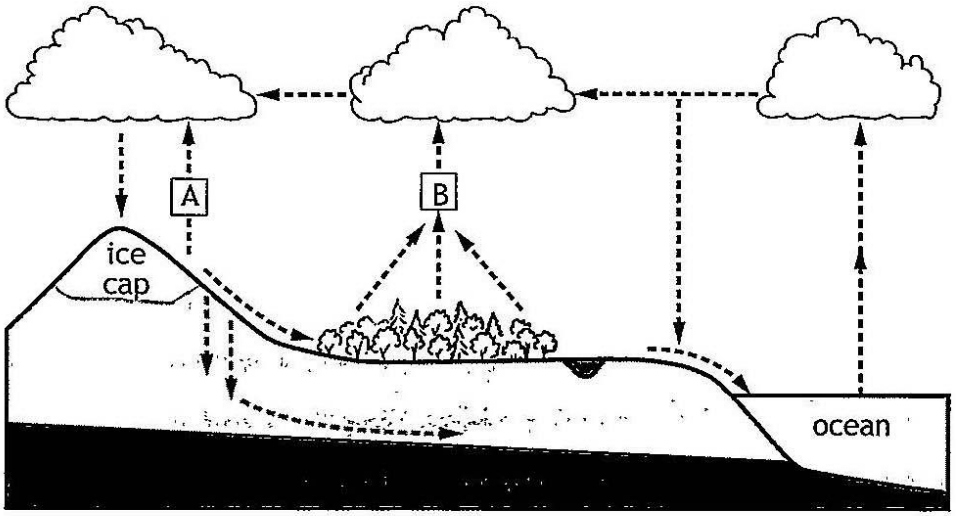
MARKS

Total marks — 100

Attempt ALL questions

Questions 10 and 11 each contain a choice

1. The model hydrological cycle below illustrates the storage and movement of water in its various states above, below and across the Earth's surface.



Model Hydrological Cycle

(a) (i) State a form of natural subterranean water storage. 1

Aquifers

(ii) Name and describe the process occurring at either A or B. 2

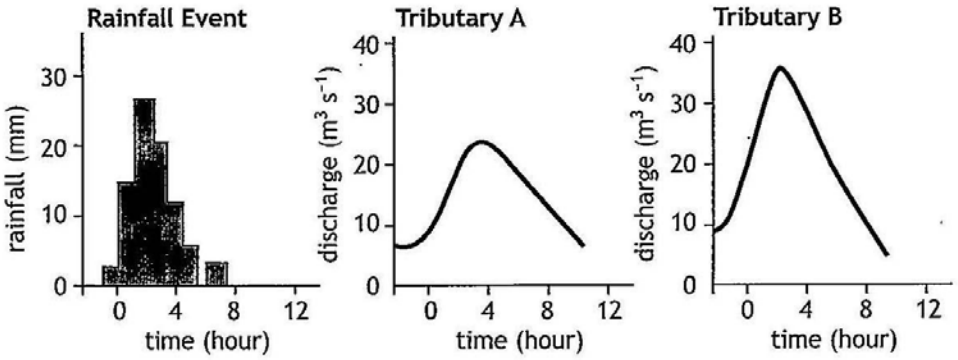
B = transpiration – transformation of water from trees and plants into water vapour.

1. (continued) MARKS

(b) The measurement of river discharge can be recorded on a river hydrograph.

In the diagram below, the rainfall event graph shows the distribution of rainfall over a twelve hour period in a river catchment.

The hydrographs illustrate the discharge of two tributaries within the river catchment during the same rainfall event.



(i) Compare the discharge between the two tributaries during the rainfall event. 3

The discharge of tributary A reaches a discharge of $25m^3s^{-1}$ after 3 hours, before returning to a normal level after 10 hours.

The discharge of tributary B however reaches a higher $35m^3s^{-1}$ after a shorter time of 2 hours. The second example also returns to normal levels after only 8 hours.

(ii) Explain how a change of land use may affect river discharge. 2

Land used for farming may be irrigated which will lower the discharge of the river.

MARKS

2. The pine marten (*Martes martes*) is an omnivorous cat-sized member of the weasel family. At different seasons, its diet includes fungi, berries, birds, eggs, beetles, carrion, and small mammals, including squirrels. It is an agile hunter, which hunts both in the trees and on the ground.

Although it was once commonly found in Britain, by the early 20th century the pine marten's range had been reduced to small populations in the pine forests of the north-west Scottish Highlands. Since 1950 it has expanded its range significantly, but it remains a rarely seen animal with an estimated population of only 4000 in 2012.

(a) Suggest **two** changes in the management of the countryside which have taken place since 1950 that would have helped the pine marten numbers to increase. 2

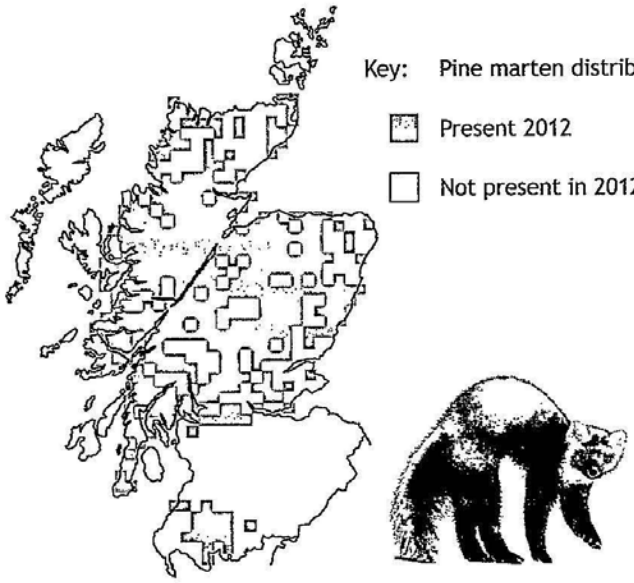
1. Rising grey squirrel numbers means the pine marten has a greater number of organisms to feed on
2. Expansion of pine woodland Provides habitats

2. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(b) The diagram shows the distribution of the pine marten in Scotland as recorded in surveys carried out in 2012.

The squares on the map represent 10 km × 10 km areas (hectads) in which pine martens were surveyed and recorded as being present.



The distribution of the pine marten in 2012 was determined by walking along a forest track for 1 km and counting the number of scats (faeces) left by the pine martens. This was carried out in the largest forest in each hectad.

Earlier research suggested that if a breeding population of pine martens was present in an area, at least seven scats would be recorded for every 4 km of transect walked.

Discuss the validity of the technique used and how it might be improved. 3

The validity of the experiment is poor as the factors at play could easily change during the experiment due to the natural environment.

The experiment is not reliable as the process was only undertaken once. This could be improved by walking the track several times.

The experiment is not random as the section walked was along a forest track rather than in the wild. This could be improved through use of a random number generator to select location

MARKS

2. (continued)

(c) The native red squirrel (*Sciurus vulgaris*) is under threat in Scotland from the introduced North American grey squirrel (*S. carolinensis*).

The table compares some features of the two species.

Squirrel species	*Mean mass* (g)	*Percentage of time spent foraging in trees* (%)
Red	300	67
Grey	550	14

(i) Calculate, as a simple whole number ratio, the mean mass of the red squirrel in relation to that of the grey squirrel. **1**

Space for calculation

$\frac{300}{50} = 6$ $\frac{550}{50} = 11$

red squirrel 6 : 11 grey squirrel

(ii) The expansion of the pine marten distribution has reached areas of the country where both red and grey squirrels are found.

With reference to data in the table above, suggest why it may be advantageous to the red squirrel that this predator is entering the area where both squirrel species are present. **2**

predation is a density-dependent factor meaning the predator will disproportionately affect the grey squirrel

Additionally, the larger mass of the grey squirrel will make it more appealing to the predator

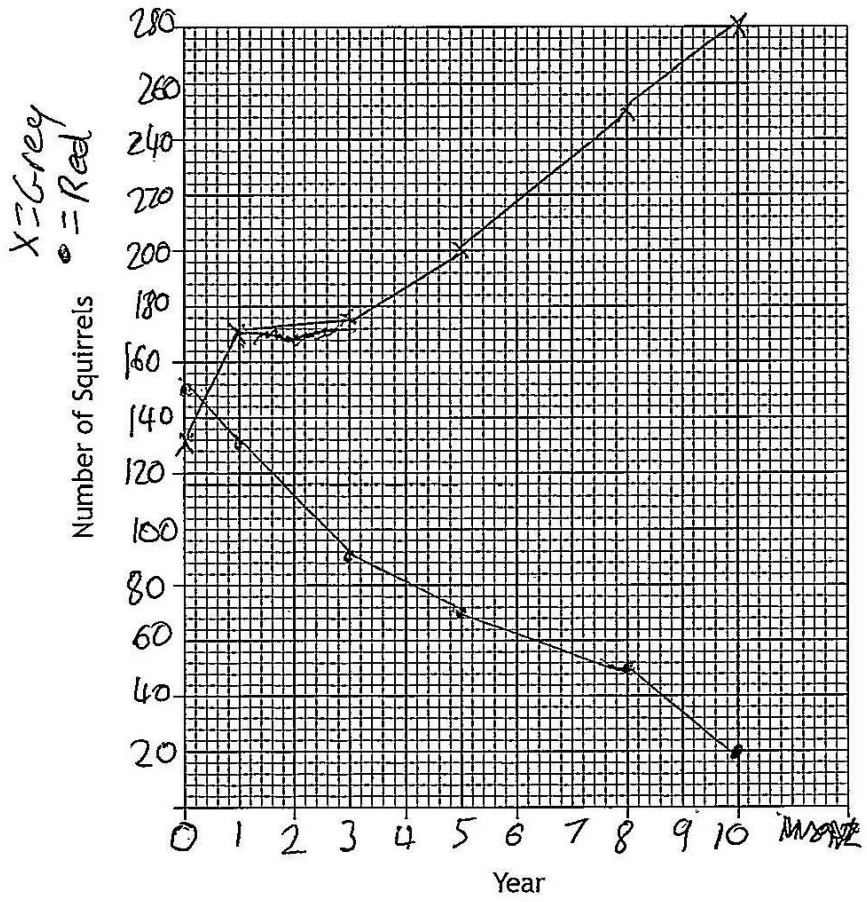
MARKS

2. (c) (continued)

(iii) The table below shows the populations of grey and red squirrels which were recorded in an area of woodland over a 10 year period.

Year	*Numbers of squirrels of each species*	
	Grey	*Red*
0	130	150
1	170	130
3	175.	90
5	200	70
8	250	50
10	280	20

Draw a line graph to show the numbers of grey and red squirrels over the period of the study. **2**



I

MARKS

3. Baryte is an abundant mineral that has many industrial uses.

(a) State **one** way in which baryte forms. 1

formed through buildup of material at Subduction zones which is heated and applied with pressure.

(b) The table below shows Argentina's baryte production from 2003 to 2009.

Year	*Production* (tonnes)
2003	6934
2004	2762
2005	3355
2006	6276
2007	37 979
2008	3170
2009	4000

(i) Calculate the percentage change from 2006 to 2007. 1

Space for calculation

$\frac{37979}{6276} \times 100 = 605.15\%$

(ii) Suggest a possible reason for the sharp increase in baryte production in 2007. 1

increased activity in Subduction Zones due to plate movements

MARKS

3. (continued)

(c) Explain how soil-forming processes can result in commercially viable deposits of baryte. 2

If the process results in a significant amount of metal in the deposit then it becomes an ore and economically viable to mine

(d) Baryte is used in many industries, often in the form barium sulfate.

(i) State a reason for the use of barium sulfate as an additive in oil drilling. 1

Effective in ensuring the purity of the oil is kept.

(ii) Barium sulfate is commonly used as a "barium meal" in biomedical imaging, to diagnose abnormalities within certain internal organs.

Explain why barium sulfate is suitable for use in biomedical imaging. 2

improves safety by protecting the patient from harmful rays.

Also used due to its abundance and relative ease of access.

[Turn over

MARKS

4. Carpets and carpet tiles consist of an upper layer of "pile" attached to a backing. The pile can be made from either natural or synthetic fibres and usually consists of twisted tufts which are often heat-treated to maintain their structure. The backing is primarily made of latex.

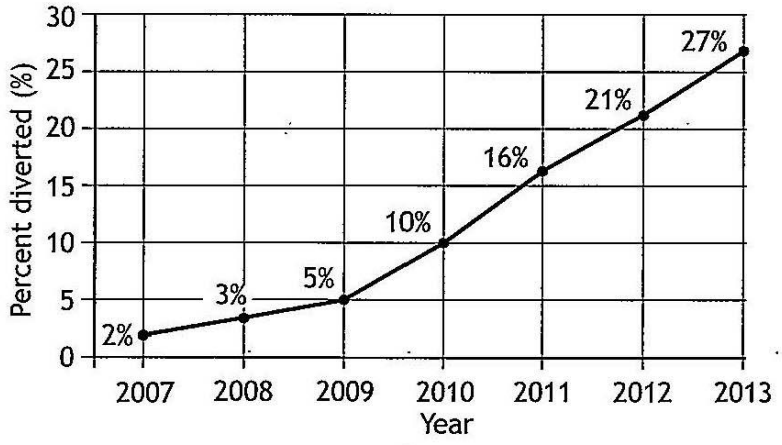
Once a carpet is no longer needed there are a number of options:

- **Reuse:** carpet tiles are cleaned and reused.
- **Recycle:** components of the carpet are separated for recycling.
- **Energy recovery:** carpets are shredded, mixed with other materials and used as secondary fuel for industry, or burned as a fuel to create electricity.
- **Disposal:** mainly to landfill.

(a) State **two** factors which would be considered in the life cycle analysis of a product such as a carpet. 2

- The resources used to make the carpet must be sustainably sourced.
- Must use ~~recycling~~ materials which can be recycled.

(b) The graph below shows the total percentage of carpets being diverted away from landfill in the UK from 2007 to 2013.



107 000 tonnes of carpets were diverted away from landfill in 2013. The remainder was sent to landfill.

Calculate, to the nearest tonne, the mass of carpets deposited in landfill in 2013. 1

Space for calculation. ~~100%~~. 100% − 27% = 73%.

107,000 × 2 = 214000
107,000 × 25 = 2,675,000
2,675,000 × 3 = 8,025,000
8,025,000 − 214000 = 7,811,000 tonnes

MARKS

4. (continued)

(c) Suggest **two** disadvantages of energy recovery compared to recycling. 2

- Outputs pollutant gases
- Is more energy intensive than recycling

(d) In addition to selling carpets, some manufacturers use a "closed-loop approach" to their business. They lease out carpet tiles which are then collected back, cleaned and reused. This is called a circular economic model.

A linear economic model is one where manufacturers take resources, make goods out of them and sell these. The majority of these goods end up in landfill.

(i) Suggest **two** environmental benefits that the circular economic model has over a traditional linear economic model. 2

- Eliminates waste to a great extent which prevents buildup of landfill which releases pollutant gases
- Eliminates need to source new resources to as much or an extent - prevents habitat loss and release of pollutant gases in collecting resources

(ii) Suggest **two** reasons why manufacturers may be resistant to using the closed loop approach. 2

- Cleaning tiles may be expensive and energy intensive
- May be more difficult to sell "used" carpet

MARKS

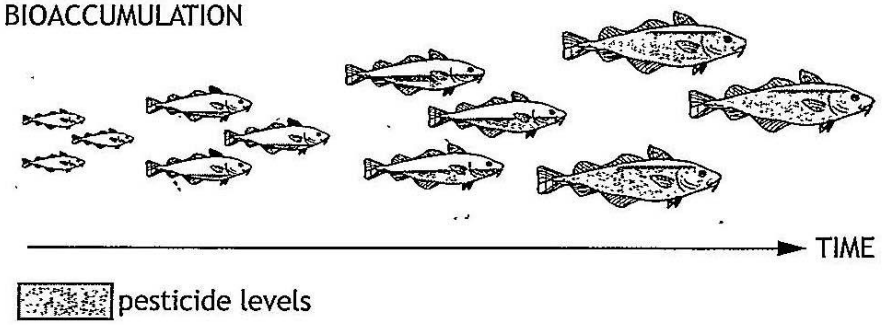
5. (a) A persistent pesticide is one which is not easily broken down in the environment.

(i) Explain how a persistent pesticide might enter a marine ecosystem. 2

An insect which forms part of the food chain of a marine animal could consume Peshicide.

(ii) The diagram below shows one way in which a persistent pesticide builds up in a marine fish species in the Arctic.

In the diagram, the axis labelled TIME refers to the growth of individual fish.



Explain, with reference to the diagram, the process of bioaccumulation. 2

The smallest fish have consumed a small trace of the peshicide. However as the peshicide remains in the ecosystem, getting more concentrated as time passes on. ~~This is known as biomagnification. This can have the effect of killing larger animals.~~

MARKS

5. (a) (continued)

(iii) Suggest how the following actions by farmers would help to reduce the effect of bioaccumulation. 2

1. Conversion to organic farming

Organic farming rejects the use of artificial Pesticides, therefore eliminating any danger to animals from it.

2. Use of biodegradable pesticides

Biodegradable Pesticides do not linger in food chains, and instead break down naturally, eliminating risk to non-target species

(b) State why the total biomass of organisms usually decreases at each successive trophic level in a food chain. 1

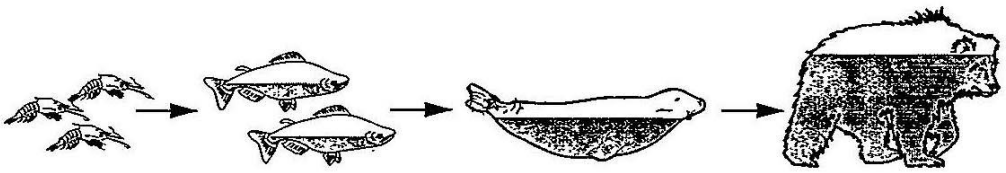
Dominant species tend to have surplus prey to eat, and therefore will be able to grow to a larger mass, which in turn aids its ability to find more prey due to its greater strength.

[Turn over

MARKS DO WRI TI MAI

5. (continued)

(c) The diagram below shows the way in which persistent pesticides build up in an Arctic food chain.



BIOMAGNIFICATION

pesticide levels

(i) Explain the process by which low levels of a persistent pesticide in marine waters can result in the death of large carnivores. 2

The dosage of Peshicide becomes more concentrated in the tissue of each animal it passes through in the food chain. This means that large animals can have such a strong dosage of Peshicide that it can result in death.

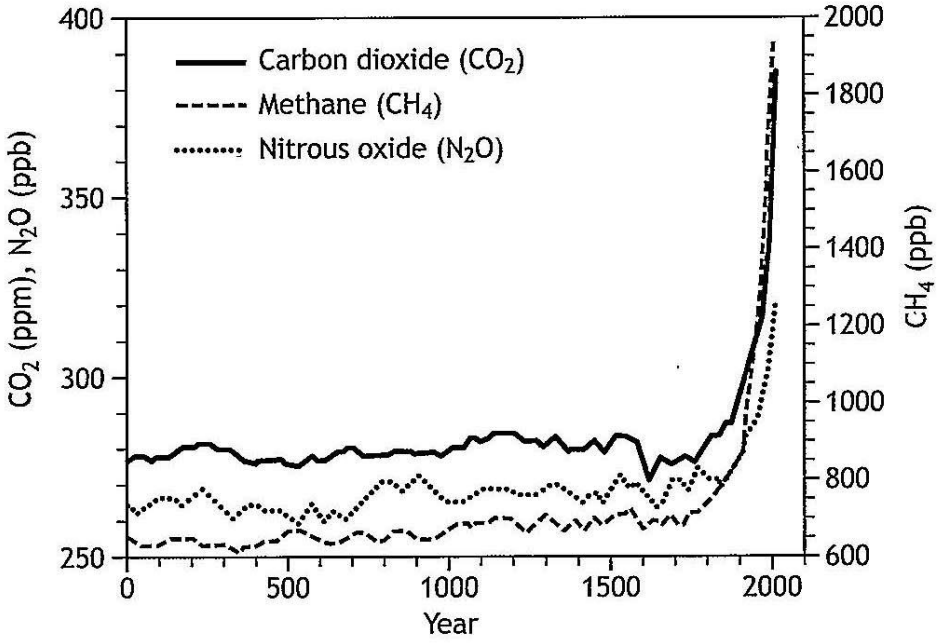
(ii) The food chain above contains both ectotherms and endotherms.

Explain why food webs involving mainly ectotherms contain longer food chains than those involving mainly endotherms. 2

As ectotherms do not use energy to keep their body temperature steady, they use less energy overall in respiration. This means each successive species on a food chain will have a greater percentage of the energy that the prey gained from its food source.

MARKS DO WRITE MARGIN

6. (a) The graph below shows greenhouse gas concentrations in the atmosphere up to the year 2000. Concentration units are parts per million (ppm) or parts per billion (ppb), indicating the number of molecules of the greenhouse gas per million or billion molecules of air.



(i) Describe the general trend shown on the graph. 1

The trend shows a rapid and vast increase in CO_2 and CH_4 from the 19th century as well as a lesser increase in N_2O

(ii) Suggest **two** possible causes for this change. 2

- Rapidly rising population resulting in need for more agricultural land and landfill for waste
- Industrial revolution resulting in increase in CO_2 emmissions from factories

(b) In 2013, the Intergovernmental Panel on Climate Change (IPCC) said that "It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century."

Explain why the IPCC cannot say for certain that human influences are the dominant cause of climate change. 1

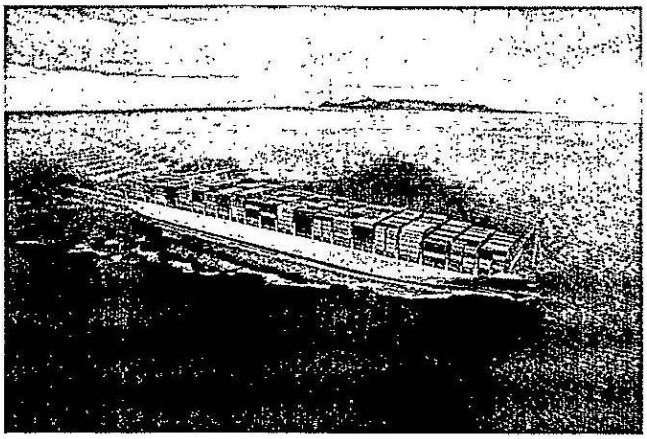
because fluctuations in climate have occurred in Earth's history without human influence.

[Turn over

MARKS

6. (continued)

(c)



CO_2 emissions from shipping have increased by more than 90% since 1990 and are currently responsible for 3% of global CO_2 emissions. One proposal to reduce emissions is slow steaming, which involves reducing the speed of the ship by 10%.

(i) Suggest a reason why shipping companies may choose not to use slow steaming. 1

Would result in a reduced amount of trade and therefore lower profit margins

(ii) The Energy Efficiency Design Index is a new set of design standards which will encourage the construction of ships that are more energy efficient.

Suggest a reason why the new design standards may not have an immediate effect in reducing greenhouse gas emissions. 1

Shipping companies may take time to upgrade to more modern and efficient ships

MARKS

6. (continued)

(d) The growth in international shipping has led to enlargement of ports and extensions to existing dockside facilities.

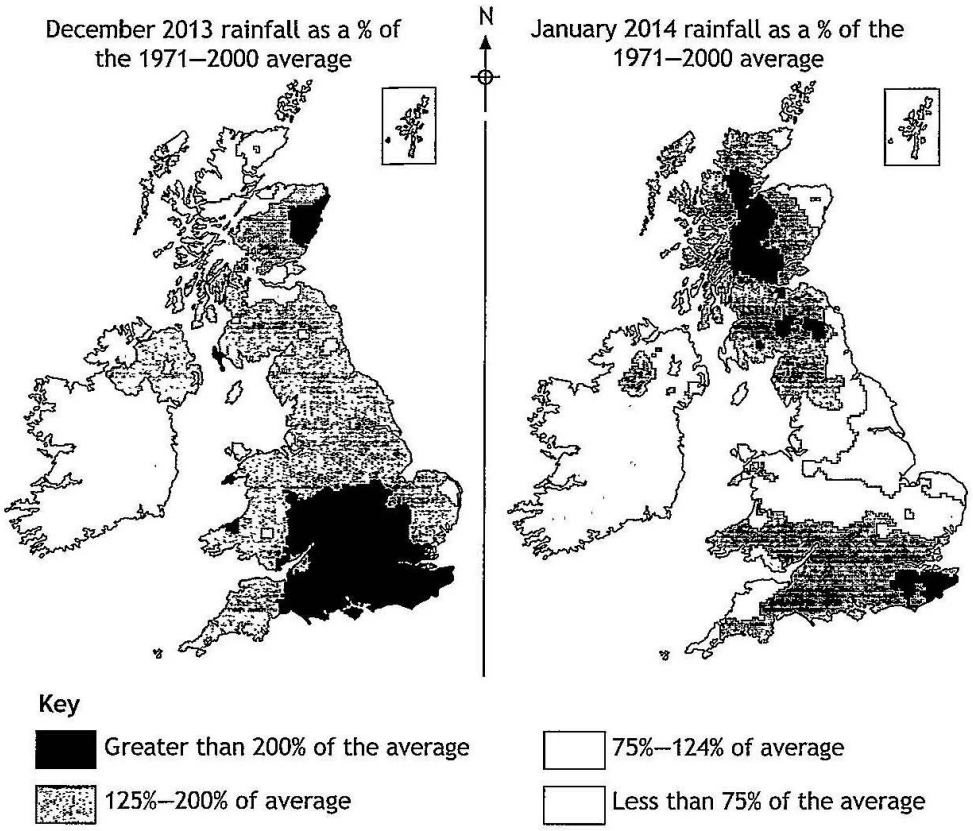
State **two** reasons why such developments require environmental assessment. 2

- could interrupt marine habitats near the dock
- could result in pollution to the water

MARKS | DO NOT WRITE IN THIS MARGIN

7. The winter of 2013–14 was the wettest on record in parts of the UK. It also brought flooding to large parts of the south of England.

The images below show rainfall in the UK across two months in the winter of 2013–14.



(a) Identify **two** changes in rainfall distribution shown in the diagrams. 2

In December the majority of the most intense (greater than 200% of average) rainfall fell in South and central England, and part of Scotland experienced less than 75% of the average.
In January much of East and central England experienced under 75% of the average and the central highlands of Scotland suffered over 200%.

7. (continued)

(b) The extreme weather conditions experienced during the winter of 2013–14 resulted in much debate around anthropogenic and natural climate variability.

(i) Explain why climate variability might have accounted for the higher than average rainfall levels in parts of Britain in January 2014. 2

Climate variability means that many areas suffer unpredictable and extreme weather. It is possible that Britain's climate is becoming more unpredictable, with higher precipitation.

(ii) Describe how a named natural factor contributes to climate variability. 2

Role of oceanic circulation in movement of warm and cool currents which affect climates through transportation of cool and warm water and air.

(c) South West England experienced flooding during the winter of 2013–14.

Suggest how flooding might impact on the structure and composition of brown earth soils. 2

flooding will aid the development of worms in the long term which will result in greater fertility and due to more organic material and better mixing of horizons.

In the short term however crops or plants growing in the soil will be damaged and the soil will have a dramatically increased water content.

[Turn over

MARKS

8. The EU Common Agricultural Policy (CAP) was created in 1962 in order to provide affordable food for citizens and a fair return for farmers. Initially it did this by providing a guaranteed minimum price for specific agricultural products — this was called market support.

(a) The CAP supports agriculture within the EU.

Describe two ways in which CAP achieves this. 2

- The CAP provides subsidies for farmers to ensure farming is a lucrative and enticing career path
- The CAP ensures that agriculture is safe by enacting legislation to halt use of illegal pesticides.

(b) Explain why EU policy aims to improve the sustainability of food production. 2

Due to a rapidly rising world population and a rapidly falling amount of food, sustainability of production is essential to feeding the world's population.

(c) Early versions of CAP encouraged increased food production which indirectly impacted on other aspects of the environment.

Explain an environmental impact of increased food production. 2

Greater food production results in an increase in ~~carbon dioxide~~ greenhouse gases in the atmosphere due to production of methane by cows.

MARKS

8. (continued)

(d) Non-food crops represent a viable alternative for many European farmers.

Describe the use of a named non-food crop. 2

Many biofuels can be used to power vehicles and heat homes, producing less pollutant gas than fossil fuels.

(e) Suggest a non-agricultural land use into which farmers can diversify. 1

farmers could diversify into producing a biofuel such as bio-methanol and bio-ethanol

[Turn over

MARKS | DO NOT WRITE THIS MARG

9. Since 2014 the British Geological Survey and the Department for Energy and Climate Change have worked together to estimate the volume of shale gas in the British Isles.

(a) (i) Describe briefly the formation of shale gas. 2

Shale gas is formed over millions of years through the accumulation of organic and inorganic material. Heat and pressure are applied to this material, although less ~~heat~~ pressure than in oil.

(ii) Describe a method of shale gas extraction. 2

underground

Hydraulic fracturing - explosives are used to create fissures in shale rock. A mixture of chemicals and water are pumped at a high pressure into these fissures, which then carry the gas to the surface for processing

(b) The development of shale gas extraction is proving to be controversial in many countries.

(i) Suggest a reason why a national government may be in favour of developing shale gas extraction within their country. 1

Shale gas can be used to heat homes and provide energy. ~~relatively low cost~~

(ii) Suggest **two** reasons why some local people may object to the extraction of shale gas in their area. 2

- Habitat destruction (People and animals) caused by assembling of drill sites
- ~~Methane~~ Chemical leaks in the process causing an enhanced greenhouse effect, polluting soil and polluting water systems

MARKS

. **(continued)**

(c) In 2014, six UK conservation organisations launched the report "Are We Fit to Frack?" which suggested setting up zones in which no shale gas extraction would be permitted.

Outline the role of a named land designation in conserving the UK's geological heritage. 2

Sites of Speafic Scientific Interest

these sites protect areas which represent a particular geological interest.

MARKS

For questions 10 and 11 choose to answer **either** A or B. Write your answers on the following pages. Diagrams may be used where appropriate.

10.A The introduction of non-native species causes ecological concern globally. A large number of non-native species, such as the grey squirrel, have been introduced to the UK, both deliberately and accidentally.

Discuss the impacts of non-native species, using a named example other than the grey squirrel, under the following headings:

(a) Impacts on local biodiversity

(b) Minimisation of these impacts **10**

OR

B A 2010 report compiled for the Cairngorms National Park Authority identified twenty-three nationally extinct species that have the potential to live in Scotland again. However, species reintroduction has been a controversial subject in recent years.

Discuss the re-introduction of nationally extinct species, using named example(s), under the following headings:

(a) Arguments in favour of re-introduction
- deer control
- biodiversity
- tourism
- study
- oysters_fishing industry

(b) Arguments against re-introduction **10**
- livestock loss
- scary
- deer/hybridisation
- diseases
- cattle

11.A In 2013 Scotland produced approximately 20 million tonnes of waste. This came from both domestic and industrial sources. In recent years the Scottish Government has introduced legislation to manage this waste.

Discuss the benefits and challenges of a piece of waste management legislation you have studied. **10**

OR

B The Scottish Government is using climate change and renewable energy policies to minimise greenhouse gas emissions in line with international targets.

Discuss the benefits and challenges of a national policy or relevant piece of legislation relating to climate change or renewable energy which you have studied. **10**

- more expensive to heat home
- cut jobs from fossil fuel plants
- cut off to GDP
- renewable energy expensive to set up
- ugly?

1.0b) SPACE FOR ANSWERS MARKS D W M

A) Arguments in favour of reintroduction

The Grey Wolf has the potential to live in Scotland again, and many have convincing arguments which support its reintroduction.

The UK's deer population is in need of control, and the introduction of Grey Wolves could prove to be an effective control as it is a natural predator of deer.

The reintroduction of wolves would also be beneficial as it increases the biodiversity of communities This would result in a healthier and more natural ecosystem.

The reintroduction of Wolves would be beneficial from an economic perspective. Many tourists, who are already be interested in Scotland's countryside, would enjoy safely viewing wolves from visitor centres (with gift shops?

The reintroduction of wolves would be beneficial from a research perspective. Many environmental scientists would be interested in studying the impact of an reintroduction of wolves.

SPACE FOR ANSWERS (continued) MARKS

Another species which has been discussed as a potential re-introduction candidate is the native oyster. This would be beneficial to the fishing industry as, if managed properly, could result in a sustainable source of food.

3) Arguments against reintroduction

In the case of the Grey Wolf there are also a number of negatives to their potential re-introduction.

One such downside is the certain loss of livestock that would occur from wolf attacks. This would impact farmers economically, resulting in a lower production rate and higher prices for meat.

A second impact that is negative would be the effect on many hikers in the proposed habitats. Many perceive wolves as aggressive and dangerous, and would be frightened to walk without protection in wolf inhabited areas.

SPACE FOR ANSWERS (continued) MARKS

In regards to negative aspects of re-introduction. one possible outcome is hybridisation This occured with the Sika deer's introduction to Scotland. This results in lowered biodiversity in the community.

Another threat with reintroduction is the spread of foriegn diseases to native species. Native species will have no defence to many illnesses that foriegn species will be immune to, which could, in extreme cases, result in the exhinction of the native species. *

finally, a possible outcome is that the non-native species may outcompete the native one. This occured upon the introduction of the grey squirrel to Scotland. The grey and red squirrels had similar diets but the grey squirrels strength allowed them to outcompete the red squirrels.

* occured upon introduction of grey squirrels to Scotland. Red squirrels suffered from foriegn diseases.

SPACE FOR ANSWERS (continued) MARI

11B) Scotland's Government have attempted to combat Climate change with the Climate Change Act. Its aim is to minimise greenhouse gas emissions while developing renewable energy.

The benefits of this legislation are numerous. If effective, its plans to cut emissions will lead to noticeably lower pollution in the atmosphere.

Also the legislation will be beneficial as it will encourage the development of renewable energy production which is free of carbon emissions, lowering pollution.

Another beneficial aspect of renewable energy is the fact that it's renewable. While oil and gas will run out relatively soon, renewable energy can be exploited indefinitely.

The legislation is beneficial as it encourages the development of renewable energy which provides jobs in construction, maintainence, and operation.

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS MARKS

The legislation also sets an example to less environmentally aware nations, hopefully encouraging them to cut their greenhouse gas emissions and develop renewable energy.

However there are a number of downsides to the legislation. The switch to renewables from fossil fuels will be costly initially. While we will spend less on collecting fossil fuels, we currently make a vast amount of money trading this oil. In addition, setting up new renewable sources of energy production can be costly.

Currently our exploitation of fossil fuels allows us to heat our homes at low prices. During the switch to renewable energy this could go up due to increased production costs.

Another negative to this legislation is the cuts to jobs that reduced reliance on fossil fuels may bring. Many people will become unemployed and may not be qualified or able to get a job at a renewable energy production plant.

ADDITIONAL SPACE FOR ANSWERS MARKS

Another negative to the legislation would be the visual impact of renewable energy sources. For some, wind turbines and hydro electric plants are undesireable and do not want them to be developed anywhere where they might be seen.

Finally, a negative to the legislation would be its miniscule global impact. Scotland, as a small nation, already has a low output of carbon emissions, especially due to its existing renewables industry. However many countries do not align with international targets, offsetting Scotland's progress by increasing their greenhouse gas emissions. Many argue that tighter international legislation is needed.