Do not write in margin

A student noticed that large numbers of daisies and common sedge grew on a pasture. The student used random quadrats to determine whether the two species of plant tended to grow together (in association) or tended to grow separately (not in association). The student obtained the following results:

Plants present	No. of quadrats
Daisies and common sedge Common sedge only Daisies only Neither daisies or common sedge	78 6 7 9
	Total = 100

The student proposed the null hypothesis that 'there was no association between daisies and sedge'. A Chi squared test was carried out to test the null hypothesis.

The results were arranged into the following contingency table:

	Daisies	No daisies	Row total
Common sedge	(O) = 78 (E) = 71.4	(O) = 6 (E) =	84
No common sedge	(O) = 7 (E) = 13.6	(O) = 9 (E) =	16
Column total	85	15	100

The formula for calculating Chi squared is: $\chi^2 = \sum \frac{(O - E)^2}{E}$

O = observed results. E = expected results

The expected numbers may be calculated by the formula:

$$E = \frac{\text{Row total}}{\text{Total}} \times \frac{\text{Column total}}{\text{Total}} \times \text{Total}$$

(a)(i) Calculate the missing E numbers on the table and insert them in the table. Show your working.

[3]

(ii) Calculate the value of x^2. Show your working.

Answer ..... [2]

(*Continued...*)

Do not write in margin

(iii) The number of degrees of freedom(n) is given by the equation:

n = (no. of rows – 1)(no of columns – 1).

How many degrees of freedom are there?

..... [1]

(iv) The critical value for χ^2 with these degrees of freedom is 3.84 at a 5% significance level. Does your value enable you to accept or reject the null hypothesis? Explain your answer.

.....

.....

..... [2]

(b) Describe how the student would use quadrats to obtain the data.

.....

.....

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.....

.....

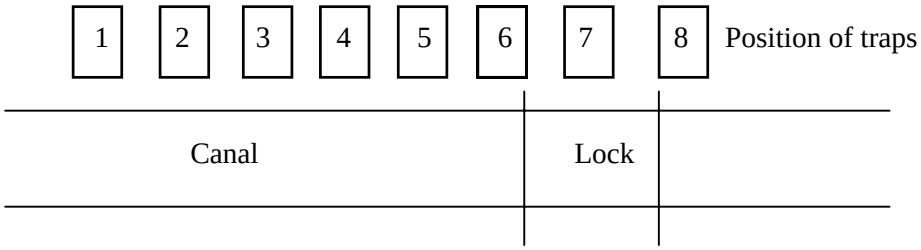
..... [5]

TOTAL / 13

QUESTIONSHEET 2

Do not write in margin

A survey was carried out to investigate the population of water voles along the bank of a canal. Eight pitfall traps were placed at regular intervals along the canal and the number of voles captured in a six week period were counted. The traps were checked twice daily and any captured voles were immediately released. It was noticed that one of the traps, situated near a lock, regularly caught fewer voles than the other traps. The position of the traps is shown below.



A Chi squared test was carried out to determine whether the difference in numbers was within random chance limits or whether it was due to some other factor, such as the presence of the lock. The results are shown in the table below:

Trap number	1	2	3	4	5	6	7	8
Number of voles caught (O)	7	9	10	10	8	7	2	11
Number of voles expected to be caught(E)								

The null hypothesis was proposed that 'the difference in numbers was not within chance limits'.

(a) (i) Calculate the values of E, that is, the number of voles you would have expected to catch if each trap was working equally. Show your working.

Write your values in the table above. [2]

(ii) The formula for calculating Chi squared is:

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O = observed results
E = expected results

Calculate the value of Chi ^{2} for this investigation. Show your working.

Answer ..... [2]

(*Continued...*)

Do not write in margin

(iii) Calculate the number of degrees of freedom.

..... [1]

(iv) The critical value for Chi^2 with these degrees of freedom is 14.07. Does this enable you to accept or reject the null hypothesis? Explain your answer and comment on its significance.

.....

.....

.....

..... [3]

(b) How could you modify the investigation to measure the population density of the voles?

.....

.....

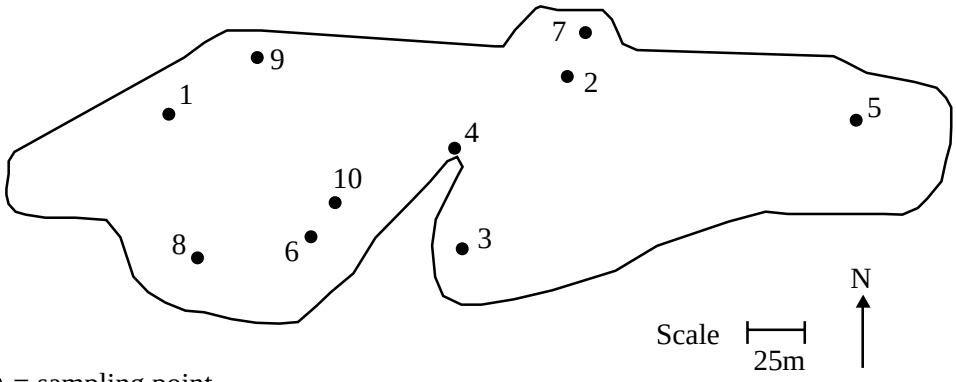
.....

..... [4]

TOTAL / 12

QUESTIONSHEET 3

A group of students decide to investigate the relationship between light intensity and the distribution of herbs in a deciduous woodland. Light intensity was measured at randomly chosen sampling points within the woodland. At each location a sampling quadrat of diameter 1.0 m^2 was set up and the number of three herb species within the quadrat was recorded. The outline of the woodland and the sampling pattern used are shown in the diagram below.



Key: ● = sampling point

(a) Outline a suitable procedure for randomly selecting sampling points in this investigation.

.....

.....

..... [2]

(b) State one advantage and one disadvantage of random sampling.

Advantage: .....

.....

Disadvantage: .....

..... [2]

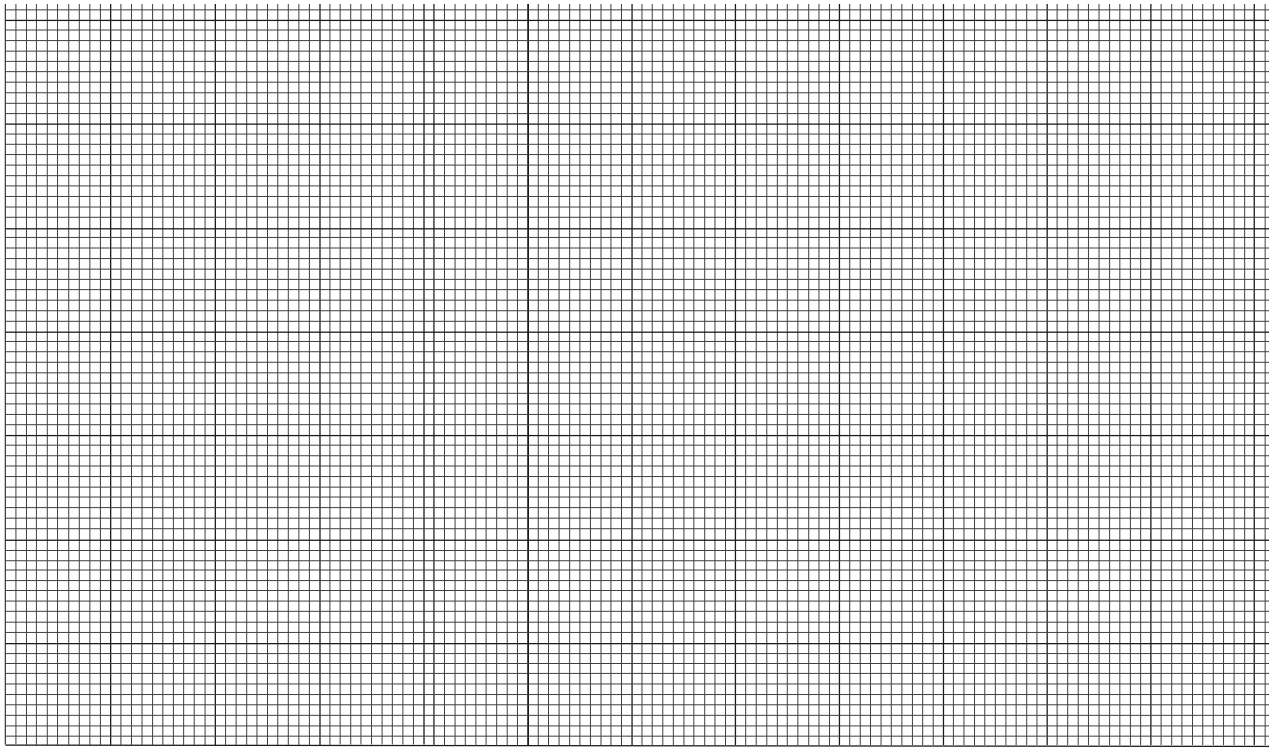
(c) A section of one student's records are shown in the table below.

	Number of herbs			Mean light intensity (% of maximum incident)
Sample point	Species A	Species B	Species C	
1	27	18	4	70
2	25	22	0	85
3	18	18	3	65
4	19	14	7	60
5	29	24	6	90
6	10	12	20	30
7	38	26	4	80
8	0	2	20	15
9	39	29	4	80
10	0	0	16	5

(*Continued...*)

Do not write in margin

(i) Plot a graph showing the relationship between mean light intensity and the number of herb species A and C.



[5]

(ii) State the relationship between average light intensity and the number of herb species C.

..... [1]

(iii) Suggest one possible explanation for the distribution of herb species C.

..... [1]

(d) Suggest two adaptations which may be seen in the leaves of plants growing in low light intensities.

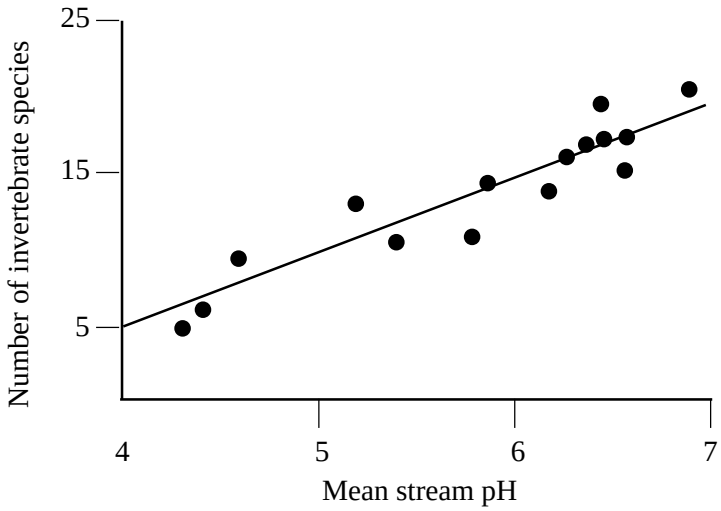
1: .....

2: ..... [2]

TOTAL / 13

QUESTIONSHEET 4

The scatter diagram below shows the result of a student's investigation into the effect of pH on the number of invertebrate species in 15 upland streams. The scatter diagram also shows the line of best fit.



(a) Describe the relationship shown.

..... [1]

(b) Explain the advantage of using 'mean stream pH'.

.....

..... [2]

(c) Suggest two ways in which stream pH may influence the number of invertebrate species in a stream.

1. .....

2. ..... [2]

(d) State two abiotic stream factors, other than pH, which may have influenced the number of invertebrate species.

1: .....

2: ..... [2]

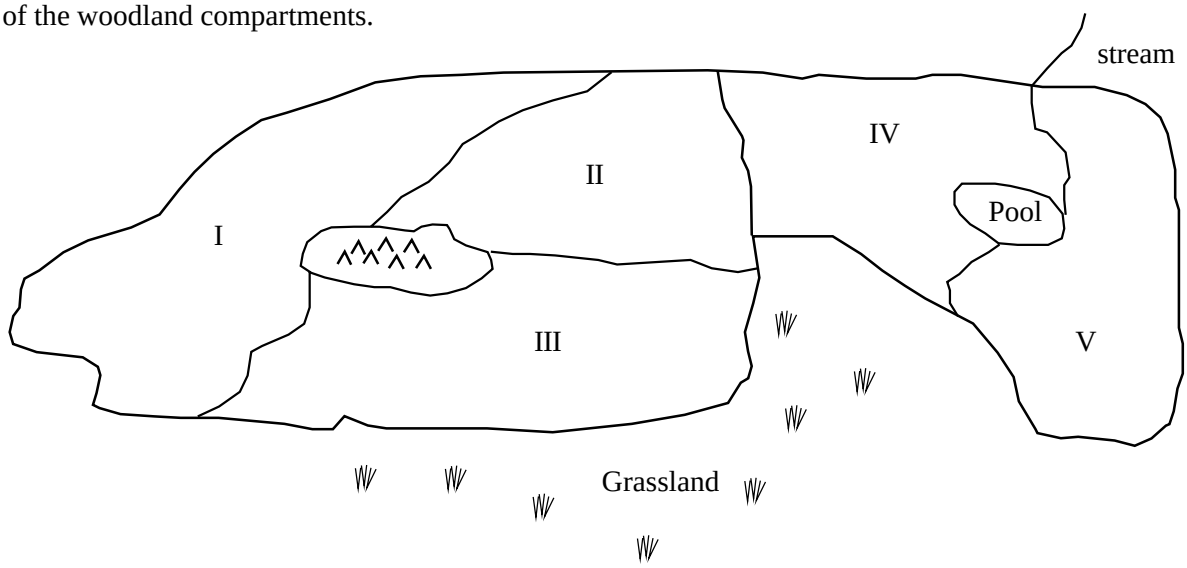
TOTAL / 7

FIELD STUDIES

QUESTIONSHEET 5

Do not write in margin

The diagram shows the outline of woodland used in a series of investigations by students. The table gives details of the woodland compartments.



Compartment	Planting year	Species	Notes
I	1981	Spruce	Dark beneath canopy with little undergrowth or herb layer
II	1906	Spruce	-
III	1945	Oak/Ash	-
IV	1900	Oak	Many gaps, heavy undergrowth
V	1900	Oak/Alder	Boggy ground around pool

(a) Suggest a suitable sampling technique for each of the following investigations:

(i) Is there significant difference in the percentage cover of herb species in similarly aged spruce and oak woodlands?

..... [1]

(ii) Does soil moisture content affect the density of alder saplings in compartment V?

..... [1]

(b) Suggest explanations for each of the following aspects of recent forestry practice:

(i) the use of coniferous tree species which bear needles (leaves) all year round.

.....

..... [2]

(ii) planting trees very close together.

.....

.....

..... [2]

TOTAL / 6

Do not write in margin

QUESTIONSHEET 6

The techniques of mark - release - recapture was used to estimate the number of woodlice in a log pile. An initial sample of 66 woodlice were marked and released. The second sample of 54, contained 16 marked woodlice.

(a) Define the term ‘population’.

.....

..... [1]

(b) Use the capture-recapture formula below to estimate the population size of the woodlice. Show your working.

$$N = \frac{S_1 \times S_2}{R}$$

Where:
N = population
S_1 = number of woodlice in first sample
S_2 = number of woodlice in second sample
R = number of marked woodlice in second sample

Answer ..... [2]

(c) State three assumptions of the capture-recapture technique.

1: .....

2: .....

3: ..... [3]

TOTAL / 6

QUESTIONSHEET 7

Do not write in margin

(a) Explain why 'throwing quadrats' is not an acceptable sampling technique.

.....

.....

..... [2]

(b) Outline how you would use random sampling to estimate the number of dandelion flowers in a square lawn.

.....

.....

.....

.....

.....

..... [5]

(c) A student required a 1% sample of a lawn measuring 25 m x 30 m. The student used a quadrat of dimensions 50 cm x 50 cm.

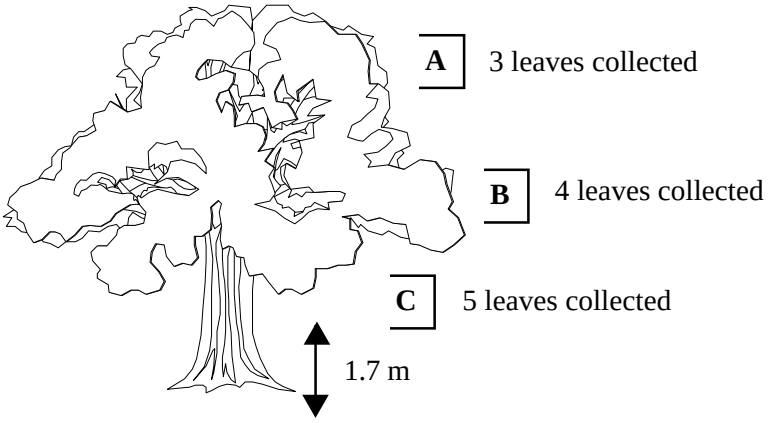
(i) Calculate the number of quadrats which would be required. Show your working.

Answer ..... [3]

TOTAL / 10

QUESTIONSHEET 8

A student investigated the effect of light intensity on the size of the leaves on a beech tree (Fagus sylvaticus) which was growing in the middle of a beech wood. The students sampling design is shown below.



The student collected leaves by use of a pruning saw attached to a number of interlocking poles. The area of each leaf was measure and recorded. The light intensity was assumed to be 100% at the top of the tree (point A), 50% in the middle (point B) and 10% at the lowest branches (point C) where actual light intensity was measured. The entire investigation was carried out at on an early morning in summer. Some of the students recordings are shown in the table below.

Sample position	Leaf area (cm^2)					Mean area (cm^2)
A	31.6	37.2	29.4			32.7
B	27.4	16.9	19.9	23.6		21.9
C	30.8	47.4	40.8	40.6	36.0	

(a) Calculate the mean area of leaves at point C. Write your answer in the table. [1]

(b) Suggest three ways by which the investigation could be improved.

1. .....

2. .....

3. ..... [3]

(c) Describe how the surface area of a leaf can be measured.

.....

.....

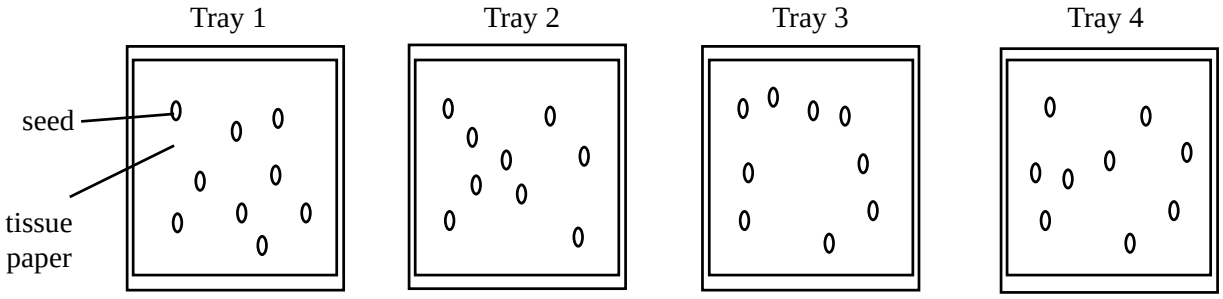
.....

..... [3]

TOTAL / 7

QUESTIONSHEET 9

In an investigation into the effects of acid rain on seed germination, a student sprayed trays of pea seeds with a range of solutions as shown in the diagram below.



Spray:	De-ionised water	Sulphuric acid pH 5	Sulphuric acid pH 4	Sulphuric acid pH 3

The student then recorded the total number of seedlings which had germinated and the length of each shoot and root, for 7 days. The student's results are shown in the table below.

Solution	Average shoot length/mm	Average root length/mm	% germination after 7 days
De-ionised water	51.6	47.0	88.8
pH5	44.5	46.3	50
pH4	34.6	30.3	22.2
pH3	14.3	24.2	0

The student learned that were weakness in both the design of the investigation and errors in their recordings in the table above.

(a) Identify:

(i) three weaknesses in the student's experimental design.

1: .....

2: .....

3: ..... [3]

(b) Suggest why increasing acidity might inhibit germination.

.....

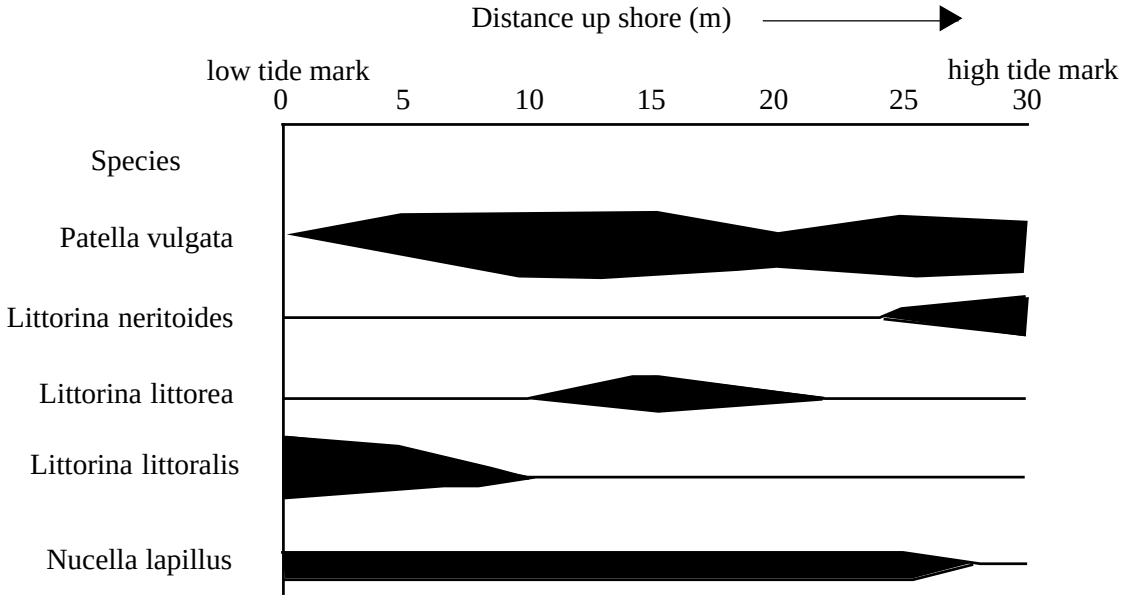
..... [2]

TOTAL / 5

QUESTIONSHEET 10

Do not write in margin

The kite diagram shows the distribution of molluscs on a rocky shore in the south of England.



Patella sps. = Limpets (herbivores)
Littorina sps. = Periwinkles (herbivores)
Nucella sps. = Whelks (carnivores)

(a) What does the width of the bar in this diagram represent?

.....

..... [1]

(b) Suggest two biotic and two abiotic factors which could account for the pattern of distribution shown.

Biotic 1: .....

2: ..... [2]

Abiotic 1: .....

2: ..... [2]

(c) Suggest reasons for the differences in distribution of:

(i) Littorina neritoides and Littorina littoralis.

.....

..... [2]

(ii) Nucella lapillus and the Littorina species.

.....

..... [2]

TOTAL / 9

QUESTIONSHEET 11

(a) State one advantage and one disadvantage of random sampling.

Advantage: .....

.....

Disadvantage: .....

.....

[2]

(b) Pleurococcus is a microscopic green algae which is commonly found on tree trunks. Outline a method which you could personally use to test the following hypothesis:

Pleurococcus occurs more commonly in the south facing aspect of trees than on the north-facing aspect.

.....

.....

.....

.....

.....

.....

[5]

(c) Suggest two reasons why Pleurococcus could occur more frequently on the south-facing sides of tree trunks.

1. .....

2. .....

[2]

TOTAL / 9

FIELD STUDIES

QUESTIONSHEET 12

Do not write in margin

The table shows the results of an investigation in the diversity of invertebrates in a pond. Samples of mud were collected using large spoons. Nets were used to sample organisms in the open water and in the weeds.

Invertebrate	Mud	Open water	Weeds
Bugs	21	70	92
Beetles	18	10	21
Water boatmen	12	5	19
Leeches	3	1	0
Molluscs	64	103	236
Nymphs	20	164	190
Surface living Organisms	0	1	0
Worms	14	0	19
Total	152	354	577

(a) Plot a histogram of this data. [4]

(b) Suggest two possible sources of error in the sampling methods used.

1: .....

2: .....

[2]

(c) Suggest two reasons why most organisms were obtained form among the weeds.

1. .....

2. .....

[2]

TOTAL / 8