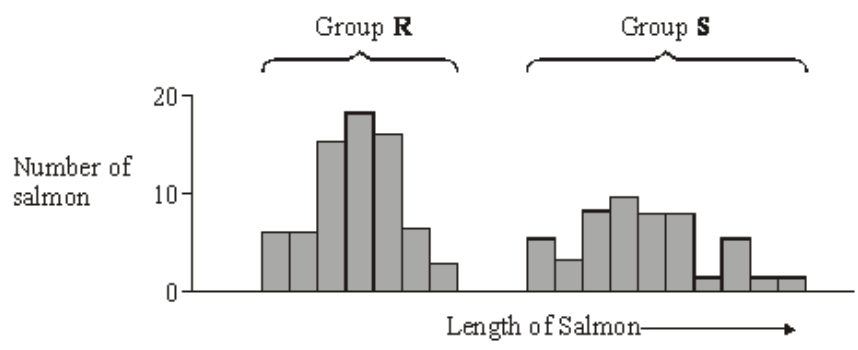


**Q1.** The graph shows the variation in length of 86 Atlantic salmon.



(a) (i) What type of variation is shown by the lengths of the salmon in group **R**? Give the evidence to support your answer.

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(1)

(ii) Give **two** possible causes of this variation that result from meiosis during gamete formation.

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(2)

(b) When comparing variation in size between two groups of organisms, it is often considered more useful to compare standard deviations rather than ranges. Explain why.

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(2)  
 (Total 5 marks)

**Q2.** IQ test scores have been used as a measure of intelligence. Genetic and environmental factors may both be involved in determining intelligence. In an investigation of families with adopted children, the mean IQ scores of the adopted children was closer to the mean IQ scores of their adoptive parents than to that of their biological parents.

(a) Explain what the results of this investigation suggest about the importance of genetic and environmental factors in determining intelligence.

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(1)

(b) Explain how data from studies of identical twins and non-identical twins could provide further evidence about the genetic control of intelligence.

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(4)

**(Total 5 marks)**

**Q3.** (a) Explain what is meant by genetic diversity.

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(1)

(b) Apart from genetic factors what other type of factor causes variation within a species?

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(1)

(c) The spotted owl is a bird. Numbers of spotted owls have decreased over the past 50 years. Explain how this decrease may affect genetic diversity.

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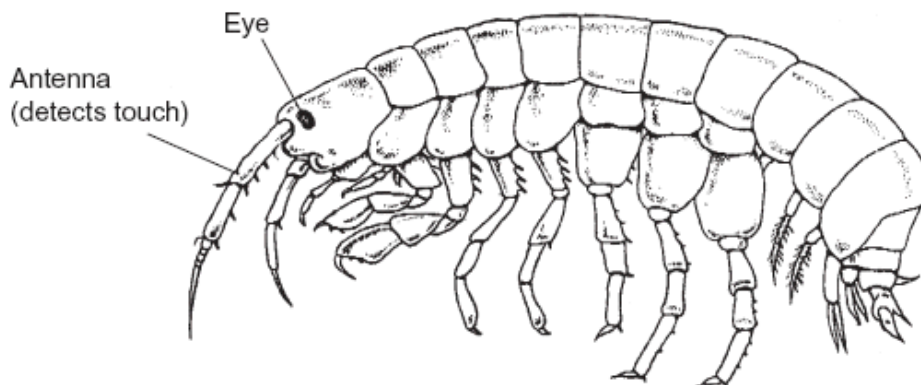
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(2)  
(Total 4 marks)

**Q4.** Figure 1 shows a fresh-water shrimp.

**Figure 1**



Biologists collected shrimps from a stream inside a cave and from the same stream when it was in the open.

They measured the maximum diameter of each shrimp's eye. They also measured the length of its antenna. From these measurements they calculated the mean values for each site. **Figure 2** shows their results.

**Figure 2**

	Shrimps from the stream	
	Inside the cave	In the open
Mean diameter of eye /mm	0.09	0.24
Mean length of antenna /mm	8.46	5.81

(a) The biologists measured the maximum diameter of each shrimp's eye.

Explain why they measured the **maximum** diameter.

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(1)

(b) A scientist working many years earlier suggested that animals which live in caves had similar adaptations. These adaptations included

- smaller eyes
- greater use of sense organs such as those involved in detecting touch.

(i) Do the data in **Figure 2** support this scientist's suggestion? Explain your answer.

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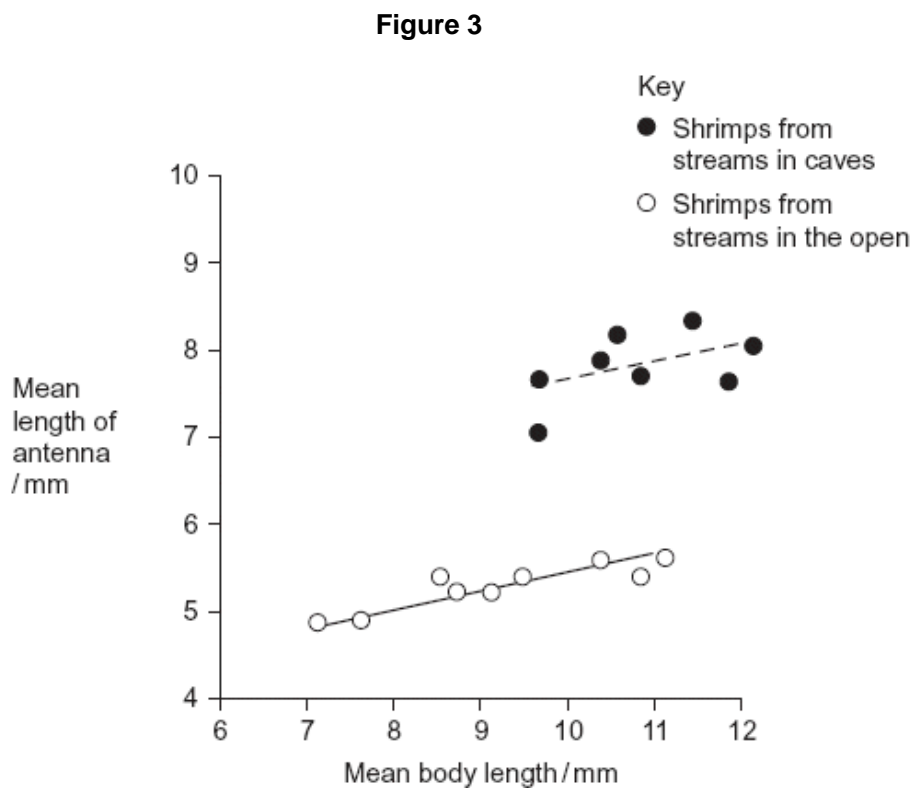
(2)

(ii) The data in **Figure 2** are mean values. Explain how standard deviations of these mean values would help you to interpret the data in **Figure 2**.

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(2)

- (c) The biologists investigated shrimps living in other streams. They measured the length of the antennae of these shrimps. They also measured their body length. **Figure 3** shows the mean antenna length plotted against mean body length for each site.



- (i) What does the information in the graph suggest about the body lengths of shrimps living in caves and living in the open?

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(2)

- (ii) Do the data in the graph support the conclusion that shrimps with longer bodies have longer antennae? Give the reason for your answer.

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(1)

Other biologists investigated the genetic diversity of these shrimps. **Figure 4** shows some of the data they collected.

**Figure 4**

Gene	Allele	Percentage of shrimps with this allele in steam	
		Inside a cave	In the open
PGI	A	0.9	2.5
	B	0.0	3.3
	C	98.2	66.4
	D	0.9	6.6
	E	0.0	21.3
ACO2	J	0.0	5.6
	K	0.0	76.7
	L	100.0	17.8

- (d) The biologists concluded that the shrimps in the open had a higher genetic diversity than those in the cave. Explain how the data in **Figure 4** support this conclusion.

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(1)

- (e) The percentage of shrimps with allele **L** in the cave is different from the percentage of shrimps with allele **L** in the open. Use your knowledge of the founder effect to suggest a reason for this difference.

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(3)

- (f) The biologists who studied these shrimps wanted to know if the shrimps living in the cave were the same species as those living in the open. They used breeding experiments to investigate this.

- (i) Describe how the biologists should carry out these breeding experiments.

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- (ii) The results of breeding experiments would help the biologists to decide whether the shrimps were the same species. Explain how.

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(3)  
 (Total 15 marks)

**Q5.** The table shows some differences between three varieties of banana plant.

	Variety A	Variety B	Variety C
Number of chromosomes in a leaf cell	22	33	44
Growth rate of fruit / cm <sup>3</sup> week <sup>-1</sup>	2.9	6.9	7.2
Breaking strength of leaf / arbitrary units	10.8	9.4	7.8

- (a) (i) How many chromosomes are there in a male gamete from variety C?

(1)

- (ii) Variety B cannot produce fertile gametes. Use information in the table to explain why.

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(2)

In some countries very strong winds may occur. Banana growers in these countries choose to grow variety B.

- (b) (i) Use the data in the table to explain why banana growers in these countries choose to grow variety B rather than variety A.

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(1)

(ii) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **C**.

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(1)

(c) Banana growers can only grow new variety **B** plants from suckers. Suckers grow from cells at the base of the stem of the parent plant.

Use your knowledge of cell division to explain how growing variety **B** on a large scale will affect the genetic diversity of bananas.

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(2)

(Total 7 marks)



