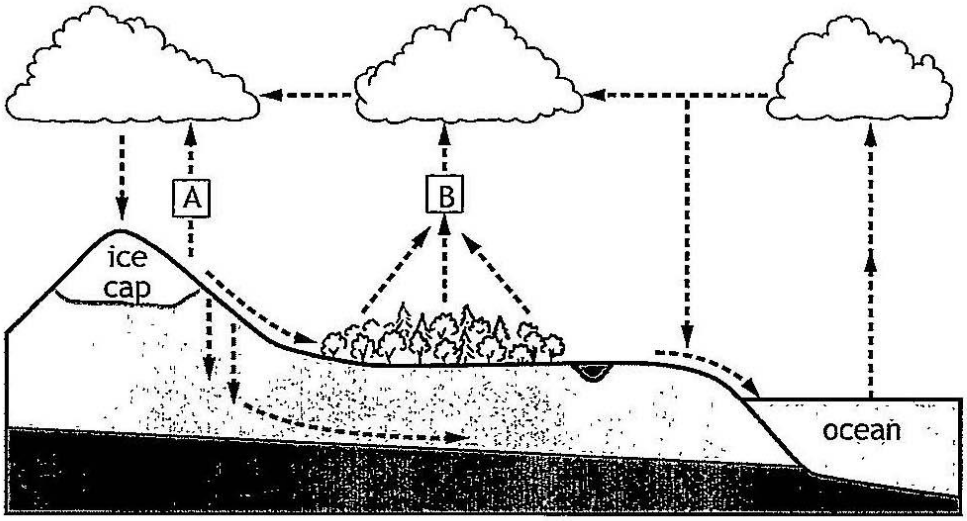
MARKS

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

Permafrost

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

B - Evapotranspiration

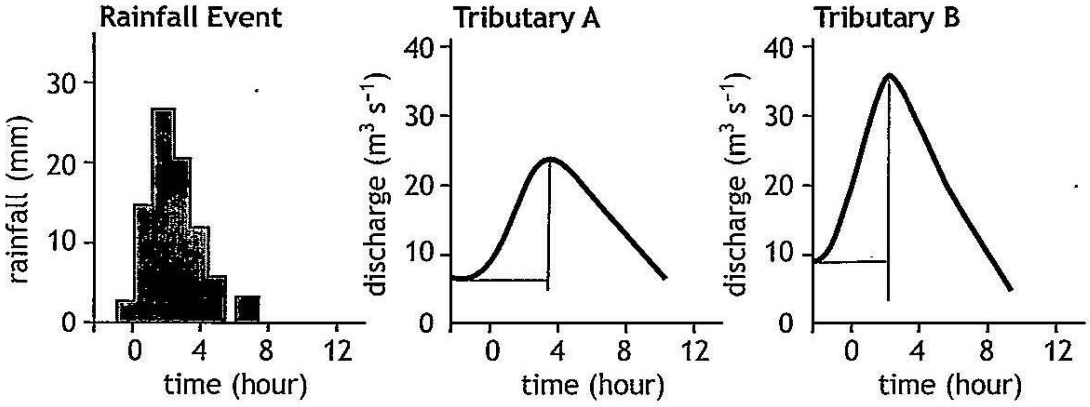
The evaporation of rainwater ~~fro~~ captured within the vegetation, being evaporated back into the water cycle.

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

Tributary B compared to Tributary A has ~~a much faster~~ speed and less of a lag time, meaning the rate of accumulation is greater. The rate and level of discharge is also greater, as tributary B reaches its peak flow at a faster rate, as well as the peak flow itself being greater. The peak flow for A is about 24 $m^3 s^{-1}$ whereas B has a peak flow of 36 $m^3 s^{-1}$.

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

If the land near a river is of an urban nature, with concrete and other impermeable rocks and surfaces, the runoff will be increased dramatically compared to a woodland environment for example. Faster runoff results in a decreased lag time between the rainfall and the increase of river discharge.

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.

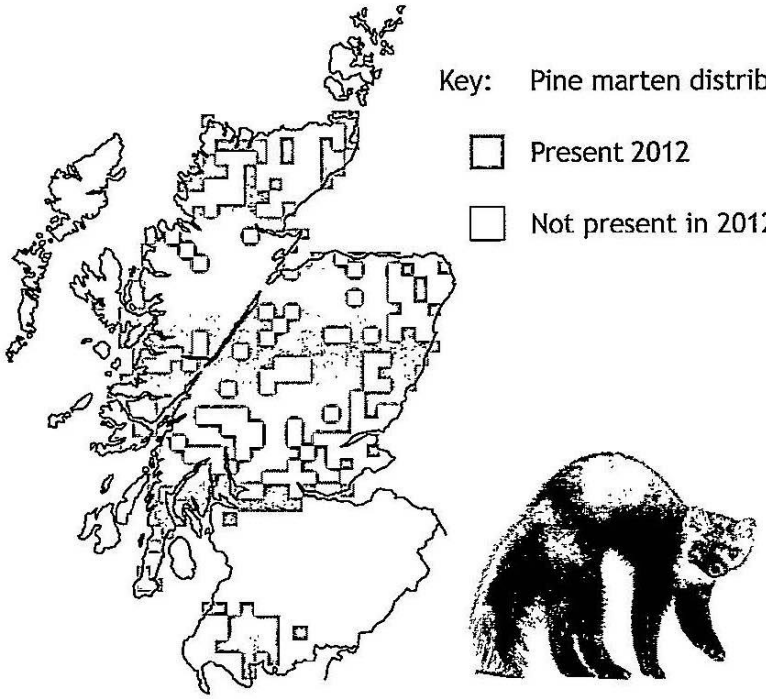
(a) Suggest **two** changes in the management of the countryside which have taken place since 1950 that would have helped the pine marten numbers to increase. 2

The countryside itself may have been adapted through introducing factors of the pine marten's habitat such as the replanting of deforested areas, allowing them to resume hunting within trees, or rebuffing the population of the pine martens prey. These reintroductions of the pine martens natural habitat allow it to continue to carry out its niche, enabling it to survive within the ecosystem and play its role.

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

Due to it being backed by research, this technique could be considered valid and reasonably effective, however it does not ~~allow~~ provide accurate figures of population, and only dictates their presence. It may not be accurate in regards to time as the faeces itself may be old, and the martens may no longer be active in that area. This could be improved by employing techniques that guage how long the faeces has been present and ~~make~~ come to a conclusion on presence from there.

MARKS DC WR MA

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

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

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

Grey squirrels pose a threat to red squirrels, but with the pine marten the grey squirrels are at risk themselves and could potentially be less likely to actively hunt red squirrels because of this new danger. Red squirrels spend two thirds of their time in the trees, making them less accessible and more energy consuming to hunt. Grey squirrels are only in the trees 14 % of the time, making them a more accessible prey that expends less energy to hunt. This in turn, makes red squirrels a secondary target, less likely to be hunted.

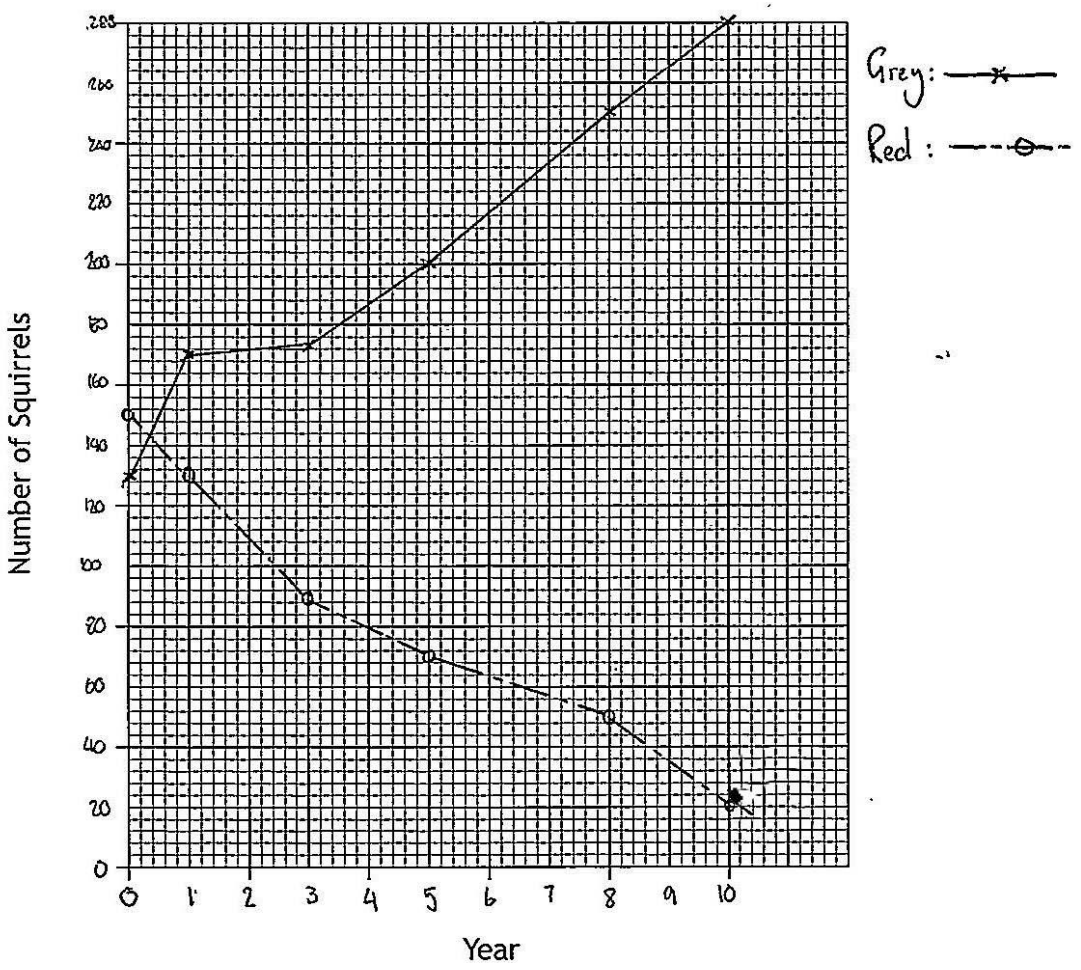
MARKS

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**



MARKS

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

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

Underground through the process of — —

(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

37,979 − 6276

= 31,706

$\frac{31,706}{6276} \times 100 = 505\ ?\ \%$

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

Industry may have needed a greater demand of ~~the~~ baryte due to this being around the time of the financial crisis.

MARKS

3. (continued)

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

Certain soil compounds can produce optimum conditions for viable deposits of baryte to form

(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

It can be used to stabilise the process.

(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

The usually ~~Fossi~~ poisonous ~~sulfur~~ effects of the sulfur element is filtered out during the production stages.

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.

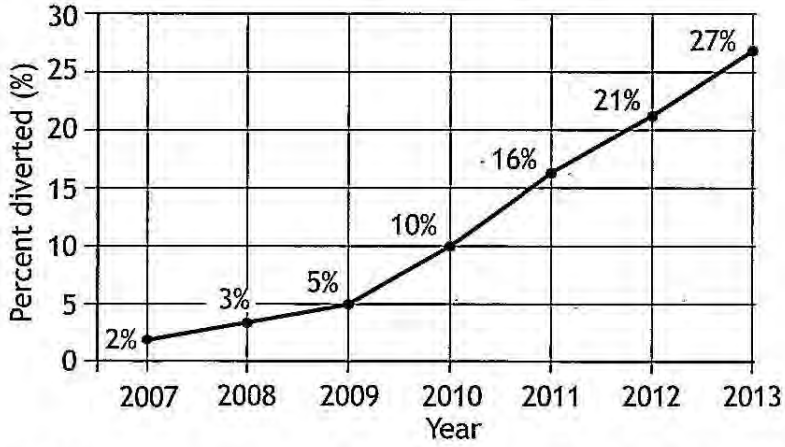
Once a carpet is no longer needed there are a number of options:

- **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 reuse of the carpet and the recycling of it into another material / object.

(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.

107,000 = 27%

$\frac{107,000}{27}$ = 3962.962

3962.962

× 73

= 289296 tonnes

MARKS

4. (continued)

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

* Natural fibres have to be remade after the carpet is shredded and these fibres are a finite resource.
* More energy would be expended remaking the carpets as well as shredding them rather than just reusing them.

(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

Carpets are reused and don't end up getting in landfill contributing to global warming.
More natural resources are also used up in the process of manufacturers taking resources and then selling them as goods.

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

The financial gain is not as direct, and they would make less of a profit in the long run. They would also have to spend more money reusing and cleaning tiles when it would be otherwise cheaper to employ the ~~threat~~ linear economic model.

[Turn over

MARKS

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

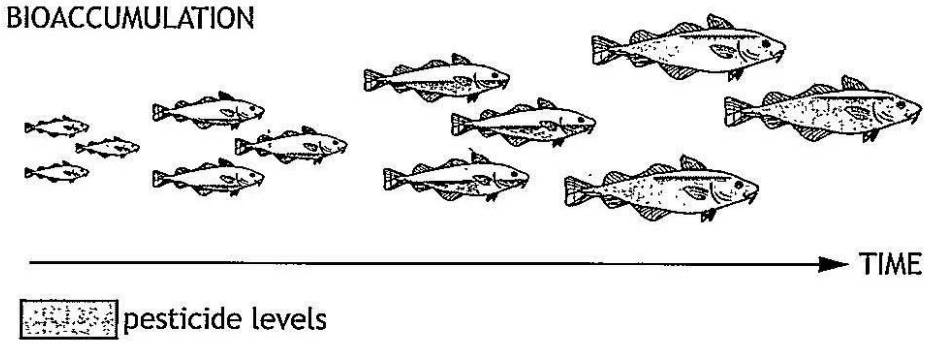
(i) Explain how a persistent pesticide might enter a marine ecosystem. 2

~~The food with that~~

Persistent pesticides may affect water supplies / rivers through farming runoff. This then leads to the sea, where fish intake it through their prey. ~~The predators that eat the fish then intake the pesticide.~~

(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

Smaller fish further down the food chain are first infected when feeding on plankton and other small creatures. The predators of these smaller infected fish then eat them, ~~infected~~ becoming infected themselves. This continues up the food chain until all species are infected.

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 would mean less harmful pesticides used & meaning those that run-off through irrigation would not have a detrimental effect.

2. Use of biodegradable pesticides

This would stop the time factor in bioaccumulation as the pesticides would eventually degrade before infecting a species.

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

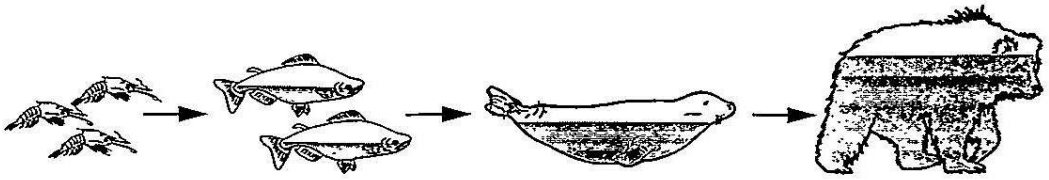
The further up the trophic level something is the less predators it has, resulting in a decreased biomass.

& and ~~the less~~ population &

MARKS

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 levels of pesticide increase as each animal from each trophic level feeds on it, meaning the next species is intaking more than the last. Large apex carnivores intake the largest amount of all species, resulting in deadly levels of the pesticide.

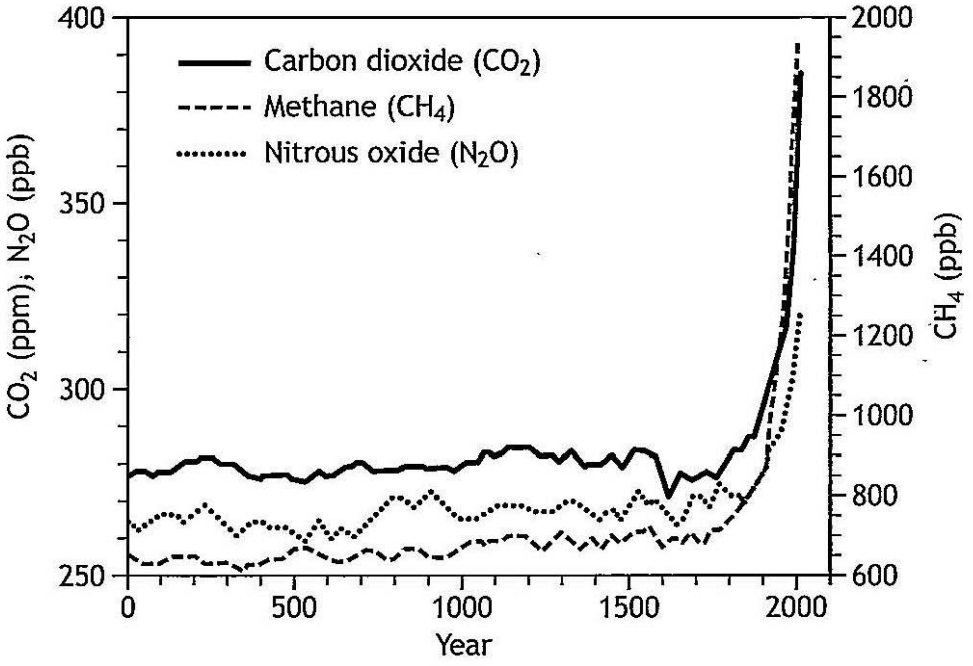
(ii) The food chain above contains both ectotherms and endotherms.

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

Ectotherms are more adaptable, allowing them to survive changes in their environment.

MARKS

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

At roughly the year 1900, the levels of all three gases increases dramatically. Prior to this, they all fluctuated but stayed generally stable.

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

The industrial revolution and the increased burning of fossil fuels caused the output of these gases to increase dramatically.

(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."

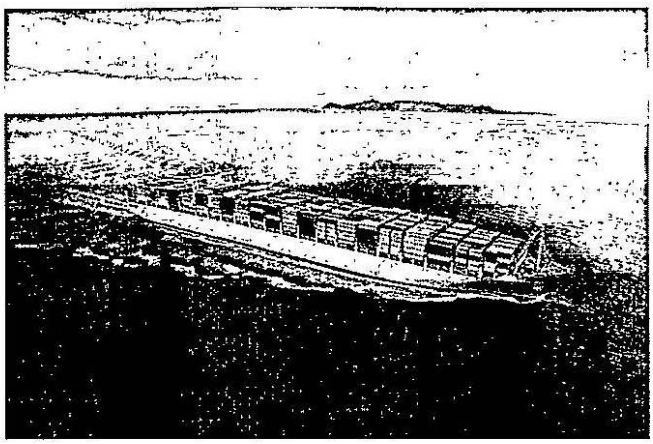
Explain why the IPCC cannot say for certain that human influences are the dominant cause of climate change. 1

Physical factors such as volcanic eruptions and varied levels of solar insolation can result in climate change, meaning it cannot be explicitly humans.

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

An already great demand for goods transported by shipping would ~~suffer~~ it mean a suffer in income caused by slower times.

(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

These design standards will take time to be set in place and every existing ship will need to be modified first.

MARKS

6. (continued)

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

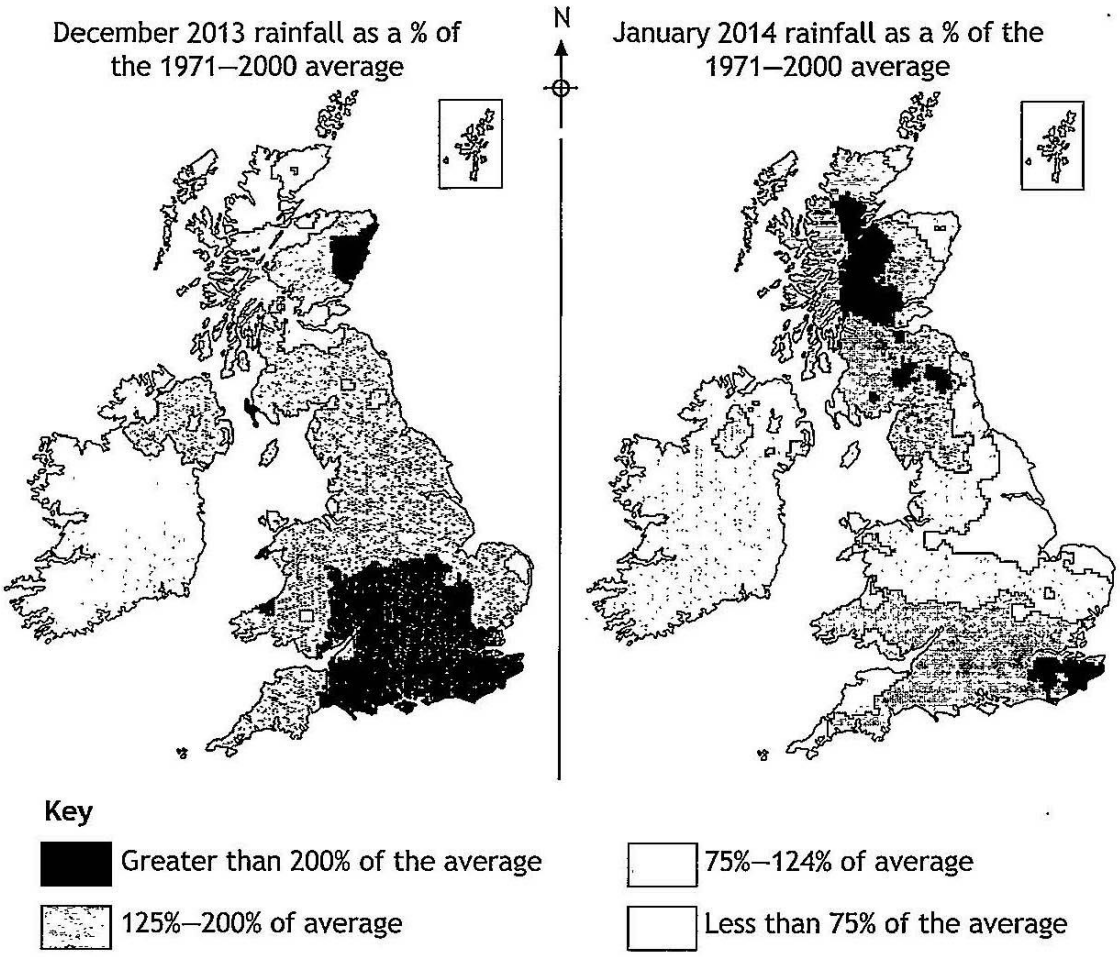
State **two** reasons why such developments require environmental assessment. **2**

Enlarged areas may result in increased levels of pollution through litter or oil spills from the ships.

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

Areas in the south of England saw the most rainfall in December 2013, *1 but this drops in January to 125 - 200% of the average, the NW Highlands, which initially gave less than 75%, jumped to 125 - 200% between December and January.

*1 with over 200% of the average

MARKS

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

The levels of rainfall weren't always consistent between December and & January suggesting it may have just been the result of variation.

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

El Niño and La Niña both contribute through effecting the climate at specific periods of time. Farmers and others in these areas effected by these climate variabilities have learned to adapt and take advantage of them.

(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 would change brown earth soils ~~that~~ through leaching. Leaching would result in the washing away of the soils nutrients, changing its composition. Flooding would also effect the ~~forest~~ A0 horizon, as biota would be unable to break down leaf litter as effectively due to huge levels of & floodway.

[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

Farmers have incentive to plant and cultivate crops due to the presence of a fair return, and citizens can put faith in them as they are guaranteed affordable produce.

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

Sustainable food production indicates a stable, developed nation / continent that proves it has a decent standard of living and that it lives up to its high praises of being developed and people friendly places.

(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

Increased food production may result in the use of synthetic fertilisers to ensure the best harvest. This may result in Algal Blooms as these fertilisers run-off into ponds and other water sources through irrigation, damaging on the ecosystem.

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**

A non-food crop, such as cotton, would be used due to its high demand and help towards the economy on the whole.

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

Afforestation

MARKS

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

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

Fracking, which involves the extraction of shale gas through underground removal schemes involving high pressure systems

(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 is cheaper and easier to extract than crude oil.

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

Fracking can cause earthquakes mainly reducing the desirability of an area. Because it occurs underground, land rows over land use can be present.

MARKS

9. (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**

A named land designation would ensure that specific areas cannot be used for fracking, and large companies would be unable to benefit from the damage caused to areas such as SSSI's.

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

(b) Arguments against re-introduction **10**

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**

MARGIN

10)

B)

a) Wolves once roamed Scotland, but were hunted to extinction. Wolves play a vital role in their ecosystem, being the apex predator. For example, when wolves were reintroduced to Yellowstone National Park in Wyoming, the elk population in the area (that was largely out of control) was put back into check by the wolves carrying out their niche. The elk had been spreading to areas previously untouched and the rate at which they consumed plants and other flora was too great for the ecosystem to handle. The reintroduction of wolves ensured the elk could not over graze the landscape, ensuring its survival. Without wolves, other predators can become over-zealous when kept out of check and can over feed on lesser prey such as rabbits and rodents. Wolves again ensure that these species can survive by keeping these other predators, such as coyotes (again found in yellowstone) out of their territories protecting the weaker species within. Wolves also prey on weaker and older deer and elk, meaning they condition the population and

SPACE FOR ANSWERS (continued) **MARKS**

enforce natural selection so that only the strongest survive. *

b) The reintroduction of ~~wolves~~ extinct species can also cause issues, as wolves can cause issues for farmers. In places like the UK where food may not be as plentiful as Yellowstone, wolves may resort to easier prey such as cattle and livestock. This would likely cause complaints from farmers who would demand action against the predators ruining their business. Unless the population was kept in total check, the reintroduced species may become too dangerous themselves, as an out of control population means an out of control species. The species themselves may over feed, causing degrading prey (such as deer) populations.

SPACE FOR ANSWERS (continued) MARKS

* Keeping a population in check is costly, and the introduction of a predator would mean that money need to be spent on culls would not have deer on them and the population control would be a completly natural process.