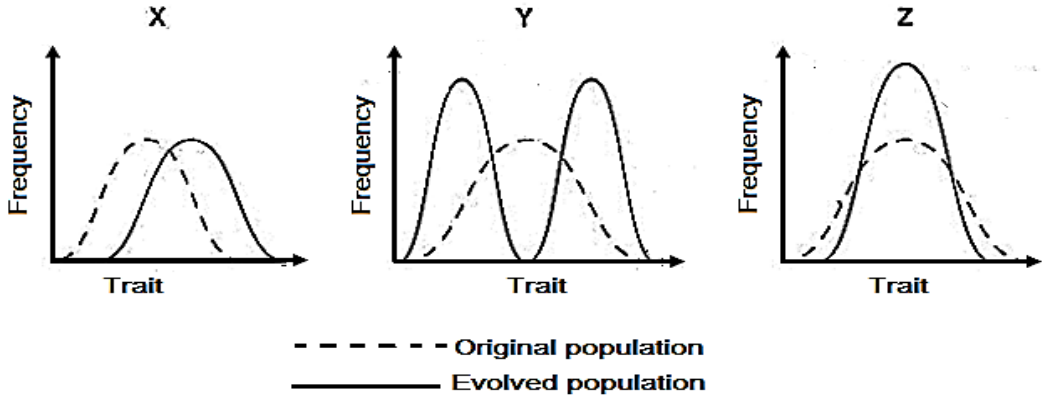
EXCEPTIONAL APPROACHES TO INTERPRETATION OF P530 /1, 2 & 3 DATABASED QUESTIONS

Description, explanation of graphs further demands candidates to interpret the questions/ scenarios provided in order to determine the topic or subtopic it has been derived.
Understanding the topic/ subtopic where the scenario/ question has been derived should drive candidates to describe and explain graphs as usual or deviate and adjust their data interpretation skills.

1.0 EXCEPTIONAL APPROACHES TO DESCRIPTIONS OF GRAPHS

Scenario 1.1: Deviation from the usual description of both independent and dependent variable.

Figures X, Y and Z show three forms of natural selection that occurs in a population of organisms.



a) Describe how the different forms of selection affect the frequency of traits of the original population.
   i. Figure X
   ii. Figure Y
   iii. Figure Z

b) With examples, explain how the different forms of natural selection arise and contribute the phenotypic frequency of the evolved population.
   i. Figure X
   ii. Figure Y
   iii. Figure Z

In the above scenario, candidates should not approach in the usual way of describing the trends in the graph (such as "~~frequency increased rapidly to a peak with increase in trait~~".
Understanding that the question is from selection as a subtopic. Therefore the effects of selection should drive the candidate.

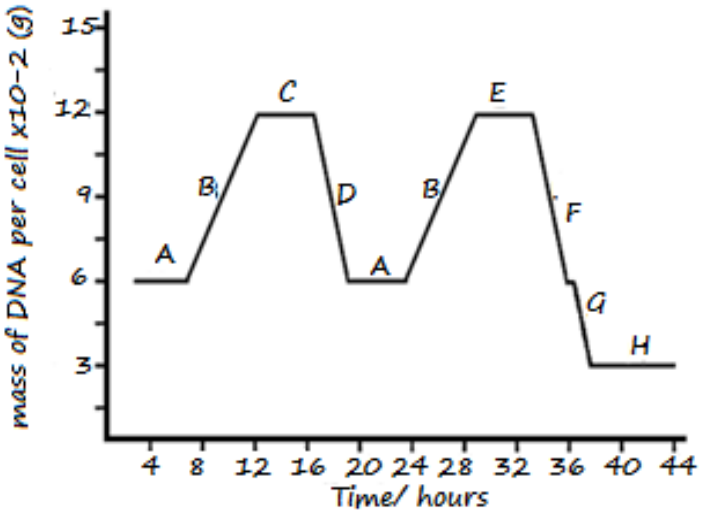
Suggested responses:

(i) Figure X.
Selection decreases trait frequency at the extreme below the mean of original population;

Selection increases frequency for the trait at the extreme above the mean of original population;
Selection shifts the mean trait of original population to a new mean towards trait above the old mean;

Scenario 1.2: Exceptions in the description of the dependent variable with predictable/ known maximum/ level of expected increase/ decrease.

The graph below shows the changes in the intracellular mass of DNA in human testicular cells (in wall of seminiferous tubules) during spermatogenesis.



(a) Describe the trend in the mass of DNA per cell with time at the different phases from the graph.

(b) Explain the above changes in mass of DNA per cell.

In this scenario, the mass of DNA per cell was recorded at different times following spermatogenesis.
In normal human spermatogenesis, testicular cells undergo normal cell division of mitosis, and subsequent meiosis to form haploid cells. Meaning increase in mass of DNA is limited and definite to doubling, while decrease in mass of DNA halves to complete mitosis, or decreases by a quarter to complete meiosis.

Suggested responses:

From 4 to 8 hours, mass of DNA per cell remained constant;
From 8 to 12 hours, mass of DNA per cell doubled; ("~~increased rapidly to a maximum~~" – in this case the rapid has no meaning)
From 12 to 16 hours, mass of DNA remained constant;
From 16 to 20 hours, mass of DNA was halved; ("~~decreased rapidly to a minimum~~")
From 20 to 24 hours, ...

Scenario 1.3: Independent variables driven by an externally applied factor other than the indicated independent variable. Descriptions must strictly be limited to the effect of such factors unless candidates are instructed to consider variations before factor.

Scenario 1.3.1:

On a hot day, a student has an ice drink. The graphs below I and II show some of the changes to the student's body produced by the iced drink.

Fig I

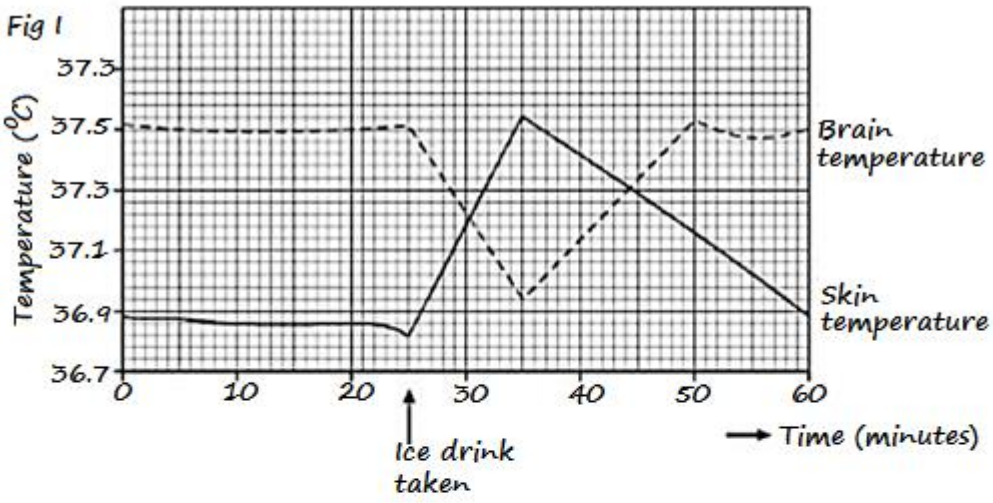
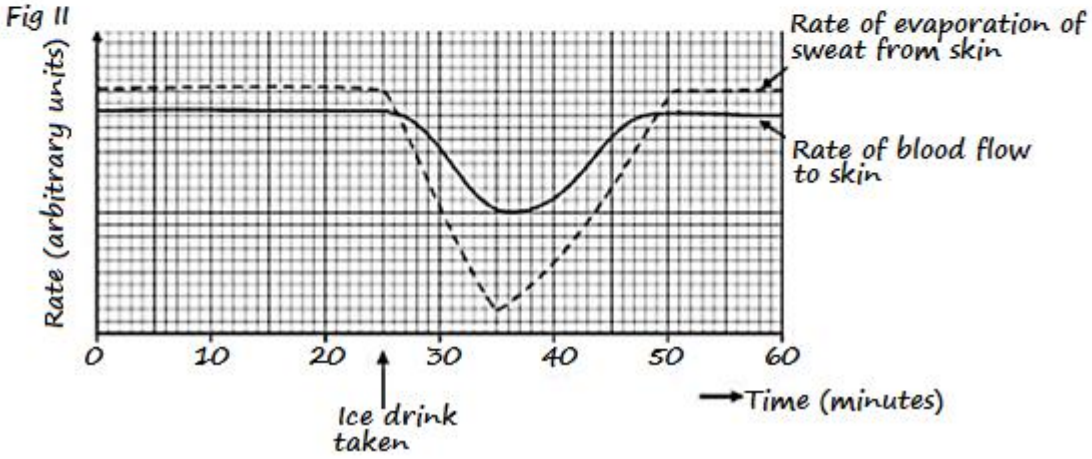


Fig II



(a) Describe the relationship between;

(i) Brain temperature and rate of blood flow to the skin.

(ii) Rate of blood flow to the skin and skin temperature.

(b) Using the two figures above, explain the effects of the ice drink taken as observed.

In the scenario above ice drink is an external factor,
All descriptions and explanations MUST begin from the point of taking in the ice drink.
Candidates should also be suspicious of the initial levels before effects of the external factor of being the normal/set point, and proceed to confirm based on the topic where the questions is obtained.
Candidates ought to be keen on such questions.

Suggested response

(a) (i)

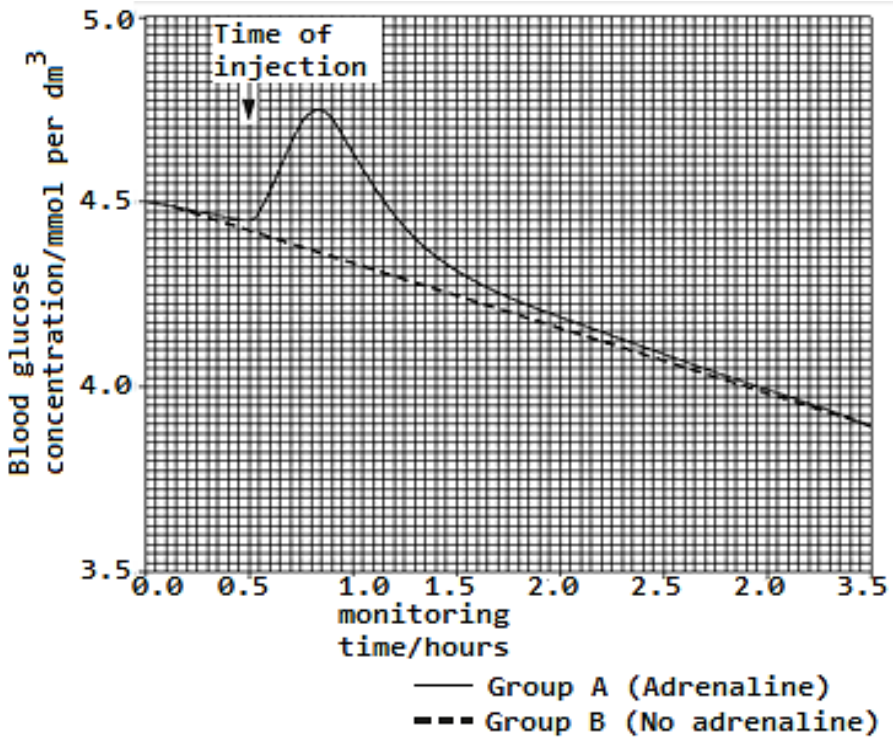
At 25 minutes when the ice was taken to 35 minutes, as brain temperature decreased to a minimum, the rate of blood flow to the skin also decreased to a minimum

From 35 minutes to 50 minutes, as brain temperature increased to a maximum, the rate of blood flow to the skin also increased to a maximum.

From 50 minutes to 60 minutes, as brain temperature remained almost constant, the rate of blood flow remained constant.

Scenario 1.3.2:

A scientist investigated the effect of adrenaline on blood glucose concentration on two groups of rats.
Group A was given an injection of adrenaline. Group B was given an injection that did not contain adrenaline. The blood glucose concentrations of the rats in both groups were monitored for three hours after the injections. The rats did not eat for 12 hours before and during the investigation. Results are shown in the figure below.



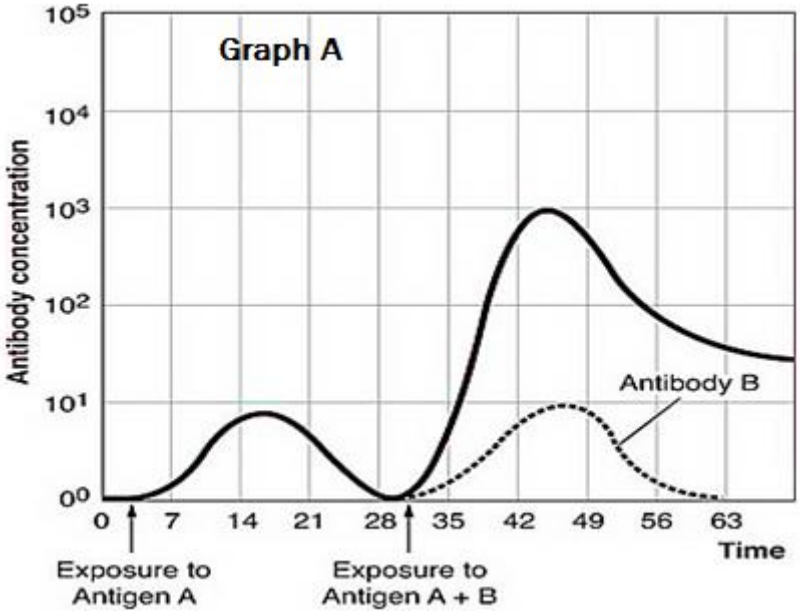
(a) Describe the blood effect of adrenaline on blood glucose concentration for group A rats.

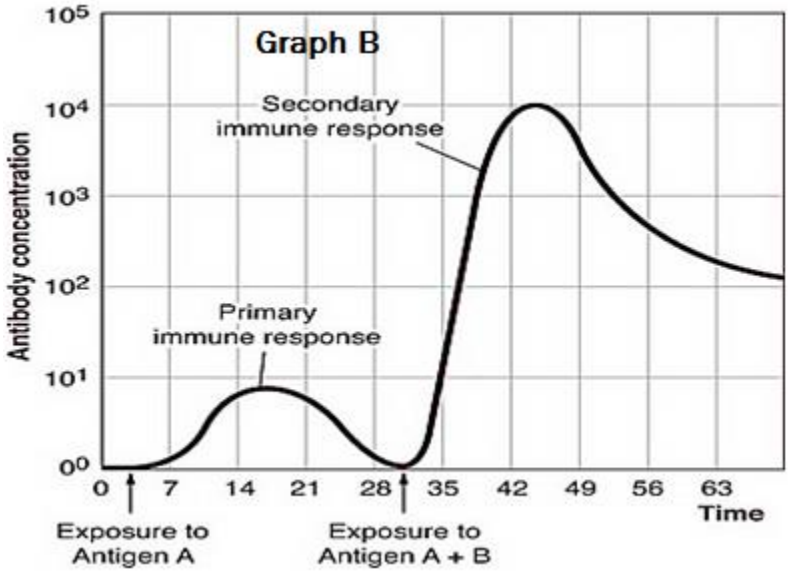
Injection of adrenaline in blood of the rat resulted into;
Rapid increase in the blood glucose concentration from 0.5hourS to 0.75hours.
Rapid and then gradual decrease in blood glucose concentration from 0.75hours to 3.5hours.

(b) Explain the results shown in the graph for group A.

Scenario 1.3.3:

The graphs below show effect of antigen exposure on the response of the immune system. Graph A and B show changes in antibody concentrations produced by the immune system on antigen A and antigen B exposure at different times.



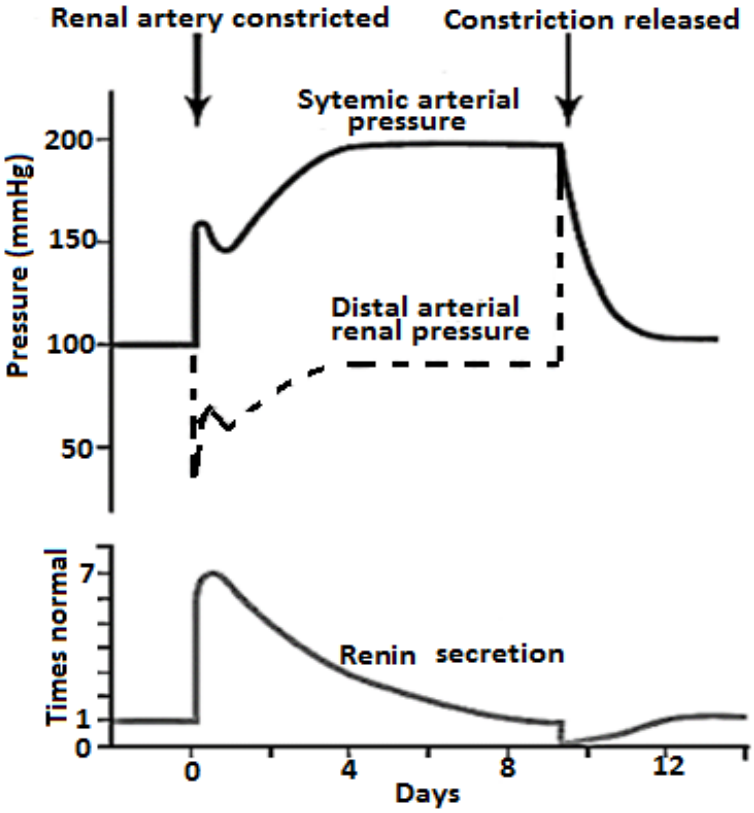


a) (i) Compare the effect of same antigen exposure on antibody concentration as indicated in graphs A and B. (06marks)

(ii) Explain the differences in the responses in (b) (i) above. (12marks)

Scenario 1.3.4:

Figure below shows effect of placing a *constricting clamp* on the renal artery of one kidney after the other kidney has been removed. Changes in systemic arterial blood pressure, renal artery distal to the clamp and rate of renin secretion are shown.



a) **Describe the effect of renal artery constriction on,**
   i. **Sytemic arterial pressure.** **(04marks)**
   ii. **Distal arterial renal pressure.** **(04marks)**
   iii. **Renin secretion.** **(03marks)**

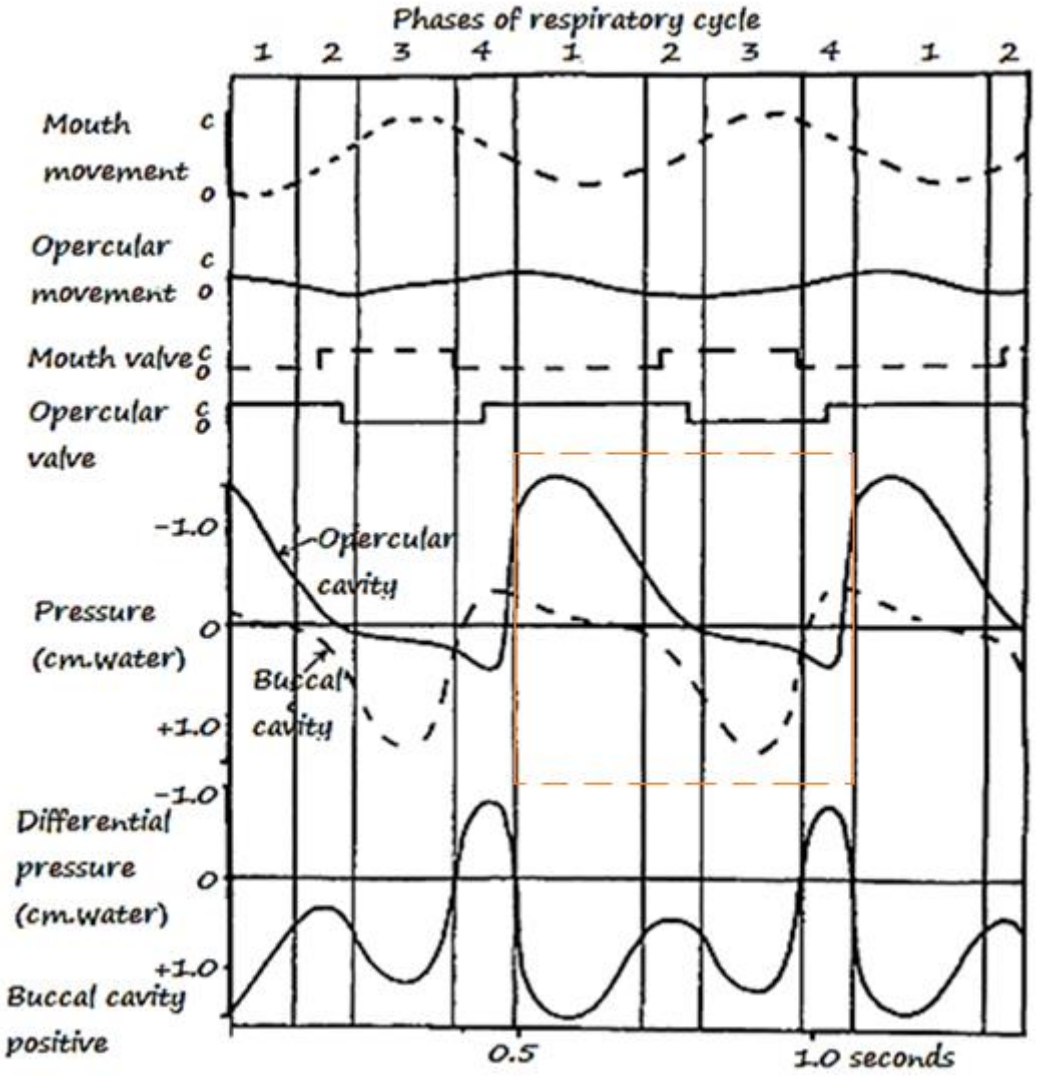
b) **Explain the observed changes in systemic arterial pressu re, distal arterial renal pressure and renin secretion during renal artery constriction.** **(10marks)**

c) **Explain the relationship between sytemic arterial pressure and distal arterial renal pressure when constriction is released.** **(07marks)**

Scenario 1.4: Independent variables described based on the stated independent variable in question and not the direction of trend. (UNEB 2022 P530/2 Qn.1). (The stated DV was stated as "percentage of substance remaining" and candidates instructed to the describe the "rate of decomposition of each substance".

Scenario 1.4.1

Figure Shows Movements of the mouth and operculum with associated pressure changes in the buccal and opercular cavities during breathing in a fish species, trout (Salmo trutta sp.) (70 gm) at 17° C. Dashed lines relate to the mouth and buccal cavity. The differential pressure between the two cavities is shown below. C and O Indicate 'closed' and 'open' respectively.



(a) Compare the pressure changes in the buccal cavity and opercular cavity in one respiratory cycle.

For any graphs presented to candidates, there is need for patience and focus to interpret the question, observe all possible unusual presentations of data/ variables so that they don't make errors in approaching the question. (For example, pressure of opercular cavity and buccal cavity, negative value are above the zero while the positive value are below the zero in this case), this has to affect the language of description.

Focus and patience, will enable candidates to determine the range of 1 cycle, however knowledge about the topic/process/cycle eases the interpretation.

Suggested responses

Similarities

Pressure in both cavities:

is negative in phase 1; is positive in phase 3; is negative at end of phase 4/cycle; is positive and the same/ equal at

end of phase 3 / start of phase 4 and towards end of phase 4/ cycle; increase rapidly at the same rate during phase 2;
Differences AWARD TABULATED DIFFERENCES-ANY CORRECT
In phase 1, opercular cavity has a greater/ more negative pressure than buccal cavity negative pressure;
In phase 2, buccal cavity attained a positive pressure while opercular cavity pressure is still negative;
In phase 3, positive pressure in buccal cavity is greater/ more than positive pressure in opercular cavity;
At the start of phase 4, opercular cavity attained positive pressure with respect to pressure in buccal cavity/ (while buccal cavity attained a negative pressure);
At the end of phase 4/ cycle, negative pressure in the opercular cavity is greater/more than negative pressure in the buccal cavity;
Maximum buccal cavity positive pressure is higher than the maximum opercular cavity positive pressure;
Minimum buccal cavity negative pressure is lower than the minimum opercular cavity negative pressure;
Maximum buccal cavity positive pressure attained in phase 3 while maximum opercular cavity positive pressure attained in phase 4;
Maximum buccal cavity negative pressure attained end of phase 4 while maximum opercular cavity negative pressure attained slightly after the start of phase 1;

(b) Account for the pressure changes in the buccal cavity in the buccal cavity during one complete respiratory cycle.

(c) What is the physiological significance of difference between the pressure in the buccal cavity and opercular cavity?

2.0 EXCEPTIONAL APPROACHES TO EXPLANATIONS OF GRAPHS

Scenario 2.1:

The table below shows changes in frequency of allele A for two populations of Darwin's finches on the Galapagos Islands over 10 generations after the effect of two different evolutionary mechanisms on the two populations.

In Population 1, after a storm passed through the Galapagos, a few finches ended up on an island where no finches were found before, mated and established a new population on that island.

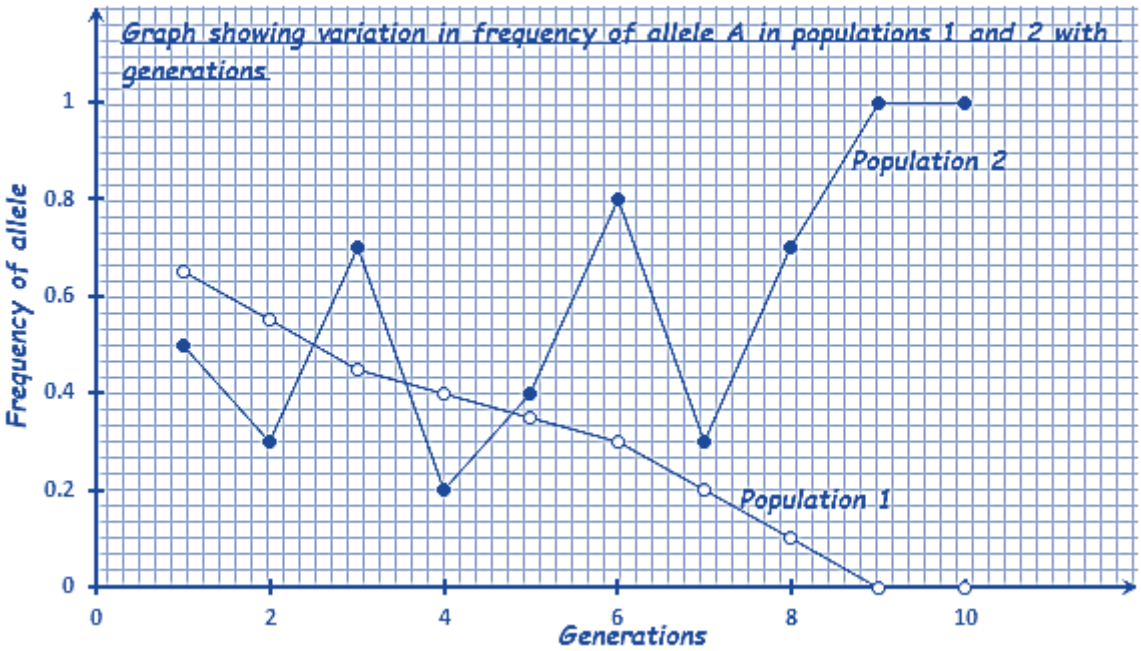
In Population 2 of Darwin's finches on an Island in the Galapagos, severe drought favoured one phenotype over the other in a population of birds that had both thin and thick size beaks.

Generations		1	2	3	4	5	6	7	8	9	10
	Population 1	0.65	0.55	0.45	0.40	0.35	0.30	0.20	0.10	0.00	0.00

Frequency of allele	Population 2	0.50	0.30	0.70	0.20	0.40	0.80	0.30	0.70	1.00	1.00

a) Present the data above on suitable graphical form.

Suggested response



b) Describe the pattern in frequency of allele A over the 10 generations in,

i. Population 1.

ii. Population 2.

c) With reference to results, explain the evolutionary mechanism that caused changes in allele frequency observed in the two populations upto the 9th generation.

Based on the plotted graph, population 2 shows fluctuations in the allele frequency, however the trend in the allele frequency increases too.
Understanding the origin of the concept, a candidate is expected to draw a straight line of best fit through the points, which is the basis of explanation of graphs showing trends in allele frequency during Directional selection.
Then explain the observation in fluctuations of allele frequency using their knowledge of population genetics and evolution.

Suggested response

Population 1.....
Population 2
Frequency of allele A increased to maximum by the 9th generation due to Directional selection; Deny - Natural selection;
Severe drought resulted into reduced number of small seeds; available for the thin beaked birds; therefore severe drought and seed size operated together to produce a

selection pressure for both thin and thick size beaked finches;
The available large seeds with thick coatings/husks remained available as food source;
Birds with thin beaks were less adapted to the selection pressure; were less favoured/selected against, died decreasing frequency for thin beak phenotype in the population completely by the 9th generation;
Birds with thick beaks were well adapted to selection pressure; and were able to crack large seeds with thick husks to obtain nutrients, survived, and reproduced; subsequently increasing the allele frequency of A of the advantageous phenotype. This shifts the mean phenotype to the extreme with thick beaks.
At the 9th generation, directional selection stopped once the new mean phenotype of population coincides with the new optimum selection pressure.

Random fluctuations in the allele frequency across generations; are due to genetic drift as alleles of other non-favored phenotypes become rare in the population.

Scenario 1.4.1

(Refer to the UNEB 2022 P530/2 QN.1)