Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S23-3430U40-1

3430U40-1

TUESDAY, 16 MAY 2023 – MORNING

SCIENCE (Double Award)
Unit 4 – BIOLOGY 2
FOUNDATION TIER

1 hour 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**9**	
3.	**8**	
4.	**8**	
5.	**8**	
6.	**6**	
7.	**10**	
8.	**5**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

Question **6** is a quality of extended response (QER) question where your writing skills will be assessed.

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Answer **all** questions.

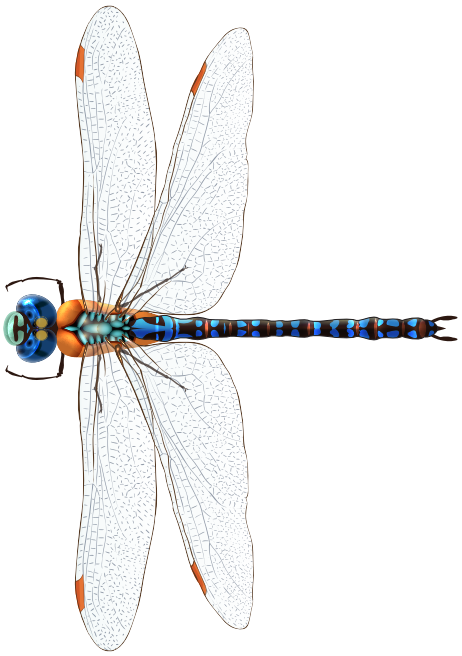
1. **Image 1.1** shows three insects:

Image 1.1

Alderfly
(Sialis lutaria)
(magnification × 2)

X **Y**

Stonefly
(Diura bicaudata)
(magnification × 0.5)



Dragonfly
(*Aeshna cyanea)*
(magnification × 1)

(a) (i) Measure the line **X – Y in centimetres**. [1]

Length of the line **X – Y** = ... cm

(ii) Multiply your answer to (i) by 2 to give the actual length of the stonefly. [1]

Actual length = ... cm

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(iii) **Complete the list below** to show the insects in order of their **actual length**. [1]

shortest Alderfly

↓

.....

longest .....

(b) **Complete Table 1.2** by writing **true** or **false** against each statement about the three insects. [3]

Table 1.2

The three insects shown:	**True** or **false**
belong to the five kingdom system of classification	true
are animals	.....
have backbones	.....
are invertebrates	.....
are in the same genus	.....
each have a separate species name	.....

6

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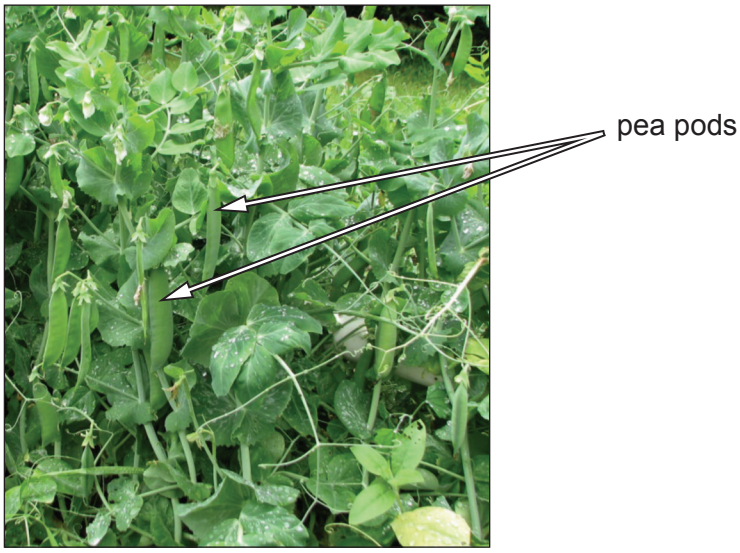
2. **Image 2.1** shows pea pods growing on pea plants (*Pisum sativum*).

Image 2.1



Peas grow inside the pods.

(a) Owain wanted to see if longer pods contain more peas than shorter pods.

He:

- Picked four pods from each of the two tallest pea plants on the same day.
- Measured the length of the eight pods.
- Counted and recorded the number of peas in each of the eight pods.

The results are shown in **Table 2.2**.

Table 2.2

Length of pod (cm)	Number of peas in pod
6.0	6
4.0	3
6.0	5
5.5	5
4.5	4
5.0	4
6.5	7
5.5	6

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(i) Calculate the mean number of peas in the eight pods. [2]
Space for working.

Mean number of peas in a pod = ...

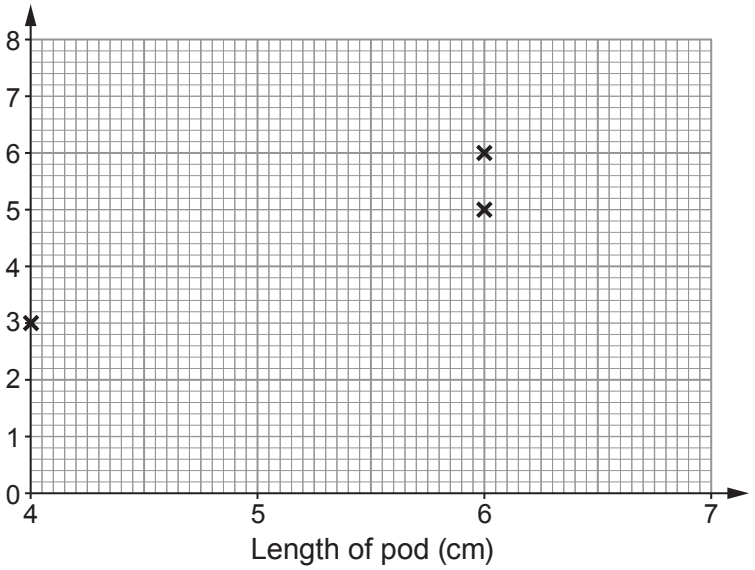
(ii) Use the results in **Table 2.2** to plot a **scattergraph** by:

I. labelling the vertical axis; [1]

II. plotting the points. The first three points have been done for you (**do not join the plots**). [2]

.....

.....



(iii) From the scattergraph:

state the relationship between pod length and number of peas. [1]

.....

.....

.....

.....

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(iv) Underline **two** statements from the list to show **two** ways that Owain could increase confidence in this investigation. [2]

count the peas again

select the plants at random

measure pod length in millimetres

collect more pods from each plant

(b) Owain used two different pea plants in his investigation. They grew in two different parts of his garden.
Choose the correct letter (**A**, **B** or **C**) from the list to complete the following sentence. [1]

Variation in the number of peas in the pods is caused by:

A genetic factors only

B environmental factors only

C both genetic and environmental factors

Answer letter = ...

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3. (a) Geraint is reading a book.

Complete the following sentences by choosing the correct words from the list below. [3]

signals **receptors** **impulses** **messages** **neurones**

Geraint's eyes have ..... that detect light reflected from the book.

Information about the light is turned into ..... which travel to the brain

along nerve cells called ..... .

(b) Scientists investigated the effect of drinking alcohol on the speed and accuracy of reading a paragraph of text.

The scientists took 24 men and split them into two groups, **A** and **B**.

- The men in group **A** each drank 500 cm^3 of beer containing 5 % alcohol.
- The men in group **B** each drank 500 cm^3 of non-alcoholic beer.
- Both groups were then given a piece of text to read out loud.
- The time taken to read the text and the number of errors made were recorded.
- The means for each group were then calculated.

The results are shown in **Table 3**.

Table 3

Group	Mean time to complete the reading (s)	Mean number of errors
A	65	3
B	58	0

(i) State **two** conclusions that you can make from the results about the effect of alcohol on reading. [2]

Conclusion 1 .....

.....

Conclusion 2 .....

.....

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(ii) State **two** ways in which the method shown made sure the men in group **A** each drank the same amount of alcohol. [2]

1. .....

.....

2. .....

.....

(iii) Group **B** is the control. Explain the importance of the control group in this investigation. [1]

.....

.....

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4. (a) **Choose words from the list below** to complete the following sentences.

ATP cytoplasm DNA nucleus protein vacuole

(i) Chromosomes are found in a cell structure called the ..... . [1]

(ii) Genes are sections of a long molecule with a double helix shape called

..... . [1]

(b) A grower crosses two plants, each with pink flowers.

×

The number of offspring plants is shown in **Table 4.1**. Some of the offspring had white flowers.

Table 4.1

Flower colour	Number of offspring
pink	21
white	7

(i) Calculate the ratio of pink flowers to white flowers. [1]

ratio of pink flowers to white flowers = ... : .....

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(ii) Complete the **two** sentences below by underlining the correct term for each.

I. The results of the cross show that the genotype of the parents is: [1]

homozygous dominant

homozygous recessive

heterozygous

II. The genotype of the offspring with white flowers is: [1]

homozygous dominant

homozygous recessive

heterozygous

(c) (i) In humans, the X and Y chromosomes are known as the sex chromosomes. Complete **Table 4.2** by placing **one** tick (✓) in each row to show the sex chromosome that may be present in the gametes. [2]

Table 4.2

Sex	Sex chromosome that may be present in the gametes		
	X only	Y only	X or Y
female			
male			

(ii) Jon and Catrin have two daughters. Catrin is expecting their third child. State the probability that this child will be a boy. [1]

Probability = ...

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5. **Image 5** shows surgery on a patient with heart disease caused by a faulty gene.

Image 5

(a) After surgery, it is important that wounds are sealed.
Explain why wounds must be sealed. [2]

.....

.....

.....

.....

(b) Patients are given antibiotics after surgery.
State the name of **one** antibiotic **and** the reason why antibiotics are given to patients. [2]

Antibiotic .....

Reason .....

.....

(c) The surgeons are using stem cells taken from the patient to replace damaged heart muscle.
Suggest **one** benefit of using stem cells from the patient rather than from a donor. [1]

.....

(d) Scientific research has produced a map of all the genes present in humans.

(i) Complete the sentence below by underlining the correct term. [1]

The complete map of human genes is called the human:

genome **gene pool** **genotype**

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(ii) Suggest **two** ways by which scientists make their work known to other scientists around the world. [2]

I. .....

.....

II. .....

.....

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6. Species **A** and **B** shown in **Image 6.1** are common moorland plants.

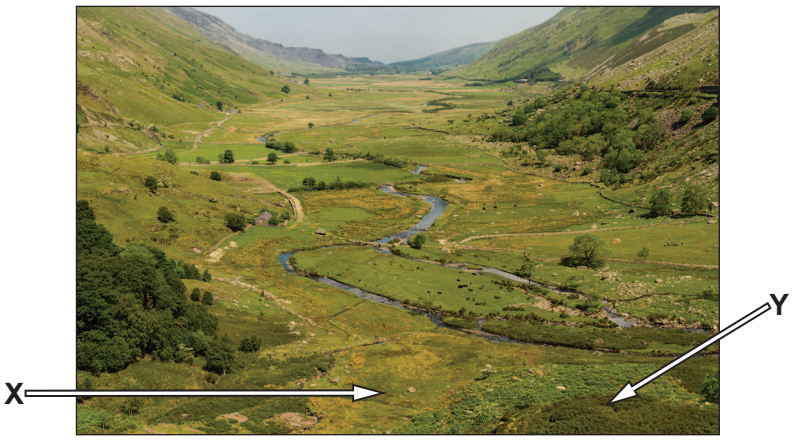
Image 6.1

Species **A**

Species **B**

Image 6.2 shows moorland in Wales.

Image 6.2



Plant distribution can be studied using the following equipment:

- 50 m tape measure
- a 1 m^2 quadrat
- notebook
- pencil
- ruler
- graph paper.

Using **all** the above equipment, describe how you would:

- investigate the distribution of species **A** and **B** between points **X** and **Y** in **Image 6.2**, which are 50 m apart
- display your results. [6 QER]

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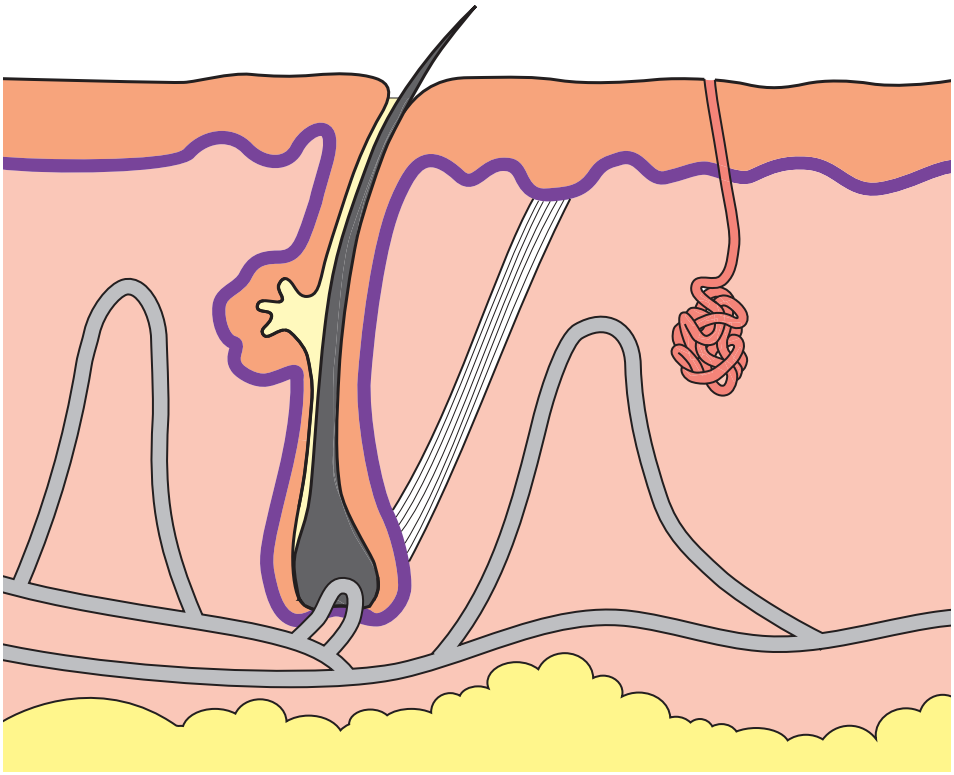
7. **Image 7.1** shows a section through human skin.

Image 7.1



(a) On **Image 7.1**, **use arrows to label**: [2]

I. the sweat duct

II. a blood vessel

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(b) Scientists investigated the effect of air temperature on both the skin temperature and core body temperatures of five volunteers. Core body temperature is the temperature of the internal organs of the body.

- The five volunteers were placed in a temperature controlled laboratory at −20 °C.
- The volunteers wore bathing suits and were kept at the temperature for 5 minutes after which their skin and core temperatures were recorded.
- The experiment was then repeated at other air temperatures over the next six days, each day at a different air temperature.

The skin temperatures at different air temperatures are shown in **Table 7.2**. The mean core body temperatures are shown on **Graph 7.3**.

Table 7.2

Air temperature (°C)	Skin temperature of volunteers (°C)					Mean skin temperature (°C)
	Volunteer number					
	1	2	3	4	5	
−20	21.4	22.0	22.6	21.8	21.5	21.9
−10	23.3	23.2	22.8	22.9	23.0	23.0
0	23.8	24.2	24.4	23.5	23.9	24.0
10	25.7	25.3	25.9	25.2	25.2	25.5
20	28.3	28.1	28.5	27.9	27.8	28.1
30	33.0	32.3	32.7	32.4	32.2	32.5
40	38.5	40.2	39.3	40.2	39.1	.....

(i) **Complete Table 7.2** by calculating the mean skin temperature of the five volunteers at a temperature of **40 °C**. [1]

(ii) I. Plot the **mean skin temperature** against the **left-hand** y-axis on **Graph 7.3**. The first two points have been plotted for you. [2]

II. **Join the plots with a ruler.** [1]

The mean core body temperature is already plotted against the right-hand y-axis.

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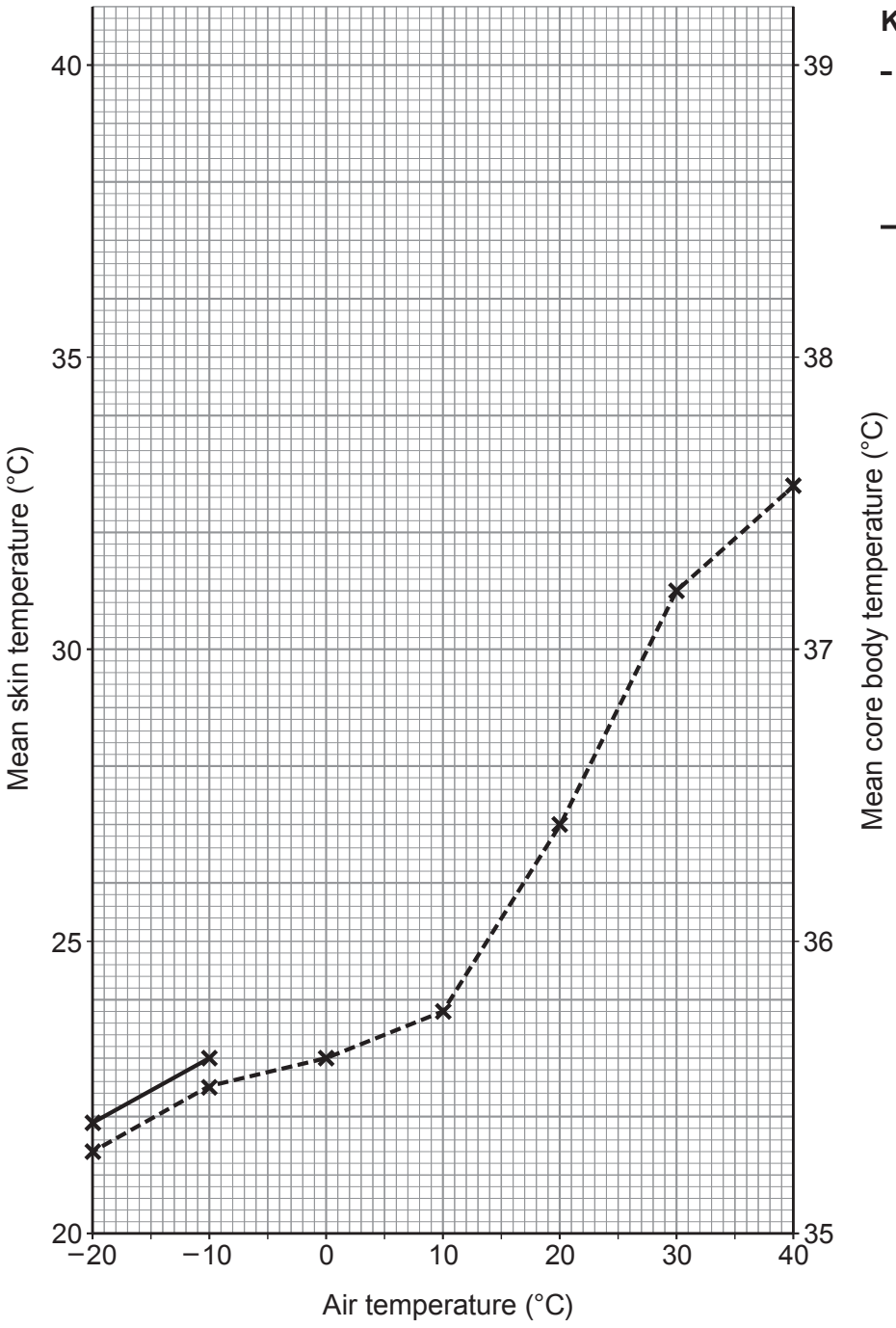
Graph 7.3



III. **From Graph 7.3** determine the mean core body temperature when the air temperature **is 25 °C**. [1]

Mean core body temperature when air temperature is 25 °C = ... °C

IV. From **Graph 7.3** state the relationship between the skin temperature and the core body temperature. [1]

.....

.....

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(c) (i) Place a tick (✓) in **one** of the boxes below to show the processes which occur in the skin when air temperature is **low**. [1]

- ☐ blood vessels constrict, sweating reduces, hairs lowered on skin surface, shivering occurs
- ☐ blood vessels dilate, sweating reduces, hairs raised on skin surface, shivering occurs
- ☐ blood vessels constrict, sweating reduces, hairs raised on skin surface, shivering occurs
- ☐ blood vessels constrict, sweating increases, hairs raised on skin surface, shivering occurs

(ii) Place a tick (✓) in **one** of the boxes below to show the processes which occur in the skin when air temperature is **high**. [1]

- ☐ blood vessels dilate, sweating increases, hairs lowered on skin surface, shivering occurs
- ☐ blood vessels dilate, sweating increases, hairs lowered on skin surface, no shivering
- ☐ blood vessels constrict, sweating increases, hairs lowered on skin surface, no shivering
- ☐ blood vessels dilate, sweating decreases, hairs lowered on skin surface, no shivering

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8. (a) State the meaning of the term biological control. [1]

.....

.....

(b) Many species of moths destroy food crops. The global effect of these pest species results in the loss of many billions of dollars per year. The stage in the life cycle of moths that causes the damage is the caterpillar, which eats the plant crop.

The simplified life cycle of most moths is shown in **Image 8.1**:

Image 8.1

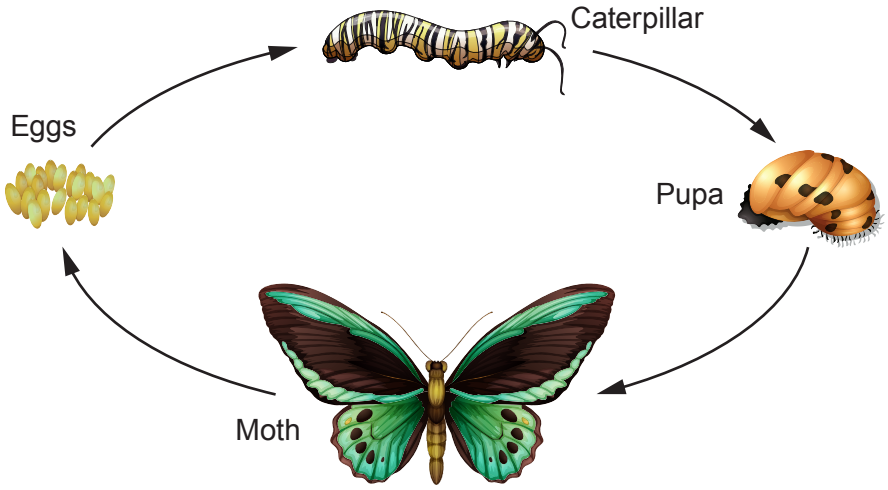

Table 8.2 shows five species of small wasps (Trichogramma) used as biological control agents. It also shows the stage in the moth life cycle they attack and the area of farmland in different countries where these biological control agents are already used successfully.

Table 8.2

Species of wasp	Stage of moth life cycle attacked by wasp	Food crops damaged by moth caterpillars	Region where wasp is used	Area of farmland where the wasp is used successfully (million hectares)
Trichogramma pretiosum	eggs	potatoes	China	2.0
Trichogramma platneri	caterpillars	corn, sugar cane	Mexico	1.5
Trichogramma acacioi	caterpillars	avocado and other fruit crops	Brazil	1.0
Trichogramma japonicum	caterpillars	rice, potatoes	South East Asia	0.3
Trichogramma ostriniae	caterpillars	corn	Europe	0.1

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As an advisor for the United Nations you are asked to advise the Government of Peru on the use of a biological control agent to prevent moth damage in potato crops.

(i) Using all the information given, suggest the best species of *Trichogramma* to use and give the reason for your choice. [2]

.....

.....

.....

.....

(ii) State **one** factor that would need to be investigated before *Trichogramma* is released into the environment in Peru. [1]

.....

.....

(iii) Suggest why it is not possible to conclude, from the information in the table, that the percentage of crops damaged by moths is less in China than it is in Europe. [1]

.....

.....

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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