Access Tuition

A-Level Biology

Y12 Practical Questions

Question Paper

Time available: 87 minutes
Marks available: 72 marks

1. (a) A student investigated a method for estimating the concentration of protein in solution by using a measure of the density of the solutions.

Copper sulfate solutions of different concentration have known densities, so they can be used to measure the density of other solutions.

The student prepared a dilution series of a copper sulfate solution.

Complete **Table 1** by giving all headings, units and volumes required to make 30 cm^3 of the concentration of the copper sulfate solution shown.

Table 1

Concentration of copper sulfate solution / $g\ kg^{-1}$	**Volume of 100 $g\ kg^{-1}$ copper sulfate solution / ____________**	**Volume of water / ____________**
75	____________	____________

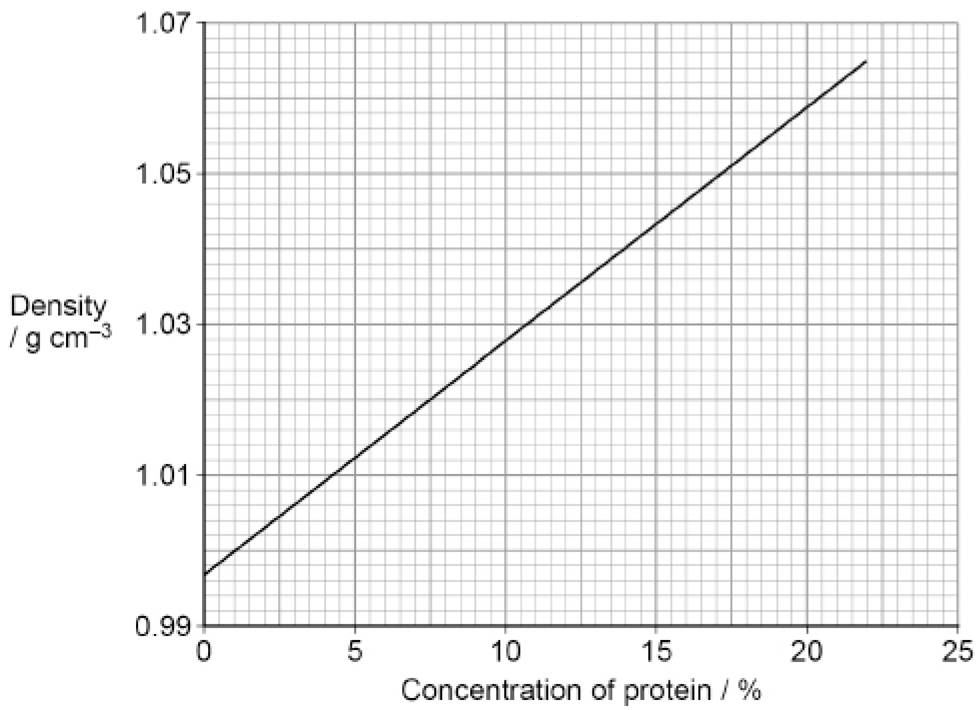
(2)

(b) **Table 2** shows the densities of the dilution series of the copper sulfate solution.

Table 2

Concentration of copper sulfate solution / g kg^{-1}	**Density of solution / g cm^{-3}**
0	0.997
25	1.014
50	1.030
75	1.048
100	1.065

The graph below shows the densities of protein solutions of different concentration.



The student put one drop of 10% protein solution into each of the copper sulfate solutions shown in **Table 2**.

Using the graph, he predicted that the drop would sink in the 0 and 25 g kg^{-1} copper sulfate solutions and float in the 50, 75 and 100 g kg^{-1} copper sulfate solutions.

Give the density of the 10% protein solution **and** explain why the student predicted that the drop would sink in the 25 g kg^{-1} copper sulfate solution.

Density of 10% protein solution ______________________________ g cm^{-3}

Explanation ____

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(2)

(c) State the range of possible concentrations of a protein solution that sinks in 75 g kg^{-1} copper sulfate solution and floats in 100 g kg^{-1} copper sulfate solution.

Minimum concentration ____________________ %

Maximum concentration ____________________ %

(1)

(d) Blood donation involves healthy donors giving blood that can be used to treat hospital patients.

When donors arrive, the haemoglobin concentration of their blood is tested.

A sample of each donor's blood is added to a copper sulfate solution to determine whether the haemoglobin concentration is high enough to donate.

Errors sometimes occur with this test.

Tom has a concentration of haemoglobin high enough to donate.

Lucy has a concentration of haemoglobin too low to donate.

Evaluate the consequences of errors occurring when Tom's and Lucy's blood samples are tested.

Consequences of measurement error for Tom's blood ________________________

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Consequences of measurement error for Lucy's blood ________________________

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(3)

(Total 8 marks)

2. (a) *Clostridium difficile* is a bacterial species that causes disease in humans.

Antibiotic-resistant strains of *C. difficile* have become a common cause of infection acquired when in hospital.

Explain how the use of antibiotics has led to antibiotic-resistant strains of bacteria becoming a common cause of infection acquired when in hospital.

(3)

(b) Scientists suggested that factors, other than antibiotic use, led to the increase in antibiotic-resistant *C. difficile* infections. One suggested factor is people eating more trehalose in their diet.

Trehalose is a disaccharide formed from two glucose molecules.

Name another disaccharide formed from two glucose molecules.

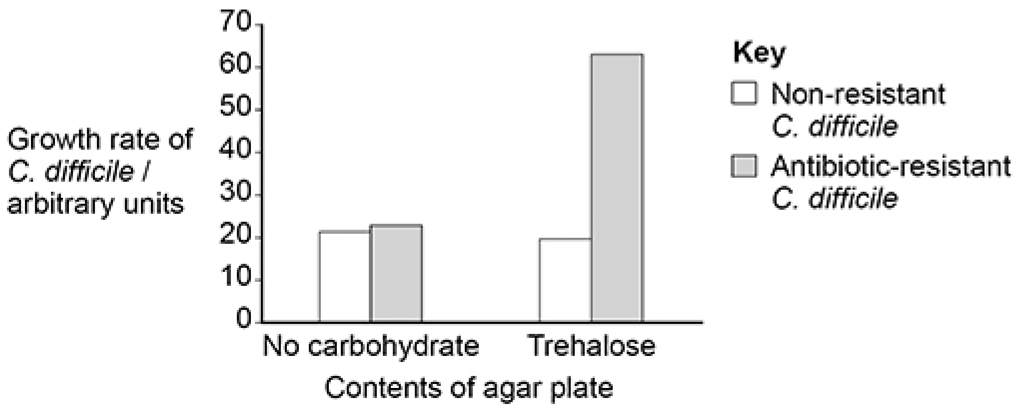
(1)

Scientists investigated the effect of trehalose on the growth rate of *C. difficile*.
They grew populations of non-resistant and antibiotic-resistant *C. difficile* on separate agar plates with:

- no carbohydrate added
- trehalose added.

They measured the growth rate of the *C. difficile*.

The graph below shows the scientists' results.



(c) Describe how the scientists could use aseptic techniques to transfer 0.3 cm^3 of *C. difficile* in liquid culture from a bottle onto an agar plate.

(3)

(d) Use the graph above to evaluate whether more trehalose in the diet could be a factor in the increased number of antibiotic-resistant *C. difficile* infections.

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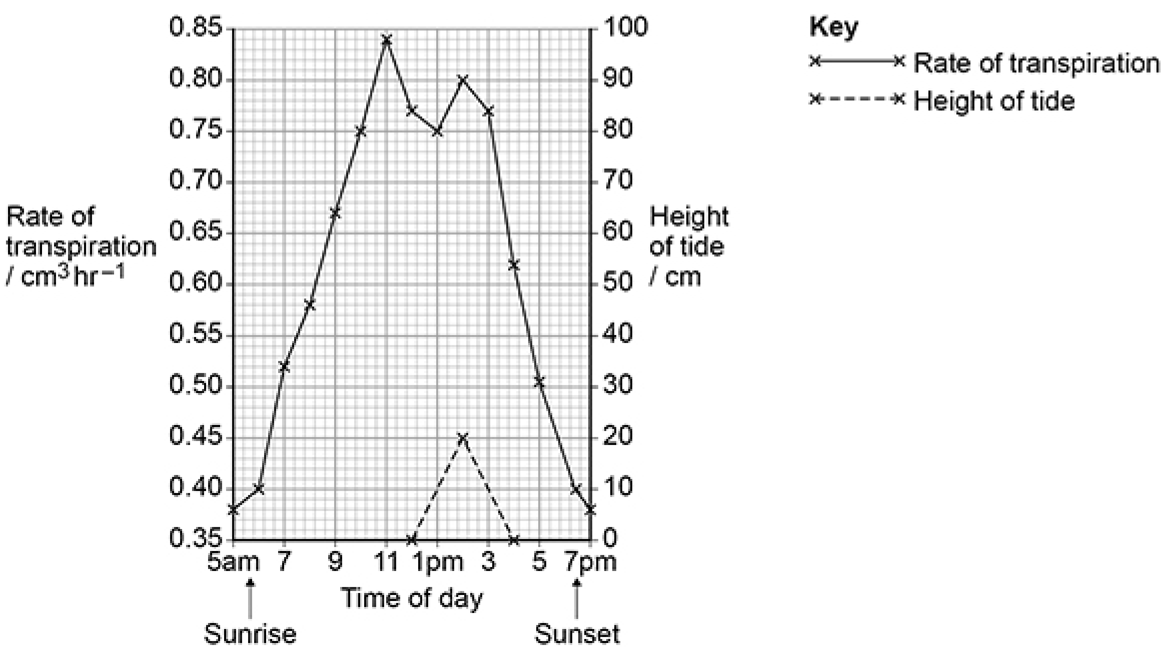
(3)

(Total 10 marks)

3. Mangrove trees grow near the sea. Sea water surrounds the lower parts of the trees at high tide.

Scientists investigated the rate of transpiration in a mangrove tree.

The figure below shows the scientists' results.



(a) Explain the rate of transpiration between 5 am and midday shown in the figure above.

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(4)

(b) Use the figure above to calculate the percentage increase in the rate of transpiration from 1 pm to 2 pm.

Percentage increase in rate of transpiration ________________ %

(2)

(c) The higher rate of transpiration at high tide shows that the mangrove tree is absorbing water from the sea water surrounding its roots.

Describe an experiment that you could do to investigate whether the mangrove root cells have a lower water potential than sea water.

You are given:

- a piece of fresh mangrove root
- sea water
- access to laboratory equipment.

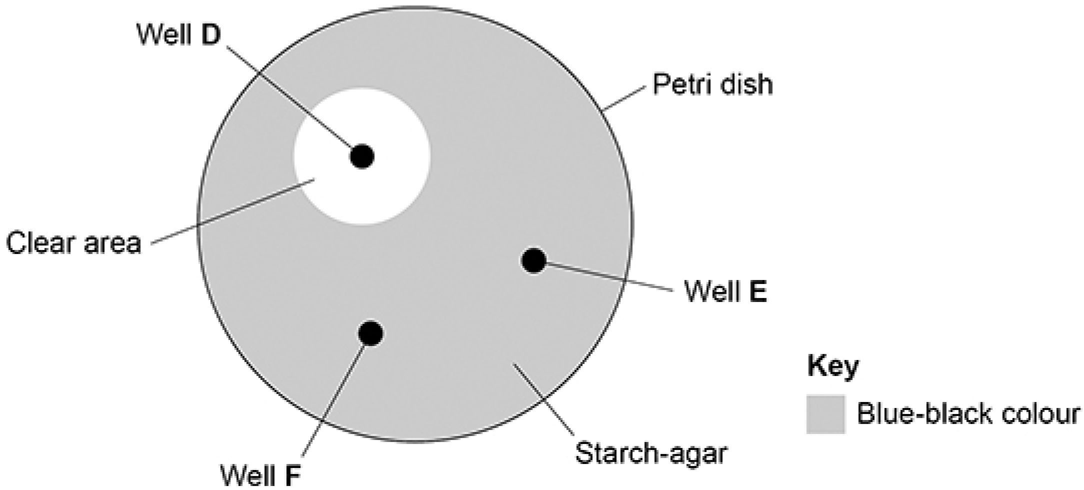
(4)

(Total 10 marks)

4. A student investigated the activity of the enzyme amylase. He cut three identical wells (**D**, **E** and **F**) in starch-agar in a Petri dish. He added 0.2 cm^3 of:

- amylase solution to well **D**
- boiled amylase solution to well **E**
- water to well **F**.

After 60 minutes, he covered the starch-agar with iodine solution. The figure below shows his results.



(a) Explain the appearance of the agar in the clear area surrounding well **D**.

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(2)

(b) What can you conclude about the activity of amylase from the appearance of the agar surrounding well **E** and well **F** in the figure above?

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(2)

(c) The student cut out a piece of agar from the clear area surrounding well **D**. He obtained a solution of the substances contained in this piece of agar.

Describe a different biochemical test the student could use with this solution to confirm that amylase had affected the starch in the clear area surrounding well **D**.

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(2)

The diameter of the clear area around well **D** is 18 mm

In a different investigation, the student prepared a dilution of the amylase solution. He did this by mixing amylase solution and water in the volumes shown in the table below.

Amylase solution / cm^3	**Water / cm^3**
1.6	2.4

He prepared a starch-agar Petri dish identical to the figure above, but with a single well. He added 0.2 cm^3 of the diluted amylase solution to this well and left the Petri dish for 60 minutes.

(d) Use all of this information to predict the diameter of the clear area that will form around the well containing the diluted amylase solution.

Give your answer to the nearest whole number.

Show your working.

Answer ___________ mm

(2)

(e) The student used a ruler to measure the diameter in mm of the clear area around well **D** in the figure above.

Use this information to explain why the answer to part (d) should be given to the nearest whole number.

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(1)

(Total 9 marks)

5. A coral reef is an underwater ecosystem formed as a ridge of mainly calcium carbonate deposits. Algae are photosynthesising organisms. Some algae grow on coral reefs. Succession results in a wide variety of fish living on coral reefs.

(a) Describe a method that could be used to determine the mean percentage cover of algae on a coral reef.

Do **not** include information on the difficulties of using your method underwater.

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(3)

(b) Explain how succession results in a wide variety of fish living on coral reefs.

Do **not** describe the process of succession in your answer.

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(2)

Ecologists investigated the effect of two fish species, the redband parrotfish and the ocean surgeonfish, on algal growth on an artificial reef. They made this artificial reef by submerging many large concrete blocks at a depth of 16–18 metres off the coast of Florida. They attached four large wire cages, **A**, **B**, **C** and **D**, to each block and populated the cages as shown.

A – No fish

B – Two redband parrotfish

C – Two ocean surgeonfish

D – One redband parrotfish and one ocean surgeonfish

After 34 weeks, the ecologists measured the mean percentage cover of all algae within each set of wire cages. The ecologists used a statistical test to find out whether the mean for each set of cages was significantly lower than the mean for set **A**.

The table below shows the probability (P) values that the ecologists obtained using this statistical test.

Set of cages	P value
B	=0.841
C	<0.001
D	=0.634

(c) Using all the information, evaluate the effect of the two fish species on algal growth on coral reefs.

(5)

(Total 10 marks)

6. (a) A student used a dilution series to investigate the number of cells present in a liquid culture of bacteria.

Describe how he made a 1 in 10 dilution and then used **this** to make a 1 in 1000 dilution of the original liquid culture of bacteria.

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(3)

(b) Using an optical microscope, the student determined there were 15 cells in 0.004 mm^3 of the 1 in 1000 dilution of the culture.

Calculate the number of cells in 1 cm^3 of undiluted liquid culture.

Answer = ____________________ Number of cells

(2)

(c) The student looked at cells in the 1 in 10 dilution during his preliminary work. He decided **not** to use this dilution to determine the number of cells in the undiluted liquid culture.

Suggest an explanation for the student's decision.

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(2)

(d) On some farms, animals are routinely given antibiotics in their food.

Scientists investigated whether these farm animals had antibiotic-resistant bacteria in their intestines. They tested the bacteria for resistance to two antibiotics, tetracycline and streptomycin.

Their results are shown in the table.

Antibiotic	**Percentage of antibiotic-resistant bacteria**
Tetracycline	29
Streptomycin	13

Suggest and explain **one** reason why bacteria resistant to tetracycline are more common than bacteria resistant to streptomycin in these farm animals.

(2)

(e) In recent years, these farm animals have not been given tetracycline in their food. Despite this, the percentage of bacteria resistant to tetracycline has remained constant.

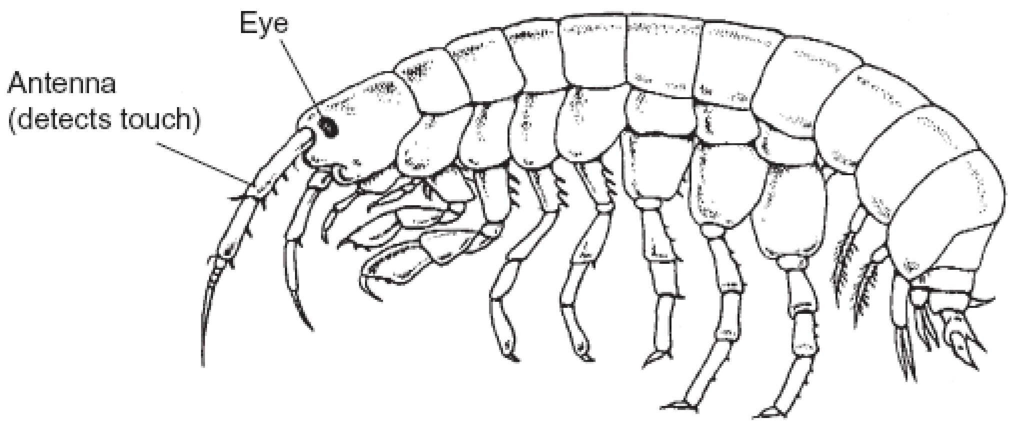
Suggest **one** reason why.

(1)

(Total 10 marks)

7. **Figure 1** shows a fresh-water shrimp.

Figure 1



Biologists collected shrimps from a stream inside a cave and from the same stream when it was in the open.

They measured the maximum diameter of each shrimp's eye. They also measured the length of its antenna. From these measurements they calculated the mean values for each site. **Figure 2** shows their results.

Figure 2

	Shrimps from the stream	
	Inside the cave	In the open
Mean diameter of eye /mm	0.09	0.24
Mean length of antenna /mm	8.46	5.81

(a) The biologists measured the maximum diameter of each shrimp's eye.

Explain why they measured the **maximum** diameter.

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(1)

(b) A scientist working many years earlier suggested that animals which live in caves had similar adaptations. These adaptations included

- smaller eyes
- greater use of sense organs such as those involved in detecting touch.

(i) Do the data in **Figure 2** support this scientist's suggestion? Explain your answer.

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(2)

(ii) The data in **Figure 2** are mean values. Explain how standard deviations of these cmean values would help you to interpret the data in **Figure 2**.

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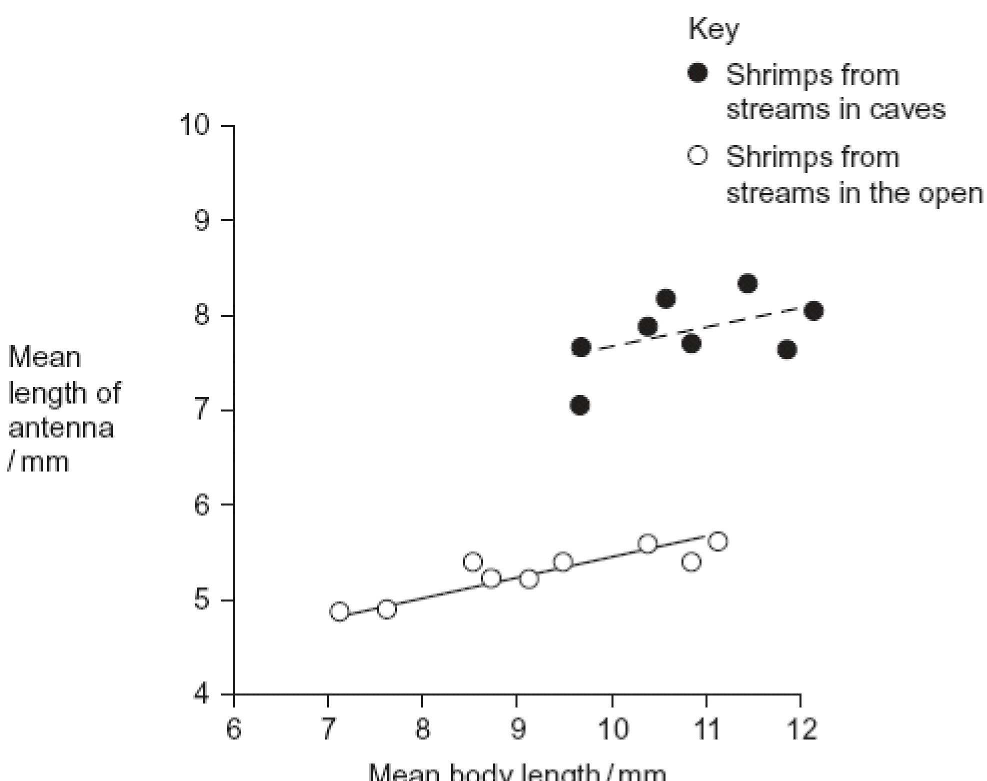
(2)

(c) The biologists investigated shrimps living in other streams. They measured the length of the antennae of these shrimps. They also measured their body length. **Figure 3** shows the mean antenna length plotted against mean body length for each site.

Figure 3



(i) What does the information in the graph suggest about the body lengths of shrimps living in caves and living in the open?

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(2)

(ii) Do the data in the graph support the conclusion that shrimps with longer bodies have longer antennae? Give the reason for your answer.

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(1)

Other biologists investigated the genetic diversity of these shrimps. **Figure 4** shows some of the data they collected.

Figure 4

Gene	**Allele**	**Percentage of shrimps with this allele in steam**	
		Inside a cave	**In the open**
PGI	**A**	0.9	2.5
	B	0.0	3.3
	C	98.2	66.4
	D	0.9	6.6
	E	0.0	21.3
ACO2	**J**	0.0	5.6
	K	0.0	76.7
	L	100.0	17.8

(d) The biologists concluded that the shrimps in the open had a higher genetic diversity than those in the cave. Explain how the data in **Figure 4** support this conclusion.

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(1)

(e) The percentage of shrimps with allele **L** in the cave is different from the percentage of shrimps with allele **L** in the open. Use your knowledge of the founder effect to suggest a reason for this difference.

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(3)

(f) The biologists who studied these shrimps wanted to know if the shrimps living in the cave were the same species as those living in the open. They used breeding experiments to investigate this.

(i) Describe how the biologists should carry out these breeding experiments.

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(ii) The results of breeding experiments would help the biologists to decide whether the shrimps were the same species. Explain how.

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(3)

(Total 15 marks)