

Instructions

- Use **black** ink or ball-point pen.
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all questions.
- Answer the questions in the spaces provided
 - there may be more space than you need.
- Show all your working in calculations and include units where appropriate.

Information

- The total mark for this paper is 50.
- The marks for **each** question are shown in brackets
 - use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- Good luck with your examination.

Turn over ▶







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Answer ALL questions.

Write your answers in the spaces provided.

1 The photograph shows a brine shrimp, Artemia salina.



 $\mbox{\ensuremath{\texttt{©}}}$ Nature Picture Library / Alamy Stock Photo $\mbox{\ensuremath{\mathsf{Magnification}}} \times 2.0$

Brine shrimps are invertebrate animals that live in salt lakes. They feed on algae and reproduce by producing eggs.

When the conditions are favourable, the eggs hatch into brine shrimps.

A student observed that eggs hatched faster when calcium ions were added to the saltwater.

the time taken for brine shrimps to hatch	ion concentration on
(a) Describe an experiment to investigate the effect of calcium the time taken for brine shrimps to hatch.	³ tuden, (5)
	toon.
	. WO.
	Tre.



(b) (i)	State two abiotic variables, other than the independent variable, that end affect this experiment. Die	ıld ^{Ss_{ludenfro}} (2)
First varial	ole	70, hammer of the second of th
Second va	riable	······································
(b) (ii)	Choose one of the variables you have identified in (b)(i). Explain how this variable could be controlled. Describe what effect it could have on the results if it is not controlled.	(2)
Variable		
How this v	variable is controlled.	
Effect it co	ould have on the results if it is not controlled.	

		(Total for Question 1 = 12 marks)
		(Storthress)
	Explain how the presence of calcium ions can at shrimp eggs to hatch.	The time taken for brine holden for brin
(=)		fact the time taken for brine
(c)	Calcium ions can bind to some enzymes.	Arbo. Bris.
		,

The photograph shows switchgrass, *Panicum virgatum*.



© Florapix / Alamy Stock Photo

This plant is grown on many farms in North America. It produces a large biomass that can be used to generate electricity or food for farm animals.

A scientist investigated the biomass produced by two different varieties of switchgrass, Almo and Kanlow.

One field was divided into twenty plots of the same area.

Ten of these plots were planted with seeds of the variety Almo and the other ten plots were planted with seeds of the variety Kanlow.

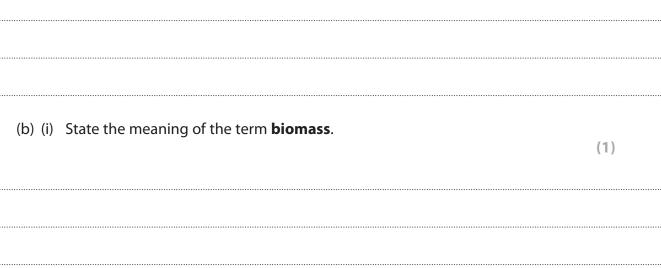
All the plots were planted with the same density of seeds.

All the plots were harvested by machine on the same day.

This was repeated each year for seven years.

The notebook shows the results of this investigation.

Kanlow biomass ×10³ kg péri_{lstudentroon, Nordhress, com} Almo biomass ×103 kg per hectare year one 20.1 year two 19.2 year three 14.2 year four 11.4 year four 11.4 year five 11.8 year five 12.6 year six 13.6 year six 15.2 year seven 14.0 year seven 16.5 (a) Write a suitable null hypothesis for this investigation. (1)



(ii) When burnt, switchgrass biomass releases 14.25 MJ kg⁻¹ of energy.

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Calculate the energy released from burning all the Kanlow biomass produced, in year four.

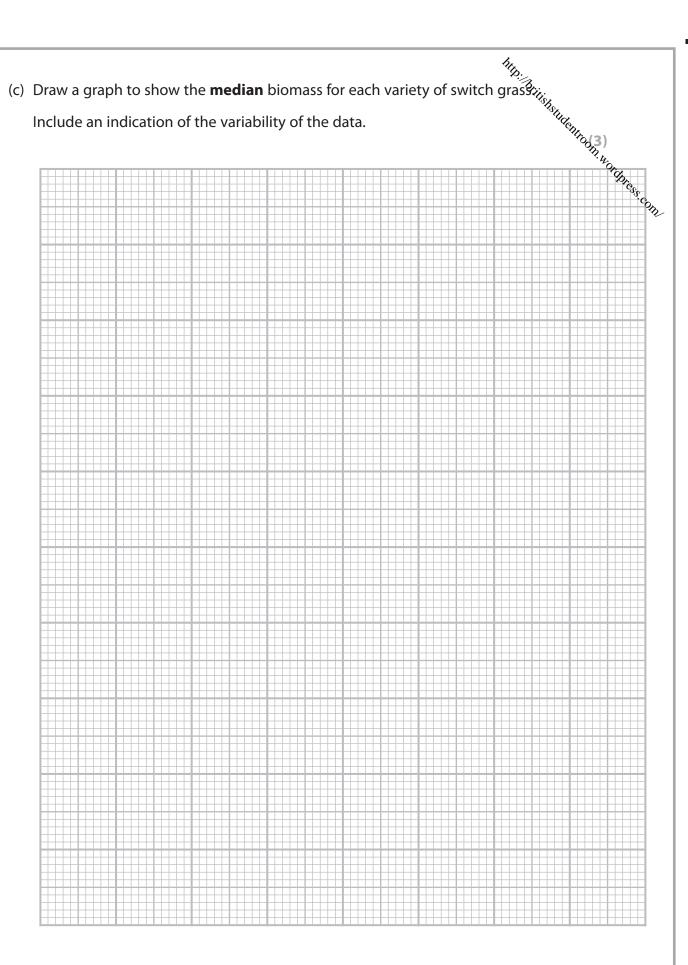
Calculate the energy released from burning all the Kanlow biomass produced, in year four.

Calculate the energy released from burning all the Kanlow biomass produced, in year four.

Calculate the energy released from burning all the Kanlow biomass produced, in year four.

(iii) Draw a suitable table to display the results of this investigation. Label the median for both varieties of switchgrass.

(2)



(d) The scientist used a Mann-Whitney \boldsymbol{U} test to analyse the data.

The following formulae were used.

$$U_1 = R_1 - \frac{n_1(n_1 + 1)}{2}$$

$$U_2 = R_2 - \frac{n_2(n_2 + 1)}{2}$$

Where n_1 and n_2 are the number of samples of each switchgrass.

The scientist calculated the value of $R_1 = 57.5$ and $R_2 = 47.5$

The value of $U_1 = 29.5$

(i) Calculate the value of U_2 .

(2)

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Answer

(ii) The table shows the critical value of U for probability value of p = 0.05. For the difference to be significant, the smallest calculated U value has to be equal to, or less than, the critical value shown in the table.

		n_{2}							
		5	6	7	8	9	10	14	15
	5	2	3	5	6	7	8	13	14
	6	3	5	6	8	10	11	17	19
	7	5	6	8	10	12	14	22	24
n ₁	8	6	8	10	13	15	17	26	29
	9	7	10	12	15	17	21	31	34
	10	8	11	14	17	20	23	36	39
	14	13	17	22	26	31	36	55	59
	15	14	19	24	29	34	39	59	64

Deduce the conclusion that can be drawn from this investigation.

Use your graph and the information in the table to support your answer.

(3)

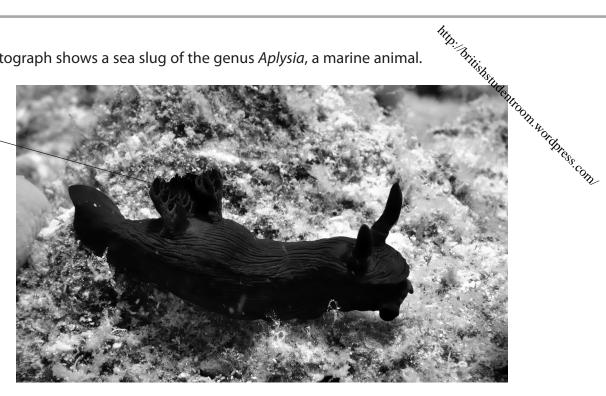
(e) Explain why it may not be reasonable to draw a used in this investigation and the results obtaine	مرانی. valid conclusion from the Method d
asea in this investigation and the results obtaine	G. Tudentoon, NO.
	· q _{Dics} .
	(Total for Question 2 = 17 marks)

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The photograph shows a sea slug of the genus *Aplysia*, a marine animal.

external gills



© walkdragon/Shutterstock

Magnification $\times 1.0$

Aplysia can be kept in tanks in a laboratory.

Aplysia absorb oxygen using external gills.

When the gills are touched, the gills are completely withdrawn into the body by a reflex action.

The gills re-emerge after some time.

The student formed the following hypothesis:

The more frequently the gills are touched the less time it takes them to re-emerge.

Plan an investigation to find evidence to support or reject this hypothesis.

	Aith	
a) Describe preliminary practical work that ye proposed method would provide quantita	ou might undertake to ensure vor	
proposed method would provide quantita	tive results.	
proposed means promot quantities	(3)	
	TA OON	
	'? _. 4 _e).
	•	(D)
		્યુ

Devise a detailed method, including an explanation of how you would control and monitor important variables.	and monitor important variables.	Devise a detailed method, including an explanation of how you would control and monitor important variables.		
		ACIII.	(10)	
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			Or Or	



	hills
(c) Describe how your results should be recorded, presented and anal to draw conclusions from your investigation.	ysed, in order
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	3. COM

(d) Suggest four limitations of your proposed methor	od. http://dritis/state/fires
	Oth, World Dress, Conn.
	(Total for Question 3 = 21 marks)
	TOTAL FOR PAPER = 50 MARKS





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