1. The student counted the number of limpets found on three parts of the rocky shore. The data is shown in the table below.

Part of shore	Number of limpets			
	Test A	Test B	Test C	Mean
Low shore (closest to sea)	15	16	17	
Mid shore	45	47	49	
High shore (furthest away from sea)	2	1	8	

(i) The student thinks one of the results is an outlier.

Circle the outlier in the table above.

[1]

(ii) Calculate the mean number of limpets found on the mid shore.

Show your working.

_____ [2]

2(a). Rainforests are an important ecosystem.

Rainforests obtain their energy from sunlight.

Explain why scientists regard sunlight as a sustainable source of energy.

---

[2]

(b). Rainforests used to be thought of as closed-loop systems.
Now, large amounts of biomass are removed when timber is harvested.

Explain the effects that the removal of timber has on the closed-loop system.

---

[2]

(c). Burning is another way that biomass is removed from a rainforest.
Rainforests are burnt to create grassland to keep cattle.

Write down **two** groups of people who might be affected by this action.

Identify the advantage **or** disadvantage to each group.

Group 1 ---

Group 2 ---

---

[2]

3. A group of students are doing fieldwork.

Anton wants to find out if the amount of light affects the distribution of plants.

He does this by comparing the plants growing in the middle of a field with those growing under a hedge surrounding the field.

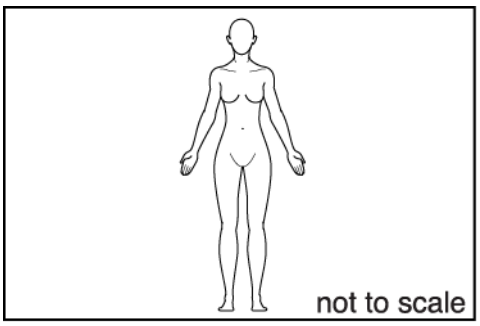
Explain how he will use a quadrat, light meter and identification key to do his investigation.

The quality of written communication will be assessed in your answer.

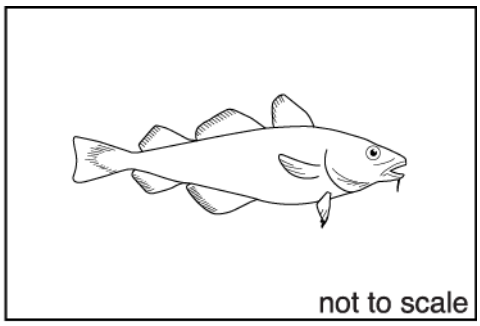
[6]

4(a). A human female usually only produces one egg at a time.

A female codfish can release over 1 million eggs at one time.



Human female



Female codfish

Suggest why there is such a large difference in the number of eggs produced by humans and by codfish.

---

[2]

(b). Suggest why the number of eggs produced by the codfish is not wasteful for the ecosystem.

---

[1]

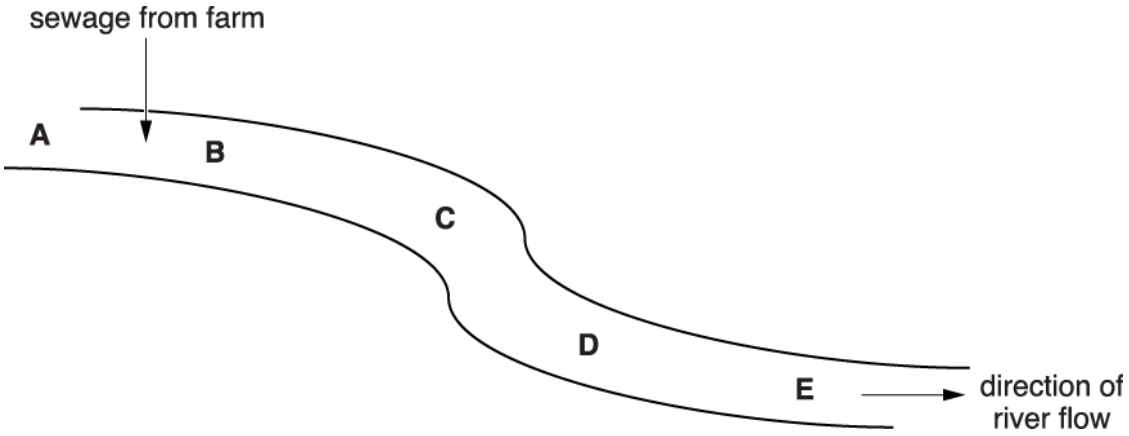
(c). Codfish live in a natural ecosystem.
Humans depend on natural ecosystems for 'ecosystem services'.

Write down **one** service provided by the ecosystem in which the codfish lives.

---

[1]

5. Sewage (animal waste) from a farm is released directly into a river.



Five samples of water are tested at each site, **A**, **B**, **C**, **D** and **E**.

The number of mayfly nymphs found in each sample is recorded in a table.

Mayfly nymphs are young stages of mayflies.

	Number of mayfly nymphs found in each sample				
Sample	Site A	Site B	Site C	Site D	Site E
1	12	0	0	6	9
2	11	0	2	5	11
3	13	0	1	5	10
4	11	1	1	6	11
5	12	0	0	5	2
mean (rounded to nearest whole number)	12	0	1	5	

Joe makes some conclusions from the data.

Which **two** statements, when taken together, correctly explain the data?

Put ticks (✓) in the boxes next to the **two** statements.

The water at site **B** is most polluted. ☐

Mayfly nymphs are adapted to living in polluted water. ☐

Mayfly nymphs cannot survive well in polluted water. ☐

Pollution in the river increases away from the farm. ☐

Mayfly nymphs are present in the sewage entering the river. ☐

Mayfly nymphs are eaten by fish in the river. ☐

[2]

6. Some farmers spray their crops with insecticides.

Insecticides kill insect pests.

Pests can develop resistance to insecticides.

Each year a farmer sprays his wheat crop with the same insecticide to kill a particular insect pest.

Each year a scientist catches all the insect pests in a 20 m^2 area of the crop before it is sprayed.

He tests the pests to see how many are resistant to the insecticide.

These are his results.

Year	Pests with no resistance	Pests with resistance
2008	1000	1
2009	223	14
2010	87	65
2011	21	392
2012	3	965
2013	0	2458

(i) What percentage of pests were resistant to the insecticide in 2008?

Show your working.

_____ % **[1]**

(ii) What percentage of pests were resistant in 2013?

_____ % **[1]**

(iii) Suggest how the farmer should use this information when spraying his crops with insecticide.

---

[2]

(iv) Suggest why the data collected by the scientist may not be sufficient to draw a valid conclusion.

---

[2]

7. Insecticides called neonics are widely used by farmers.

Neonics kill insect pests that live on crop plants.

Research studies have suggested that use of neonics on crops can cause honey bee populations to decrease.

Other studies have linked neonics to decreases in bird populations.

(i) To try to protect honey bees, the European Union banned the use of neonics on flowering crops.

Suggest why the ban applied to **flowering** crops.

---

[1]

(ii) Write down **two** ways in which use of neonics could have caused a decrease in the numbers of birds.

1 ---

---

2 ---

---

[2]

(iii) Do you support the continued use of neonics on flowering crops?

Justify your answer.

---[3]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1		i	8 ✓	1	
		ii	FIRST CHECK THE ANSWER ON THE ANSWER LINE IF answer = 47 award 2 marks (45 + 47 + 49) / 3 ✓ 47 ✓	2	
			Total	3	
2	a		Never runs out; Idea qualified eg can't use it up like coal; External source of energy	1 1	ignore reusable accept always there Examiner's Comments Most candidates gained one mark for recognising the reasons why sunlight was regarded as a sustainable source of energy.
	b		Goes open loop; Has an effect on food web / other organisms;	2	Examiner's Comments As in previous series candidates still have great difficulties with open / closed loop systems. Many candidates gained one mark for explaining one effect but failed to recognise that the system would become open loop once the changes had occurred.
	c		Farmers – more meat; Rest of world – less resources / O_2;	2	Examples could include native people, indigenous groups with a loss of habitat / homes / resources Scientists, medicines / cures from plants Examiner's Comments This question reflected the range of abilities within the candidates, marks gained were split with similar numbers gaining zero, one or two marks. Many incorrect responses reflected some candidates' inability to correctly read the question. Many responses referred to animals being affected, when the question specifically required a response about the effect on groups of people.

Question			Answer/Indicative content	Marks	Guidance
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
3			**Level 3 (5–6 marks)** A good description of **all three** pieces of equipment. Quality of written communication does not impede communication of the science at this level. **Level 2 (3–4 marks)** A good description of **two** pieces of equipment **OR** a basic description of **all three** pieces of equipment. Quality of written communication partly impedes communication of the science at this level. **Level 1 (1–2 marks)** A good description of **one** piece of equipment **OR** a basic description of **two** pieces of equipment. Quality of written communication impedes communication of the science at this level. **Level 0 (0 marks)** Insufficient or irrelevant science. Answer not worthy of credit	6	**This question is targeted at grades up to C** **Indicative scientific points may include:** **Quadrats** • a quadrat is a square frame • put quadrat on ground • plant counts in quadrat • random / grid distribution of quadrats • use of a transect line • estimate % plant cover • take several readings in / across the two areas **Light meter** • measures light levels / intensities • hold equipment at ground level • take a reading • take several readings in / across the two areas **Identification key** • compare plants seen to description / image in key • use to find names / species of plants • in each quadrat • compare plant types / species between the two areas • binary / dichotomous choices within key **Additional scientific point** • use a statistical test to support differences. **Use the L1, L2, L3 annotations in Scoris; do not use ticks.** **Examiner's Comments** A six-mark extended-writing question. From some of the responses it was clear that some candidates were unclear on what quadrats and identification keys are, or how to use them. Most candidates were

Question			Answer/Indicative content	Marks	Guidance
					able to construct some sort of response, but often there was a lack of detail which prevented many marks being awarded. Some candidates gave answers about the plants in the two areas rather than about how to investigate them.
			Total	6	
4	a		*Any two from* Humans look after young / good survival rate Cod abandon young / low survival rate Humans internal fertilisation, cod external	2	**Accept** (cod) do not look after eggs / young owtte **Examiner's Comments** Many candidates found it difficult to make suitable suggestions for the very large differences in the number of eggs produced by humans and fish.
	b		Food / energy recycled	1	**Accept** used for energy **Do not accept** reused
	c		*Any one from …* Water (Fish for) food	1	**Accept** CO_2 sink
			Total	4	
5			<table><tr><td>The water at site **B** is most polluted.</td><td>✓</td></tr><tr><td>Mayfly nymphs are adapted to living in polluted water.</td><td></td></tr><tr><td>Mayfly nymphs cannot survive well in polluted water.</td><td>✓</td></tr><tr><td>Pollution in the river increases away from the farm.</td><td></td></tr><tr><td>Mayfly nymphs are present in the sewage entering the river.</td><td></td></tr><tr><td>Mayfly nymphs are eaten by fish in the river.</td><td></td></tr></table>	2	More than 2 boxes ticked, negate 1 mark for each additional tick. Examiner's Comments In this question candidates were asked to use the data to identify two statements that when taken together, could explain the data. A high proportion of candidates struggled to identify the correct conclusions with many candidates gaining no marks. Those candidates scoring one mark on this question for the correct identification of 'the water at site B is most polluted'.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
6		i	0.1%	1	accept 0.09% Examiner's Comments This question required candidates to calculate the percentage of insects resistant to pesticides, using data in the table provided. There were very few candidates who were able to calculate this value and many candidates wrote down 2458 from the table.
		ii	100%	1	Examiner's Comments This question was much better answered and over half of the candidates were able to calculate this value as 100%.
		iii	he needs to change to a new / different pesticide; that the pests are not resistant to OR because pests are now resistant to the old pesticide	2	**accept** insecticide or chemicals **accept** use a stronger pesticide **ignore** become immune **accept** alternative words for pest such as insect Examiner's Comments This question required candidates to suggest how the farmer should use the information when spraying his crops. Just over half of the answers scored at least 1 mark and most of these were for an understanding that the farmer needed to change to a different pesticide.
		iv	any 2 from small area; small sample; pests may travel in and out of sample area; only did the test once / should repeat it	2	**ignore** same area **accept** only 1 farmer / farm Examiner's Comments This was a poorly answered question. Candidates were asked to look at the data provided and suggest why it was not sufficient to draw a valid conclusion. Very few had understood that 20 square meters was a small area or that the sample size was small.
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
7		i	bees are pollinators/collect pollen (so are likely to visit flowering crops) ✓	1 (AO 2.1)	ALLOW bees collect nectar / feed on flowers / use flowers to make honey
		ii	killing bees/spiders therefore birds have less/no food ✓ idea of bioaccumulation / neonics passed through/along/up the food chain ✓	2 (AO 2.1 × 2)	<u>Examiner's Comments</u> A good number of candidates were able to use the food chain provided in the question to work out that if neonics were killing bees there would be less food for spiders, and that this would lead to a decrease in the spider population and therefore there would be less food for birds. Few candidates suggested that neonics could be passed along the food chain, and it was rare to see 2 marks here.

Question			Answer/Indicative content	Marks	Guidance
		iii	*yes because:* **Any three from:** we need to protect our crops/food from pathogens/diseases carried by insects ✓ we need to protect our crops/food from damage done by insects ✓ need to protect farmers' livelihoods ✓ to ensure we have enough crops/food to eat ✓ OR *no because:* **Any three from:** it kills/harms bees/insects/spiders/birds ✓ idea of lack of food for animals that eat bees/insects/spiders/birds ✓ idea of bioaccumulation / neonics passed through/along/up the food chain ✓ idea that we should protect bees because they are pollinators (which is important/useful/vital) ✓ moral/ethical argument against harming animals ✓ need more research/data before discontinuing use ✓ ref. to switching to alternative methods (of protecting crops from insects) ✓	3 (AO 3.2a × 3)	no mark for saying yes; the marks are for the justification no mark for saying no; the mark are for the justification <u>Examiner's Comments</u> No marks were credited for saying yes or no in answer to this question – all of the marks were for the justification. More than 50% of candidates were able to score 1 mark, but many did not go beyond one reason in support of their answer. Less than one third of candidates scored 2 marks, and very few scored 3. Some responses switched between reasons in support of yes and no without making it explicit which side of the argument they were supposed to be supporting, which made it more difficult to award marks.
			Total	6	