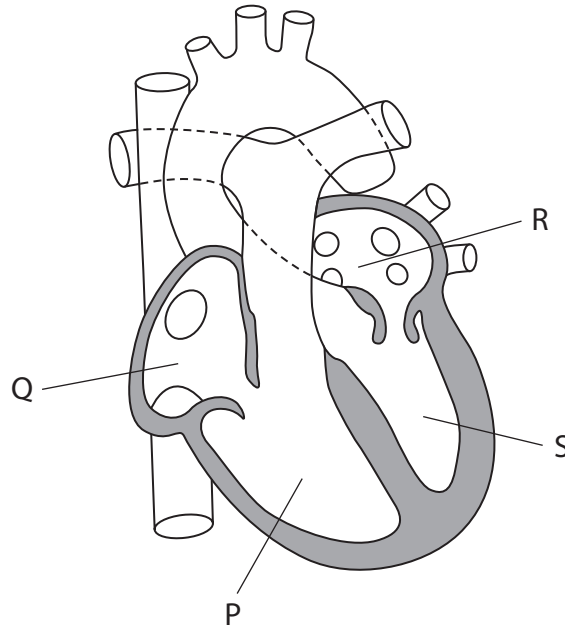


Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 The diagram shows part of the internal structure of a human heart.



(a) (i) How many of the following statements about the human heart are correct?

- structures P and S fill with deoxygenated blood when structures Q and R contract
- structure R receives blood from the pulmonary vein
- when the cardiac muscle walls of P and S undergo diastole, blood leaves the heart and enters the aorta and pulmonary artery

(1)

- A none
- B one
- C two
- D three

(ii) Complete the diagram to show the location of the semilunar valve in the pulmonary artery.

(1)



(iii) Describe the role of this semilunar valve in the cardiac cycle.

(3)

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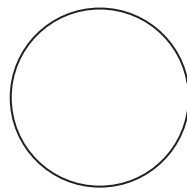
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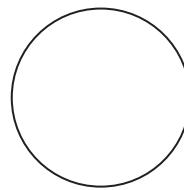
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(b) The diagrams show a cross-section of an aorta and a vena cava.



aorta



vena cava

(i) Complete the diagrams to show the relative sizes of the lumens.

(1)

(ii) Which of the following would be in contact with the blood in an undamaged vena cava?

(1)

- A collagen
- B endothelial cells
- C epithelial cells
- D smooth muscle cells

(Total for Question 1 = 7 marks)



P 7 4 4 7 2 A 0 3 3 2

2 The photograph shows red, white and pink snapdragon flowers.

Plants with genotype $F^R F^R$ have flowers with red petals.

Plants with genotype $F^W F^W$ have flowers with white petals.



(Source: © Irina Kryvasheina/Alamy Stock Photo)

(a) Deduce why heterozygous snapdragon plants produce flowers with pink petals.

(3)

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(b) (i) Two snapdragon plants with genotype F^{RW} were crossed.

Determine the probability of each petal colour in the offspring of this cross, using a genetic diagram.

(3)

Petal colour	Probability
Pink	
Red	
White	

(ii) There were 416 plants produced from this cross.

Predict how many of these plants will have flowers with white petals.

(1)

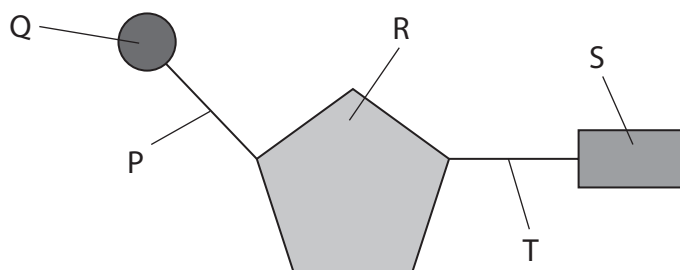
(Total for Question 2 = 7 marks)



P 7 4 4 7 2 A 0 5 3 2

3 Nucleic acids are involved in protein synthesis.

(a) The diagram shows the structure of a nucleotide.



(i) Which labelled structure would contain the element phosphorus?

(1)

- A P
- B Q
- C R
- D S

(ii) Structure R is different in a DNA nucleotide compared with an RNA nucleotide.

Name structure R in a DNA nucleotide and in an mRNA nucleotide.

(1)

DNA nucleotide

mRNA nucleotide

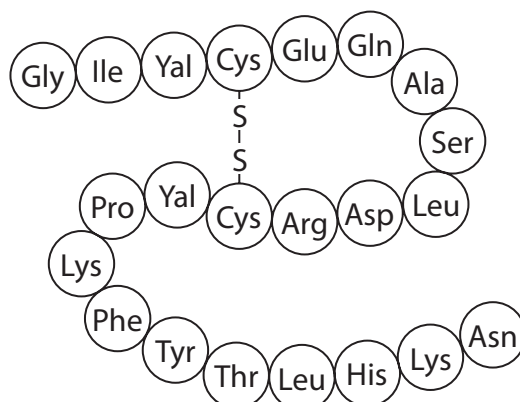
(iii) Which of the following bases would be found in a DNA nucleotide, but not in an RNA nucleotide?

(1)

- A Adenine
- B Cytosine
- C Guanine
- D Thymine



(b) The diagram shows a polypeptide chain.



(i) Which row shows the correct type of monomer and the type of reaction that joins the monomers together?

(1)

	Monomer	Type of reaction
<input type="checkbox"/> A	amino acid	condensation
<input type="checkbox"/> B	amino acid	hydrolysis
<input type="checkbox"/> C	fatty acid	condensation
<input type="checkbox"/> D	fatty acid	hydrolysis

(ii) Which of the following types of bond are involved in forming the tertiary structure of a protein?

(1)

- A disulfide bridge, ester bond and ionic bond
- B disulfide bridge, hydrogen bond and ionic bond
- C disulfide bridge, ester bond and hydrogen bond
- D disulfide bridge, glycosidic bond and hydrogen bond



(iii) Describe the role of RNA in the formation of this polypeptide chain.

(4)

Area with horizontal dotted lines for writing the answer.

(Total for Question 3 = 9 marks)

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4 Red blood cells contain haemoglobin.

(a) Oxygen molecules enter red blood cells and bind to haemoglobin.

Glucose molecules can also enter red blood cells.

The table gives some information about these molecules.

Molecule	Properties
Glucose	large, polar molecule
Oxygen	small, non-polar molecule

Describe how oxygen and glucose molecules can enter red blood cells.

(2)

Oxygen.....

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Glucose.....

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(c) Haemolysis is the breaking open of a red blood cell, causing the release of haemoglobin.

The effect of concentration of three different alcohols on the haemolysis of red blood cells was investigated.

Samples of red blood cells were treated with different concentrations of three alcohols.

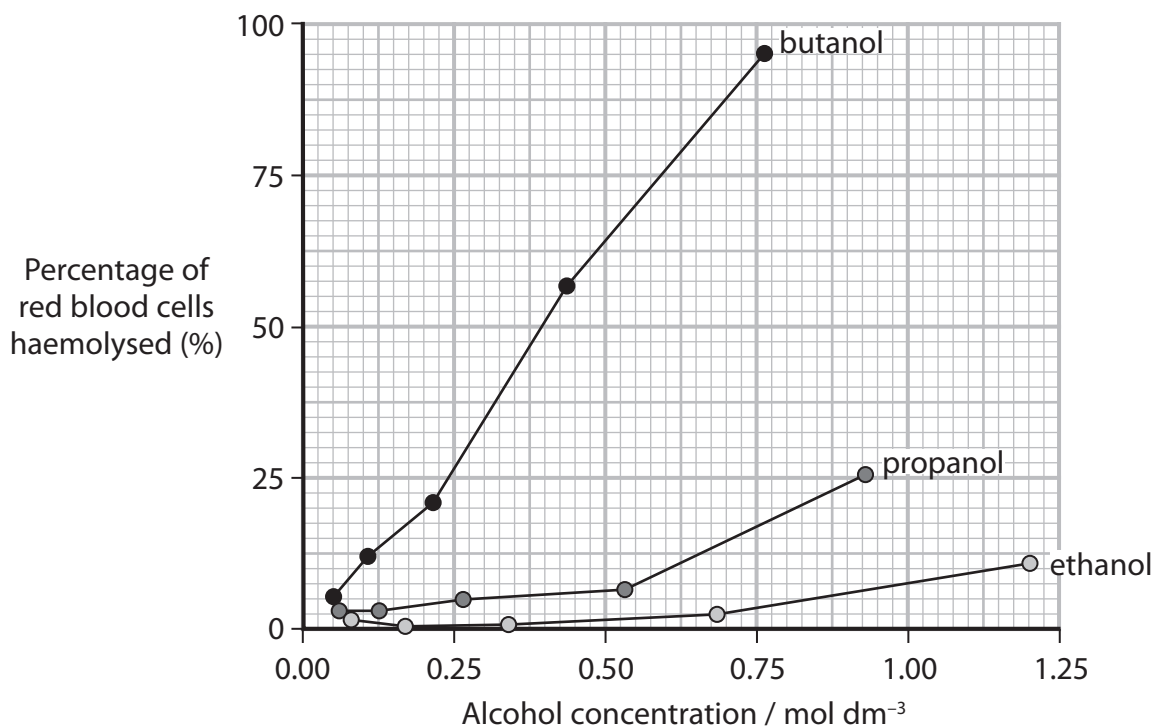
The table shows the formulae of the alcohols.

Alcohol	Formula
Ethanol	$\text{CH}_3\text{CH}_2\text{OH}$
Propanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
Butanol	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

A microscope was used to count the number of intact red blood cells.

The investigation was repeated twice.

The mean percentage of red blood cells that had haemolysed was calculated, and the results are shown in the graph.



(i) State and justify a suitable control for this investigation.

(2)

(ii) Evaluate the effect of concentration of the three alcohols on the haemolysis of red blood cells.

(4)

(Total for Question 4 = 11 marks)

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6 The effect of enzyme concentration on the rate of reaction was investigated.

Starch is a polysaccharide.

(a) Which of the following statements about polysaccharides is correct?

(1)

- A** starch contains amylose, a straight chain containing 1,6 glycosidic bonds
- B** glycogen contains amylopectin, a branched chain containing both 1,4 and 1,6 glycosidic bonds
- C** polysaccharides containing both 1,4 and 1,6 glycosidic bonds allow a rapid release of energy
- D** starch and glycogen are both soluble in water

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P 7 4 4 7 2 A 0 1 7 3 2

*(i) Explain how to carry out a valid investigation to collect the data shown in the table.

(6)

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7 Obesity indicators, such as body mass index (BMI), can be used to assess the risk of a person developing coronary heart disease (CHD).

(a) The table shows categories of BMI.

BMI	Classification
Less than 20	underweight
20–24.9	normal
25–29.9	overweight
30–40	obese
Greater than 40	severely obese

A man has a body mass of 65 kg.

He has a normal BMI.

Calculate the minimum and maximum possible heights for this man in metres.

Use the formula

$$\text{BMI} = \frac{\text{mass}}{(\text{height in m})^2} \tag{2}$$

minimum height m

maximum height m



P 7 4 4 7 2 A 0 2 1 3 2

(b) One risk factor for coronary heart disease (CHD) is obesity.

The table shows the incidence of CHD for people with a differing number of risk factors.

Number of risk factors	Incidence of CHD per 100 000 people
0	60
1	130
2	210
3	615

(i) Describe the relationship between the number of additional risk factors and the incidence of CHD.

(2)

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(ii) State **one** risk factor for CHD other than obesity.

(1)

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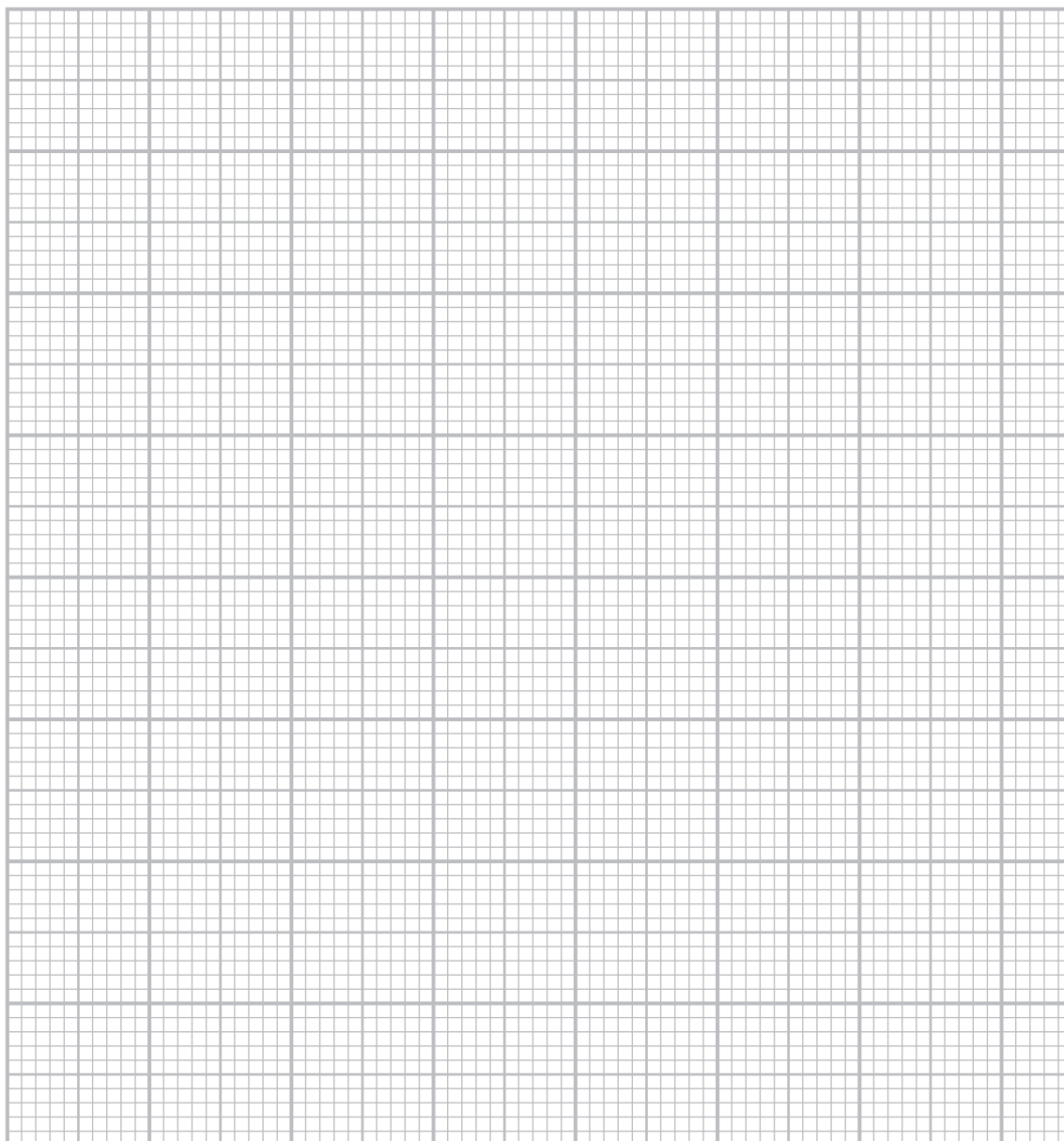
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(c) The table shows the number of deaths due to CHD in three countries.

Country	Number of deaths per 100 000	
	Men	Women
England	240	110
France	100	20
Russia	700	200

Plot these data in a suitable graphical form.

(4)



(d) Atherosclerosis is a type of cardiovascular disease (CVD) that causes the narrowing of coronary arteries.

(i) How many of the following types of medication would reduce the risk of CVD?

(1)

- anticoagulants
- antihypertensives
- statins

A none

B one

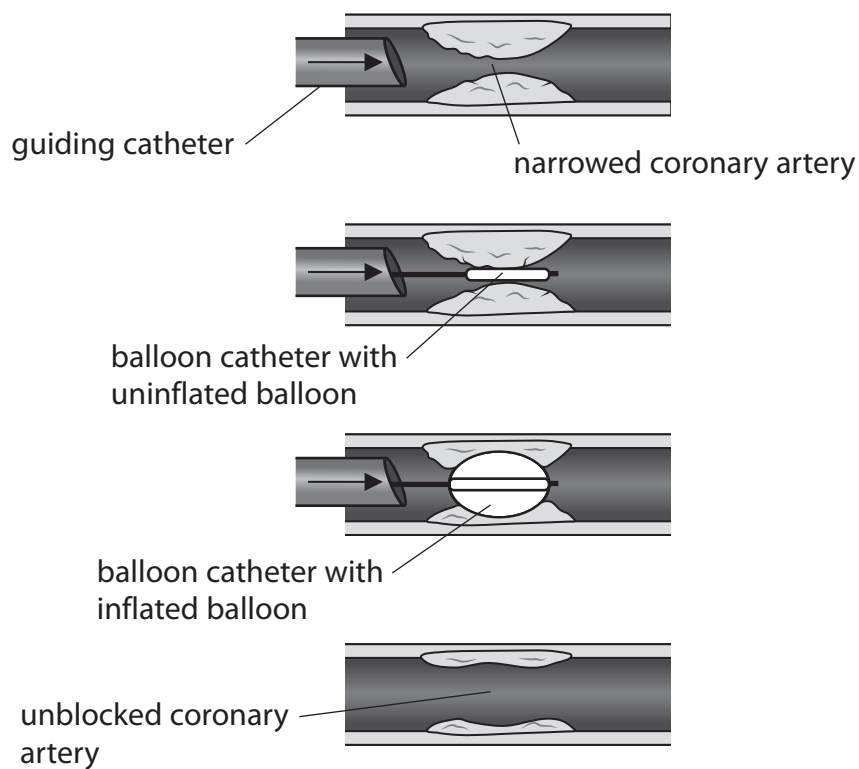
C two

D three

The diagram shows a procedure called balloon angioplasty.

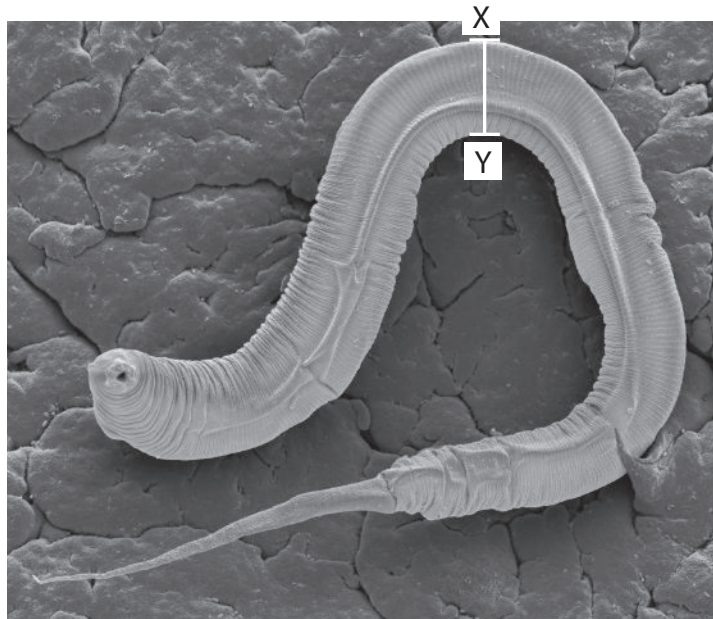
Balloon angioplasty can reduce the immediate risk of a person having a heart attack.

It will not prevent further narrowing of coronary arteries due to atherosclerosis.



8 Some organisms do not have a circulatory system.

The photograph shows the nematode *Caenorhabditis elegans*, as seen using an electron microscope.



Magnification $\times 1300$

(Source: © Science Photo Library/Alamy Stock Photo)

(a) (i) Calculate the actual width of the nematode from X to Y.

(2)

Answer μm

(ii) Explain why this nematode does not need a circulatory system.

(2)

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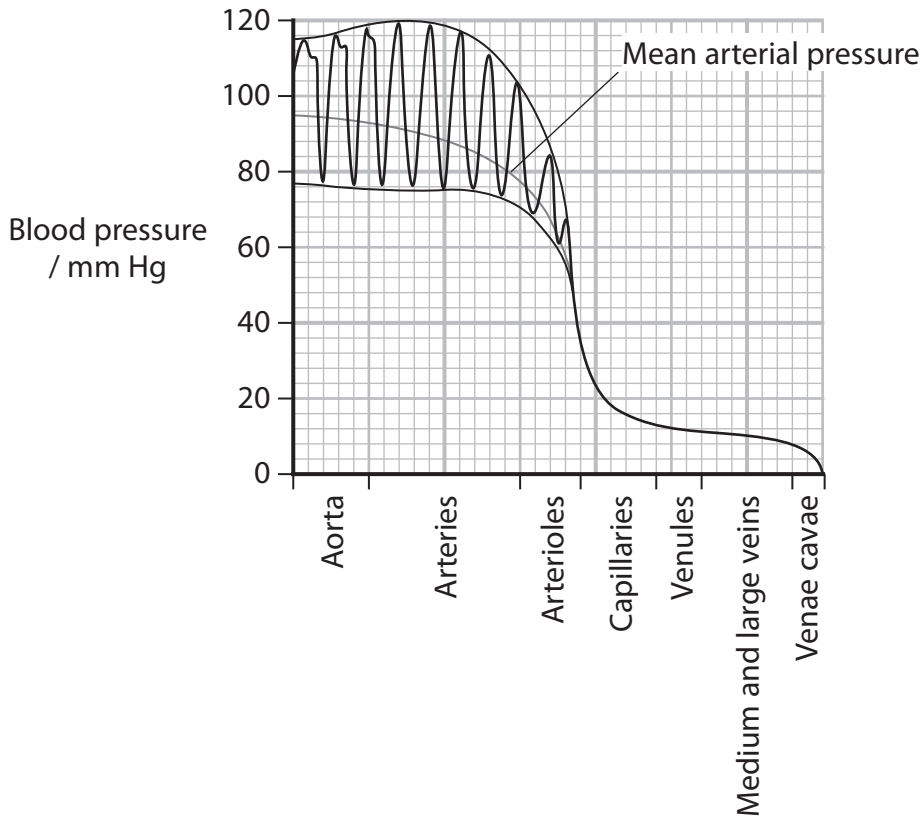
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(b) Humans have a circulatory system.

The graph shows the change in blood pressure in different human blood vessels.



(i) Explain why the blood pressure increases and decreases in the aorta.

(2)

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(ii) Calculate the percentage decrease in blood pressure as blood travels through the capillaries.

Give your answer to two significant figures.

(2)

Answer %



P 7 4 4 7 2 A 0 2 7 3 2

(c) The squid is an invertebrate animal that lives in the sea.

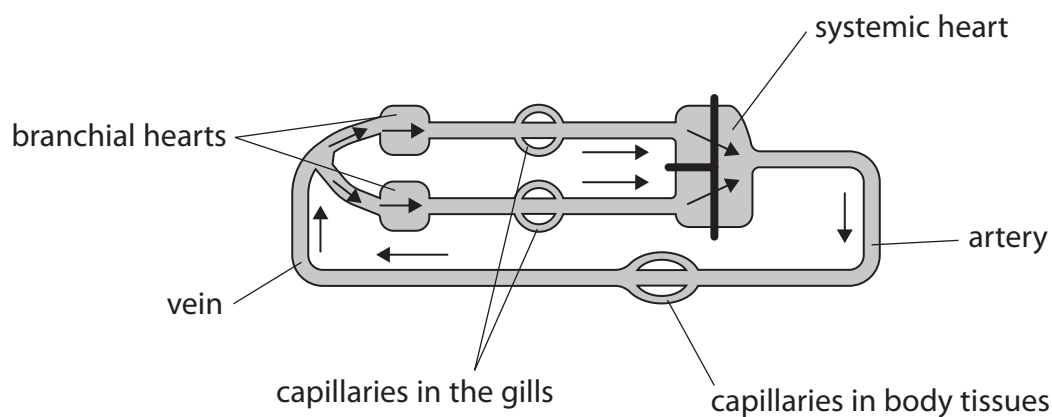
The photograph shows a squid.



(Source: © bonchan/Shutterstock)

The diagram shows the circulatory system of a squid.

The gills contain gas exchange surfaces.



(i) Compare and contrast the circulatory systems of a squid and a human.

(3)

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