



**Section A**

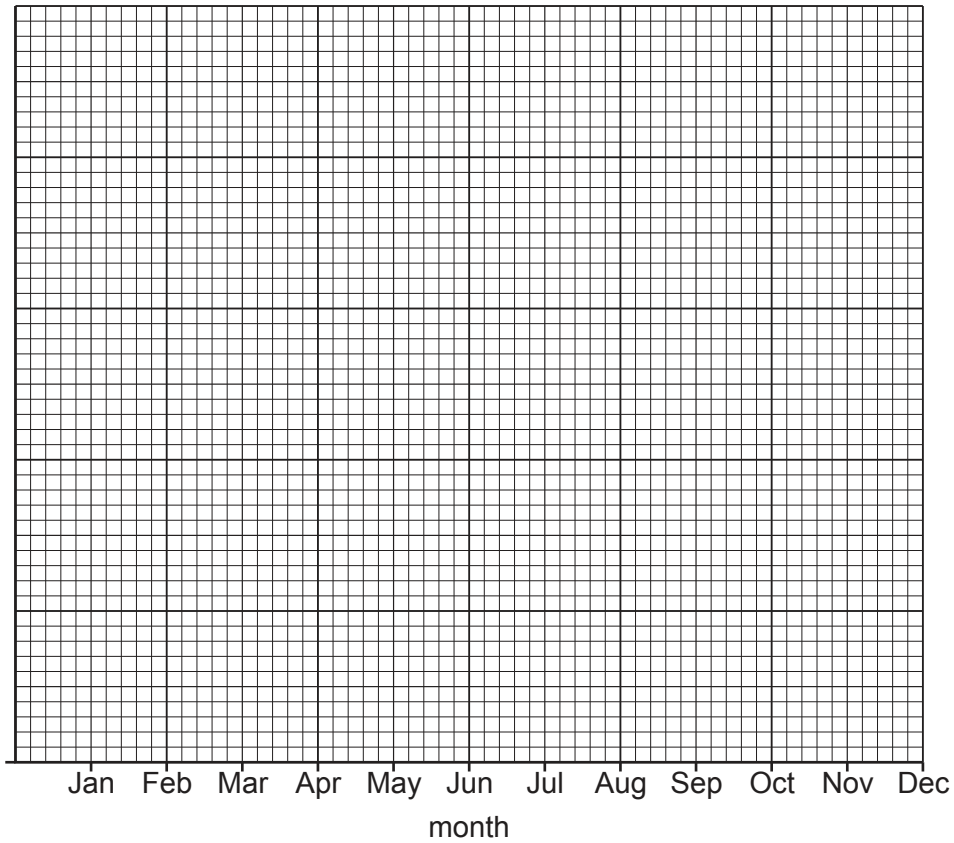
- 1 In an upwelling, deep, cold water rises to the surface. Table 1.1 shows the upwelling strength each month during 2007 in a coastal area.

Upwelling strength is measured as the volume of water rising per second over 100 m of coast.

**Table 1.1**

<b>month</b>	<b>upwelling strength/m<sup>3</sup> per second</b>
Jan	40
Feb	50
Mar	100
Apr	180
May	175
Jun	170
Jul	90
Aug	70
Sep	65
Oct	60
Nov	50
Dec	40

- (a) (i) Draw a line graph to show the strength of upwelling over the year. Join your points with ruled, straight lines.



[5]

- (ii) Suggest **two** factors that affect the upwelling strength at different times of year.

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2 .....

[2]

- (b) Black rockfish are a species of fish found in this coastal area.

The food chain for black rockfish is shown in Fig. 1.1.

phytoplankton → zooplankton → black rockfish → halibut

**Fig. 1.1**

Name an organism shown in Fig. 1.1 that is a herbivore.

..... [1]

- (c) Scientists investigated the mean depth of ocean water that black rockfish were found in each month.

The depth anomaly is the difference between the mean annual depth that black rockfish were found at and the mean monthly depth they were found at. On one day of each month, the scientists measured the depth of five black rockfish. They used these measurements to calculate the mean monthly depth.

The scientists calculated the depth anomaly for each month using the following formula.

$$\text{depth anomaly} = \text{mean annual depth} - \text{mean monthly depth}$$

- (i) Table 1.2 shows the depth readings for five black rockfish measured on one day in May 2008.

**Table 1.2**

fish number	depth / m
1	2.0
2	2.0
3	3.0
4	4.0
5	3.0

The mean annual depth of the black rockfish is 6.0 m.

Calculate the depth anomaly of the black rockfish for May.

Show your working.

..... m [3]



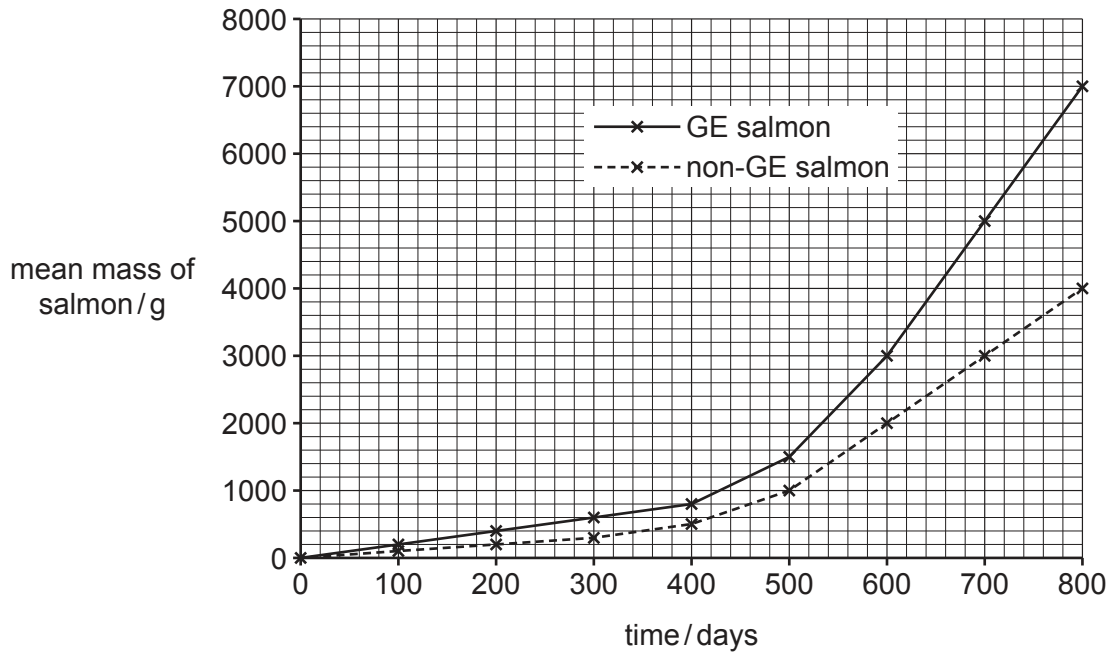
- 2 Scientists have produced genetically engineered (GE) salmon that grow faster than salmon that have not been genetically engineered (non-GE).

They inserted a section of DNA that contains a growth-promoting gene into salmon eggs.

- (a) State why DNA is classed as a polynucleotide.

..... [1]

- (b) Fig. 2.1 shows the change in mass of GE salmon compared to the change in mass of non-GE salmon.



**Fig. 2.1**

- (i) Calculate the difference in mean mass of the GE salmon compared to the non-GE salmon after 600 days.

..... g [1]

- (ii) The mean growth rate of the non-GE salmon between 600 and 800 days was 10 g/day.

Calculate the mean growth rate of the GE salmon between 600 and 800 days.

Include the units with your answer.  
Show your working.

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(iii) Describe the change in mass of the GE salmon between 0 and 800 days shown in Fig. 2.1.

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(iv) Use Fig. 2.1 to suggest why commercial aquaculture benefits from growing GE salmon.

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(v) When grown in aquaculture, GE salmon produce less food waste and fewer faeces compared to non-GE salmon.

Suggest why growing GE salmon in aquaculture may be less harmful to the environment compared to growing non-GE salmon.

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(c) Scientists suggest wild species of fish are at risk if GE salmon escape.

Scientists investigated the effect of the presence of GE salmon and non-GE salmon on the survival of steelhead trout.

The investigation also looked at the presence or absence of other predatory fish species.

- Four tanks were set up, each with different combinations of fish species.
- The combinations of fish species are shown in Table 2.1.
- The number of steelhead trout and salmon were counted after 27 days.

The results are shown in Table 2.1.

**Table 2.1**

<b>tank</b>	<b>contents of tank at start</b>	<b>number of steelhead trout surviving after 27 days</b>	<b>number of salmon surviving after 27 days</b>
A	25 steelhead trout 25 non-GE salmon	21	24
B	25 steelhead trout 25 non-GE salmon 2 predator fish	4	21
C	25 steelhead trout 25 GE salmon	20	24
D	25 steelhead trout 25 GE salmon 2 predator fish	3	20

The scientists concluded that the GE salmon are no more of a risk to wild species of fish than non-GE salmon. Use Table 2.1 to discuss the scientists' conclusion.

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[Total: 15]









