

4 (a) (i) Ions have a number of important roles in living organisms.

Complete the table below by identifying the ion that plays each of the roles. Choose from the following list.

$\text{NH}_4^+$	$\text{Cl}^-$	$\text{H}^+$	$\text{OH}^-$	$\text{PO}_4^{3-}$	$\text{Ca}^{2+}$
<b>Important role</b>			<b>Ion</b>		
Production of nitrate ions by bacteria			$\text{NH}_4^+$		
Loading of phloem					
DNA structure					
Cofactor for amylase					

[2]

(ii) Dissolved ions diffuse between blood plasma and tissue fluid.

Pressure differences at the arterial and venous ends of capillaries are responsible for the formation of tissue fluid. The following measurements were made in one capillary:

- Net hydrostatic pressure at the arterial end was 4.6 KPa
- Net oncotic pressure was -3.0 KPa
- Net hydrostatic pressure at the venous end was 2.3 KPa.

Use this information to explain the movement of fluid in and out of a capillary.

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(b) Copper (II) ions act as irreversible non-competitive inhibitors of the enzyme catalase.

(i) Describe how a non-competitive inhibitor works to inhibit the activity of an enzyme.

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(ii) Catalase is found in all living things that are exposed to oxygen. It protects cells from oxidative damage by breaking down hydrogen peroxide to water and oxygen.

Catalase is a useful biomarker of oxidative stress in fish exposed to water contaminated with copper ions.

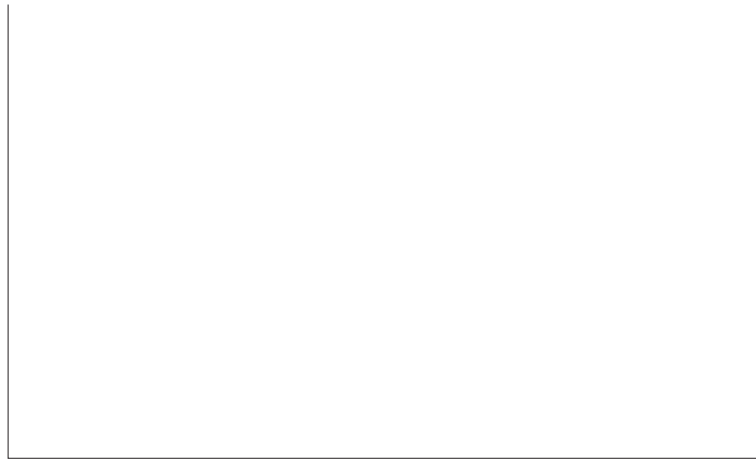
A group of students carried out an experiment to explore the effects of copper sulfate on the action of catalase. They measured the activity of catalase exposed to different concentrations of copper sulfate.

The results of their experiment are shown in Table 4.

Concentration of copper sulfate (moles dm <sup>-3</sup> )	Volume of oxygen gas produced (cm <sup>3</sup> )
0.00	14.50
0.05	10.50
0.10	7.55
0.15	5.80
0.20	4.20

**Table 4**

In the space provided below, **sketch** a graph of the results in Table 4.



[2]

(iii) What can the students conclude from their results?

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(iv) Three rivers in the Himalayan foothills were polluted with copper, which affected the aquatic wildlife. Scientists were provided with one dead Indian Barb fish, *Esomus danricus*, from each of the rivers.

Scientists were unable to take a direct measurement of the copper ion concentration in the fish.

Using the information provided in 4(b)(ii), suggest how the scientists could use the fish tissue to compare the copper ion pollution in the three rivers.

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