Q1. (a) Explain the meaning of these ecological terms.

Population ....

....

Community ....

....

(2)

(b) Some students used the mark-release-recapture technique to estimate the size of a population of woodlice. They collected 77 woodlice and marked them before releasing them back into the same area. Later they collected 96 woodlice, 11 of which were marked.

(i) Give **two** conditions necessary for results from mark-release-recapture investigations to be valid.

1 ……...

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2 ……...

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(2)

(ii) Calculate the number of woodlice in the area under investigation. Show your working.

Answer ....

(2)

(c)   Explain how you would use a quadrat to estimate the number of dandelion plants in a field measuring 100 m by 150 m.
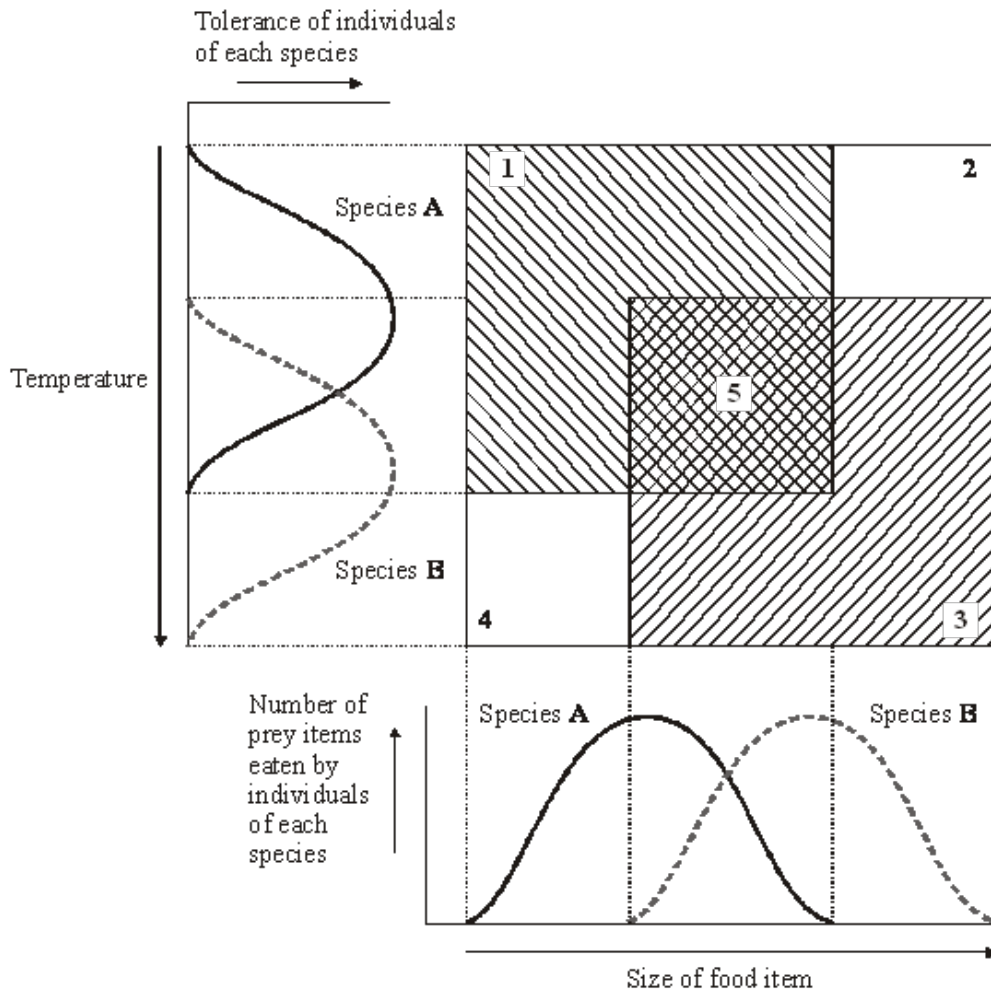
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(3)

(d)   Two similar species of birds (species **A** and species **B**) feed on slightly different sized insects and have slightly different temperature preferences. The diagram represents the response of each species to these factors.

(i) Which of the numbered boxes describes conditions which represent

the niche of species **A**; ....

the niche of species **B**; ....

insects too small for species **B** and temperature too warm for species **A**; ....

insects too large for species **A** and temperature too cool for species **B**? ....

(2)

(ii) These two species are thought to have evolved as a result of sympatric speciation. Suggest how this might have occurred.
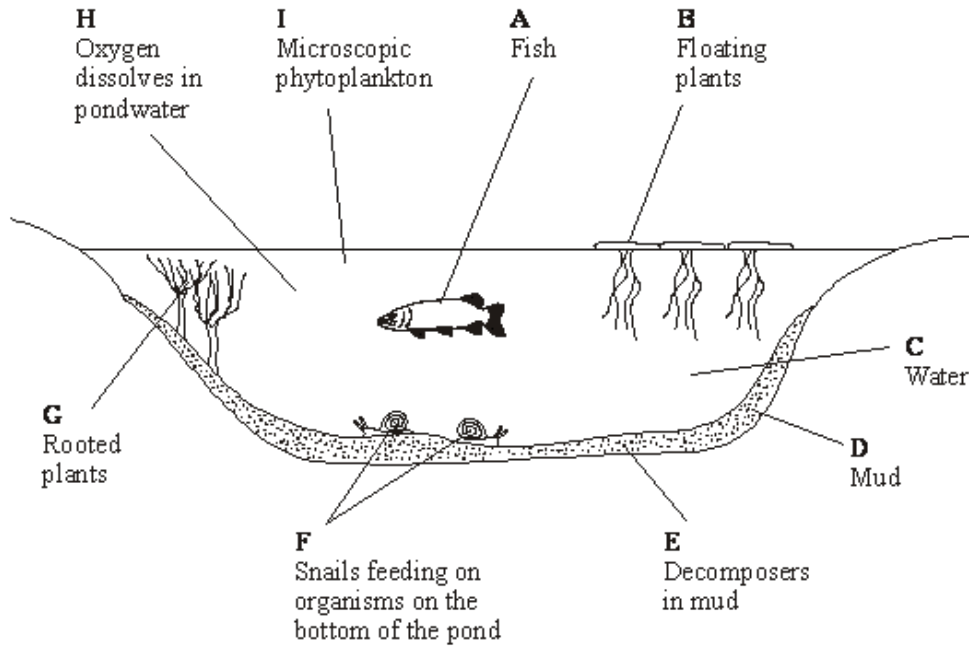
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(4)
(Total 15 marks)

Q2.   The diagram shows some of the components of a pond ecosystem.

H
Oxygen
dissolves in
pondwater

I
Microscopic
phytoplankton

A
Fish

B
Floating
plants

C
Water

G
Rooted
plants

D
Mud

F
Snails feeding on
organisms on the
bottom of the pond

E
Decomposers
in mud

(a)   (i)   What is an ecosystem?

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(1)

(ii)   List the letters that represent those components that are part of the pond community.

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(1)

(b)   New Zealand pygmy weed has been introduced into many garden ponds and has spread
to some natural ponds. Here, it competes with naturally occurring plants. Suggest how the
introduction of pygmy weed may lead to a reduction in the diversity of the community in a
natural pond.

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(3)
(Total 5 marks)

Q3. Fur seals live in Antarctic seas. They feed on fish and shrimp-like animals called krill. During the summer the fur seals come ashore to breed. The table shows the number of fur seals breeding on an Antarctic island from 1956 to 1986.

Year	Number of adult fur seals
1956	100
1964	100
1970	200
1975	100
1976	1600
1981	2900
1983	3100
1986	11700

(a)   (i)   Calculate the mean annual growth rate of this fur seal population over the period 1981 – 1986. Show your working.

Answer ....

(2)

(ii)   Scientists suggested that the increase in the fur seal population was due to an increase in commercial whaling. Many species of whale living in Antarctic seas feed on krill. Explain how an increase in whaling might have resulted in an increase in the seal population.
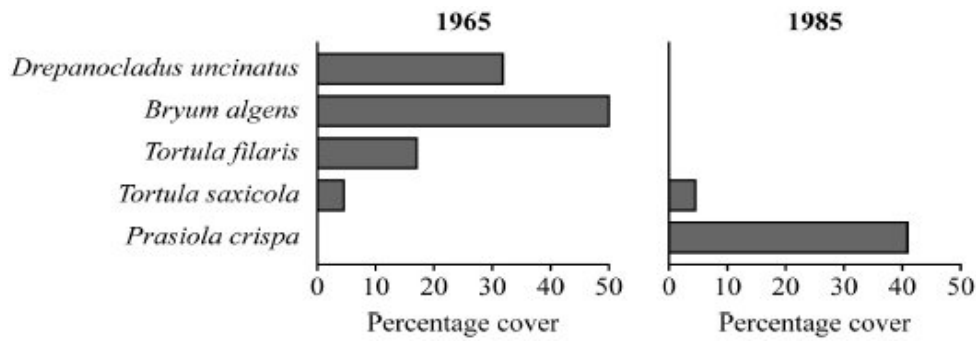
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(2)

Research workers set up permanent quadrats to investigate the effect of the seals on the island vegetation. The diagram shows the percentage cover of the plants in one of the permanent quadrats in 1965 and again in 1985.

(b) Give **two** advantages of collecting quantative data about plant distribution as percentage cover.

1 …...

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2 ....

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(2)

(c) The seals affected the vegetation in the quadrat over the time period. Describe how.

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(3)

(d) *Prasiola crispa* colonises soil with a high concentration of nitrogen-containing ions. Explain the increase in *P. crispa* in this quadrat.

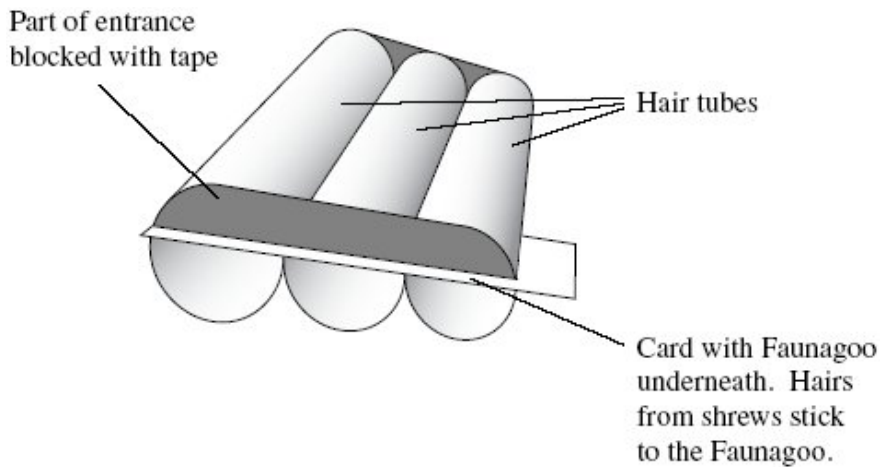...

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(2)
(Total 11 marks)

Q4. Shrews are small mammals. Three species of shrew live in mainland Britain. The table shows some features of these shrews.

Species	Mean body mass / g	Mean length of head and body / mm	Food
Common shrew	10	79	Mainly insects and
Pygmy shrew	5	58	other small
Water shrew	13	85	invertebrates

A team of biologists investigated a method of estimating the abundance of shrews. They used plastic tubes, called hair tubes. Some of the hairs from a shrew that enters one of these tubes stick to glue in the tube. These hairs can be used to identify the species of shrew. The diagram shows a set of these hair tubes.

Part of entrance blocked with tape

Hair tubes

Card with Faunagoo underneath. Hairs from shrews stick to the Faunagoo.

(a) (i) Faunagoo is a glue that remains sticky after wetting and drying. Explain the advantage of using Faunagoo in these hair tubes.

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(1)

(ii) The diagram shows that the biologists partly blocked the entrances to the tubes with tape. Suggest why they partly blocked the entrances.

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(1)

(b)   The biologists needed to find a way of distinguishing between the hairs of the three species of shrew. They collected hairs from shrews of each species. For each species, they selected hairs at random and made different measurements.

Explain why the biologists selected the hairs at random.

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(1)

(c)   Repeatable measurements are measurements of the same feature that are very similar.

In this investigation, each measurement was made by two observers. This helped the team to check the repeatability of these measurements.

(i)   Explain why it was important to check the repeatability of the measurements.

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(2)

(ii)   You could use a scatter diagram to check the repeatability of measurements made by two observers. Describe how.

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(2)

(d)   The biologists used hair tubes to find the abundance of shrews along the edges of some fields. They also used traps that caught shrews without harming them. They selected areas where all three species of shrew were present.

- They put sets of hair tubes at 5 m intervals along the edges of the fields. They inspected the tubes one week later and recorded the number of sets of tubes that contained shrew hairs. They called this the hair tube index.

- At each site where they used hair tubes, they set traps immediately after using the hair tubes. They recorded the number of different shrews caught in these traps.

(i)   The research team found the hair tube index. Explain why they could not use the hair tubes to find the total number of shrews present.

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(1)

(ii)   The research team set the traps immediately after using the hair tubes. Explain why setting the traps immediately after using the hair tubes would make comparisons between the two methods more reliable.
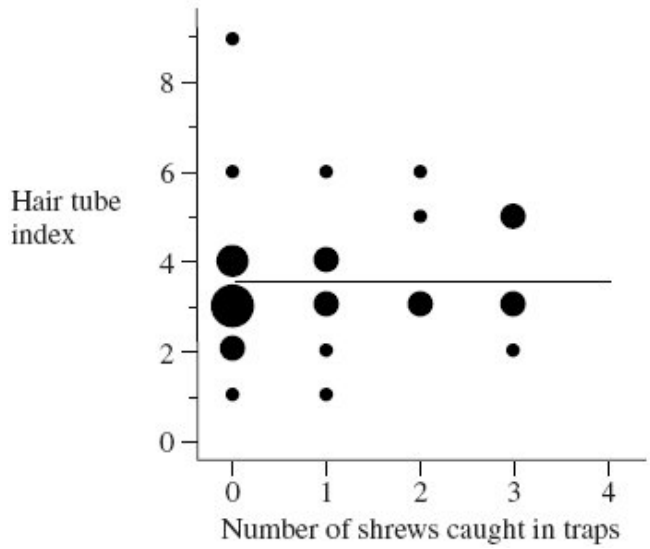
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(2)

The graphs are types of scatter diagram called bubble plots. They show hair tube index plotted against the number of shrews caught in traps. The area of the bubble is proportional to the number of records plotted.

Common shrew

Hair tube index (y-axis)
Number of shrews caught in traps (x-axis)
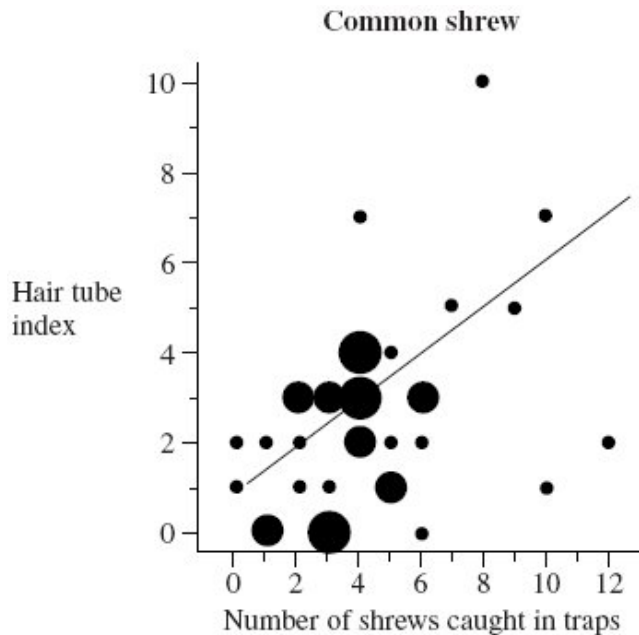
Pygmy shrew

(e) Explain why a statistical test was necessary in analysing the results for the common shrew. Use the terms chance and probability in your answer.

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(2)

(f) (i) The biologists concluded that hair tubes were a reliable way of measuring the abundance of common shrews. Give evidence from the graph to support this conclusion.

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(1)

(ii) Use information in this question to evaluate the use of hair tubes as a way of measuring the abundance of pygmy shrews.

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(2)
(Total 15 marks)

Q5. Woods can be coppiced to provide a continuous supply of useful logs and poles. Coppicing involves cutting down some trees in a wood to leave stumps. New shoots grow from the stumps. After about 15 years, these trees can be coppiced again.

Because coppicing produces a wood with patches of light and shade, the diversity of plants and animals in a coppiced wood is high.

Ecologists investigated the effect of coppicing on the flowering of wild daffodils growing in a wood in Cumbria. Some areas of the wood were coppiced and some areas were not. The graph shows some results from this investigation.
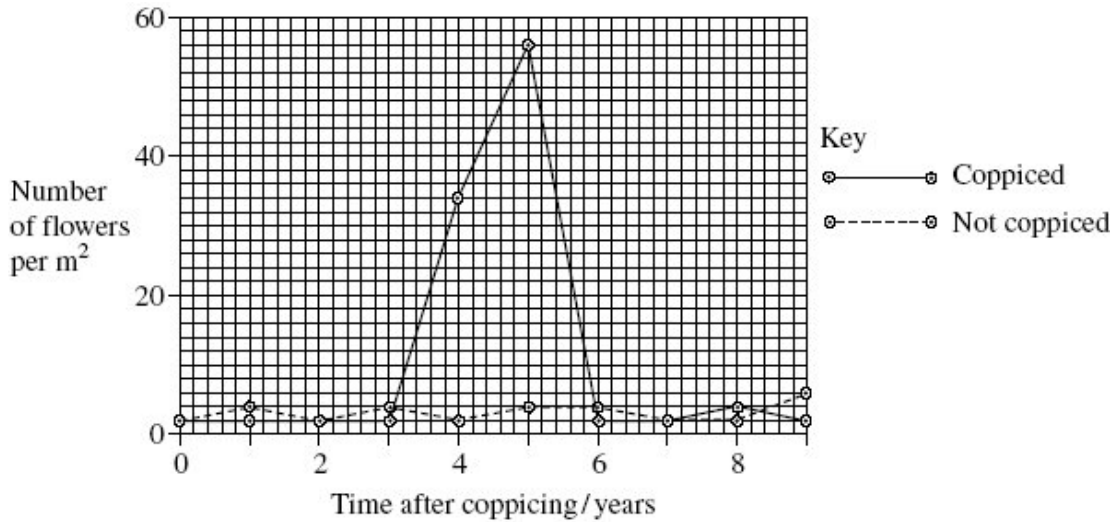
(a) You could collect data for the coppiced plots by using quadrats.

    (i) Describe how you would place the quadrats at random.

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       (2)

    (ii) Describe how you would decide the number of quadrats to use in order to collect representative data.

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       (2)

(b)   Members of the public visit this wood to see wild daffodils in flower. Explain how the information in the graph could help the owners to manage the wood so that there were many wild daffodils in flower every year.

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(2)

(c)   The ecologists analysed the relationship between the number of daffodils in flower in the whole wood and data collected from a nearby weather station for the previous year.

They used the Spearman rank correlation test. The table shows their results.

Month	Climatic factor	Correlation coefficient	Statistical significance
July	Total rainfall	+ 0.65	significant
August	Total rainfall	+ 0.74	significant
July	Monthly mean temperature	− 0.78	significant
August	Monthly mean temperature	− 0.65	significant

The ecologists concluded that a wet, cool summer produces good flowering the following spring. Do you support this conclusion? Use the data in the table to explain your answer.

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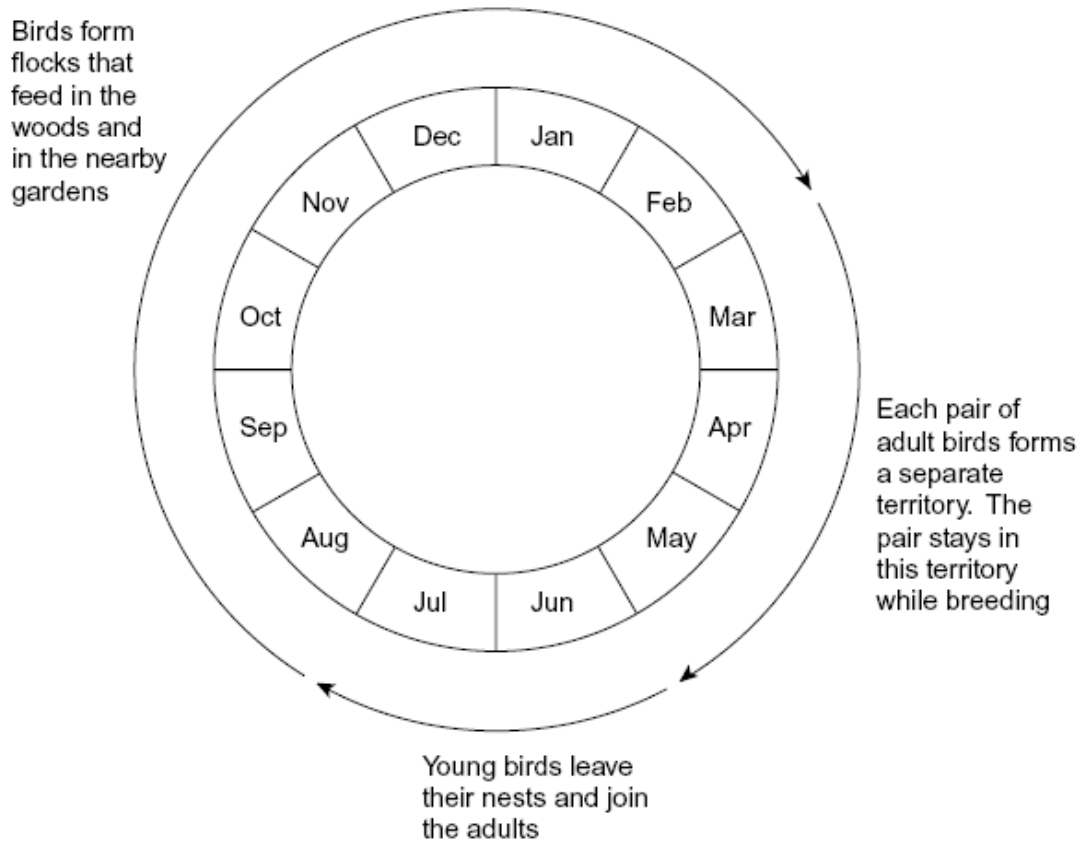
(2)
(Total 8 marks)

Q6.   (a)   Blue tits are small birds that live in woods. An ecologist estimated the size of the blue tit population visiting gardens near a wood in November.

- She trapped 28 blue tits. She marked all of these birds with small metal rings on their legs.

- Two weeks later, she trapped another sample of blue tits. Of these birds, 18 were marked and 20 were not marked.

Use the data to estimate the size of the blue tit population. Show your working.

Size of population ....

(2)

(b)   The diagram shows some features of blue tit behaviour at different times of the year.

Birds form flocks that feed in the woods and in the nearby gardens

Each pair of adult birds forms a separate territory. The pair stays in this territory while breeding

Young birds leave their nests and join the adults

(i) Using mark-release-recapture to estimate the size of a blue tit population in June would **not** give reliable results. Explain why.

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(2)

(ii) Using mark-release-recapture to estimate the size of a blue tit population in March would **not** give reliable results. Explain why.

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(2)

(c) Whales spend most of their time deep in the sea but they come to the surface to breathe. When they are at the surface, scientists obtain small samples of their skin. The scientists find the base sequence in some of the DNA from these samples. The base sequence is different in each whale.

You could use the information about the base sequence to estimate the size of the whale population by using mark-release-recapture. Explain why.

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(2)
(Total 8 marks)

Q7. The young of frogs and toads are called tadpoles. Ecologists investigated the effect of predation on three species of tadpole. They set up four artificial pond communities.

Each community contained

- 200 spadefoot toad tadpoles
- 300 spring peeper frog tadpoles
- 300 southern toad tadpoles.

The ecologists then added a different number of newts to each pond. Newts are predators. **Figure 1** shows the effect of increasing the number of newts on the percentage survival of the tadpoles of each species.

Figure 1
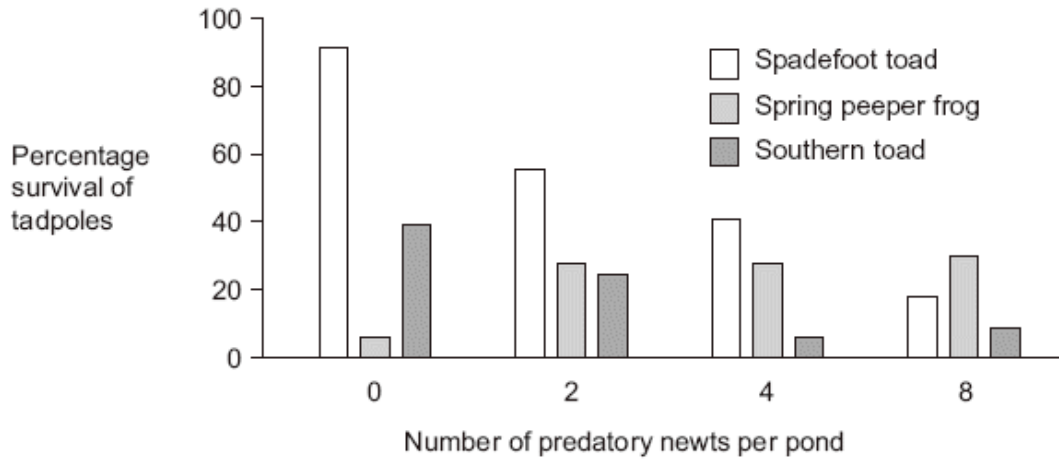
(a) (i) Describe the effect of an increase in the number of newts on the percentage survival of the tadpoles of each of the **toad** species.

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(2)

(ii) Suggest an explanation for the effect of an increase in the number of newts on the percentage survival of the tadpoles of spring peeper frogs.

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(2)

Figure 2 shows how the masses of the tadpoles were affected in each pond during the investigation.

Figure 2

Legend:
☐ Spadefoot toad
▨ Spring peeper frog
▨ Southern toad

Y-axis: Mean mass of tadpoles in pond

X-axis: Number of predatory newts per pond (0, 2, 4, 8)
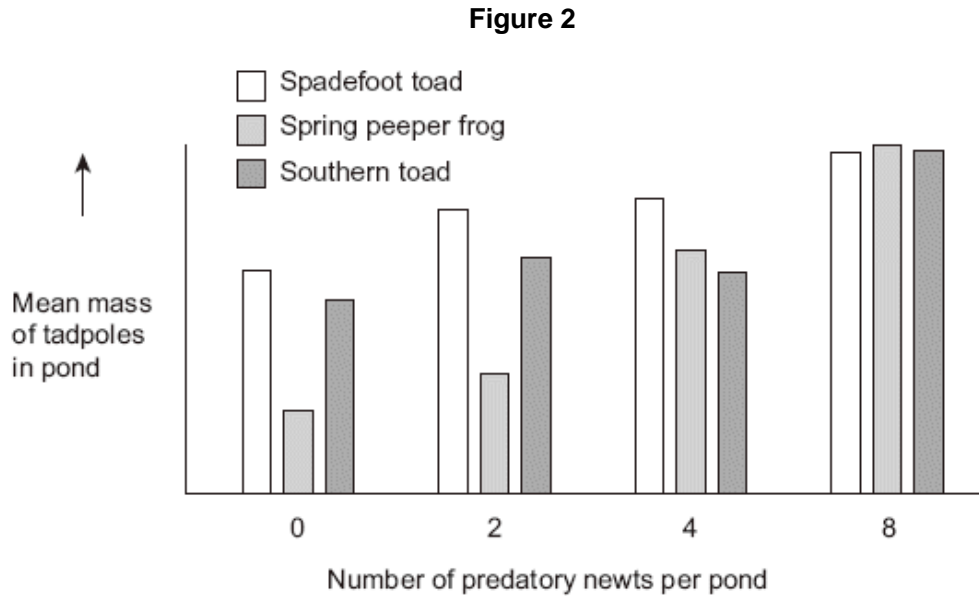
(b)   Using the information provided in **Figure 1** explain the results obtained in **Figure 2**.

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(2)
(Total 6 marks)

Q8.   A Sri Lankan scientist investigated the effect of human disturbance on the organisms living on a rocky seashore. He chose three areas for the study. These areas had different amounts of human disturbance.

The scientist measured human disturbance by walking from one end of the beach to the other. He recorded the number of people he encountered. **Figure 1** shows his results.

Figure 1

	Site **R**	Site **G**	Site **U**
Mean number of people encountered per hour (± standard deviation)	2.2 (± 2.1)	17.6 (± 9.6)	34.6 (± 11.6)

(a)   (i)   What conclusions can you draw about the number of people visiting Site **R** compared with the number of people visiting the other two sites? Give evidence from **Figure 1** to support your answer.

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(2)

(ii)   The scientist reported that the difference between the number of people visiting Site **R** and the number visiting the other two sites differed significantly ($p < 0.05$).

Use the words probability and chance to explain the meaning of *differed significantly (p < 0.05).*

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(2)

(b) The scientist used quadrats to find the number of species at each of the three sites. He carried out a preliminary investigation and recorded the total number of species in an increasing number of quadrats. **Figure 2** shows the results.
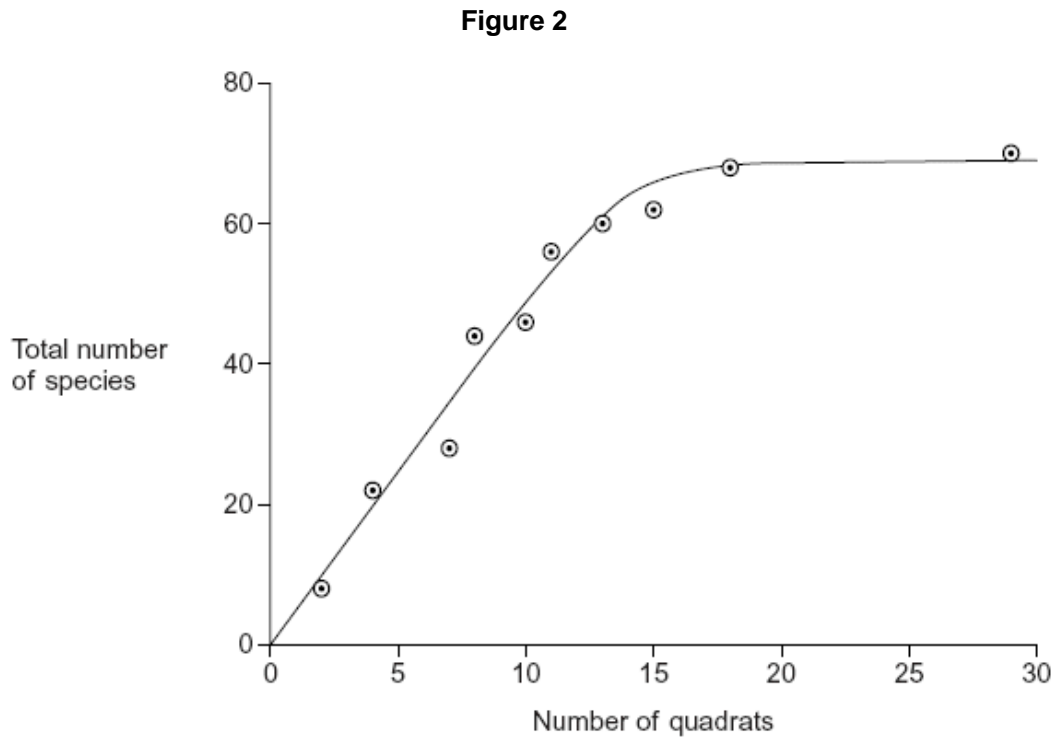
Figure 2

(i) Use **Figure 2** to explain why 10 would **not** be an appropriate number of quadrats to use.

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(1)

(ii) Use **Figure 2** to explain why 25 would **not** be an appropriate number of quadrats to use.

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(1)

The scientist measured the dry biomass of seaweeds at each of sites **R**, **G** and **U**. He collected all the organisms of a particular species in a quadrat and incubated them in an oven at a temperature of 80 °C.

(c)   The scientist incubated the seaweeds at 80 °C. Suggest why incubating them at a higher temperature would **not** produce valid results.

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(1)

As well as measuring the dry biomass of the seaweeds, the scientist measured the dry mass of the animals present. He also measured the abundance of each species. **Figure 3** shows the data he collected.

Figure 3

	Site **R**	Site **G**	Site **U**
Mean number of people per hour	2.2	17.6	34.6
Mean number of species of seaweed per quadrat	4.2	2.1	1.3
Ratio of dry biomass of animals to dry biomass of seaweeds	0.15	0.06	0.03
Ratio of dry biomass of animals to abundance of animals	0.20	0.10	0.09
Ratio of dry biomass of seaweeds to abundance of seaweeds	0.79	1.57	3.24

(d)   The ratio of the dry biomass of animals to the dry biomass of seaweeds is always a lot less than one. Explain why.

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(2)

(e)　(i)　Conservation officers were working on the beaches used in this investigation. They noticed that there were fewer larger seaweeds on beaches used by a large number of people than on beaches visited by only a few people. Explain how the data in **Figure 3** support this.

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(2)

(ii)　What conclusions can you draw from the data in **Figure 3** about the effect of human disturbance on the animals living on the seashore? Explain your answer.

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(4)
(Total 15 marks)

Q9.　(a)　Explain what is meant by the ecological term population.

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(1)

(b) Four factors may affect the size of a human population. They are

- Birth rate (**B**)
- Death rate (**D**)
- Emigration rate (**E**)
- Immigration rate (**I**).

Use all the letters **B**, **D**, **E** and I to write a formula showing

(i) a population that stays the same size

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(1)

(ii) a population that is increasing in size.

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(1)

(c) The table shows some features relating to the human population of Mexico in 2007.

Features	
Total population / millions	107
Birth rate per 1000 population	20
Death rate per 1000 population	5
Life expectancy / years	76

(i) In 1990 the life expectancy was 70 years. Suggest **one** reason for the change in life expectancy since 1990.

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(1)

(ii) Use the information in the table to calculate the size of the population of Mexico in 2008. Show your working.
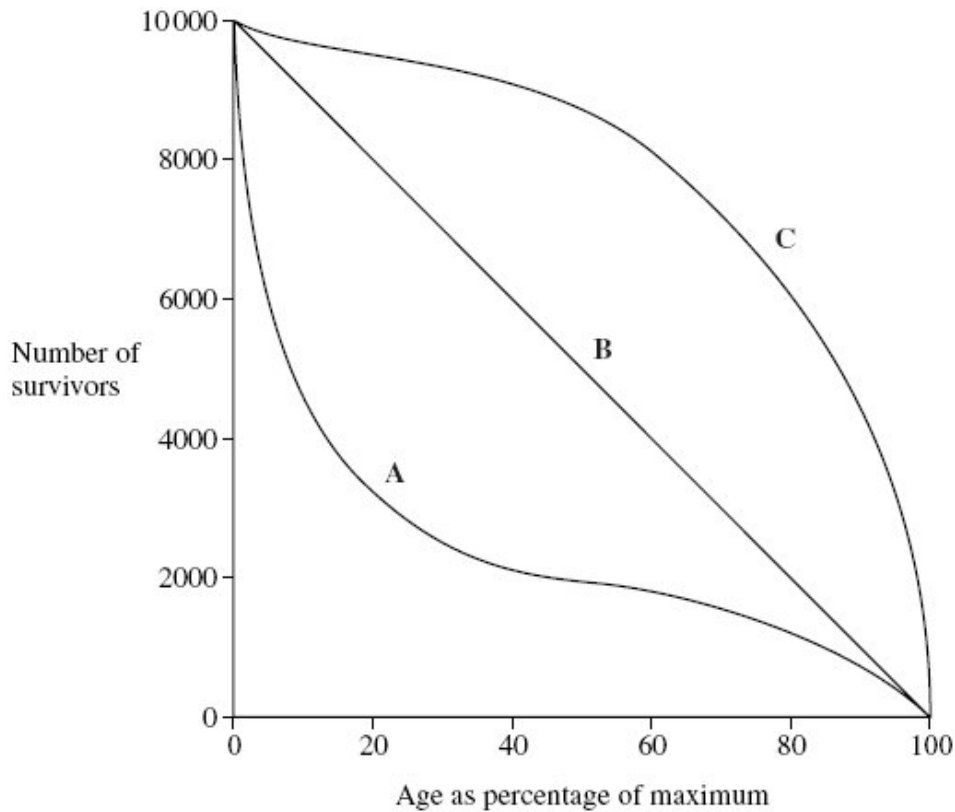
Answer ....

(2)
(Total 6 marks)

Q10.   (a)   Explain what is meant by the ecological term, population.

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(1)

(b)   The diagram shows three survival curves, **A**, **B** and **C**.

Age as percentage of maximum

(i)   Assume that the maximum age of a person living in a developed country is 95 years.

The diagram can be used to find the average life expectancy of people living in developed countries. Explain how.

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(3)

(ii)   Curve **A** is a survival curve for people living in the UK in 1750. Explain why the curve is this shape.

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(2)
(Total 6 marks)

Q11.   (a)   In a demographic transition, give **one** factor that might cause

(i)   an increase in the birth rate; ....

....

(ii)   a decrease in the death rate. ....

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(2)

(b)   Births, deaths and migration affect population growth. The graph shows the effects of these factors on a human population between 1960 and 2000. During this period the death rate was almost constant.
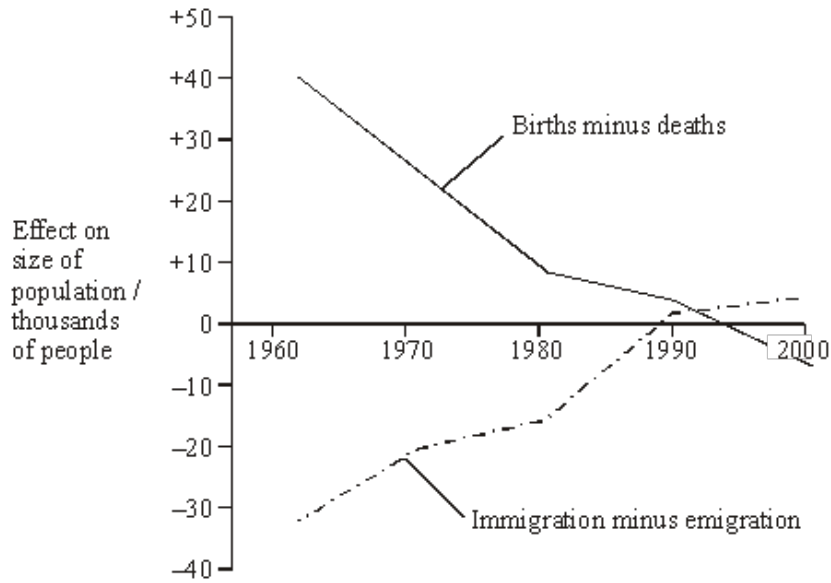
(i)   From the information given, what does the graph show about changes in birth rate between 1960 and 1980? Explain your answer.

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(2)

(ii)   Describe the effect of immigration and emigration on the growth of this population between 1960 and 2000.

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(2)
(Total 6 marks)

Q12. The table shows the birth rate, death rate and life expectancy in England and Wales in four different years. You may assume there was no migration.

Year	1851	1901	1931	1961
Birth rate per 1000 population	34.3	28.5	15.8	17.6
Death rate per 1000 population	22.0	16.9	12.3	11.9
Female life expectancy at birth / years	41.9	52.4	62.9	74.0
Male life expectancy at birth / years	39.9	48.5	58.7	68.1

(a)　(i)　Give the year when the population was growing at the slowest rate. Explain your answer.

Year ……...

Explanation ....

....

(2)

(ii)　The population of England and Wales in 1851 was 18 million. Calculate the size of the population in 1852. Show your working.

Answer ....

(2)

(b)　One reason for the decrease in the death rate between 1851 and 1931 was the introduction of mass vaccination. Explain how vaccinating a large proportion of the population reduces the death rate.

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(2)

S (c) Suggest a genetic explanation for the difference in life expectancy of females and males.

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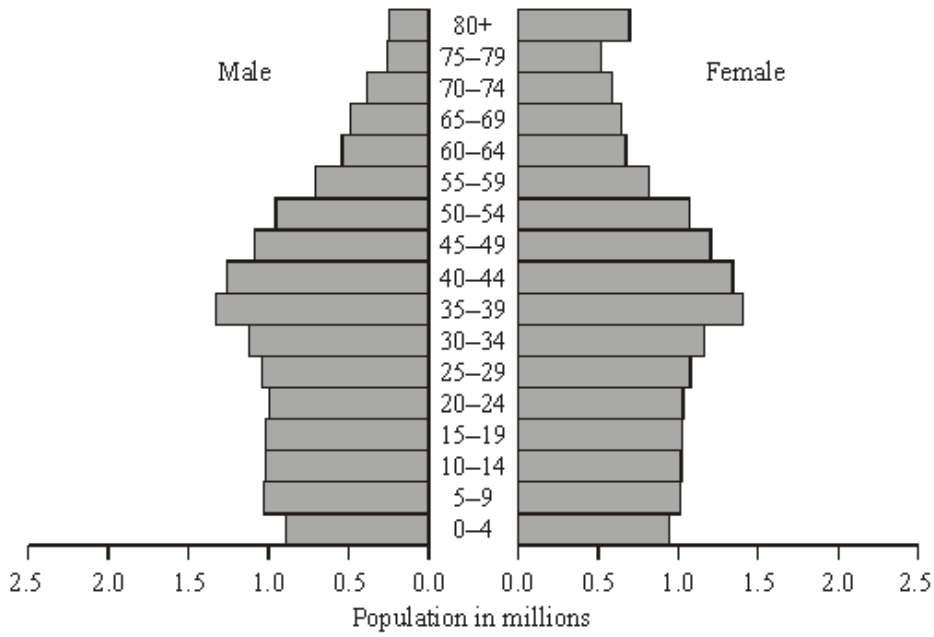
(3)
(Total 9 marks)

Q13. (a) The population pyramids show the age distribution in two countries in 2000.

Country A

Country B

(i) Describe the pattern of age distribution in each country.

Country A ....

....

....

Country B ....

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(2)

(ii) The population size of the two countries is about the same. In which country is the population growing more rapidly? Explain your answer.

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(1)

(b) What information is required in order to calculate the growth rate of a population?

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(2)
(Total 5 marks)