Q1. Compare the efficiency of these two food chains.

Food chain **A** grain → humans

Food chain **B** grain → bullocks → humans

In your answer, make **full use** of the following data.

Food	Consumer	Percentage of available energy transferred as useful energy
Grain	Human	9%
Grain	Bullock	12%
Bullock	Human	10%

One kilogram of grain has 80 000 kJ of available energy.

Q2. Earthworms are important soil organisms. When they burrow, they help to bring air into the soil as well as improving drainage. Earthworms also bury leaves in the soil. These decay making the soil more fertile. Earthworms in turn are eaten by voles, moles, foxes, badgers and birds.

New Zealand flatworm

In some parts of the United Kingdom, earthworms are being killed by New Zealand flatworms. The animals are spreading quickly and have no natural enemies.

The flatworms do not make their own burrows. They only use the burrows made by the earthworms in order to attack them.

(a) Explain, as fully as you can, why it is important to control or get rid of these New Zealand flatworms in Britain.

(4)

(b) Suggest **one** possible way, giving **one** advantage and **one** disadvantage, that this New Zealand flatworm could be controlled.

(3)

M1. (food chain) A gives 7200kJ
(of useful energy)

or *7.2MJ*
or *7200000J*
unit essential in each case

1

(food chain) B gives 960kJ (of useful energy)

or *0.96MJ*
or *960000J*
unit essential in each case

credit 1 mark if ***both*** *are numerically correct but unit omitted*

1

same comparison made in **each** case
e.g. for each kilogram of grain

or *refers to more stages in food chain results in less efficiency*

1

(so) (food chain) A is 7.5 times more efficient than (food chain) B

or *for every unit of useful energy given*

to a person by B, A gives $7\frac{1}{2}$ *units*

or *food chain B is only 13(.3)% as efficient as food chain A*
or *makes a correct comparison in percentage terms*

1

[4]

M2. (a) *idea:*
soil wetter
soil less aerated
less food for moles/voles/foxes/badgers/birds
soil less fertile (less leaves in soil <u>not</u> enough on its own)
less food grown
earthworms die out/fewer earthworms
(<u>not</u> just "earthworms get eaten")

any 4 for 1 mark each

4

(b) method
advantage
disadvantage
*e.g.**

- chemical
- kills worm/affects reproduction/maintains earthworm population
- persistent/food chain/kill earthworm

or

- import biological central/predator/disease/parasite
- kills worm/affects reproduction/maintains earthworm population
- may attack other animals/cause same sort of problems as New Zealand worms

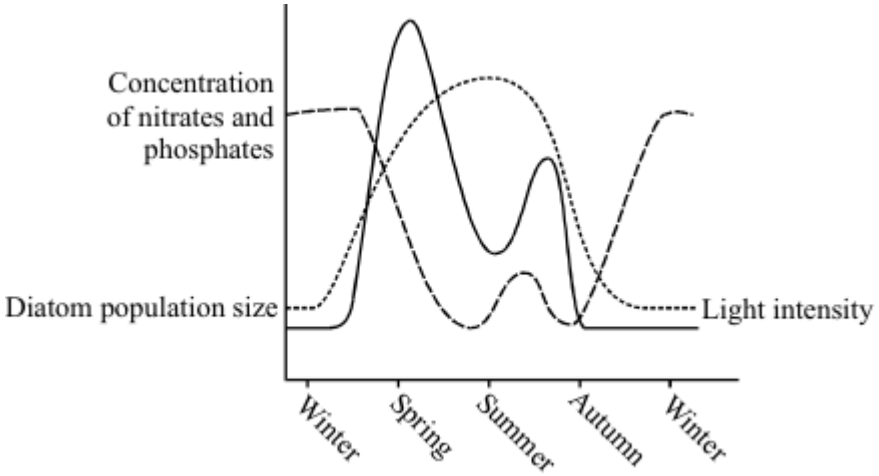
(* credit other plausible suggestions for method/advantage/disadvantage)

Q3. A food chain in the North Atlantic Ocean is:

diatoms → small fish → large fish

The graphs show how over a year:

- the population size of diatoms in the North Atlantic varies;
- the light intensity alters;
- the concentration of nitrate and phosphate minerals alters.



(a) Explain why the light intensity is a major factor in controlling the numbers of diatoms.

(2)

(b) (i) Suggest **two** reasons why the population of diatoms decreases between spring and summer.

(2)

(ii) Give **two** reasons why the population of diatoms decreases in autumn.

(2)

(c) Use the information on the graph to suggest what change causes the number of diatoms to increase in the late summer. Give a reason for the change.

(2)

M3. (a) diatoms photosynthesise **or** are producers

1

the amount of growth depends upon the energy **or** light they get

accept more light means more growth
***or** they multiply more in more light*
do not accept they need light

1

(b) (i) eaten by small fish

do not accept eaten by fish

1

minerals **or** nitrate **or** phosphates
or nutrients **or** food supply used up
or reduced

1

(ii) any **two** from

gets colder
light decreases
end of their life span **or** die

accept more being eaten than being formed

eaten by small fish

do not accept a decrease in nitrates
***or** phosphates*

1

(c) increased minerals **or** nitrates **or** phosphates

1

any **one** from

due to death **or** decay of diatoms **or** fish

do not accept death of large fish

1

influx of minerals in an ocean current

*do not accept extraneous pollution **or***
dumping by a ship

1

[8]

Q4. Read the passage.

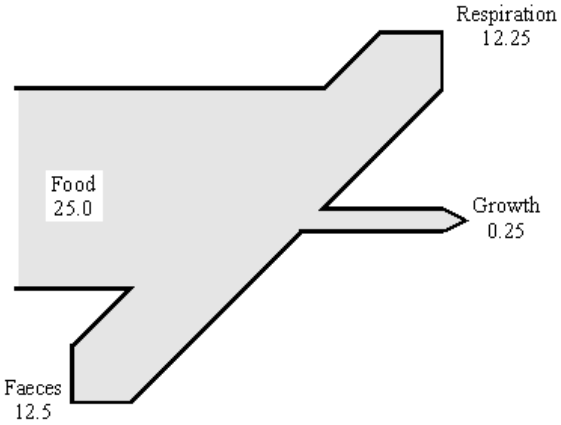
Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

The diagram shows the flow of energy through a koala.
The numbers show units of energy.



(i) Calculate the percentage of the food intake which is converted into new tissues for growth. Show your working.

..... %

(2)

(ii) Give **three** different ways in which the koala uses the energy released in respiration.

1

1

1

(3)

(Total 5 marks)

M4. (i) 0.25 × 100 / 25

gains 1 mark

but
1%

gains 2 marks

2

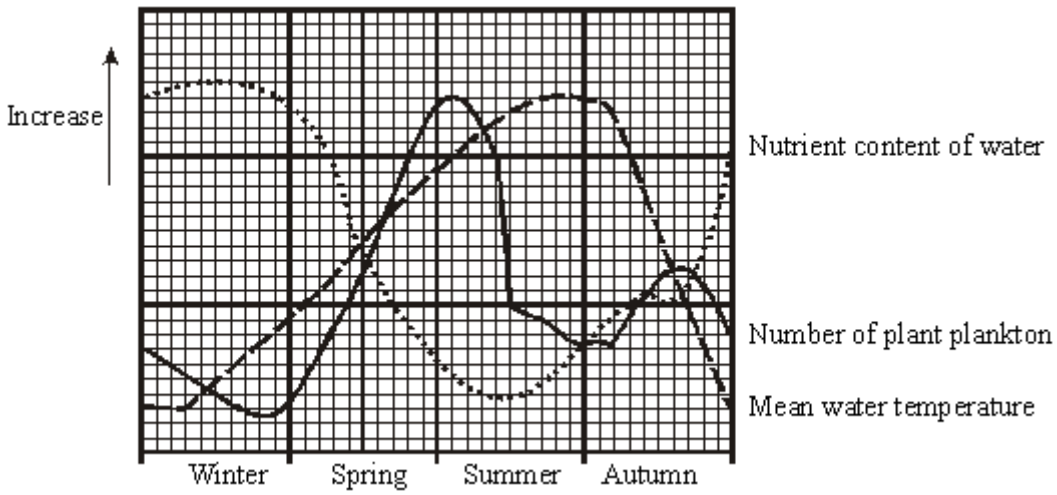
(ii) muscle contraction / limb movement / moving around / chewing
heartbeat / breathing / internal muscle activity
maintaining body temperature / keeps body warm
active uptake synthesising substances (*reject* growth)

any three for 1 mark each

3

[5]

Q5. Plant plankton are aquatic microscopic organisms that photosynthesise. The graph shows the numbers of plant plankton in the North Sea at different times of the year.



Use the data and your knowledge of photosynthesis and growth to explain:

(a) why numbers of plant plankton were low in winter but increased rapidly during the spring,

(3)

(b) the reduction in numbers of plant plankton in the early summer.

(1)

(Total 4 marks)

Q6. Read the passage.

Glutton up a gum tree

Along the banks of the Cygnet River on Kangaroo Island, the branches of the dying gum trees stretch out like accusing fingers. They have no leaves. Birds search in vain for nectar-bearing flowers.

The scene, repeated mile upon mile, is an ecological nightmare. But, for once, the culprit is not human. Instead, it is one of the most appealing mammals on the planet – the koala. If the trees are to survive and provide a food source for the wildlife such as koalas that depend on them, more than 2000 koalas must die. If they are not removed the island's entire koala population will vanish.

Illegal killing has already started. Worried about soil erosion on the island, some farmers have gone for their guns. Why not catch 2000 koalas and take them to the mainland? "Almost impossible," says farmer Andrew Kelly. "Four rangers tried to catch some and in two days they got just six, and these fought, bit and scratched like fury."

Use the information from the passage and your own knowledge and understanding to give the arguments for and against killing koalas to reduce the koala population on Kangaroo Island.

##

(a) light and/or temperature too low in winter,
increasing light in spring leads to increase in photosynthesis
increasing temperature in spring leads to increasing metabolism/ growth/reproduction

for 1 mark each

3

(b) they run out of minerals

for 1 mark

1

[4]

M6. pros e.g.:

gum trees survive therefore less soil erosion
therefore food webs not disrupted
if no culling, whole Koala population may die
easier to cull because Koalas are difficult to catch

cons e.g.:

Koala's 'right to life' / ethical issue
better to transfer to reserves on mainland than kill
could use tranquillisers to catch without killing
could allow population to stabilise naturally

max 4 of the above; max 3 pros or cons.

[4]

Q7. Professor John Lawton researches into the problem of controlling the spread of bracken.
Bracken is a fern which threatens upland farms, partly because it poses a health risk to people and animals.

Professor Lawton is waiting for government permission to release the Conservular caterpillar which feeds on the bracken.

The Secretary of State has to decide whether the Conservular caterpillar can be released.

The article printed below describes some of the problems faced by the Secretary of State.

David the caterpillar to bracken's Goliath

Yorkshire farmer Maurice Cottrill has just forked out £500 to have a helicopter hover over his land and spew out gallons of chemicals aimed at destroying one of the most pervasive and dangerous weeds known to man – bracken. In a little box in a laboratory near Ascot, Berkshire, lies a tiny caterpillar which could have done the job for nothing.

Whether or not that caterpillar and thousand of its chums will ever be let loose on the massive carpet of bracken that is sweeping over Britain at the rate of 53 square kilometres a year has to be decided by the Secretary of State for the Environment.

Weed control through the release of imported insects has never been tried in Britain before. If the Secretary of State permits the experiment, the caterpillar is in for the feast of its life, because five years of painstaking research have proved that bracken is its only food. However, is that the full story? Will the beast stop there, or will it go on, wreaking unforeseen devastation. Can scientists predict what will happen when imported insects are released into the wild?

Bracken is poisonous – more than 20 000 sheep and 1 000 cattle suffer poisoning each year. Its spores are carcinogenic, posing a threat to hill walkers. Bracken costs a depressing £4m a year to control while rendering useless grazing land valued at £5m annually. "Bracken is one factor which is leading to hill farming becoming uneconomic", says the director of the Ramblers Association. "We are worried about that because, the more uneconomic hill farms become, the more prospect there is of the forestry industry taking over."

The National Farmers Union are concerned about the consequences of the caterpillar getting out of control. What if it started consuming garden ferns? What if it loved potatoes? On the other hand, the caterpillar might help to preserve important uplands where wildlife flourishes when bracken is kept at bay. However, the experiment takes the scientists into unknown territory.

World-wide, 94 species of weeds have been controlled by biological releases involving 215 types of animal in 50 countries. Professor Lawson says that approximately one-third have achieved effective control and the remainder have failed.

Upland farms are artificial ecosystems, created and maintained mainly for the rearing of sheep and cattle. These farms are being threatened by the spread of bracken. Up to now the only treatment for bracken has been to use herbicides.

Use the article to explain, as fully as you can, what advice you would give the Secretary of State.

Explain the arguments for and against that lead to your decision.

You will **not** receive marks for simply copying extracts from the article.

(Total 8 marks)

M7. Cogently argued based on biological principles, for **and**
against introduction of caterpillar
maximum of 4 pros e.g.
fewer chemicals used therefore less expense
less chemical damage to other plants
consequent benefits to food chains
fewer farm animals poisoned therefore more economic
countryside more varied therefore more attractive to tourists
tourists bring economic advantages
greater variety of habitats therefore greater variety of species

any 4 for 1 mark each

4

cons e.g.
danger to livelihoods if crops destroyed by caterpillar
relatively low chance of success since only one third of schemes
effective world-wide
unlikely to be natural predators therefore ecological balance affected

any 2 for 1 mark each

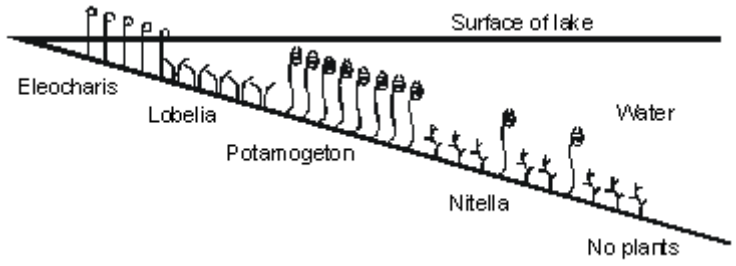
2

cogently argued case **gains up to 2 marks**

2

[8]

Q8. This is a diagram of a belt transect showing the major types of plants growing on the bottom of a lake.



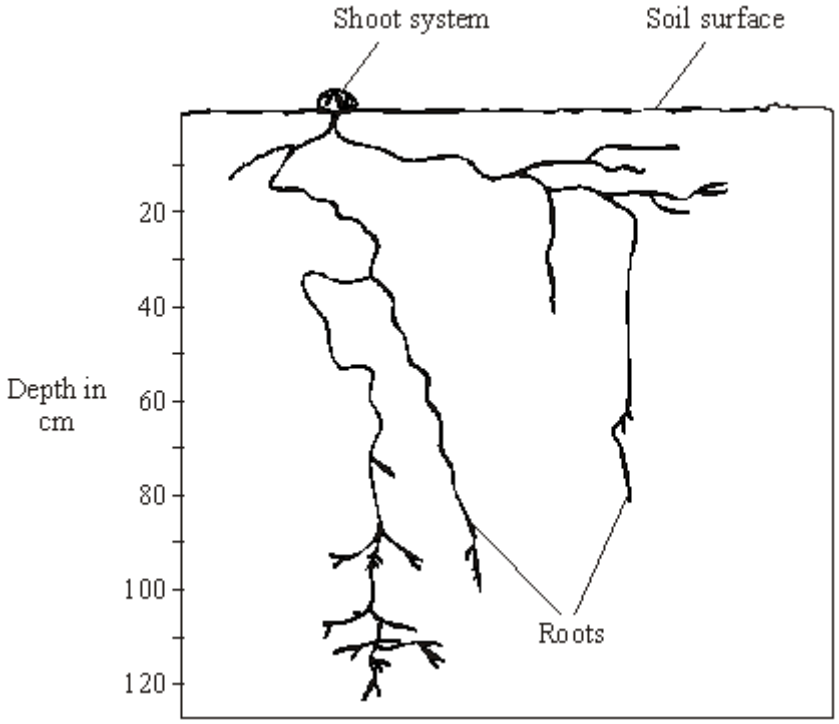
(a) Suggest, and explain, **two** reasons why a much smaller population of Nitella plants is found amongst the Potamogeton plants than further down in the lake.

(4)

(b) Describe how you would use the belt transect technique to measure the abundance and distribution of plants which live on the bottom of a shallow lake.

(3)
(Total 7 marks)

Q10. The diagram shows the desert plant, *Fredolia.*



Describe and explain **three** adaptations of *Fredolia,* which you can see in the diagram, that help it to survive in dry conditions.

M8. (a) e.g.:
competition for light because potamogeton plants taller
competition for nutrients taller plants may have longer roots
each for 1 mark

4

(b) descriptions of:
measuring tape or similar quadrat
method of estimating cover (inside quadrat)
each for 1 mark

3

[7]

M10. any **three** from adaptation **and** effect:
ignore references to ions throughout ignore animals eating plant

few leaves / no leaves / little growth above ground / low surface area
above ground so less water loss
*do **not** accept zero water loss*

deep roots

so can reach water **or** because surface soil is likely to dry out
accept 'moisture' for water

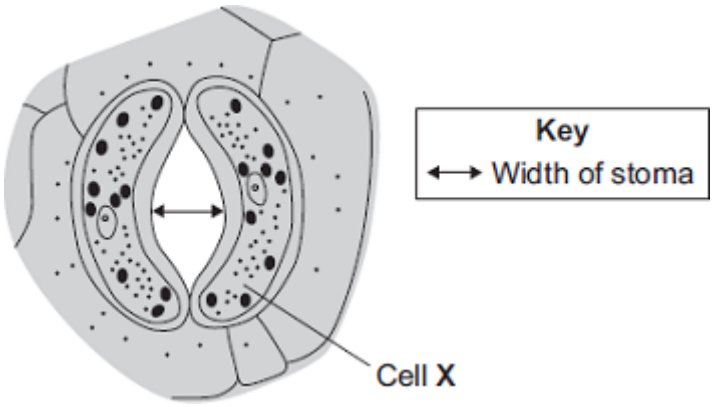
roots near surface so can obtain water when it does rain

widespread roots or many roots so can obtain water from a large area

swollen stem so can store water

[3]

Q9. Plant leaves have many stomata.
The diagram shows a stoma.



(a) Name cell **X** . ……..

(1)

(b) The table shows the mean widths of the stomata at different times of the day for two different species of plant.
Species **A** grows in hot, dry deserts.
Species **B** grows in the UK.

	Time of day in hours	Mean width of stomata as a percentage of their maximum width	
		Species A	Species B
Dark	0	95	5
	2	86	5
	4	52	6
	6	6	40
Light	8	4	92
	10	2	98
	12	1	100
	14	0	100
	16	1	96
	18	5	54
	20	86	6
Dark	22	93	5
	24	95	5

The data in the table show that species **A** is better adapted than species **B** to living in hot, dry deserts.

Explain how.

(4)
(Total 5 marks)

M9.(a) guard cell

ignore stoma / stomata

1

(b) Species A :

allow converse points for species B

stomata open in dark / at night **or** close in light / in day

1

stomata closed during warm(est) period **or** open when cool(er)

1

heat (energy) /warmth increases evaporation / transpiration

must give explicit link between heat and transpiration

1

reduces water loss / evaporation / transpiration

ignore photosynthesis

1

Q11. The photograph shows a sand gazelle.

The sand gazelle lives in the Arabian Desert where temperatures often reach 45 °C.

(a) The sand gazelle feeds only at dawn and at dusk. At other times it stays in the shade.

Suggest how this helps the animal to conserve water.

.....

.....

.....

.....

(2)

(b) During the dry season, the sand gazelle's liver and heart shrink in size. This reduces the amount of oxygen that the body needs.

Suggest how needing less oxygen helps the animal to conserve water.

.....

.....

.....

.....

(2)

(Total 4 marks)

M11. (a) stays cool

ignore shade

1

less sweat

1

(b) any **two** from:

- breathing rate less
- less water lost via breath

  less can be implied
- less water <u>from</u> respiration

2

[4]

Q12. Squirrels live in woodland.

Table 1 shows:

- the total area of England, Scotland and Wales
- the area of different types of woodland in these countries.

Table 1

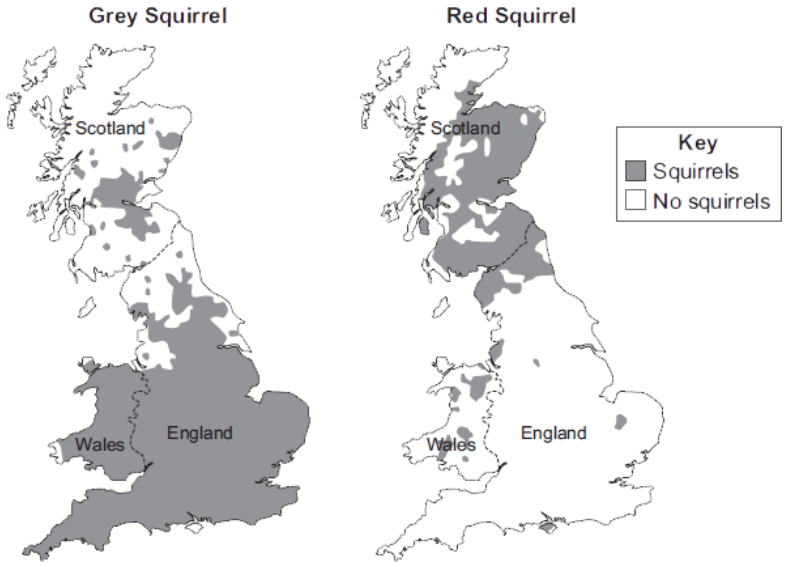
Country	Total area of country in thousands of km²	Area of woodland in thousands of km²		
		Coniferous woodland	Broadleaf woodland	Total
England	130	3.6	7.8	11.4
Scotland	79	10.4	3.0	13.4
Wales	21	1.9	0.9	2.8

(a) Look at the data for the three countries. Estimate which country has the greatest proportion of its area suitable as a habitat for squirrels.

Support your answer with relevant figures.

(2)

(b) The maps show the distribution of grey squirrels and red squirrels in England, Scotland and Wales.



Scientists suggested that the distribution of grey squirrels and red squirrels is linked to the type of trees in woodlands.

(i) The information for England and Scotland supports this suggestion.

How?

(1)

(ii) Give **one** piece of evidence that contradicts this suggestion.

M12. (a) Scotland

1

any **one** from

- Scotland 15 to 20% / about 1/5th to 1/7th but England and Wales / the others are less / lower / reasonable estimated figures
- $\frac{13.4}{79}$ is greater than England / $\frac{11.4}{130}$ and Wales / $\frac{2.8}{21}$

1

(b) (i) broadleaf woodlands have more grey squirrels **or** broadleaf woodlands have less red squirrels

allow converse referring to conifers

1

(ii) Wales has more conifers and / but more grey squirrels
or
Wales has less broadleaf and / but more grey squirrels

allow converse for red squirrels

1

(c) any **three** from:

answers must be comparative they = grey squirrels

grey squirrels

allow converse arguments for red squirrels

- have wider range/ more types of food
- are resistant to parapox (virus) but reds are not

ignore reference to other disease

- have more young each year / litter
- young more likely to survive (in mixed populations)

3

[7]

c) Red squirrels are native to the UK.
Grey squirrels were introduced to the UK from the USA over 100 years ago.

Table 2 gives information about the two types of squirrel.

Table 2

	Grey squirrel	**Red squirrel**
Population in UK	2.5 million	140 000
Main food types	Seeds, nuts, tree bark, birds' eggs, young birds	Cones from coniferous trees, nuts, tree bark, berries
Health	Can become immune to para-pox virus	Cannot become immune to par-apox virus
Reproduction	Up to 9 young, twice a year	Up to 6 young, twice a year
Survival rate of young in mixed populations	41 %	14 %
Length of life	2 – 4 years	Up to 7 years

In most parts of the UK the population of grey squirrels is increasing, but the population of red squirrels is decreasing.

Suggest why.

Use information from **Table 2**.

M12. (a) Scotland

1

any **one** from

- Scotland 15 to 20% / about 1/5th to 1/7th but England and Wales / the others are less / lower / reasonable estimated figures
- $\frac{13.4}{79}$ is greater than England / $\frac{11.4}{130}$ and Wales / $\frac{2.8}{21}$

1

(b) (i) broadleaf woodlands have more grey squirrels **or** broadleaf woodlands have less red squirrels

allow converse referring to conifers

1

(ii) Wales has more conifers and / but more grey squirrels
or
Wales has less broadleaf and / but more grey squirrels

allow converse for red squirrels

1

(c) any **three** from:

answers must be comparative they = grey squirrels

grey squirrels

allow converse arguments for red squirrels

- have wider range/ more types of food
- are resistant to parapox (virus) but reds are not

ignore reference to other disease

- have more young each year / litter
- young more likely to survive (in mixed populations)

3

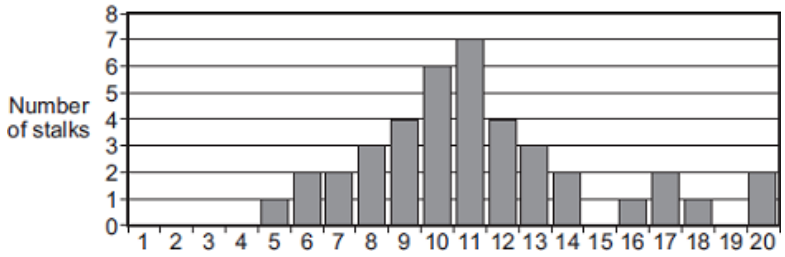
[7]

Q14. Some students studied bluebell plants growing in two different habitats.

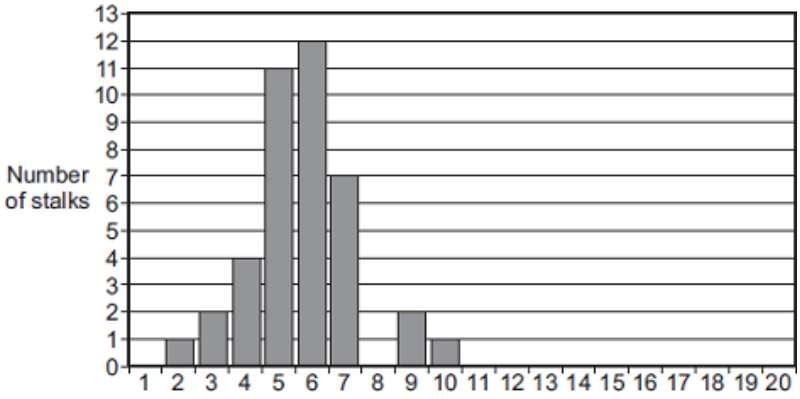
Habitat **A** was a sunny field next to woodland.
Habitat **B** was a shady, moist woodland.

A bluebell plant can have several flowers on one flower stalk. The students counted the number of flowers on each of 40 bluebell flower stalks growing in each habitat.
The bar charts show the results.

Habitat A: Sunny field next to woodland



Habitat B: Shady, moist woodland



(a) The students wanted to collect valid data.
Describe how the students should have sampled the bluebell plants at each habitat to collect valid data.

(2)

(b) (i) The students used the bar charts to find the mode for the number of flowers per stalk in the two habitats.

The mode for the number of flowers per stalk in habitat **A** was 11.

What was the mode for the number of flowers per stalk in habitat **B**?

Mode = ...

(1)

(ii) The students suggested the following hypothesis:

'The difference in the modes is due to the plants receiving different amounts of sunlight.'

Suggest why.

(2)

(iii) Suggest how the students could test their hypothesis for the two habitats.

(2)

(c) Suggest how receiving more sunlight could result in the plants producing more flowers per stalk.

(2)

(Total 9 marks)

M14.(a) use of quadrat / point frame

allow description

1

randomly placed / random sampling

ignore reference to transects

1

(b) (i) 6

1

(ii) more light in A / in field / where sunny

ignore sun

1

more / better / faster photosynthesis in A / with more light

allow converse

1

(iii) use light meter / measure light intensity in both habitats

1

take many measurements at same time of the day

1

or

laboratory / field investigation with 2 batches high light and low light (1)

count or number of flowers in each (1)

counting point is dependent on investigation point

(c) more glucose / energy available

allow other named product eg protein

allow if more energy produced

1

for growth

dependent on 1st mark

Q15. In January 2011 more than 600 000 people collected results for the UK national bird survey.

People recorded the number of each species of bird they saw in 1 hour on 1 day in their garden.

Some of the results are shown in the table below.

Species	Mean number of birds seen per garden	Percentage of gardens in which the bird was seen
House sparrow	4.1	64.5
Starling	3.9	51.3
Blackbird	3.2	95.2
Goldfinch	1.5	33.5

(a) A student looked at the table and said:

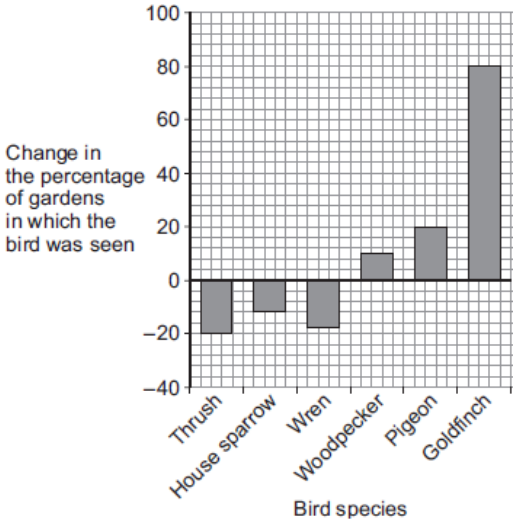
"In the UK, house sparrows are more common than blackbirds."

Suggest **three** reasons why the student's statement may **not** be true.

(3)

(b) A survey in 2012 was done in the same way as the 2011 survey.

The graph below shows changes in the percentages of gardens in which some birds were seen from 2011 to 2012.



(i) Calculate the percentage of gardens in which goldfinches were seen in 2012.

Use information from the graph and the table.

Answer = ... %

(2)

(ii) Suggest **two** reasons why goldfinches were seen in more gardens in 2012 than in 2011.

(2)

(Total 7 marks)

M15.(a) any **three** from:

- blackbirds seen in higher % of / more gardens
- multiplying mean number by percentage of gardens seen in shows blackbird is higher

  *allow **1** additional mark for correct figures showing this, ie 264 sparrows: 305 blackbirds*
- only done on one day / month / hour

  eg only done in January
- only done in gardens (one bird may prefer a different habitat)
- problem of (correct) identification
- may re-count same ones

  if neither point 5 or 6 given allow 1 mark for idea of error / miscounted
- people may quote false numbers / may make it up

3

(b) (i) 60.3

*award **2** marks for correct answer, irrespective of working*

*award **1** mark for 33.5 + (33.5 × 80 / 100) or equivalent with no answer or incorrect answer **or** award **1** mark for 26.8*

2

(ii) any **two** from:

- change in temperature

  a comparison is required

  eg cooler / warmer / less frost (in 2012)
- fewer predators
- more food **or** less competition for food
- more nesting space **or** less competition for nesting space
- less disease (in 2012)

  allow idea that people may be better / worse at identifying birds / gold-finches

  allow idea of movement to gardens (due to poor food supply elsewhere)

2

Q17. The photographs show four different species of bird.

Great tit

© JensGade/iStock

Blue tit

© Marcobarone/iStock

Coal tit

© MikeLane45/iStock

Long-tailed tit

© Andrew Howe/iStock

The table gives information about the four species of bird in winter.

Bird species	Mean body mass in grams	Mean energy needed in kJ per day	Mean percentage of day spent feeding
Great tit	21	84.2	75
Blue tit	12	62.4	81
Coal tit	9	49.5	88
Lond-tailed tit	7	42.0	92

(a) (i) Calculate the energy needed per day per gram of body mass for the blue tit.

Answer = ... kJ per day per gram of body mass

(2)

(ii) Describe the trend for energy needed per day per gram of body mass for the four species of bird.

(1)

(iii) Suggest an explanation for the trend you have described in part (a)(ii).

(2)

(b) Describe and explain the trend shown by the data for the time spent feeding in winter for the birds.

(2)

(Total 7 marks)

M17.(a) (i) 5.2

*award **2** marks for correct answer, irrespective of workingor lack of it*
*award **1** mark for 62.4 ÷ 12 only with incorrect or no answer*

2

(ii) the smaller the (mass of the) bird the more energy is needed(per gram of body mass)

allow converse
ignore figures

1

(iii) smaller bird has larger surface area : volume / mass ratio

allow converse

1

so heat / energy lost more quickly

allow lose more heat / energy
if (a)(ii) describes a trend of more energy with increasing body mass
*allow **one** mark for idea of more energy needed for flight*

1

(b) larger birds spend less time feeding

accept converse
allow the less energy they need per day the longer they spend feeding

1

since they need less food per gram of body mass (to satisfy energy needs)

1

Q18. On a rocky shore, when the tide goes in and out, organisms are exposed to the air for different amounts of time.

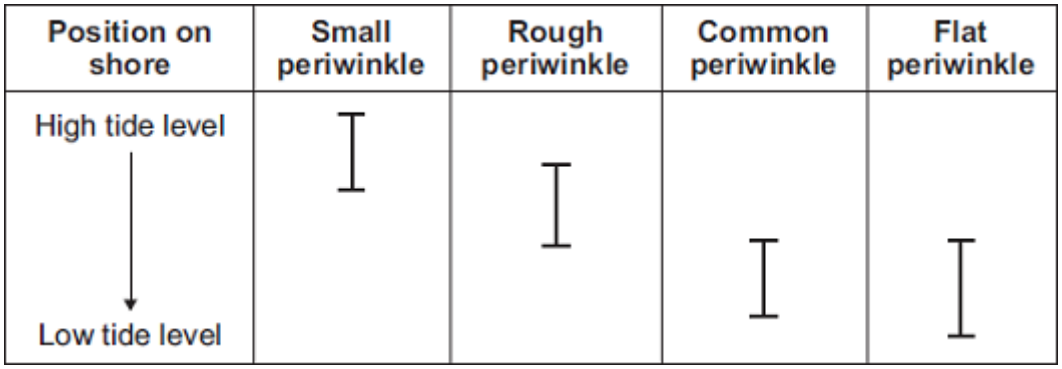
(a) On hot, windy days when the tide is out the concentration of the salt solution in rock pools may become very high.

What term is used to describe organisms that can survive in severe conditions such as very high concentrations of salt solution?

(1)

(b) Periwinkles are types of snail.
Students surveyed the different types of periwinkle living on a rocky shore.

The diagram shows the results of the students' survey.
The highest position that the sea water reaches on the shore is called the high tide level.
Each bar represents the range of habitats for each type of periwinkle.



(i) Which **two** types of periwinkle are likely to compete with each other to the greatest extent?

(1)

(ii) Explain your answer to part (b)(i).

(1)

(iii) The small periwinkle can survive much nearer to the high tide level than the flat periwinkle.

Suggest **two** reasons why the flat periwinkle cannot survive near to the high tide level.

(2)

(Total 5 marks)

M18.(a) extremophile(s)

1

(b) (i) common (periwinkle) and flat (periwinkle)
*either order, **both** required*

1

(ii) (common and flat) both live in the same habitat / area / named area
allow habitats overlap the most

1

(iii) any **two** from:

- would have wrong food
- would otherwise be exposed to (specific) predators
- cannot tolerate extended exposure to air **or** reduced submersion in seawater
allow cannot tolerate temperature / dehydration
- cannot tolerate high salt concentration (in rock pools)
allow low salt concentration (in rock pools)
- cannot compete with small periwinkle

2

[5]