Write your name here

Surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number	Candidate Number

Biology A (Salters Nuffield)

Advanced

Paper 2: Energy, Exercise and Co-ordination

Specimen Paper for first teaching September 2015

Time: 1 hour 30 minutes

Paper Reference

9BN0/02

You do not need any other materials.

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.*
- You may use a scientific calculator.
- Questions labelled with **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.

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

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

Turn over ▶

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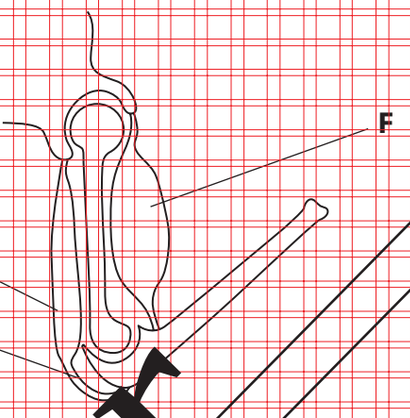
Answer ALL questions.

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 Movement of the arm at the elbow joint results from the contraction of muscles.

The diagram shows some of the structures in a human arm.



(a) Give the term for a pair of muscles that bring about movement at a joint.

(1)

(b) (i) Give a reason why **F** can be described as a flexor muscle.

(1)

(ii) Describe how **G** interacts with **E** to enable movement at this joint.

(2)

Redacted

(c) (i) Muscle contains actin and myosin protein fibres.

Which of the following describes the primary structure of a protein?

(1)

- ☒ **A** amino acids joined by hydrogen bonds
- ☒ **B** amino acids joined by ester bonds
- ☒ **C** amino acids joined by peptide bonds
- ☒ **D** amino acids joined by phosphodiester bonds

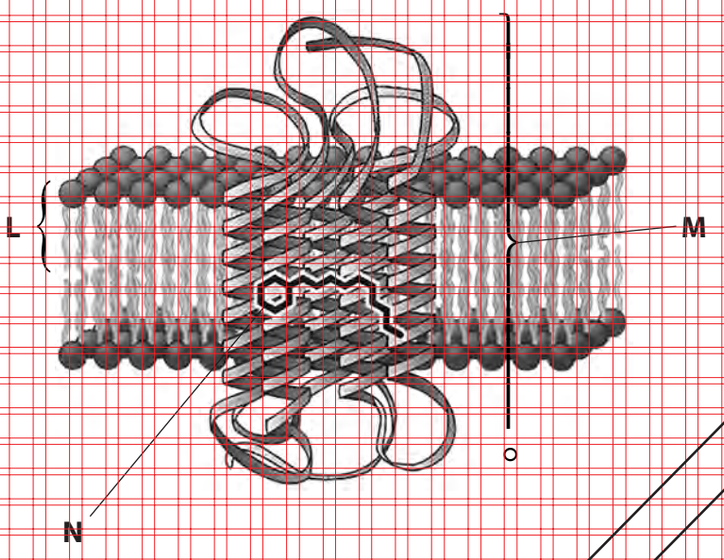
(ii) Describe the structure of an amino acid.

(3)

(Total for Question 1 = 8 marks)

Rapid

2 The diagram shows part of the membrane of the outer segment of a rod cell.



(a) Which of the following is the part labelled **L**?

(1)

- ☒ **A** fatty acid tail
- ☒ **B** phosphate head
- ☒ **C** phospholipid
- ☒ **D** phospholipid bilayer

(b) (i) Give the name of the visual pigment labelled **M**.

(1)

.....

(ii) Give the name of the light-absorbing part of the visual pigment labelled **N**.

(1)

.....

Redacted

(c) Describe how the absorption of light by the part labelled **N** results in an action potential in the optic nerve.

(3)

(Total for Question 2 = 6 marks)

Exemplar

3 There are many factors that affect the development of cardiovascular disease.

The table contains information about four different patients.

Patient	Gender	Age	Systolic blood pressure / mm Hg	HDL: Total cholesterol
E	Female	49	120	60 : 160
F	Female	67	150	60 : 140
G	Male	51	170	30 : 180
H	Male	67	140	60 : 140

(a) (i) Which **two** of these patients are at the greatest risk of developing cardiovascular disease?

(1)

- ☒ **A** E and F
- ☒ **B** F and G
- ☒ **C** G and H
- ☒ **D** H and E

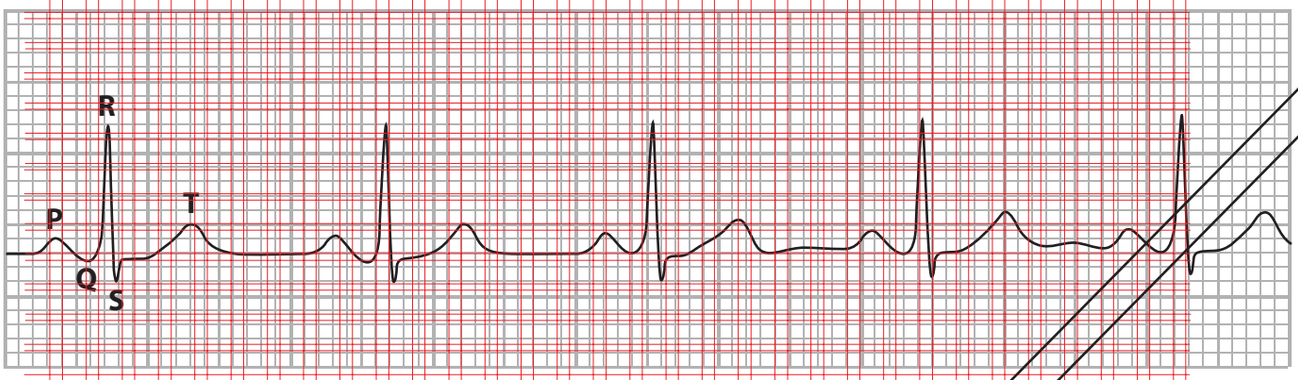
(ii) Explain why these two patients have the greatest risk of developing cardiovascular disease.

(4)

Reflar

(b) Electrocardiograms can aid the diagnosis of heart conditions.

A doctor recorded the following electrocardiogram for a patient with a healthy heart.



(i) State what is measured along the x-axis and y-axis of this electrocardiogram.

(1)

.....

.....

(ii) Which part of an electrocardiogram indicates the depolarisation of the atria?

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(iii) Which part of the electrocardiogram indicates when the atrioventricular valves would close?

(1)

☒ **A** P to Q

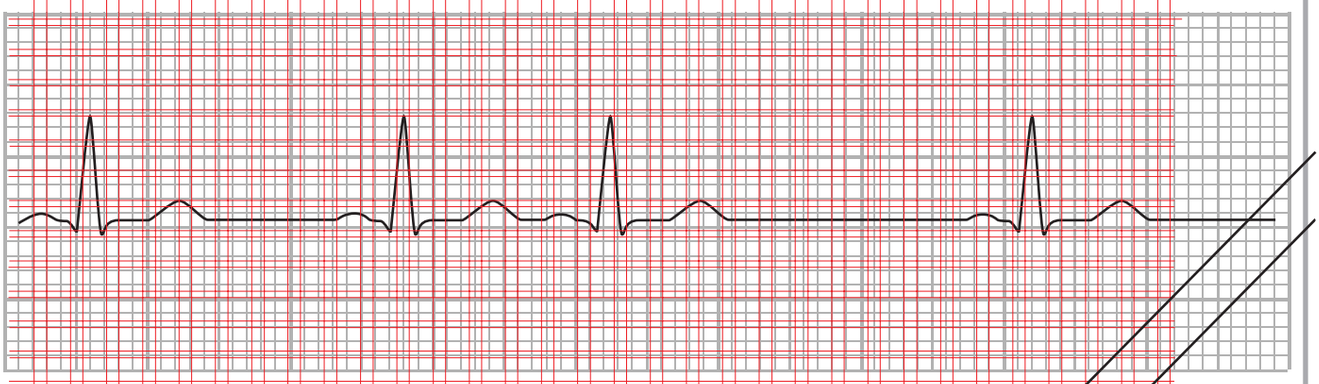
☒ **B** Q to R

☒ **C** S to T

☒ **D** T to P

Exemplar

(c) The doctor recorded this electrocardiogram for another patient.



Explain why the electrocardiogram indicates that this patient has a heart condition.

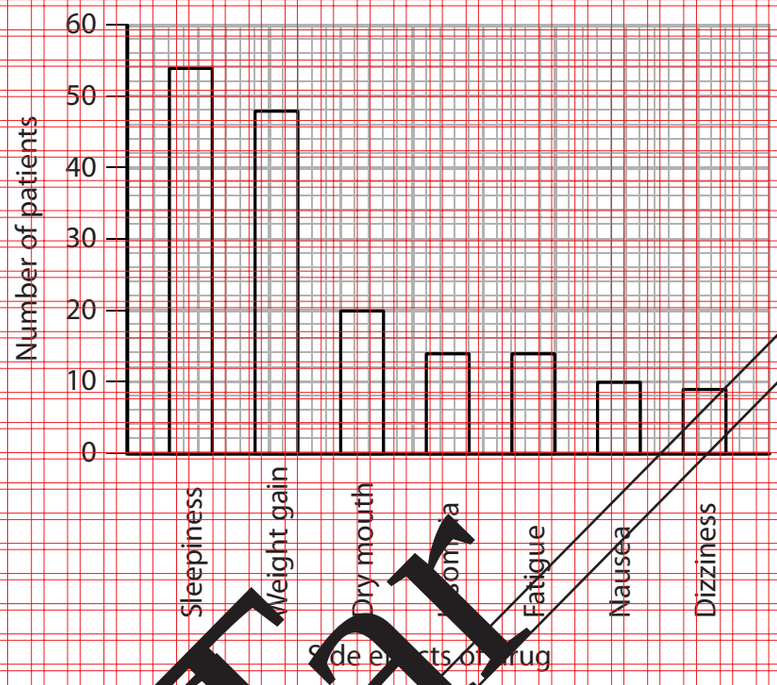
(2)

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(d) Another factor that is associated with an increased risk of heart disease is the use of antidepressant drugs.

There are a number of drugs available for treating depression.

The graph shows some of the side effects of one of these drugs.



Explain why the side effects of this antidepressant drug could increase the risk of developing heart disease.

(4)

(Total for Question 3 = 14 marks)

Exemplar

4 The maintenance of blood glucose levels is an example of homeostasis.

(a) State what is meant by the term **homeostasis**.

(1)

.....

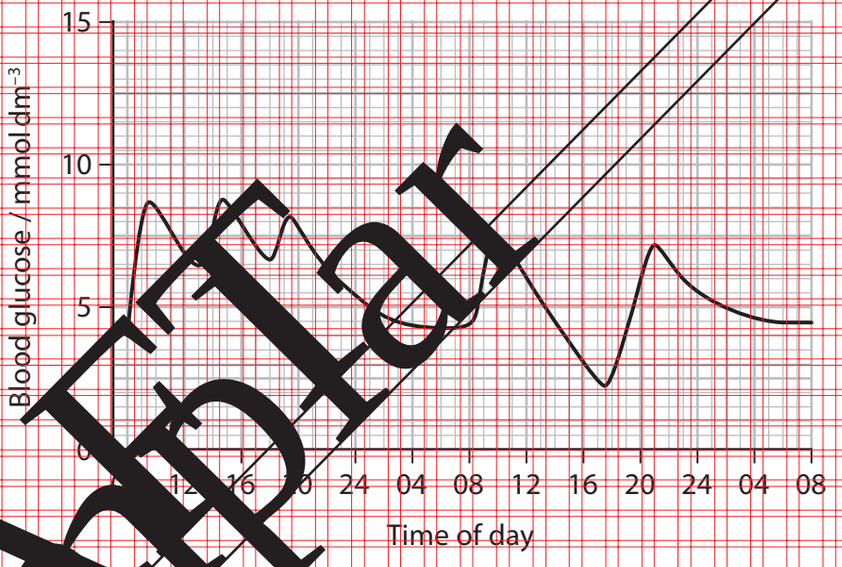
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(b) People with type 1 diabetes have to inject insulin to control their blood glucose levels.

Blood glucose levels are normally maintained between 4 and 8 mmol dm^{-3}.

The graph shows the changes in blood glucose over the course of two days for a person with diabetes being treated with insulin.



If insulin is injected and a meal is missed, blood glucose levels may fall too low.

Calculate the change in mass of glucose in 1 dm^{-3} of blood between 10:00 h and 17:00 h on Day 2.

A blood glucose level of 4 mmol dm^{-3} is equivalent to 72 mg 100 cm^{-3}.

(3)

Answer ..... mg

Redacted

(c) Glucagon is a hormone that is usually released when the level of blood glucose falls too low.

Glucagon stimulates the liver to break down glycogen into glucose.

(i) Which of the following processes breaks down glycogen into glucose?

(1)

☒ **A** condensation

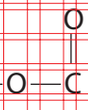
☒ **B** hydrolysis

☒ **C** methylation

☒ **D** phosphorylation

(ii) Which arrangement shows the structure of the bond that is broken in this process?

(1)

☒ **A** 

☒ **B** 

☒ **C** 

☒ **D** 

DRAFT

(d) Some people have a disorder that reduces their ability to produce an enzyme required to break down glycogen. This enzyme is glycogen phosphorylase.

The symptoms of this disorder include muscle weakness and lack of stamina when exercising.

(i) Explain why a low concentration of this enzyme would cause the symptoms described.

(3)

(ii) Devise an experiment to investigate the effect of glycogen phosphorylase concentration on the breakdown of glycogen.

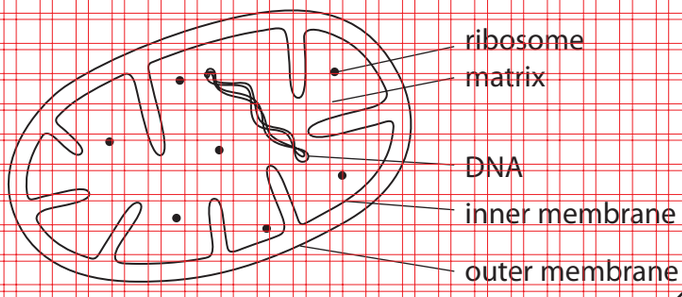
(3)

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(Total for Question 4 = 12 marks)

5 Mitochondria are organelles found in eukaryotic cells.

The diagram shows a mitochondrion.



(a) Where in the mitochondrion does the Krebs cycle take place?

(1)

- ☒ **A** inner membrane
- ☒ **B** matrix
- ☒ **C** outer membrane
- ☒ **D** ribosome

(b) Compare and contrast the structure of a prokaryotic cell with that of a mitochondrion, as shown in the diagram.

(3)

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(c) Mitochondrial diseases are caused by mutations in the DNA of the mitochondria.

One type of mitochondrial disease is caused by the production of defective ATP synthase.

(i) Explain how a mutation in the mitochondrial DNA could result in defective ATP synthase being produced.

(3)

(ii) Mitochondrial myopathy is a mitochondrial disease. The symptoms of this disease vary in severity.

The table shows the relationship between the percentage of mitochondria with mutated DNA in parents and the severity of the symptoms in their child.

Percentage of mitochondria with mutated DNA in the mother (%)	Percentage of mitochondria with mutated DNA in the father (%)			
	0	20	50	80
0	No symptoms	No symptoms	No symptoms	No symptoms
20	No symptoms	No symptoms	No symptoms	No symptoms
50	Mild symptoms	Mild symptoms	Mild symptoms	Mild symptoms
80	Severe symptoms	Severe symptoms	Severe symptoms	Severe symptoms

Redhat

Explain the effects that the percentage of mitochondria with mutated DNA in the parents has on the severity of symptoms in their child.

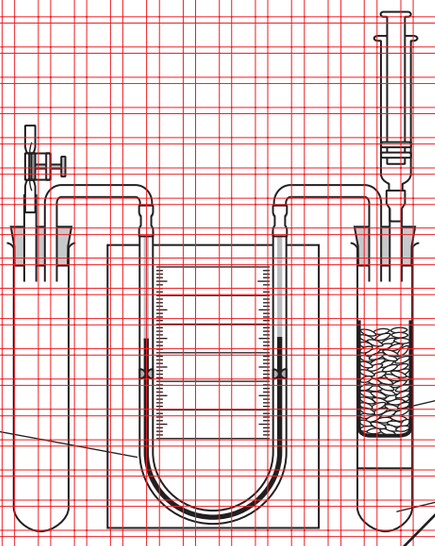
(3)

(Total for Question 5 = 10 marks)

Exemplar

6 An investigation was carried out to test the effect of temperature on the rate of respiration in germinating seeds.

The diagram shows the respirometer that was used to carry out this investigation.



(a) (i) Describe the purpose of the potassium hydroxide solution in this respirometer.

(2)

Redan

(ii) The level of the coloured oil dropped on the left-hand side by 8.2 mm in 12 minutes.

Calculate the rate of respiration of these seeds. Express your answer as volume of oxygen used per minute to two decimal places.

(Volume of cylinder = $\pi r^2 h$)

(3)

Answer .....

*(b) Devise an investigation, using this respirometer, to obtain valid data to show the effect of temperature on the rate of respiration in germinating seeds.

(6)

(Total for Question 6 = 11 marks)

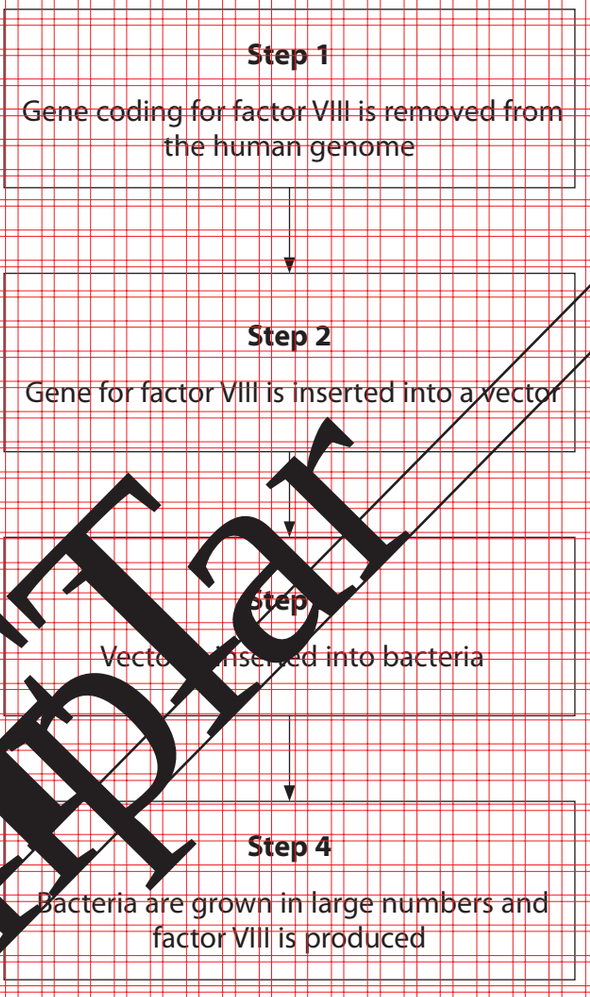
Exemplar

7 Haemophilia is a genetic disorder where blood does not clot normally.

It can be treated by injecting factor VIII, a protein involved in the blood-clotting process that is not produced by people with haemophilia type A.

Bacteria can be genetically modified to produce factor VIII.

(a) The diagram shows some of the steps involved in genetically modifying bacteria to produce factor VIII.



(i) Describe the difference between a gene and the genome

(2)

Redacted

(ii) Give the name of the type of enzyme that would be used to insert the gene into the DNA of the vector at Step 2.

(1)

(iii) Give an example of a suitable vector that would be used in Step 2 or 3.

(1)

(iv) Describe how the genetically modified bacteria would use the gene from the human genome to produced factor VIII in Step 4.

(2)

Exemplar

(b) Factor VIII is required for the activation of prothrombin.

Explain why the blood-clotting process does not take place normally when a person with haemophilia type A cuts their hand.

(3)

(Total for Question 7 = 9 marks)

Reflar

8 Some marine snails produce chemicals called conotoxins. These chemicals paralyse the prey of these snails by interfering with the conduction of nerve impulses to muscles.

Conotoxins can be modified to produce painkillers.

The table shows the membrane proteins affected by different conotoxins.

Type of conotoxin	Membrane protein affected
Alpha	acetylcholine receptors
Delta	voltage-gated sodium ion channels
Kappa	voltage-gated potassium ion channels
Omega	calcium ion channels

*(a) Analyse the data to explain how conotoxins can interfere with the conduction of nerve impulses to muscles.

(6)

DRAFT

(b) The effects of conotoxins on the nervous system were first demonstrated in experiments involving animals.

These experiments were involved in the development of painkillers from conotoxins.

(i) Describe the ethical issues concerning the use of animals in this research.

(2)

Exemplar

(ii) After testing on animals, painkillers undergo three-phased testing.

In an investigation testing the effectiveness of a painkiller produced from conotoxin, the new painkiller was tested on a group of healthy volunteers.

Explain the reasons for this stage in the testing of the painkiller.

(2)

(Total for Question 8 = 10 marks)

Example

9 An experiment was carried out to investigate mineral deficiencies on the growth of seedlings.

The effects of two mineral deficiencies on two different species of plant were investigated.

Test tubes were half filled with an aqueous gel containing a mineral solution without calcium ions. Seeds of rice or fenugreek were placed separately in these test tubes.

These test tubes were placed by a window for two weeks to allow the seeds to germinate and the seedlings to grow.

This was repeated using test tubes containing mineral solution without magnesium ions.

(a) A control should have been used in this investigation.

(i) Which of the following would be a suitable control?

(1)

☒ **A** complete mineral ion solution

☒ **B** distilled water

☒ **C** dry gel

☒ **D** tap water

(ii) In this investigation, a control would have improved

(1)

☒ **A** accuracy

☒ **B** precision

☒ **C** repeatability

☒ **D** validity

Redhat

(iii) The table gives some properties of rice seeds and fenugreek seeds.

Property of seeds	Rice	Fenugreek
Number per g	200	500
Calcium ion content / mg $100g^{-1}$	21	176
Magnesium ion content / mg $100g^{-1}$	177	191

The calcium content of one fenugreek seed was calculated to be 3.52 µg.

Calculate the calcium content of one rice seed.

(3)

Answer ..... µg

Exemplar

(iv) After two weeks, the seedlings of both rice and fenugreek grown in both solutions had green leaves.

The rice seedlings grown in mineral ion solution without calcium ions were shorter than the rice seedlings grown in mineral solution without magnesium ions.

The fenugreek seedlings grown in mineral ions solution without calcium ions grew to normal height.

Explain what is shown by these observations.

(3)

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(b) The only source of light provided for the plants was from outside the window. All of the seedlings grew towards the window.

Explain the reason for this response of these seedlings to light.

(3)

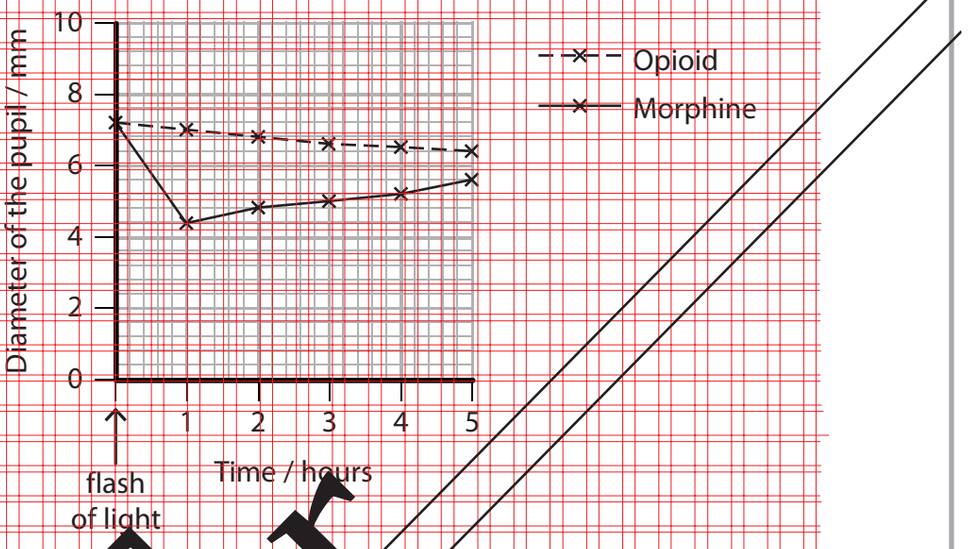
(Total for Question 9 = 11 marks)

Example

10 Opioids are used to treat moderate to severe pain. They are a group of drugs synthesised from morphine.

(a) Opioids and morphine both affect the size of the pupil of the eye.

The graph shows the effects of these drugs on the diameter of the pupil following exposure to a flash of light.



Calculate the rate of change in pupil diameter between one and five hours after exposure to light for those individuals who had taken morphine.

(2)

Answer ..... mm h^{-1}

Redacted

(ii) Explain the effect of opioids on the diameter of the pupil, between one and five hours after exposure to a flash of light.

(3)

(iii) Comment on reasons why the results of this investigation may not prove that any changes in pupil size were the direct result of either the opioid or morphine.

(4)

(Total for Question 10 = 9 marks)

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