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External Assessment 2022

ENVIRONMENTAL SCIENCE

ESS315118

Section **A**

Pages	12
Questions	5
Information Sheet	1

Preparation time for this exam: 15 minutes

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
- The exam is **three (3)** hours in length. It is suggested that you spend **approximately 36 minutes** in total answering the questions in this section.
- The **Environmental Science Information Sheet** can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address:
 - Criterion 2 develop, interpret and analyse experiments and investigations.

Marker Use	
C2	/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	5	5	36 minutes	36 marks
Section D	5	5	36 minutes	36 marks
Section E	5	5	36 minutes	36 marks
Totals	26	26	180 minutes (3 hours)	180 marks

Question 1

Marker use

The seeds of some plants require a period of cold exposure in order to germinate.

A student decided to investigate the effect of cold exposure on seeds of the swamp gum *Eucalyptus regnans*. She placed 10 seeds of *E. regnans* on moist filter paper in each petri dish, which she then placed in a refrigerator at 2°C for varying periods of time. When each petri dish was removed from the refrigerator it was left on a laboratory bench for two weeks.

The results from the experiment are given in the following table:

Dish Number	Time in refrigerator	Number of seeds germinating
1	1 day	0
2	1 week	0
3	2 weeks	1
4	3 weeks	6
5	4 weeks	8
6	2 months	7

a) Identify the independent variable in this experiment.

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b) Identify the dependent variable in this experiment.

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c) Write a hypothesis for this experiment.

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d) i. State **two (2)** other variables which would need to be controlled in this experiment.

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ii. Explain why these variables need to be controlled.

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Question 1 continues

Question 1 continued

Marker use

e) Discuss whether the results of the experiment support or negate your hypothesis.

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f) Describe **two (2)** modifications to improve the validity of this experiment.

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Total Q1

/ 10

Section A continues

Question 2

The National Waterbug Blitz is a citizen science program that monitors the health of waterways (rivers, streams, lakes and dams) in Australia. Participants identify and collect stream invertebrates. This data is used to provide a score for each site, known as SIGNALT.

a) Describe an appropriate method for collecting stream invertebrates.

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b) Populations of mayflies contribute to the SIGNALT score. Mayflies, such as the one shown below, are only found in areas of high water quality. State the term used for this kind of species.

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c) i. State **two (2) abiotic** variables that could affect the stream invertebrates present at a particular site.

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ii. State how both of these abiotic variables could be measured.

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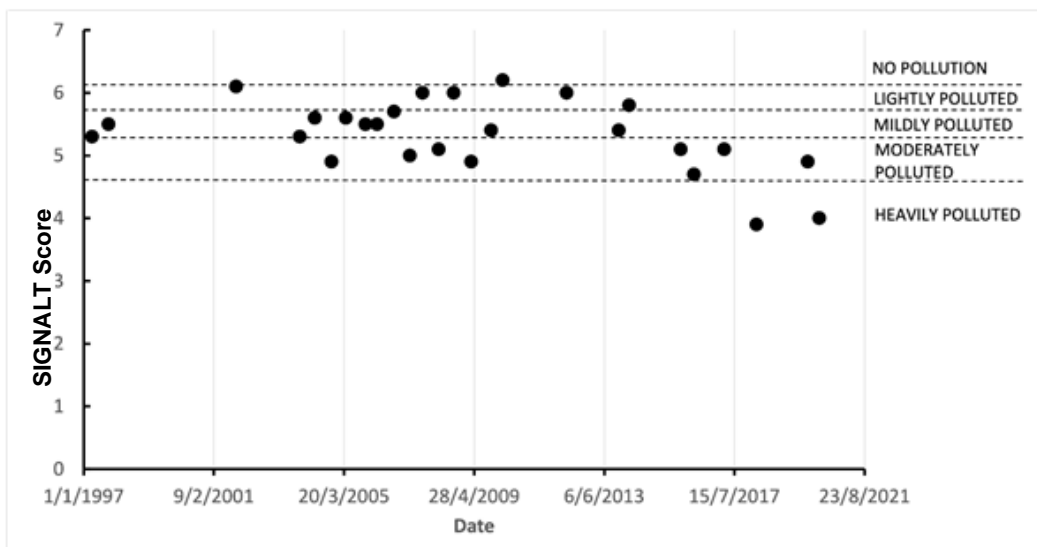
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Question 2 continues

Question 2 continued

Marker use

This chart shows SIGNALT data from one site near the mouth of the Don River in northern Tasmania for 13 years.



d) Describe the trends shown in the dataset with respect to the pollution status of the Don River.

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e) Explain the purpose of monitoring the same site over a long period.

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Total Q2

Section A continues

9

Question 3

A student learned that some herbicides can affect the growth of tadpoles at a concentration of only a few mg/L.

The student wanted to test the following hypothesis:

Increasing concentrations of herbicide will result in decreased growth of the tadpoles in size.

Design a suitable **laboratory** experiment to test this hypothesis. Make sure you provide details of your experimental setup, independent and dependent variables, control treatment and replication.

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7

Total Q3

7

Section A continues

Question 4

Foxgloves are a popular garden flower because of their large, brightly coloured flowers. They are an environmental weed in Tasmania. Numbers have increased considerably in the last five years, particularly in some areas of the state.

Low-cost drones can be used to remotely assess populations of foxgloves. These surveys are normally conducted in summer.

a) Suggest a reason why the surveys are conducted in summer.

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b) Explain **two (2)** advantages of using drone surveys rather than other methods.

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c) Data from the surveys are used to help inform the control of foxgloves. Describe **two (2)** factors that would need to be taken into account when designing a survey to cover the whole of Tasmania.

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2

Total Q4

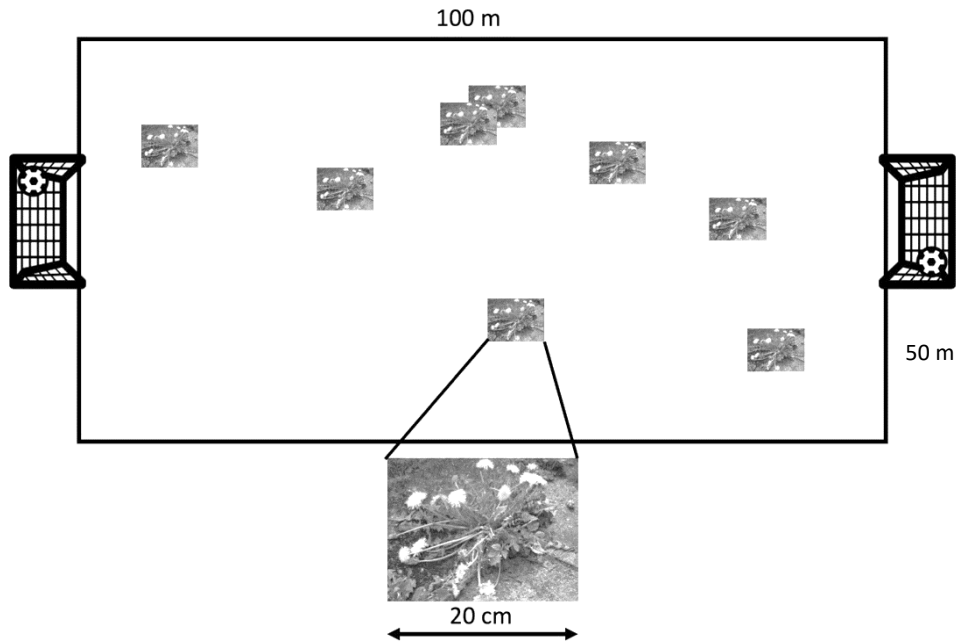
5

Section A continues

Section A continued

Question 5

Two groups of students wanted to investigate the population of dandelion plants on their 100m x 50m school sports ground as shown in the diagram below. One group chose to use quadrats and count all the dandelions in each quadrat. The other used a transect from goal to goal and counted all the dandelions within the transect.



a) Suggest a suitable quadrat size for this study.

/ 1

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b) The first group of students decided to use 20 quadrats. Explain how the students should select where these quadrats are placed on the sports ground.

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c) Describe **one (1)** advantage and **one (1)** disadvantage of using the transect method for this study.

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Total Q5

/ 5

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End of Section A

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External Assessment 2022

ENVIRONMENTAL SCIENCE

ESS315118

Section **B**

Pages	12
Questions	6
Information Sheet	1

Suggested working time: 36 minutes

Instructions:

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- Write your answers in the spaces provided in this exam paper.
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- All answers must be written in **English**.
- You **must** make sure your answers address:
 - Criterion 5 apply ecological concepts and processes.

Marker Use	
C5	/ 36

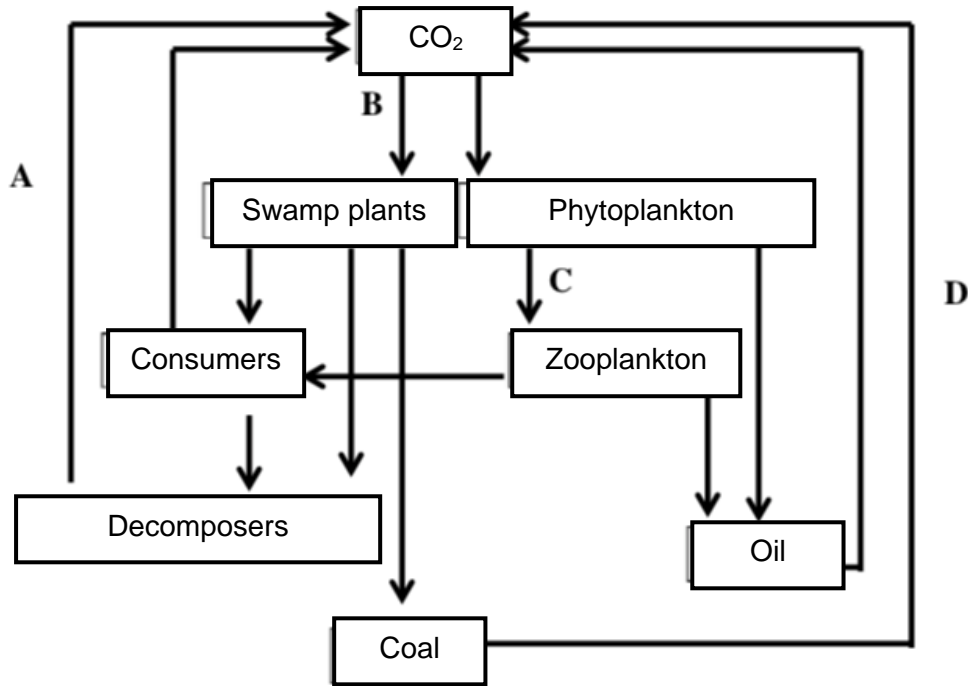
Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	5	5	36 minutes	36 marks
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Section E	5	5	36 minutes	36 marks
Totals	26	26	180 minutes (3 hours)	180 marks

Question 6

Marker use

The following diagram shows **part** of the Carbon Cycle concerning the formation of fossil fuels.



a) Name the processes represented by the letters A, B, C and D.

- A.
- B.
- C.
- D.

/ 2

b) Describe **one (1)** other process **not shown** in the diagram which removes atmospheric carbon dioxide.

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-

/ 1

c) Carbon and nitrogen are found both in the atmosphere and in living organisms. Outline the major differences in how plants obtain each of these elements.

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/ 2

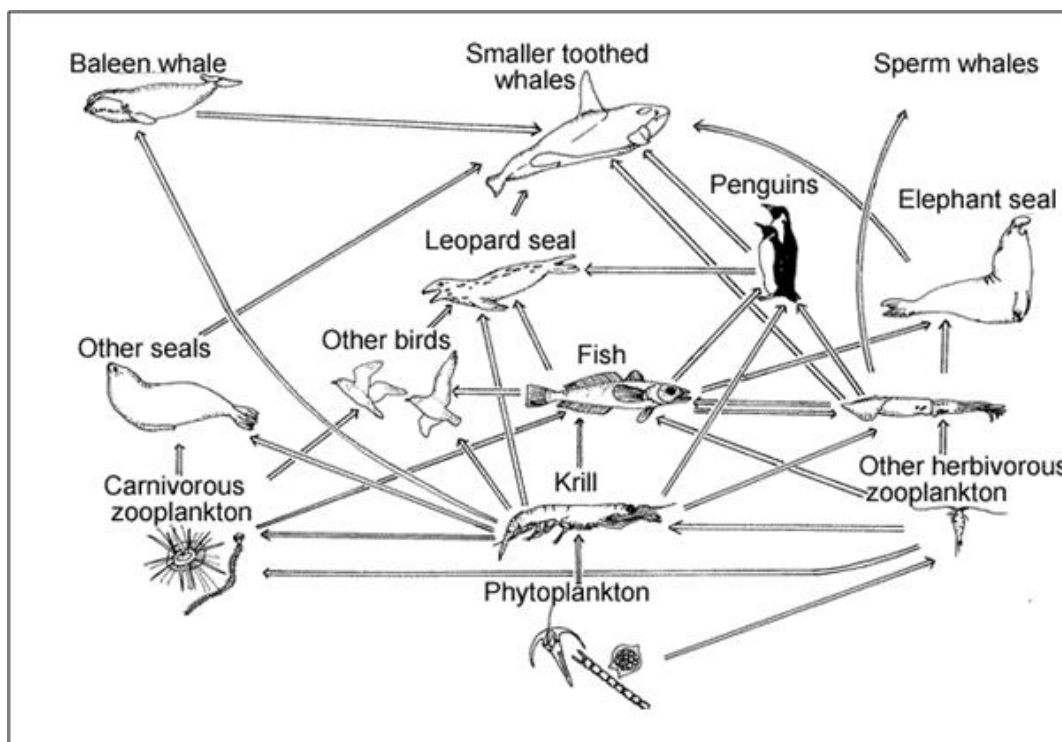
Total Q6

Section B continues

/ 5

Question 7

The following diagram shows an Antarctic marine food web.



a) Identify **one (1)** producer in this food web.

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1

b) In the past, baleen whales were hunted extensively, almost to extinction in some cases. Describe **one (1)** effect on krill and **one (1)** effect on another species in the food web due to decreases in baleen whale populations.

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2

Question 7 continues

Question 7 continued

Marker use

- c) Using information from the food web, construct and label a food chain containing **five (5)** organisms.

/ 2

- d) Using the laws of thermodynamics, explain why it is not possible to have a 'super-predator' that feeds on sperm whales and smaller toothed whales.

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- e) Explain whether the food web shows an open or closed ecosystem.

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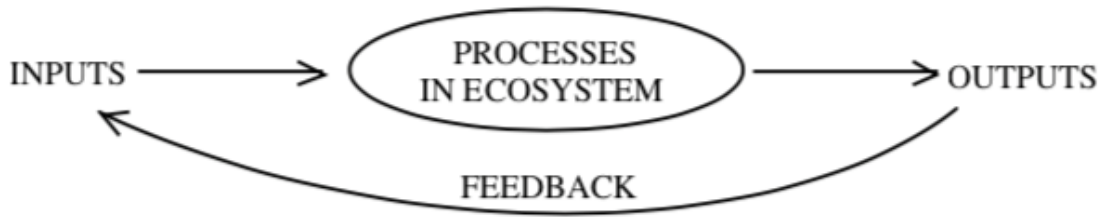
Total Q7

Section B continues

/ 9

Question 8

In a systems approach to ecology, feedback occurs when the outputs of a particular process affect the inputs. Both negative and positive feedbacks can occur in ecosystems.



In the following two examples, identify the type of feedback that is occurring and explain what will happen in the system as time goes on.

- a) Rabbits are herbivores and are preyed upon by foxes. Following a period of extended rainfall, there is an abundance of grass.

2.5

Type of feedback:

Explanation:

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- b) Methane, a potent greenhouse gas, is produced by microorganisms. Under warmer conditions microorganisms produce methane faster.

2.5

Type of feedback:

Explanation:

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Total Q8

Section B continues

5

Question 9

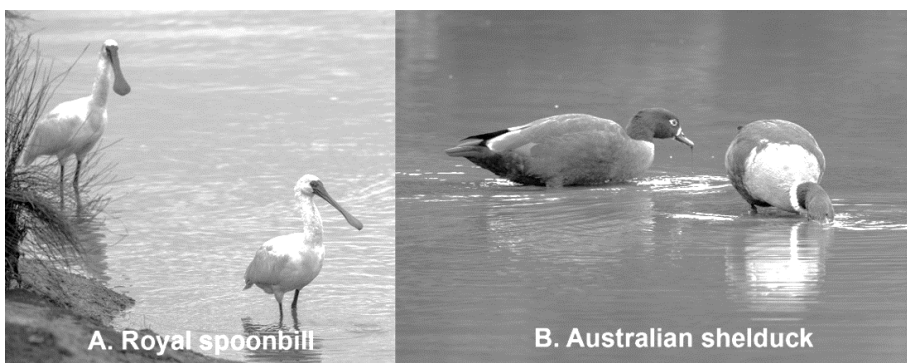
- a) Interactions between organisms of different species can be positive (+), neutral (0) or negative (-). In the table below, read the description of the interaction, identify the effect of the interaction on each species and state the type of interaction.

2

Description	Effect on species 1	Effect on species 2	Type of interaction
Two animal species. Great white shark (species 1) eats Australian fur seal (species 2)			
Two tree species. Native cherry (species 1) inserts its roots into the roots of blue gum (species 2) and extracts water			
Two animal species. Blind pistol shrimp (species 1) makes a burrow. Goby (species 2) lives in the burrow and warns the shrimp when another organism approaches			
After fire, two young tree species growing next to each other. White gum (species 1) and stringybark (species 2)			

- b) Consider the two Tasmanian waterbirds shown below, one of which is a specialist and the other a generalist.

2



A. Royal spoonbill

B. Australian shelduck

- i. Suggest which species is the specialist:
- ii. Explain your choice with respect to visible features of the birds:

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- c) Explain why two species cannot occupy the same ecological niche.

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Total Q9

2

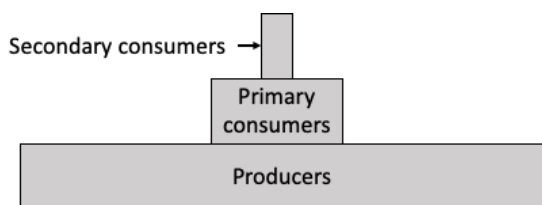
6

Question 10

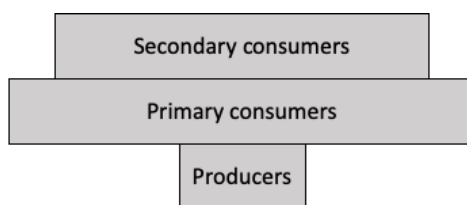
The diagram below shows the pyramid of **numbers** for two different ecosystems:

1. **Rainforest ecosystem.** The primary producers are trees, primary consumers are insects and secondary consumers are birds.

2. **Savannah ecosystem.** The primary producers are grasses, primary consumers are antelopes and secondary consumers are lions.



Ecosystem A



Ecosystem B

a)

i. Match the description of the ecosystem with the appropriate diagram.

Ecosystem A:

Ecosystem B:

1

ii. Justify your choice using the information provided.

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2

Question 10 continues

Question 10 continued

Marker use

- b) Explain what the pyramid of biomass might look like for **both** ecosystems. Sketches can be used in your answer.

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Total Q10

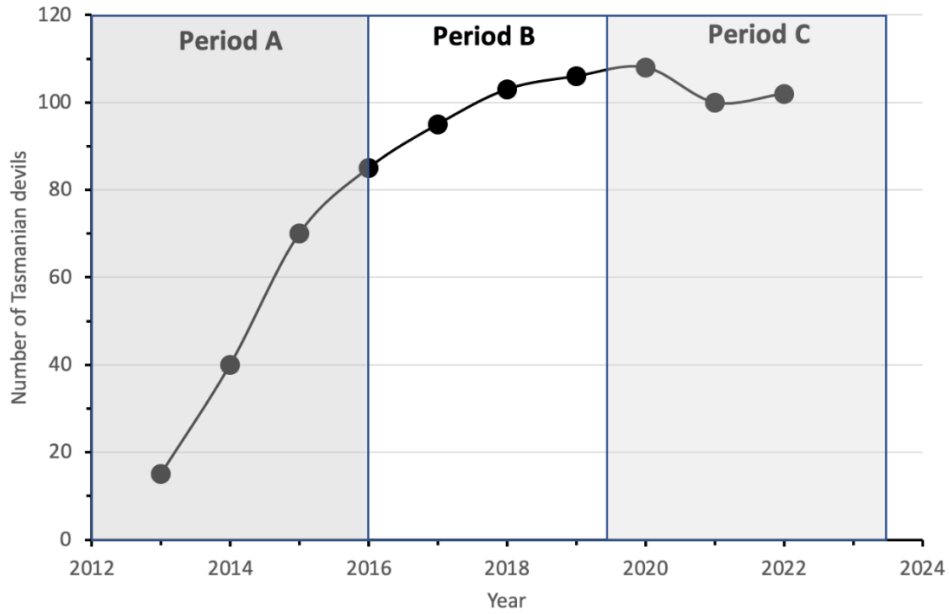
Section B continues

6

Question 11

In 2013, Tasmanian devils were introduced to Maria Island as part of a plan to establish an ‘insurance population’ of healthy animals not infected with Devil Facial Tumour Disease (DFTD). No devils were present on Maria Island before the introduction.

Initially, 15 Tasmanian devils were relocated from the mainland. Surveys of the number of devils were conducted every year. Data from these surveys are shown below:



a) State which portion of the graph, (A, B or C) represents exponential growth of the population.

1

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b) Estimate the approximate carrying capacity of the population.

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c) Explain the changes in the population of devils for the entire period shown on the graph.

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Total Q11

5

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End of Section B



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ENVIRONMENTAL SCIENCE

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Section **C**

Pages	12
Questions	5
Information Sheet	1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
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- The **Environmental Science Information Sheet** can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address:
 - Criterion 6 apply concepts and processes of ecosystem change.

Marker Use	
C6	/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36
Section B	6	6	36 minutes	36
Section C	5	5	36 minutes	36
Section D	5	5	36 minutes	36
Section E	5	5	36 minutes	36
Totals	26	26	180 minutes (3 hours)	180

Question 12

Marker use

The Great Southern Reef (GSR) is an enormous series of reefs that extends around Australia's southern coastline covering more than 70 000km² from New South Wales to Western Australia and around Tasmania. The GSR is home to hundreds of unique species such as the weedy seadragon *Phyllopteryx taeniolatus*, see photo to right.



The GSR is subject to many environmental influences, both natural and anthropogenic.

a) For each of the time periods provided, describe **one (1)** natural **abiotic** change affecting the ecosystem:

3

i. Diurnal (daily).....

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ii. Seasonally (yearly).....

.....

iii. Irregularly.....

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b) Explain **two (2)** effects that diurnal or seasonal changes might have on the organisms living in the Great Southern Reef.

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c) Explain the concept of biodiversity with respect to the Great Southern Reef.

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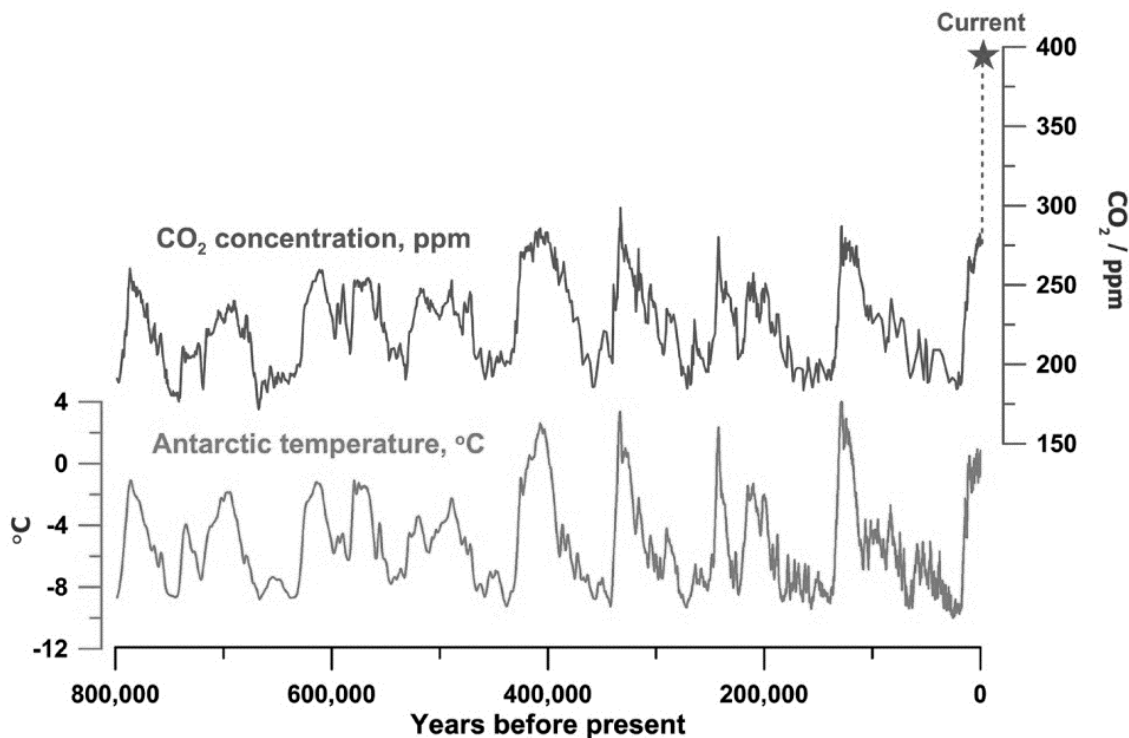
Total Q12

Section C continues

7

Question 13

The following graph shows changes in atmospheric carbon dioxide (CO₂) concentration and corresponding mean annual temperature in Antarctica measured over the last 800 000 years.



a) State the approximate concentration of CO₂ in the atmosphere 400 000 years ago.

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b) Describe the changes in Antarctic temperature over the time period shown and their relationship with atmospheric CO₂ concentration.

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Question 13 continues

Question 13 continued

Marker use

c) Describe **one (1)** method scientists have used to determine past levels of CO₂.

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d) Explain the cause of the large increase in CO₂ shown by the dotted line on the graph.

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e) Mean temperatures on the Antarctic peninsula have increased by about 3°C in the past 50 years. Suggest **two (2)** impacts on Antarctic ecosystems that might result from this increase in temperature.

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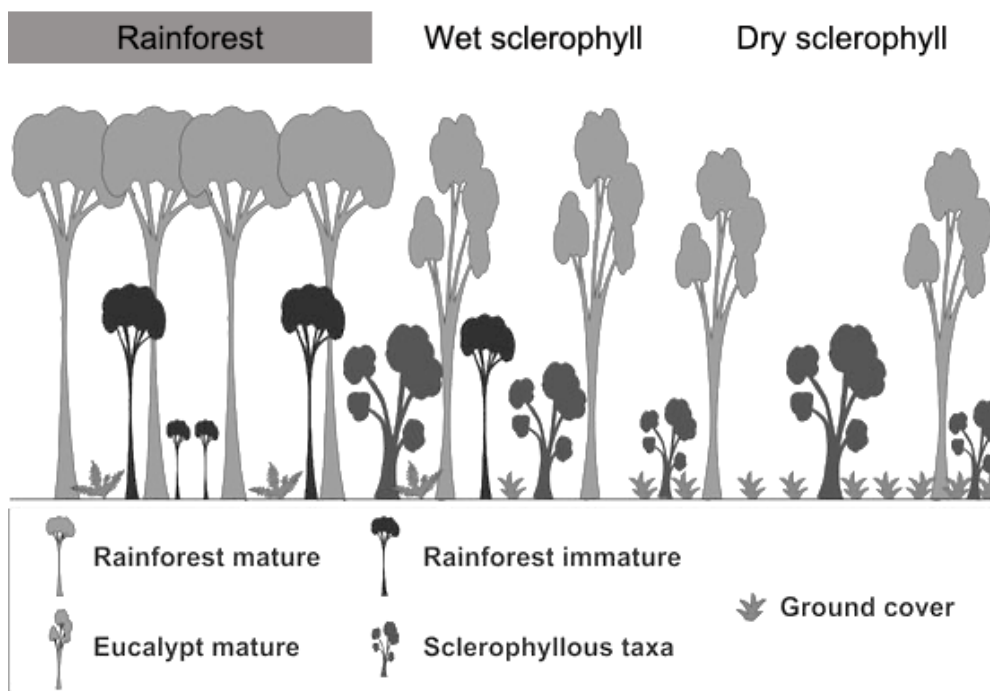
Total Q13

10

Section C continues

Question 14

The following diagram shows a representation of three types of forest in Tasmania.



a) Referring to the diagram, describe **two (2)** differences between rainforest and dry sclerophyll forest.

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b) Fire regime has a major influence on forests in Tasmania. Explain how the frequency and severity of fires determines the distribution of the three forest types shown.

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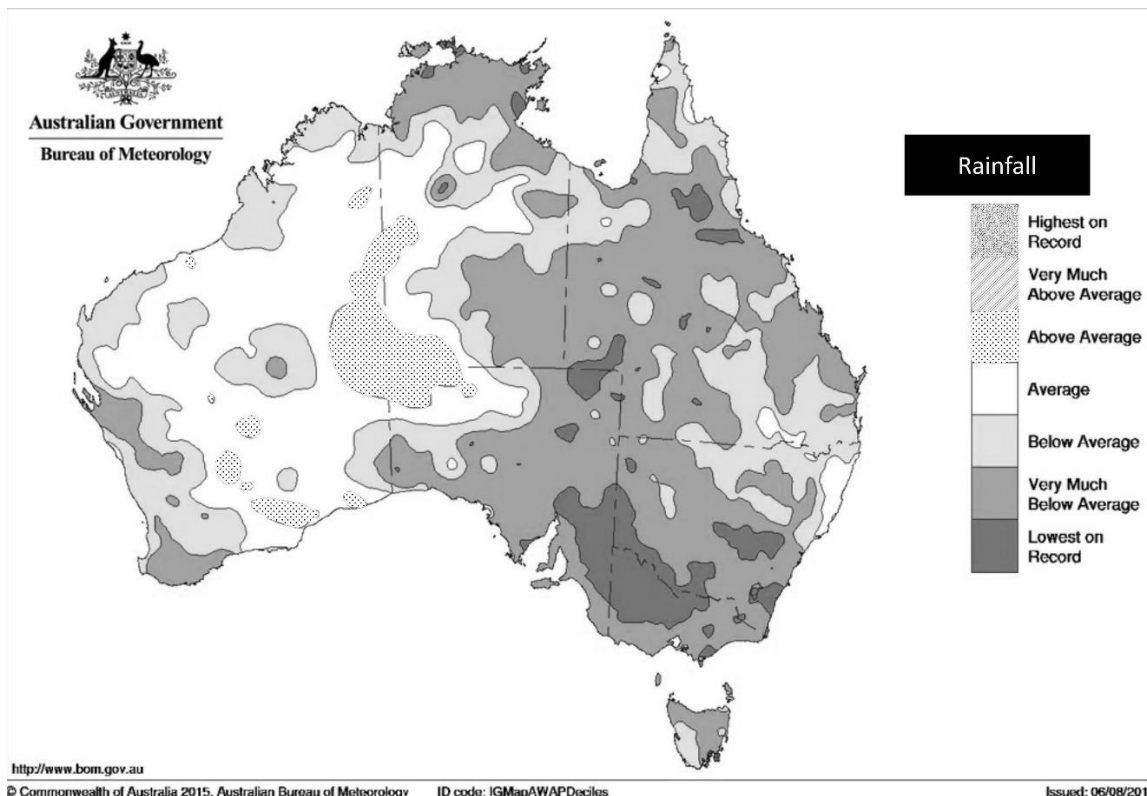
Total Q14

5

Section C continues

Question 15

This map shows the rainfall patterns for March 1982 - February 1983. Darker shades represent decreased rainfall compared to the long-term average.



a) Identify whether this is an El Niño or La Niña year, providing an explanation for your choice.

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b) This weather pattern was associated with higher-than-average temperatures on the east coast of Australia. Describe **two (2)** effects of these increased temperatures on the Great Barrier Reef.

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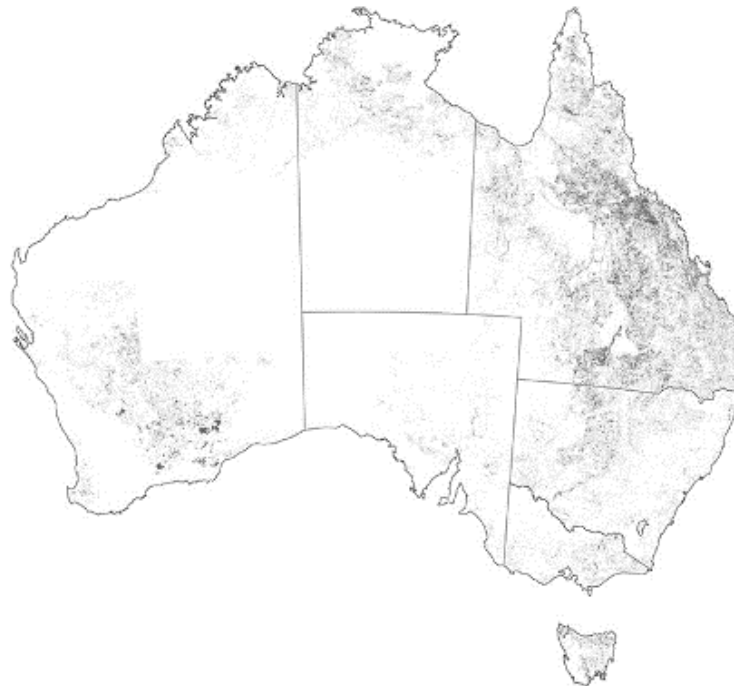
Total Q15

Section C continues

4

Question 16

Habitat loss is the single biggest threat to biodiversity in Australia. Dark areas in the following map shows the loss of habitat for threatened species since the year 2000.



a) Describe what is meant by the term 'threatened species'.

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b) Explain **two (2)** ways in which habitat loss can negatively affect a species.

/ 2

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c) Describe how climate change can increase habitat loss.

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Question 16 continues

Question 16 continued

Marker use

d) State an introduced species in Australia and describe its impact in detail.

Species:.....

Impact:.....

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e) Describe **two (2)** control methods to eliminate or reduce populations of an invasive species.

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Total Q16

10

Section C continues

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End of Section C

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Section **D**

Pages	12
Questions	5
Information Sheet	1

Suggested working time: 36 minutes

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 - Criterion 7 apply concepts relating to human dependence and impact on ecosystems.

Marker Use	
C7	/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36
Section B	6	6	36 minutes	36
Section C	5	5	36 minutes	36
Section D	5	5	36 minutes	36
Section E	5	5	36 minutes	36
Totals	26	26	180 minutes (3 hours)	180

Question 17

Marker use

- a)
i. Explain the difference between renewable and non-renewable resources.

1

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- ii. Provide an example of each.

1

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Ecosystem services can be divided into four categories: provisioning, regulating, supporting and cultural services.

- b) In the table below, define each of these categories (½ mark each) and provide **one (1) specific example** of a service from each category that could be provided by a **forest** (1 mark each).

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Category	Definition	Specific Forest Example
Provisioning		
Regulating		
Supporting		
Cultural		

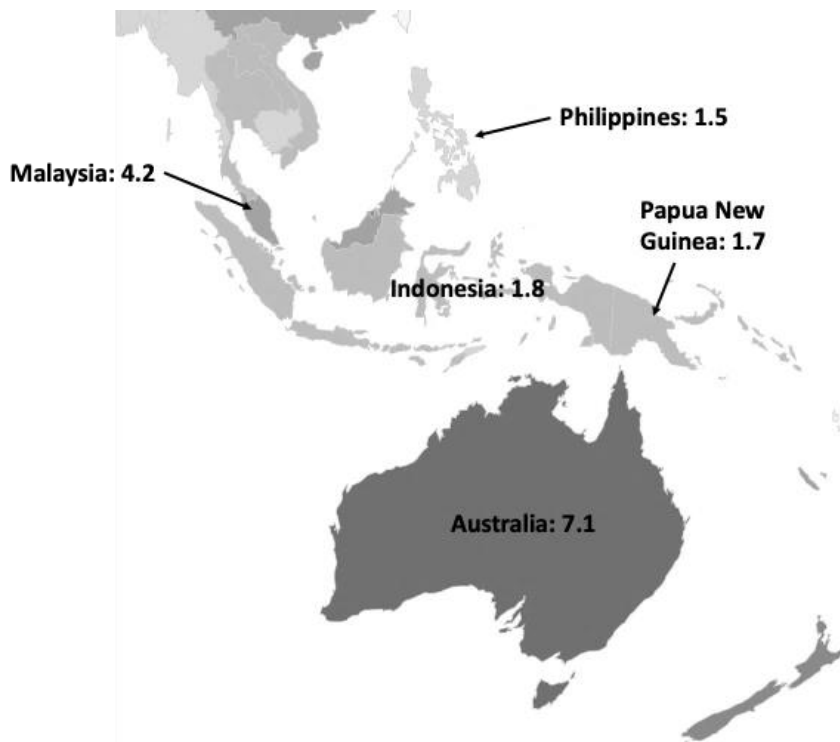
Total Q17

Section D continues

8

Question 18

The map shown below gives the ecological footprint of Australia and some neighbouring countries in global hectares per person (gha/person).



a) Explain why Australia's per person global footprint is more than four times that of the Philippines.

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b) In the period 2000-2016, Malaysia's ecological footprint increased from 3.2 to 4.2 gha/person while Australia's decreased from 7.9 to 7.1 gha/person. Suggest reasons for these changes.

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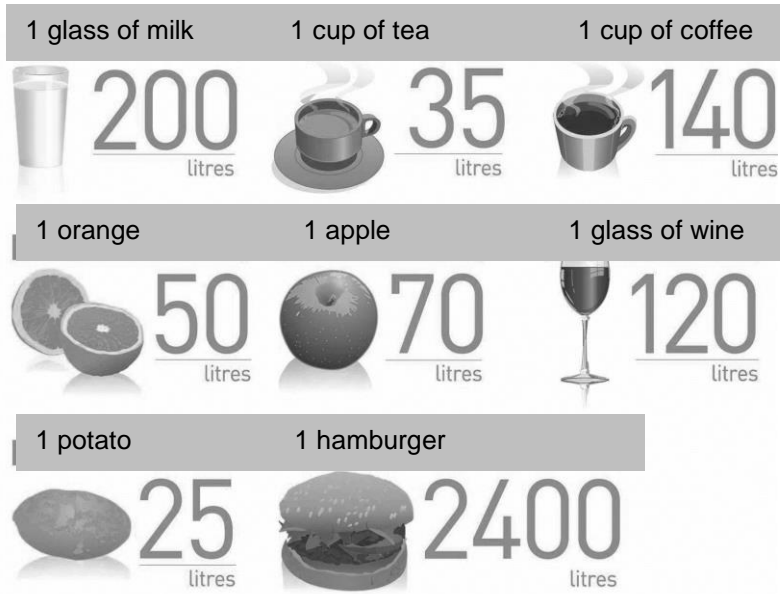
Question 18 continues

Question 18 continued

Marker use

Most water that we use is needed not for our household (showers, washing etc.) but for the products we use (food and clothes). This is called 'embedded' or 'virtual' water.

The images below show **average global litres of water** required to produce various foodstuffs.



c) Explain why a glass of milk requires five times as much water to produce as a cup of tea.

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d) Describe **two (2)** ways in which a person could reduce the amount of embedded water that they consume.

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Total Q18

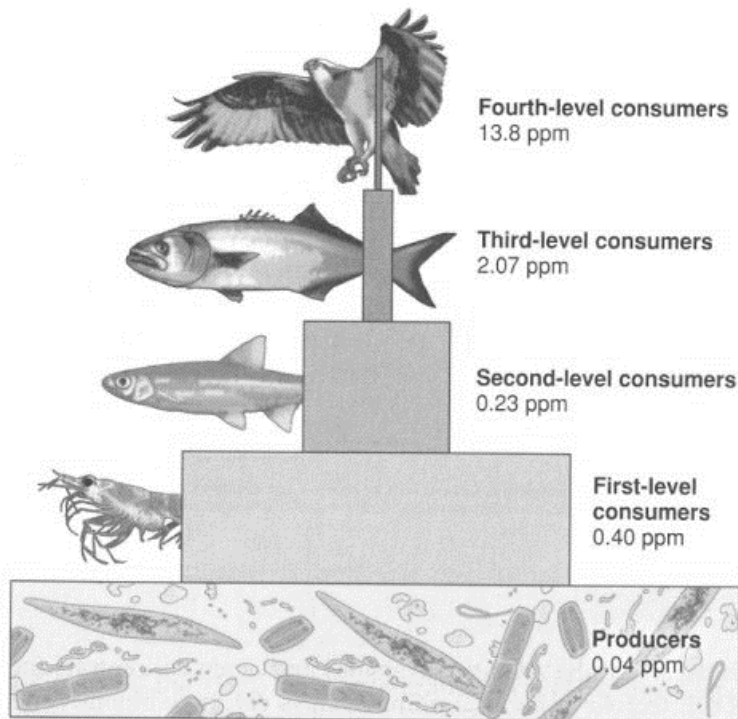
Section D continues

8

Question 19

DDT (or dichlorodiphenyltrichloroethane) is a synthetic chemical compound that has been used widely as an insecticide to control pests in food crops. DDT washes from crops into rivers.

A farmer applied DDT to their wheat crop. The diagram below shows the amounts of DDT found in different organisms in a nearby riverine ecosystem.



a) Circle the correct **four (4)** characteristics of DDT in this system from the choices given below:

- | | | | |
|----|---------------------------|----|-----------------------------|
| 1. | Primary pollutant | OR | Secondary pollutant |
| 2. | Point source of pollution | OR | Diffuse source of pollution |
| 3. | Biodegradable | OR | Non-biodegradable |
| 4. | Persistent | OR | Transient |

2

b) Explain the observation that fish-eating birds were found dead beside the river.

2

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Question 19 continues

Question 19 continued

Marker use

- c) Over time, the farmer found that they had to use increasing amounts of DDT to control the insect pests. Describe the process which is occurring.

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- d) Outline **two (2)** alternatives to using DDT to control insect populations in food crops.

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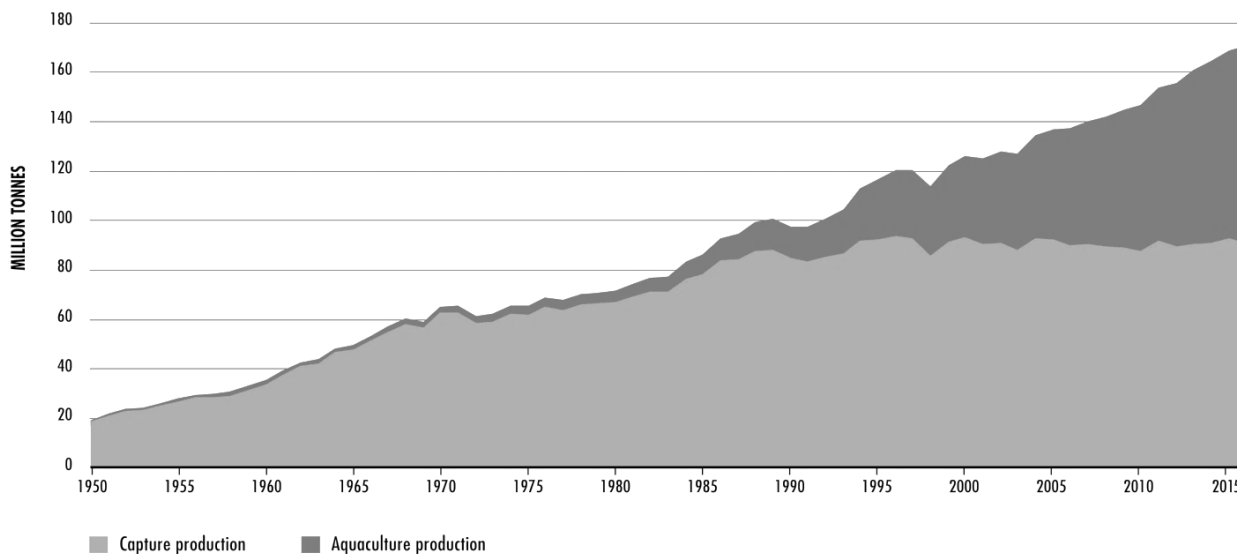
Total Q19

Section D continues

8

Question 20

The graph below shows the global production of fish from wild (capture) fisheries and aquaculture from 1950-2017.



a) Estimate the increase in aquaculture production between 1990 and 2015. Show your working.

2

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b) Explain why capture fisheries have remained approximately constant since 1985.

2

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Question 20 continues

Question 20 continued

Marker use

- c) Aquaculture is predicted to expand to meet increased demand over the next 50 years. Identify **two (2)** environmental problems associated with aquaculture and suggest potential solutions for each.

2

Problem 1:

Potential Solution:

Problem 2:

Potential Solution:

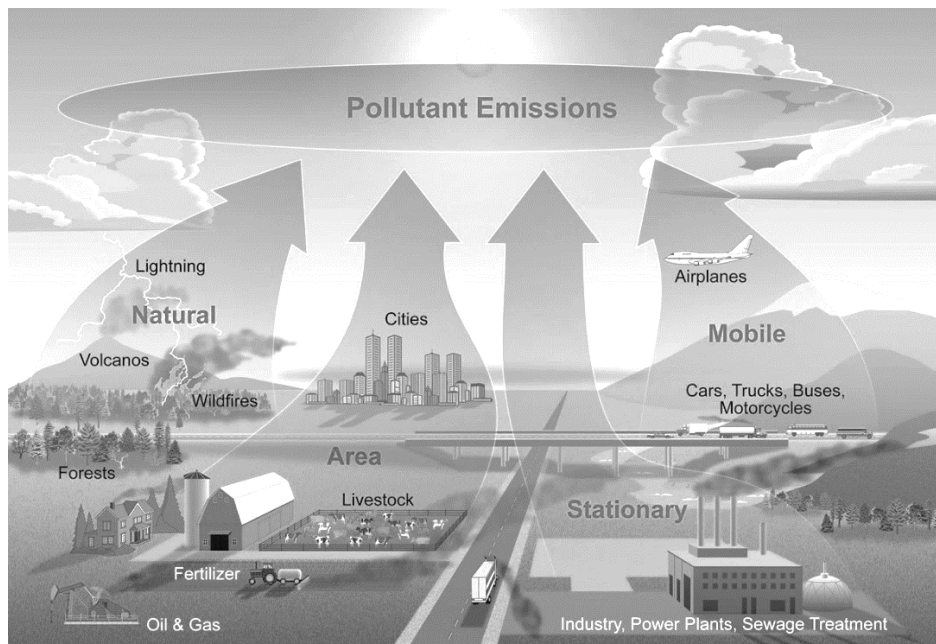
Total Q20

Section D continued

6

Question 21

Atmospheric pollution can be generated through many processes, both natural and anthropogenic as shown in the graphic below.



Using **two (2) specific examples** of atmospheric pollutants, describe the following:

- Where they originate from and how they are generated.
- Effect on humans and other organisms.
- Potential mitigation measures.

Pollutant 1:

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Pollutant 2:

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3

3

Total Q21

6

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End of Section D



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Section **E**

Pages	12
Questions	5
Information Sheet	1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each question.
- Write your answers in the spaces provided in this exam paper.
- The exam is **three (3)** hours in length. It is suggested that you spend **approximately 36 minutes** in total answering the questions in this section.
- The **Environmental Science Information Sheet** can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address:
 - Criterion 8 apply principles and processes related to ecologically sustainable management of the environment.

Marker Use	
C8	/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	5	5	36 minutes	36
Section B	6	6	36 minutes	36
Section C	5	5	36 minutes	36
Section D	5	5	36 minutes	36
Section E	5	5	36 minutes	36
Totals	26	26	180 minutes (3 hours)	180

Question 22

Marker use

Traffic congestion is a major problem in many cities around the world.



a) Identify the common resource and explain why traffic congestion is a 'Tragedy of the Commons'.

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b) Suggest **one (1)** solution to traffic congestion.

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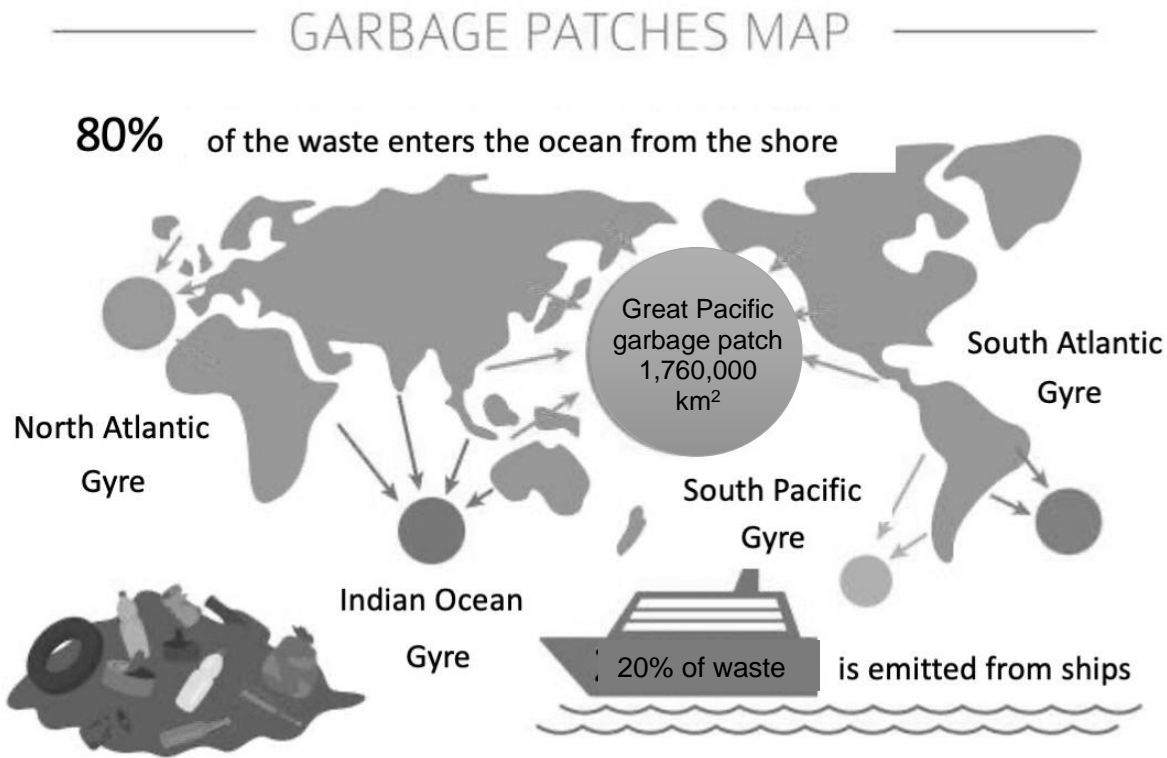
Total Q22

Section E continues

4

Question 23

Plastic pollution is a significant issue in the world’s oceans. Plastic from land and from ships, mostly fishing vessels, ends up in large areas known as gyres – shown in the infographic below. One of these is the Great Pacific Garbage Patch (GPGP).



a) Describe how plastic on land might end up in the oceans.

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b) In economics, an externality is a cost (negative) or benefit (positive) that is experienced by people who are not involved in the particular economic activity. Explain why the Great Pacific Garbage Patch is a negative externality.

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Question 23 continues

Question 23 continued

Marker use

- c) Explain how full-cost pricing (polluter pays) could be one solution to plastic pollution from **both** land-based activities and fishing.

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- d) Describe, in detail, another strategy that could be used to deal with the issue of plastic pollution in oceans.

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Total Q23

Section E continues

9

Question 24

Hydraulic fracturing, known as ‘fracking’, is a method of extracting oil and gas using a high-pressure mixture of water, sand and synthetic chemicals to break apart the rock in which they are found.

Fracking has been proposed in many places around Australia, including Tasmania. It has been resisted by community groups such as the Lock The Gate Alliance. They’ve cited concerns including water use, environmental contamination and climate change.

- a) Evaluate whether fracking has a Social License to Operate.

2

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- b) For each of the sustainable development principles listed in the table below, discuss whether fracking satisfies or breaches the principle. Provide evidence to support your discussion.

6

Principle	Discussion
Intergenerational Equity	
Intragenerational Equity	
Ecological Integrity	

Total Q24

Section E continues

8

Question 25

In 2020, the Tasmanian State Government produced a report on bypass options for roads in central Hobart, identifying five potential options. Before proceeding with any of the options an Environmental Impact Assessment (EIA) would need to be conducted.

a) Explain the purpose of an EIA.

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b) Describe **two (2)** issues that would need to be considered in each of the categories given below:

6

i. Social:

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ii. Economic:

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iii. Biophysical environment:

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c) For **one (1)** of the issues that you have identified, explain how it could be monitored to ensure that the project meets its Environmentally Sustainable Development (ESD) obligations.

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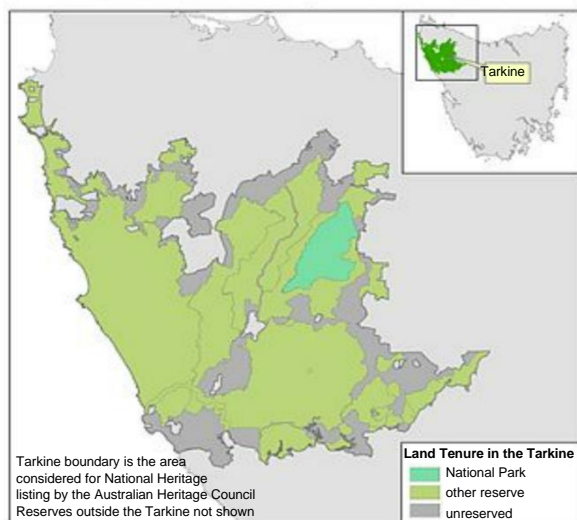
Total Q25

9

Section E continues

Question 26

Some conservation organisations are advocating the creation of a new takayna/Tarkine National Park on the west coast of Tasmania.



Source: https://en.wikipedia.org/wiki/Tarkine#/media/File:Tarkine_land_tenure_Tasmania.jpg

- a) State which level of government, Local, State or Federal, would be legally responsible for the creation of the National Park.

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- b) In developing a Management Plan for the area, explain why a baseline study would need to be conducted.

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- c) Explain how this National Park could help Australia fulfil its objectives for a Comprehensive, Adequate and Representative (CAR) reserve system.

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Total Q26

6

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End of Section E

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