Gold Paper

Question Paper 7

Level	A Level
Subject	Biology
Exam Board	OCR
Paper	Gold Paper
Booklet	Question Paper 7

Time allowed: **77 minutes**

Score: **/57**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

A group of microorganisms called slime moulds includes the species *Dictyostelium discoideum*.

The life cycle of *D. discoideum* is shown in Fig. 5.1.

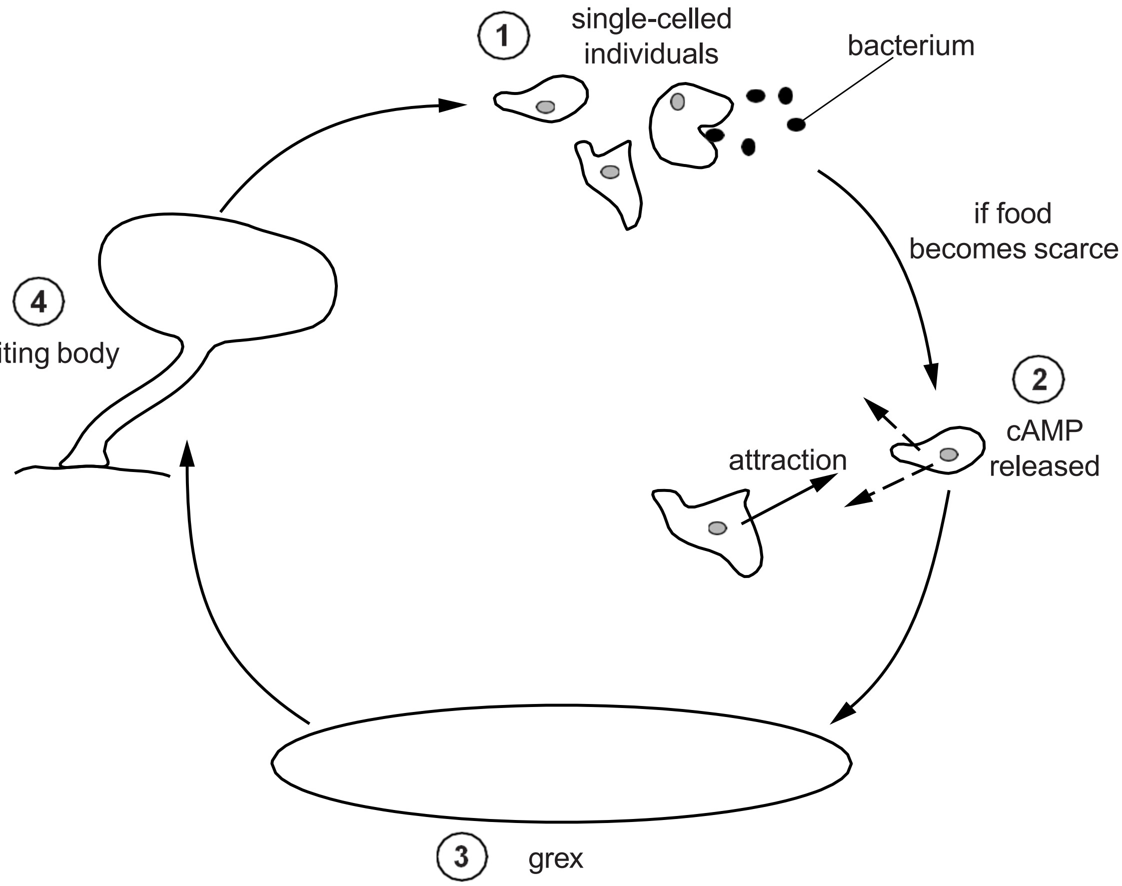

Fig. 5.1

1 When plenty of food is available this slime mould exists as single-celled individuals which feed and reproduce asexually.
The slime mould cells feed on bacteria.
The slime mould cells are attracted to folic acid which has been released by the bacteria.

2 When food becomes scarce the slime mould cells release a chemical (cAMP) which attracts other slime mould cells.

3 The slime mould cells then group and stick together to form a multicellular mass called a grex.
The grex moves in a coordinated way in search of a more suitable environment.
As the grex moves, the cells release the chemical DIF. DIF causes some cells to become stalk cells and others to become spore cells.

4 When the grex reaches suitable conditions, it forms a fruiting body consisting of a stalk and spores.
These spores are released and develop into new, individual, slime mould cells.

(a) (i) Suggest the type of cell division used by *D. discoideum* for reproduction during stage 1 of its life cycle. **[1]**

(ii) At what stage of the life cycle does differentiation begin? **[1]**

(b) Communication and cooperation between cells is essential for the survival of *D. discoideum*.

(i) State the correct term for communication between cells. **[1]**

(ii) Describe **two** examples of communication between cells that occur during the life cycle of *D. discoideum*.

[2]

(iii) The plasma membranes of the slime mould cells are specially adapted for communication.

Using the information on page 12, and your biological knowledge, suggest how the plasma membrane of *D. discoideum* is adapted for cell communication.

[2]

(c) Individual cells of *D. discoideum* can divide once every hour. A grex may consist of 100 000 individual cells.

Calculate how many hours it would take for one cell to produce enough cells to form a grex.

[1]

[Total: 8]

(a) The fruit fly, *Drosophila melanogaster*, the zebra fish, *Danio rerio*, and the mouse, *Mus musculus*, have all been used by scientists to find out more about how genes control development in all animals, including humans. They are described as 'model organisms'.

(i) Suggest why information gained from studying such model organisms can be applied to humans.

[2]

(ii) Suggest **two** characteristics that researchers should look for when choosing an organism for research into how genes control development.

[2]

(b) Fig. 3.1 and Fig. 3.2, **on the insert**, show the heads of two *Drosophila* fruit flies.

Fig. 3.1 shows a normal wild type fly.
Fig. 3.2 shows a mutant fly.

(i) Name the type of microscope used to take the two pictures. **[2]**

(ii) State one significant difference between the two heads. **[1]**

(iii) Name the type of gene which, if mutated, gives rise to dramatic changes in body plan.

[1]

(c) Describe how the information coded on genes is used to synthesise polypeptides **and** how these polypeptides control the physical development of an organism.

In your answer, you should consider both the synthesis of polypeptides and their roles.

[8]

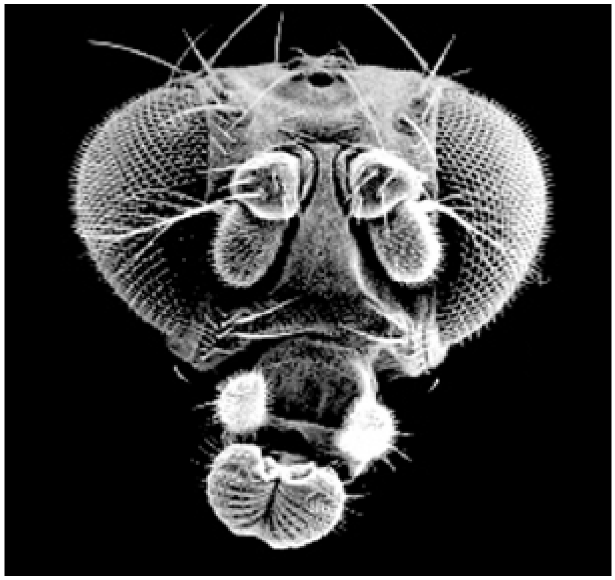

Fig. 3.1

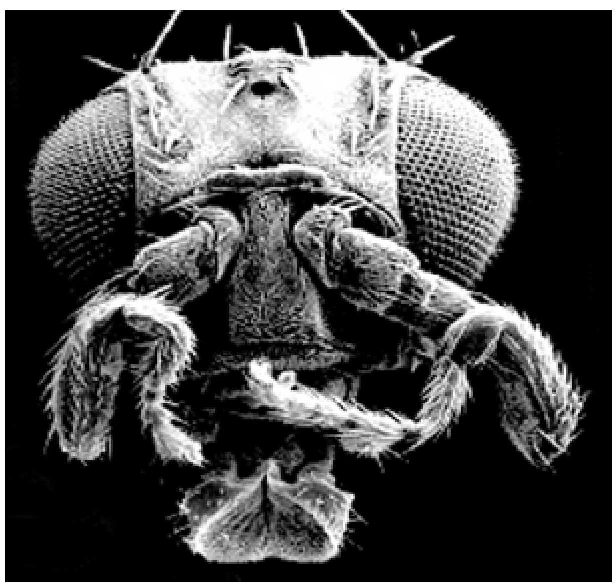

Fig. 3.2

[Total: 16]

The sweet pea plant has been used to study inheritance since the nineteenth century. The seeds of the sweet pea can vary in colour and shape.

The gene that controls colour has two alleles:

- **Y** is dominant and produces yellow seeds.
- **y** is recessive and produces green seeds.

The gene that controls shape has two alleles:

- **R** is dominant and produces round seeds.
- **r** is recessive and produces wrinkled seeds.

(a) In the nineteenth century, Gregor Mendel crossed a pea plant that was heterozygous for both seed colour and shape with a pea plant that had green and wrinkled seeds.

(i) List the gametes that would be produced by a sweet pea plant that was heterozygous for both seed colour and shape. **[1]**

(ii) List the genotypes of the offspring that were produced from Mendel's cross and state the corresponding phenotypes. **[2]**

(b) When Mendel crossed two pea plants that were heterozygous for both seed colour and shape, the ratio of phenotypes in the offspring was:

- 9 yellow round
- 3 green round
- 3 yellow wrinkled
- 1 green wrinkled.

Some students tried to recreate this investigation using a modern variety of plant that showed the same phenotypic variation in seed colour and shape.

The students crossed two of the modern plants that were heterozygous for both seed colour and shape. The results of this cross were:

- 58 yellow and round
- 31 green and round
- 21 yellow and wrinkled
- 2 green and wrinkled

The students used the chi-squared test to compare their data to the expected 9 : 3 : 3 : 1 ratio.

(i) Use the chi-squared formula $\chi^2 = \sum \frac{(O-E)^2}{E}$ to calculate the χ^2 value for these data.

You may use the table below for working out.

..

[3]

Table 17 shows a χ^2 probability table.

Degrees of freedom	Probability (*p*)					
	0.95	**0.90**	**0.10**	**0.05**	**0.025**	**0.01**
1	0.00	0.02	2.71	3.84	5.02	6.64
2	0.10	0.21	4.61	5.99	7.38	9.21
3	0.35	0.58	6.25	7.82	9.35	11.34
4	0.71	1.06	7.78	9.49	11.14	13.28
5	1.15	1.61	9.24	11.07	12.83	15.09
6	1.64	2.20	10.64	12.59	14.45	16.81
7	2.17	2.83	12.02	14.07	16.01	18.48

Table 17

(ii) After analysing the results, the students stated that the inheritance of the seed colour and shape in their investigation was different from that in Mendel's investigation.

Using Table 17, discuss whether the results of the investigation and the chi-squared test support the students' statement.

[3]

(iii) A ratio that is different from the expected 9 : 3 : 3 : 1, in a cross such as this, can be the result of epistasis.

Suggest and explain one reason, **other** than epistasis, why the phenotype ratio might not be 9 : 3 : 3 : 1.

Suggestion

Explanation

[3]

(c) The yellow colour in peas is the result of an enzyme that breaks down chlorophyll, which is green.

- The **Y** allele codes for the production of an enzyme that breaks down chlorophyll.
- The **y** allele is the result of a mutation in the **Y** allele.
- The **y** allele codes for an inactive form of this enzyme.

(i)* Outline how the **Y** allele codes for the production of this enzyme **and** explain why the **y** allele codes for an enzyme with a different primary structure. **[6]**

(ii) With reference to the proteins coded for by the seed colour gene, explain why the **y** allele is recessive. **[1]**

[Total: 19]

Question 4

(a) Glycolysis is the initial stage of cellular respiration.

(i) State **precisely** where in the cell glycolysis occurs. **[1]**

(ii) Outline the process of glycolysis.

In your answer, you should use appropriate technical terms, spelled correctly. **[4]**

(b) Yeast cells can carry out **anaerobic** respiration.

Fig. 5.1 outlines the process of anaerobic respiration in yeast.

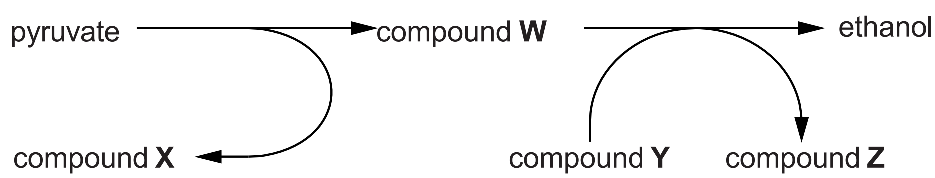

Fig. 5.1

Identify the compounds **W** to **Z**.

[4]

(c) In South-East Asia the main source of commercial sugar is the palm, *Borassus flabellifer*. Sap of this species has a high sugar content. Yeasts and bacteria, however, can contaminate the sap as it is collected and ferment the sugar, producing ethanol. This contamination makes it less suitable as a source of sugar.

A study was carried out to investigate the effect of three treatments traditionally used to reduce fermentation during the collection of the sap. The sap is treated in one of the following ways:

- with a weak alkaline solution (treatment **A**)
- with bark from the tree *Vateria copallifera* (treatment **V**)
- with bark from the tree *Careya arborea* (treatment **C**)

The sap was collected from the palm trees over a 60-hour period. Samples of the collected sap were taken at 15 hour intervals. In each sample, the concentration of alcohol and the number of bacteria were recorded.

The results are shown in Table 5.1.

Treatment	Sample time (hours)	Alcohol concentration (%)	Number of bacteria (10^6 cm^{-3})
Control (no treatment)	15	0.2	19
	30	3.5	800
	45	5.2	2200
	60	2.6	3400
A	15	0.0	3
	30	0.1	4
	45	0.2	5
	60	0.3	7
V	15	0.2	110
	30	1.1	2900
	45	1.2	2400
	60	1.8	2000
C	15	0.4	230
	30	1.1	160
	45	1.3	3
	60	3.6	40

Table 5.1

(i) With reference to Table 5.1, describe the effect of the different treatments on the alcohol concentration of the treated samples compared with the control samples. **[2]**

(ii) Suggest a reason for the difference in alcohol concentration **at 60 hours** between the two bark treatments **V** and **C**.

[1]

(iii) To be used as a source of commercial sugar, the sap needs to be as uncontaminated as possible.

Suggest, with a reason, which of the treatments shown in Table 5.1 would be the best for use with sap so that it is suitable as a source of commercial sugar. **[2]**

[Total: 14]