GCE Biology

S21-A400U20-1

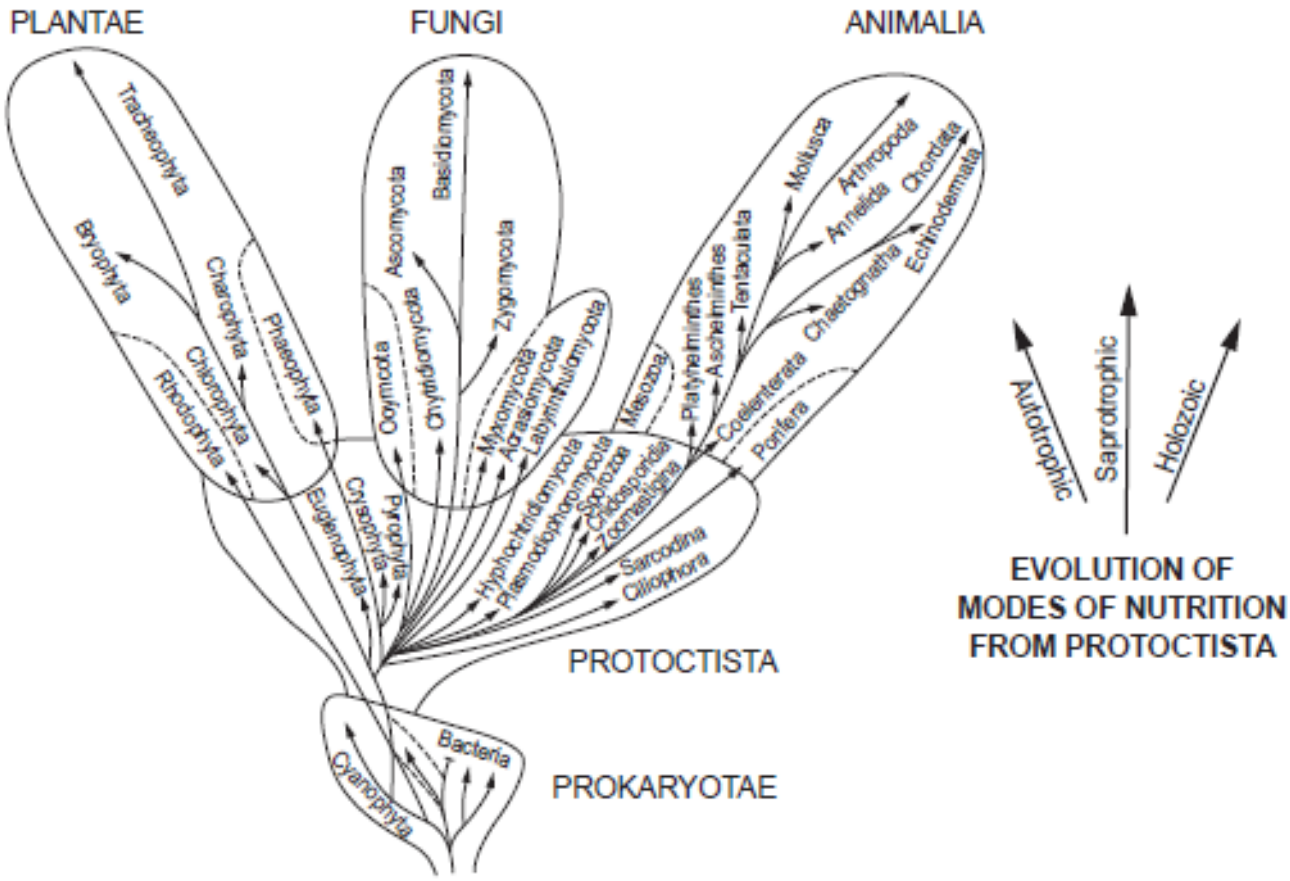
Assessment Resource 14

Continuity of Life Resource E

Answer **all** *questions.*

1. Classifying organisms is important because it allows scientists to better understand evolutionary relationships. In 1969, RH Whittaker proposed a five Kingdom system including evolutionary relationships based on modes of nutrition.

Figure 1.1



(a) (i) Explain how the three arrows indicating mode of nutrition on Figure 1.1 illustrate the evolution of the three higher Kingdoms from the Protoctista. [3]

.....

.....

.....

.....

.....

.....

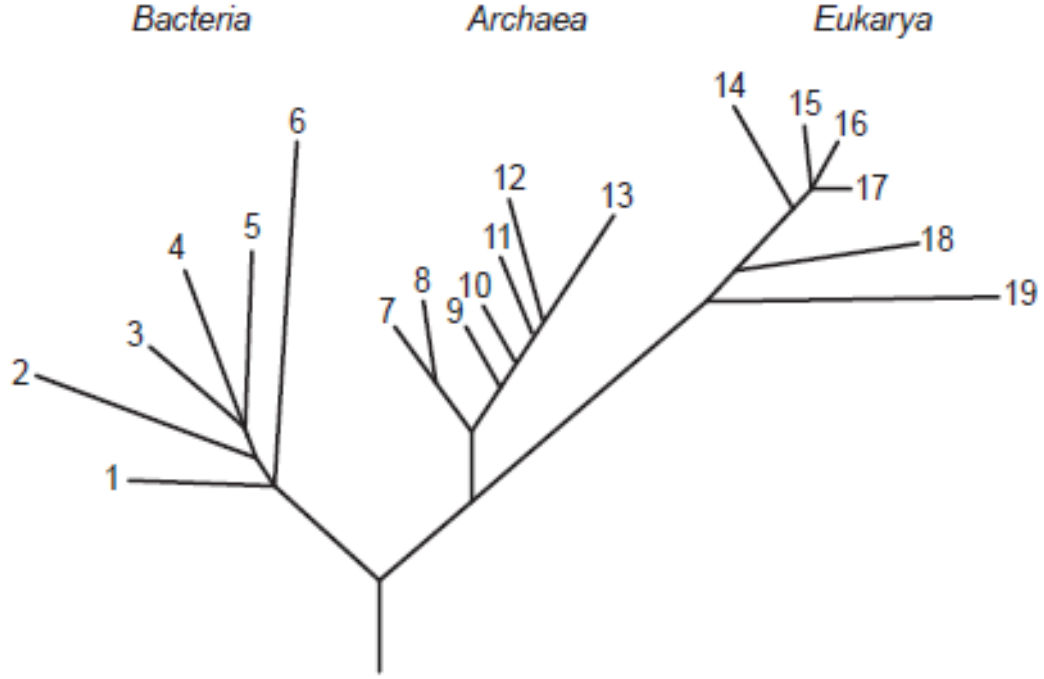
.....

(ii) Identify which of the Kingdoms is described in the following extract taken from the 1969 paper.
"Primarily multinucleate organisms with eukaryotic nuclei dispersed in a walled and often septate mycelial syncytium, plastids and photosynthetic pigments lacking."
[1]

.....

In 1990, Carl Woese justified replacing the five Kingdom system because, *"Molecular comparisons show that life on this planet divides into three primary groupings, commonly known as the bacteria, the archaea, and the eukarya."* He illustrated his suggestion with a phylogenetic tree. Figure 1.2 is adapted from it.

Figure 1.2



(b) (i) State the term that is used for the three primary groups in this system. [1]

.....

(ii) Name a biochemical technique that can be used to investigate evolutionary relationships between organisms. [1]

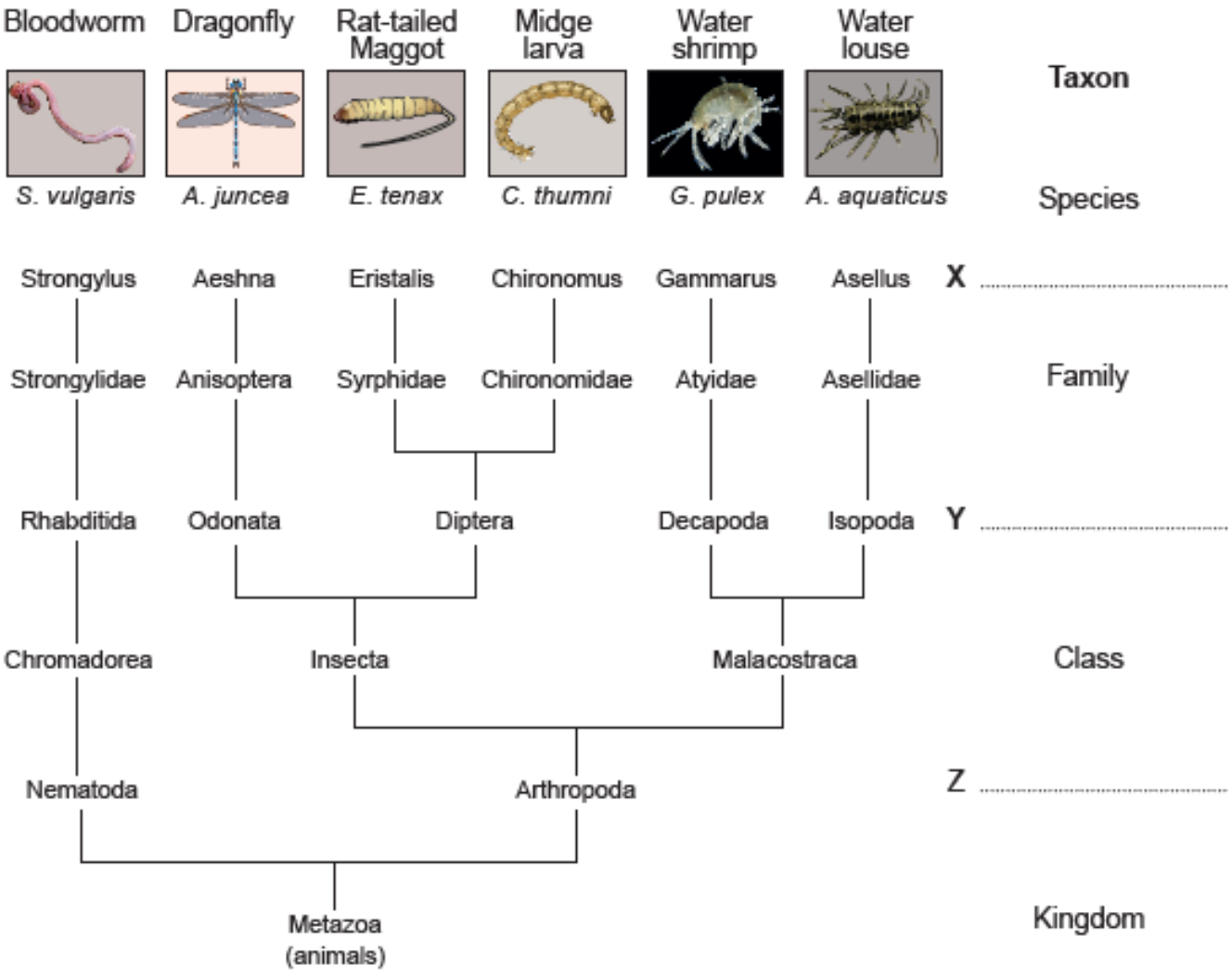
.....

(iii) **Write a letter X** on the phylogenetic tree in Figure 1.2 to show the **most recent** common ancestor of the Eukarya. [1]

Examiner only

(c) The phylogenetic tree in Figure 1.3 shows the evolutionary relationships between some organisms that were caught during a survey of a stream.

Figure 1.3



(i) **Complete Figure 1.3** by writing in the names of the missing taxa **X**, **Y**, Z. [1]

(ii) Using information from the phylogenetic tree in Figure 1.3, place dragonfly, midge larva, bloodworm and water louse in order of how closely related they are to the rat-tailed maggot, from most related to least related. [1]

Rat-tailed maggot

Most closely related .....

.....

.....

Least closely related .....

2 A species of bird called the Monarch flycatcher *(Monarcha castaneiventris)* is found on the Solomon Islands. There are a number of sub-species of this bird which have distinctive plumage colourings and live on different islands.

(a) Explain why they are classified as sub-species and not as separate species. [1]

.....

.....

One sub-species is polymorphic. The undersides of the three forms of the sub-species found on the islands are shown in Figure 2.1

Figure 2.1

chestnut chestnut-black black

(b) In breeding experiments:

- chestnut crossed with black always produced chestnut-black offspring,
- chestnut-black crossed with other chestnut-black produced offspring of all three phenotypes.

Using appropriate symbols, complete the key to identify the alleles involved.
Use these symbols to complete the genetic diagram below to show a cross between two chestnut-black parents and predict the phenotype ratio of the offspring. [4]

Key: Allele for Chestnut colour ..... Allele for Black colour .....

Parental phenotypes:	chestnut-black	x	chestnut-black
Parental genotypes:	.....	x	.....
Gametes:	.....	x	.....

F_1 Genotypes ....

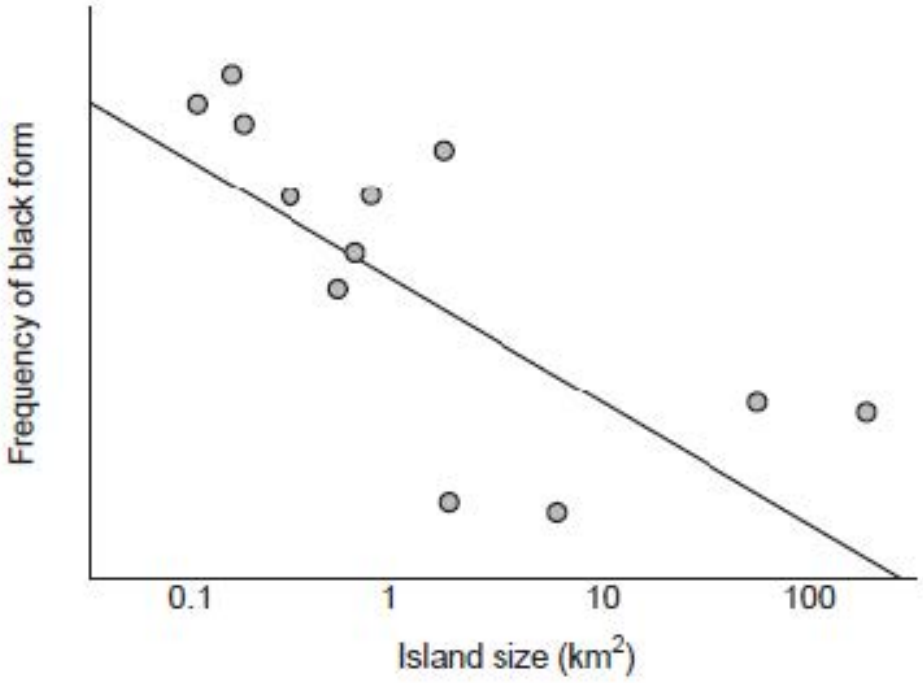
F_1 Phenotypes ....

Phenotype ratio .....

A group of scientists studied the frequency of the black forms on the Russell Islands within the Solomon group.

Their results are shown in Figure 2.2. The island size is shown as a log scale.

Figure 2.2



Monarch flycatchers are known to be territorial and behaviour studies have shown increased aggression in black forms.

(c) State the trend shown on the graph and use the information about the birds' behaviour to suggest a possible mechanism to account for the trend. [3]

.....

.....

.....

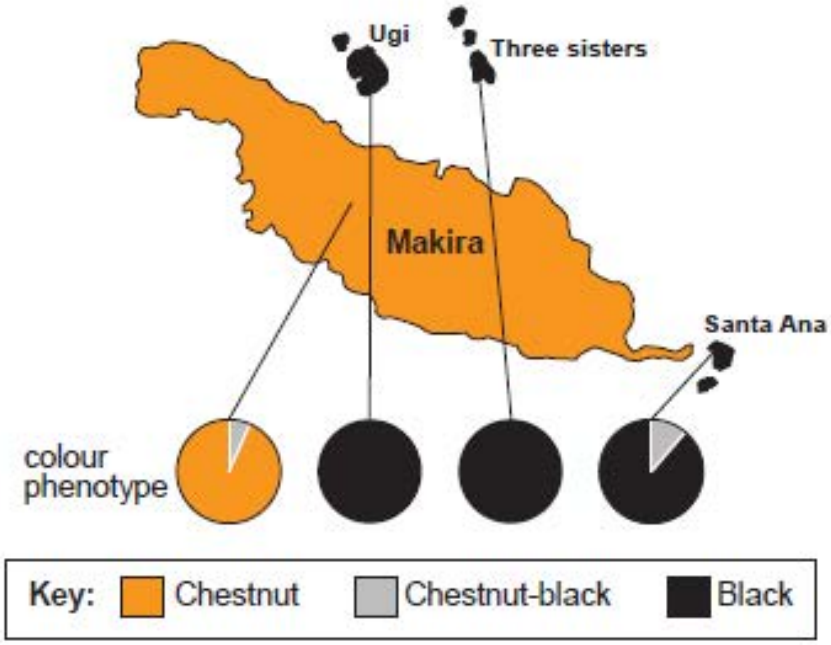
.....

.....

.....

(d) Figure 2.3 shows the distribution of the phenotypes on the southern-most islands of the Solomon group.

Figure 2.3



(i) Explain how the evidence from the phenotype distribution in Figure 2.3 supports your answer from part *(c)*. [1]

.....

.....

(ii) Explain the presence of chestnut-black forms on Santa Ana. [2]

.....

.....

.....

.....

(e) Since the 1950s, nuclear weapons tests have taken place in the South Pacific. Suggest how this might have accounted for the emergence of the black phenotype on the Solomon Islands. [2]

.....

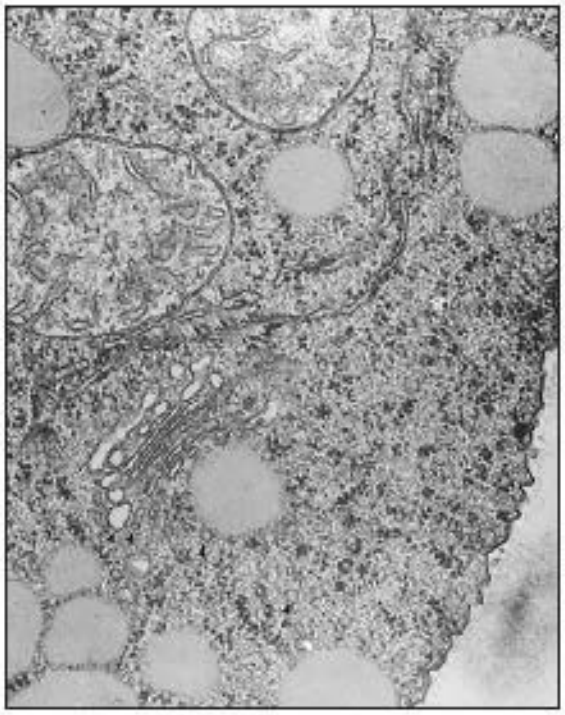
.....

.....

.....

3 The brewing industry relies on biological processes that take place in two organisms, barley and yeast. Figure 3.1 is an electron micrograph showing part of a cell from the aleurone layer of a germinating barley grain.

Figure 3.1



(a) **Complete the table below** by naming the organelles that carry out the following functions. **Label each of the organelles on the photomicrograph** using the letters A and B. [2]

Organelles	Name	Function
A	.....	synthesises proteins
B	.....	packages proteins

In the brewing process the sugars produced by the germinating grains are extracted and are used to provide yeast with their respiratory substrate.

(b) Give the word equation for anaerobic respiration in yeast. Explain why it is less efficient than aerobic respiration for the yeast but essential to the brewing industry. [3]

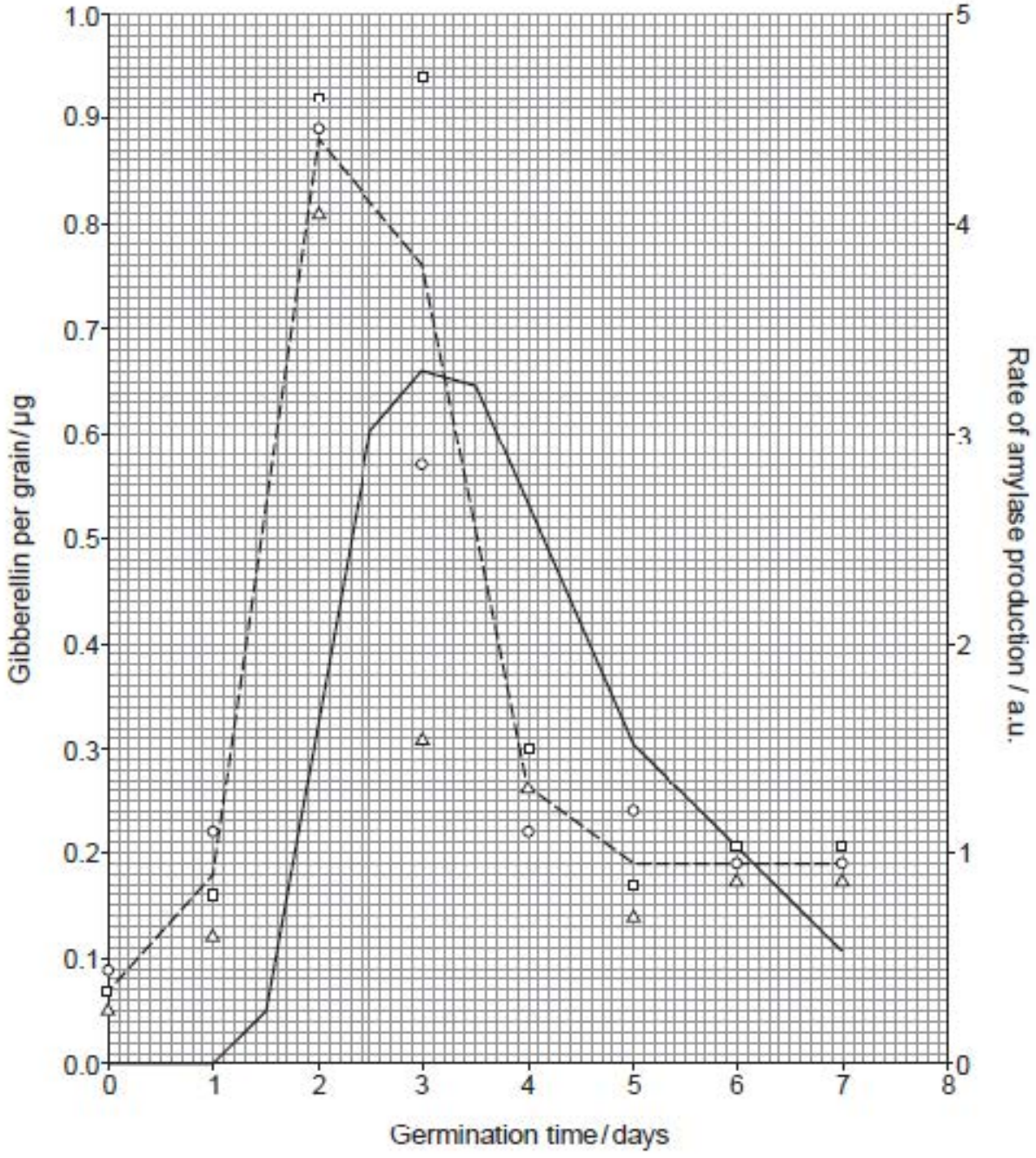
.....

.....

.....

Gibberellin is a hormone which induces the production of amylase. The production and effects of gibberellin on barley germination were studied by three separate teams of scientists. Each team repeated the experiment ten times. Figure 3.2 shows the results of the investigation.
The mean gibberellin production for each team is indicated with a different symbol; team 1. ▫ team 2. ○ team 3. △.
The dashed line indicates the mean gibberellin production for all repeats for all teams.
The solid line indicates the mean rate of amylase production in the barley grains for all repeats for all teams.

Figure 3.2



(c) Reliability has two aspects, repeatability, which describes the variation in the data from one team and reproducibility, which describes the variation in the data between different teams.

(i) State how reproducibility is represented on Figure 3.2 and comment on the reproducibility of the data obtained. [3]

.....

.....

.....

.....

.....

.....

(ii) Name a mathematical value that each team could have calculated to indicate the variability of its results and the aspect of reliability of the experiments that would be assessed by this value. Describe how this aspect could have been improved. [3]

I. mathematical value .....

II. aspect of reliability .....

III. Improvement .....

.....

(iii) Identify a statistical test that could have been used to test if the mean results from teams 1 and 3 were significantly different. [1]

.....

(iv) The solid line on Figure 3.2 shows the rate of production of amylase in the barley grains. Explain what evidence from the graph supports the hypothesis that the production of gibberellin induces the production of amylase. [2]

.....

.....

.....

.....

.....