

Past-paper walk-through

Introduction to Natural Selection ■ 7.1

eXercise

Questions in this set

- 2014 Q1

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 1

2014 ■ Q1

Trichomes are hairlike outgrowths of the epidermis of plants that are thought to provide protection against being eaten by herbivores (herbivory). In a certain plant species, stem trichome density is genetically determined.

To investigate variation in stem trichome density within the plant species, a student counted the number of trichomes on the stems of six plants in each of three different populations. The student used the data to calculate the mean trichome density (numbers of hairs per square centimeter) for each population. The results are provided in the table below.

TRICHOME DENSITY IN THREE PLANT POPULATIONS (number of trichomes/cm²)

Question 1

Population	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Mean	
Standard Error of the Mean (SEM)	—	—	—	—	—	—	—	I 8 11 9 10 8
	6	9	1		II 12	6 15	9 13	8 11
	1					III 13	17	9 14
							12	16 14 1

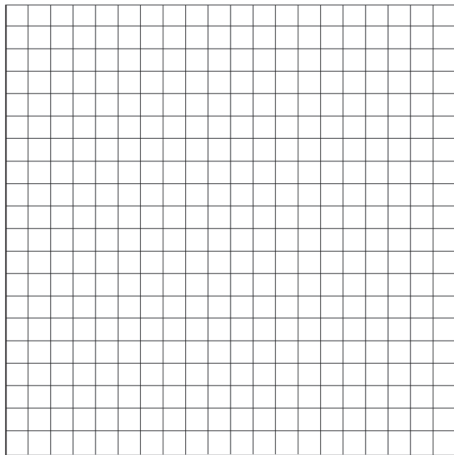
[Below the parts is a blank graph grid (approximately 18 columns $\times$ 22 rows) with no axis labels provided, for the student to create their own labeled graph.]

- (a) On the axes provided, ****create**** an appropriately labeled graph to illustrate the sample means of the three populations to within 95
- (b) Based on the sample means and standard errors of the means, **identify** the two populations that are most likely to have statistically significant differences in the mean stem trichome densities. **Justify** your response.
- (c) **Describe** the independent and dependent variables and a control treatment for an experiment to test the hypothesis that higher trichome density in plants is selected for in the presence of herbivores. **Identify** an appropriate duration of the experiment to

Question 1

ensure that natural selection is measured, and **predict** the experimental results that would support the hypothesis.

Question 1



Question 1

Population	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Mean	Standard Error of the Mean (SEM)
I	8	11	9	10	8	6	9	1
II	12	6	15	9	13	8	11	1
III	13	17	9	14	12	16	14	1

Solution 1

(a)

Mark scheme

- Construct a bar graph (or modified bar graph) plotting the sample mean trichome density for each population — Population I = 9, Population II = 11, Population III = 14 trichomes/cm² — with error bars extending ± 2 SEM (each SEM = 1, so bars span mean-2 to mean+2). Full credit (3 points) requires: (1) axes correctly labeled and scaled with proper units (trichome density in trichomes/cm²; Populations I, II, III); (2) a bar graph or modified bar graph with the means correctly plotted; (3) error bars showing $2 \times \text{SEM}$ above and below each mean.

Solution 1

(b)

Mark scheme

- Identification (1 point): Populations I and III. Justification (1 point): the 95% confidence intervals ($\text{mean} \pm 2 \text{ SEM}$) for Populations I and III do not overlap — Population I's upper bound ($9 + 2 = 11$) is less than Population III's lower bound ($14 - 2 = 12$), i.e. $(\text{sample mean} + 2 \text{ SEM of Population I}) < (\text{sample mean} - 2 \text{ SEM of Population III})$.

Solution 1

(c) Mark scheme

- Present independent variable, dependent variable, control, duration, and prediction consistently — points are earned in a single row only (5 points max).
Accepted row 1: Independent variable = presence of herbivores (1 pt); Dependent variable = trichome density (1 pt); Control = absence of herbivores (1 pt); Duration = more than one generation (1 pt); Prediction = increased trichome density relative to control (1 pt).
Accepted row 2: Independent variable = trichome density in the presence of herbivores; Dependent variable = reproductive success OR number of plants; Control = plants with lower trichome density; Duration = more than one generation; Prediction = size of the population with higher trichome density will be larger than the control population.