NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION – MARCH 2017

LIFE SCIENCES: PAPER II

Time: 2 hours 100 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 13 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. Read the questions carefully.
5. Read the sources provided for the data response questions and use the information and your own knowledge to answer Questions 1 and 2.
6. Source material is also provided for the essay. Use this information and your own knowledge to first plan and then write your response.
7. Number the answers exactly as the questions are numbered.
8. Use the total number of marks that can be awarded for each part of the questions in Questions 1 and 2 as an indication of the detail required.
9. 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 zebra population of the Makgadikgadi Pans National Park in Botswana.

Nothing Can Stop the Zebra – A 150-mile fence in the Kalahari Desert appeared to threaten Africa's zebras, but now researchers can breathe a sigh of relief.

Zebras migrating to the Makgadikgadi Pans

[Source: <http://smithsonianmag.com>]

Zebra undertake migrations every year in search of water and grazing. They can cover up to 480 kilometres a year as they travel and the migration involves up to several thousand zebra. The results of studies on their migrations were astounding to researchers when they realised that zebra, large and highly visible animals, moved this kind of distance and appear to do so every year. Zebra migration routes in many parts of Africa have been disrupted, often by fence construction. As a result, zebra populations diminish and local economies that depend on ecotourism may suffer. Phenomena like this newly discovered migration show these animals need large, wide-open spaces in order to survive.

The fence, which the Botswana government installed on the western edge of the Makgadikgadi Pans National Park in 2004, was primarily intended to protect cattle on neighbouring farmlands from lions that live in the park. But wildlife experts became concerned about the barrier's impact on zebras. They had reason to worry, given Botswana's disastrous history with fences. In 1983, during a devastating drought, at least 50,000 wildebeest died because a fence blocked their route to water.

But trying to predict how the new fence would affect the vast zebra herds that rely on that expanse of land for grazing and water was no easy task. Christopher Brooks, a scientist who works on conservation projects in Africa, started the Zebra Research Project as he was "concerned that a fence could have serious negative consequences, but there was no solid ecological data" about the zebras and their migration. Despite being among the most recognisable of large African animals, zebras and their extraordinary movements turn out to be rather mysterious.

Jonathan Bradley, a biologist from Bristol University, has taken over the running of the Makgadikgadi Zebra Migration Research Project, which is attempting to answer the question: Would a two-metre high electrified fence stretching 150 miles across the zebras' territory disrupt their migration? The project aims to understand the impact of fencing policies on all wildlife across Africa.

Zebras come in three distinct species: Plains, Mountain and Grevy's; Plains zebras are the most widespread, occurring throughout much of southern and eastern Africa. As members of the *Equus* genus, they are closely related to horses. Zebras are not well suited to domestication since they are unpredictable and have been known to attack people trying to handle them. Like a human fingerprint, a zebra's stripe pattern is unique. There are many theories about why the stripes evolved. The dizzying lines might distort a zebra's outline, for instance, or make the animal look bigger, confusing predators.

Hindquarters of three zebra species showing differences in stripes

Grevy's Zebra **Mountain Zebra** **Plains Zebra**

[Source: <http://photos.travellerspoint.com>]

During the dry season, zebras live along the Boteti River, the only regular source of water. When the rains come, in early summer, the herds move to open grassland, where temporary pools fill with water, and then on to the rain-filled saltpans, where nutritious grasses grow on the edges. Zebra are regarded as a keystone species in the Makgadikgadi. Leading the migration, zebras eat longer grasses, exposing short, sweet shoots for the more selective wildebeest that trail them, while the small population of springbok, bringing up the rear, must settle for leftovers. Then there are the predators that zebras sustain. Lions eat them and brown hyenas scavenge their carcasses.

Map showing the position of the Makgadikgadi Pans National Park

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

Bradley has fitted radio collars to ten zebra mares providing him with valuable insights into zebra migrations within southern Africa. He tracks zebras and maps out their movements. The mares are from different social units. A social unit may consist of 50 or so zebras made up of a lone stallion, one to six mares and all their offspring. These small, tightknit families come together by the thousands for the seasonal migration in search of grass and water.

Stallions fight to protect mares in their harems or abduct mares in heat. (Bradley tracks mares rather than stallions because the females are less likely to fight with each other and damage the collars.) The ties that bind a stallion and his harem are profound. Bradley once noticed a lone stallion standing for hours in the riverbed, not eating. When Bradley approached, he saw that the stallion was standing vigil over a dead mare.

This young zoologist has witnessed this single-minded devotion when he has darted mares to collar them. "Once the tranquilisers start to take effect, some stallions bite on the females' necks to try to keep them upright and moving," he says. "While we're busy with the female, the stallion moves through the herd, constantly calling, looking for his missing mare. When she wakes up and calls, the stallion heads directly to her." Mares, too, are loyal, often remaining with a single harem for life, a period that can span 16 years.

By tracking the zebras' movements, Brooks and Bradley discovered that zebras are more resilient than previously thought. The Makgadikgadi researchers recorded them trekking in dry months more than 34 kilometres a day to preferred grazing lands. During such trips, the animals go without water for up to seven days.

In 1989, after years of drought, the Boteti River dried up. Too many animals were competing for too little water. Elephants bullied zebras and wildebeest. Prowling lions set off terrifying stampedes of zebras. In 2007 in an attempt to protect wildlife during the drought, government authorities and lodge owners dug holes and filled them with water. "The zebra stood 20 yards away, watching us dig. When we pumped the first water, they were there in an instant," says Bernie Esterhuyse from Leroo La Tau safari lodge. "I had tears in my eyes when I saw them finally drink in peace."

Ten years into the Zebra Migration Project, Bradley and his colleagues can report that the species is thriving. Early indications are that the Makgadikgadi fence does not restrict their migration. Reduced competition from cattle has meant more grazing for zebras inside the park. More zebra foals are surviving beyond their first year, and the population appears to be growing.

[Adapted from: <http://www.smithsonianmag.com> March 2011]

1.1 According to the text, are the following statements TRUE or FALSE? Write only the number of the question and TRUE or FALSE next to the number on your Answer Book.

1.1.1 Individual zebra can be identified by their unique stripes. (1)

1.1.2 Zebras are wild animals suitable for domestication. (1)

1.1.3 Mountain Zebra are the most common and widespread species in Africa. (1)

1.2 Suggest why the zebra are regarded as a keystone species. (2)

1.3 1.3.1 What type of competition exists between the cattle and the zebra? (1)

1.3.2 How has a decrease in competition between the cattle and the zebra benefited the zebra? (2)

1.4 Describe an example of resource partitioning in carnivores from the text. (2)

1.5 1.5.1 Suggest a possible hypothesis for the investigation being conducted by James Bradley. (3)

1.5.2 How is James Bradley collecting data for his research? (2)

1.5.3 How can the study on zebra migrations be useful to humans? (2)

1.6 1.6.1 Explain the social structure that exists in zebra populations. (4)

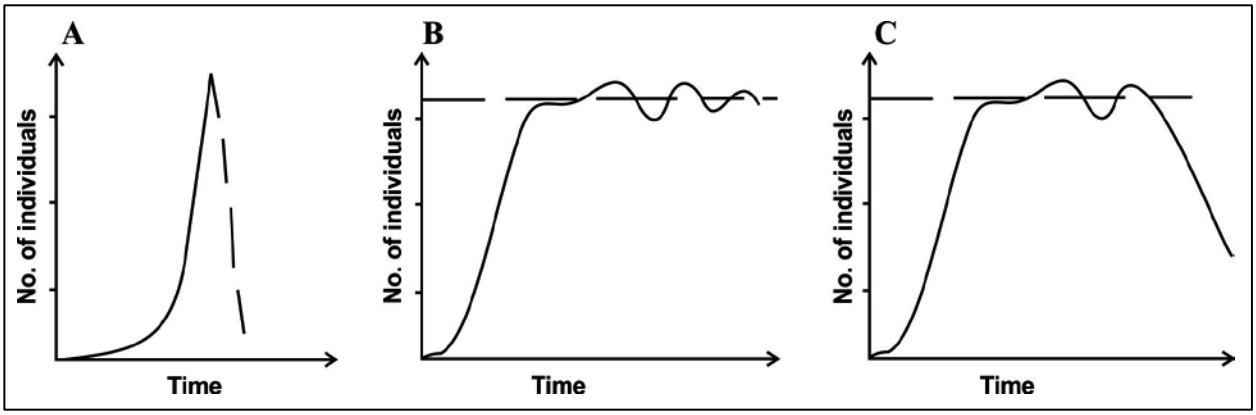
1.6.2 Explain ONE way in which the social organisation of zebra is different to the organisation of a social animal that you studied. (2)

1.6.3 Describe how a zebra's stripes can work as a survival strategy. (1)

1.7 In 2007 lodge owners attempted to help the wildlife survive a crippling drought by digging waterholes.

1.7.1 Is drought regarded a density dependent or density independent factor for the zebra? (1)

1.7.2 Which of the following graphs, A, B or C, would represent the effect of drought on a zebra population that had reached carrying capacity in its area? Explain your choice.



[Source: <http://www.tutorvista.com>]

(2)

1.7.3 Name the type of growth curve of a zebra population that is maintained at carrying capacity. (1)

1.7.4 Do you think that the establishment of artificial waterholes is interfering with the carrying capacity of the environment? Explain your answer. (2)

[30]

QUESTION 2

Read the information on a coastal bird, the African Black Oystercatcher, and answer the questions that follow.

Description

The African Black Oystercatcher is a black bird with pink legs and feet, a bright orange-red beak and red eyes surrounded by an orange eye ring. The African Black Oystercatcher is near endemic to the coast of southern Africa. It is found along the coast from Angola to Mozambique with breeding places from Namibia to KwaZulu-Natal, South Africa.

An African Black Oystercatcher

[Source: <https://en.wikipedia.org/wiki/African_oystercatcher>]

Habitat

These birds are found living on rocky and sandy coasts along the mainland and on islands off the coast. Nests are simple shallow holes in the ground excavated in sandy soil, lined with rocks and shells. The nests are typically placed near the high-water mark, hidden by rocks or kelp seaweed.

Mussels growing on rocks

[Source: <http://www.open.edu>]

Food

Their main diet consists of marine organisms, e.g. mussels, limpets, whelks and crustaceans. Rocky coasts have a great variety of food for the birds. They forage exclusively during low tide in the intertidal zones.

Breeding

These birds are monogamous slow breeders. Breeding takes place from October to April. Females will lay 1–2 well-camouflaged eggs in sand or rock depressions. Both parents incubate eggs for about 32 days before hatching. The chicks hatch simultaneously and are dependent on the parents for food and shelter. The larger chick will fledge earlier than the smaller chick and it will have a greater chance of survival. Adults are known to live for over 18 years.

Friends and Foes

These birds roost in flocks of up to 200 individuals during non-breeding season. These large numbers protect them from predators. Feral cats, house rats, kelp gulls, genets, foxes, jackals and snakes prey on the African Black Oystercatcher. Uncontrolled domestic dogs also prey on young chicks. These birds excrete nutrient-rich guano (faeces), which may land in the sea. Algae growing along the shore absorb this nutrient-rich guano. The algae therefore grow and reproduce faster and are consumed by limpets. The limpets also grow and reproduce faster increasing the food available for the African Black Oystercatcher. The role of the African Black Oystercatcher is to control the population of its prey within the marine ecosystem.

Threats to African Black Oystercatcher populations include human disturbances in the form of recreational cars on beaches, introducing predators at the breeding sites, degradation and destruction of breeding areas through urban developments, coastal diamond mining and pollution.

Conservation status and importance of the African Black Oystercatcher
The global population of the African Black Oystercatcher is 6 670. Due to the small population size of less than 10 000 individuals, the International Union for Conservation of Nature regards the African Black Oystercatcher as "Near Threatened".

The African Black Oystercatcher population is currently stabilising due to improved management plans that were put in place to protect these birds as well as the additional food source in the form of the alien Mediterranean Mussel. This bird has played a vital role in reducing and controlling the population of the alien invasive Mediterranean Mussel within the marine ecosystem, thus reducing competition between the native and alien mussels and increasing the population of native mussels along the coast of South Africa.

The Oystercatcher Conservation Programme was established to increase the conservation of this species, raise public awareness and get local communities involved in the conservation of these birds. In 2000, a national ban of recreational vehicles along the beaches of South Africa was put in place. This ban reduced the level of disturbance along South Africa's coasts, thus increasing the bird's breeding success and populations along the coastal areas.

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

2.1 Provide the correct biological terms for the following descriptions:

2.1.1 an organism unique to a specific region (1)

2.1.2 a group of oystercatchers that interbreed, living in the same area of coastland (1)

2.1.3 the relationship between domestic dogs and young African Black Oystercatcher chicks (1)

2.2 Describe the ecological niche occupied by the African Black Oystercatcher. (5)

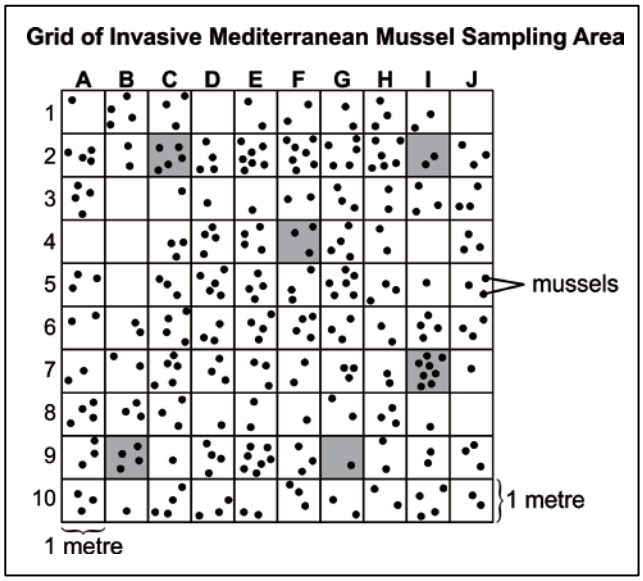
2.3 2.3.1 What is the conservation status of the African Black Oystercatcher? (1)

2.3.2 List THREE threats posed by humans that influence the survival of the African Black Oystercatcher. (3)

2.3.3 Beaches are there to be enjoyed by all for recreation. In your opinion, is it correct to ban humans from beaches where African Black Oystercatcher are found? Give a well-explained reason for your answer. (2)

2.3.4 Suggest and explain an alternative way to protect the African Black Oystercatcher other than banning people from breeding sites. (2)

2.4 Ecologists wanted to gain an idea of how many invasive alien mussels were growing on the rocks at a breeding site. They marked out an area as seen below and counted the mussels in a number of random samples.



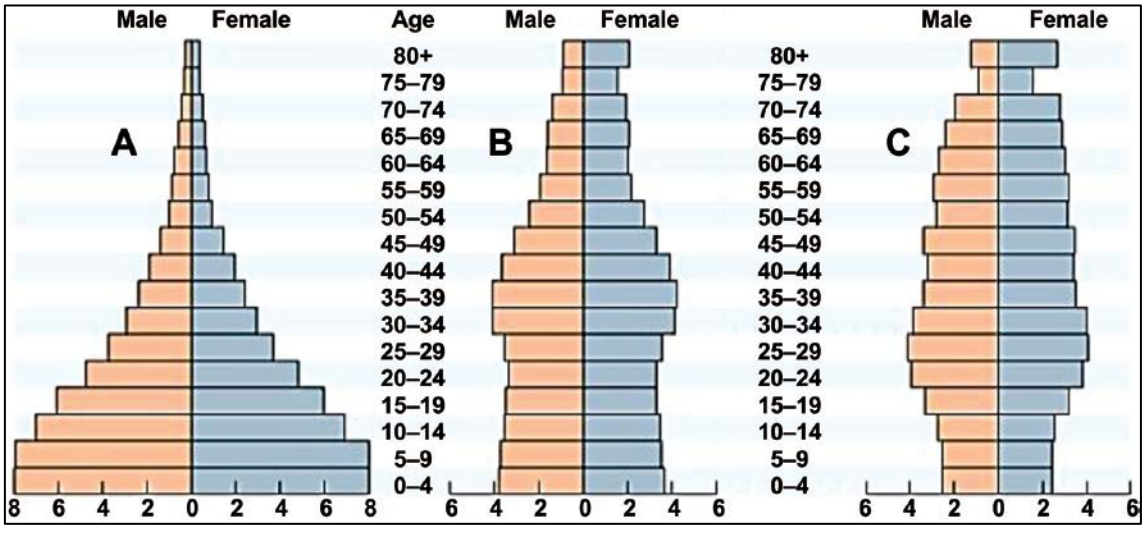
[Source: <http://www.oocities.org>]

2.4.1 Why is it important to take random samples in the given area? (2)

2.4.2 Areas where quadrats were placed are shaded on the diagram above. Use these quadrats to estimate the number of mussels in the marked-out area. Show all working. (4)

2.4.3 Describe ONE other precaution that could be taken to ensure the accuracy of estimating the size of the population. (2)

2.5 Study the diagrams below of different human population pyramids.



2.5.1 Which letter, A, B or C, represents the population pyramid of South Africa? Explain a visible reason for your answer. (2)

2.5.2 Draw a table of two differences which would exist in countries represented by the population pyramids A and C. (4)

[30]

60 marks

SECTION B

QUESTION 3

Fracking in the Karoo will have more advantages than disadvantages for South Africa.

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.

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.
- to integrate your own relevant biological knowledge – it is important to do so.
- 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.

40 marks

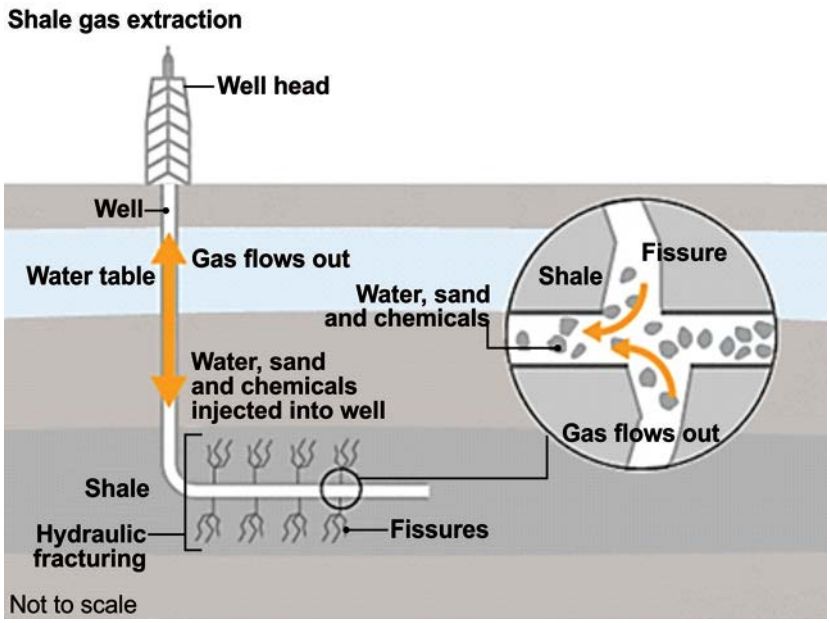
SOURCE A What is fracking?

Fossil fuels such as coal are a non-renewable source of energy. Natural gas deposits in rock can supplement the energy requirements of countries and place less reliance on coal for fuel.

Fracking is the process of drilling down into the earth before a high-pressure water mixture is directed at the rock to release the gas inside. Water, sand and chemicals are injected into the rock at high pressure that allows the gas to flow out to the head of the well.

The term fracking refers to how the rock is fractured apart by the high-pressure mixture.

**fractured = broken apart*



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

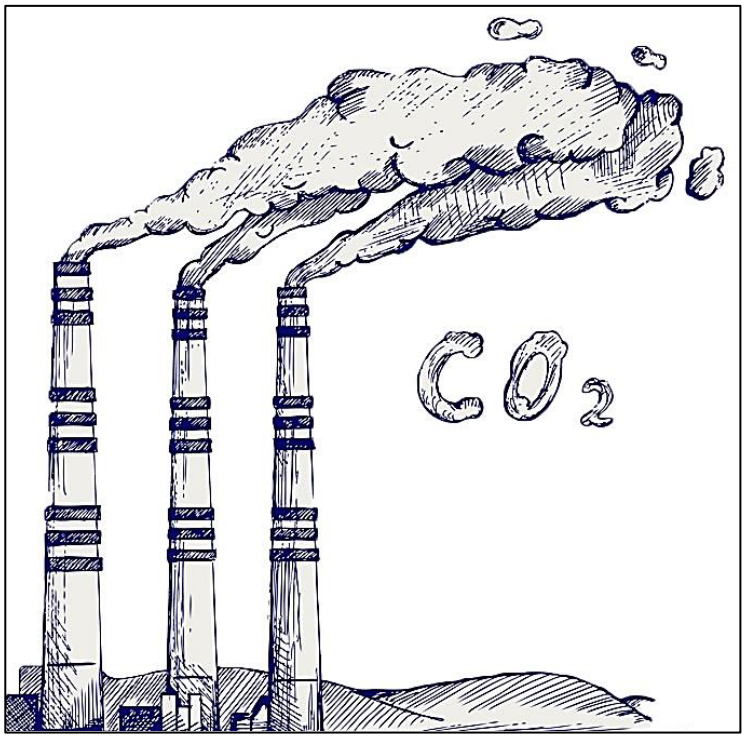
SOURCE B South Africa's natural gas reserves

According to the United States Information Administration, fracking has revolutionised USA oil and natural gas production. Advancements in shale gas and oil production could mean that the USA will meet all of its energy requirements by 2030. This is remarkable as the USA was for decades the largest importer of oil from the Middle East.

Rank	Country	Natural shale gas Trillion cubic metres (tcm)
1	China	33
2	Unites States	23
3	Argentina	19
4	Mexico	16
5	South Africa	15
6	Canada	11

[Adapted from: <www.financialsense.com>]

SOURCE C



[<http://www.momscleanairforce.org>]

SOURCE D South Africa's power crises

In 2015 South Africa was crippled by power blackouts as Eskom battled to supply electricity to the country. In 2016 Eskom did not expect to implement electricity blackouts until April. Africa's most advanced economy is battling its worst electricity crisis, with Eskom scrambling to keep the lights on in millions of homes and businesses.

Recent research from three scientific journals suggests that usable coal reserves in South Africa are much smaller than previously thought. Jeremy Wakeford, chair of the International Association for the Study of Peak Oil (ASPO International) in South Africa, discussed the studies in their latest newsletter, and how they challenge the "commonly believed concept that South Africa has abundant coal reserves that will last 200 years or more ... given the country's overwhelming dependence on coal, this issue has huge ramifications for our future development path."

Coal provides 70% of the country's energy supply, supports 90% of electricity generation, is used to make a quarter of the country's liquid fuels using the Sasol process, and is a big earner of foreign exchange through exports to foreign users.

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

SOURCE E Dangers of fracking

Possible side effects	Problems
Water Pollution	Water full of dangerous chemicals is pumped into the ground in huge amounts. It is supposed to be extracted after the process of fracking. However, sometimes it does not rise up to the surface but rather seeps through the ground towards other water sources like rivers, ponds and even the sea.
Air Pollution	Fracking may release chemicals such as benzene and methane into the air that are known to cause cancer. This happens just after the gas has been tapped but before the actual production begins, which means that it is not caught and therefore is released into the air that people and animals breathe.
Noise and Light Pollution	Fracking processes go on throughout the day and night, meaning that light pollution goes on at all times, and the heavy, noisy vehicles that bring materials and carry gas away can disturb the sleep of those living in the area of a fracking plant.
Can Lead to Drought	Each gas well requires enormous amounts of water to complete each fracturing job. In a country that is already facing acute water shortage, fracking on a large scale can lead to severe drought.
Exposure to Toxic Chemicals	Up to 600 chemicals are used in fracking fluid, including known carcinogens and toxins such as lead, uranium, radium, methanol, formaldehyde, hydrochloric acid, mercury, and ethylene glycol.

[Adapted: <http://www.conserve-energy-future.com>]

SOURCE F Karoo considered to have potential as a future World Heritage Site

The Succulent Karoo, which consists primarily of winter-rainfall desert, is one of only two desert biodiversity hotspots in the world. For an arid region, it has extraordinarily high plant diversity and endemism, including the world's richest succulent flora. Some 40% of the 6,356 plant species occur nowhere else on the planet.

The Succulent Karoo is home to a wide variety of insects and reptiles, with more than 1/4 of the hotspot's 70 scorpions being endemic. There are also over 75 species of mammals, including the Golden Mole, although elephants, Black Rhinoceros, and Cape Buffalo that used to populate the area have since disappeared.

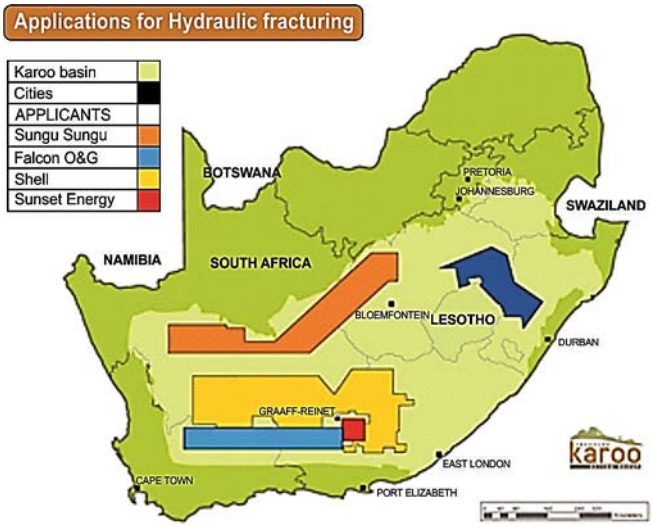
Despite the amazing diversity, the hotspot is a very fragile ecosystem as evidenced by 28 species of plants dependent exclusively on two types of long-tongued flies for pollination. This exclusivity means that any damage to the fly's population may also reduce the population of the plants.

A Golden Mole

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

SOURCE G Fracking the Karoo *The Economist* – 18 October 2012

The Karoo, "the land of great thirst", covers much of the 800 miles between Johannesburg and Cape Town. The semi-desert area is known for its arid beauty and aching poverty. But deep beneath its sheep- and ostrich-dotted expanses could lie untold wealth—in the form of natural gas.



[Source: <http://www.greenbusinessguide.co.za>]

America's Energy Information Administration (EIA) suspects South Africa might boast shale gas reserves of around 485 trillion cubic feet. The gas would only be accessible by hydraulic fracturing—"fracking"—pumping water and chemicals into rock at high pressure.

In April 2011, in response to opposition from environmental groups and the local community, South Africa's government slapped a moratorium on fracking. But last month Collins Chabane, a minister in the president's office, announced that the cabinet was lifting the ban.

A study by a technical task team appointed last year had clearly showed that exploration was safe. Three foreign companies—Royal Dutch Shell, Falcon Oil & Gas and Sunset Energy—have been granted licences to explore for gas.

A report by one of the companies argues that fracking would bring what the area so urgently needs: jobs and development. If only a tenth of the estimated gas can be extracted, thousands of jobs could be created and it would provide South Africa with 400 years' worth of energy. For a country that regularly endures power cuts, that would mean a brighter future. The government reckons that the sales value would be almost a trillion rand.

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

SOURCE H The Karoo – tourist destination

South Africa is a country that has an enormous tourist industry. Much of that industry is based on the natural beauty of the country.

SA's rich fossil heritage

South Africa's Karoo rock is an almost continuous sedimentary record of palaeontological history for a period of 120 million years. It is the only place in the world with such an extensive and continuous record. South Africa has one of the richest fossil records and collections in the world and the fossil tourism industry could create many jobs.

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

Total: 100 marks