Model Answers: Medium

1a

a) The type of variation represented by Fig. 1 is….

- Continuous (variation); [1 mark]

Reasons:

- The values / quantitative differences do not fall into discrete categories **OR** there is a lack of discrete categories; [1 mark]
- There is a range of values between the two extremes within which the phenotype will fall; [1 mark]

[Total: 3 marks]

1b

b) The role of environmental factors on the number of spines can be explained as follows:

- The more frequent the cacti are grazed (by herbivores) the greater the number of spines that would be present **OR** the less frequent the cacti is grazed the smaller the number of spines that would be present; [1 mark]
- Those that are grazed more frequently will require more protection (from herbivores) than those that are not frequently grazed **OR** those that are grazed less frequently will not require as much protection as those that are exposed to frequent grazing; [1 mark]

[Total: 2 marks]

1c

c) Contrasting continuous and discontinuous variation with one another:

- Different alleles at a single locus have a small effect on the phenotype in continuous variation **WHILE** it will have a large effect on the phenotype in discontinuous variation; [1 mark]
- Different genes can have the same or additive effect on the phenotype in continuous variation **WHILE** different genes will have different effects on the phenotype in discontinuous variation; [1 mark]
- A large number of genes / polygenes may have a combined effect on the phenotype in continuous variation **WHILE** a smaller number of genes may have an effect on the phenotype in discontinuous variation; [1 mark]

[Total: 3 marks]

Remember when a question asks you to contrast two concepts, you must focus on the main differences between them. In this case, you must make mention of both continuous and discontinuous variation in your answer to receive the marks.

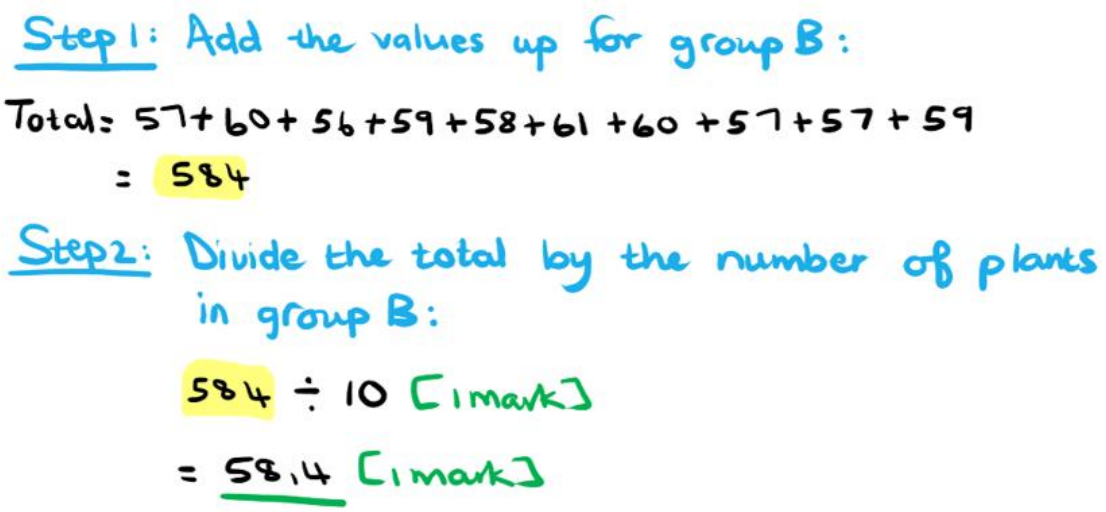
2a

a) Calculating the mean leaf length for group **B** would be as follows:

- 584 ÷ 10; [1 mark]
- = 58.4; [1 mark]

Full marks awarded for the correct answer only.

[Total: 2 marks]



2b

b) The data must have the following characteristics:

- It must have a normal distribution; [1 mark]
- The data must be continuous; [1 mark]

[Total: 2 marks]

2c

c) The null hypothesis for this investigation is as follows:

- There is no significant difference between the leaf length of group **A** and **B OR** there is no significant difference between the leaf length of plants grown under high and low light intensity; [1 mark]

[Total: 1 mark]

The null hypothesis will always state that there is no significant difference between the groups of data that you are comparing. The outcome of the statistical test that is performed will determine whether the null hypothesis is accepted or rejected.

2d

d) The students can draw the following conclusion from their results:

- The probability that the difference in leaf length between the two groups is due to chance is very small **OR** p-value/significance level is less than (critical value of) 0.05 (at 18 degrees of freedom); [1 mark]
- The null hypothesis/H_0 can be rejected; [1 mark]
- (Therefore) there is a (statistically) significant difference between the leaf length of the two groups; [1 mark]

[Total: 3 marks]

Scientists consider a probability of 0.05 as the critical value for accepting that chance is responsible for the difference observed between two data sets. The greater the *t*-value, the smaller the probability that the difference is due to chance. In the case of leaf length, the *t*-value of 29.7 at 18 degrees of freedom is much greater than 2.101, which is the *t*-value if the probability was 0.05. This means that the differences observed in leaf length between group A and B is not due to chance and was most probably influenced by the levels of light intensity.

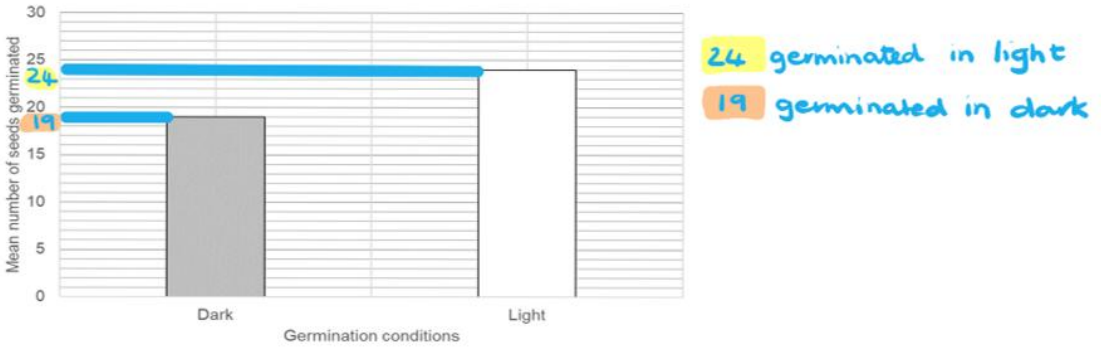
3a

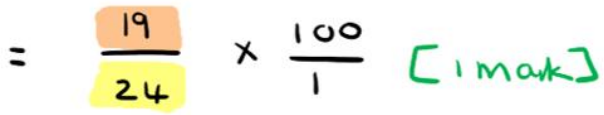
a) The mean number of seeds germinating in dark conditions as a percentage of the mean number of seeds germinating in light conditions can be calculated as follow:

- (19 ÷ 24) x 100; [1 mark]
- =79.2; [1 mark]

Full marks awarded for the correct answer only.

[Total: 2 marks]





3b

b) The *t*-test would not be suitable to use on the data in Fig.1 because....

- The data is not continuous **OR** data forms two discontinuous categories; [1 mark]
- The data does not have a normal distribution; [1 mark]

[Total: 2 marks]

3c

c) The *t*-value can be calculated as follows:

- ; [1 mark]
- ; [1 mark]
- ; [1 mark]

Full marks awarded for the correct answer only.

[Total: 3 marks]

The key to this calculation is to substitute the values correctly for each population and double-check that you calculated correctly.

$\overline{x_1} = 13$

$\overline{x_2} = 14$

$s_1^2 = (1.80)^2 = 3.24$

$s_2^2 = (1.74)^2 = 3.03$

$$t = \frac{(13 - 14)}{\sqrt{\frac{3.24}{20} + \frac{3.03}{20}}} = \frac{1}{\sqrt{0,314}}$$

[1 mark]

$$= \frac{1}{0,56} \quad [1 \text{ mark}]$$

$$= 1,79 \quad [1 \text{ mark}]$$

3d

d) The conclusion that can be made is as follows:

- Null hypothesis/H_0 can be accepted; [1 mark]
- The difference in beak size between the populations is due to chance **OR** there is no significant difference in beak size between the populations; [1 mark]

[Total: 2 marks]

The t-value calculated in part c) was less than the critical value at a probability of 0.05. This means that any difference observed between the population is not significant and is most likely due to chance.