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**International**
**Advanced Level**

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# Biology

## Advanced Subsidiary
## Unit 1: Lifestyle, Transport, Genes and Health

Monday 9 October 2017 – Morning
**Time: 1 hour 30 minutes**

Paper Reference
**WBI01/01**

**You must have:**
Calculator, HB pencil, ruler

Total Marks

### Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

### Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

### Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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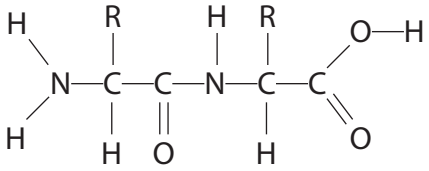
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**Answer ALL questions.**

**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** A dipeptide is formed from two amino acids joined together.

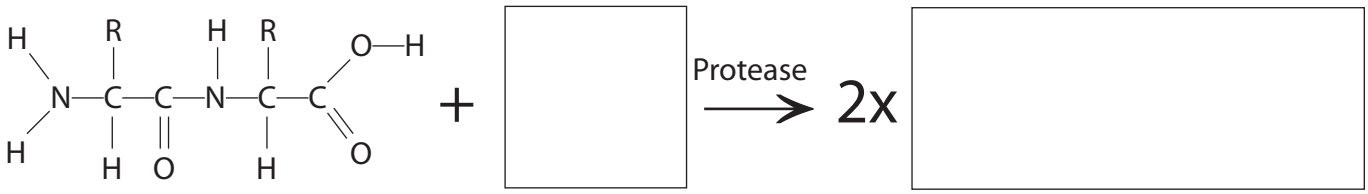
The diagram below shows a dipeptide.



Proteases are enzymes that break down dipeptides.

(a) Complete the diagram to show this reaction.

**(2)**




(b) Name this type of reaction.

**(1)**

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(c) Name the bond being broken in this reaction.

**(1)**

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(d) Explain how proteases catalyse the breakdown of dipeptides.

**(2)**

**(Total for Question 1 = 6 marks)**

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**2** In mammals, gas exchange takes place in the lungs.

(a) Put a cross ☒ in the box to complete the following sentence.

Oxygen can diffuse through cell membranes because

**(1)**

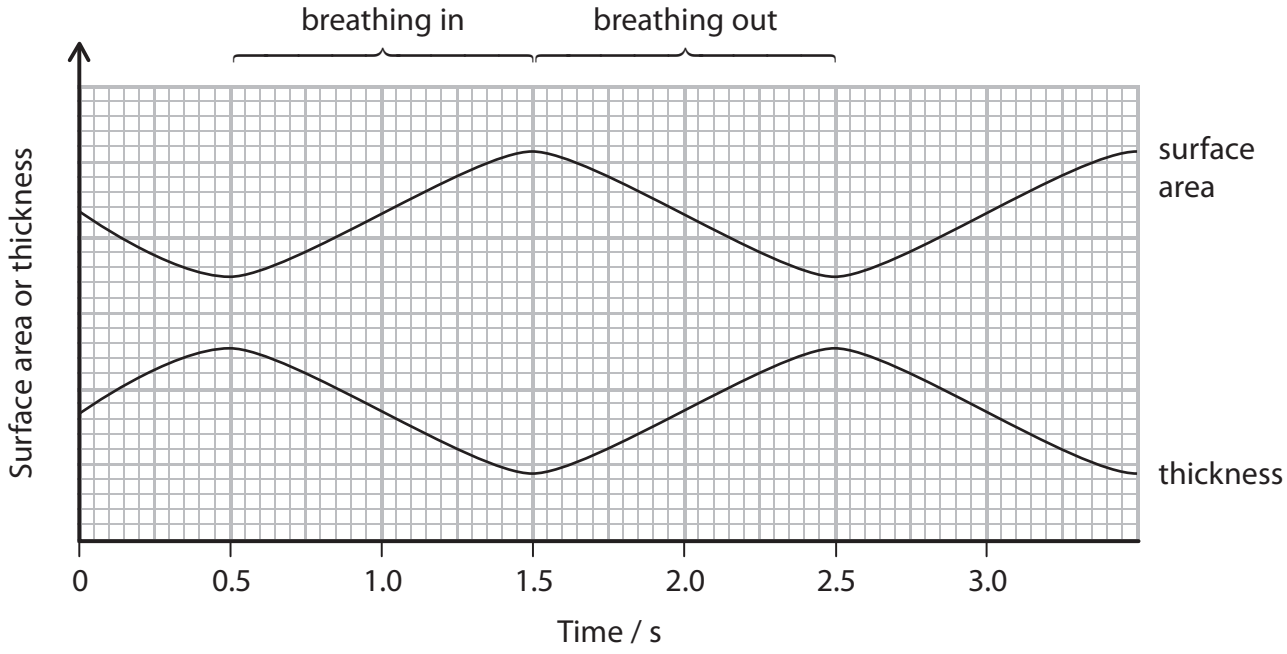
☒ **A** cell membranes contain carbohydrate

☒ **B** cell membranes contain cholesterol

☒ **C** oxygen is a non-polar molecule

☒ **D** oxygen is a polar molecule

(b) The graph below shows changes in surface area and thickness of the gas exchange surface during breathing.




(i) Name the part of the lung through which gas exchange occurs.

**(1)**

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(ii) Put a cross ☒ in the box to complete the following sentence.

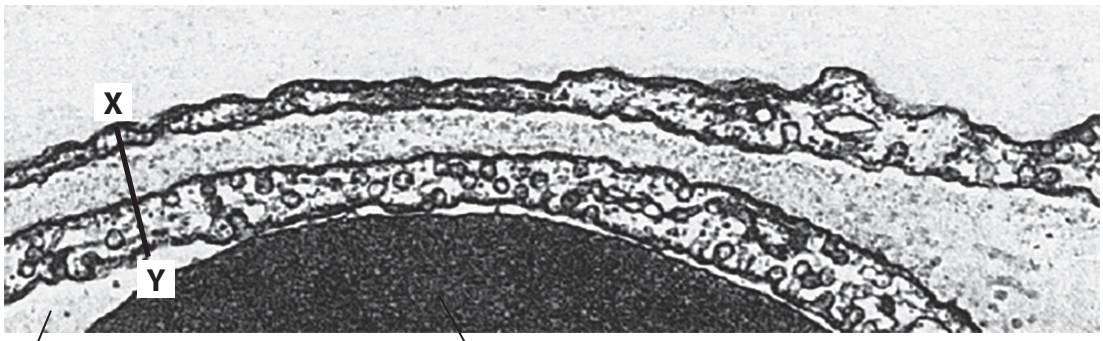
The rate of diffusion of oxygen across the gas exchange surface will be greatest at

**(1)**

- ☒ **A** 1.1 s
- ☒ **B** 1.5 s
- ☒ **C** 2.0 s
- ☒ **D** 2.5 s

(c) The electron micrograph below shows part of a human lung.

Scale: 1 μm ($1 \times 10^{-3}$ mm)




(i) Measure the distance between **X** and **Y** on the electron micrograph.

Use your measurement to calculate the thickness of the tissues between **X** and **Y**.

Show your working.

**(2)**

..... μm

(ii) Name the type of cell that forms the wall of a capillary.

**(1)**

.....

**(Total for Question 2 = 6 marks)**

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**3** The fluid mosaic model can be used to explain the properties of cell membranes.

(a) Explain what is meant by the term **fluid mosaic**.

**(2)**

(b) A drop of blue dye was placed in the middle of a large tray of water. The time taken for the blue dye to travel 10 cm from the centre of the tray was 2 minutes.

(i) Put a cross ☒ in the box to complete the following sentence.

The water 20 cm from the centre of the tray started to turn blue after

**(1)**

☒ **A** less than 2 minutes

☒ **B** 2 minutes

☒ **C** 4 minutes

☒ **D** more than 4 minutes

(ii) Name the process by which the dye moves.

**(1)**

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(c) Read through the following passage about the effect of solute concentration on potato cells.

(i) Write on the dotted lines the most appropriate word or words to complete the passage.

**(4)**

A cube of potato tissue was placed in a beaker of distilled water at 25 °C. After 20 minutes, this cube would ..... in mass. The solute concentration inside the cells is ..... than the solute concentration outside the cells. The membrane of the cells is ..... to water and this allows the process of ..... to occur.

(ii) A cube of potato tissue was placed in boiling water before being placed in the beaker at 25 °C. After 20 minutes, this cube had decreased in mass.

Give an explanation for this observation.

**(2)**

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**(Total for Question 3 = 10 marks)**

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**4** Obesity and smoking are risk factors for cardiovascular disease (CVD).

(a) Explain how energy imbalance results in obesity.

**(2)**

(b) Selenium is a trace element that may affect the development of obesity.

In one study, data were collected on dietary selenium intake and body mass index (BMI).

The table below shows some of the data from this study.

| BMI group | Classification | Mean dietary selenium intake / μg $kg^{-1}$ $day^{-1}$ | |
|---|---|---|---|
| | | Women | Men |
| 18.5 to 24.9 | Normal weight | 1.70 | 1.74 |
| 25.0 to 29.9 | Overweight | 1.44 | 1.48 |
| 30.0 to 34.9 | Obese | 1.22 | 1.14 |
| 35.0 to 39.9 | | 1.09 | 1.00 |
| ⩾40 | | 0.93 | 0.90 |

(i) Calculate the percentage difference in mean dietary selenium between the lowest and highest BMI group in men.

Show your working.

**(2)**

.....%

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(ii) State **one** conclusion that can be drawn from the data in the table.

**(1)**

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(iii) BMI is one indicator of obesity.

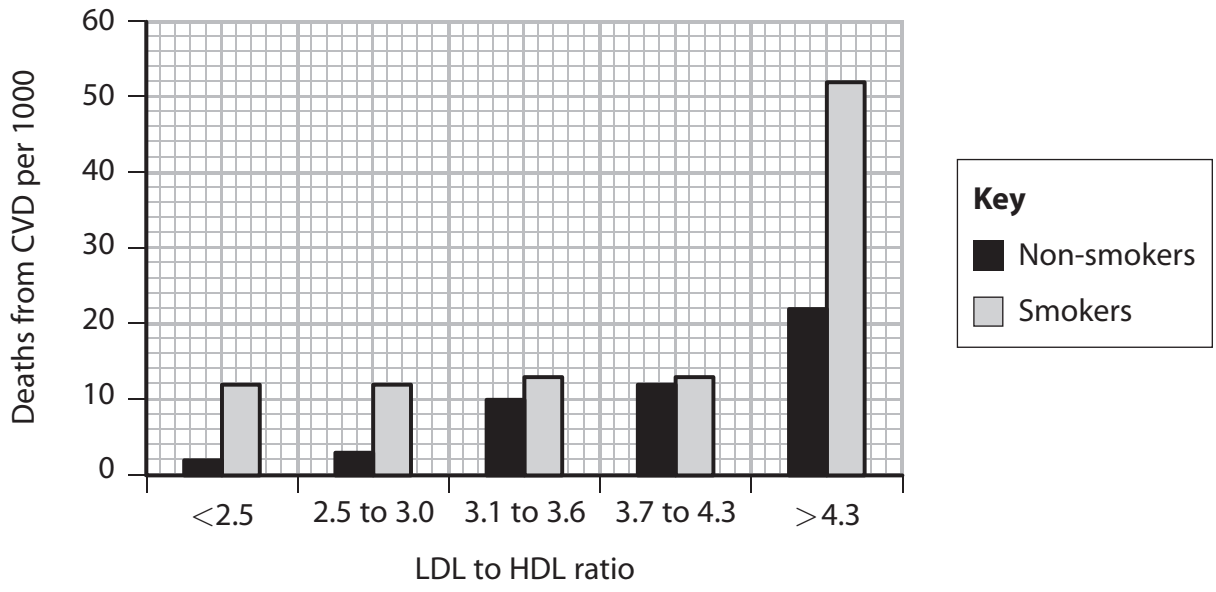
Give **one** other indicator of obesity.

**(1)**

.....

(c) The relationship between blood LDL to HDL ratio and deaths from CVD was studied. Two different groups were used in this study: smokers and non-smokers.

The graph below shows the results of this study.




(i) Put a cross ☒ in the box to complete the following sentence.

The results of this study show that in non-smokers

**(1)**

☒ **A** a large LDL to HDL ratio causes CVD that results in death

☒ **B** a small LDL to HDL ratio causes CVD that results in death

☒ **C** there is a correlation between the LDL to HDL ratio and deaths from CVD

☒ **D** there is no correlation between the LDL to HDL ratio and deaths from CVD

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(ii) Explain why smokers with a LDL to HDL ratio of $>4.3$ have a greater risk of death from CVD than non-smokers.

**(3)**

**(Total for Question 4 = 10 marks)**

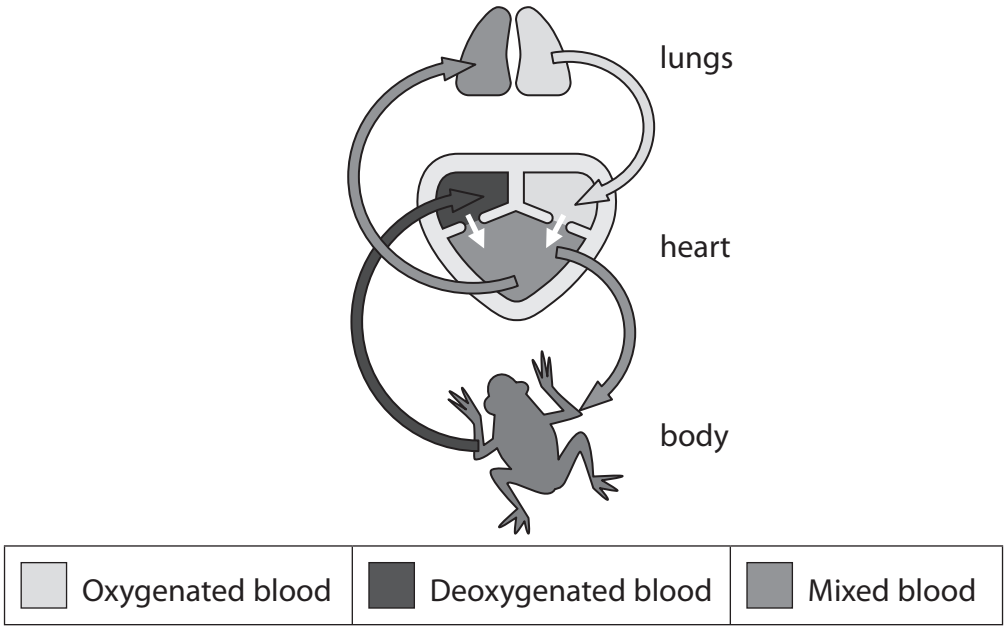
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**5** Many animals have a heart and a circulation system.

The diagram below shows the structure of the heart and circulation system of a frog.




(a) Using the information in the diagram and your own knowledge, compare the heart and circulation system of the frog with the heart and circulation system of a human.

**(4)**

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(b) Explain why gas exchange is more efficient in the lungs of humans than in the lungs of frogs.

**(3)**

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*(c) Explain the role of heart valves in the human cardiac cycle.

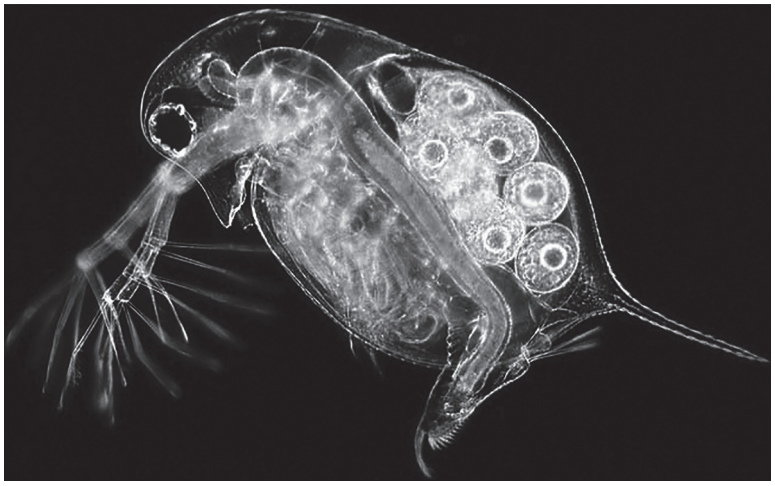
**(5)**

**(Total for Question 5 = 12 marks)**

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**6** The photograph below shows a specimen of *Daphnia*.



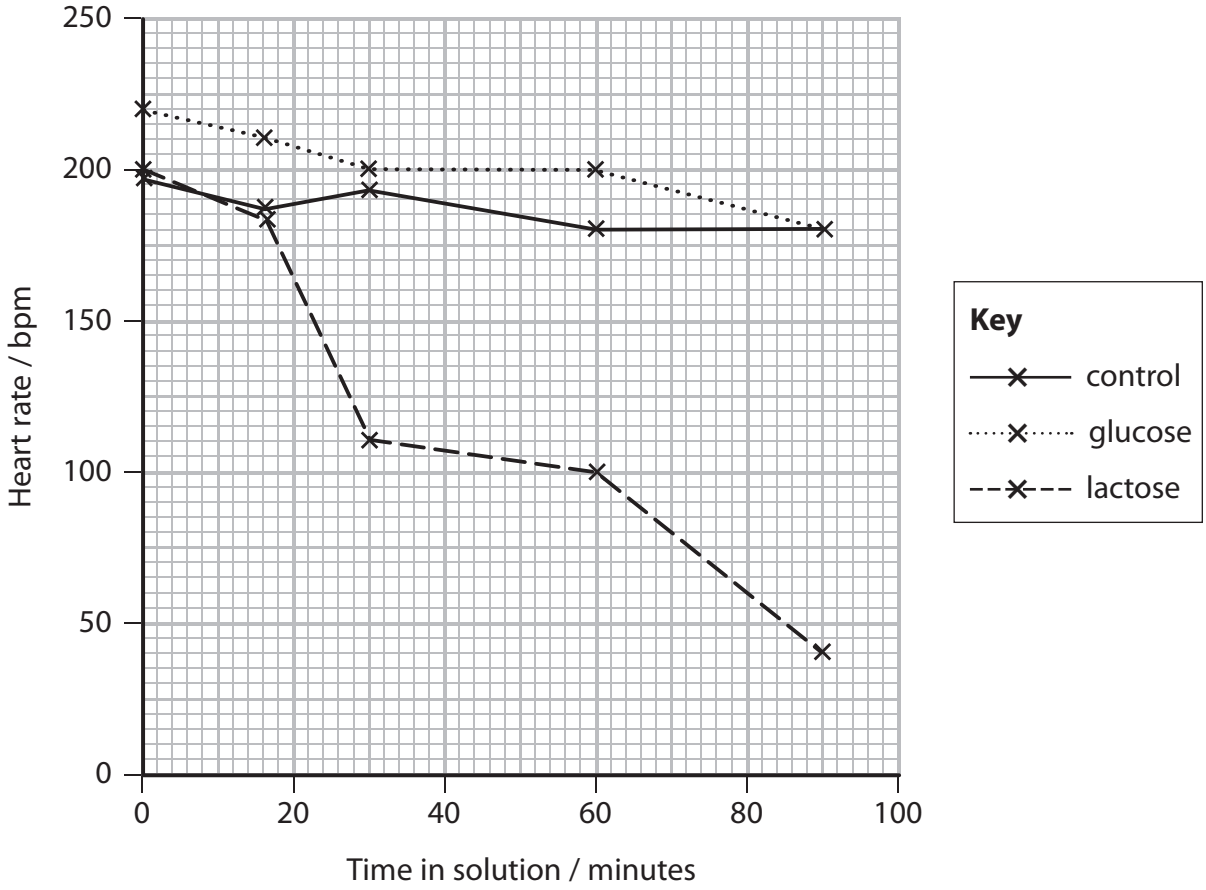
Magnification ×30

*Daphnia* can be used to study the effect of soluble molecules on heart rate.

In an experiment, *Daphnia* were suspended in a solution of glucose and a solution of lactose. A control solution was also used.

Their heart rates were recorded.

The graph below shows the heart rates of *Daphnia* in these three solutions.




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(a) (i) Describe how the heart rate of *Daphnia* could be measured in this experiment.

**(4)**

(ii) Using the information in the graph, describe the effects of glucose and lactose on the heart rate of *Daphnia*, compared with the control.

**(3)**

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(iii) Below are some statements about the structure of glucose and lactose:

- lactose is made from glucose and fructose
- only lactose contains a glycosidic bond
- glucose and lactose are both monosaccharides.

Put a cross ☒ in the box next to the number of these statements that are correct.

**(1)**

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

(b) The scientist carrying out this study suggested the following hypothesis:

lactose affects the heart rate by blocking an ion channel in the cell membrane of heart muscle cells.

(i) Suggest why lactose, but not glucose, could block the ion channels.

**(2)**

.....

.....

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.....

(ii) Suggest the name of another sugar that might be used to test this hypothesis.

Predict the effect of this sugar on heart rate.

**(2)**

Sugar .....

Predicted effect .....

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**(Total for Question 6 = 12 marks)**

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**7** Cystic fibrosis is a recessive condition caused by mutations in the CFTR gene.

(a) Several alleles of the CFTR gene have been identified.

Put a cross ☒ in the box to complete each of the following sentences.

(i) A gene is a sequence of nucleotides that contains

**(1)**

☒ **A** hexose sugars and the bases A, C, G and T

☒ **B** hexose sugars and the bases A, C, G and U

☒ **C** pentose sugars and the bases A, C, G and T

☒ **D** pentose sugars and the bases A, C, G and U

(ii) An allele is a form of a gene that

**(1)**

☒ **A** always affects the phenotype

☒ **B** never affects the phenotype

☒ **C** affects the phenotype only in a heterozygous genotype

☒ **D** sometimes affects the phenotype when it is a recessive allele

(b) In the space below, draw **one** family pedigree to show all the possible outcomes when both parents are heterozygous for cystic fibrosis.

Use the symbols shown in the key.

**(3)**

**Key**

- female with cystic fibrosis
- female carrier
- unaffected female
- male with cystic fibrosis
- male carrier
- unaffected male

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(c) The genetic code for the CFTR protein is carried in DNA.

(i) Explain why the genetic code uses three bases rather than two.

**(2)**

*(ii) DNA replicates and cells divide during the development of tissues.

Describe the process of DNA replication.

**(5)**

**(Total for Question 7 = 12 marks)**

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**8** Prothrombin is a protein involved in the blood clotting process.

(a) Describe the role of prothrombin in the formation of blood clots.

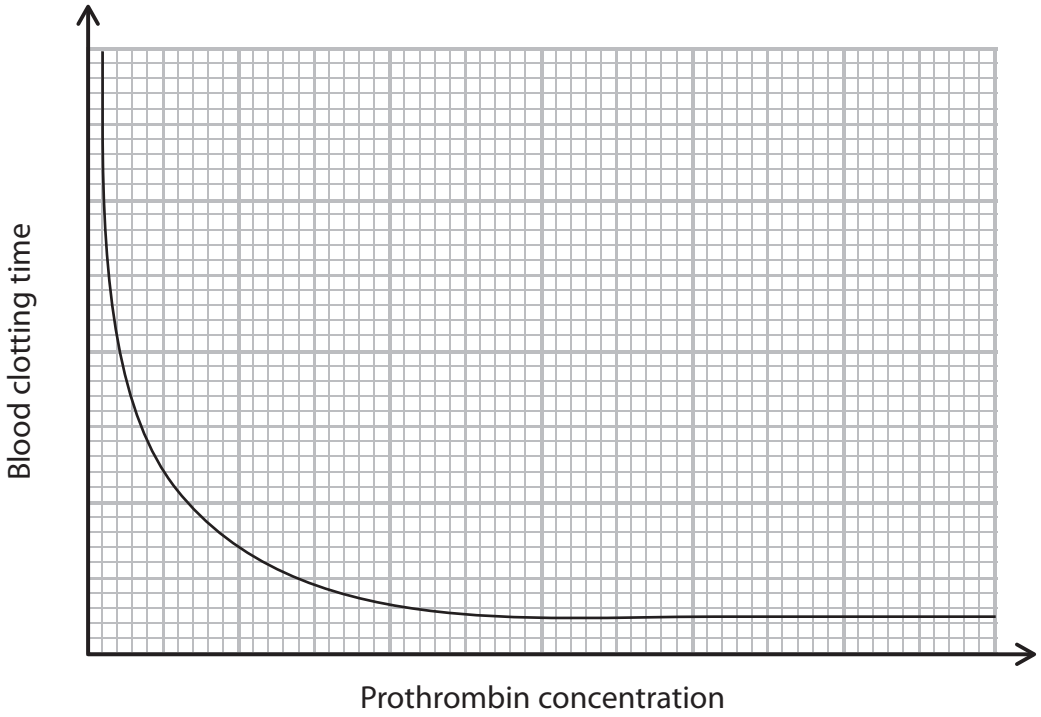
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(b) The graph below shows the relationship between prothrombin concentration and blood clotting time.




Using the information in the graph, explain the relationship between prothrombin concentration and blood clotting time.

**(3)**

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(c) Mutations in the gene coding for prothrombin have been associated with an increased risk of blood clotting and heart attack.

The table below shows the effect of mutations in the prothrombin gene and a person's blood group on the risk of having a heart attack.

| Prothrombin mutation | Relative risk of heart attack | |
|---|---|---|
| | blood group O | other blood groups |
| Mutation not present | 1.0 | 1.4 |
| Heterozygous for the mutation | 1.3 | 2.2 |
| Homozygous for the mutation | 4.1 | 8.3 |

(i) Using the information in the table, describe the relationship between blood group, prothrombin mutation and the risk of having a heart attack.

**(3)**

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(ii) Suggest why a mutation in the prothrombin gene changes the risk of having a heart attack.

**(3)**

**(Total for Question 8 = 12 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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