result in the expression of more harmful recessive genes which are normally masked. If non disjunction occurs in mitosis, then areas of an organism/organ may develop cells that are different from surrounding tissue. 	<ul style="list-style-type: none"> Down syndrome / Patau syndrome / Turner's syndrome Some forms of cancer may result from non disjunction during mitosis.
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27 2019:42

(10 marks)

(a) **Natural Selection**

One mark for each point)

- A phenotype is mainly an expression of the genotype of the individual, it is determined by the genes, e.g. dark skin in the case of the Sentinelese is an inherited trait.
- The environment can also cause the skin to become darker as it is tanned, melanocytes produce more melanin that helps protect the skin, but this is not inherited as no change occurs in the gametes.
- The Sentinelese phenotype may have resulted from a series of mutations, as skin colour is a polygenic trait. It is believed to be controlled by at least three pairs of genes.
- The dark skin phenotype is an advantage in a very sunny environment.
- Dark skin protects the skin from dangerous UV radiation that can cause skin cancer.
- The darker the skin, the more melanin in the skin that further protects it.
- Individuals with the darkest skin are more likely to survive and reproduce more offspring in this environment.
- Their offspring will inherit these genes and survive in greater numbers.
- The frequency of genes for dark skin will increase in the Sentinelese population over time.
- If the population of Sentinelese remain isolated the frequency of genes for dark skin will remain high as it will not be diluted by other genes.

Chapter 7: Evidence for evolution**MULTIPLE-CHOICE QUESTIONS**

1 (2014:17)	(d)	2 (2014:21)	(b)	3 (2014:24)	(c)	4 (2014:26)	(c)
5 (2015:19)	(b)	6 (2015:20)	(d)	7 (2016:12)	(c)	8 (2016:18)	(c)
9 (2016:19)	(b)	10 (2016:21)	(d)	11 (2016:27)	(c)	12 (2016:28)	(d)
13 (2016:29)	(b)	14 (2017:07)	(d)	15 (2017:25)	(c)	16 (2017:27)	(c)
17 (2018:11)	(b)	18 (2018:23)	(c)	19 (2018:24)	(a)	20 (2019:05)	(b)
21 (2019:11)	(a)	22 (2019:15)	(c)	23 (2019:16)	(d)		

SHORT ANSWER QUESTIONS

24 2014:31

(9 marks)

- (a) (i) Vestigial (organs) (1)
 (ii) Any ONE of the following: (1)
 Coccyx/body hair/tonsils/piloerector muscles/segmentation of abdominal muscles/
 nictitating membrane in the eye/pointy canine teeth/pyramidalis muscle
 (connected to pubic bone)
 (iii) • These structures are remains of organs/structures that were required/
 had a purpose/use in ancestral/earlier forms/species
 • Changes in the environment/selection pressures have reduced them/made them
 non-functional
 • No longer needed/body doesn't waste energy maintaining these structures
 • Suggests ancestral relationship with organisms that have functional forms
 of the same structures/organs
 (1 mark for each of 3 points = 3 marks)
- (b) (i) Comparative embryology (1)
 (ii) • Closely related organisms are more similar/have more similarities in the
 early stages of embryonic life (1) OR (1)
 • More distantly related organisms show more differences in their embryonic
 development/anatomy (1)
 (iii) • Yes (1) (2)
 • Vertebrates show similar early embryonic anatomy/development/stages of
 early life very similar/early stages have gill pouches/tail (1)

25 2015:34

(10 marks)

- (a) • Fossil D (1) (2)
 • The greater the amount/concentration of fluoride ions the older the bone is (1)
- (b) • The bone will absorb the fluoride ions from its surroundings/environment/groundwater (1) (2)
 • The concentration/amount of fluoride ions varies from place to place/between locations/will be
 different/specific to particular areas (1)
- (c) (i) • Stratigraphy/Principle of superposition (1)
 (ii) Any one of the following: (1)
 • Fossils can be reburied/buried more deeply by animals/humans (1)
 • Earth movements/geological disturbances/layers folded/turned upside down (1)
 • Error in dating by fluorine technique
- (d) Any four of the following points: (4)
 • MUST include name: carbon dating/radiocarbon dating/carbon 14 dating (1)
 • Based on decay of C14 to nitrogen/N
 • Decays at known rate/half life of 5730 years
 • Compare the amount of C14 to C12/C14:c12 ratio determined
 • Can date up to 70 000 years (acceptable range 60 000–70 000)

26 2016:37

(4 marks)

- (b) Potassium – Argon/K – Ar (1)
 1 mark each for any 3 dot points (3)
 • Radioactive K-40 breaks down to Ar-40 (and Ca-40)
 • K-40 has a half life of 1.3 billion years
 • Ratio of K-40 : Ar-40 can be measured in volcanically formed rocks older than 200000 years
 • Age of this rock can be determined by measuring the ratio of K-40 to Ar-40
 • Fossils in or associated with volcanically formed rocks older than 200000 years can be dated

27 2016:39

(5 marks)

- (d) 1 mark for each dot point (3)
 • Proteins are long chained molecules (polymers) made up of a particular number and sequence of
 amino acid molecules
 • The sequence and number of amino acids in a protein is determined by chromosomal DNA
 • By comparing proteins from different organisms, comparisons of their DNA can be determined that
 indicates their degree of relatedness

- (e) Either answer below 1 mark for each dot point (2)
- Unlikely/No
 - Fossils are generally too old and any protein has degenerated
- or
- Possibly/Yes
 - If some protein like haemoglobin has been preserved on the bone

28 2017:35 (5 marks)

- (b) Usually only small samples of DNA are found in fossils – in order to study them a greater quantity is required (1)
- (c) (i) C (1)
- (iii) A (1)
- (d) One mark for each point (2)
- A
 - The corpse is not exposed to bacteria/fungi and is not decomposed/The corpse is preserved in rock in anaerobic conditions

29 2017:38 (7 marks)

- (a) (i) Stratigraphy(1)
- (ii) One mark for each point(3)
- Sedimentary layer 1
 - Layers are laid down on top of each other, the oldest layer lies below the other layers
 - Layer 1 lies below layer 2 and 3 therefore it is older than both
- (b) An index fossil is a fossilised organism that was widely distributed and present on earth for a short period of time (1)
- One mark each for any two points (2)
- Using index fossils to date relatively is more precise because of their short span of life on Earth
 - Sedimentary rocks that contain the same fossils are assumed to be the same age
 - Index fossils found in sedimentary rock in one area will indicate the relative ages of other sedimentary rock layers above and below
 - Index fossils in one area can be used to date rocks in another area

30 2018:39 (11 marks)

- (a) One mark for each point (3)
- Comparative anatomy.
 - Comparing the structures e.g. the bones, helps to determine how closely related two organisms may be.
 - Organisms that have a similar structures are considered to be more closely related than those that have very different structures. / Organisms with similar structures are believed to have a more recent common ancestor.
- (b) One mark for each point (2)
- Because these six limbs have a similar number of bones arranged in the same order and position, they provide evidence that the six organisms have a comparatively recent ancestor.
 - The bones are different and the different formed appendages that result from these bones show that each animal has adapted to a different environment.
- (c) (i) One mark for each point (2)
- Suitable – The age of the specimen is less than 70 000 years.
 - Unsuitable – Less than 3 grams of specimen.
- OR
- Suitable – 3 or more grams of specimen available.
 - Unsuitable – The age of the specimen is greater than 70 000 years.
- (ii) One mark for each point (4)
- Because C-14 continuously forms in the atmosphere and breaks down at the same rate as it forms, the proportion of unstable C-14 to stable C-12 in the atmosphere remains the same (i.e. C-14:C-12 is 1:10¹²).
 - Plants absorb carbon in carbon dioxide during photosynthesis and the carbon is passed to animals in the food chain. While alive both animals and plants contain the two isotopes of carbon in the ratio of C-14:C-12 = 1:10¹².
 - On dying the ratio in both plant and animal fossils changes, the amount of C-14 decreases as it decays to nitrogen with a half-life of 5730 years, while the amount of C-12 stays the same.
 - Therefore, as it ages the fossil's C-14:C-12 ratio becomes progressively less than 1:10¹². The ratio can be used as a measure of how old the fossil is until the amount of C-14 becomes too small to measure (at about 70 000 years).

31 2019:40

(6 marks)

- (a) Strata 3 (1)
- (b) One mark for each point (3)
- Principle of Superposition
 - Older strata have been laid down as sediment on the bottom of the ocean, sea or large lake first. Younger sediments are laid down as they are formed on top. The top stratum should be the youngest layer provided the rock has not been disturbed.
 - Fossils found imbedded in older strata are assumed to be older than fossils found imbedded at a higher level in younger strata.
- (c) One mark for each point (2)
- The date given in the preamble was about 65 000 years, this is an absolute date, an actual number of years has been given. The principle of Superposition provides only relative dating.
 - More than one dating method may have been used as different methods are used for different materials and cover different periods of time. /Using different dating methods may enable scientists to cross check to confirm the accuracy of other results.

EXTENDED ANSWER QUESTIONS

32 2016:42

(10 marks)

- (b) **Why fossil record is important** 1 mark each for any 4 dot points (4)
- A complete record would show progressive changes in species with time
 - It would show relatedness between species
 - It would enable the identification of organisms that show adaptive radiation occurring
 - Transitional organisms could be observed
 - It would provide evidence of organisms that have lived in the past
 - Enable a better understanding of the climate through observation of the adaptations possessed by animals that lived at the time
 - The time at which adaptive radiation occurred could be determined more accurately
 - It would provide evidence of when extinctions had occurred
- Factors that can affect fossil formation** 1 mark each for any 3 dot points (3)
- Soil ph e.g. bones are more likely to be fossilised in alkaline soil
 - Rapidity of burial – removes organism from scavengers and other disturbance
 - Whether animal has a hard shell, bones or soft bodied – soft bodied animals decompose quickly
 - Climate – humidity, rainfall, temperature
 - Soil moisture – promotes microorganism activity
 - Bacteria and fungi present
 - Oxygen levels in the environment – anaerobic conditions inhibit most microorganisms
 - Presence of scavenging animals in the environment
 - Proximity to human activity – fossils are more likely disturbed/destroyed in vicinity of humans
- Why fossils are difficult to locate** 1 mark each for any 3 dot points (3)
- Earth's crust changes with faults and folding – movement may destroy fossils
 - Some fossils are buried deep within the earth/fossils may be located in old strata well below the surface
 - Fossils may be in remote location
 - Fossils may be in sedimentary rock deep in the ocean
 - Fossils may be encased in volcanic lava
 - Destroyed due to erosion and weathering
 - Human activity – buildings, mine tailings etc may disturb/bury/destroy fossils

33 2017:40

(12 marks)

- (b) Students may choose any absolute dating technique provided it is suitable for the age of the corresponding fossil.
- Potassium–Argon (K-Ar) dating, which can be used to date rocks older than 200 000 years and up to several billion years, would be suitable to date *A. afarensis*. (1)
- One mark each for any five of the following points (5)
- *Australopithecus afarensis* lived in Africa between 3.9 and 2.9 million years ago.
 - An absolute dating method suitable to date fossils of this species must be able to date fossils older than 2.9 million years.
 - Fossils that are known to be the same age as rocks that can be dated using K-Ar dating can be dated using this method