Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

154005209 4

ENVIRONMENTAL MANAGEMENT **0680/21**

Paper 2 Management in Context **May/June 2023**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

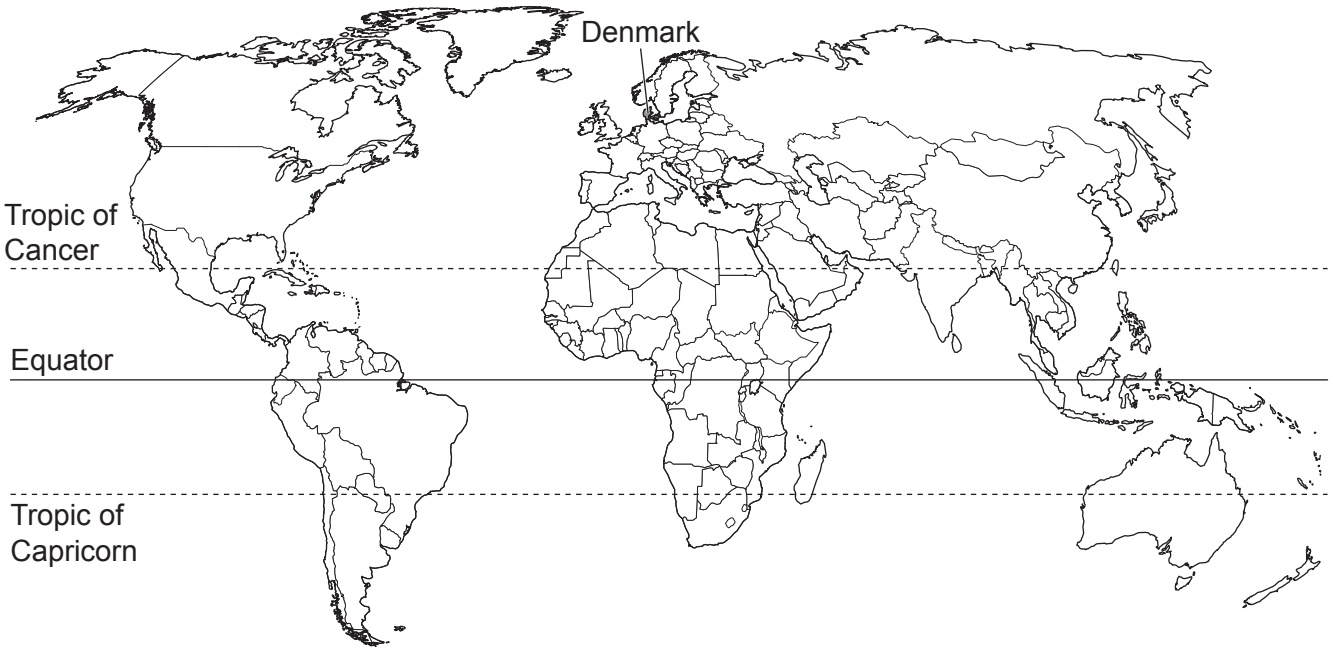
- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

world map showing the location of Denmark



map of Denmark

Key

★ capital city

• urban areas

Area of Denmark: 43 094 km^2

Population: 5.8 million (in 2021)

Children per woman: 1.77

Life expectancy: 81.4 years

Currency: euro

Language: Danish

Climate of Denmark: temperate with windy winters and cool summers

Terrain of Denmark: low-lying and flat with 7300 km of coastline

Main economic activities of Denmark: pharmaceuticals, maritime shipping, renewable energy and agricultural production

Denmark is a more economically developed country (MEDC). All sectors of the economy are growing. 88% of the population live in urban areas.

[Turn over

1 **(a)** **(i)** Calculate the number of people living in **rural** areas in 2021.

..... [2]

(ii) Suggest **two** reasons why only a small number of people live in **rural** areas.

1 .....

.....

2 .....

.....
[2]

(b) The photograph shows a wheat field near the capital city, Copenhagen.

The table shows climate data for the location.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average temperature /°C	0	1	3	6	12	15	17	17	14	10	5	2
average rainfall /mm	88	86	85	79	70	70	74	78	83	86	88	89
average number of wet days	17	13	12	13	11	13	14	14	15	16	16	17

(i) State the type of farming shown in the photograph.

..... [1]

(ii) The wheat in the photograph is planted in April. It is harvested in August.

Wheat needs a minimum average temperature of 12 °C to grow.

State the number of months wheat grows in this field.

..... [1]

(iii) Give **two** reasons why most farmers near Copenhagen do **not** use irrigation methods to grow crops.

Use information from the table in your answer.

.....

.....

.....

..... [2]

(iv) Describe the **environmental** impacts of mismanagement of irrigation.

.....

.....

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.....

..... [3]

(c) Farmers use fertilisers containing nitrate ions to improve wheat yields.

(i) State the names of the **two** other main ions present in fertilisers.

1 .....

2 .....

[2]

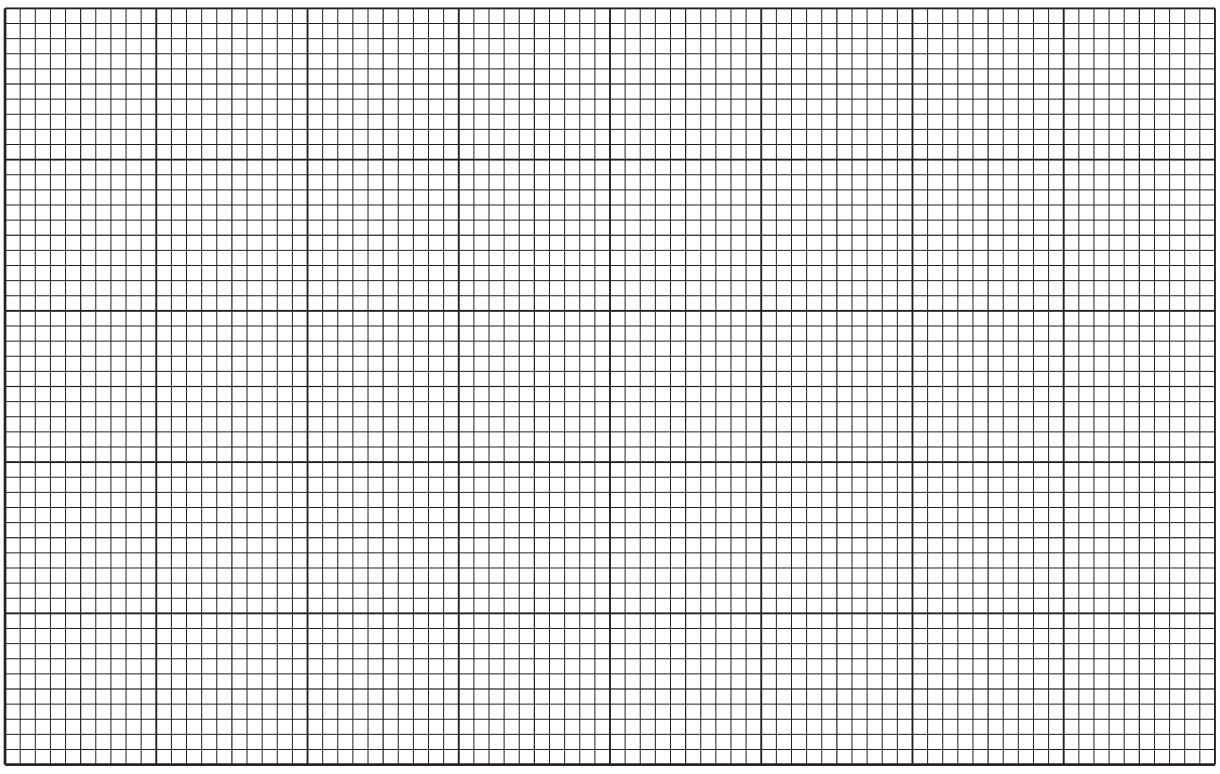
(ii) Nitrous oxide is released when bacteria break down nitrogen compounds in the soil.

Nitrous oxide is a greenhouse gas.

The table shows the nitrous oxide emissions from farming in Denmark over a 20-year period.

year	nitrous oxide emissions / 1000 tonnes
1	25
5	23
9	20
13	18
17	16
21	16

Plot a bar chart of the data in the table.



[4]

(iii) Describe the trend shown by the data.

.....

.....

.....

..... [2]

(iv) Suggest **two** reasons why nitrous oxide emissions from farming in Denmark will **not** reach zero tonnes in the future.

1 .....

.....

2 .....

.....

[2]

(d) Greenhouse gas emissions contribute to climate change.

Suggest reasons why the population of Denmark may be impacted by climate change.

.....

.....

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..... [4]

[Total: 25]

2 The photograph shows a field in Denmark planted with apple trees.

(a) (i) This field has a soil containing three particle sizes.

Circle the smallest particle size.

sand **clay** **silt**

[1]

(ii) A fertile soil contains a balance of mineral ions.

State **three** other components of a fertile soil.

1 .....

2 .....

3 .....

[3]

(iii) Apples are grown as a cash crop.

State what is meant by cash crop.

.....

..... [1]

(b) A student wants to investigate the yield of apples from the field.

The student considers two plans to find the total number of apples in the field.

Plan A

step 1 Count the total number of trees in the field.
step 2 Count the total number of apples on one tree.
step 3 Multiply the total number of apples on one tree by the total number of trees in the field.

Plan B

step 1 Count the total number of trees in the field.
step 2 Count the total number of apples on one tree.
step 3 Repeat step 2 for another nine trees selected at random.
step 4 Multiply the average number of apples on one tree by the total number of trees in the field.

(i) Suggest why the student decides to use **Plan B**.

.....

..... [1]

(ii) Suggest a method the student can use to select the nine trees at random.

.....

.....

.....

..... [2]

(iii) Draw a table the student can use to record all the data from **Plan B**.

[3]

(iv) Scientists are breeding new varieties of apple trees to increase future yields.

Describe **one** method the scientists can use to produce new varieties of apple trees.

.....

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.....

..... [3]

[Total: 14]

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3 The photograph shows part of a forest in Denmark being harvested.

The forests in Denmark are managed to promote biodiversity.

(a) (i) The management aims to maintain the forest ecosystem.

State what is meant by the term ecosystem.

.....

..... [1]

(ii) Describe how timber extraction can be done to maintain biodiversity.

.....

.....

.....

..... [2]

(iii) The wood on the trailer is 3.0 m long, 2.5 m wide and 2.5 m in height.

1.0 m^3 of wood has a mass of 1.25 tonnes.

Calculate the total mass of wood on the trailer.

..... tonnes [2]

(iv) The wood is processed into wood chips. The wood chips are burned instead of coal in power stations to generate electricity.

Explain **two** differences between wood chips and coal as an energy resource.

.....

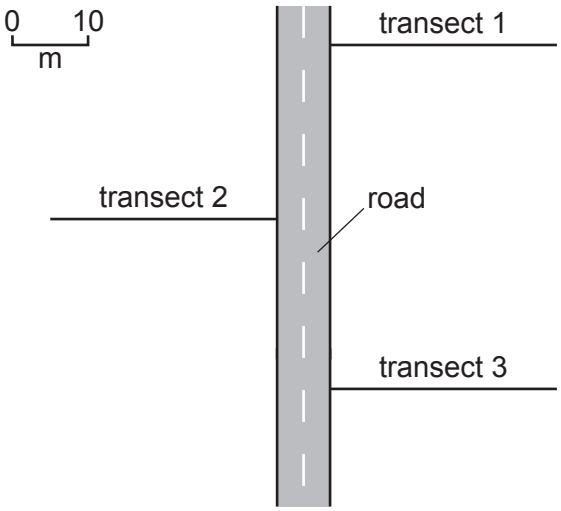
.....

.....

..... [2]

(b) A student uses transect lines to survey the plant species, other than trees, in the forest shown in the photograph.

The transect lines are placed as shown.



(i) Describe how the student can use a quadrat to record the number of different plant species.

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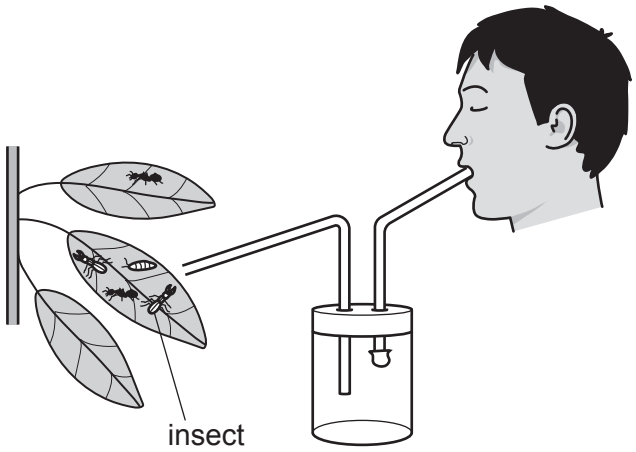
..... [5]

(ii) The student decides to investigate the number of different types of insect living on plants along the transects.

The student uses the equipment shown in the diagram.



State the name of the equipment used by the student.

..... [1]

(iii) The student wants to compare the number of different types of insect on the leaves of plants at the beginning and end of each transect.

Suggest how the student can ensure that the comparison is fair.

.....

.....

.....

..... [2]

(iv) The results of the investigation are shown in the table.

	beginning of transect	**end of transect**
average number of different types of insect	9	14
average total number of insects	26	49

Suggest a suitable conclusion for these results.

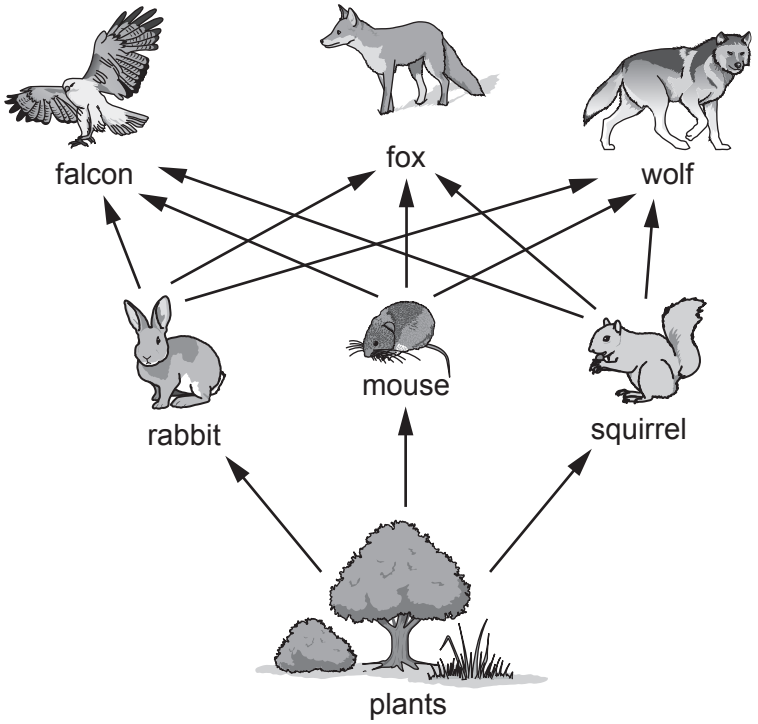
.....

.....

.....

..... [2]

(c) The diagram shows a food web in a forest.



(i) Explain why plants are called producers.

.....

.....

.....

..... [2]

(ii) Explain the flow of energy through this food web.

.....

.....

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.....

..... [3]

(d) Explain how seed banks and zoos can help to maintain biodiversity.

seed banks .....

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.....

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zoos .....

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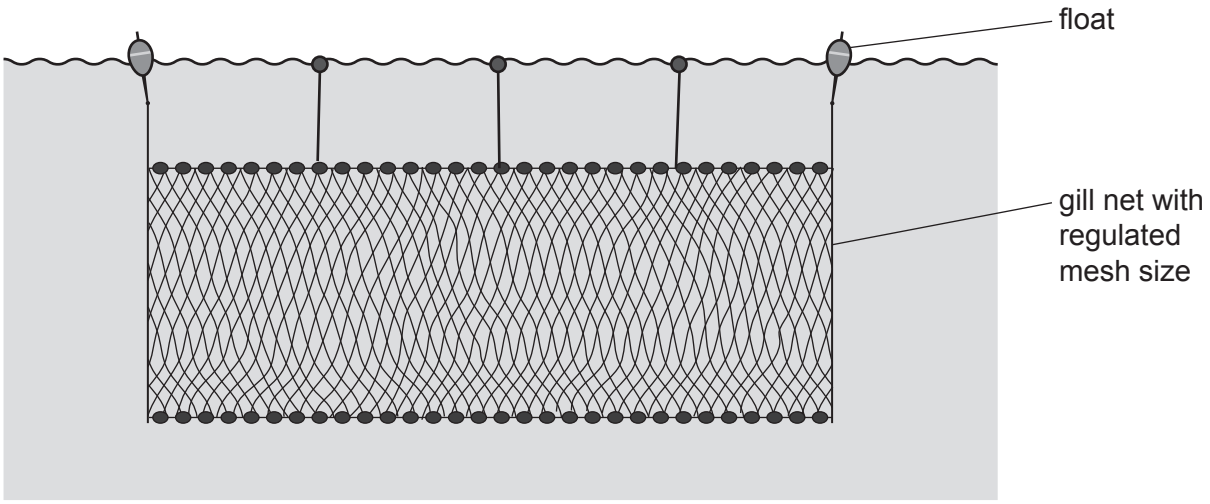
.....

[6]

[Total: 28]

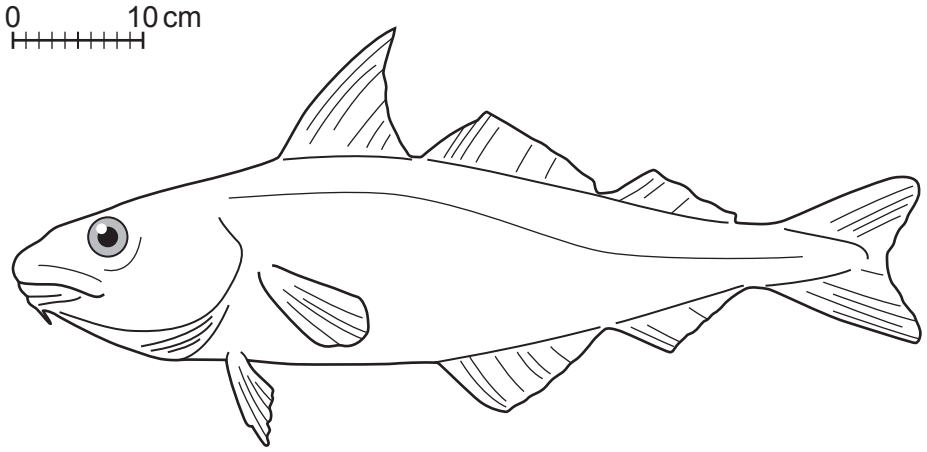
4 Many small fishing boats in Denmark use a gill net to catch fish. The mesh size of the gill net is regulated.

The diagram shows a gill net.



(a) Haddock are caught for human consumption using gill nets.

The diagram shows an adult haddock.



(i) Estimate the length of the haddock.

..... cm [1]

(ii) Explain what may happen to the haddock population if the mesh size of the gill net is **not** regulated.

.....

.....

.....

.....

.....

..... [3]

(iii) State **three** strategies, other than regulating mesh size, that can be used to control fishing in Denmark.

1 .....

2 .....

3 .....

[3]

(b) Some fish are processed into fish meal.

Fish meal has a high protein content. It is used to feed animals on farms to help them grow quickly.

Give **two** reasons why some people think this is **not** a sustainable activity.

1 .....

.....

2 .....

.....

[2]

(c) There are several fish farms around the coast of Denmark.

Describe the benefits and limitations of fish farms.

benefits .....

.....

.....

.....

.....

limitations .....

.....

.....

.....

.....

[4]

[Total: 13]

Cambridge Assessment International Education

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ENVIRONMENTAL MANAGEMENT **0680/21**

Paper 2 Management in Context **May/June 2023**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

[Turn over

PUBLISHED

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	5.8 × 0.12; 696 000;	**2**
1(a)(ii)	*any two from in rural areas:* M1 not many jobs / risk of being unemployed; M2 only agriculture as available work / mechanisation of agricultural; M3 migration; M4 lack of services or infrastructure / fewer stated services e.g. medical care / education / communications;	**2**
1(b)(i)	commercial / arable / crops;	**1**
1(b)(ii)	4;	**1**
1(b)(iii)	*any two from:* M1 many wet days; M2 similar rainfall every month; M3 no dry season / rains all year; M4 suitable data quoted e.g. 70 mm every month, every month has between 7−89 mm, minimum of 11 wet days each month	**2**
1(b)(iv)	*any three from:* M1 waterlogging / flooding; M2 low oxygen or air in soil; M3 reduced crop yield; M4 salinisation; M5 loss of, fertility / fertiliser; M6 leaching (of nutrients); M7 leading to eutrophication; AVP; e.g. soil erosion / increased surface run-off	**3**
1(c)(i)	potassium phosphate;	**2**

Question	Answer	Marks
1(c)(ii)	M1 both axes labelled: (nitrous oxide) emissions / 1000 tonnes AND year; M2 sensible linear scale with plotting that covers half the grid space; M3 correct plotting ± half small square tolerance; M4 bars of equal width;	**4**
1(c)(iii)	*any two from* (steady) decreases; constant (between year 17−21); relevant quoted data e.g. 25 to 18 (1000 tonnes) / stable at 16 (1000 tonnes);	**2**
1(c)(iv)	*any two from:* M1 farming always needed; M2 some fertilisers (always) needed; M3 NOx released from farm machinery; M4 M5 AVP; e.g. there will always be N compounds to break down / not possible to stop bacterial activity in the soil;	**2**

Question	Answer	Marks
1(d)	*any four from:* M1 sea level rise; M2 flooding; M3 drought M4 loss of farmland; M5 loss of habitat / loss of biodiversity; M6 reduction in crop yield / new crops could be grown; M7 displacement of people / forced migration / loose their homes; M8 increased land prices; M9 transport routes cut / damage to infrastructure; M10 salinisation of water supplies; M11 extreme weather / changed weather patterns; M12 impact on energy costs; M13 M14 AVP;	**4**

Question	Answer	Marks
2(a)(i)	clay;	**1**
2(a)(ii)	*any three from:* M1 air; M2 water; M3 microorganisms / bacteria / fungi; M4 organic matter;	**3**
2(a)(iii)	crop grown, to be sold / for a profit;	**1**
2(b)(i)	more representative / larger sample / anomalies can be identified;	**1**
2(b)(ii)	*identifying trees:* give a number or letter to each tree; *random selection method*: number generator / numbers out of a bag / phone book / number table;	**2**

Question	Answer	Marks
2(b)(iii)	M1 table drawn ; M2 headings: tree (number) **AND** number of apples (on tree); M3 9 to 10 cells for data ;	**3**
2(b)(iv)	*max three from either method:* M1 genetic, engineering / manipulation; M2 identify the gene for high yield (from a high-yielding tree); M3 extract the gene (from the high-yielding tree); M4 insert the gene (into a stock tree); **OR** M1 selective breeding; M2 select two suitable parent trees (e.g. high-yielding); M3 cross-breed the parents; M4 select the most promising offspring;	**3**

Question	Answer	Marks
3(a)(i)	all the living or biotic **AND** non-living or abiotic components (in an area);	**1**
3(a)(ii)	*any two from:* M1 selective logging / sustainable harvesting; M2 species, not made extinct / can recover; M3 replant native species; M4 protected **zones** in the forest;	**2**
3(a)(iii)	M1 calculation of volume = 18.75 (m^3); M2 ($\times$ 1.25 =) 23 (tonnes);	**2**

Question	Answer	Marks
3(a)(iv)	*any two **comparative** differences from:* M1 *coal*: carbon dioxide emitted **AND** *wood*: carbon neutral or less carbon dioxide emitted; M2 *coal*: more energy dense (than wood); M3 *coal*: releases sulfur dioxide or NOx / leads to acid rain **AND** wood: does not;	**2**
3(b)(i)	max [5] **Note**: to gain 5 marks at least 1 mark must come from each section *max two from quadrats:* M1 quadrat of stated dimensions, e.g. 1 m^2; M2 quadrat placed at, regular intervals / stated intervals; M3 sample all (three) transects; *counting:* M4 count the number of species (in the quadrat); M5 description of how to deal with plants partially in an quadrat; *recording:* M6 record number in a table; *repeating:* M7 repeat same investigation; M8 repeating on different days;	**5**
3(b)(ii)	pooter;	**1**
3(b)(iii)	*any two from:* M1 same plant species / same type of plant; M2 same number of leaves; M3 same size of leaves; M4 same time of day; M5 same person; M6 same plant height; M7 examine each leaf for same period of time; M8 count / identify, the number of types of insect;	**2**

Question	Answer	Marks
3(b)(iv)	*any two from end of transect or away from the road has:* more types; larger numbers; more biodiversity;	**2**
3(c)(i)	*any two from:* M1 photosynthesis; M2 chlorophyll absorbs light energy; M3 *reactants*: carbon dioxide and water; M4 *products*: glucose and oxygen; M5 light energy to chemical energy;	**2**
3(c)(ii)	*any two from:* M1 energy transfers when organisms eaten / stated example of feeding from food web e.g. plant eaten by rabbit; M2 lost as heat; M3 idea of only 10% of energy passed between levels / 90% is lost; *lost through:* M4 respiration; M5 digestion; M6 (excreted) waste (products); M7 movement; M8 death / decomposition; M9 maintaining body temperature / thermoregulation; M10 feeding / consumers do not consume the whole organism; M11 reproduction;	**3**

Question	Answer	Marks
3(d)	(both) prevents extinction / protects endangered species; seeds / animals can be reintroduced into wild; *max five seed banks:* maintains genetic record / source of genes; development of new plants, e.g. drought-resistant wheat; development of medicines; AVP; *max five zoos:* allows (captive) breeding; reduces impact of, predation / hunting / poaching; prevents inbreeding / international cooperation; education / awareness; AVP;	**6**

Question	Answer	Marks
4(a)(i)	70 (cm) ;	**1**
4(a)(ii)	population likely to decline / overfishing; small mesh size catches young fish; not able to breed;	**3**
4(a)(iii)	*any three from:* M1 area or total size of net; M2 quotas; M3 closed seasons; M4 protected areas; M5 licenses; M6 international economic exclusion zone (EEZ); M7 M8 AVP; e.g. size of boats / number of boats / CCTV on boats / patrols / monitoring / tracking of boats / number of fishing days;;	**3**

Question	Answer	Marks
4(b)	*any two from:* overfishing / will run out of fish / population of fish decreases; many species are caught that are not eaten / a lot of bycatch; lead to overproduction of farm animals; removing many species of fish impacts food chains;	**2**
4(c)	*any four (max three from one section):* *benefits* increased food supply; less work / less use of energy (than going to sea); safer (than going to sea); no bycatch; preserves wild stocks; allows harvesting all years / no seasons; not weather-dependent; *limitations* pollution from, organic matter / fish meal / oil / pesticides / waste / antibiotics; spreads disease; risk of escape; impact on food chain;	**4**

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CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

9175949733

ENVIRONMENTAL MANAGEMENT **0680/22**

Paper 2 Management in Context **May/June 2023**

1 hour 45 minutes

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This document has **20** pages. Any blank pages are indicated.

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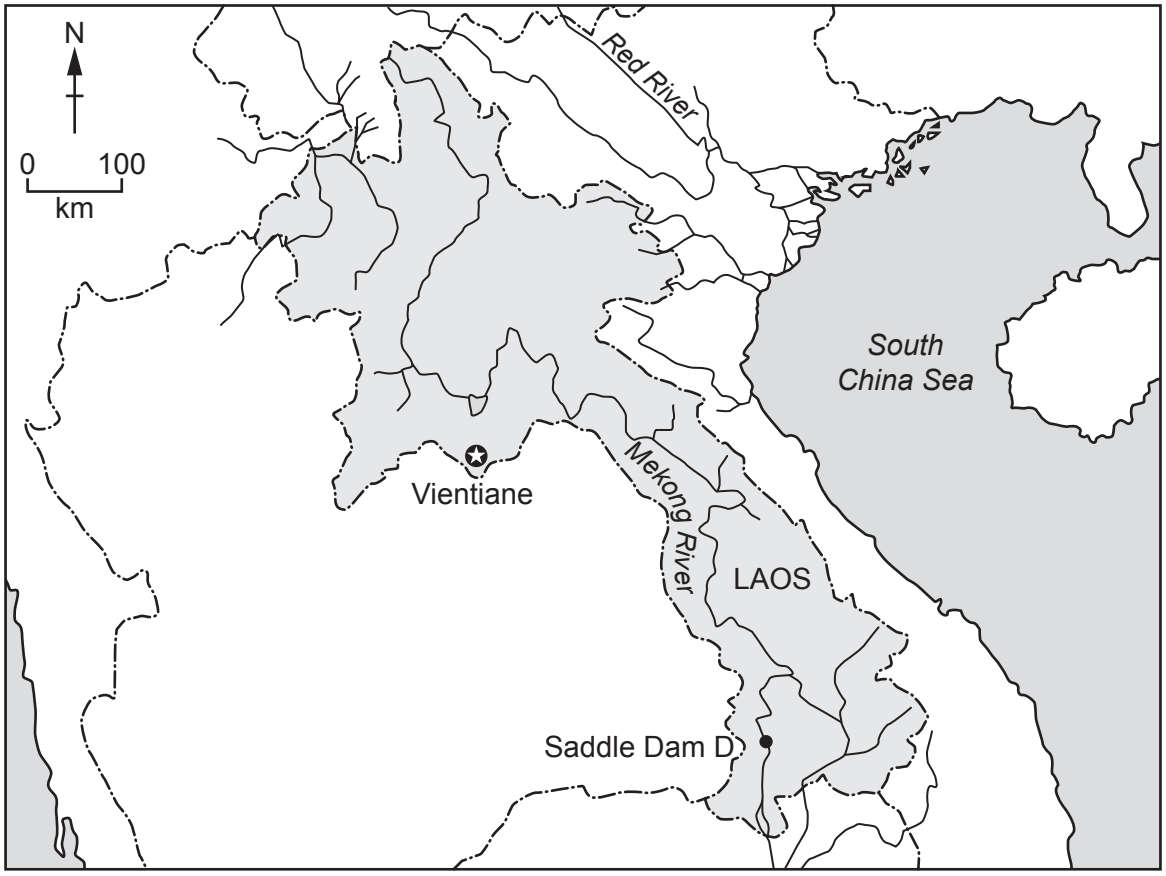
[Turn over

world map showing the location of Laos

map of Laos

Key

- capital city
- international boundaries
- river



Area of Laos: 237 955 km^2

Population: 7 400 700 (in 2021)

Children per woman: 2.7

Life expectancy: 68.9 years

Currency: kip (9354 LAK = 1 USD)

Language: Lao, French, local languages

Climate of Laos: hot tropical with rainy season May to October

Terrain of Laos: mountains and steep-sided valleys

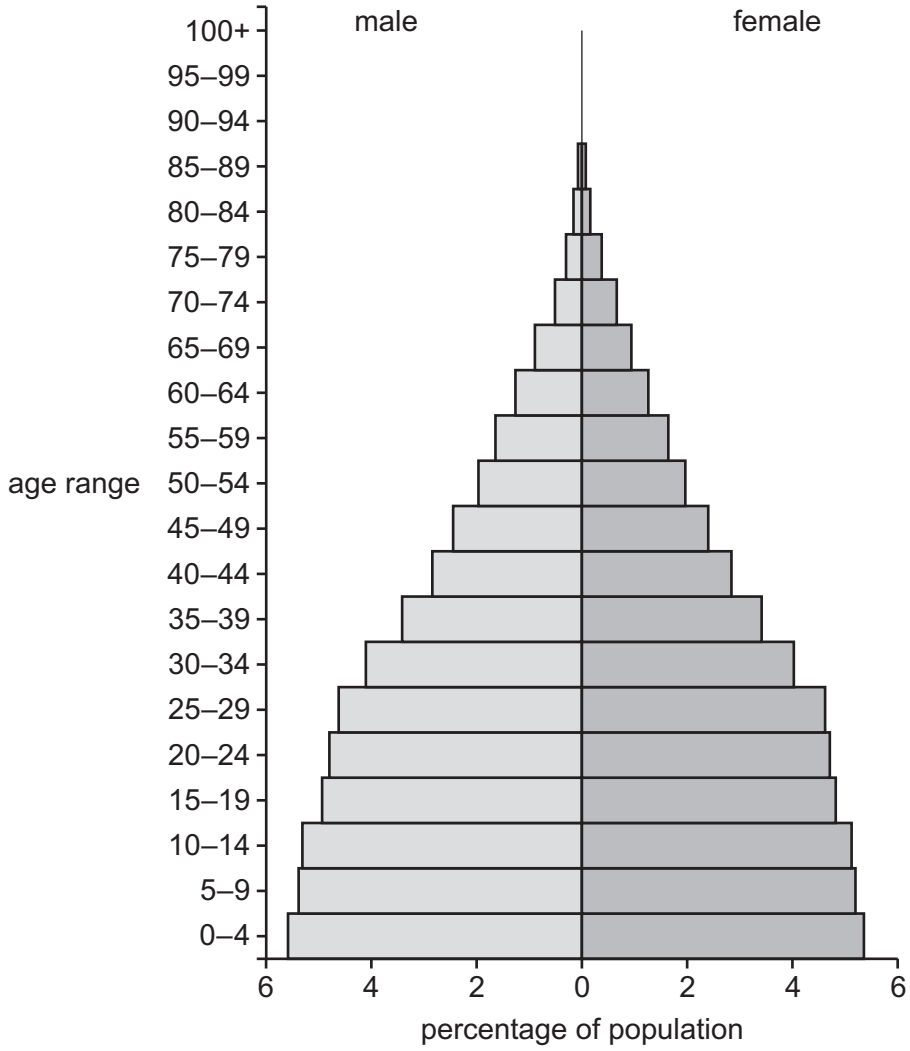
Main economic activities of Laos: agricultural production, tourism, mining, silk and cotton production

Natural resources: timber, hydroelectric power, tin, gold and gemstones

Laos is a less economically developed country (LEDC). Most parts of the economy are growing. Unemployment is low.

[Turn over

1 **(a)** The diagram shows the population pyramid for Laos in 2021.



(i) Describe the **shape** of this population pyramid.

.....

.....

.....

..... [2]

(ii) In 1979, the population of Laos was 3 258 200.

In 2021, the population of Laos was 7 400 700.

Calculate the average annual increase in population.

..... per year [2]

(iii) Suggest reasons why Laos has a rapidly increasing population.

.....

.....

.....

.....

.....

..... [3]

(b) Population growth in Laos has increased the demand for electricity.

The government of Laos has invested in hydroelectric power and will soon be generating electricity from 90 sites.

Laos has one coal-fired power station.

(i) Suggest the **environmental** advantages of using hydroelectric power rather than coal to generate electricity.

.....

.....

.....

.....

.....

..... [3]

(ii) Suggest reasons why Laos is suitable for using hydroelectric power to generate electricity.

.....

.....

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..... [3]

(iii) Hydroelectric dams increase the supply of electricity.

Suggest other **economic** benefits of dams for local people.

.....

.....

.....

.....

.....

..... [3]

(c) Saddle Dam D was built between 2013 and 2018. It was one of the largest hydroelectric dams in Laos.

Heavy rains in 2018 caused the dam to burst.

This was reported in a newspaper.

> **Laos dam collapse – many missing after villages flooded**
>
> Saddle Dam D has burst due to heavy rain.
>
> A large volume of water (5 000 000 000 m^3) was released into the local countryside. Roads and bridges were washed away.
>
> At least 40 people are dead and more than 100 people are missing. Over 6500 people are now homeless.
>
> Some local people say they did not receive a warning before the dam burst. They think the construction company used low quality building materials.

(i) Suggest **three** reasons why many people were affected when the dam burst.

1 .....

.....

2 .....

.....

3 .....

.....

[3]

(ii) Suggest reasons why the number of deaths caused by this disaster increased in the long term.

.....

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..... [4]

(iii) The dam was rebuilt and now generates 410 megawatts (MW). 90% of this electricity is exported to other countries.

Calculate the quantity of electricity in MW that is exported.

..... MW [1]

(d) Large quantities of minerals are used to construct dams.

(i) State **four** factors that affect the cost of extraction of minerals.

1 .....

2 .....

3 .....

4 .....

[4]

(ii) Describe the process of restoring an open-pit surface mine to a forest after mineral extraction has finished.

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..... [4]

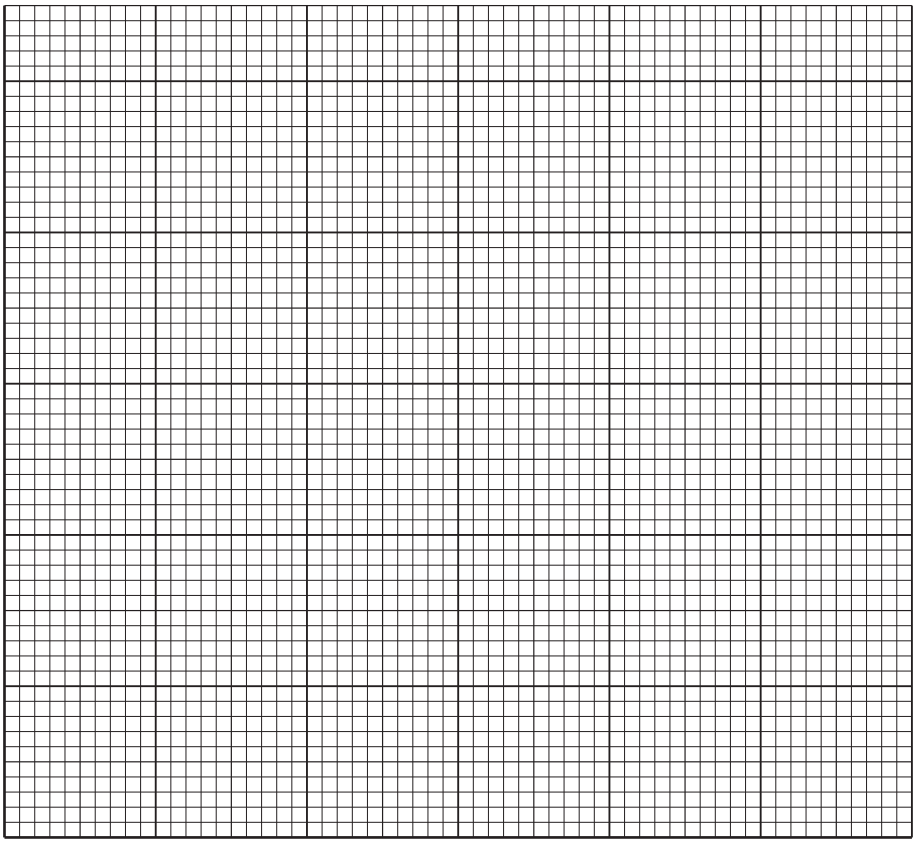
[Total: 32]

2 Fish are an important part of the diet of people in Laos.

(a) The table shows the annual fish consumption per person for some countries.

country	annual fish consumption per person / kg
Brazil	9
Iceland	91
India	7
Laos	25
South Africa	6
USA	22

(i) Plot a bar chart of the data in the table.



[4]

(ii) Suggest reasons why the annual fish consumption per person varies in different countries.

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..... [3]

(b) The government of Laos wants to encourage the construction of fish farms to help meet future demand for fish.

Scientists investigate the suitability of some species for fish farming in Laos.

The results are shown in the table.

fish species	maximum length / m	maximum mass / kg	annual maximum yield / tonnes per hectare
African catfish	1.5	60	6.8
bighead carp	0.6	40	0.8
common carp	1.2	40	0.9
shark catfish	1.3	25	2.3
snakehead	1.0	8	1.4

(i) Calculate the range in maximum mass shown in the table.

..... kg [1]

(ii) Rank the fish according to their maximum length, starting with the largest.

largest 1 .....

2 .....

3 .....

4 .....

smallest 5 .....

[2]

(iii) The African catfish is **not** normally found in the wild in Laos.

Suggest the limitations of using the African catfish for fish farming in Laos.

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..... [4]

(iv) Explain why fish farming is more sustainable than catching wild fish.

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..... [2]

(c) A fish farmer is thinking about changing the species of fish being farmed.

The fish farmer uses a questionnaire to find out the local demand for a new species of fish.

(i) Describe **one** way the fish farmer can select a representative sample of local people to answer the questionnaire.

.....

.....

.....

..... [2]

(ii) The results of the questionnaire are shown.

	percentage	
question	**yes**	**no**
Do you eat fish at least once a week?	50	50
Do you eat more fish now than 5 years ago?	35	65
Would you eat a new species of fish?	17	83

Explain why the fish farmer decides **not** to change the species of fish being farmed.

.....

.....

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.....

..... [3]

(iii) State **three** abiotic factors that affect the growth of farmed fish.

1 .....

2 .....

3 .....
[3]

(iv) Some fish eat water plants and other fish eat mainly insects.

Explain why the farming of plant-eating fish is more energy efficient than the farming of insect-eating fish.

.....

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..... [2]

[Total: 26]

3 The photograph shows a farmer preparing some fields for rice production.

(a) **(i)** State the name of the strategy used to reduce soil erosion which is shown in the photograph.

..... [1]

(ii) State **four** other strategies that can be used to reduce soil erosion.

1 .....

2 .....

3 .....

4 .....

[4]

(b) State how the activities shown in the photograph affect surface run-off and evaporation.

Give a reason for each answer.

surface run-off .....

.....

evaporation .....

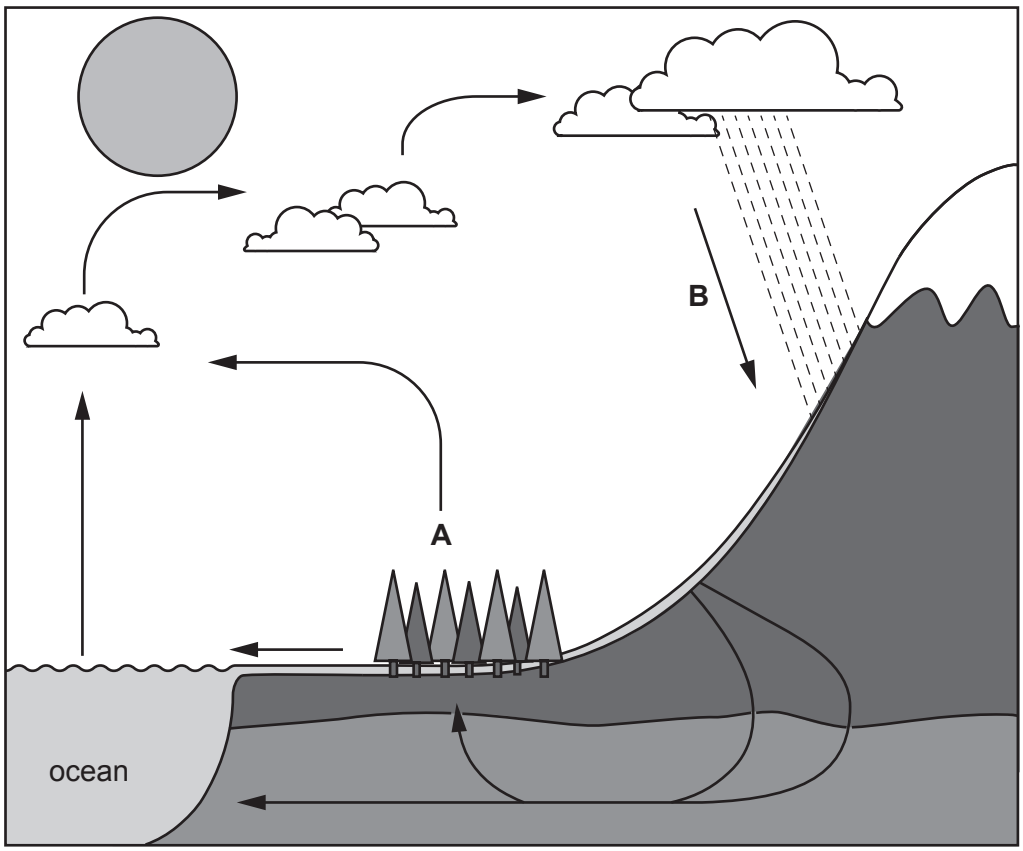
.....

[2]

(c) The diagram shows part of the water cycle.

Key

→ process



State the names of processes **A** and **B**.

A .....

B .....

[2]

(d) A student in Laos investigates the growth of newly planted trees to find the best growing conditions.

The student:
- plants 100 young trees of similar size
- puts the trees into four groups, A–D, each of 25 trees
- gives each group of 25 trees a different treatment
- selects a sample of 5 trees from each group
- measures the heights of the trees in the sample after 3 years.

The results are shown in the table.

sample	increase in height after 3 years / m			
	group A	**group B**	**group C**	**group D**
	no extra treatment	**weeds removed regularly**	**fertiliser added when planting**	**tree guards added to stop grazing by animals**
tree 1	1.4	1.8	1.7	1.2
tree 2	1.0	1.9	1.9	1.3
tree 3	1.7	2.4	1.4	1.5
tree 4	1.3	2.1	1.6	1.1
tree 5	1.4	2.6	2.2	1.4
average	1.4	2.2	.....	1.3

(i) Complete the table to show the average for group C. [1]

(ii) State why the student includes group A in the investigation.

..... [1]

(iii) Write a suitable conclusion for this investigation.

.....

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.....

..... [3]

(iv) Suggest **three** ways the student can confirm the results of the investigation.

1 .....

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2 .....

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3 .....

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[3]

(e) Explain how afforestation helps with the management of atmospheric pollution.

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.....

..... [5]

[Total: 22]

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Cambridge Assessment International Education

Cambridge IGCSE™

ENVIRONMENTAL MANAGEMENT **0680/22**

Paper 2 Management in Context **May/June 2023**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

[Turn over

PUBLISHED

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	M1 wide(r) at base / narrow(er) at top / triangle shape; M2 similar shape for males and females;	**2**
1(a)(ii)	M1 7 400 700 – 3 258 200 **or** 4 142 500; M2 98 631;	**2**
1(a)(iii)	*any three from:* M1 Laos is an LEDC; M2 economic growth (of country or for people); M3 lack of, contraception / family planning resources; M4 improved or good healthcare; M5 improved or good, access to safe drinking water / sanitation; M6 improved or good, infrastructure / access to electricity; M7 migration (into Laos) / immigration; M8 job opportunities; M9 pronatalist policies / policies to encourage large families / no antinatalist policies / financial incentives to have children	**3**
1(b)(i)	*any three advantages of HEP:* M1 does not produce, carbon dioxide / greenhouse gases; M2 does not contribute to global warming / (enhanced) greenhouse effect / climate change; M3 does not produce sulfur dioxide / oxides of nitrogen; M4 does not contribute to acid rain / smog; M5 renewable resource; M6 less visual pollution (due to less mining); M7 idea of sustainability / reserves of coal left (for future generations)	**3**
1(b)(ii)	M1 idea of suitable sites for building dams / mountainous / steep sided valleys/ terrain is suitable; M2 many rivers / large quantities of (natural) water stores or sources; M3 rainy season / high volume of rainfall;	**3**

Question	Answer	Marks
1(b)(iii)	*any three from economic benefit from:* M1 employment; M2 tourism opportunities; M3 improved infrastructure; M4 reduced flooding (so less damage to farms / crops / homes); M5 stated economic benefit **to farmers** e.g. silting so no need to buy fertilisers / idea of improved or high crop yield (due to better irrigation)	**3**
1(c)(i)	*any three from:* M1 people live / densely populated, near dam; M2 **large area** flooded / large volume of water; M3 no early warning / no disaster plan; M4 dam was poorly constructed; M5 bridges / roads / power supply / infrastructure, destroyed; M6 homes destroyed / people left homeless; M7 people could not evacuate / happened at night / people were asleep / no evacuation plan; M8 no medical help / aid could not reach area / no rescue teams; AVP e.g. mountainous terrain (so difficult to evacuate)	**3**
1(c)(ii)	*any four from:* M1 lack of adequate shelter / exposure; M2 poor sanitation / lack of **clean** water; M3 spread of (water related) diseases / named disease; e.g. cholera, typhoid M4 lack of access to, medicines / medical facilities / hospitals / medical treatment; M5 loss of crops or food or farmland / starvation / famine / land underwater so cannot crops cannot be planted; M6 loss of jobs / loss of income / no money to pay for flood recovery; AVP;	**4**
1(c)(iii)	369 / 370 (MW);	**1**

Question	Answer	Marks
1(d)(i)	*any four from:* M1 idea of difficult to extract due to geology: e.g. depth or hardness of surrounding rock / overburden / terrain; M2 accessibility (to site) e.g. lots of rivers to cross M3 legislation / taxes / licences / permits; M4 availability of workers / idea of hourly rate paid to workers; M5 type of extraction or mine or mining / whether it is surface or subsurface M6 use of machinery; M7 waste disposal; M8 quality of rock / grade of rock / how much of the rock contains the mineral / amount of mineral present in the rock / ore contains unwanted material or toxic material	**4**
1(d)(ii)	*any four from:* M1 idea of filling pit using, mining waste / overburden / rocks; M2 cover with (top)soil; M3 improve soil / add organic matter / add manure or fertiliser; M4 bioremediation / cleaning of polluted soil; M5 plant, grass / vegetation / trees / seeds; M6 irrigate or water vegetation;	**4**

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)(i)</td><td>M1 axes correctly labelled and unit: x-axis: country and y-axis: (annual) fish consumption AND person / kg;
M2 suitable linear scale with plots cover at least half the grid;
M3 bars correctly plotted;
M4 bars of equal width;

<table><tr><th>country</th><th>annual fish consumption per person / kg</th></tr><tr><td>Brazil</td><td>9</td></tr><tr><td>Iceland</td><td>91</td></tr><tr><td>India</td><td>7</td></tr><tr><td>Laos</td><td>25</td></tr><tr><td>South Africa</td><td>6</td></tr><tr><td>USA</td><td>22</td></tr></table></td><td>4</td></tr>
<tr><td>2(a)(ii)</td><td>any three from:
M1 availability of, fish / other food sources / land-based protein;
M2 high cost / tax on fish / ora other food;
M3 cultural reasons / traditions / fashion / trends;
M4 idea of ease of storage e.g. availability of refrigeration;
M5 idea of fish is not safe to eat / polluted waters;</td><td>3</td></tr>
<tr><td>2(b)(i)</td><td>52;</td><td>1</td></tr>
</table>

Question	Answer	Marks
2(b)(ii)	M1 largest and smallest identified; M2 remaining fish in correct order; African (catfish) shark (catfish) common (carp) snakehead bighead (carp)	**2**
2(b)(iii)	*any four from:* M1 may not tolerate or be adapted to local conditions / local conditions not suitable; M2 large or heavy so difficult to handle / need large space; M3 may require, a lot of food / specialist food / lack of usual diet; M4 low reproductive success / difficult to breed; M5 risk of disease (from or to other species); M6 compete with wild population / disrupt food web / have no natural predators / become invasive (if they escape); M7 cost of, importing / transport;	**4**
2(b)(iv)	*any two from:* *catching wild fish less sustainable as can lead to:* M1 overfishing / stock depletion / (wild) fish population increases; M2 reduction in breeding; *fish farming more sustainable as:* M3 higher-yielding / can harvest all year round; M4 less bycatch / reduces risk of catching juveniles;	**2**
2(c)(i)	M1 use a, systematic / random, sampling method; M2 method described: *random*: number generator / names in hat *systematic*: every nth person;	**2**
2(c)(ii)	*any three from:* M1 only half the people eat / fish demand for fish is, low or equal; M2 demand for fish is not increasing / people do not eat more fish (in 5 years); M3 most people won't, try new species / change ways; M4 farmer would lose income / not many people would buy (new) fish;	**3**

Question	Answer	Marks
2(c)(iii)	*any three from:* M1 temperature; M2 water; M3 oxygen (level); M4 salinity; M5 light (intensity); M6 pH (water);	**3**
2(c)(iv)	*any two from:* M1 *plant-eating fish:* at lower trophic level / eat producers / are primary consumers; M2 energy is lost / 90% energy lost / 10% energy transferred, between trophic levels M3 energy lost as heat / movement / respiration other named process;	**2**

Question	Answer	Marks
3(a)(i)	terracing;	**1**
3(a)(ii)	*any four from:* M1 maintaining vegetation cover / planting vegetation; M2 adding, organic matter / manure; M3 mixed cropping / intercropping / crop rotation; M4 wind breaks; M5 contour ploughing; M6 **improved** irrigation or named example e.g. trickle drip; M7 bunds; M8 reduction in grazing;	**4**
3(b)	*surface run-off:* reduced or slowed **AND** due to reduced gradient / less slope; *evaporation:* increased **AND** due to, large surface area / open to the sun;	**2**

Question	Answer	Marks
3(c)	**A** transpiration; **B** precipitation;	**2**
3(d)(i)	1.8 (m);	**1**
3(d)(ii)	as a control / for comparison;	**1**
3(d)(iii)	*idea that:* M1 group B or weed removal, is the best treatment / trees tallest; M2 group C or adding fertiliser, increases growth / trees 2nd tallest / 2nd best treatment; M3 group D or using tree guards, has no effect / least successful / trees shortest;	**3**
3(d)(iv)	*any three from:* *repeat:* M1 same experiment; M2 greater number of trees / more than 5 trees; M3 different tree species; M4 different, soils / locations; M5 continue over longer time period / carry on over more years; AVP;	**3**
3(e)	*any five from:* M1 increasing number of trees; M2 trees photosynthesise; M3 **reduces** concentration of (atmospheric) CO_2 / trees capture carbon M4 more trees **reduces** impact of (enhanced) greenhouse effect / global warming; M5 trees act as carbon sink or store; M6 trees trap particulate matter;	**5**

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CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

8500039795

ENVIRONMENTAL MANAGEMENT **0680/23**

Paper 2 Management in Context **May/June 2023**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **20** pages. Any blank pages are indicated.

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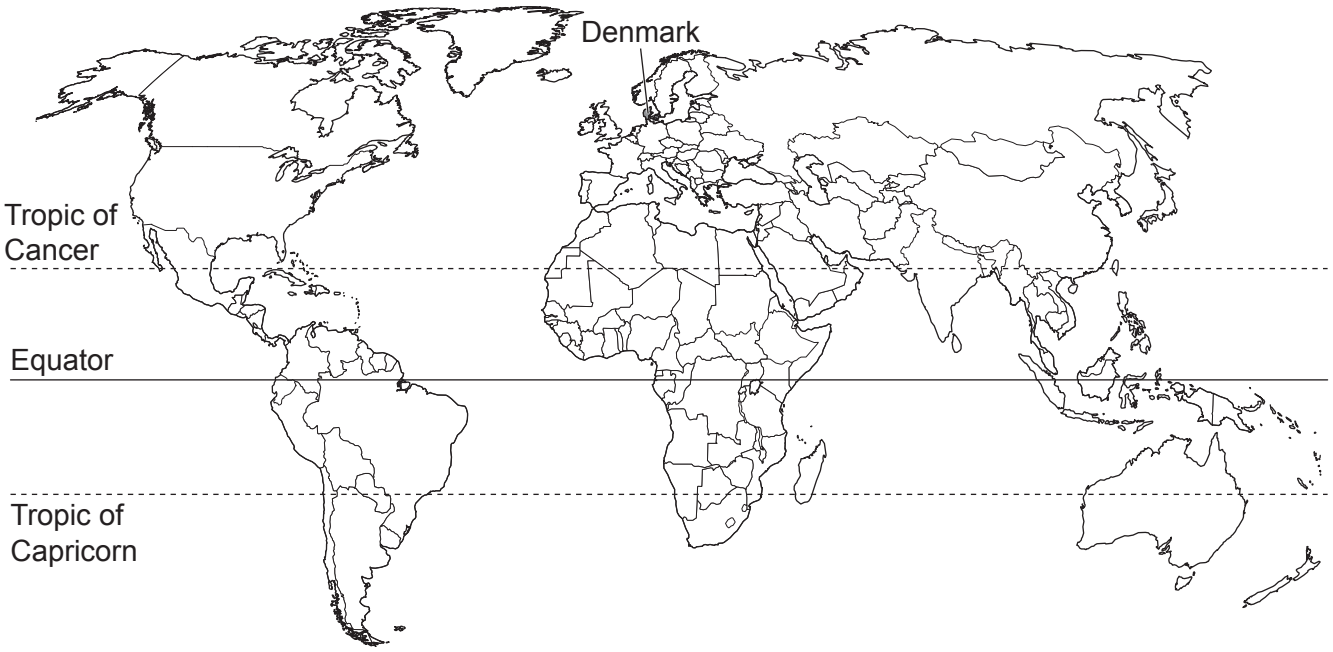
[Turn over

world map showing the location of Denmark



map of Denmark

Key

★ capital city

• urban areas

Area of Denmark: 43 094 km^2

Population: 5.8 million (in 2021)

Children per woman: 1.77

Life expectancy: 81.4 years

Currency: euro

Language: Danish

Climate of Denmark: temperate with windy winters and cool summers

Terrain of Denmark: low-lying and flat with 7300 km of coastline

Main economic activities of Denmark: pharmaceuticals, maritime shipping, renewable energy and agricultural production

Denmark is a more economically developed country (MEDC). All sectors of the economy are growing. 88% of the population live in urban areas.

[Turn over

1 **(a)** **(i)** Calculate the number of people living in **rural** areas in 2021.

..... [2]

(ii) Suggest **two** reasons why only a small number of people live in **rural** areas.

1 .....

.....

2 .....

.....
[2]

(b) The photograph shows a wheat field near the capital city, Copenhagen.

The table shows climate data for the location.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
average temperature /°C	0	1	3	6	12	15	17	17	14	10	5	2
average rainfall /mm	88	86	85	79	70	70	74	78	83	86	88	89
average number of wet days	17	13	12	13	11	13	14	14	15	16	16	17

(i) State the type of farming shown in the photograph.

..... [1]

(ii) The wheat in the photograph is planted in April. It is harvested in August.

Wheat needs a minimum average temperature of 12 °C to grow.

State the number of months wheat grows in this field.

..... [1]

(iii) Give **two** reasons why most farmers near Copenhagen do **not** use irrigation methods to grow crops.

Use information from the table in your answer.

.....

.....

.....

..... [2]

(iv) Describe the **environmental** impacts of mismanagement of irrigation.

.....

.....

.....

.....

.....

..... [3]

(c) Farmers use fertilisers containing nitrate ions to improve wheat yields.

(i) State the names of the **two** other main ions present in fertilisers.

1 .....

2 .....

[2]

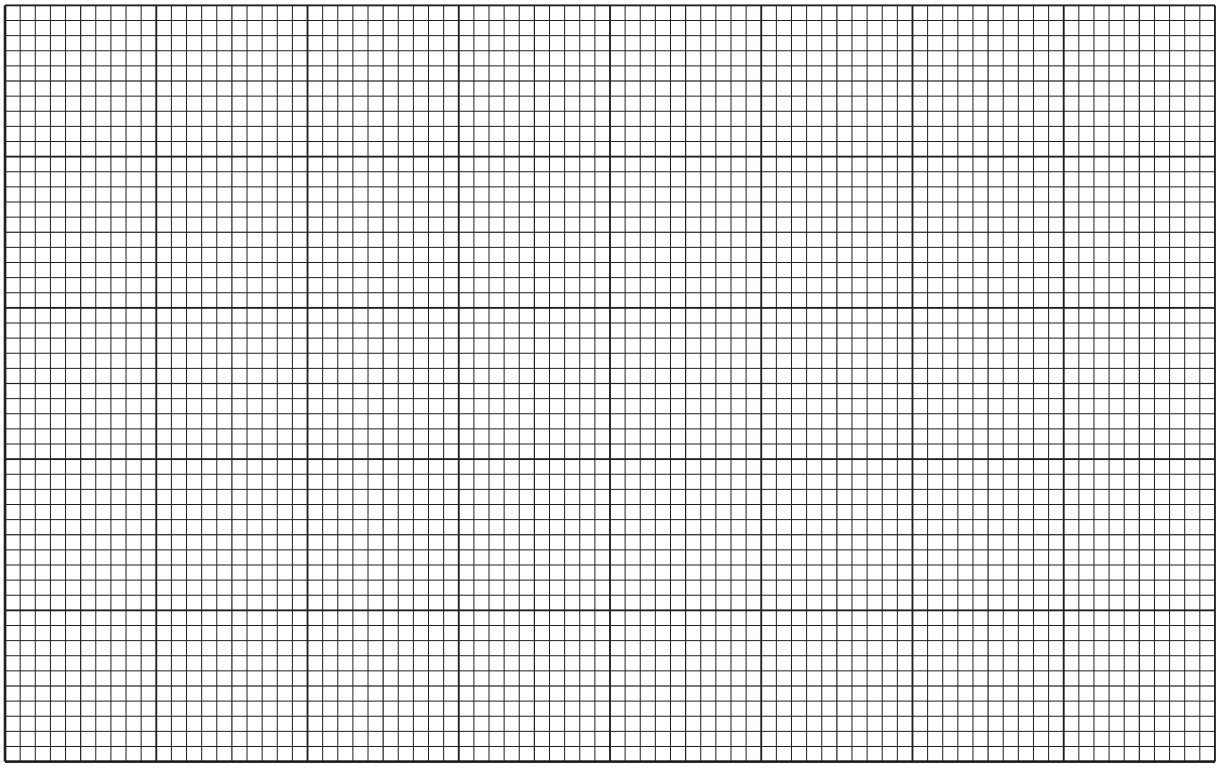
(ii) Nitrous oxide is released when bacteria break down nitrogen compounds in the soil.

Nitrous oxide is a greenhouse gas.

The table shows the nitrous oxide emissions from farming in Denmark over a 20-year period.

year	nitrous oxide emissions / 1000 tonnes
1	25
5	23
9	20
13	18
17	16
21	16

Plot a bar chart of the data in the table.



[4]

(iii) Describe the trend shown by the data.

.....

.....

.....

..... [2]

(iv) Suggest **two** reasons why nitrous oxide emissions from farming in Denmark will **not** reach zero tonnes in the future.

1 .....

.....

2 .....

.....

[2]

(d) Greenhouse gas emissions contribute to climate change.

Suggest reasons why the population of Denmark may be impacted by climate change.

.....

.....

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.....

.....

.....

.....

..... [4]

[Total: 25]

2 The photograph shows a field in Denmark planted with apple trees.

(a) (i) This field has a soil containing three particle sizes.

Circle the smallest particle size.

sand **clay** **silt**

[1]

(ii) A fertile soil contains a balance of mineral ions.

State **three** other components of a fertile soil.

1 .....

2 .....

3 .....

[3]

(iii) Apples are grown as a cash crop.

State what is meant by cash crop.

.....

..... [1]

(b) A student wants to investigate the yield of apples from the field.

The student considers two plans to find the total number of apples in the field.

Plan A

step 1 Count the total number of trees in the field.
step 2 Count the total number of apples on one tree.
step 3 Multiply the total number of apples on one tree by the total number of trees in the field.

Plan B

step 1 Count the total number of trees in the field.
step 2 Count the total number of apples on one tree.
step 3 Repeat step 2 for another nine trees selected at random.
step 4 Multiply the average number of apples on one tree by the total number of trees in the field.

(i) Suggest why the student decides to use **Plan B**.

.....

..... [1]

(ii) Suggest a method the student can use to select the nine trees at random.

.....

.....

.....

..... [2]

(iii) Draw a table the student can use to record all the data from **Plan B**.

[3]

(iv) Scientists are breeding new varieties of apple trees to increase future yields.

Describe **one** method the scientists can use to produce new varieties of apple trees.

.....

.....

.....

.....

.....

..... [3]

[Total: 14]

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3 The photograph shows part of a forest in Denmark being harvested.

The forests in Denmark are managed to promote biodiversity.

(a) (i) The management aims to maintain the forest ecosystem.

State what is meant by the term ecosystem.

.....

..... [1]

(ii) Describe how timber extraction can be done to maintain biodiversity.

.....

.....

.....

..... [2]

(iii) The wood on the trailer is 3.0 m long, 2.5 m wide and 2.5 m in height.

1.0 m^3 of wood has a mass of 1.25 tonnes.

Calculate the total mass of wood on the trailer.

..... tonnes [2]

(iv) The wood is processed into wood chips. The wood chips are burned instead of coal in power stations to generate electricity.

Explain **two** differences between wood chips and coal as an energy resource.

.....

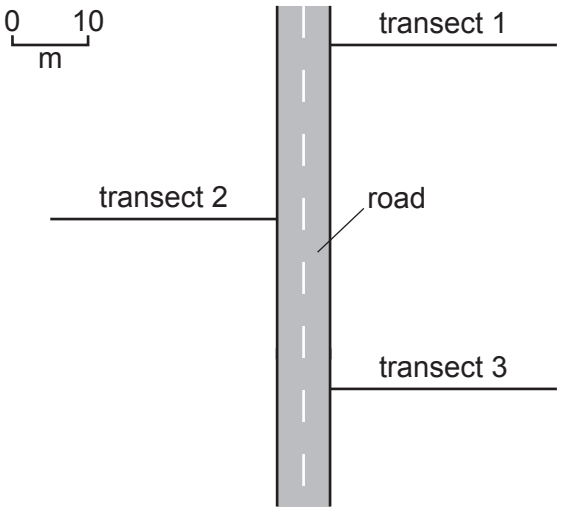
.....

.....

..... [2]

(b) A student uses transect lines to survey the plant species, other than trees, in the forest shown in the photograph.

The transect lines are placed as shown.



(i) Describe how the student can use a quadrat to record the number of different plant species.

.....

.....

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.....

.....

.....

.....

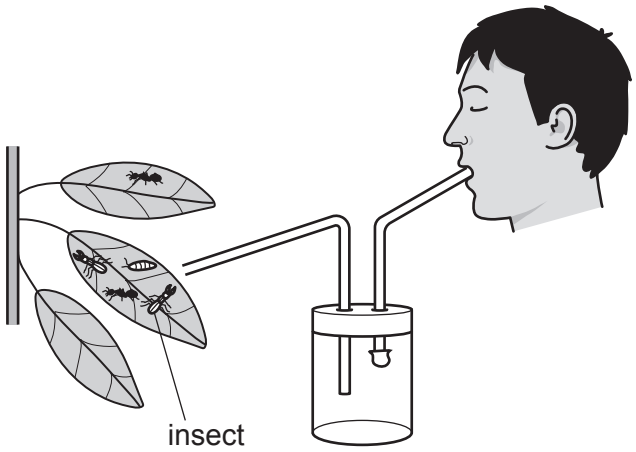
.....

.....

..... [5]

(ii) The student decides to investigate the number of different types of insect living on plants along the transects.

The student uses the equipment shown in the diagram.



State the name of the equipment used by the student.

..... [1]

(iii) The student wants to compare the number of different types of insect on the leaves of plants at the beginning and end of each transect.

Suggest how the student can ensure that the comparison is fair.

.....

.....

.....

..... [2]

(iv) The results of the investigation are shown in the table.

	beginning of transect	**end of transect**
average number of different types of insect	9	14
average total number of insects	26	49

Suggest a suitable conclusion for these results.

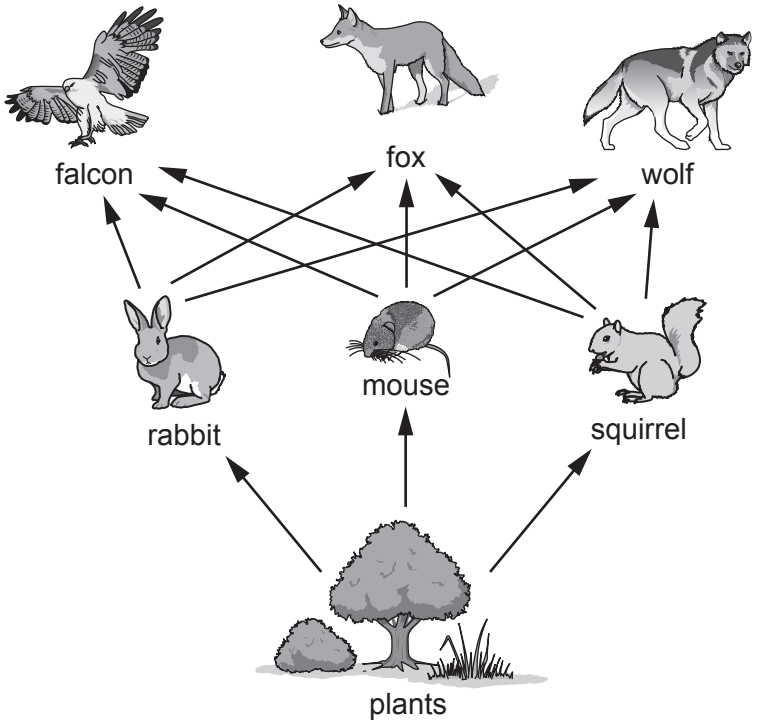
.....

.....

.....

..... [2]

(c) The diagram shows a food web in a forest.



(i) Explain why plants are called producers.

.....

.....

.....

..... [2]

(ii) Explain the flow of energy through this food web.

.....

.....

.....

.....

.....

..... [3]

(d) Explain how seed banks and zoos can help to maintain biodiversity.

seed banks .....

.....

.....

.....

.....

.....

zoos .....

.....

.....

.....

.....

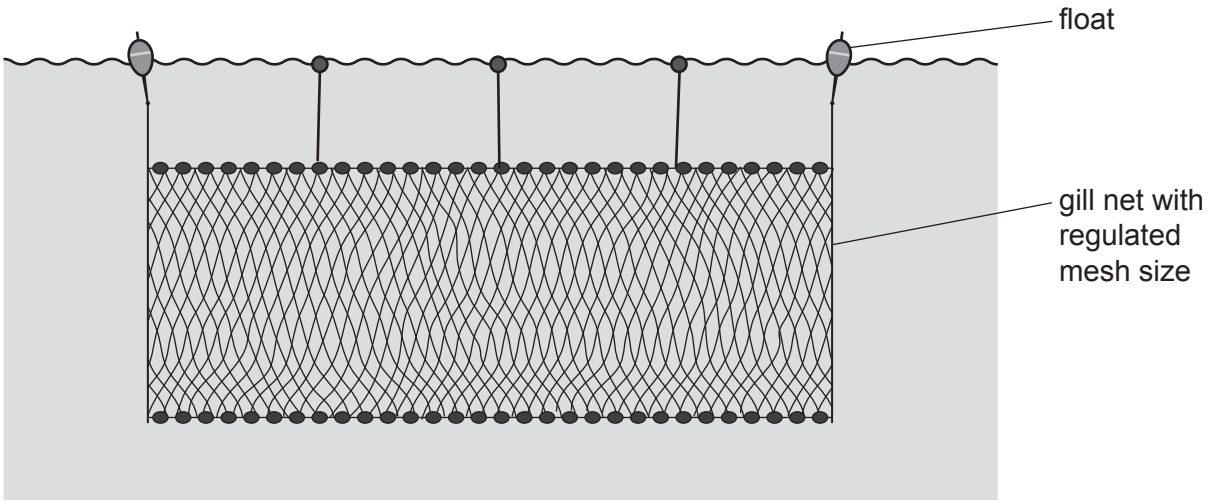
.....

[6]

[Total: 28]

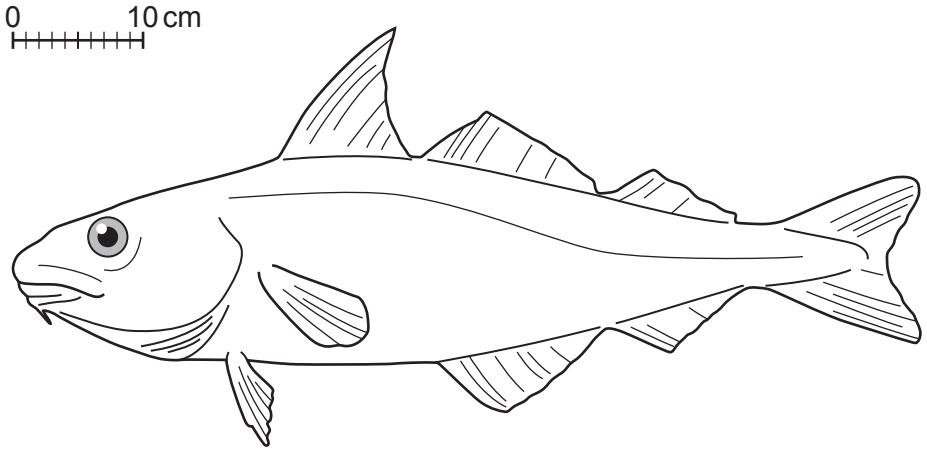
4 Many small fishing boats in Denmark use a gill net to catch fish. The mesh size of the gill net is regulated.

The diagram shows a gill net.



(a) Haddock are caught for human consumption using gill nets.

The diagram shows an adult haddock.



(i) Estimate the length of the haddock.

..... cm [1]

(ii) Explain what may happen to the haddock population if the mesh size of the gill net is **not** regulated.

.....

.....

.....

.....

.....

..... [3]

(iii) State **three** strategies, other than regulating mesh size, that can be used to control fishing in Denmark.

1 .....

2 .....

3 .....

[3]

(b) Some fish are processed into fish meal.

Fish meal has a high protein content. It is used to feed animals on farms to help them grow quickly.

Give **two** reasons why some people think this is **not** a sustainable activity.

1 .....

.....

2 .....

.....

[2]

(c) There are several fish farms around the coast of Denmark.

Describe the benefits and limitations of fish farms.

benefits .....

.....

.....

.....

.....

limitations .....

.....

.....

.....

.....

[4]

[Total: 13]

Cambridge Assessment International Education

Cambridge IGCSE™

ENVIRONMENTAL MANAGEMENT **0680/23**

Paper 2 Management in Context **May/June 2023**

MARK SCHEME

Maximum Mark: 80

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2023 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

[Turn over

PUBLISHED

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5: Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).
GENERIC MARKING PRINCIPLE 6: Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Science-Specific Marking Principles

1	Examiners should consider the context and scientific use of any keywords when awarding marks. Although keywords may be present, marks should not be awarded if the keywords are used incorrectly.
2	The examiner should not choose between contradictory statements given in the same question part, and credit should not be awarded for any correct statement that is contradicted within the same question part. Wrong science that is irrelevant to the question should be ignored.
3	Although spellings do not have to be correct, spellings of syllabus terms must allow for clear and unambiguous separation from other syllabus terms with which they may be confused (e.g. ethane / ethene, glucagon / glycogen, refraction / reflection).
4	The error carried forward (ecf) principle should be applied, where appropriate. If an incorrect answer is subsequently used in a scientifically correct way, the candidate should be awarded these subsequent marking points. Further guidance will be included in the mark scheme where necessary and any exceptions to this general principle will be noted.
5	‘List rule’ guidance For questions that require ***n*** responses (e.g. State **two** reasons …): • The response should be read as continuous prose, even when numbered answer spaces are provided. • Any response marked *ignore* in the mark scheme should not count towards ***n***. • Incorrect responses should not be awarded credit but will still count towards ***n***. • Read the entire response to check for any responses that contradict those that would otherwise be credited. Credit should **not** be awarded for any responses that are contradicted within the rest of the response. Where two responses contradict one another, this should be treated as a single incorrect response. • Non-contradictory responses after the first ***n*** responses may be ignored even if they include incorrect science.

6 Calculation specific guidance

Correct answers to calculations should be given full credit even if there is no working or incorrect working, **unless** the question states 'show your working'.

For questions in which the number of significant figures required is not stated, credit should be awarded for correct answers when rounded by the examiner to the number of significant figures given in the mark scheme. This may not apply to measured values.

For answers given in standard form (e.g. $a \times 10^n$) in which the convention of restricting the value of the coefficient (a) to a value between 1 and 10 is not followed, credit may still be awarded if the answer can be converted to the answer given in the mark scheme.

Unless a separate mark is given for a unit, a missing or incorrect unit will normally mean that the final calculation mark is not awarded. Exceptions to this general principle will be noted in the mark scheme.

7 Guidance for chemical equations

Multiples / fractions of coefficients used in chemical equations are acceptable unless stated otherwise in the mark scheme.

State symbols given in an equation should be ignored unless asked for in the question or stated otherwise in the mark scheme.

Question	Answer	Marks
1(a)(i)	5.8 × 0.12; 696 000;	**2**
1(a)(ii)	*any two from in rural areas:* M1 not many jobs / risk of being unemployed; M2 only agriculture as available work / mechanisation of agricultural; M3 migration; M4 lack of services or infrastructure / fewer stated services e.g. medical care / education / communications;	**2**
1(b)(i)	commercial / arable / crops;	**1**
1(b)(ii)	4;	**1**
1(b)(iii)	*any two from:* M1 many wet days; M2 similar rainfall every month; M3 no dry season / rains all year; M4 suitable data quoted e.g. 70 mm every month, every month has between 7−89 mm, minimum of 11 wet days each month	**2**
1(b)(iv)	*any three from:* M1 waterlogging / flooding; M2 low oxygen or air in soil; M3 reduced crop yield; M4 salinisation; M5 loss of, fertility / fertiliser; M6 leaching (of nutrients); M7 leading to eutrophication; AVP; e.g. soil erosion / increased surface run-off	**3**
1(c)(i)	potassium phosphate;	**2**

Question	Answer	Marks
1(c)(ii)	M1 both axes labelled: (nitrous oxide) emissions / 1000 tonnes AND year; M2 sensible linear scale with plotting that covers half the grid space; M3 correct plotting ± half small square tolerance; M4 bars of equal width;	**4**
1(c)(iii)	*any two from* (steady) decreases; constant (between year 17−21); relevant quoted data e.g. 25 to 18 (1000 tonnes) / stable at 16 (1000 tonnes);	**2**
1(c)(iv)	*any two from:* M1 farming always needed; M2 some fertilisers (always) needed; M3 NOx released from farm machinery; M4 M5 AVP; e.g. there will always be N compounds to break down / not possible to stop bacterial activity in the soil;	**2**

Question	Answer	Marks
1(d)	*any four from:* M1 sea level rise; M2 flooding; M3 drought M4 loss of farmland; M5 loss of habitat / loss of biodiversity; M6 reduction in crop yield / new crops could be grown; M7 displacement of people / forced migration / loose their homes; M8 increased land prices; M9 transport routes cut / damage to infrastructure; M10 salinisation of water supplies; M11 extreme weather / changed weather patterns; M12 impact on energy costs; M13 M14 AVP;	**4**

Question	Answer	Marks
2(a)(i)	clay;	**1**
2(a)(ii)	*any three from:* M1 air; M2 water; M3 microorganisms / bacteria / fungi; M4 organic matter;	**3**
2(a)(iii)	crop grown, to be sold / for a profit;	**1**
2(b)(i)	more representative / larger sample / anomalies can be identified;	**1**
2(b)(ii)	*identifying trees:* give a number or letter to each tree; *random selection method*: number generator / numbers out of a bag / phone book / number table;	**2**

Question	Answer	Marks
2(b)(iii)	M1 table drawn ; M2 headings: tree (number) **AND** number of apples (on tree); M3 9 to 10 cells for data ;	**3**
2(b)(iv)	*max three from either method:* M1 genetic, engineering / manipulation; M2 identify the gene for high yield (from a high-yielding tree); M3 extract the gene (from the high-yielding tree); M4 insert the gene (into a stock tree); **OR** M1 selective breeding; M2 select two suitable parent trees (e.g. high-yielding); M3 cross-breed the parents; M4 select the most promising offspring;	**3**

Question	Answer	Marks
3(a)(i)	all the living or biotic **AND** non-living or abiotic components (in an area);	**1**
3(a)(ii)	*any two from:* M1 selective logging / sustainable harvesting; M2 species, not made extinct / can recover; M3 replant native species; M4 protected **zones** in the forest;	**2**
3(a)(iii)	M1 calculation of volume = 18.75 (m^3); M2 ($\times$ 1.25 =) 23 (tonnes);	**2**

Question	Answer	Marks
3(a)(iv)	*any two **comparative** differences from:* M1 *coal*: carbon dioxide emitted **AND** *wood*: carbon neutral or less carbon dioxide emitted; M2 *coal*: more energy dense (than wood); M3 *coal*: releases sulfur dioxide or NOx / leads to acid rain **AND** wood: does not;	**2**
3(b)(i)	max [5] **Note**: to gain 5 marks at least 1 mark must come from each section *max two from quadrats:* M1 quadrat of stated dimensions, e.g. 1 m^2; M2 quadrat placed at, regular intervals / stated intervals; M3 sample all (three) transects; *counting:* M4 <u>count</u> the number of <u>species</u> (in the quadrat); M5 description of how to deal with plants partially in an quadrat; *recording:* M6 record number in a table; *repeating:* M7 repeat same investigation; M8 repeating on different days;	**5**
3(b)(ii)	pooter;	**1**
3(b)(iii)	*any two from:* M1 same plant species / same type of plant; M2 same number of leaves; M3 same size of leaves; M4 same time of day; M5 same person; M6 same plant height; M7 examine each leaf for same period of time; M8 count / identify, the number of types of insect;	**2**

Question	Answer	Marks
3(b)(iv)	*any two from end of transect or away from the road has:* more types; larger numbers; more biodiversity;	**2**
3(c)(i)	*any two from:* M1 photosynthesis; M2 chlorophyll absorbs light energy; M3 *reactants*: carbon dioxide and water; M4 *products*: glucose and oxygen; M5 light energy to chemical energy;	**2**
3(c)(ii)	*any two from:* M1 energy transfers when organisms eaten / stated example of feeding from food web e.g. plant eaten by rabbit; M2 lost as heat; M3 idea of only 10% of energy passed between levels / 90% is lost; *lost through:* M4 respiration; M5 digestion; M6 (excreted) waste (products); M7 movement; M8 death / decomposition; M9 maintaining body temperature / thermoregulation; M10 feeding / consumers do not consume the whole organism; M11 reproduction;	**3**

Question	Answer	Marks
3(d)	(both) prevents extinction / protects endangered species; seeds / animals can be reintroduced into wild; *max five seed banks:* maintains genetic record / source of genes; development of new plants, e.g. drought-resistant wheat; development of medicines; AVP; *max five zoos:* allows (captive) breeding; reduces impact of, predation / hunting / poaching; prevents inbreeding / international cooperation; education / awareness; AVP;	**6**

Question	Answer	Marks
4(a)(i)	70 (cm) ;	**1**
4(a)(ii)	population likely to decline / overfishing; small mesh size catches young fish; not able to breed;	**3**
4(a)(iii)	*any three from:* M1 area or total size of net; M2 quotas; M3 closed seasons; M4 protected areas; M5 licenses; M6 international economic exclusion zone (EEZ); M7 M8 AVP; e.g. size of boats / number of boats / CCTV on boats / patrols / monitoring / tracking of boats / number of fishing days;;	**3**

Question	Answer	Marks
4(b)	*any two from:* overfishing / will run out of fish / population of fish decreases; many species are caught that are not eaten / a lot of bycatch; lead to overproduction of farm animals; removing many species of fish impacts food chains;	**2**
4(c)	*any four (max three from one section):* *benefits* increased food supply; less work / less use of energy (than going to sea); safer (than going to sea); no bycatch; preserves wild stocks; allows harvesting all years / no seasons; not weather-dependent; *limitations* pollution from, organic matter / fish meal / oil / pesticides / waste / antibiotics; spreads disease; risk of escape; impact on food chain;	**4**