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**Answer BOTH questions.**

**Write your answers in the spaces provided.**

1. Catclaw mimosa (*Mimosa pigra*) is a plant which may form dense thorny thickets as high as 6 metres. It is an invasive weed in Northern Australia, where it is a hazard to livestock.

One method used to control it is by the use of stem-mining moths. Plants infected by moths produce fewer seeds, but this may not be effective in all habitats.

A group of students tested the effectiveness of this method of biological control in two habitats: a floodplain and a woodland. Both habitats had catclaw mimosa plants growing in them. The students selected two sites in each habitat. In each habitat, one site had mimosa plants that were infected with stem-mining moths and the other had no infection.

At all four sites, eleven permanent  $0.5 \times 0.5$  m quadrats had been prepared and the students collected the top 2 cm of soil from each. They sieved the soil and counted the total number of mimosa seeds they found in each sample.

The raw data table compiled by the students is shown below.

**Number of seeds in each  $0.5 \times 0.5$  m quadrat**

**In floodplain without mining moths**

729, 500, 805, 900, 606, 825, 751, 830, 758, 505, 605

**In floodplain with mining moths**

350, 255, 400, 512, 200, 306, 241, 194, 369, 491, 340

**In woodland without mining moths**

42, 46, 61, 33, 22, 29, 38, 51, 33, 28, 48

**In woodland with mining moths**

52, 65, 48, 39, 60, 35, 34, 55, 62, 38, 32



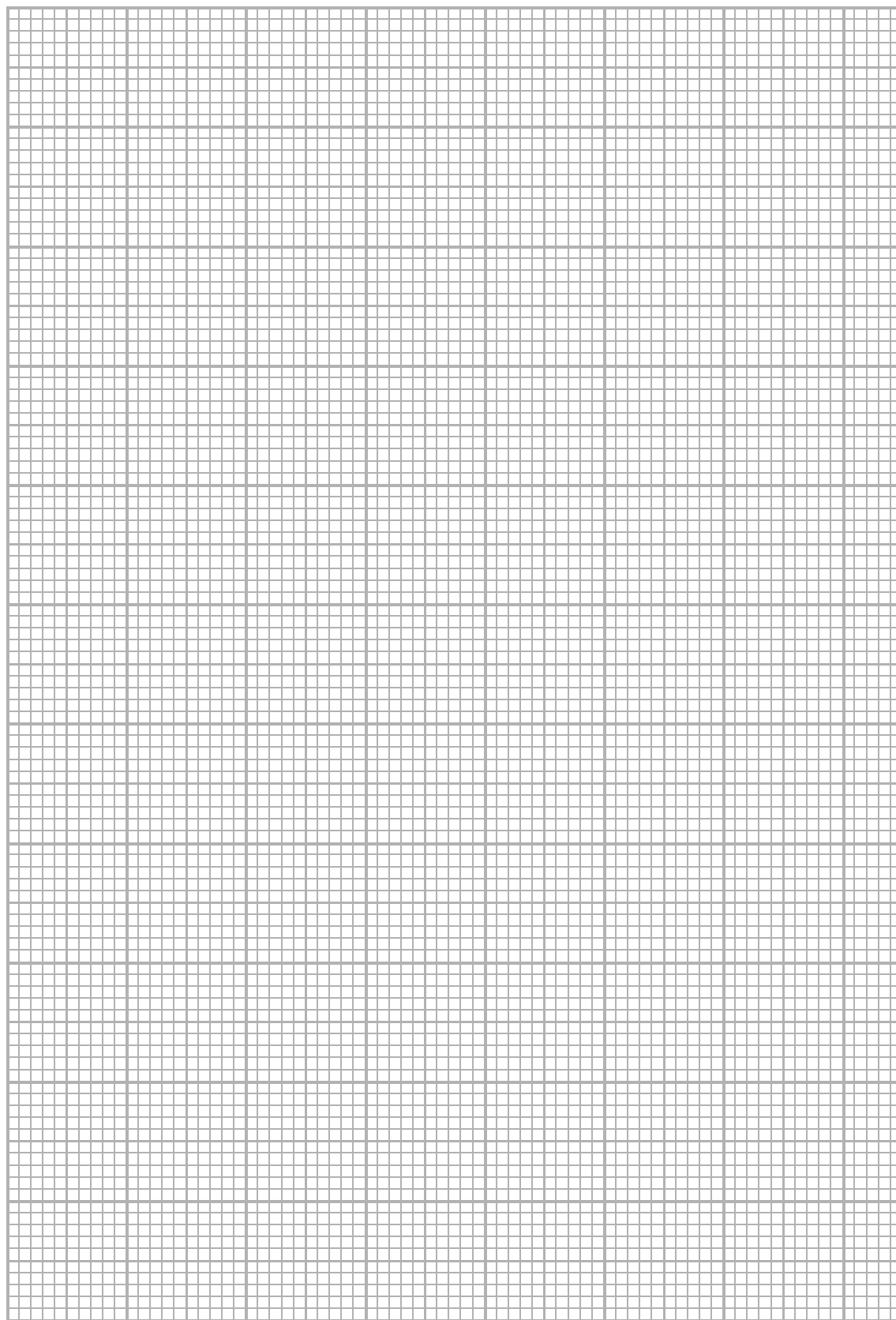
(a) Prepare a table of the raw data and organise it in such a way that the **median** number of seeds with and without stem-mining moths in each of the habitats can be identified.

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(4)



(b) Use the data in your table to present the information in a suitable graphical form so that the effects of the moths in the two habitats can be compared.



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(3)



(c) State a suitable null hypothesis for this investigation.

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(1)

(d) The students decided to apply the Mann-Whitney U test to the data. This statistical test determines if the differences between the medians is significant.

The calculations produced two U values for each set of data. In order to support a difference between the numbers of seeds produced by infected and non-infected plants in each habitat, the smaller U value is required to be the same as, or less than, the critical value.

For the floodplain sites these values were  $U_1 = 119$  and  $U_2 = 2$  and for the woodland sites these values were  $U_1 = 36$  and  $U_2 = 85$ .

The table below shows the critical values for the Mann-Whitney U test at the  $p = 0.05$  level.

Sample size $n_1$	Sample size $n_2$					
	7	9	11	13	15	17
7	8	12	16	20	24	28
9	12	17	23	28	34	39
11	16	23	30	37	44	51
13	20	28	37	45	54	63
15	24	34	44	54	64	75
17	28	39	51	63	75	87



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What conclusion can be drawn from this investigation? Use the information in the table to explain your answer.

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(2)

(e) What other conclusion, concerning the effectiveness of this type of biological control in different habitats, can be made from these data?

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(1)

(Total 11 marks)

Q1

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7

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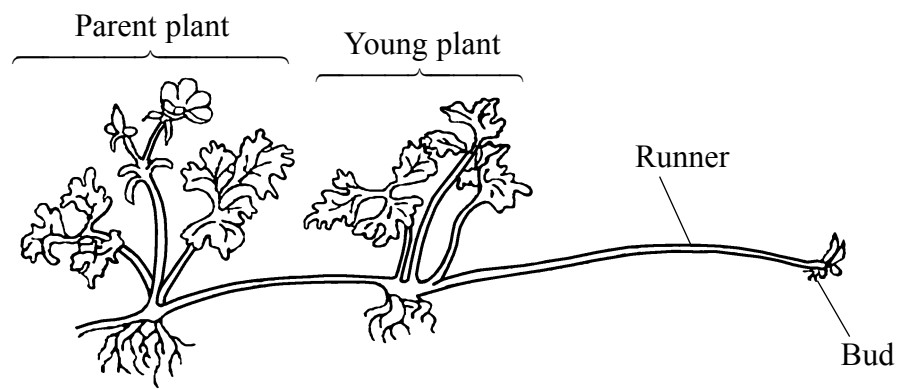
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2. Creeping buttercup (*Ranunculus repens*) reproduces sexually by seeds, but it also reproduces asexually by means of runners. Runners are stems that grow from the parent plant along the surface of the soil. Creeping buttercup often grows in fields of short grass.

The structure of a creeping buttercup plant is shown in the diagram below.



Design an investigation that can be undertaken outdoors to test the hypothesis that the number of plants reproducing **asexually** is linked to the density of plants.

Your answer should be given under the following headings.

(a) Plan of the investigation to be carried out.

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(c) Limitations of your method and an indication of further work that could be undertaken to provide additional evidence for your conclusions.

**Limitations** .....

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**Further work** .....

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Q2

(Total 21 marks)

**TOTAL FOR PAPER: 32 MARKS**

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