NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2017

LIFE SCIENCES: PAPER II

Time: 2 hours | 100 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 16 pages. Please check that your question paper is complete.
2. All questions must be answered in the Answer Book provided.
3. This paper consists of three questions. Question 1 and Question 2 are case studies and Question 3 is an essay.
4. Start **each question** on a **new** page.
5. Read the questions carefully.
6. Read the sources provided for the data response questions and use the information and your own knowledge to answer Questions 1 and 2.
7. Source material is also provided for the essay. Use this information and your own knowledge to first plan and then write your response.
8. Number the answers exactly as the questions are numbered.
9. Use the total number of marks that can be awarded for each part of the questions in Question 1 and 2 as an indication of the detail required.
10. It is in your own interest to write legibly and to present your work neatly.

SECTION A

QUESTION 1

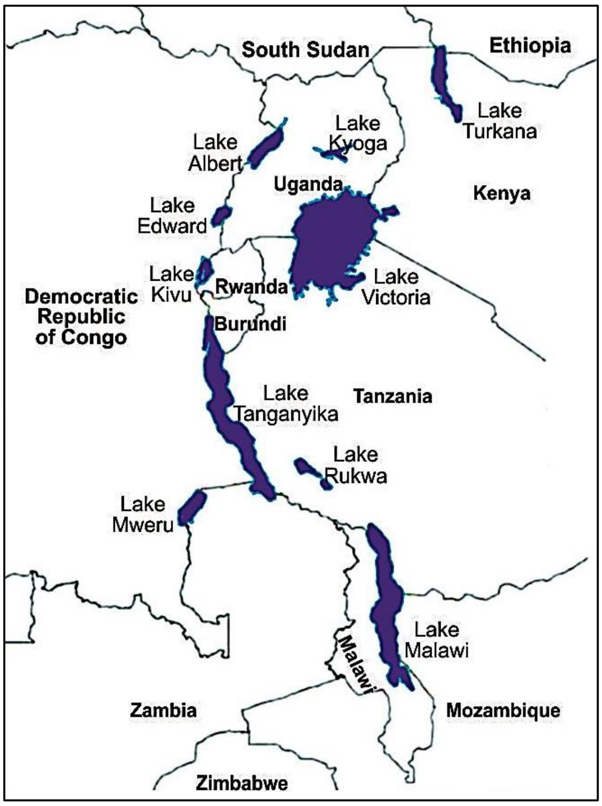
Read the information below on the speciation of the African cichlid fish in the great lakes of East Africa and use the information to answer the questions that follow:

Example of cichlids from Lake Malawi

The cichlid fish of the East African Great Lakes are the largest living example of vertebrate speciation identified to date. These lakes and their surrounding waters support over 1 550 species of cichlid fish, many of which are descended from a single common ancestor within the past 10 million years. Cichlids come in a vast assortment of colours, forms and habits. They are indigenous to warm rivers and lakes in Africa, Madagascar, southern India, Sri Lanka and South and Central America. Most of these regions were once part of the ancient southern continent of Gondwana, which fragmented 180 million years ago. This shows that cichlids have an ancient lineage.

[Adapted from: <http://www.petsmart.com>]

Map of East Africa showing position of Great African Rift lakes



Lake Tanganyika is nine to twelve million years old and has some 200 cichlid species.

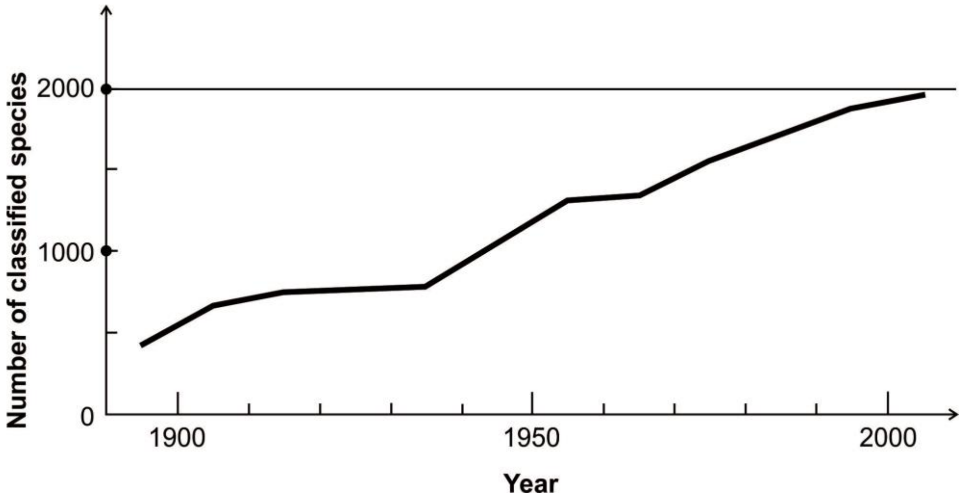
Lake Victoria formed between 250 000 and 750 000 years ago; it contains more than 400 species of cichlids.

There are about another 150 cichlid species in the surrounding rivers and smaller lakes.

Lake Malawi is about four million years old and contains about 800 cichlid species.

The speciation rate in the lakes has been record-breaking and scientists are still researching and classifying new species. Research from Lake Tanganyika suggests a mechanism for the speciation of cichlids: repeated isolation. It appears that successive drops in the level of Lake Tanganyika, by as much as 610 metres, meant that populations that used to exchange genes instead became isolated in small pockets of water. They developed independently, coming into contact once again as the water level rose – but they could no longer interbreed.

Number of classified African cichlid species that have been discovered

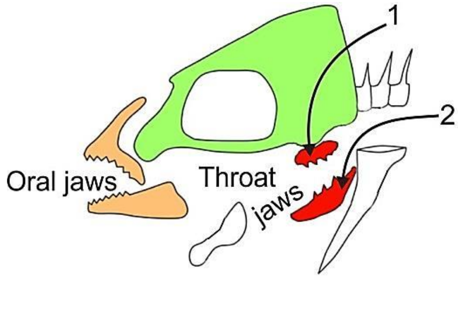
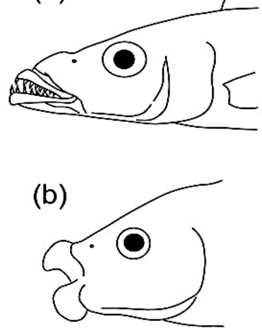


Adapted from: <http://tetsumi.raindrop.jp>]

FACTORS THAT HAVE LED TO RAPID CICHLID EVOLUTION

1. **Adaptations of Jaws (mouthparts)**

Cichlids have two sets of jaws: oral jaws in the mouth, to suck, scrape or bite off bits of food, and a second set in the throat, to crush, slice or pierce the food before it is swallowed. They are the only freshwater fish to possess such a modified second set of jaws (see diagram A below; numbers 1 and 2). Both sets of jaws are exceedingly versatile and adaptable. The two sets of jaws, finely adapted to food habits, allow each species to occupy its own very specific ecological niche so hundreds of species can coexist without directly competing. If these cichlids had tried to eat the same food, most would have been driven to extinction.

A Diagram showing the main parts of the modified jaws of cichlids.	**B** Examples of modified cichlid jaws	
	(a) (b) 	A piscivore – sharp teeth to grip prey An algae grazer – big lips to suck up bits of soil and algae

[Adapted from: <http://www.pnas.org>]

Types of cichlid Feeding Specialisations

Herbivorous cichlids eat algae in different ways:
- algae grazers suck up large amounts of substrate (soil, stones) while scraping or rasping at an algae-covered surface, then filtering the substrate out of their gills and swallowing the algae
- algae browsers are more selective and seldom ingest the substrate with their food
- algae scrapers rake the substrate with specialised teeth
- algae suckers consume mainly floating algae

Piscivorous cichlids feed on other fish or fish parts:
- piscivores consume whole fish as prey
- scale eaters approach other cichlids from behind and grab a mouthful of scales from their sides
- paedophages ram the mouth of a mouth brooder fish to dislodge the eggs and young and then rapidly eat them
- carnivorous cichlids eat insects and shrimp
- crushers, with large molars, crush small thin-shelled snails

2. **Reproductive Strategies**

Another reason that cichlids have been able to exploit a variety of habitats is their reproductive behaviour. Selecting mates based on preferences leads to reproductive isolation between the different species. The following are some examples of reproductive isolation strategies.

2.1 **Mouth brooders**

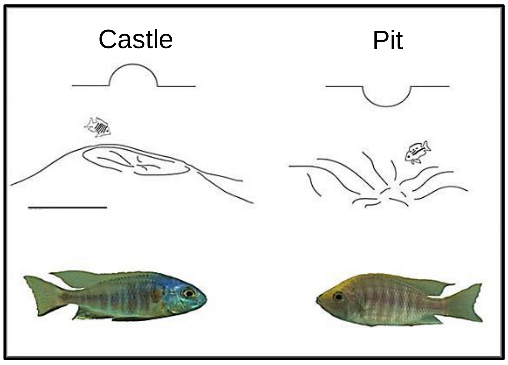
One strategy of many cichlids is to hold fertilised eggs or young in their mouths. This provides a safe place where their offspring can hide when danger threatens. The mouth brooders lay far fewer eggs than other fish and so can invest much time and energy on each offspring.

The total population of a mouth-brooding species is often small, so that only a few hundred fish, living in one rock outcrop in a lake, can constitute a species. Any mutation is likely to spread faster through a small population than a large one and lead to differentiation of a species. Therefore, the smaller population sizes of mouth brooders may have contributed to the evolution of this diverse group of cichlid species.

Image of a mouth brooder with 'babies' in her mouth

2.2 **Bower builders** (nest-builders)

For many male African cichlid fish, the best way to attract a mate is to build a really nice pit or sand castle on a lake bottom. Males, of mouth-brooding cichlids, compete with one another to fertilise the most eggs. Sometimes they form congregations in which they dart around and 'show off' to attract females. When a female is enticed to lay a few eggs over his bower (she usually picks the largest), the male quickly fertilises them and she then takes the eggs into her mouth and swims on, looking for another male.



Two types of cichlid bowers – castles and pits

Male cichlids can spend a long time building their bowers. They pick up and move vast quantities of stones and sand and arrange them in heaps to make castles or pits.

2.3 **Preference for colours**

Female cichlids are often a drab grey or brown, but males tend to be brilliantly coloured. The variety of colours has arisen because of the preferences of the females. In this case, sexual selection, rather than pressure for survival, has driven the speciation. The different colours of otherwise identical fish can serve as a barrier separating distinct species, e.g. a female of a species that prefers yellow males will **not** mate with a red one.

Secrets in the cichlid genes

Until very recently, biologists did not know how these hundreds of cichlid species were related. The earliest cichlids first colonised Lake Tanganyika. Much later some of these fishes left the lake and invaded river systems, through which they reached Lakes Victoria and Malawi. (See map on page 2)

Studies of mitochondrial DNA show that the cichlids in Lake Victoria are genetically very close to one another – far closer than to structurally similar cichlids in the other two main lakes. Cichlids with different anatomical features for the same functions occur in all three lakes. Biologists have believed that such features seem so unique and so unlikely to evolve more than once that the fishes with the same specialisations should be closely related. If that were so, the features to scrape algae for example, would have evolved only once and then spread into and evolved in the other lakes. But algae scrapers in Lake Victoria and Lake Malawi have evolved independently of those in Lake Tanganyika. The genetic studies thus show that evolution repeatedly discovers the same solutions to the same ecological challenges.

It also appears that structural characteristics can evolve at an incredibly uneven pace, sometimes completely out of step with genetic changes. Speciation seems to occur in bouts and not steadily over time. Some of Lake Tanganyika's species have physically altered very little over time – a number of fossil cichlids look very similar to their modern descendants in the lake. On the other hand, the cichlids of Lake Victoria – with their diversity in size, pattern and shape – evolved in an extremely short time span.

[Adapted from: Scientific American (1999); <http://www.sciencedirect.com>, <https://www.hindawi.com> and <http://animaldiversity.org>]

1.1 Study the following table which consists of two biological names/terms in **COLUMN 2** and a description *taken from the text* in **COLUMN 1**.

Decide which term from COLUMN 2 relates to the description in COLUMN 1.

Write down the correct term (option 1 or 2) in your answer book next to the appropriate question number. (1.1.1–1.1.4)

	COLUMN 1	**COLUMN 2**
1.1.1	'invest much time and energy per offspring'	1. Parental care 2. Oviparous
1.1.2	'populations that used to exchange genes, instead became isolated in small pockets of water'	1. Sympatric speciation 2. Allopatric speciation
1.1.3	'evolution repeatedly discovers the same solutions to the same ecological challenges'	1. Divergent evolution 2. Convergent evolution
1.1.4	'these regions were part of the ancient southern continent of Gondwana which fragmented 180 million years ago'	1. Biogeography 2. Continental drift

(4)

1.2 The World Wildlife Foundation has named some of the lakes as the most important in the world in terms of lake biodiversity.

1.2.1 From the graph on page 3, determine how many African cichlid species were identified by the year 1900. (1)

1.2.2 If identification continued at the same current rate, use the graph to predict (extrapolate) the number of cichlid species that would be classified by 2020. (1)

1.3 What evidence is there in the text to suggest that cichlid evolution is an example of punctuated equilibrium? (2)

1.4 1.4.1 Describe clearly how the structure of the jaws as seen in diagram A on page 3 led to the rapid speciation of cichlids. (5)

1.4.2 Draw a suitable table to summarise the information on the feeding specialisations of the piscivorous cichlids. (6)

1.5 How does the information obtained from analysing the mitochondrial DNA of cichlids in the African lakes add to the theory of cichlid evolution? (3)

1.6 Darwin's theory of natural selection states that there is phenotypic variation amongst individuals and the most advantageous traits persist and lead to "survival of the fittest".

Describe how the example of bower builders supports this theory and how the example of variation in colouration does not fit this theory. (6)

1.7 Cichlids are sought after worldwide by freshwater aquarium enthusiasts and many people try to breed enhanced features in their cichlids such as different or brighter colours in some species.

1.7.1 State the correct term for this type of breeding. (1)

1.7.2 Suggest ONE disadvantage of this breeding practice in cichlids. (1)

[30]

QUESTION 2

Read the following information on human evolution and use it and your own knowledge to answer the questions that follow.

In the first half of the 20th century, the region thirty miles northwest of Johannesburg, South Africa, produced so many fossils of our early ancestors that it became known as the Cradle of Humankind. It was declared a World Heritage Site in 1999. The Sterkfontein Caves in this area contain the discovery of a 2,3-million-year-old fossil *Australopithecus africanus* (nicknamed "Mrs. Ples"). Sterkfontein alone has produced more than a third of early hominid fossils ever found prior to 2010. Nearby this site, the Rising Star Cave system contains the Dinaledi Chamber (chamber of stars) in which were discovered fifteen fossil skeletons of an extinct species of hominid, named *Homo naledi*. The Dinaledi Chamber contains over 1 500 *H. naledi* fossils, the most extensive discovery of a single hominid species ever found in Africa.

Hominid fossils discovered by Lee Berger and his team of researchers

Lee Berger, an American paleoanthropologist started working at the University of the Witwatersrand in the early 1990s and began to hunt for hominid fossils. But the spotlight in human evolution had long since shifted to the Great Rift Valley of East Africa. Most researchers regarded South Africa as an interesting side story to human evolution but not the main plot. Berger was determined to prove them wrong.

What he most wanted to find were fossils that could shed light on the main outstanding mystery in human evolution; the origin of our genus, *Homo*, between two million and three million years ago. On the one side are the apelike australopithecines, such as *Australopithecus afarensis* (3,85 – 2,95 mya) and its most famous representative, Lucy, a skeleton discovered in Ethiopia in 1974. On the other side is *Homo erectus* (2 mya – 100 000 years ago), a tool-wielding, fire-making, globe-trotting species of the "out of Africa" hypothesis with its big brain and body proportions much like ours. Within that almost million-year gap between them, a bipedal animal was transformed into a self-aware human being, *Homo sapiens*, a creature not just adapted to its environment but able to apply its mind to master it. How did that evolution happen?

The fossil record is frustratingly unclear. Slightly older than *H. erectus* is a species called *Homo habilis*, or "handy man" – because it is believed to be responsible for the stone tools that were found at Olduvai Gorge in Tanzania. Berger has long argued that *H. habilis* was too primitive to deserve its privileged position at the root of our genus. Some other scientists agree that it really should be called *Australopithecus*. But Berger has been nearly alone in arguing that South Africa was the place to look for the true earliest *Homo*. Then, in 2008, he made a truly important discovery. In Malapa, he and his nine-year-old son, Matthew, found some hominid fossils. Dated to about 2 million years ago, they were the first major finds from South Africa in decades. In most ways, they were very primitive, but they had some oddly modern traits too. Berger decided the skeletons were a new species of australopithecine, which he named *Australopithecus sediba*.

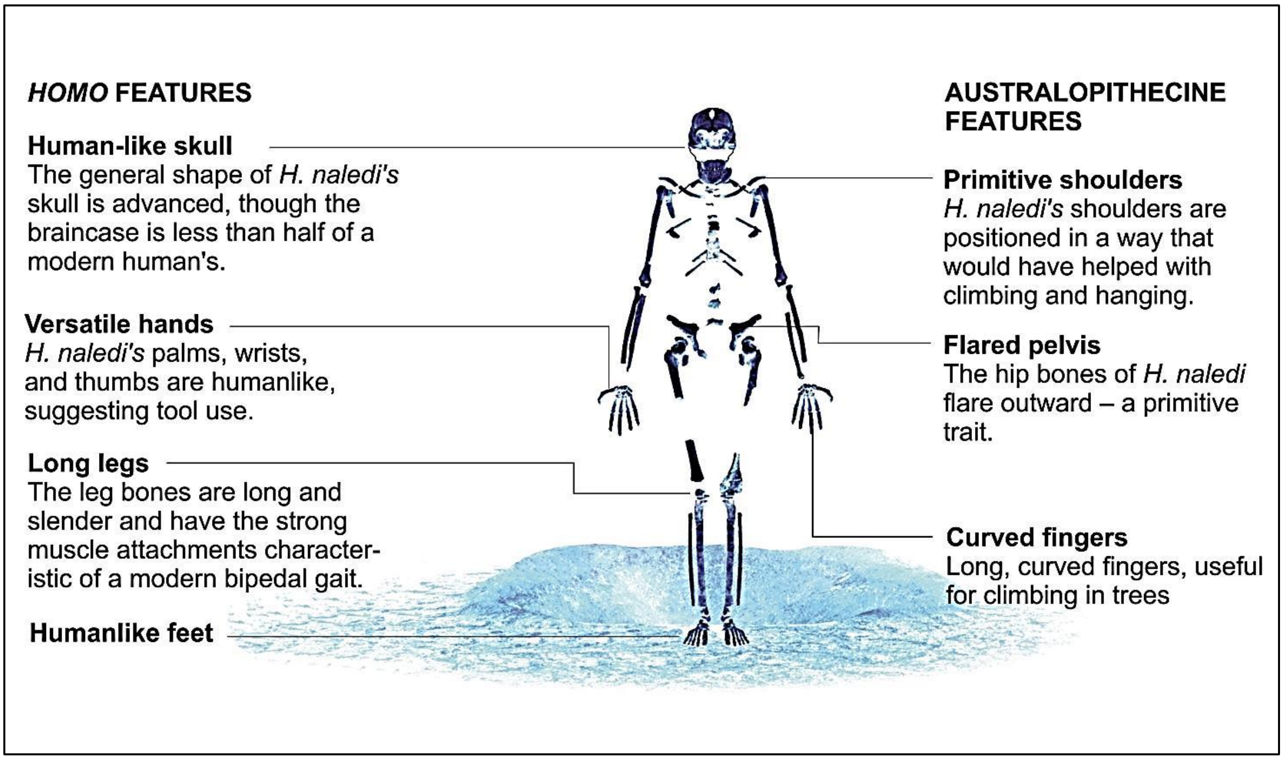
Then in 2012, some cavers discovered bones in the Rising Star Cave system. Parts of the skeletons looked astonishingly modern. But other parts were just as astonishingly primitive – in some cases, even more apelike than the australopithecines.

Global collaboration in analysing the Rising Star fossils

In palaeoanthropology, specimens are traditionally kept confidential until they can be carefully analysed and the results published, with full access to them only given to the discoverer's closest collaborators. This would mean that answering the mystery of the Rising Star find could take years, even decades. Berger wanted answers by the end of the year. In his opinion all researchers in the field of palaeontology should have access to important new information as quickly as possible.

Along with about 20 senior scientists who had helped him work on *A. sediba*, Berger invited more than 30 young scientists to Johannesburg from about 15 countries, for an intensive "fossil fest" lasting six weeks. To some older scientists who weren't involved, putting young people on the front line just to rush the research seemed hasty. But for the young scientists in question, it was "a paleo fantasy come true. At university, you dream of a pile of fossils no one has seen before, and **you** get to figure it out." Their findings were astounding; "You could almost draw a line through the hips – primitive above, modern below. The message we're getting is of an animal right on the cusp of the transition from Australopithecus to *Homo*," said Berger.

Summary of important features of *Homo naledi.*



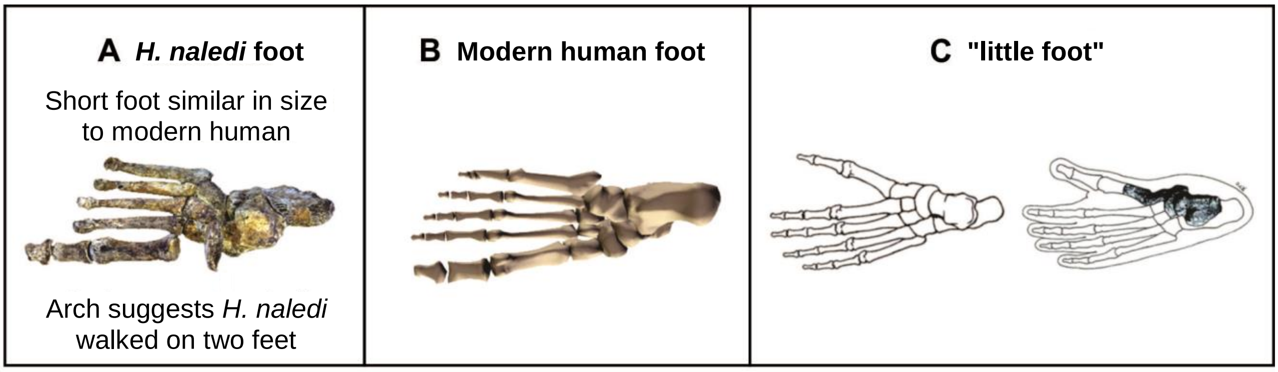
[Adapted from: <http://news.nationalgeographic.com>]

Two important features of *Homo naledi*

1. The general structure of the head looks advanced enough to be called *Homo* but their braincases were tiny – a mere 560 cubic centimetres for the males and 465 cubic centimetres for the females. This is far less than *H. erectus*'s average of 900 cubic centimetres, and well under half the size of our own (*Homo sapiens)*. A large brain is the key to humanness, representative of a species that has evolved to live by its wits.

2. The feet were virtually indistinguishable from our own. Except for the slightly curved toes, the arches suggest an efficient long-distance stride.

Diagrams showing the feet of A- *Homo naledi*; B- modern human; C- Little Foot



[Adapted from: <https://www.researchgate.net>]

To add to the mystery of their origin, mixed soil sediments in the cave where *H. naledi* was found make it difficult to date the bones. Berger and his team believe that *H. naledi* was even closer to modern humans than *Homo erectus* is, and it clearly belonged in the *Homo* genus. They called it *Homo naledi*, named for the cave where the bones had been found. Berger also hypothesises that *H. naledi* disposed of their dead in one of the chambers of the caves where the bones were found. Disposal of the dead is a feature of humanity. It brings closure for the living, confers respect on the departed, or assists in their transition to the next life. But *H. naledi*, Berger emphatically stresses, was *not* human – which makes the behaviour all the more intriguing.

[Adapted from: <http://news.nationalgeographic.com> and <https://www.researchgate.net>]

2.1 Using the information provided, state whether the following statements are **True** or **False**.

2.1.1 *Homo naledi* is named after the cave where its bones were found. (1)

2.1.2 From the early 1990s to the beginning of the 21st century, many new hominid fossils were found in South Africa. (1)

2.1.3 Analysis of the sediments in the cave which covered *Homo naledi* fossils gives their exact geological age. (1)

2.1.4 It is hypothesised that *Homo naledi*, like modern humans, disposed of their dead. (1)

2.1.5 *Homo habilis* left Africa and moved into other parts of the world where regional populations slowly evolved into modern humans. (1)

2.2 Compare the braincases of *Homo naledi* and *Homo erectus* and state one of the evolutionary implications of these differences. (3)

2.3 How did Berger go against traditional scientific practice when he investigated the bones of *Homo naledi* and why did he do this? Use information from the text and your own knowledge to answer this question. (4)

2.4 *Homo naledi* has been described by scientists in the following way: "You could almost draw a line through the hips – primitive above, modern below."

Explain what is meant by this statement and refer to specific features in the image on page 8. (5)

2.5 Study the diagrams of the foot bones on page 9.

2.5.1 Using visible features, arrange the diagrams in order of most primitive to most evolved foot structure. Write only the letters A to C in the correct order. (1)

2.5.2 How do the arrangements/structures of foot bones indicate bipedalism? Refer to relevant features you see in the diagrams. (2)

2.5.3 Why is bipedalism an important development in the history of modern humans? (4)

2.6 Draw a simple timeline of the **South African** hominids as listed below, including modern humans, which are described in the source. Your timeline must show dates of when they lived. Include the relative position of *Homo naledi* to show where you suggest it would fit into the evolutionary history of humans.

Show only the following hominids and the geological times mentioned in the source. (The timeline does not have to be to scale.)

Australopithecus sediba
Homo naledi
Homo sapiens
Australopithecus africanus (6)

[30]

60 marks

SECTION B

QUESTION 3

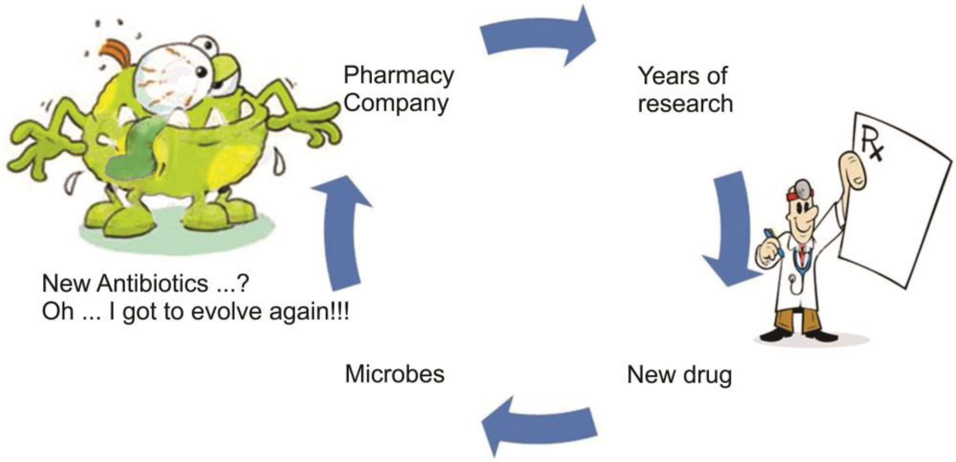
The rapid evolution of antibiotic resistance in bacteria will lead to the extinction of modern *Homo sapiens*.

Using the source material provided as well as your own knowledge, discuss your opinion on the above statement in the form of a 2½–3 page essay.

40 marks

To answer this question, you are expected to:
- Read the source material carefully and present a debated argument to illustrate your point of view.
- Select relevant information from sources A to H below.
- It is important to integrate your own relevant biological knowledge.
- Take a definite stand on the question and arrange the information to best develop your argument.
- Write in a way that is scientifically appropriate and communicates your point of view clearly.
- **Provide** a clear **plan** of your essay before you start writing. Note that the plan will be marked as part of the assessment of this question.

SOURCE A Evolution of resistant bacteria



An antibiotic resistant bacterium has the resistance to antibiotics coded into its DNA. As we create more antibiotics and introduce them into the environment, in animals, and in humans, microbes get smarter and they evolve for survival. Bacteria can acquire resistance either through a genetic mutation or by receiving genetic material from other bacteria who already have resistance.

[Adapted from: <http://1.bp.blogspot.com> and <http://www.who>]

SOURCE B Scientists report …

In the face of bacterial threats that can evade modern medicines, researchers are trying every trick in the book to develop new, effective antibiotics.

[Source: <http://www.the-scientist.com>]

In the battle against infectious disease, humankind has inadvertently given rise to deadly enemies. Antibiotic resistance is a stunning example of evolution by natural selection. Bacteria with traits that allow them to survive the onslaught of drugs can thrive, re-ignite infections, and launch to new hosts on a cough. Evolution generates a medical arms race. The bad news is that bacteria – with their fast doubling times and ability to swap genes like trading cards – evolve quickly. The good news is that in the 150 years since Darwin, we have grown to understand the rules of the race. But can we win this war?

[Source: <https://www.uspharmacist.com>]

The idea of a magic bullet is gone. We need a magic shotgun.

— Gerard Wright, McMaster University

SOURCE C The science world is freaking out over this 25-year-old's answer to antibiotic resistance. Could this be the end of superbugs?

26 September 2016

A 25-year-old student has just come up with a way to fight drug-resistant superbugs *without* antibiotics.

The new approach has so far only been tested in the lab, but it could offer a potential solution to antibiotic resistance, which is now getting so bad that the United Nations recently declared it a "fundamental threat" to global health.

In addition to the common hospital superbug, scientists are now also concerned that gonorrhoea is about to become resistant to all remaining drugs. But Shu Lam, a 25-year-old PhD student in Australia, has developed a star-shaped polymer that can kill six different superbug* strains without antibiotics, simply by ripping apart their cell walls.

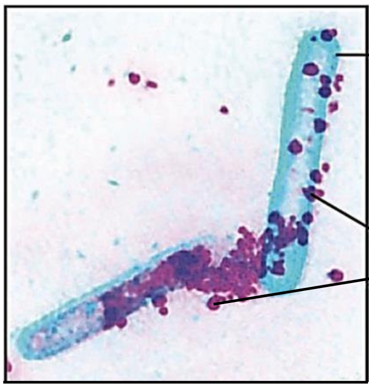
(*superbug: a **bacterium** that has become resistant to antibiotics that are usually used to treat it)

The research has been published in *Nature Microbiology*, and according to Smith, it's already being hailed by scientists in the field as "a breakthrough that could change the face of modern medicine".

So far, Lam has only tested her star-shaped polymers on six strains of drug-resistant bacteria in the lab, and on one superbug in live mice. But in all experiments, they've been able to kill their targeted bacteria – and generation after generation don't seem to develop resistance to the polymers.

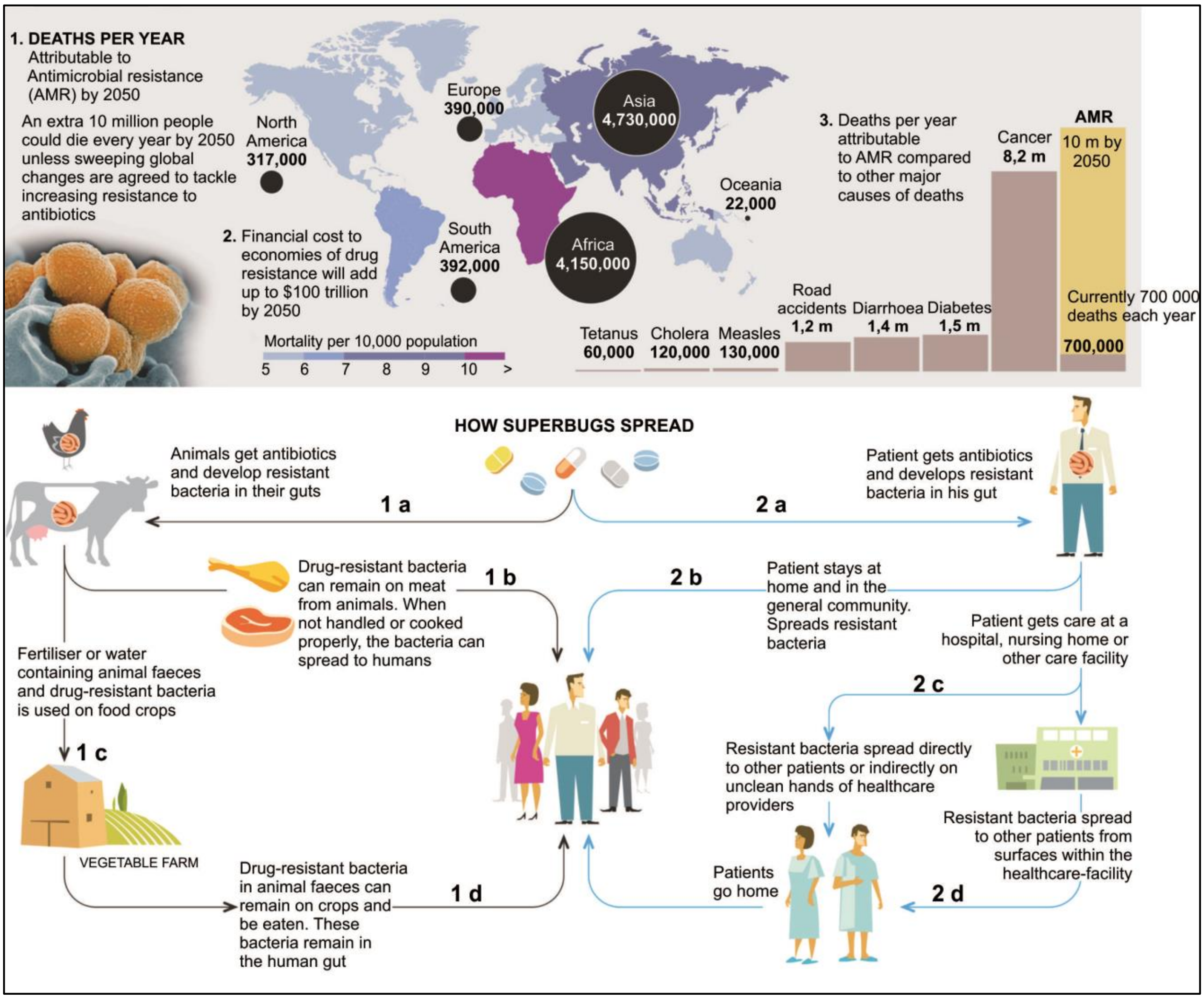
Unlike antibiotics, which "poison" bacteria, and can also affect healthy cells in the area, the polymers that Lam has designed are so large that they don't seem to affect healthy cells at all.

The polymers surrounding and ripping apart bacterial cells below:



[Adapted from: <http://www.sciencealert.com>]

SOURCE D The dangers of superbugs



[Adapted from: <https://www.cdc.gov>]

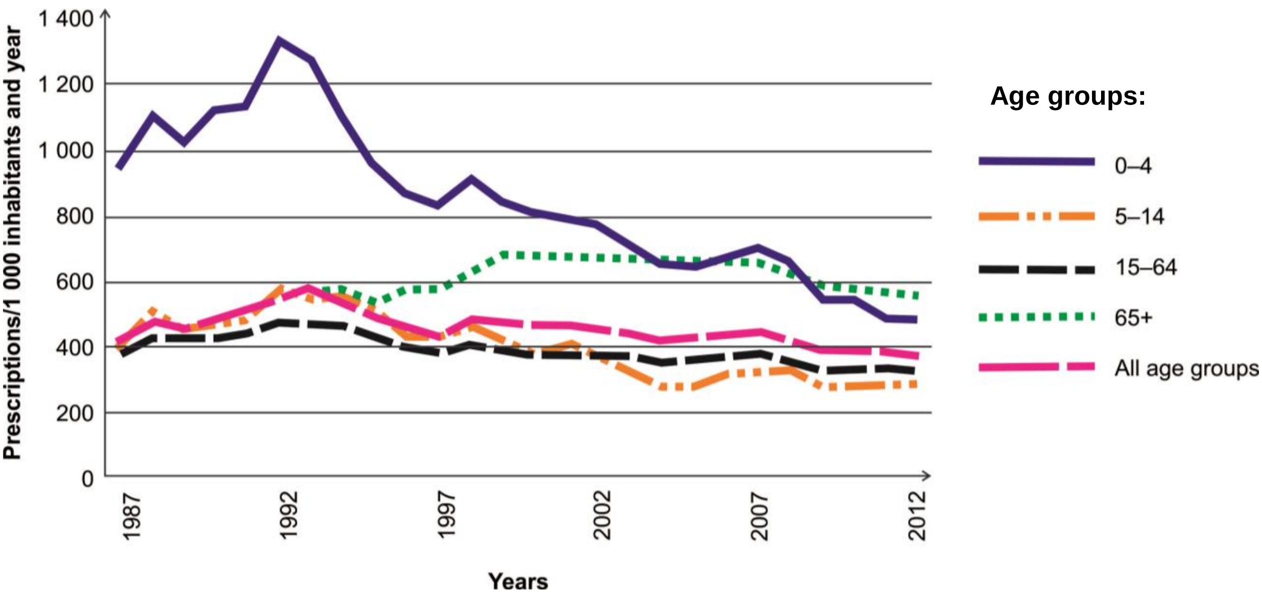
SOURCE E SYMBIOCARE **Fighting antibiotic resistance 24/7**

The Swedish healthcare system is ranked as one of the best in the world. *Symbiocare – Health by Sweden* is a Swedish government initiative founded in 2010. Its purpose is to promote Swedish healthcare and to encourage collaboration amongst countries.

Sweden has acknowledged the urgent threat to public health of antibiotic resistance and for many years has worked hard to reduce the impact. Education, prevention and proper monitoring have resulted in Sweden's comparatively low antibiotic consumption.

During the past two decades, antibiotic use in Sweden has been reduced by 50% in children under the age of four. This progress has been made without producing any measurable negative outcomes.

Sales of antibiotics in outpatient care continues to decrease in Sweden



The clear link between antibiotic resistance and consumption made Sweden draw up national treatment recommendations on how and when to use antibiotics.

- Sweden regulates sales of medicines and patients can only obtain antibiotics with a prescription issued by a licensed practitioner after confirming a bacterial infection.
- The most basic of the measures taken to prevent the spread of infection is the consistent application of hygiene routines and appropriate clothing in the workplace by all medical personnel.

[Source: <http://www.symbiocare.org>]

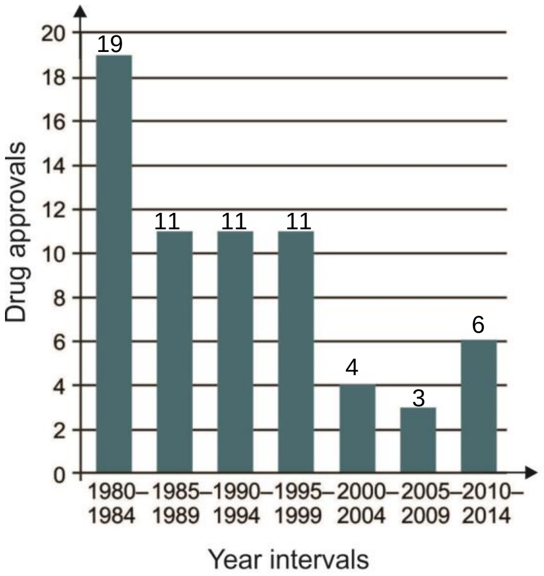
SOURCE F Availability of few new antibiotics

The development of new antibiotics has essentially stopped.

Of the 18 largest pharmaceutical companies, 15 abandoned the antibiotic field. Antibiotic research has been scaled back as a result of funding cuts due to the global economic crisis.

Antibiotic development is no longer considered to be an investment for the pharmaceutical industry. Because antibiotics are used for relatively short periods and often cure the condition, antibiotics are not as profitable as drugs that treat chronic conditions, such as diabetes, psychiatric disorders or asthma.

Number of Antibacterial New Drug Application Approvals Versus Year Intervals



The number of new antibiotics developed and approved has decreased steadily over the past three decades (although six new drugs were approved in 2014), leaving fewer options

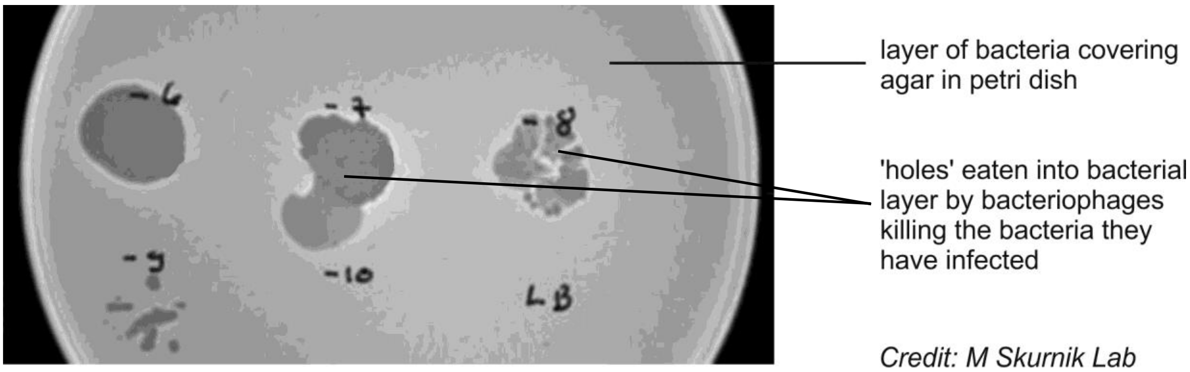
[Adapted from: <https://assets.publishing.service.gov.uk>]

SOURCE G Bacteriophages cure bacterial infections

November 16, 2016 (University of Helsinki)

Phage therapy may be a solution to treating infections caused by antibiotic-resistant bacteria. Since 2013, researchers have collected bacteriophages to combat antibiotic-resistant bacterial strains, and hope to start clinical phage therapy trials in the near future.

An agar plate infected with bacteria and bacteriophages



Credit: M Skurnik Lab

Bacteriophages (phages) are viruses that kill bacteria. They control the number of bacteria and maintain ecological balances in nature. Each bacteriophage infects only a few bacterial species or types, potentially making them real precision-guided "smart weapons" in the battle against bacterial infections.

"Unlike antibiotics, phages do not disturb the normal microorganisms in the body. And importantly, they can be used against antibiotic-resistant bacteria," Skurnik adds.

The first clinical trials with phage therapy have recently been carried out in the United States, the United Kingdom and Belgium. The trials have concentrated mainly on establishing the safety of the therapy. No adverse effects have been observed in these trials.

Phage therapy was started a hundred years ago – the introduction of antibiotics suspended its use. Bacteriophages – bacteria eaters – were identified already in 1896 and were studied closely in the 1920s. At that time, phage therapy was used to treat both animal and human infections – such as cholera and bubonic plague in India, often with good results.

In Western countries the invention of antibiotics ended scientists' interest in phage therapy for several decades; however, this was not the case in Eastern Europe. The Eliava Institute in Georgia is still one of the most renowned phage therapy centres in the world. In the new millennium Western countries have realised the increasing threat of antibiotic resistance and a new interest in the potential use of phage therapy has emerged.

[Source: <https://www.sciencedaily.com>]

SOURCE H **A new antibiotic kills pathogens without developing detectable resistance**

Earlier this year researchers from Northeastern University and NovoBiotic Pharmaceuticals reported in the journal *Nature* that they had isolated a new antibiotic, called *teixobactin*, which can prevent some of a bacterium's ability to become resistant to it for up to 30 years.

Microfluid chip being used by scientists to search dirt for new sources of antibiotics
Credit: Slava Epstein/Northeastern U

The researchers discovered *teixobactin* in bacterial cells they found in nature – in this case, a patch of dirt in Maine, USA. Microbes found naturally in the environment could be a potential source of new antibiotic drugs. One of the new bacterial species, which the researchers named *Eleftheria terrae*, produced a chemical that killed a variety of disease-causing bacteria in lab cultures. The development of new antibiotics indicates that scientists may be able to tap into previously unexplored sources for new drugs.

[Adapted from: <http://www.nature.com>]

Total: 100 marks