NATIONAL SENIOR CERTIFICATE EXAMINATION
EXEMPLAR 2008

LIFE SCIENCES: PAPER II

Time: 2½ hours 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 10 printed pages. Please check that your question paper is complete. Detach the booklet from the middle of your question paper.

2. Question 1 must be answered in the booklet provided. Questions 2, 3, 4 and 5 must be answered in the Answer Book.

3. Read the questions carefully.

4. Number your answers exactly as the questions are numbered.

5. Use the total marks which can be awarded for each question as an indication of the detail required.

6. It is in your interest to write legibly and to present your work neatly.

QUESTION 2

Many fuels, such as coal, contain small amounts of sulphur. Coal in South Africa has a high sulphur content. During burning, the carbon in coal forms carbon dioxide and smoke, and the sulphur forms sulphur dioxide. Sulphur dioxide reacts with moisture in the air and falls as acid rain, sometimes a large distance from the where the coal is burned. Acid rain seeps into the ground and into rivers.

[Adapted from *Hill*]

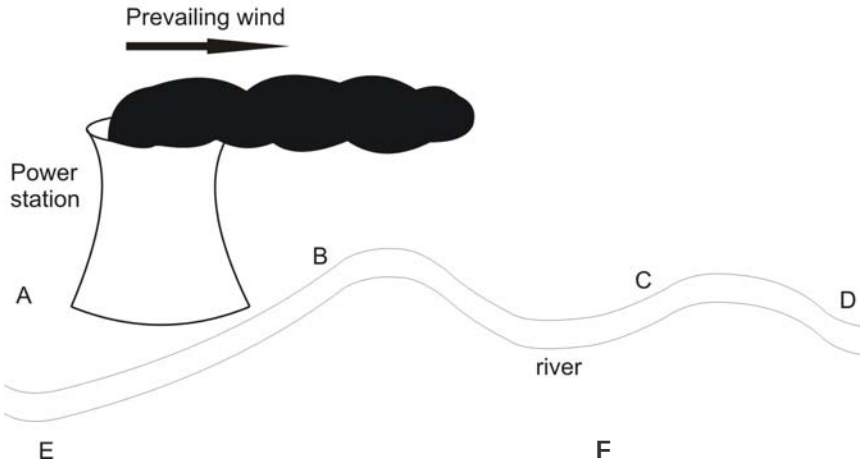
Some pupils living in Bethal, Mpumalanga carried out an investigation in an area around one of the coal-burning power stations in the area.

The extract below shows part of their report.

Aim: To find out how much air pollution is caused by a local coal-burning power station.

Method: We did our investigation in June this year. We chose June because we thought that with winter coming, the power station would be burning more coal than usual to make more electricity.

Map of area sampled



We collected rocks with the same type of lichens on them and placed the rocks in six areas, at positions A to F shown on the map above. We left the rocks for all of June. We decided to use lichens because they grow in this area and we have found out that they are very sensitive to air pollution, so we are using them as an indicator of air pollution. We also found out that lichens, which appear to be a single plant, are actually a symbiotic relationship between a fungus and a photosynthetic alga.

At the end of June we asked the mother of one of our group to help us find how much sulphur there was in the lichens. She works at the laboratory attached to the power station around which we did the experiment and we thank her for helping us determine the results.

The table below shows our results in ppm (parts per million).

Position	Sulphur concentration/ ppm
A	0.02
B	3.30
C	2.10
D	1.50
E	0.01
F	0.02

2.1 What conclusion could the pupils have made from the results? (3)

2.2 Did these pupils carry out their investigation in a scientifically correct way? Explain your answer and suggest ways in which they could improve their investigation. (16)

2.3 The pupils think that air pollution from the same power station is causing more and more people in the community to suffer from asthma.

Plan an experiment the pupils could carry out to test their idea. (11)

30 marks

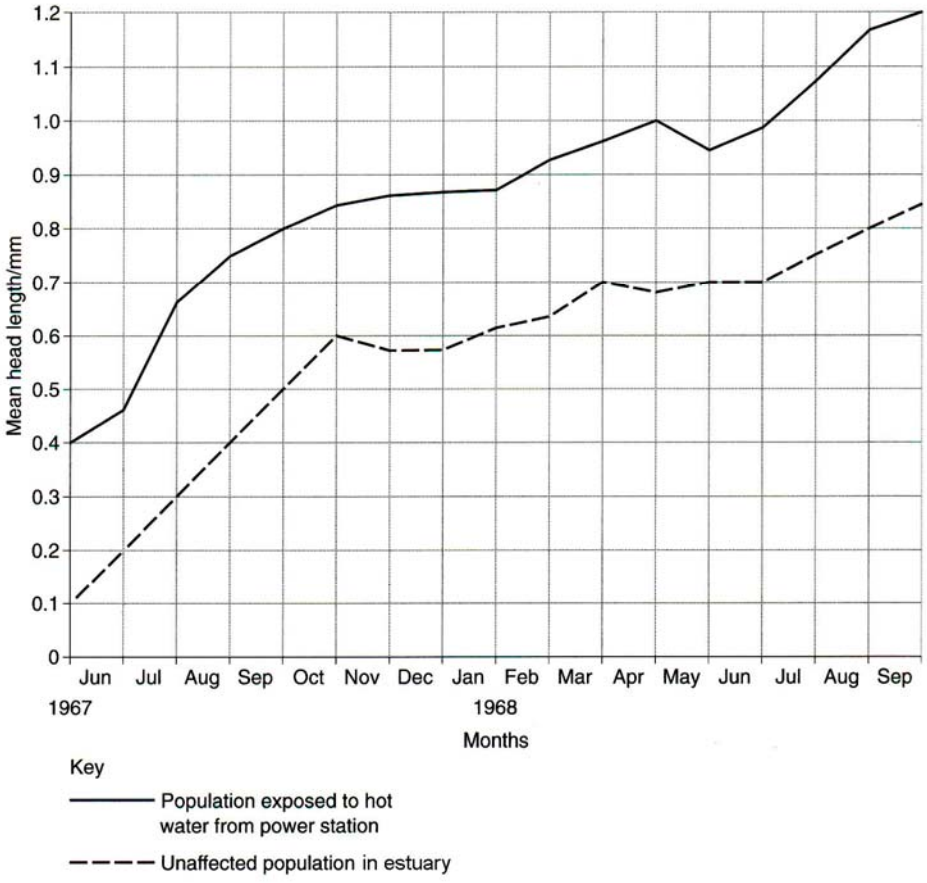
QUESTION 3

Most aquatic organisms get their oxygen directly from the water. Varying water temperatures have different effects on organisms. Oxygen content in water is higher at lower water temperatures and in running water. Higher temperatures have a beneficial effect on body processes of plants and animals because they increase metabolic rate or energy output which can then increase growth.

3.1 Rivers and estuaries may become polluted by hot water released from the cooling towers of power stations.
Suggest how thermal pollution can cause death of aquatic organisms. (2)

The sand hopper *Urothoe*, is a small crustacean which lives in river estuaries. An investigation was carried out into the effects of thermal pollution on the growth of *Urothoe.*

Graph I below shows the results of the study.

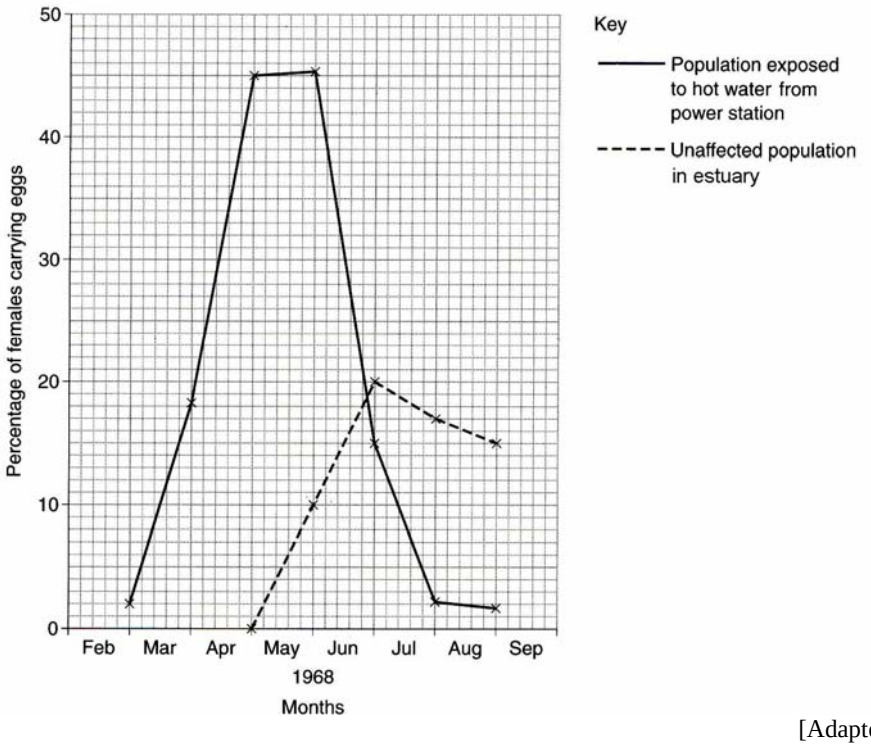


[Adapted from *Clamp*]

3.2 Where and how was the study carried out? (6)

3.3 Compare the head lengths of the two populations at the beginning of January 1968 and suggest an explanation for the difference. (4)

Graph II below shows the effect of thermal pollution on the percentage of female sand hoppers carrying eggs from the beginning of March to the end of August 1968. Females carry eggs only during the breeding season.



[Adapted from *Clamp*]

3.4 How can you explain the difference between the two curves? (4)

3.5 Do you think thermal pollution is an advantage or a disadvantage to sand hoppers? Give reasons for your answer. (4)

Sand hoppers and their eggs are preyed on by various fish, and people living near rivers and estuaries catch these fish for food.
A nuclear power station was built near an estuary in which fish prey on sand hoppers and their eggs. Fishermen noticed, about 10 years after the nuclear power station began operating, that they were catching monster fish, i.e. fish that were twice the size of fish before the nuclear power station was built. The fishermen were pleased with their catches because they were able to sell the fish their families could not eat. Scientific investigations subsequently showed that the nuclear power station was responsible for thermal pollution and the release of radioactive material into the estuary.

3.6 By referring to Darwin's theory of natural selection, explain the appearance of monster fish in the river. (6)

3.7 Give a reason why the local people should not eat the monster fish. (4)

30 marks

QUESTION 4

4.1 Read the following information about dinosaur extinction.

What caused the mass extinction of the dinosaurs?

Theory A
One theory scientists put forward to explain this mass extinction is based on huge volcanic eruptions which occurred in an area in India (called the Deccan Traps) about 65 million years ago. Some eruptions produced flows of lava that released sulphur dioxide into the air, while other eruptions were so powerful that they brought the metal iridium from deep within the Earth to the surface. These volcanic eruptions spewed ash and other compounds into the atmosphere, causing widespread fires. The ash and dust spread throughout the Earth's atmosphere blocking out the sun's rays for many years. Plants died, the Earth cooled and the dinosaurs became extinct.

Theory B
A second theory, the asteroid impact theory, suggests that a giant asteroid hit the Earth at the end of the Cretaceous era, 65 million years ago. The impact caused dust to rise throughout the atmosphere, blocking out the sun's rays for many years. Plants died, the Earth cooled and dinosaurs became extinct. The impact of the hot, burning asteroid would have started widespread fires.
Evidence for this theory is based on the presence of a layer of the metal, iridium, between two clay layers separating older Cretaceous rocks and younger Tertiary rocks throughout the world (meteors and asteroids contain iridium, which is rare in the Earth's crust). A very large impact crater has been found off the Mexican coast.

4.1.1 Write a flow chart to summarise the theory of volcanic eruptions being responsible for dinosaur extinction. A flow chart is a series of statements separated by arrows.
Begin with the following statement:

Volcanic eruptions released ash and other compounds into the air. (5)

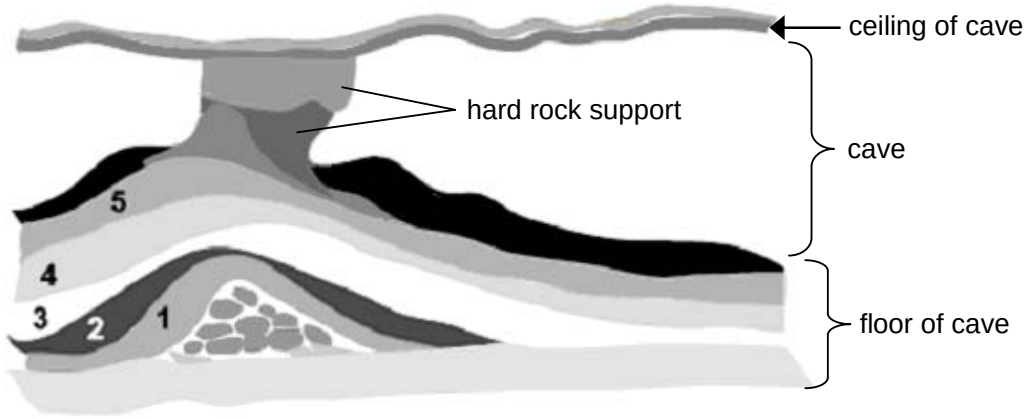
↓

4.1.2 Which theory A or B, do you think, is better at explaining the extinction of the dinosaurs? Explain your answer. (5)

4.1.3 Compare and contrast the volcanic eruption theory (A) for mass extinction of the dinosaurs with the present-day sixth extinction. (7)

4.2

The diagram below shows one of the Naracoorte caves, in South East Australia, which has been open for scientific study for some time.
The caves were formed when water and carbon dioxide dissolved the calcium carbonate (limestone) in the rocks. Hard rock remains form the ceiling of the caves. The floor of these caves contain the greatest number, most diverse and best preserved fossils of the Pleistocene Epoch (1.8 million years to 10 000 years ago) in Australia. The fossils formed over a 300 000 year period while there was a hole in the ceiling of the cave. Animals, plants and soil accumulated in the cave. The hole blocked up about 15 000 years ago.



[Adapted from *VSE*]

4.2.1 What do the layers numbered 1 to 5 in the diagram above represent? (3)

Some fossils, a skull and a few other bones, have now been identified as an Australian lion, *Thylacoleo carnifax*. There are no lions in Australia today. After studying the fossil parts, scientists have concluded that the lion was alive between 100 000 and 200 000 years ago and that it weighed about 120kg and had a very muscular body.

4.2.2 How did the scientists reach these conclusions? (4)

4.2.3 When visitors first came to Naracoorte, they walked around a room in a museum where there were fossils in explanatory displays, cave visits were not allowed. It is now being suggested that visitors be taken on conducted tours through the caves.
Suggest how the Naracoorte Caves Authorities, who operate the cave system, should manage the visits if they decide to allow them to take place. (6)

30 marks

QUESTION 5

Do you think enough is being done in South African communities to protect children from the effects of lead pollution?

Read the source material (A – F) provided below to assist you in making a decision. Your written response should be 1 to 1½ pages in length and must be supported by evidence from the source material.

20 marks

SOURCE A A CONCERNED MOTHER SPEAKS

I became interested in the lead problem after I read about its effects in the local newspaper and then on the Internet. We live in the hills above town and its industrial areas, and I thought we would be clear of any pollution. I had tests done in the area where we live and was shocked to discover lead levels as high as 100 000 mg/kg in the area. I then decided to have my children's lead blood levels tested. My youngest son, Harry, was found to have a level of 31 µg/dl, more than three times the international recommended safety level of 10 µg/dl.
I found out that lead poisoning is common in young children because they crawl on the ground and often pick up lead on their hands. All small children put their fingers into their mouths. I developed a whole range of ways to help my son. I wet-mopped the floors twice a week to stop lead particles spreading. When I had guests, I asked them to remove their shoes and walk over a towel to minimise lead being brought into the house.

SOURCE B SOME SOURCES OF LEAD IN THE ENVIRONMENT

The main sources of lead are petrol fumes, wastes from industry and flakes from lead-based paint. Many residential areas have been built on old industrial sites, such as paint and pigment factories, crystal glass and battery casing plants, all of which use lead in their manufacturing processes.

SOURCE C NOTICES

Notice 1 displayed in all buildings at PD Copper Lead Zinc Silver Mining Company mine and smelter in the Northern Cape

PD Copper Lead Zinc Silver Mining Company
Memo from Medical Superintendent to all employees working at this smelter:
Before eating or drinking, wash your hands and wash under fingernails to remove lead.
Display this notice in all washrooms and where employees have meals.

Notice 2 displayed in all buildings at PD Copper Lead Zinc Silver Mining Company mine and smelter in the Northern Cape

PD Copper Lead Zinc Silver Mining Company
Reminder to all employees working at this smelter
Visit the Clinic to have your lead blood level tested on the first Tuesday of each month.
This is an equal-opportunity company and all members of any family living on site can have their blood tested at the Clinic, at no cost.
We are required by law to keep records of lead blood levels of all employees.
Medical Superintendent

SOURCE D EFFECT OF SOCIAL FACTORS

Social factors need to be considered for children at risk. Exposure to lead tends to be higher in the lower socio-economic groups of the South African population. Poorer people are forced to live in areas that are more exposed to industrial pollution, closer to busy roads and highways or in housing with old, flaking lead-based paint and lead water pipes. All of these are causes of lead release into the environment.

In an informal settlement in the Durban metropolitan region, 50% of children had blood lead concentrations above 10 µg/dl, while in a rural area located 90 - 120 km from Durban only 2% of children had blood lead concentrations above this level.
Blood lead levels among Johannesburg children ranged from 6 to 26 µg/dl, with a mean level of 11.9 µg/dl. In the lead mining town of Aggeneys in the Northern Cape and in the comparison rural community of Pella about 40 km away, average blood lead levels of young children were higher than would be expected in a rural setting (16 µg/dl in Aggeneys and 13 µg/dl in Pella)

[Adapted from *MRC Publication*]

SOURCE E PART OF A RESPONSE TO A PROPOSED PETROL STATION BEING BUILT NEAR A PRE-SCHOOL

'Placing a petrol station next door to a kindergarten (pre-school) is extremely worrying because, in our view, it's very likely that increases in dangerous air pollutants such as lead will place the children's health at significant risk,' a spokeswoman for the local community, Ms Immig, said.
'The community, who oppose the development, rightly believe their concerns have not been adequately addressed and are currently seeking legal advice about health and safety issues. Obviously, the EPA (Environment Protection Authority) are also concerned about the health impacts or they wouldn't have recommended an air quality assessment to be carried out,' said Ms Immig.
'We have advised the pre-school to monitor air toxins. If the petrol station is built, they should continue to monitor air toxins. Any increases in levels of pollutants will give them grounds on which to proceed legally,' said Ms Immig.
'Conflicting information is being provided about the actual distance the petrol station will be from the kindergarten and it's high time that the local council and developers heed the advice of the EPA and carry out an air quality assessment before deciding on the location.'
'The development has become so controversial that the developers would be well advised to consider a less hazardous location for their petrol station,' Ms Immig concluded.

SOURCE F SOME FINDINGS OF THE SOUTH AFRICAN MEDICAL RESEARCH COUNCIL

'The introduction of unleaded petrol has undoubtedly been of benefit to young South African children,' says Ms Angela Mathee, a Senior Specialist Scientist at the MRC's Environment and Health Research Group.

According to her, preliminary results from a survey of children's blood lead levels currently being undertaken by the MRC indicate that, on average, the blood lead levels of Grade 1 children attending schools in various Cape Town suburbs has decreased by 57% since 1991. This was when unleaded petrol was first introduced.

'The study showed that the average blood lead level among children attending Cape Town inner city schools now equals 7 µg/dl. This is down from 16 µg/dl in the 1980s and early 1990s, when only leaded petrol was available at concentrations ranging from 0,4 to 0,836 g/litre,' she says.

An MRC study conducted in Cape Town in 1991 showed that more than 90% of inner city children had blood lead levels equaling or exceeding the international action level of 10 µg/dl. The figure for 2002 equals 21%.

'We are hopeful that the phase-out of leaded petrol planned for 2006 will further reduce South African children's blood lead concentrations - bringing these closer to the level of 2 to 3 µg/dl, which we are now seeing among children in countries such as the USA where the use of leaded petrol ceased many years ago,' she says.

[Adapted from **Estimating the burden of disease attributable to lead exposure in South Africa in 2000,** *MRC publication*]

TOTAL FOR THIS PAPER: 150 MARKS