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91606



NEW ZEALAND QUALIFICATIONS AUTHORITY
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Level 3 Biology, 2016

91606 Demonstrate understanding of trends in human evolution

2.00 p.m. Thursday 10 November 2016
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of trends in human evolution.	Demonstrate in-depth understanding of trends in human evolution.	Demonstrate comprehensive understanding of trends in human evolution.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Achievement

TOTAL

13

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QUESTION ONE

Documenting similarities and differences between Hominid species is fundamental to understanding their biological and evolutionary relationships. The skulls A and B show some similarities and differences. Anthropologists have agreed that Skull A is older than Skull B.

Skull A



<https://blogopithecus.files.wordpress.com/2009/03/tcahd-3d-reconstruction.jpg>

Skull B



www.sideshowtoy.com/mas_assets/jpg/KAM05_press01-001.jpg

www.anthrophoto.com/cgi-bin/ImageFolio31//imageFolio.cgi?search=under&img=&cat=&bool=phrase



www.sideshowtoy.com/mas_assets/jpg/KAM05_press02-001.jpg

http://www.dlt.ncssm.edu/tiger/360views/Hominid_Skull-Homo_erectus_PekingMan_1200x900/top-bottom/Hominid_Skull-Homo_erectus_PekingMan-top-900.jp

Discuss the selective forces which would support the evolutionary changes observed in Skull B compared to Skull A.

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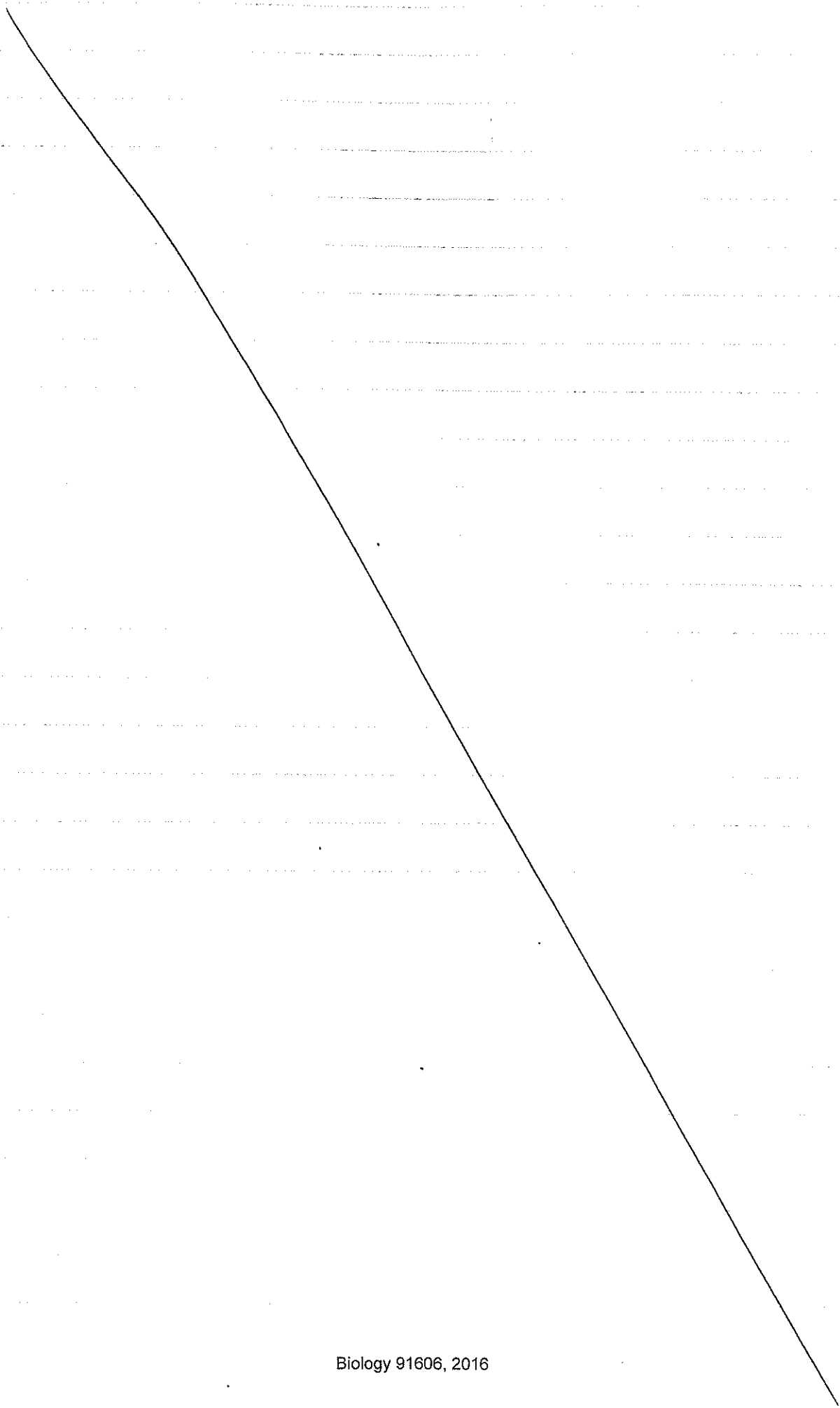
In your discussion:

- describe FOUR features that support Skull A being older than Skull B
- explain how these identified features can be linked to evidence of bipedalism, and to the types of food these hominids ate
- discuss how the changes in the skull features have led to evolutionary trends in bipedalism, diet, and intelligence of hominids.

Skull A has a larger brow ridge, the Foramen Magnum is further to the back, it has larger teeth, and it has a larger nuchal ridge at the back of its head. These features indicate that skull A is older than skull B. Having a large brow ridge and teeth indicates that this individual (skull A) ate tough, raw foods, which it needed a lot of strength to chew up. The Foramen Magnum towards the back of its head indicates that this individual ~~may have~~ was in the process of evolving to bipedalism, and may have been partially bipedal. This is supported by the larger nuchal ridge, as this is where the neck muscles attach in order to hold the head upright. Skull B also has a larger brain case which indicates it was more intelligent and therefore more evolved than skull A. The ~~the~~ zygomatic arch in skull A is also much larger, indicating a tough raw diet requiring large, strong jaw muscles.

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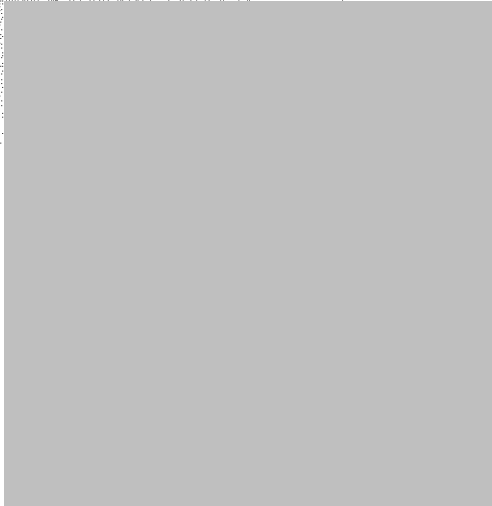
An evolutionary trend in bipedalism is the ~~movement~~ movement of the Foramen Magnum from the back of the skull, to directly centered underneath. The increase in brain size (cranial capacity) indicates a trend of increasing intelligence. Decreasing teeth ^{and} zygomatic arch ~~width~~ size indicates the diet becoming softer, as hominids began cooking & butchering food.



A4

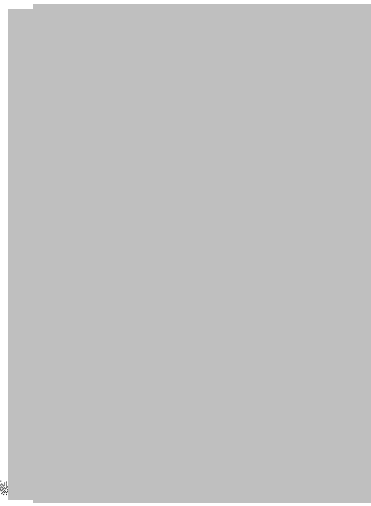
QUESTION TWO

Homo habilis, *Homo erectus*, and *Homo neanderthalensis* have developed different forms of cultural evolution to help them survive successfully in their ecological niche. Some of these forms of cultural evolution are shown in the pictures below.



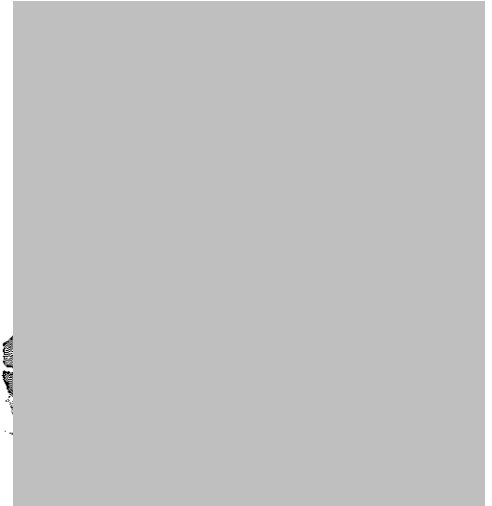
Homo habilis

<http://earlyman.yolasite.com/homo-habilis.php>



Homo neanderthalensis

<http://ies.aquiscelenis.climantica.org/2012/02/20/homo-neanderthalensis/>



<http://hoopermuseum.earthsci.carleton.ca/neanderthal/neanderthal.jpg>



Homo erectus

www.erasmatazz.com/library/science/the-phylogeny-of-play.html

www.flashofgold.com/14-events-that-changed-military-history/

Analyse the different aspects of cultural evolution.

In your analysis:

- define cultural evolution
- describe the different forms of cultural evolution associated with *Homo habilis*, *Homo erectus*, and *Homo neanderthalensis*
- explain how these different forms of cultural evolution are adaptive advantages for the species who use them
- discuss the advantages and disadvantages that cultural evolution has had on biological evolution.

Cultural evolution is all of the non-biological aspects of evolution. Cultural evolution includes tools, language, fire, art, clothing etc. A form of cultural evolution associated with all three of these Homo species is tools. Homo habilis were the first hominins to develop tools. They made simple 'pebble tools' by striking a few flakes off a rock. These tools ^(Oldowan tools) were used for cutting meat, wood, and plants, and for crushing bones to access protein-rich bone marrow. Homo erectus further developed tools, striking a few more flakes off on both sides of a rock (Acheulian tools). These tools were used for similar purposes. Both Oldowan and Acheulian tools were simple, versatile, and not specialised. Homo neanderthalensis made slightly more specialised tools, which were also used for hunting (Mousterian tools). Tools allowed hominids to access protein-rich meat and bone marrow, which grew their cranial capacity. This acted as a positive feedback loop, as they became more intelligent and further developed more specialised tools. This was a clear advantage for biological evolution. H. erectus ~~was~~ discovered fire and began using it to cook food and harden the ends of spears and other tools. Cooked food is easier to digest, so they had more energy available to reproduce. This was also an advantage for

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biological evolution as it increased their chances of survival and reproduction.

H. neanderthalensis began burying their dead. This indicates that they thought there was something more after death, which the dead would need their bodies for (e.g. reincarnation). This was probably ~~not~~ a disadvantage for biological evolution, as having buried carcasses nearby would increase the spread of disease therefore decreasing survival rates.

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QUESTION THREE

Modern humans began to migrate out of Africa around 100 000 years ago. Map 1 below shows the migration paths that modern humans took.

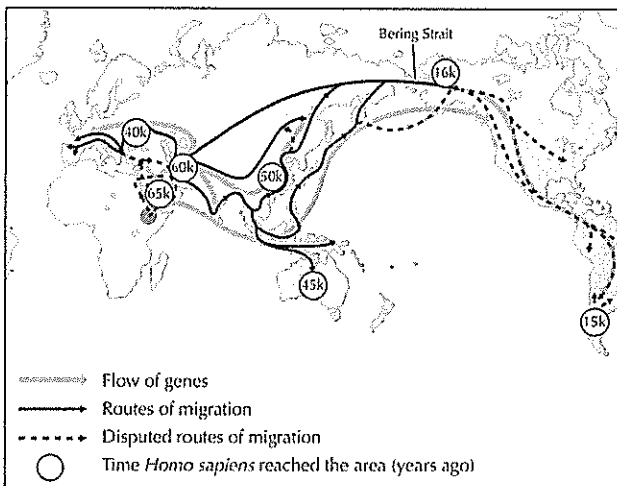
As humans moved through Europe and Asia they would have met these earlier hominins, like the Neanderthals in Europe and Denisovans in Asia (Map 2).

Scientists analysed the genetic information of more than 1 500 people from all around the world, and determined that ancestors of modern humans interbred (admixture) with Neanderthals and Denisovans.

Today, the genetic makeup of most people born outside Sub-Saharan Africa is 1 to 4 percent Neanderthal. The Denisovans also left Africa early, and like their Neanderthal relatives, they interbred with *Homo sapiens*.

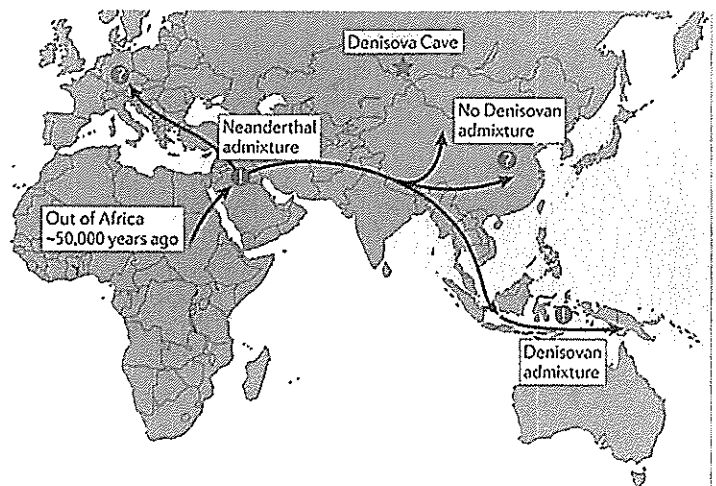
The Tibetan people have a variant of the EPAS1 gene that allows them to deal with low oxygen with fewer red blood cells than the rest of us. Their blood stays thin and healthy 4.8 kilometres up. This gene can be traced back to the Denisovans; they shared this gene with people who now live in Tibet.

HLA is a gene that helps white blood cells destroy micro-organism intruders in our bodies. Researchers believe people carrying this gene can thank Neanderthals and Denisovans for it, as these hominins had already adapted to infections and diseases found outside Africa.



Map 1. Migration Routes of *Homo sapiens*

Adapted from: Sinclair, Anna Roberts & M. *Level 3 Biology Study Guide*, 3rd Edition. ESA Study Guide



Map 2. Migration Route and Regions of Admixture

http://www.nature.com/nrg/journal/v12/n9/fig_tab/nrg3029_F4.html#figure-title-history/

Discuss the advantages and disadvantages of taking the various migration routes, and the possible effects that this has had on cultural and biological evolution.

In your discussion:

- describe the reasons for dispersal to other regions, and identify the benefits gained from the dispersal
- explain how changes in the environment could have influenced the migration routes used
- explain how the evidence of mtDNA and DNA analysis support the 'out of Africa' dispersal model
- discuss how admixture (interbreeding of two previously isolated populations) could have helped with dispersal.

Humans dispersed out of Africa to other regions of the world due to ~~many~~ many possible reasons, such as climate change (making it geographically possible for them to emigrate), curiosity, hunting for food, increased competition, or over-population. Changes in the environment may have influenced the migration routes that ~~the~~ humans used. Oceans, mountains, or deserts could have stopped humans migrating. However, land bridges ~~could~~ would have allowed humans to migrate around the world. The 'out of Africa' hypothesis is supported by mtDNA, which has shown that there was an 'eve' in Africa which all modern humans descended from.

Admixture could have helped with dispersal as populations of Neanderthal/Denisovans would already possess adaptations to aid survival outside of Africa. Interbreeding with these populations would give offspring the successful traits to increase survival and reproduction. The hybrid offspring would have been fitter than both parent populations, Neanderthals and human.

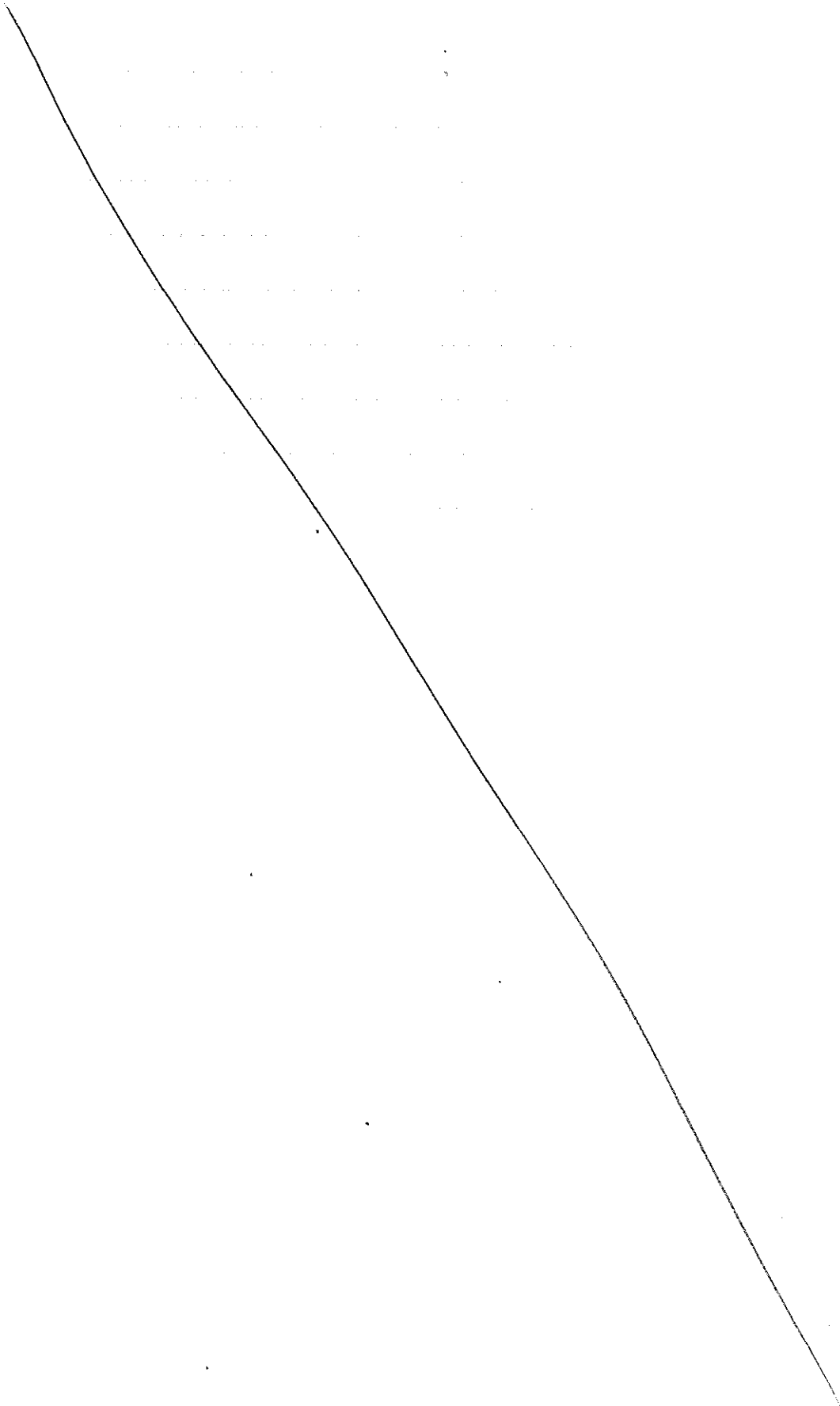
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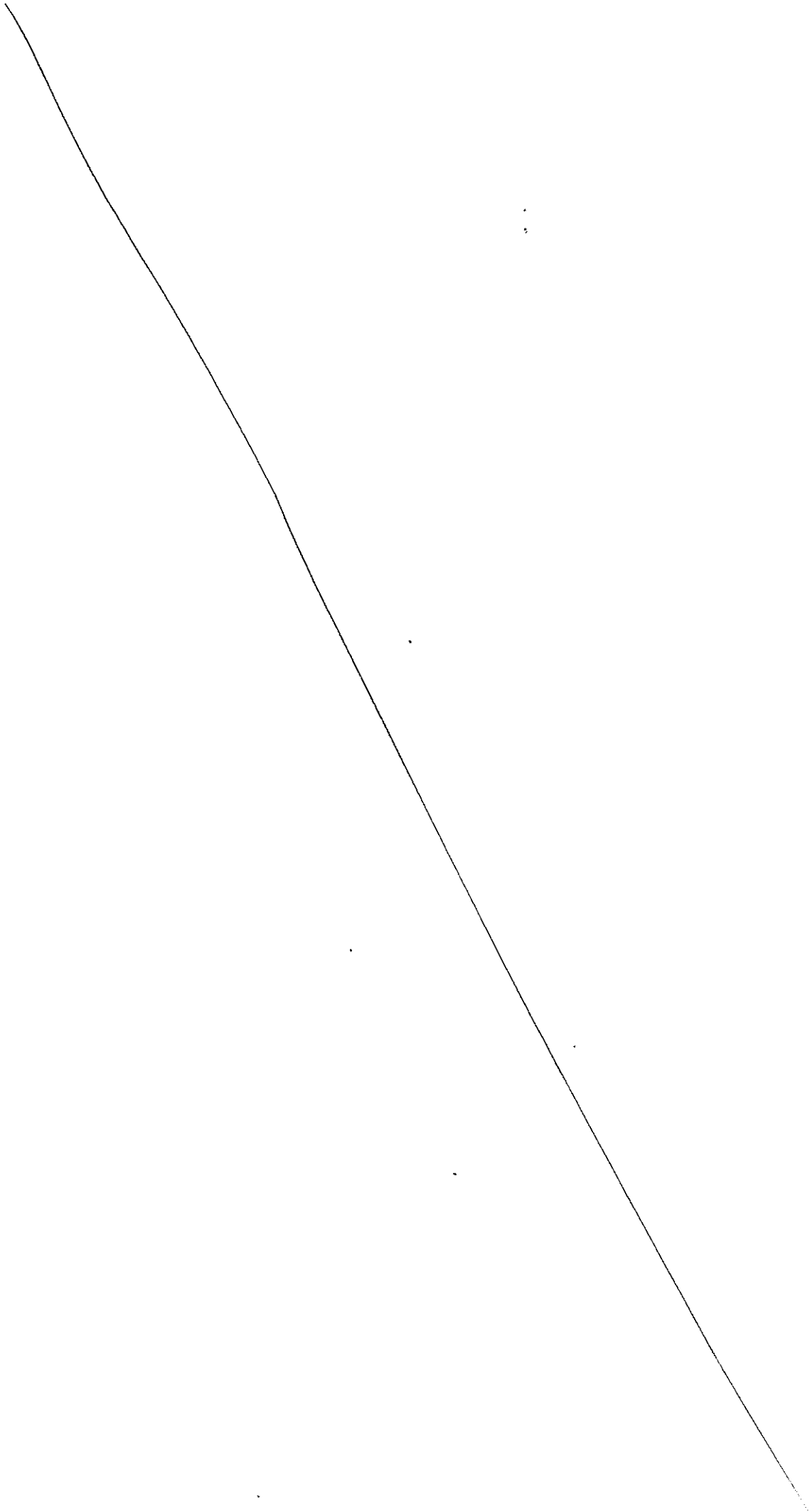
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Annotated Exemplar Biology Level 3, 91606

Achieved exemplar 2016

Subject:	Biology	Standard:	91606	Total score:	13
Q	Grade score	Annotation			
1	A4	<p>The candidate correctly identified the location (or function) of 4 skull features which support skull A being older than skull B.</p> <p>In order to attain Merit the candidate needed to explain how one or more of the features can be linked to evidence of bipedalism or to types of food eaten.</p>			
2	M5	<p>The candidate correctly explained two adaptive advantages in the cultural evolution of <i>H. erectus</i> and <i>H. neanderthalensis</i>.</p>			
3	A4	<p>The candidate correctly identified 2 reasons for the dispersal of <i>H. sapiens</i> - competition for resources and change in ocean level/ land bridges.</p> <p>Also stated the Out of Africa theory is supported by the use of mtDNA to trace back to a 'mitochondrial 'Eve' and that admixture would have increased the survival and reproduction rate of these hybrids.</p> <p>To attain Merit the candidate needed to explain the importance of the environment for dispersal or the evidence used to support the Out of Africa dispersal model.</p>			