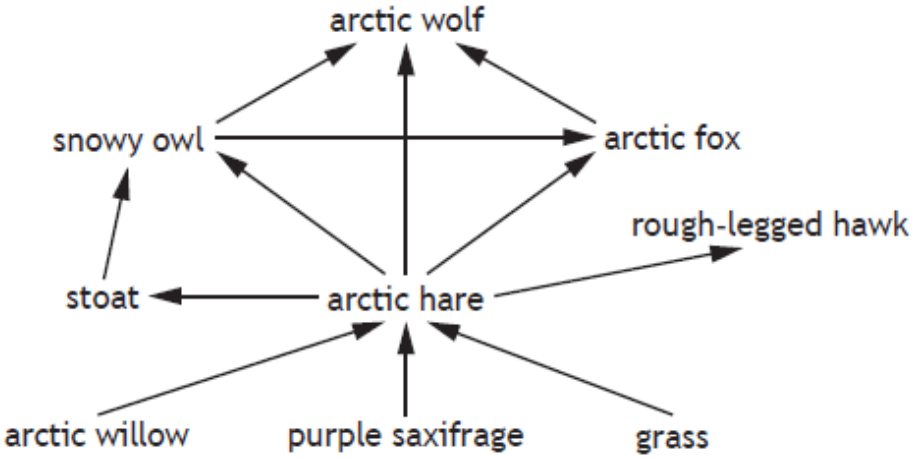
SECTION 1 — 66 marks

Attempt ALL questions

MARKS

**1.** (a) The food web shows some of the organisms in the tundra ecosystem.




(i) State the source of energy for the food web. **1**

**Example 1**

the producers

**Example 2**

sunshine

(ii) Identify one herbivore from the food web. **1**

**Example**

hare

(iii) Explain why there are arrows pointing both towards and away from the arctic fox. **2**

**Example 1**

the fox is a secondary consumer which means it eats most things in this foodweb but it is also eaten by the artic wolf (tetiary consumer)

**Example 2**

because it eats purple saxifrage grass and arctic willow but it also gets eaten by other

**Example 3**

They show which way energy travels when one species eats another species.

(iv) Suggest how the snowy owl and rough-legged hawk avoid competition for the arctic hare. **1**

**Example 1**

Snowy owl also eats stoat so the need for the arctic hare isn't as high.

**Example 2**

Snowy owl eats stoat and arctic hare but rough-legged hawk also eats arctic hare, so snowy owl has more food sources.

(b) The image shows a stoat.

A team of scientists used the capture-mark-recapture method to estimate the stoat population.

During the first trapping session they captured 12 stoats and marked them. The marked stoats were then released.

During the second trapping session 15 stoats were captured, 5 of which were already marked.

(i) Suggest a way in which the stoats could be marked by the scientists. **1**

**Example 1**

using rings around their feet

**Example 2**

Using sat nav collars

(ii) Calculate the estimated stoat population using the formula

$$N = \frac{MC}{R}$$

where $N$ is the estimated stoat population
$M$ is number captured in the 1st trapping session
$C$ is the number captured in the 2nd trapping session
$R$ is the number of marked stoats in the 2nd sample. **1**

(c) The coat colour of the stoat changes from brown in the summer to white in the winter.

(i) Suggest an advantage to the stoat of this colour change. **1**

**Example**

brown in summer allows them to hide in long grass. White in winter allows them to hide in snow.

(ii) State the term used to describe a feature, such as colour change, which allows the stoat to live successfully in its habitat. **1**

**Example**

Adaption

(iii) Increasing temperature in the stoats' habitat is causing a reduction in snowfall.

Suggest an impact on the stoat caused by a reduction in snowfall.
Explain your answer. **2**

**Example 1**

they will start to not change colour which will make the stoats easier to hunt which will decrease their populations. In the long run, they will stop adapting which can lead to them going extinct.

**Example 2**

Death - if they can't hunt for food properly or they get too cold

**Example 3**

Higher temperatures will allow plants to survive for longer, meaning that arctic hare could breed more as there will be more food for them. This will mean more food for the stoat and their numbers will increase

MARKS

**2.** It is estimated that one in every six children does not have access to clean water. According to the United Nations Children's Fund (UNICEF) about 1·5 million children worldwide die every year from waterborne diseases such dysentery, cholera, and salmonellosis. Most of these children live in developing countries that do not have access to a clean water supply.

If everyone who did not have access to a clean water supply boiled their drinking water such deaths could be avoided. It is usually a lack of fuel for boiling the water that forces people to drink water that is unsafe.

(a) Using information from the passage, name a disease that can be spread through water supplies. **1**

**Example**

Malaria

(b) Suggest two reasons why families might lack fuel for boiling water. **2**

**Example 1**

1 Cost

2 Transportation

**Example 2**

1 Might not live near some where by fuel

2 Might not be able to afford it

(c) The Jompy Boiler, an innovation by a Scottish plumber, could reduce the number of people drinking contaminated water. It takes the form of a tightly coiled metal tube that sits over a fire.

Cold, contaminated water goes in one end of the tube and as it moves through the coil is heated to boiling point. This kills waterborne diseases. Boiled, clean water comes out of the other end of the tube. While it is being used, a cooking pan may be placed on top of the coil.

(i) The Jompy Boiler can produce clean water at a rate of 1 litre per minute.

Each person requires 3 litres of clean water for drinking and cooking per day.

Calculate how long it will take to produce enough clean water for a family of 5 for 1 week. **2**

**Example 1**

5 x 3 = 15

15 x 7 = 105 105 litres

**Example 2**

105

(ii) Suggest how the Jompy Boiler can help contribute to sustainable development. **1**

**Example 1**

water doesn't get wasted, which means it won't run out

**Example 2**

There will be less people dying

**Example 3**

Safe water means that people won't get sick and will be able to go to work or school.

(d) The quality of water in Scotland is monitored.

Name the national organisation responsible for monitoring water quality in Scotland. **1**

**Example**

Scottish Environment Protection Action

(e) Give one way in which you could reduce water use in the home. **1**

**Example**

Only turn the dishwasher and washing machine on when they're full.

**MARKS**

**3.** There are 8 million pet dogs and 9 million pet cats in the UK.

(a) Like people, pets also have a carbon footprint.

State what is meant by the term *carbon footprint.* **1**

**Example 1**

the amount of carbon dioxide each living organism produces.

**Example 2**

When a cat or dog has about movement the excrement lets off toxics into the Atmosphere

**Example 3**

How much CO2 a living thing lets out, like during a dog walk.

(b) A pet's annual 'ecological footprint' can also be measured. This is the area of land needed to support a pet. The units of an ecological footprint are global hectares (gha).

A cat has an annual ecological footprint of 0·15 gha, which is about the same as is needed for a small car. Smaller pets such as a goldfish (0·00034 gha), hamster (0·014 gha), and a budge (0·007 gha) have much less impact on the environment.

(i) Complete the table to show the annual ecological footprints of the pets mentioned by
- adding appropriate headings
- arranging the pets in order from smallest to largest annual ecological footprint
- completing the annual ecological footprint for each pet. **3**

**Example 1**

| Breeds of animals | Annual ecological footprint (gha) |
|---|---|
| CAt | 0.15 gha |
| Hamster | 0.014 |
| Budgie | 0.007 |
| Goldfish | 0.00034 |

**Example 2**

| Breeds of animal | Annual ecological footprint |
|---|---|
| Goldfish | 0.0034 |
| Budgie | 0.007 |
| Hamster | 0.014 |
| Cat | 0.15 |

(ii) A border collie needs 280 kg of dog food per year.

One kilogram of dog food requires 0·003 gha to produce.

Calculate the ecological footprint of the border collie. **1**

MARKS

4. The Kelpies are horse-head sculptures made from stainless steel. Each Kelpie is 30 metres high and weighs 300 tonnes.

Stainless steel is a mixture of iron and other elements.


(a) Name one use of iron other than for sculptures. **1**

**Example 1**

buildings

**Example 2**

Forth rail bridge

(b) (i) The iron used to make stainless steel sculptures was extracted from iron ore.
Describe the formation of iron ore. **2**

**Example 1**

iron ore is formed under the weight of the ground. forming for millions of years from bits of broken down rock, containing the mineral (iron).

**Example 2**

Forms in the sea when organisms release gases that join with iron in the water.

(ii) Name the industrial equipment used to process the iron from iron ore. **1**

**Example**

Iron ore is mixed with coal and limestone and heated at very high temperature until the iron melts and runs out.

(c) The percentage of iron in stainless steel can vary. It can range from 90–95% of the total mass.

Calculate the maximum mass of iron contained in both the Kelpies. **1**

**Example 1**

100% = 300 tonnes
÷100 ÷100
1% = 3
95% = 285

285 tonnes

**Example 2**

95 x 300
= 28500 x 2

57000 tonnes

(d) Scale models of the Kelpies were made. These are transported around the country and displayed to encourage people to visit the full size sculptures.

The models are made on a 1:10 scale.

(i) Calculate the height of the scale model Kelpies. **1**

(ii) Describe one environmental impact of transporting the scale model Kelpies. **1**

**Example 1**

Cars release carbon dioxide

**Example 2**

The kelpies are 30m high and very heavy so will need huge lorries to move them, and these will be slow moving and hold up traffic.

**MARKS**

**5.** The Cairngorms National Park in Scotland contains several Sites of Special Scientific Interest (SSSIs).

(a) State one reason why an area may be designated as a SSSI. **1**

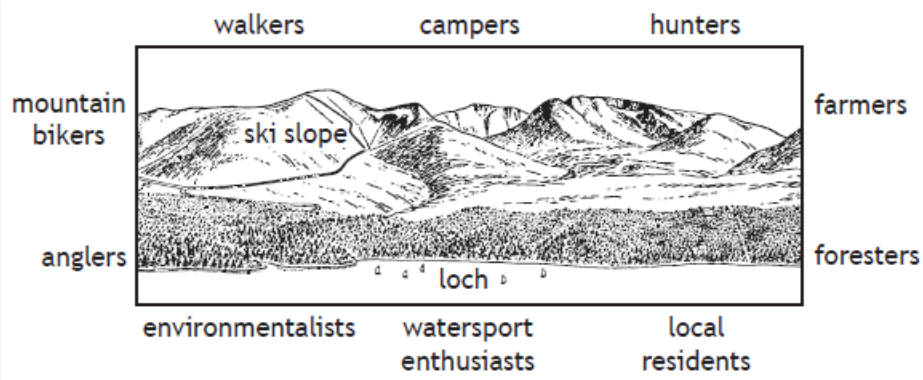
**Example 1**

because it might have lots of stuff for research

**Example 2**

Because of its mountains and the species adapted to live in them.

(b) The Cairngorm National Park has a range of terrestrial and aquatic environments. Many people visit, live and work in the Cairngorms. Some of these stakeholders are identified in the diagram.




(i) Using the diagram, identify two stakeholders who may come into conflict and suggest two reasons why conflict may occur between them. **2**

**Example 1**

Anglers and watersport enthusiasts
- Disturbing fish
maybe disturbing or fishing nearby

**Example 2**

Campers and environmentalists.
campers leave lots of mess behind, like tents, bottles and human waste
Environmentalists get angry because they have to clean up the campers mess when they leave.

(ii) Describe how these conflicts could be reduced. **2**

**Example 1**

have designated areas where only hunters are allowed to go. Set up traps to only lure the animals which need hunted, without disturbing the other organisms living in that ecosystem.

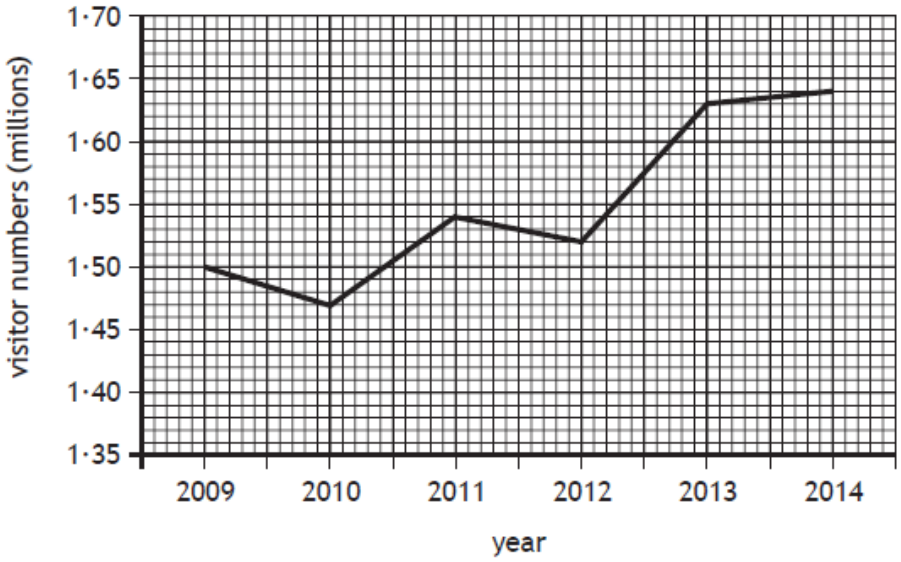
**Example 2**

No one is allowed in the loch while the anglers and fishing boats are on the loch

**Example 3**

Make it illegal to camp unless in a campsite run by the park.

(c) The graph shows the number of visitors to the Cairngorm National Park over a 5 year period.




Calculate the percentage increase in visitor numbers from 2009 to 2014. **2**

**Example 1**

1·50 − 1.64 14 %

**Example 2**

2009 = 1·50 2014 = 1.64

$\frac{0.14}{1.64} = 8.5$ 9 %

(d) The table provides information about some of the species found in the Cairngorms.

| Species | | Habitat | Food source |
|---|---|---|---|
|  | pine marten | native and plantation forest | nuts, berries, eggs, small rodents |
|  | red deer | moorland, native forest | grasses, heather, shrubs, trees |
|  | red grouse | heather moorland | heather shoots, small invertebrates |
|  | golden eagle | moorland, mountain | small mammals, birds |

(i) From the table, identify an omnivore. **1**

(ii) Red deer are hunted in the Cairngorms.

Suggest a reason for and a reason against hunting as a sustainable activity. **2**

**Example 1**

for - keeps red deer populations under control which means other species with a similar niche don't have to compete as much, keeping biodiversity

against - they might over hunt meaning that red deer will no longer breed to produce offspring which can then lead to their extinction.

**Example 2**

After a while deers teeth disappear which Means its impossible to eat. They are a species that attract gillies, Stalkers and keepers also shooting parties to shoot the deer

(iii) After many years of decline, golden eagles and pine martens are increasing in numbers.

Suggest how human activities may have contributed to this increase in numbers.

**Example 1**

No leaving litter on ground so the animals can get to them and cause damage

**Example 2**

Encouraging landowners not to kill them.

(iv) The Cairngorms include large areas of forest.

Explain the differences between native and plantation forestry. **2**

**Example 1**

Native is trees that naturalised in Scotland Plantation is different trees and plant species from different country

**Example 2**

Native forestry is not managed. Plantation forestry is trees which are specially grown for things like telegraph poles and building.

(v) Name the national organisation with responsibility for conservation and education about environments such as the Cairngorms. **1**

**Example**

SNH – Scottish National Heritage

MARKS

**6.** The Scottish Government has set a target for 100% of Scotland's electricity to be produced by renewable sources.

The construction of wind farms is one way that the Scottish Government is planning to meet this target.

(a) Describe the energy change in a wind turbine. **1**

**Example**

Wind moves the blades and spins the turbine, which generates electricity.

(b) Suggest one benefit to the environment of wind farms. **1**

**Example 1**

Less electricity wasted

**Example 2**

Is a clean fuel source.

(c) Wind farms can be located on land or offshore. The largest wind farm is being constructed off the coast of Scotland. It will eventually provide one million households with electricity.

(i) There are 2·5 million households in Scotland.

Calculate the percentage of Scottish households that the offshore wind farm will provide with electricity. **1**

(ii) Suggest two advantages of locating the wind farm offshore. **2**

**Example**

Leaves land free to grow crops.
People don't have to see or hear them.

(d) Some people disagree with siting the wind farm off the coast of Scotland.

From the list below underline one group of people who might disagree with siting the wind farm off the coast of Scotland and suggest a reason why they might disagree. **1**

**Example**

Fishermen Coastal hotel owners Sailing clubs

Reason

Exclusion zone around the turbines

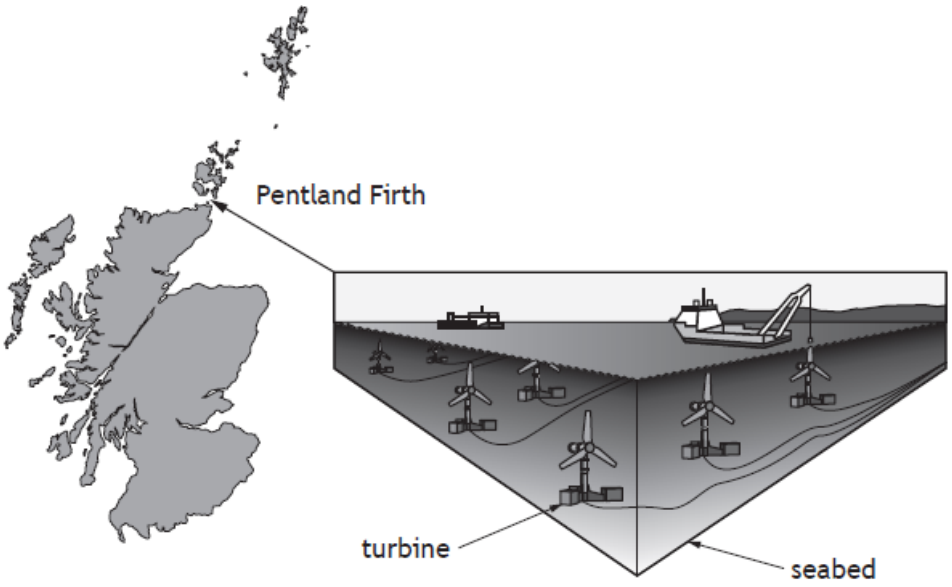
(e) Name a non-renewable source of energy used for generating electricity. **1**

**Example**

Waste.

MARKS

**7.** The Pentland Firth tidal power plant will be the biggest tidal turbine plant in Europe.




(a) State three factors that need to be taken into consideration when deciding where to site a tidal power plant. **3**

**Example 1**

- Sufficient water supply
- Strong wind to make strong waves to move the turbines
- make sure it is in an area where no habitats are ruined.

**Example 2**

- To have a decent current to power the farm.
- The waters deep enough
- That the seabed can be attached on.

(b) Suggest one environmental and one economic impact on the local area arising from the use of a tidal power plant. **2**

**Example 1**

Environmental pollution levels dropping as nothing is getting released into the air.

Economic over time, it would be more cost effective than having to extract all these fuels for electricity

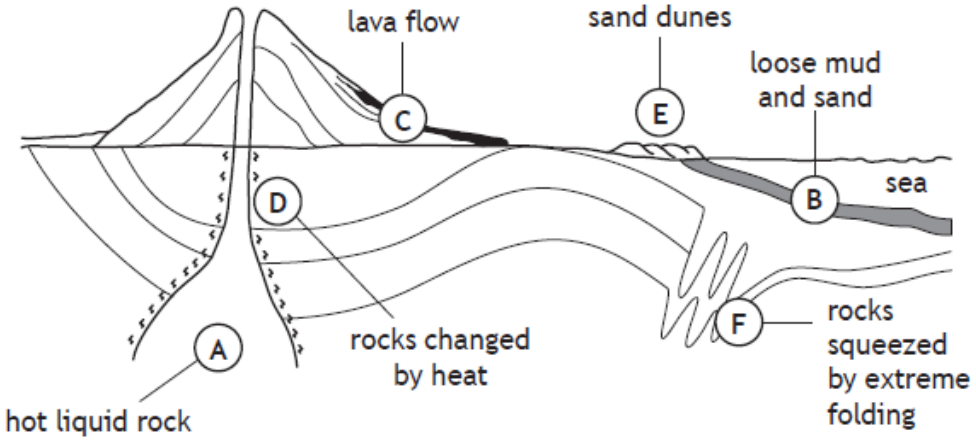
**Example 2**

Environmental It's powering homes

Economic It will cost alot of money

MARKS

**8.** (a) The diagram shows a section of the Earth's crust.




(i) Complete the table by naming the rock type that will form at each location.

Choose from igneous, sedimentary, and metamorphic. **3**

(ii) The sand at position B will eventually turn in a porous rock.

Give two reasons why the rock formed in this area will contain water. **2**

**Example 1**

Reason 1 the spaces in between the grains will be large as water not *

Reason 2 formed in water therefore will contain it as it absorbed it.

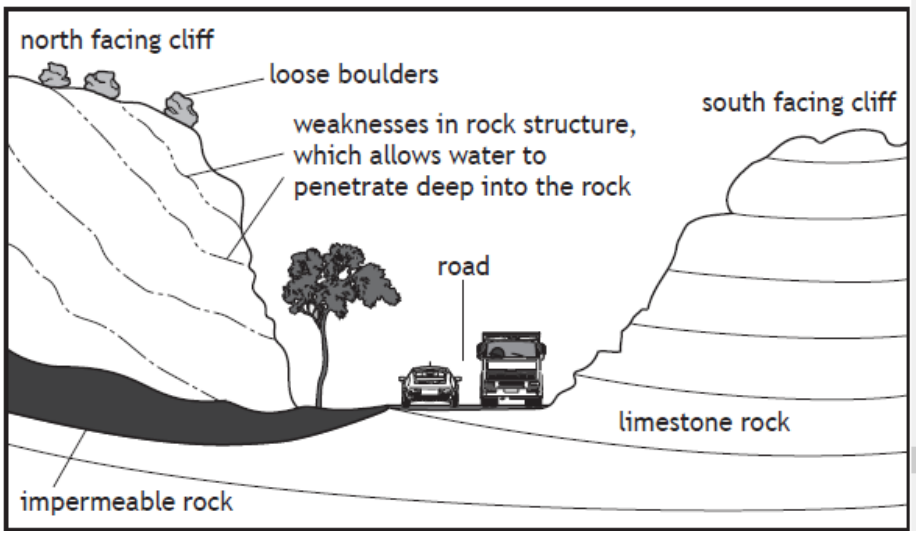
* heavy enough to compact them

**Example 2**

Reason 1 Because it's right under of the sea

Reason 2 Because it could wash and sand and the water can easily get through it

(b) A glen in the Scottish Highlands has a very wet climate. Temperatures often drop below freezing point, especially during the night.




(i) Name two weathering processes that will affect the cliff faces on the sides of the glen. **2**

**Example 1**

Process 1 Erosion

Process 2 Decomposition

**Example 2**

Process 1 rain

Process 2 snow

**Example 3**

Process 1 Thermal weathering

Process 2 Freeze-thaw weathering

(ii) The Scottish Government sends geologists to inspect the north facing cliff before the start of every winter.

Suggest two reasons why this is necessary. **2**

**Example 1**

- it's near a road so if bits of rock are loose it will fall onto road causing accidents.
- limestone is a money income so need to make sure it can be extracted.

**Example 2**

To see how loose boulders are and the weakness of the cliff.

**Example 3**

because it has loose boulders

and a weak rock structure, which can break off and hit cars

**SECTION 2 — 20 marks**
**Attempt ALL questions**

Settlement X lies at the estuary of a major Scottish river, and sits on one of the largest shingle complexes in Britain. The shingle complex comprises rock debris continuously transported by the river from the Cairngorm Mountains since the last ice age, deposited as rounded stones in the river mouth. Sea level rise at the end of the last ice age flooded the estuary, leaving behind extensive deposits of shingle on the land surface as sea level fell again.

The shingle complex is constantly shaped by river and coastal processes. Shingle transported by river down to the estuary is moved westwards by coastal currents. Currently, the shingle complex extends 1 km inland and 8 km along the coast. The shingle banks closest to the shore have long provided protection to coastal communities, including Settlement X, against high tides and storms.

The shingle complex, the river, and the estuary are exceptional sites in their own right, and also as an integrated system. Two SSSI designations are in place, on account of the geomorphological nature of the shingle plus the range of specialised species it supports. Geomorphology refers to the formation and structure of a landform, such as the shingle banks.

Tourism brings valuable revenue to the area. Large numbers of wildlife enthusiasts visit the estuary each year, while the river supports salmon fishing, distilleries, canoeing and rafting companies, and local communities along its length. Golf courses sit on either side of the river, and hotels and B&Bs offer food and accommodation.

Sea level change and an increase in storm events over the last few decades have significantly eroded the shingle banks closest to the shore. In storm events, waves ‘over-top’ the banks, and have broken through them on occasion. Such events are now occurring almost annually and are also increasing in intensity. At the same time, the shingle banks are under threat from behind, due to increased precipitation affecting the river’s flow rate and volume.

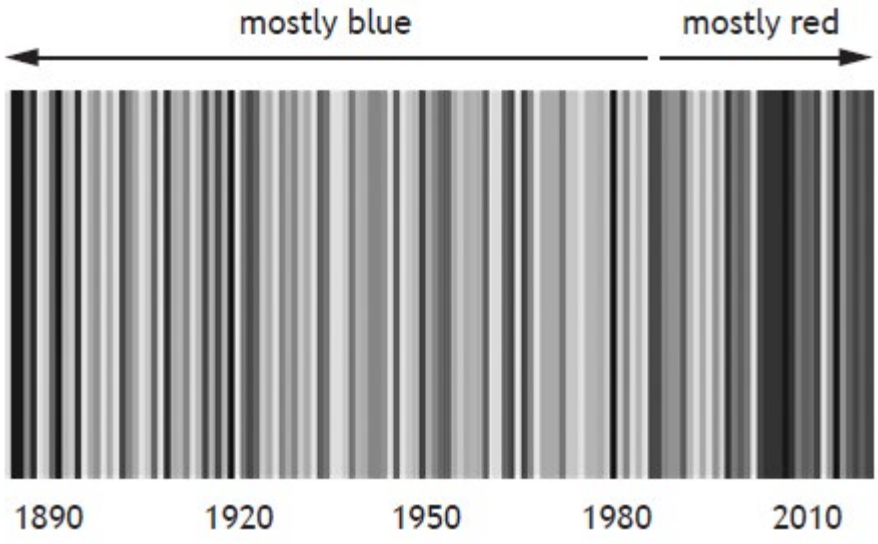
A team of coastal engineers has been commissioned to assess options for protection of the shingle complex and communities located behind them.

Using the information provided here and in the supplementary source booklet, as well as your knowledge of environmental science, attempt the following questions.

**MARKS**

**1.** The UK Climate Change Risk Assessment (2017) lists risks linked to changes in temperature that are particularly likely to impact on Scotland (**Source D**).

The 'warming stripe' diagram is a visual representation of changes in temperature measured in Scotland between 1884 and 2019. Each stripe represents the average temperature in Scotland over a year. Blue lines represent cooler than average temperature and red lines represent warmer than average. The darker the line, the more the temperature differs from the average.




(a) Describe the overall trend shown in the diagram. **1**

**Example**

From 1884 to 2010 the heat increases

(b) Freshwater drawn from the river is used by local communities and industries.

Suggest one way that climate change might affect water quality. **1**

**Example**

water could become so that it doesn't have as much oxygen due to the bacteria entering it.

MARKS

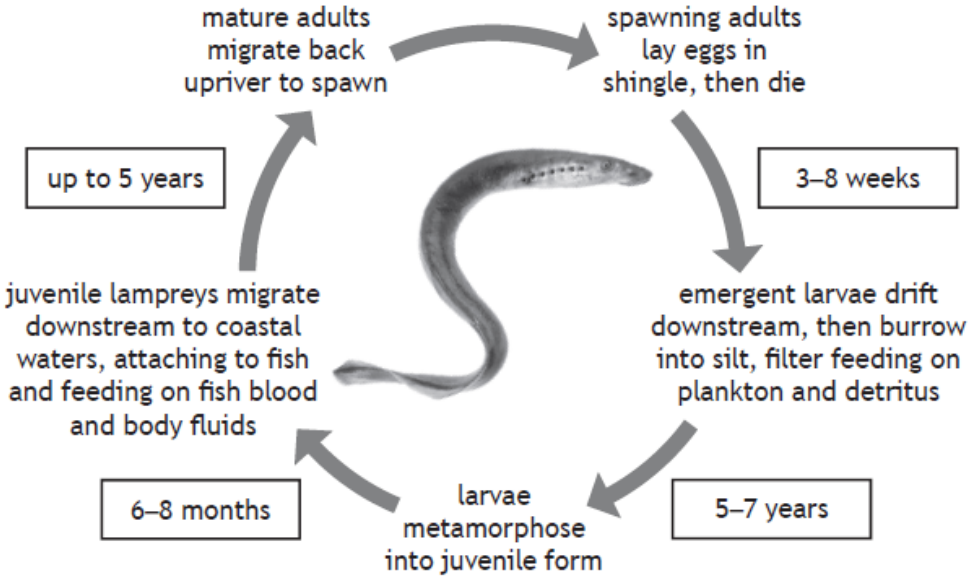
**2.** The sea lamprey is one of the species designated under the river's SSSI (Source C).

The sea lamprey is a jawless, eel-like vertebrate.

The juvenile and adult forms have a sucker-like mouth, lined with rows of sharp teeth.

Sea lampreys are able to survive in both freshwater and saltwater at different stages of their lifecycle.

The lifecycle stages are largely driven by water temperature.




Sea lamprey requirements:

- minimal obstructions likely to prevent migration up or down a river
- good quality water
- clean sand and gravel areas for spawning
- silt for larvae to burrow into
- supply of organic matter for filter feeding by larvae
- plentiful supply of host fish for juveniles

(a) Newly-hatched sea lampreys are filter-feeders that consume algae and dead organic matter found on river bottoms.

State the term used to describe an organism that feeds on dead organic matter. 1

**Example**

Herbivore

(b) Explain why juvenile sea lampreys require a plentiful supply of fish in the area. **1**

**Example 1**

To ensure they grow and survive

**Example 2**

because they feed on their blood

(c) Explain one way that climate change could impact significantly on sea lamprey survival. **2**

**Example 1**

The water quality

**Example 2**

They may need to go else where if the fish they eat goes else where for food

**Example 3**

it would impact on the temperature and quality of the water which good water is needed for lamprey survival

the temperatures would increase, making it hard for them to breed.

MARKS

**3.** A forestry plantation covering 818 hectares of the shingle complex was leased to the national organisation responsible for forestry management, in the late 1930s. Planting with trees helps stabilise large areas of the shingle.

(a) The table shows the proportion of land within the plantation covered by different tree species.

| Tree species | Coverage | |
|---|---|---|
| | Hectares | % |
| Scots pine | 401 | 49 |
| Corsican pine | | 13 |
| Mixed broadleaves | 16 | 2 |
| Lodgepole pine | 25 | 3 |
| Mixed conifer | 245 | 30 |
| Other | 25 | 3 |

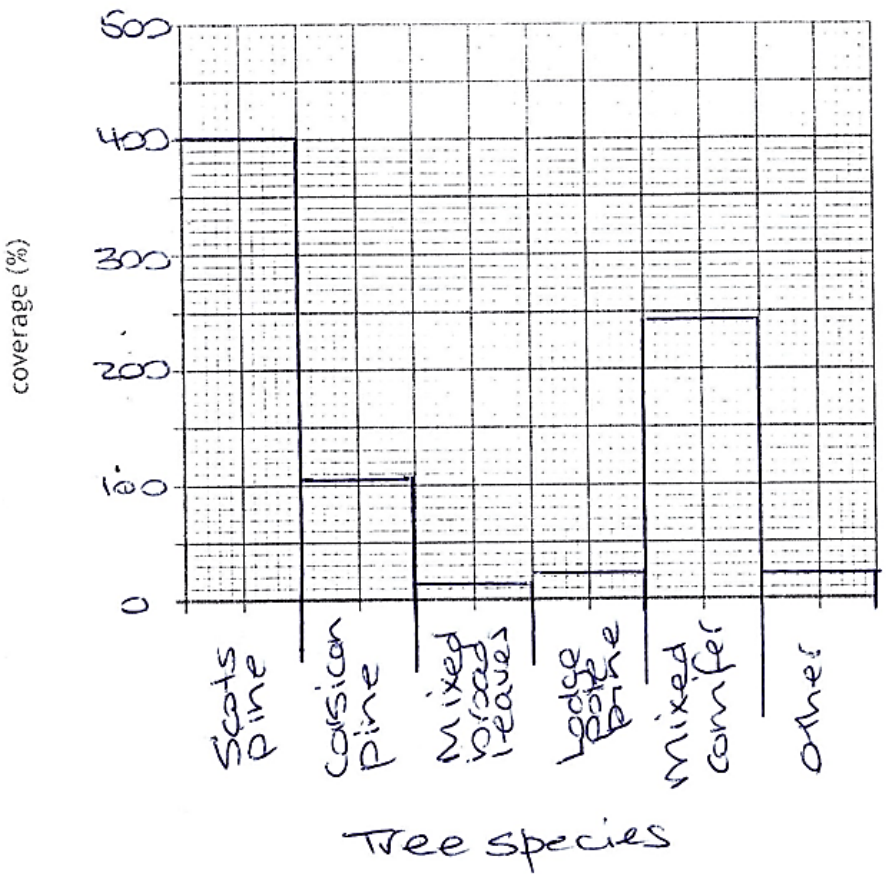
(i) Complete the table by calculating the area planted with Corsican pine, rounded to the nearest hectare. **1**

**Example**

401 + 16 + 25 + 245 + 25 = 712 = 89

(ii) Using information from the table, draw a bar graph to show the percentage of land covered by the different tree species present in the plantation. **2**

**Example**




(iii) Part of the plantation lies within a SSSI. Forestry and Land Scotland (FLS) is required to prepare a conservation management plan for this area.

Name the national organisation that will advise FLS on best conservation practice within the SSSI. **1**

(iv) The conservation management plan includes a requirement for the periodic requirement of gorse from the shingle. Gorse is an extremely hardy, evergreen, prickly, native shrub.

Suggest why there is a need to remove the gorse from the shingle complex. **1**

**Example 1**

So they don't kill other species

**Example 2**

because it grows on top of the shingle making it hard to extract

(b) (i) The shingle consists of well-rounded, resistant rocks that have been transported up to 170 km by the river, from the Cairngorm Mountains.

Explain why the shingle is well-rounded on arrival at the estuary. **2**

**Example 1**

because it's been in water which rounds the Rocks

**Example 2**

Because there may not be a strong enough current to carry it any further

(ii) Describe how the rounded nature of the rocks will impact on the porosity of the shingle. **1**

**Example**

because they are rounded it makes them more porous. the spaces between the rocks are larger, allowing water to pass through.

| | | MARKS |
|---|---|---|
| **4.** | A review of coastal engineering options for the estuary was carried out in 1996.<br><br>The estimated costs of the coastal engineering options in 1996 are shown in Source E.<br><br>The graph in Source F shows that £100 in 1996 was equivalent to £196 in 2020, when adjusted for inflation.<br><br>Calculate the increase in the estimated cost of the most expensive option shown in Source E between 1996 and 2020. | **2** |
| **5.** | A do-nothing scenario could have serious consequences for the area, but coastal engineering is hugely expensive. The local authority must decide whether to implement coastal engineering in this area.<br><br>Using evidence from the sources and your knowledge of environmental science, decide whether coastal engineering should be implemented in this area.<br><br>Justify your answer. | **4** |

**Example 1**

because over the years of having it will cost too much - it also Takes alot of planning and construction takes too long - it wont look good - visual impact - ~~Projects~~ disturbs nature, destroys habitats

**Example 2**

Yes because it may cost you more in the long run if alot of things go wrong if you dont act on it.

**Example 3**

Although really costly with all the needed costal engineering (there would also be a huge profit because of the single production. Also if it is implemented there are lots of advantages that come with this.

Breas water : one-off construction
minimal maintanance needed
will trap. shingle so it would be more cost effective when it comes to extracting shingle.

Rock. armour : still has a natural look really easy to maintain

MARKS

## SECTION 3 — 14 marks

### Questions 10 and 11 each contain a choice

Write your answers to questions 10 and 11 on the following pages.
You may use diagrams where appropriate.

**10. A** The image shows some of the activities on a farm.

Choose activities associated with the image and

- describe ways that the activities can cause damage to the environment
- discuss the potential solutions for reducing the damage. **7**

OR

**B** Scotland's fish stocks are of valuable economic importance.
Discuss ways in which fish stocks can be conserved. **7**

**11. A** The atmosphere contains approximately 80% nitrogen.
Describe the nitrogen cycle and its role in sustaining life on Earth. **7**

OR

**B** Carbon is an element found in all living things.
Describe the carbon cycle and its role in sustaining life on Earth. **7**

**10 A Example 1**

10. A) The cows are in to river. Which will have an effect on the biodiversity of the river due to the cows waste going into the river. Along with the farmer fertilising right next to the river, This will lead to Euthrophication. Which will also have an effect on the biodiversity of the river. The effect it will have on the river is that the cows waste will be toxic to the fish and invertebrates that live there. Which will lead to the death of them. Euthrophication runoffs will also end up killing them - And will be harmful to any other species who will come and drink at the river. Potential solutions would be to fence the river or cows off from getting to the river. And have a border to where farmers have to not fertilise so the run-offs don't end up in the river or use natural fertilisers without chemicals.

Option one

**Example 2**

There is spraying going on which is not allowed 5 meters from the river bank and could pollute the water with such things as fertiliser pesticides and herbicides, also the cattle in the river with their fecal matter. There will be pollution in the river because of that and of the chemicals in the sprayer and the cattle may drink the chemicals and be harmed or die.

**10 B Example**

10 B

Overfishing and fishing stocks running low has always been problematic. To control the amount of fish being fished, controls have been put in place. Having nets with bigger holes, to allow the small fish to exit, only having certain times in the year (after most fish have bred) would mean that they aren't disturbed, producing new fertile offspring. Soon after breeding season they can fish again. If fishing with cages, make holes bigger in the cages to allow the small fish to exit. Only fish a limited quantity at a time. Have special controls put in place to control the amount of fish coming out the ~~water~~ sea for example.

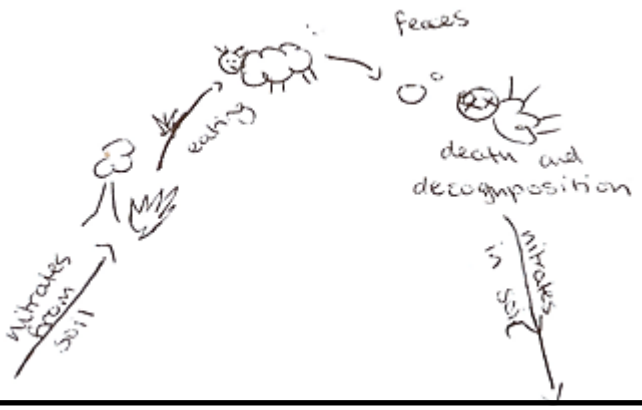
**11 A Example 1**

11. A) Nitrogen cycle - Lightening goes into the ground so where Nitrates are from decomposing animals / waste / leaf matter, that then helps feed on plants that

**Example 2**

11. B

Nitrogen comes from the air and is changed into nitrates. Nitrates go into the soil by precipitation and is extracted through the roots of the plant. Plants use them to make proteins like chlorophyll. They are then eaten by animals which pass them out through urine and feces. Those act as fertiliser going back into the soil fertilising new plants.




**11 B Example**

The carbon cycle is when a quantity of grass or plants have grown and has reached a point for the potential to eat so the animal comes and eats the grass or plants then either defecates letting of fumes or if it produces fecal matter that also lets off fumes