GCE Biology

S21-A400U20-1

Assessment Resource 12

Continuity of Life Resource C

1. The photograph shows all the chromosomes from a blood cell of a mammal.

(a) (i) Explain why red blood cells could not have been used to produce the photograph of the chromosomes. [1]

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(ii) Use the photograph to deduce the sex of the mammal and explain your choice. [1]

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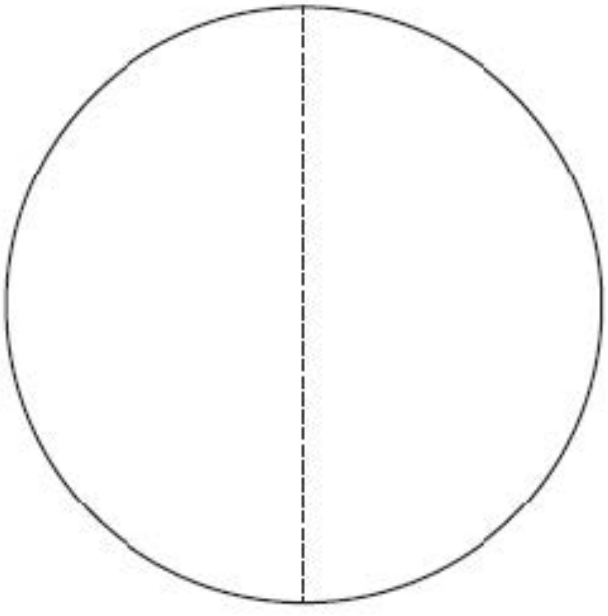
(iii) In this mammal, how many chromosomes would be present in [1]

I. a kidney cell; .....

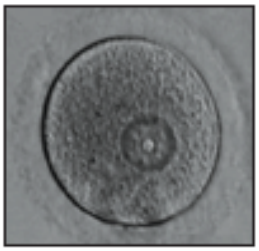
II. gametes? .....

(iv) The circle below represents the outline of the mammal cell at metaphase I of meiosis, and the dotted line the equator of the cell.
Complete the drawing to show the spindle and how **the sex chromosomes** as shown above would be arranged. [2]



(b) Starfish, *Asterias rubens*, reproduce sexually by spawning. When starfish spawn, the males release spermatozoa and the females release oocytes in large numbers.

The oocytes are suspended at early prophase of the first meiotic division.



The nuclei of early oocytes are called germinal vesicles.

Breakdown of the germinal vesicle indicates resumption of meiosis (re-initiation).

Re-initiation is naturally stimulated by contact with spermatozoa. Scientists have shown that it is possible to stimulate re-initiation by exposing the oocytes to suitable concentrations of calcium ions (Ca^{2+}).

Sea water has a typical calcium concentration of 400 mg dm^{-3}.

Suggest a suitable hypothesis for this investigation and design an experiment to investigate how calcium ion concentration affects meiosis in starfish. Make sure you suggest suitable values for the independent variable as well as identifying the dependent variable and two controlled variables. [6]

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(c) Some human fertility problems are due to poor morphology (abnormal shape) or poor motility (not moving normally) of spermatozoa. These causes of infertility can be treated by a special type of In Vitro Fertilisation (IVF) called Intra-Cytoplasmic Sperm Injection (ICSI). It differs from conventional IVF in that a single spermatozoon is injected directly into a secondary oocyte, instead of fertilisation taking place in a dish where many spermatozoa are placed near a secondary oocyte.

Intra-Cytoplasmic Sperm Injection

However, fertilisation does not always proceed to completion. A solution of a 'calcium ionophore' may be used to stimulate gated calcium ion channels in the oocyte plasma membrane. Ionophores are molecules that facilitate ion passage in or out of cell membranes.

(i) Use your knowledge of the structure of the plasma membrane to state what is meant by the term *'gated calcium ion channel'*. [2]

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(ii) In humans, before fertilisation the oocytes are suspended in metaphase II. Explain how the ionophore molecules might improve the success rate of ICSI. [2]

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2. Wheat grain size is determined by the plants' genetics (i.e. variety), and the length of the grain filling period (time between fertilisation and harvesting). Plant breeders cross varieties of wheat in order to increase grain size. The photograph below shows the results of one such cross.

(a) Distinguish between **continuous** and **discontinuous** variation. You should give an example, which is visible in the photograph, for each one. [3]

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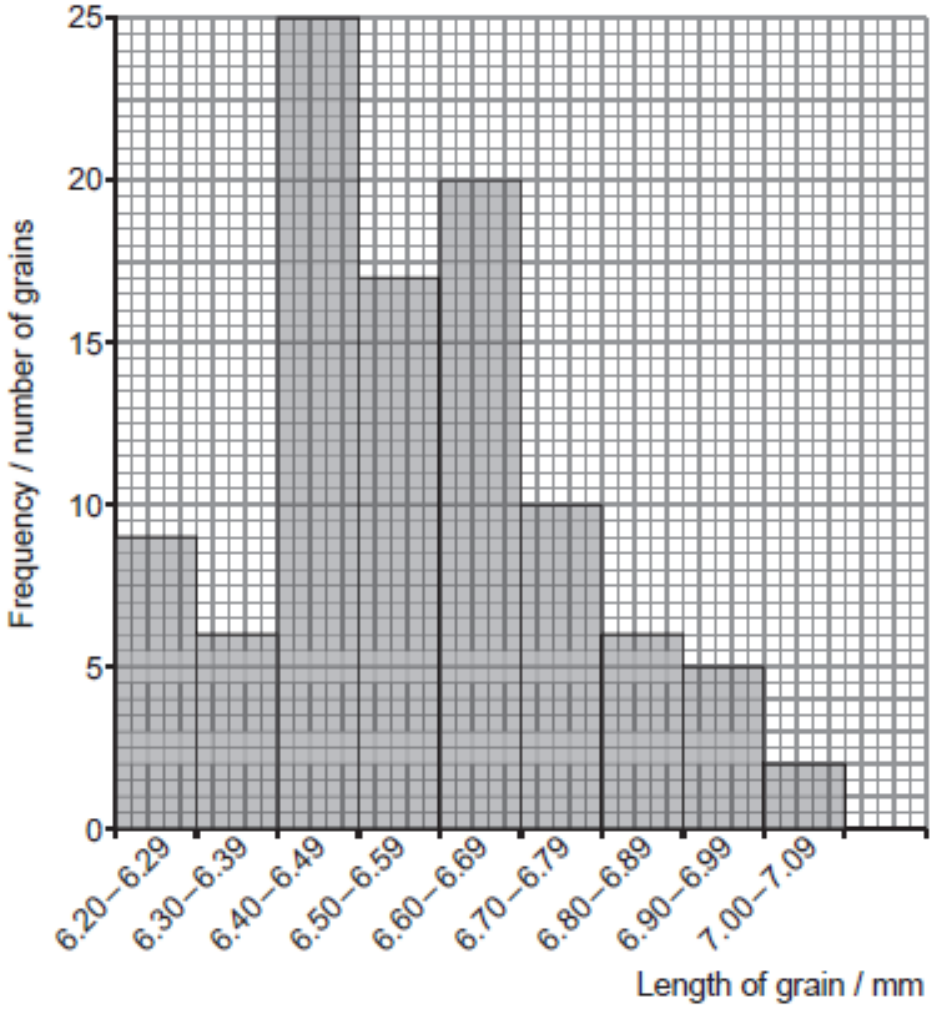
The graph below shows the distribution of grain length in a sample of the hybrid wheat variety. The grains were measured to the nearest 0.01 mm.



(b) (i) What is the total number of grains in the sample? [1]

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(ii) The student calculated three different averages for the length of hybrid grains. The mean was 6.57 mm. The other two values were 6.45 mm and 6.52 mm. With reference to the graph, state which of these values is more likely to be the mode and give a reason for your choice. [2]

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(iii) What evidence is there from the graph that the length of hybrid grains is not normally distributed? [1]

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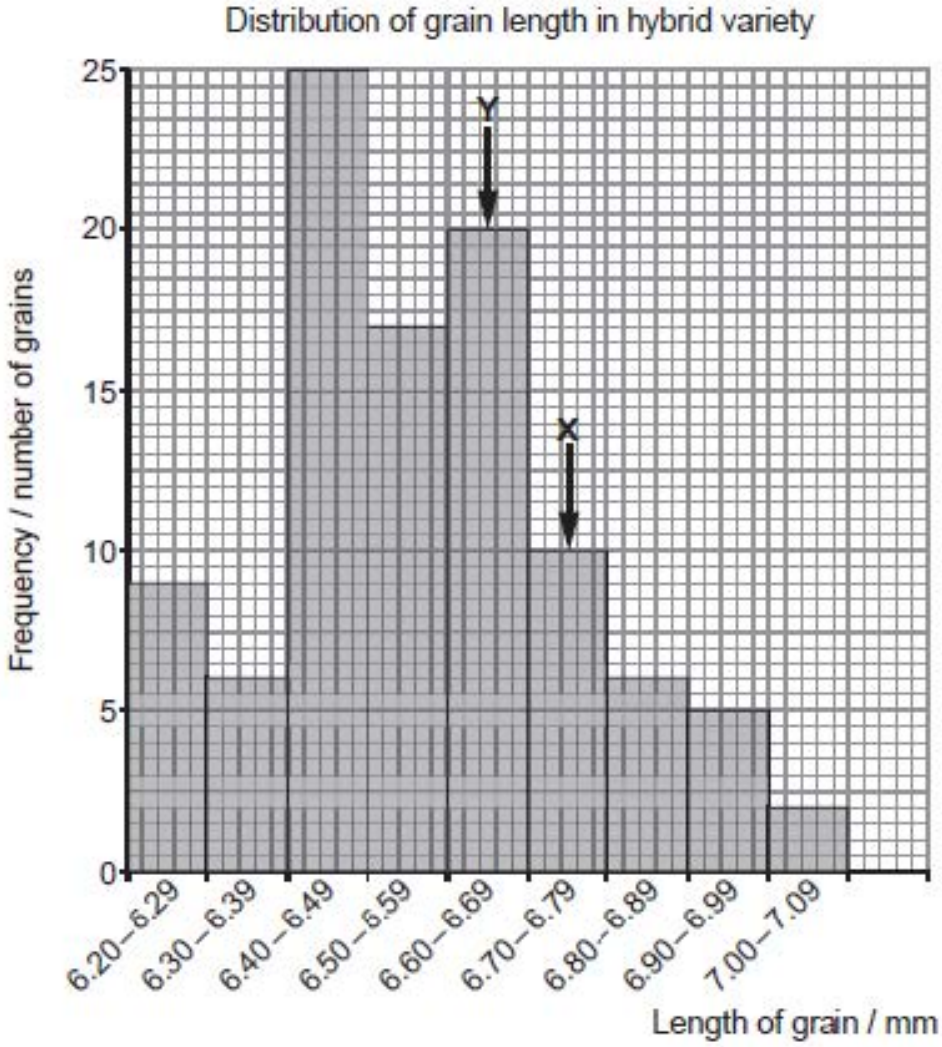
For each parental variety the mode and median were the same. Arrow **X** shows the mode and median for parental variety A and Arrow **Y** shows the mode and median for parental variety B.



(iv) Consider the following statement:

'There is no significant difference in the length of the hybrid grains and the length of the grains of parental type B.'

Describe any evidence from the graph above to support the statement and name the terms used to describe; the type of hypothesis represented by the statement and the statistical test that could be used to test the hypothesis. [3]

Evidence .....

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Type of hypothesis .....

Statistical test .....

As soon as fertilisation has occurred, the embryo and endosperm begin to develop with the plant redirecting products of photosynthesis to the develcping grains. The longer the period of grain fill the larger wheat grain size. Grain size can be influenced by the availability of water and nutrients, and disease management.

(c) With reference to the information provided above, explain the following:

(i) there is a saying amongst farmers, "When you think the crop is ready to harvest, take a holiday"; [1]

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(ii) the use of nitrate fertiliser to increase grain size; [3]

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(iii) the use of fungicide to increase grain size. [2]

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(d) In the USA wheat prices are quoted per bushel, (a unit of volume). In Europe wheat prices are quoted per kg. Rex Ryder is a Kansas farmer who harvests his wheat into a truck that holds 998 bushels. During the harvest in 2015 he filled the truck 22 times. His farm covers 492 acres.

Estimate how many bushels of wheat he produced per acre to the nearest bushel and suggest **one** advantage and **one** disadvantage of using prices per kg rather than per bushel. [3]

Estimate

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Advantage

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Disadvantage

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