1 Fig. 4.1 shows a representation of part of a carbohydrate molecule called agarose.

One of the subunits of agarose is a sugar called galactose.

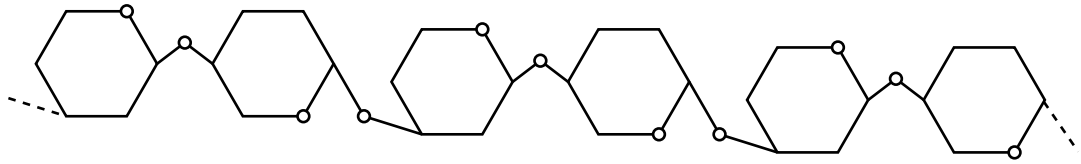

Fig. 4.1

(a) **(i)** Identify the type of carbohydrate molecule of which the carbohydrate agarose is an example.

..... **[1]**

(ii) Starch contains a carbohydrate called amylose. Amylose does not contain galactose.

Using the information in Fig. 4.1, identify **one** similarity and **one further** difference in structure between agarose and amylose.

similarity .....

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difference .....

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..... **[2]**

(b) Agarose forms part of a more complex carbohydrate called agar, which is used as a growth medium for bacteria. Bacteria cannot break down the agarose in agar.

Suggest why bacteria cannot break down agarose.

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..... **[1]**

(c) A student wished to demonstrate experimentally that bacteria cannot break down agarose.

The student used a culture of *E.coli* bacteria which had been grown in a solution containing starch.

Two tubes, **A** and **B**, were set up as follows:

Tube **A**: contained 0.1 cm^3 of the *E.coli* culture and 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Tube **B**: contained 5 cm^3 of a nutrient solution in which agarose was the only carbohydrate.

Both tubes were incubated at 30 °C for 2 hours.

A sample from each tube was then tested for the presence of reducing sugar.

The results are shown in Table 4.1.

Table 4.1

source of sample	conclusion from test
tube **A**	very small amount of reducing sugar present
tube **B**	no reducing sugar present

(i) Explain the purpose of tube **B**.

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..... **[2]**

(ii) The student wrote the following conclusion:

My experiment showed that bacteria must be able to break down agarose. This is because reducing sugar was present in tube ***A***.

Suggest an alternative explanation for the presence of reducing sugar in tube **A** that is **not** consistent with the student's conclusion.

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..... **[1]**

(iii) Suggest **two** ways in which the **reliability** of the experiment could be improved.

1 .....

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2 .....

..... **[2]**

(d) (i) The student did **not** have access to a colorimeter when testing solutions for the presence of reducing sugar.

Describe how the student could carry out a chemical test for reducing sugar **and** suggest how he could estimate the amount of reducing sugar in the sample from tube **A**.

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..... **[5]**

(ii) Another student suggested that the agarose may have been broken down to a **non-reducing** sugar.

Describe how the test for reducing sugar could be modified to investigate this hypothesis.

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..... **[3]**

[Total: 17]

2 Malaria is a disease caused by a eukaryotic parasite.

(a) State **two** features of the malarial parasite that indicate that it is **not** a prokaryote.

1 .....

2 ..... **[2]**

(b) In a piece of word-processed homework, a student stated that one species of parasite that causes malaria is called:

Plasmodium Vivax

State **one** error made by the student.

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..... **[1]**

(c) The malarial parasite is carried by an insect, the female *Anopheles* mosquito.

(i) Describe how the mosquito transmits the malarial parasite to a human.

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..... **[3]**

(ii) In order to fight the spread of malaria, insecticides have been used in areas where the *Anopheles* mosquito breeds.

One problem that can occur when using insecticides in this way is the development of insecticide resistance.

Suggest **one other** reason why some people might be concerned about using insecticides.

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..... **[1]**

(iii) Suggest how the effects of insecticide use on a population of *Anopheles* mosquitoes could be measured **and** state the steps that should be taken in order to produce valid and reliable results.

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..... **[5]**

[Total: 12]

3 Two-spot ladybirds, *Adalia bipunctata*, show a colour polymorphism. They are normally red with two black spots. However, melanic individuals occur which are black with two red spots.

A student investigated the proportion of these colour forms in the ladybird population along a transect going up a hill near his school.

(a) (i) Suggest a suitable technique by which the student might have collected his samples of ladybirds along this transect.

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..... **[1]**

(ii) The student's teacher suggested he should make several transects up the hill rather than just one transect.

Explain why this is good experimental design.

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..... **[1]**

(b) The student's results are shown in Table 7.1.

Table 7.1

height above sea level (m)	total number of red form of ladybird	total number of black form of ladybird
100	93	7
200	78	13
300	71	16
400	54	14

(i) Suggest a method of processing this data to make comparisons between the frequency of the red form and black form of ladybird at the different altitudes more valid.

Explain why your method is an improvement.

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..... **[2]**

(ii) Evaluate whether the student was correct to conclude as follows:

"My data showed a positive correlation between increasing altitude and the frequency of the black form of the ladybird. I therefore concluded that high altitude causes the black form to survive better."

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..... **[3]**

(c) The black, melanic, form of the ladybird is caused by an allele (**B**) that is dominant.

The red form of the ladybird is therefore homozygous recessive at this locus (**bb**).

(i) State what is meant by the term *recessive*.

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..... **[1]**

(ii) The data in Table 7.1 give the total number of the red form of ladybird found as 296, and the total number of the black form of ladybird as 50.

The Hardy-Weinberg principle states that:

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

Use the Hardy-Weinberg principle and the figures given above to calculate the frequency of the dominant allele, p, and the recessive allele, q, in the two-spot ladybird population.

Show each step in your working. **Give your answers to 2 decimal places**.

p = ...

q = ... **[3]**

[Total: 11]

4 **(a)** **(i)** Name the process by which water leaves a cell.

..... **[1]**

(ii) Describe the routes that water molecules take through the **cell surface membrane**.

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..... **[2]**

A student carried out an investigation to determine the effects of different sucrose concentrations on cells from pieces of onion epidermis.

- Strips of epidermis were taken from an onion.
- Separate pieces of epidermis were placed into water and a range of sucrose solutions.
- The pieces of epidermis were left for 30 minutes before being removed.
- The pieces of epidermis were then viewed at high power under the microscope.

The student counted 100 cells from each piece of epidermis. The student noted how many cells had become plasmolysed.

The results are shown in Table 6.1.

Table 6.1

concentration of sucrose solution ($mol\,dm^{-3}$)	water potential of sucrose solution (kPa)	percentage of cells plasmolysed (%)
0.0	0	0
0.1	–260	0
0.3	–860	3
0.4	–1120	7
0.5	–1450	39
0.6	–1800	57
0.7	–2180	83
0.8	–2580	94
1.0	–3500	100

(b) None of the onion epidermis cells this student observed had burst when left in pure water.

Explain why plant cells do not burst when they are left in pure water.

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..... **[2]**

(c) **(i)** The water potential of the onion epidermis cells can be assumed to be the same as the water potential of a solution that causes 50% plasmolysis.

Use the information in Table 6.1 to **estimate the water potential** inside these onion epidermis cells.

..... **[1]**

(ii) Suggest how the student could construct and use a graph to obtain a better estimate of the water potential.

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..... **[2]**

(d) Suggest how the student could modify the procedure to make the results more reliable and accurate.

reliable .....

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accurate .....

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..... **[4]**

[Total: 12]