AQA qualification support

AS/A-level Environmental Science

Preparing to Teach

Specimen assessment materials and mark schemes

BOOKLET 2

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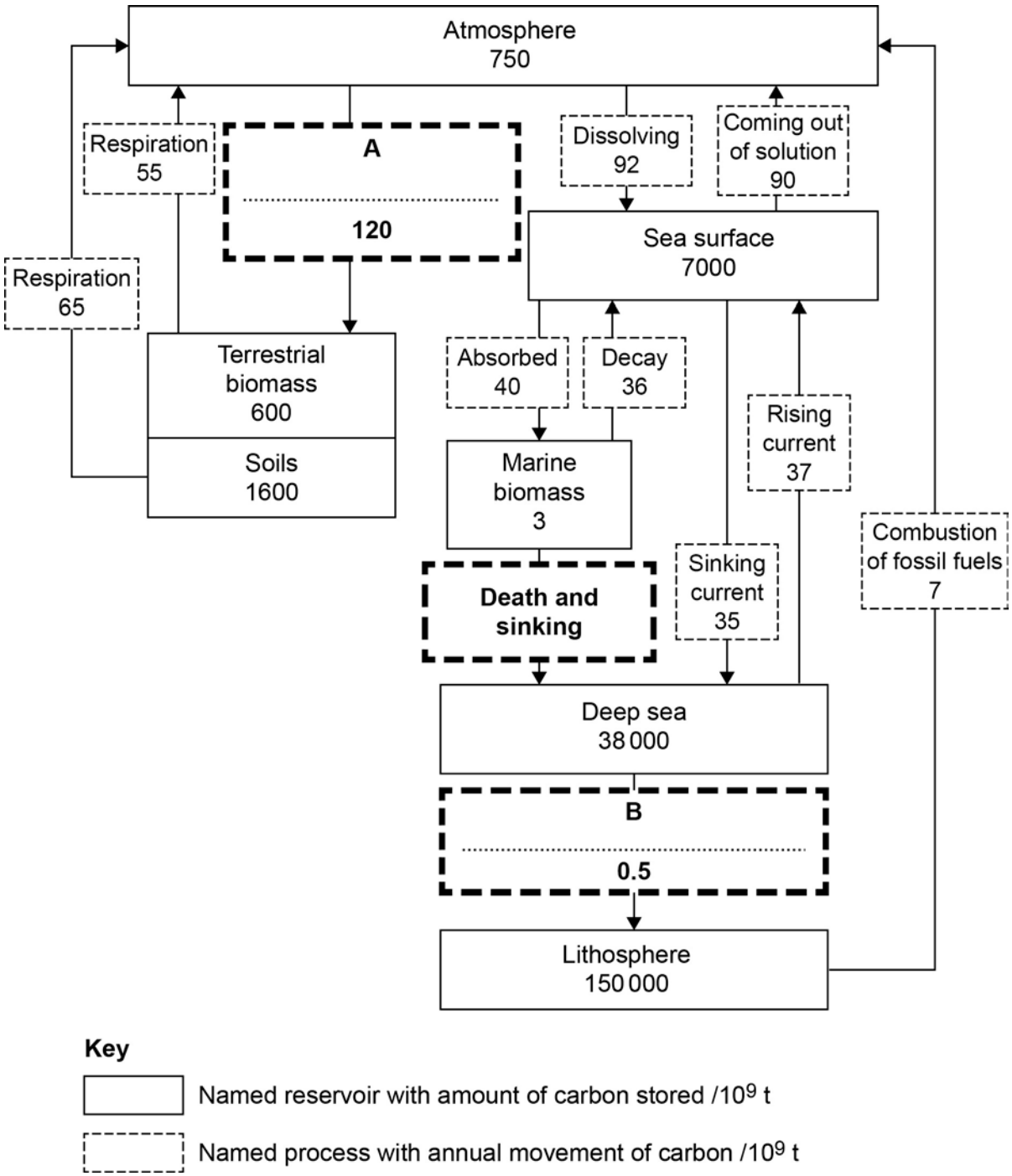
Contents

Page

AS Paper 1- Q.1 and mark scheme

0 1 . 0 **Figure 1** shows some features of the carbon cycle.

Figure 1



0 1 . 1 Complete **Figure 1** by adding the names of the **two** missing transfer processes **A** and **B**.

[2 marks]

0 1 . 2 The amount of carbon in the marine biomass is in a state of dynamic equilibrium.

Calculate the amount of carbon moved annually from the marine biomass by the process of death and sinking.

[1 mark]

$\not{/}\ 10^9$ t

0 1 . 3 Calculate the residence time for carbon dissolved in the sea surface reservoir, using the formula:

$$\text{residence time} = \frac{\text{amount in the reservoir}}{\text{annual movement in or out of the reservoir}}$$

[1 mark]

years

0 1 . 4 **Figure 1** shows that the amount of carbon in the atmosphere is **not** in a state of dynamic equilibrium. Growing more trees could help restore the balance of carbon in the atmosphere.

Calculate the mass of extra carbon that would have to be absorbed by trees to restore a state of dynamic equilibrium in the atmosphere.

[1 mark]

10^9 t

Qu	Part	Marking guidance	Comments	Total marks	AO
01	1	A = photosynthesis B = sedimentation/fossilisation		2	AO2
01	2	4	Absorbed – Decay = Death and sinking	1	AO2
01	3	42.42 Accept 42.4	7000/(36 + 37 + 92) = 42.4 Or 7000/(90 + 35 + 40) = 42.4	1	AO2
01	4	5	(7 +90 + 55 + 65) – (92 + 120) = 5	1	AO2

AS Paper 1- Q.3 and mark scheme

Act (1981).

Describe how the Wildlife and Countryside Act (1981) protects animal species.

[2 marks]

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0 3 . 2 Give **two** scientific reasons why the conservation of wildlife is important for future agricultural productivity.

[2 marks]

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0 3 . 3 Give **one** conservation designation that may be used to protect the habitat of endangered species in the UK.

[1 mark]

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0 3 . 4 Explain why biological corridors are important in wildlife conservation.

[3 marks]

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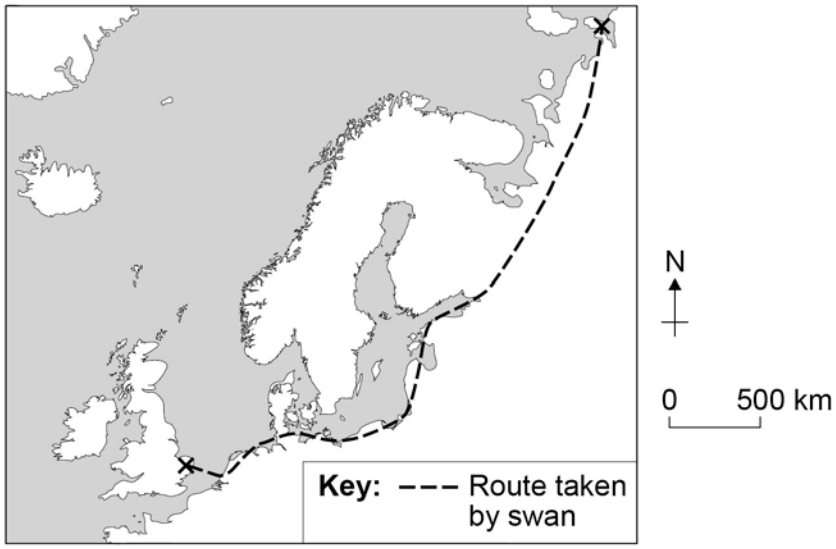
0 3 . 5 **Figure 2** shows leg rings used in ecological studies of birds and **Figure 3** shows a Bewick's Swan with an electronic tracking collar.

Figure 2

Figure 3

Figure 4 shows the route taken by one Bewick's Swan as it migrated from the UK to Russia.

Figure 4



Explain why the electronic tracking collar provides more useful information about swan migration than the leg rings.

[2 marks]

Qu	Part	Marking guidance	Comments	Total marks	AO
03	1	Any **two** from: • illegal to kill • illegal to injure • illegal to collect • illegal to sell • illegal to disturb breeding/nesting sites • designation of protected habitat		2	AO1
03	2	Any **two** from: • role in nutrient recycling • source of genes for crop breeding/GM • crop pollination • role in biological control of pests		2	AO1
03	3	One **named** conservation designation: eg Site of Special Scientific Interest/SSSI Local Nature Reserve/LNR National Nature Reserve/NNR Ramsar site Special Area of Conservation/SAC Special Protection Area/SPA Natura 2000 site Marine Nature Reserve/MNR Marine Conservation Zone/MCZ Marine Protected Area/MPA National Park Reject AONB/Green Belt/unqualified nature reserve/unqualified Country Park		1	AO1

03	4	Decreased fragmentation/prevents islandisation links habitats Any **two** from: • increased access to resources on other areas • prevention of separation of breeding populations • reduced inbreeding risk of isolated populations • larger gene pool of populations that can mix • allows recolonisation after local extinction	Students must show an understanding that the conservation role of biological corridors is for the wildlife in the habitats they link, not in the corridor habitat itself.	1 2	AO2

03	5	Any **two** from: • the tracking collar provides continual data record throughout the journey • intermediate destinations can be identified • periods of travel/rest can be identified • feeding sites can be identified • threats to survival can be identified • in-journey habitats that need protecting can be identified Accept converse statements about leg rings	2	AO2

AS Paper 1- Q.4 and mark scheme

0 4 . 0 **Table 2** shows the carbon storage in trees and dead organic matter of three areas of forest.

Table 2

	Mangrove forest	**Temperate broadleaf forest**	**Tropical rainforest**
Total living biomass/ t ha^{-1}	4320	2297	1558
Water content of living biomass / % mass	50	35	45
Carbon in living biomass / % of total carbon	32	45	85
Above ground living biomass / % of total living biomass	48	75	84
Below ground living biomass / % total living biomass	52	25	16
Carbon in dead organic matter / t ha^{-1}	660	180	120
Carbon content of wood / % of dry biomass	49.0	48.5	48.2

0 4 . 1 Use information from **Table 2** to calculate the mass of carbon dioxide that would be released if the trees from 25ha of mangrove forest were cut down and then burnt.

Atomic masses: C = 12, O = 16.

[3 marks]

Show your working

Mass of CO_2

Qu	Part	Marking guidance	Comments	Total marks	AO
04	1	One mark for correct answer for each stage: First mark Total dry biomass above ground = 54000 Carbon in above ground biomass = 12700.8t CO_2 released = 46569.6t Accept 46566.67 – 46569.6 ecf Three marks for correct final answer with no working/correct working	Calculation commentary (4320/100 x 50) x 25 = 54000t 48% of this is above ground 54000/100 x 48 = 25920t 49% of this is C 25920/100 x 49 = 12700.8t Mass of CO_2 from C combustion 12700.8/12 x 44 = 46569.6t	3	AO2

AS Paper 1- Q.10 and mark scheme

Table 5 shows features of the water samples collected from five different sources:

- a geothermal spring
- seawater
- a river
- rain water
- a limestone aquifer.

Table 5

	Sample A	**Sample B**	**Sample C**	**Sample D**	**Sample E**
Calcium content / mg l^{-1}	24.0	0.60	104.0	7.5	400.0
Sodium chloride / mg l^{-1}	25.0	0.85	80.0	55.0	35 000.0
Total dissolved solids / mg l^{-1}	135.0	3.20	670.0	220.0	40 000.0
pH	7.4	5.70	7.6	5.5	8.2
Temperature range / ^{o}C	4 – 18	0 – 24	9.8 – 10.1	45	9.5 – 17.5
Turbidity	Medium/high	Low	Low	Low	Low/medium
Dissolved oxygen / % saturation	65 – 92	100	45 – 65	40	75 – 90
Faecal coliform count / number per 100 ml	0 – 5050	0	0	0	0 – 450

1 0 . 1 Using the information from **Table 5** and your own knowledge, identify the source at which **Sample A** was collected.

[1 mark]

A Geothermal spring ⬭

B Seawater ⬭

C River water ⬭

D Rain water ⬭

E Limestone aquifer ⬭

1 0 . 2 Using the information from **Table 5** and your own knowledge, identify the source at which **Sample B** was collected.

[1 mark]

A Geothermal spring ⬭

B Seawater ⬭

C River water ⬭

D Rain water ⬭

E Limestone aquifer ⬭

1 0 . 3 Using the information from **Table 5** and your own knowledge, identify the source at which **Sample D** was collected.

[1 mark]

A Geothermal spring ⬭

B Seawater ⬭

C River water ⬭

D Rain water ⬭

E Limestone aquifer ⬭

1 0 . 4 Use data from **Table 5** and your own knowledge to justify each of your choices of source in questions **10.1**, **10.2** and **10.3**.

[3 marks]

Sample A

Sample B

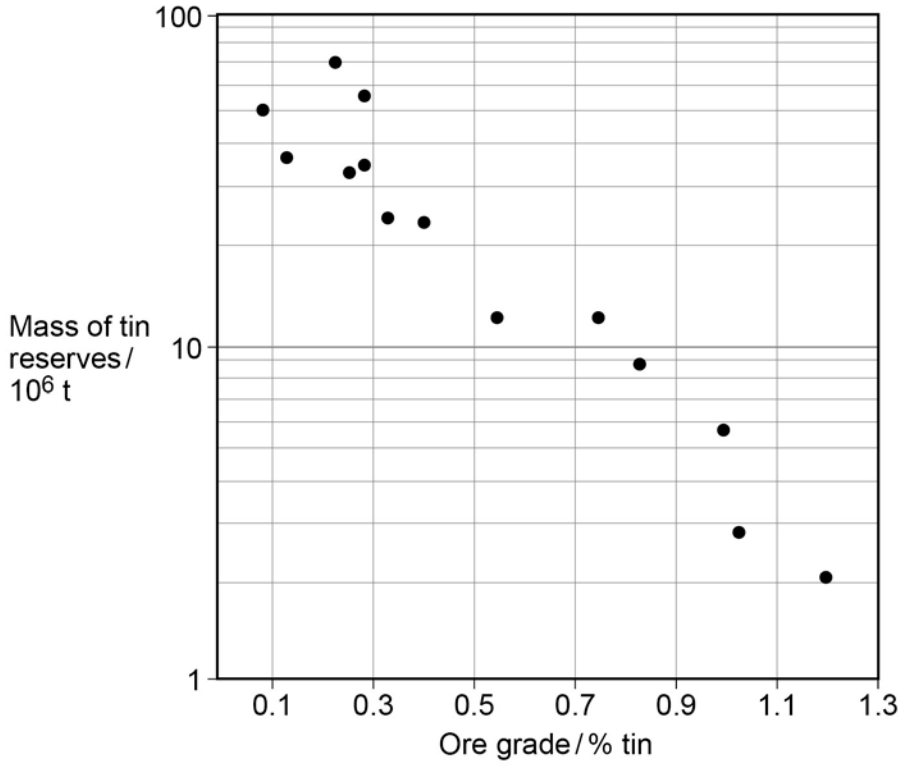
Sample D

Qu	Part	Marking guidance	Comments	Total marks	AO
10	1	One mark for correctly identifying the water source **Sample A**: river water (**C**)	Students should be able to analyse the table of data and select the information that allows the correct water sources to be identified and the other possibilities to be rejected.	1	AO3 = 1
10	2	One mark for correctly identifying the water source **Sample B**: rainwater (**D**)	Students should be able to analyse the table of data and select the information that allows the correct water sources to be identified and the other possibilities to be rejected.	1	AO3 = 1
10	3	One mark for correctly identifying the water source **Sample D**: geothermal spring (**A**)	Students should be able to analyse the table of data and select the information that allows the correct water sources to be identified and the other possibilities to be rejected.	1	AO3 = 1
10	4	One mark for features that identify it and exclude others, for each source **Sample A**: high turbidity, high maximum coliform count, but low dissolved solid/calcium/sodium level. **Sample B**: highest dissolved oxygen saturation, lowest dissolved solid/chloride/calcium content. **Sample D**: highest temperature, no coliform bacteria, low turbidity.	Students should be able to analyse the table of data and select the information that allows the correct water sources to be identified and the other possibilities to be rejected.	3	AO3 = 3

A-level Paper 1- Q.3 and mark scheme

0 3 . 2 **Figure 4** shows the mass of tin reserves that occur at different ore grades.

Figure 4



Draw a line of best fit and use it to estimate the mass of tin ore that would exist in ores of 0.35% purity.

[1 mark]

_____ /10^6 t

0 3 . 3 Explain why a reduction in the market price for tin would change the 'cut-off ore grade'.

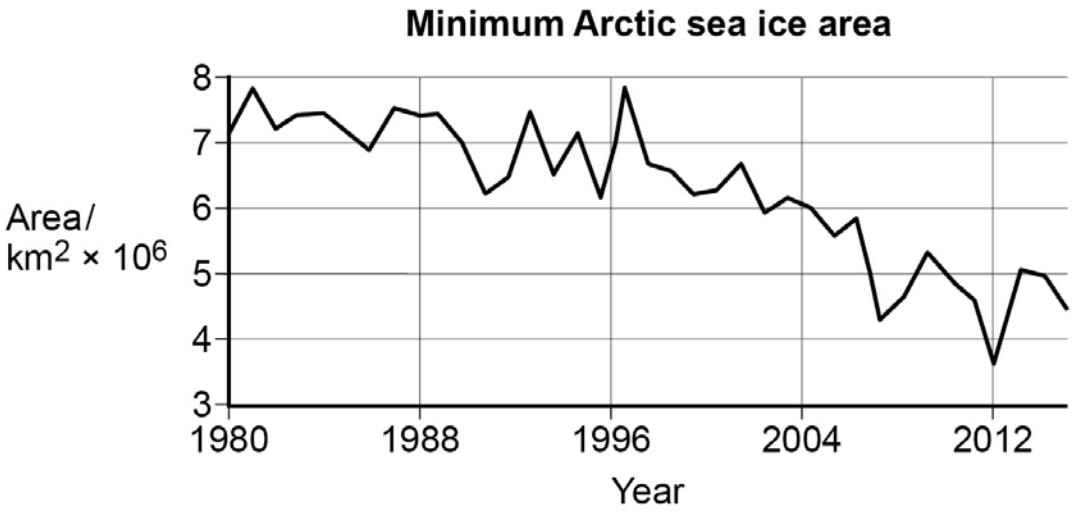
[2 marks]

Qu	Part	Marking guidance	Comments	Total marks	AOs
03	2	32 Accept correct reading from the logarithmic y-axis using the line of best fit they have drawn	Students must show an understanding that logarithmic scales have cycles with a 10-fold change in values with each cycle.	1	AO2
03	3	Less money available for extraction/processing Increased Cut off ore grade (COOG)	Students must show understanding of the relationship between extraction costs, ore purity and economic viability.	2	AO2

A-level Paper 1- Q.10 and mark scheme

1 0 . 0 **Figure 12** shows changes in the area of Arctic ice in the sea.

Figure 12



1 0 . 1 Use information from **Figure 12** to calculate the difference in mean annual change in ice area between 1980 to 1996 and 1996 to 2012.

[2 marks]

Show your working

Difference = _____

1 0 . 2 Use details of named technologies to explain how satellite surveys are used to collect reliable data about changes in the mass of ice on the Earth's surface.

[4 marks]

1 0 . 3 Explain why it is difficult to accurately predict future changes in the amount of ice on land.

[9 marks]

Qu	Part	Marking guidance	Comments	Total marks	AOs
10	1	First mark for calculating rates for both periods Second mark for calculation of difference Rate 1980 -1996 7.2 – 6.7/16 = 0.03 Rate 1996 - 2012 6.7 – 3.8/16 = 0.18 Difference = 0.18 – 0.03 = 0.15 Accept correct calculations based on values from graph ± 0.1 of values shown above. Maximum possible range 0.126 to 0.172 Award both marks for correct answer with no working.		2	AO2

10	2	Any **two** details of satellite or sensor operation (related to ice mass surveys): eg Features of satellite orbits • Polar orbit • Low altitude orbit • Short orbital period • Multiple orbits/composite image Any **two** details of data collected or named sensor/satellite: Data collected by sensors • Gravity measurement • Change in orbit height/velocity • Change in distance between satellites (for GRACE) • Radar altitude measurement • Radar altitude measurement to surface of sea/ice surface • Estimate ice height above sea level allows ice mass estimate Named satellite/sensors Satellites that monitor ice mass • GRACE • Gravity field and steady-state Ocean Circulation Explorer (GOCE) Sensors that monitor ice mass • Electrostatic Gravity Gradiometer (EGG) • Gravimeter		4	AO1 = 2 AO2 = 2

10	3	9 mark levels of response question Lack of accurate data on past trends • ice core data not available in all areas Impact of negative feedback mechanisms • ice cover – albedo • low-level cloud cover - albedo • natural carbon sequestration Impact of positive feedback mechanisms • melting permafrost • low albedo of exposed ground/water • methane hydrate • increased forest/peat fires • increased DOM decay Lack of understanding of natural processes affecting: • temperature • precipitation • wind direction • wind velocity Lack of understanding of interconnections of natural processes Time delay between cause and effect Different timescales of effects Future changes in human activities (that affect climate change) • greenhouse gas emissions • carbon sequestration/CCS • geoengineering		9	AO1 = 4 AO2 = 3 AO3 = 2

A-level Paper 2- Q.8 and mark scheme

0 8 . 0 African Forest Elephants are identified as vulnerable on the IUCN Red List. The population is thought to have declined by around 65% between 2002 and 2011. They breed relatively slowly, with a maximum population growth rate of 5% per year. In 2014, the death rate caused by poaching was estimated to be 9% per year. Elephants are herbivores, eating many foods including the fruit of more than 70 tree species. They sometimes reach the fruit they want by pushing trees over.

Some of these fruits are only eaten by African Forest Elephants, such as *Omphalocarpum* which has large tough fruit that they split open with their tusks. The elephants are not ruminants and do not repeatedly chew and re-digest their food, so about 50% of their food passes out undigested in their dung.

Elephants travel longer distances than other forest mammals to find food, travelling up to 60 km along paths to avoid having to push through the dense forest vegetation. They travel in small family groups, although males are often solitary.

In moist areas, they clear vegetation and create waterholes so they can drink and get access to essential mineral nutrients.

African Forest Elephants have few natural predators, although young or old individuals may be killed by predators.

Being such large, impressive animals, elephants are popular with the public and raise the profile of wildlife conservation. However, there are few ecotourism opportunities in the forests of West Africa where they live.

0 8 . 1 Use the information above and your own knowledge to explain why the African Forest Elephant is considered to be a keystone species.

[5 marks]

Qu	Part	Marking guidance	Comment	Total marks	AO
08	1	Any **five** reasons from: • Disproportionate effect on the community relative to their abundance/low functional redundancy • Seed dispersal • Seeds not destroyed by rumination/chewing • Undigested seeds in dung • Greater dispersal distance of seeds • Paths for other species • Create water holes • Creation of clearing • Increased water availability • Increased mineral nutrient availability • Dung is food for other species • Other species that rely on trees • Control of named abiotic factors	Students must understand the concept of keystone species and apply this to an unfamiliar species. They must analyse and interpret the passage to select information that demonstrates this role for the African Forest Elephant.	5	AO2 = 2 AO3 = 3

A-level Paper 2- Q.9 and mark scheme

0 9 . 0 The likelihood that a fish species is overexploited is affected by its breeding biology and the fishing methods used.

Table 6 shows Details of the ecology and fisheries of the Atlantic Mackerel and Orange Roughy.

Table 6

Feature	Fish species	
	Atlantic Mackerel *Scomber scombrus*	Orange Roughy *Hoplostethus atlanticus*
Age of first breeding /yrs	2	20
Eggs laid per kg of mass	80 000	30 000
Maximum lifespan /yrs	20	150
Maximum length /cm	45	75
Maximum mass /kg	2.5	7.0
Water depth /m	0 - 100	500 - 1200
Mean length of caught fish/cm	30	35
Mean age of caught fish /yrs	2	10
Time of fishing	During spawning season when fish congregate to mate and lay eggs	During spawning season when fish congregate to mate and lay eggs
Habitat	Pelagic water (near surface and mid-water)	Demersal (near seabed)
Shoal composition	Single species shoals	Mixed species shoals
Fishing area and method	European Union: purse seining and handlines Iceland: pelagic trawling	All areas: demersal trawling

0 9 . 1 Use information from **Table 6** and your own knowledge to explain why the Orange Roughy is more vulnerable to overfishing than the Atlantic Mackerel.

[2 marks]

0 9 . 2 Use information from **Table 6** to suggest why fishing for Atlantic Mackerel is less likely to produce a lot of by-catch than fishing for Orange Roughy.

[2 marks]

0 9 . 3 Apart from the total mass of fish caught, what data about fish catches may show that a population is being overfished?

[2 marks]

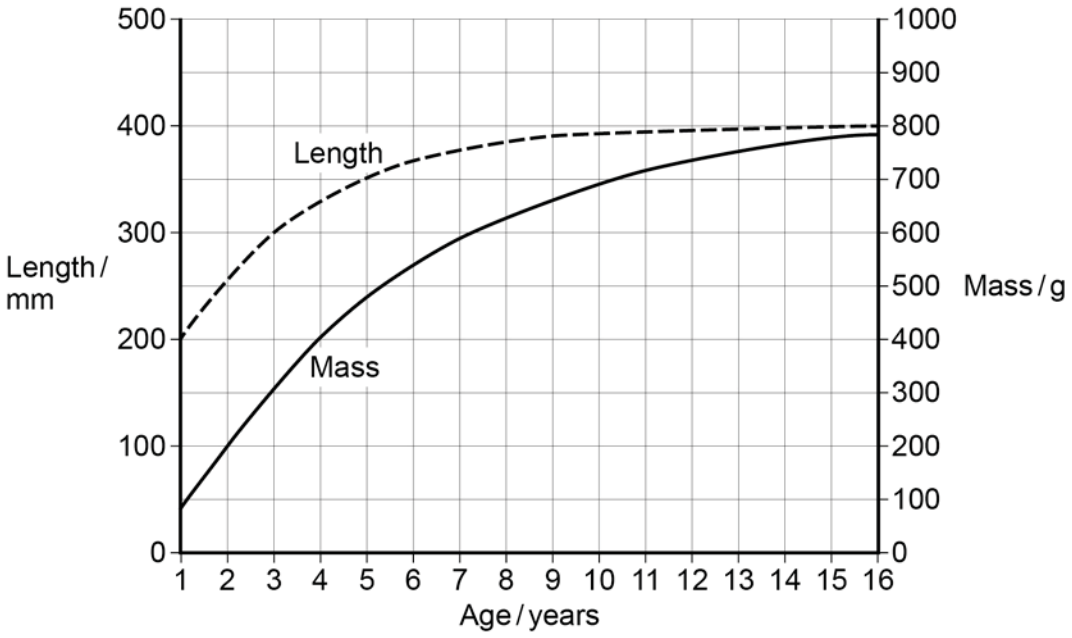
0 9 . 4 Use data from **Table 6** to calculate the mean annual mass increase for Orange Roughy as a percentage of that for Atlantic Mackerel.

Assume both fish reach maximum mass and age.

[2 marks]

0 9 . 5 **Figure 8** shows the increase in the mass of Atlantic Mackerel as they get older.

Figure 8



Use information from **Table 6** and **Figure 8** to calculate the number of eggs produced by a typical female Atlantic Mackerel in its first year of breeding.
Show your working.

[1 mark]

0 9 . 6 Explain how an improvement in net design may reduce by-catch.

[2 marks]

0 9 . 7 Explain how long term catches may be increased by the use of No-Take Zones and minimum catchable size regulations.

[4 marks]

No-Take Zones

Minimum catchable size regulations

Qu	Part	Marking guidance	Comment	Total marks	AO
09	1	Any **two** factors with data from: • Orange Roughy has a later age of first breeding: 2 vs 20 yrs • Orange Roughy has a lower fecundity: 30 000 vs 80 000 • Orange Roughy can be caught before breeding: Mackerel: breeding age: 2; age caught: 2 Orange Roughy: breeding age: 20; age caught 10	Students must analyse and interpret the data in the table to select the significant values and explain the difference in overfishing risk.	2	AO3
09	2	Any two of: • Mackerel are caught in single species shoals • Named more selective fishing method used for Mackerel: /purse seining/hand lines • Mackerel are pelagic/there is no demersal/seabed catch		2	AO3
09	3	Any **two** from: • Earlier age at first breeding • Smaller mean mass • Younger mean age • Lower genetic diversity	Students must show they understand the data that must be collected to estimate Maximum Sustainable yield and therefore detect overfishing.	2	AO1
09	4	Mackerel mean growth rate = 0.125 kg yr^{-1} Orange Roughy mean growth rate = 0.0467 2.68 times as fast Accept 2.677/2.679	Calculation commentary Max mass/max age = 2.5 kg/20yrs Max mass/max age = 7.0 kg/150 yrs 0.125/0.0466 = 2.68	2	AO2
09	5	First mark 0.2 kg mass at first breeding Second mark 0.2 x 80 000 = 16 000	Calculation commentary From Table 6, the age of first breeding is 2 years. From Figure 8, the mass at age 2 is 200g. From Table 6, fish produce 80 000 eggs per kg.	1	AO2

Level of response mark scheme: 9-mark questions

Level	Marks	Descriptor
3	7 - 9	A comprehensive response to the question, with the focus sustained. A conclusion is presented in a logical and coherent way, fully supported by relevant judgements. A wide range of knowledge and understanding of natural processes/systems is applied. The answer clearly identifies relationships between environmental issues. Relevant environmental terminology is used consistently and accurately throughout, with no more than minor omissions and errors.
2	4 - 6	A response to the question which is focussed in parts but lacking appropriate depth. A conclusion may be present, supported by some judgements, but it is likely not all will be relevant. A range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there may be a few inconsistencies, errors and/or omissions. The answer attempts to identify relationships between environmental issues, with some success. Environmental terminology is used, but not always consistently.
1	1-3	A response to the question which is unbalanced and lacking focus. It is likely to consist of fragmented points that are unrelated. A conclusion may be stated, but it is not supported by any judgments and is likely to be irrelevant. A limited range of knowledge and understanding of natural processes/systems is shown. There is an attempt to apply this to the question, but there are fundamental errors and/or omissions. The answer may attempt to identify relationship between environmental issues, but is rarely successful. Limited environmental terminology is used, and a lack of understanding is evident.
	0	Nothing written worthy of credit.

Level of response mark scheme: 25-mark questions

Level	Marks	Descriptors
5	21-25	A comprehensive response with a clear and sustained focus. Content is accurate and detailed. Relationships are identified, reflecting the holistic nature of environmental science and the answer as a whole is coherent. A wide range of relevant natural processes/systems and environmental issues are described and articulated clearly. These are applied systematically to the question, with clear relevance to the context. Where conclusions are made, these are fully supported by judgements and presented in a logical and coherent way. Relevant environmental terminology is used consistently and accurately throughout. If there are errors, these are very minor indeed and not sufficient to detract from the answer.
4	16-20	A response in which the focus is largely sustained, with content that is mainly accurate and detailed. Relationships are identified and the answer is largely coherent. A range of natural processes/systems and environmental issues are described and articulated clearly. In most cases, these are applied appropriately to the question but, in some, it is less clear why they are relevant. Where conclusions are made, these are supported by judgements which are mostly coherent and relevant. Relevant environmental terminology is used consistently and throughout, with no more than minor errors.
3	11-15	A partial response which is focused in parts. The content is mostly accurate but not always detailed. There is an attempt at identifying relationships, but the answer as a whole is not fully coherent. A range of natural processes/systems and environmental issues are described, most are articulated clearly. In some cases, these are applied appropriately to the context but, in most, it is less clear why they are relevant. Where conclusions are made, it is not always clear how they relate to the judgments given and are likely to contain errors. Relevant environmental terminology is used, but not consistently and there may be errors.
2	6-10	An unbalanced response, lacking in focus. The content may be inaccurate and lacking detail. There is some attempt at identifying relationships, but the answer is not coherent. A limited range of natural processes/systems and environmental issues are described but not articulated clearly and likely to contain errors and/or omissions. There is a limited attempt to apply them to the context. Any conclusions are likely to be asserted, with no supporting judgements and fundamental errors. Environmental terminology is used, but not always appropriately and sometimes