

BIOLOGY

Standard Level

Wednesday 12 May 1999 (morning)

Paper 3

1 hour 15 minutes

A

Candidate name:	Candidate category & number:										
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%; height: 20px;"></td> <td style="width: 10%;"></td> </tr> </table>										
<p>This examination paper consists of 7 Options. The maximum mark for this paper is 45.</p> <p style="text-align: center;">INSTRUCTIONS TO CANDIDATES</p> <p>Write your candidate name and number in the boxes above.</p> <p>Do NOT open this examination paper until instructed to do so.</p> <p>Answer ALL of the questions from THREE of the Options in the spaces provided.</p> <p>At the end of the examination, complete box B below with the details of the Options answered.</p>											

B

OPTIONS ANSWERED	
Number of extra sheets attached	

C

EXAMINER	TEAM LEADER
/15	/15
/15	/15
/15	/15
TOTAL /45	TOTAL /45

D

IBCA
/15
/15
/15
TOTAL /45

EXAMINATION MATERIALS

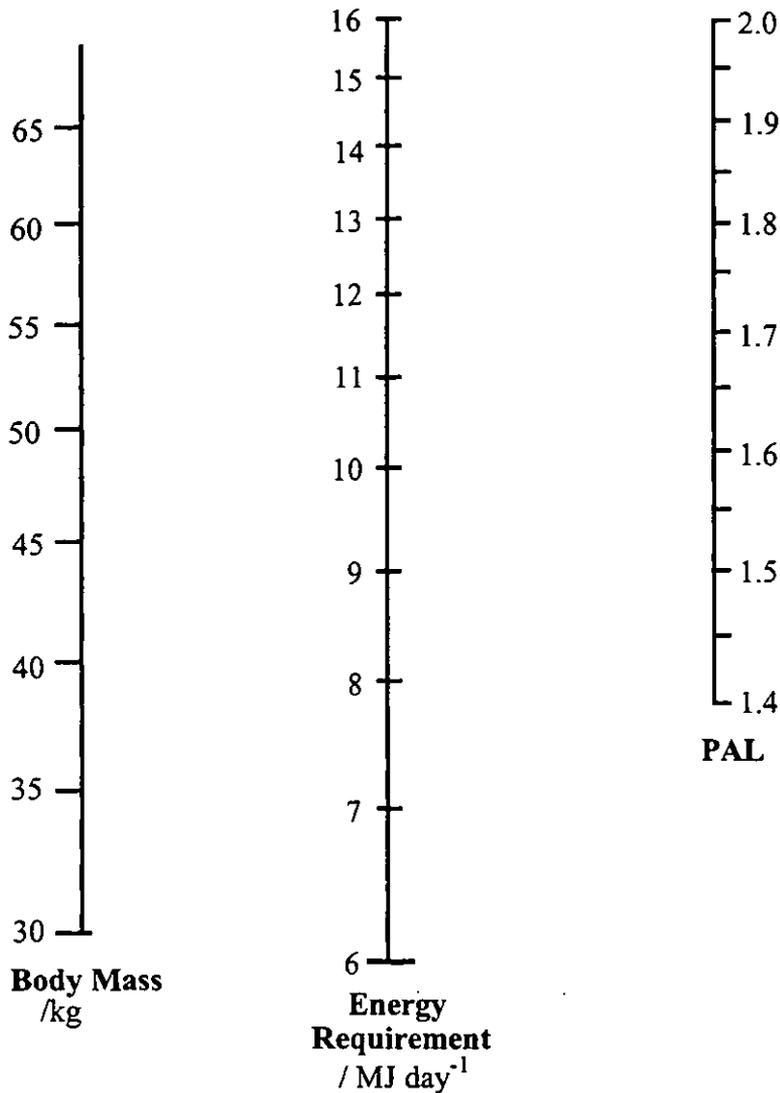
Required:
 Calculator

Allowed:
 A simple translating dictionary for candidates not working in their own language

Option A — Diet and Human Nutrition

A1. Humans vary considerably in the amount of energy that they need in their diet. Two factors which affect the energy requirement are body mass and physical activity. The amount of physical activity carried out can be measured and expressed as a numerical value, PAL (physical activity level). In teenage boys PAL values range from 1.4 (inactive) to 2.0 (extremely active).

The nomogram below can be used to estimate the energy requirements of boys from 10 to 18 years old if their body mass and PAL are known.



- (a) Estimate, using the nomogram, the energy requirement for a boy with
 - (i) a mass of 60 kg and PAL of 1.4 [1]
.....
 - (ii) a mass of 40 kg and PAL of 1.8 [1]
.....

(This question continues on the following page)

(Question A1 continued)

- (b) State the relationship between
 - (i) physical activity level and energy requirement [1]
.....
 - (ii) body mass and energy requirement. [1]
.....

- (c) Suggest **one** reason for the relationship between
 - (i) physical activity level and energy requirement [1]
.....
 - (ii) body mass and energy requirement. [1]
.....

- (d) Predict how the energy requirement of a 10 to 18 year old boy would differ from that of
 - (i) a 10 to 18 year old **girl** with the same mass and PAL as the boy [1]
.....
 - (ii) an adult man with the same mass and PAL as the boy. [1]
.....

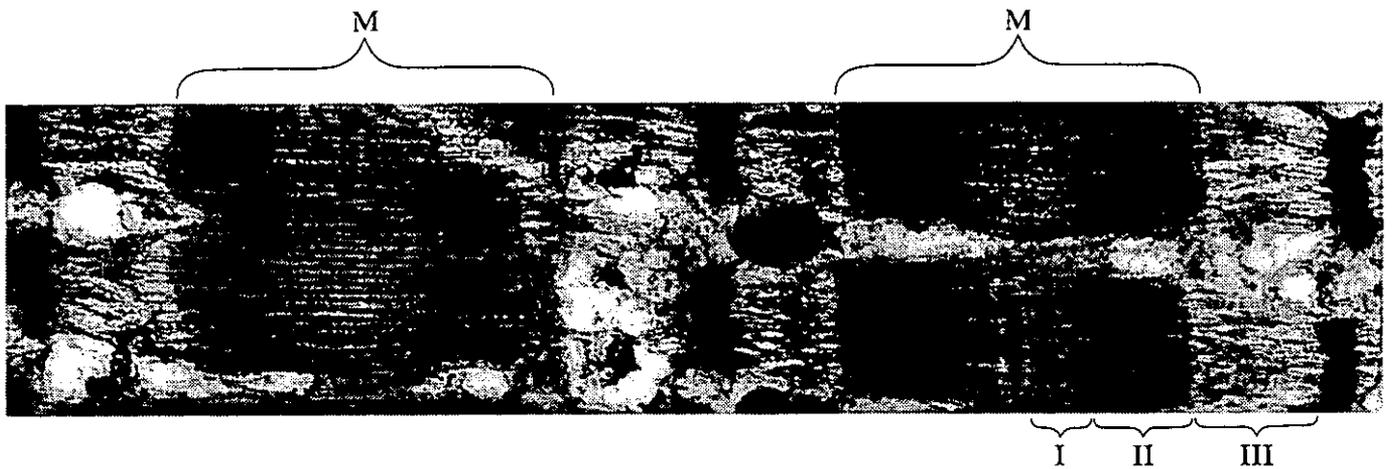
A2. Outline **two** uses of carbohydrates in the human body. [2]
1.
.....
2.
.....

A3. (a) List **two** foods that can be eaten by lactovegetarians but not by vegans. [2]
.....

(b) Discuss the possibility of cyanocobalamin deficiency in the diet of vegans. [3]
.....
.....
.....

Option B — Physiology of Exercise

B1. The electron micrograph below shows part of a myofibril, taken from a skeletal muscle. The parts marked M contain myosin filaments. Three other regions are labelled I, II and III.



[Source: Dr G Newman, EM Unit, University of Wales College of Medicine]

- (a) (i) State **one** type of filament, apart from myosin, which is present in myofibrils. [1]

- (ii) Identify in which of the regions labelled I, II and III these other filaments can be found. [1]

- (b) The myofibril is partly contracted. Deduce which of the regions would increase in length if
- (i) the myofibril contracted more [1]

- (ii) the myofibril relaxed [1]

(This question continues on the following page)

(Question B1 continued)

- (c) The skeletal muscle fibre from which the myofibril in the micrograph was obtained was red in colour. Explain, using this information, what type of muscle fibre it was. [3]

.....
.....
.....

B2. During exercise the body can be injured. One type of injury is a dislocation.

- (a) Outline what happens in a dislocation. [2]

.....
.....
.....

- (b) State the type of structures in the body which normally prevent dislocation. [1]

.....

- B3.** (a) Explain how proprioceptors help control of muscle contraction. [3]

.....
.....
.....
.....
.....

- (b) State precisely which part of the brain controls muscle contraction. [2]

.....
.....

Option C — Cells and Energy

C1. The results of an investigation of photosynthetic pigments in ivy leaves (*Hedera helix*) is shown below.

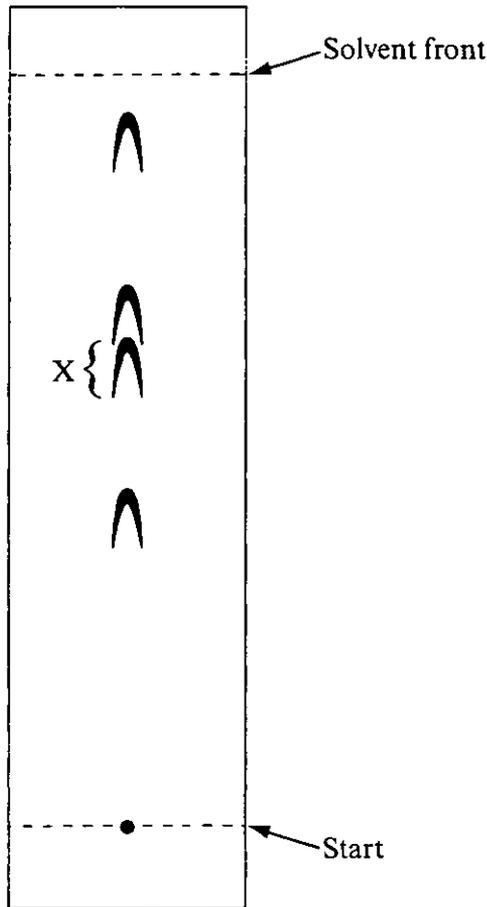


Table of R_f values

Pigment	R_f
carotene	0.95
phaeophytin	0.83
xanthophyll	0.71
chlorophyll <i>a</i>	0.65
chlorophyll <i>b</i>	0.45

(a) Measure the distance travelled by spot X. Answer: [1]

(b) (i) The solvent front travelled 100 mm.

Calculate R_f for spot X, where $R_f = \frac{\text{distance moved by spot}}{\text{distance moved by solvent}}$ [1]

Answer:

(ii) Identify the pigment in spot X using the table of R_f values above. [1]

Answer:

(iii) State one way, apart from R_f values, which could be used to identify the spot X. [1]

.....

(This question continues on the following page)

(Question C1 continued)

- (c) Deduce which of the photosynthetic pigments listed in the table of R_f values was not present in *Hedera helix*. [1]

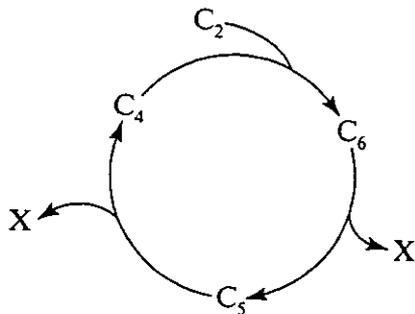
.....

- (d) Suggest **one** advantage to the plant of having more than one photosynthetic pigment. [1]

.....

.....

C2. A simplified version of the Krebs cycle is shown below.



- (a) Deduce which product of the Krebs cycle is shown as X. [1]

.....

- (b) Explain which products of the Krebs cycle are useful. [3]

.....

.....

.....

.....

C3. Some proteins in membranes are used for active transport.

- (a) List **three** other functions of proteins in membranes. [3]

1.

2.

3.

- (b) Explain the reasons for large numbers of vesicles often being found near to the Golgi apparatus of cells. [2]

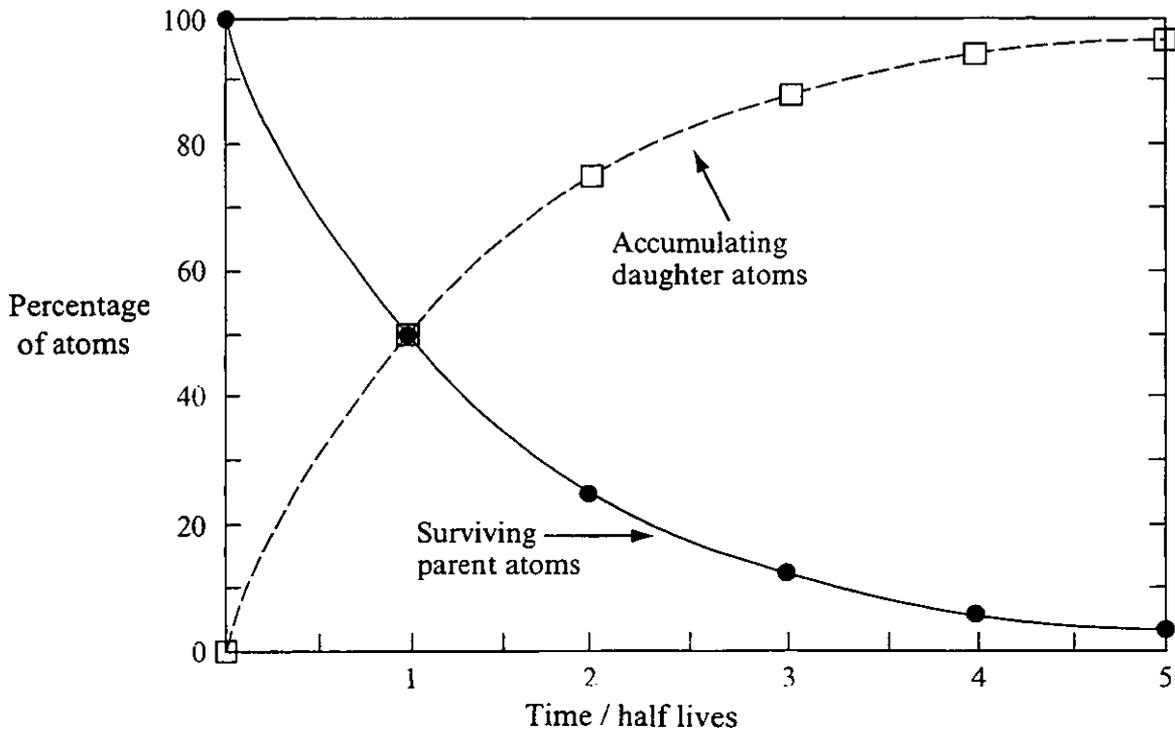
.....

.....

.....

Option D — Evolution

D1. The graph below shows the decay curve for a radioisotope and the curve of accumulation of atoms formed by radioactive decay.



(a) The half life of ^{40}K is 1250 million years. Calculate the percentage of atoms of ^{40}K that remain in a sample 2500 million years after it was formed. [1]

.....
.....

(b) Estimate, using the decay curve, the percentage of ^{40}K atoms that remain 1875 million years after the formation of a sample. [1]

.....
.....

(c) The atom formed by the decay of ^{40}K is ^{40}Ar . Explain how the age of a sample containing equal numbers of ^{40}Ar and ^{40}K atoms can be found using the decay curve. [2]

.....
.....
.....

(This question continues on the following page)

(Question D1 continued)

- (d) Explain, with reference to the decay curve, the reason why $^{40}\text{Ar}/^{40}\text{K}$ ratios cannot be used to obtain accurate ages for specimens that are less than 10 000 years old. [2]

.....

.....

.....

.....

- (e) State the radioisotope that can be used to give accurate ages for specimens less than 10 000 years old. [1]

.....

- D2.** (a) List **two** examples of human characteristics that have developed by cultural evolution. [2]

1

2

- (b) Outline the difference between genetic and cultural evolution. [2]

.....

.....

.....

.....

- D3.** Explain briefly the evidence that supports the endosymbiotic theory of the origin of eukaryotic cells. [4]

.....

.....

.....

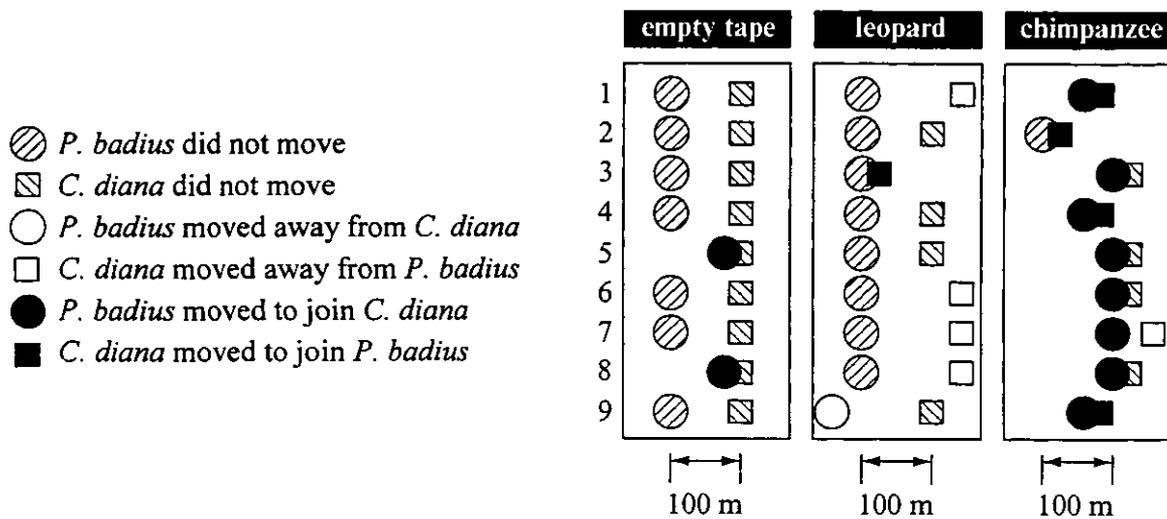
.....

.....

.....

Option E — Neurobiology and Behaviour

E1. Monkeys sometimes form groups containing members of more than one species. This behaviour pattern was observed in the forest of the Tai National Park in the Ivory Coast. The two species involved were *Procolobus badius* (red colobus monkeys) and *Cercopithecus diana* (diana monkeys). Nine groups were found which spent part of the day with the two species separated and part as a mixed species group. An experiment was done to test the hypothesis that these mixed species groups are formed to reduce predation. The nine groups were tested at times when they had divided into separated species groups. A tape recorder was placed at an equal distance from each group and either an empty tape or a recording of the sound made by a monkey predator (leopard or chimpanzee) was played. The movements of the monkeys were measured and are shown in the figures below.



[Source of data: Noë and Bshary, *Proceedings of the Royal Society of London* (1997), 264, pages 253-259]

- (a) (i) State whether *P badius* or *C diana* moved more in response to the sound of the leopard. [1]
.....
- (ii) State which **one** of the three recordings caused the **fewest** mixed species groups to form. [1]
.....
- (b) Compare the movement of the monkeys in response to the sound of the leopard and the sound of the chimpanzee. [3]
.....
.....
.....
.....

(This question continues on the following page)

(Question E1 continued)

- (c) Discuss the evidence from the experiment that mixed species groups are formed in response to the sound of a predator. [2]

.....
.....
.....
.....

- E2. Compare the role of the rods with the role of the cones in the retina. [3]

.....
.....
.....
.....

- E3. (a) Define *operant conditioning*. [1]

.....
.....
.....

- (b) Outline the experiments of Skinner into operant conditioning. [4]

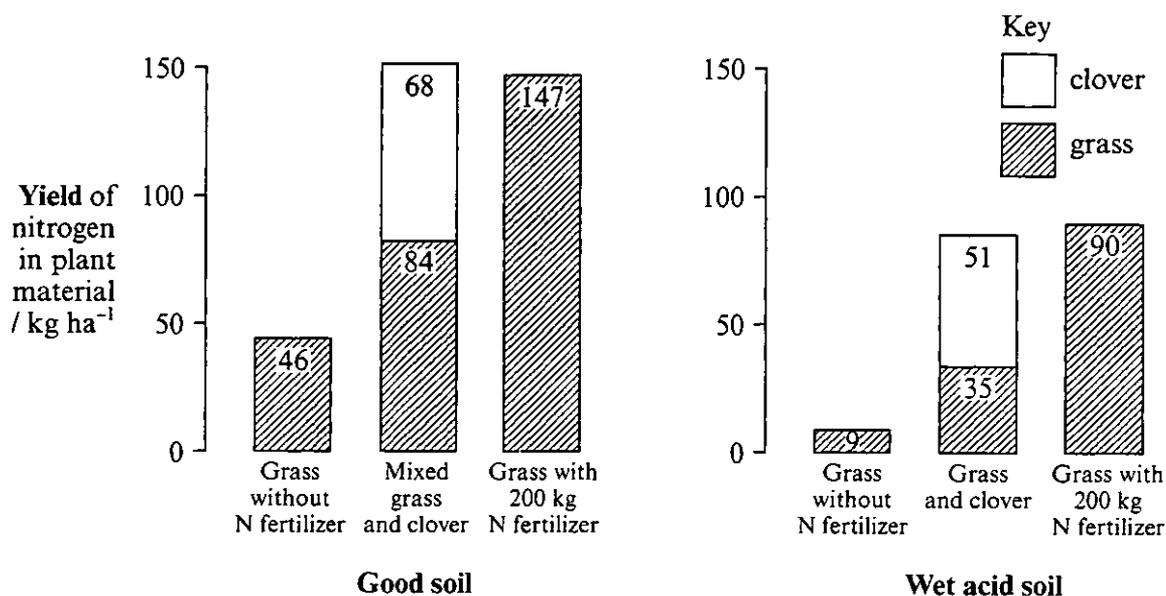
.....
.....
.....
.....
.....

Option F — Applied Plant and Animal Science

F1. In an investigation of growing food for sheep, grass was grown on good soil under the following conditions:

- I. grass without nitrogen fertiliser
- II. mixed grass and clover without nitrogen fertiliser
- III. grass with 200 kg per hectare of nitrogen fertiliser.

The experiment was carried out at the same time on wet acid soil. The yield of nitrogen in the plant material that grew was measured. The results are shown below.



[Source of data: Munro *et al*, *J Br. Grassland Society*, (1974), 29, pages 213-223]

- (a) State whether the yield from grass without nitrogen fertiliser is greater on wet acid soil or on good soil. [1]
.....
- (b) Identify on which soil type nitrogen fertiliser caused
 - (i) the greatest increase in yield from grass [1]
.....
 - (ii) the greatest **percentage** increase in yield from grass. [1]
.....

(This question continues on the following page)

(Question F1 continued)

- (c) Compare the yield from grass and clover grown together on wet acid soil with the yield on good soil. [2]

.....

.....

.....

.....

- (d) Discuss briefly whether a farmer on wet acid soil should grow clover with grass or should use nitrogen fertiliser on grass to increase the amount of nitrogen in plant material for feeding to sheep. [3]

.....

.....

.....

.....

F2. Flowering plants can be commercially produced by methods of vegetative propagation such as the rooting of cuttings.

- (a) Outline how plant growth substances can be used to promote the rooting of cuttings. [2]

.....

.....

.....

- (b) Explain briefly the importance of vegetative propagation in production of flowering plants. [2]

.....

.....

.....

F3. Suggest **three** reasons for the need for international collaboration in solving the world food problem. [3]

1.

.....

2.

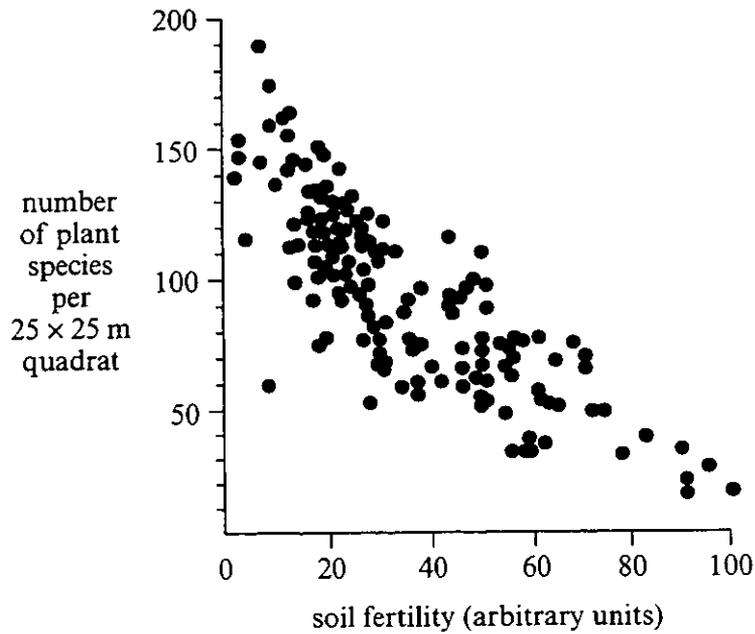
.....

3.

.....

Option G — Ecology and Conservation

G1. In a study of plant species diversity, a large number of forests in Ghana were surveyed. In each forest, soil mineral nutrient content and rainfall were measured and the number of plant species was counted. The scattergram below shows the soil mineral content and number of plant species in each of the forests studied.



[Source of data: Hall and Swaine, *Journal of Ecology*, (1976) 64, 913-951]

(a) Using only the data in the graph,

(i) state the maximum number of plant species found in a 25 m x 25 m quadrat in the forests surveyed;

[1]

.....

(ii) estimate the median plant species diversity;

[1]

.....

(iii) state two differences in number of plant species found in forests with high soil fertility and the number found in forests with low soil fertility.

[2]

1.

.....

2.

.....

(This question continues on the following page)

(Question G1 continued)

(b) The annual rainfall in the forests varies from 900 mm in the driest to 1800 mm in the wettest. There is a **negative** correlation between the rainfall and soil mineral nutrient content in the forests in Ghana.

(i) Suggest a reason for this correlation. [1]

.....
.....

(ii) Predict the relationship between the rainfall and the number of plant species found in these forests. [1]

.....

(iii) Predict whether a similar study of temperate forest would show higher or lower plant diversity. [1]

.....

G2. Draw a simple diagram to show the movement of water in the water cycle. [4]

G3. Discuss the use of environmental monitoring in conservation. [4]

.....
.....
.....
.....
.....
.....