Surname	Centre Number	Candidate Number
Other Names		0

GCSE – NEW

C400UA0-1

S18-C400UA0-1

BIOLOGY – Component 1
Concepts in Biology

HIGHER TIER

TUESDAY, 15 MAY 2018 – AFTERNOON

2 hours 15 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**16**	
2.	**14**	
3.	**9**	
4.	**12**	
5.	**8**	
6.	**14**	
7.	**14**	
8.	**11**	
9.	**12**	
10.	**10**	
Total	**120**	

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01

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question **8***(a)*.

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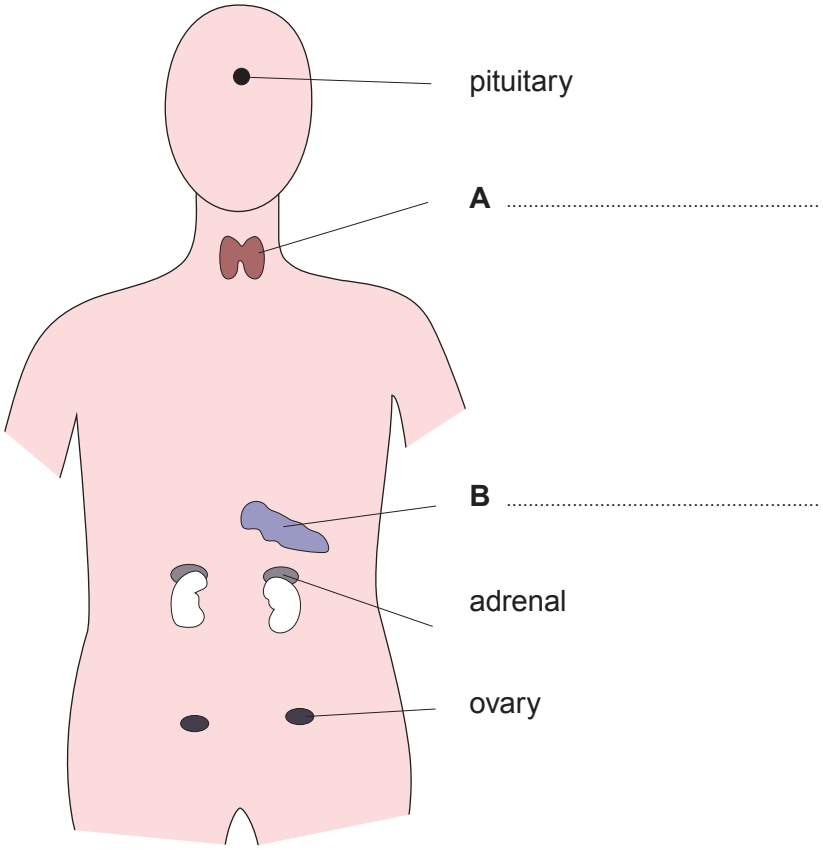
Answer **all** *questions.*

1. The diagram below shows some of the glands in the body which produce hormones.



(a) (i) Label glands **A** and **B**. [2]

(ii) Describe how hormones reach the organs of the body where they act. [1]

.....

(iii) If internal conditions in the body change, hormones enable the balance to be restored. State the scientific term for this process. [1]

.....

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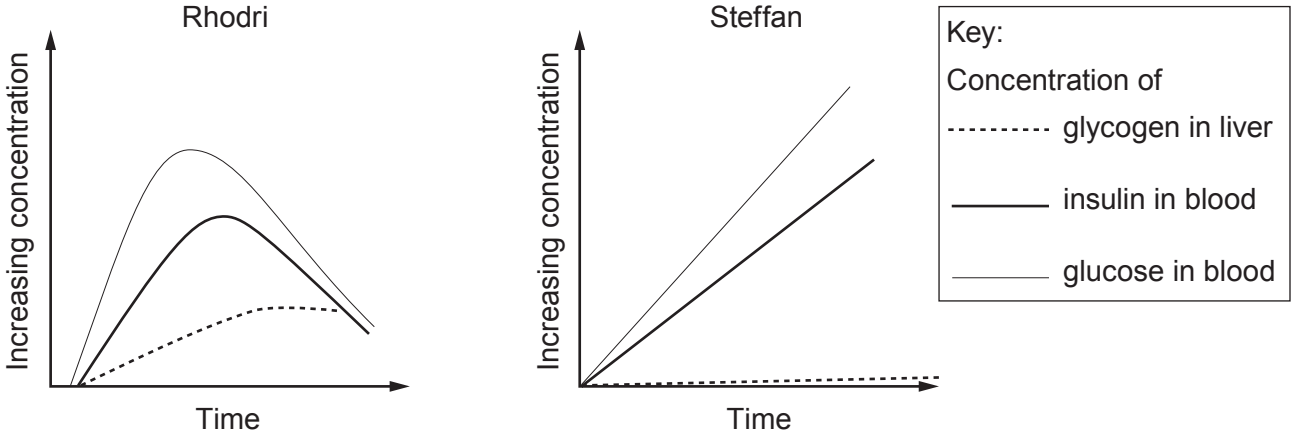
(b) The hormone insulin helps control the concentration of glucose in the blood.

The sketch graphs below show the results of an investigation into the control of blood glucose concentration in two people. They both drank 100 cm^3 of glucose solution and the concentrations of glucose and insulin in the blood were monitored. The concentration of glycogen in the liver was also recorded.



Steffan has a medical condition. State the name of this medical condition, give **two** pieces of evidence from the graphs which support your answer and suggest how this condition could be treated. [4]

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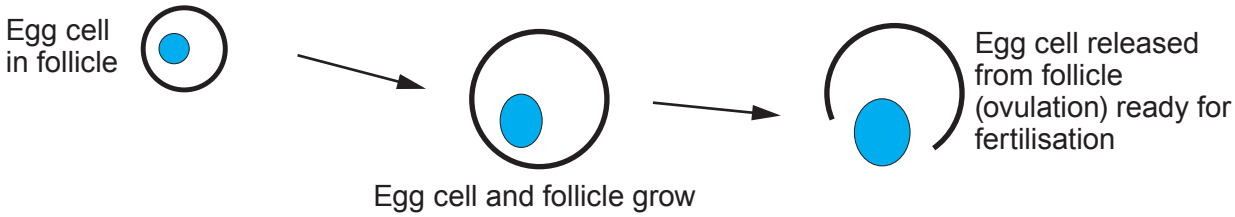
(c) The development of an egg cell in the human ovary is shown in the diagram below.



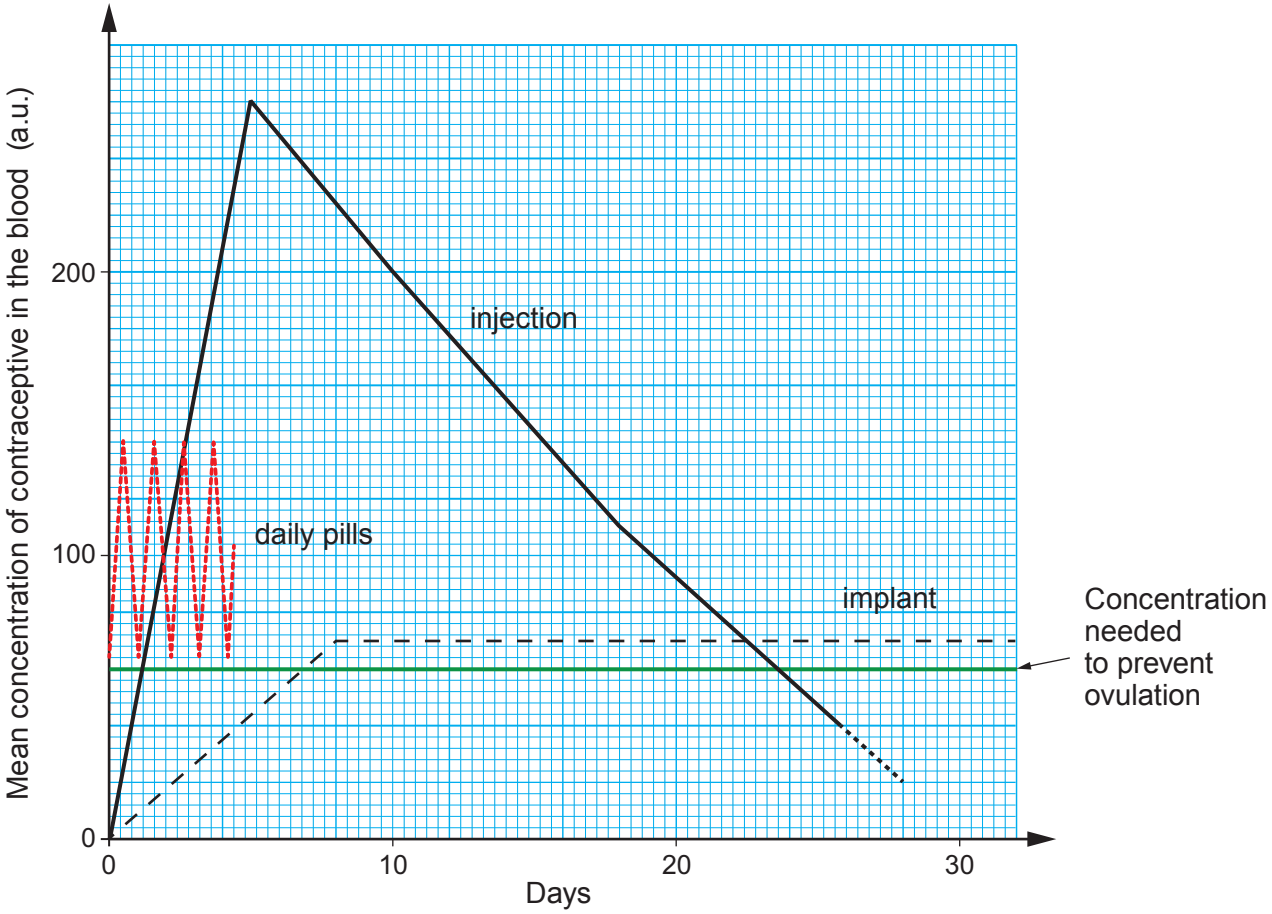
Hormones control this process and can be used in contraceptives.

The graph shows the result of an investigation of a hormonal contraceptive which prevents ovulation, so that fertilisation cannot occur. It was administered in three ways as follows;

Group 1 as a pill taken daily,

Group 2 as an injection given once which lasts a few weeks,

Group 3 as an implant into the body which lasts three years.



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From this graph.

(i) State the minimum concentration of contraceptive in the blood needed to prevent ovulation. [1]

..... a.u.

(ii) Calculate:

I. the difference between the highest and lowest mean concentration of contraceptive in the blood for the group taking daily pills. [1]

difference = ... au

II. the percentage increase from day 2 to day 5 in mean concentration for the group having an injection. [2]

Percentage Increase = ... %

(iii) Suggest how many days after receiving the injection it would **need** to be repeated. Give a reason for your answer. [1]

Answer ..... days

Reason .....

.....

(iv) Describe **two** advantages and **one** disadvantage of an implant over the other hormonal methods of contraception. [3]

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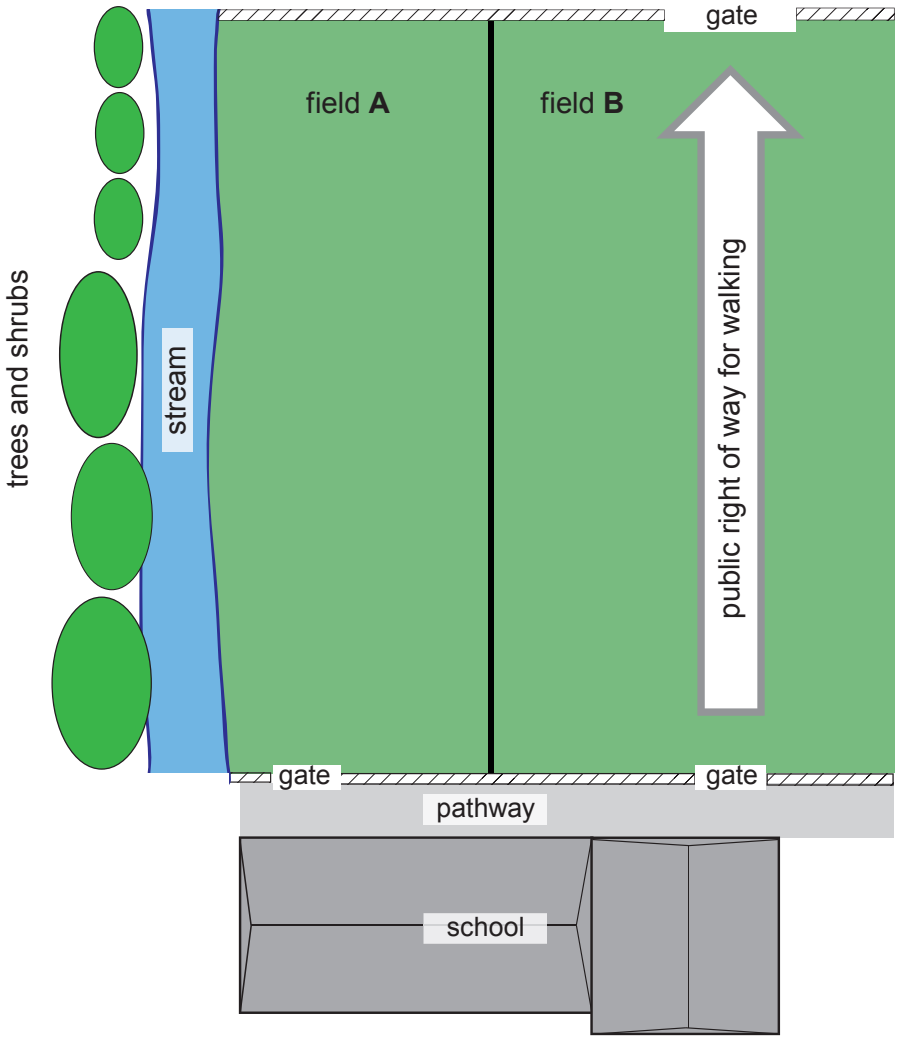
Turn over.

2. Students investigated the abundance of plantain (*Plantago sp.*) and bugleweed (*Ajuga sp.*) in two fields (**A** and **B**). **A** measured 250 m^2 and **B** measured 375 m^2.

plantain
(*Plantago sp.*)

bugleweed
(*Ajuga sp.*)

Trampling by walkers occurred in field **B** as a public right of way passed through, as shown below.



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The students used six quadrats of 1 m^2, which they placed randomly in the fields to investigate the abundance of plantain and bugleweed.

Results of the investigation

	Plantain		Bugleweed	
	Field **A**	Field **B**	Field **A**	Field **B**
Total number of plants counted in six quadrats	34	41	38	5
Mean number of plants per m^2 quadrat	.....	.....	6.3	0.8
Estimated total number of plants in field	.....	.....	1575	300

(a) (i) **Complete the results table** by calculating [2]

I. the mean numbers of plantain per m^2;

II. the estimated total numbers of plantain in the fields.

Space for working

(ii) From the results, state what can be concluded about the effects of trampling on the plant species. Explain your answer. [2]

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(iii) From the information in the diagram, suggest **two** variables, apart from trampling, which could have affected the results, giving **one** reason for each variable. [2]

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(b) (i) Describe a technique the students could have used to place their quadrats at random and obtain their data. [3]

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(ii) State why the students should have increased the number of quadrats used. [1]

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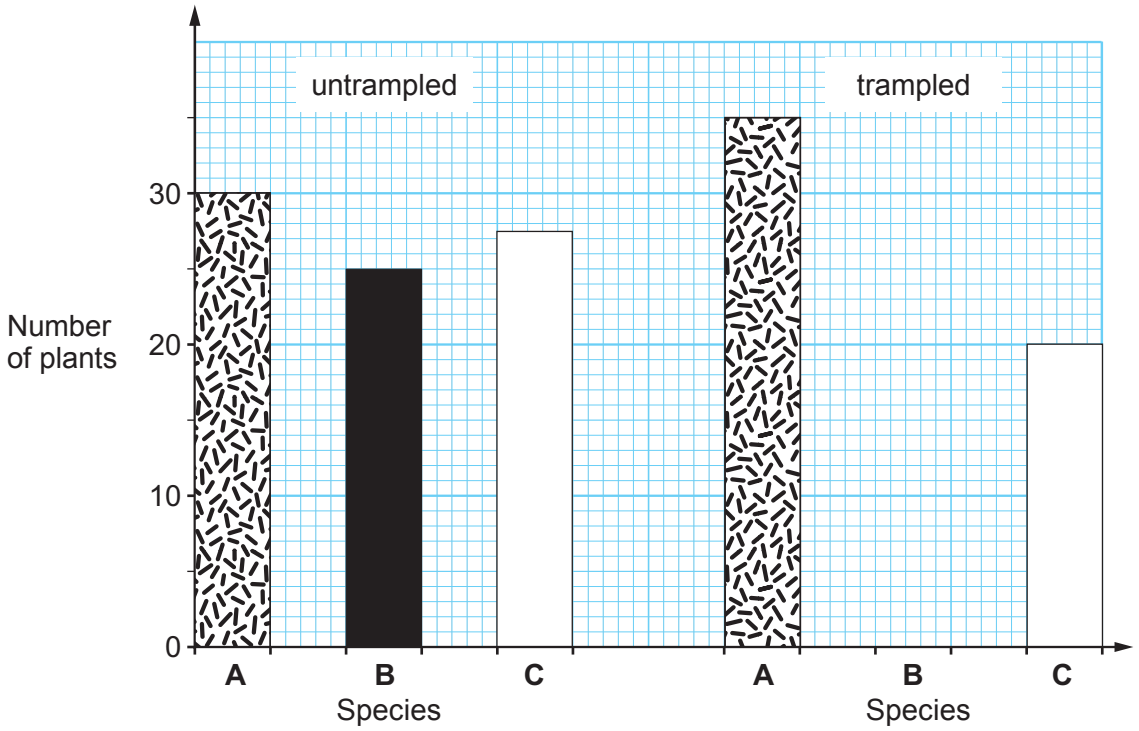
(c) The bar chart below shows the results of an investigation on the effects of trampling carried out by conservation scientists in an area of grassland. They studied three species of plants, **A**, **B** and **C**.



(i) From the information in the bar chart, state the evidence that biodiversity has been affected by trampling. [2]

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(ii) State **two** reasons why it is important to protect the biodiversity of habitats. [2]

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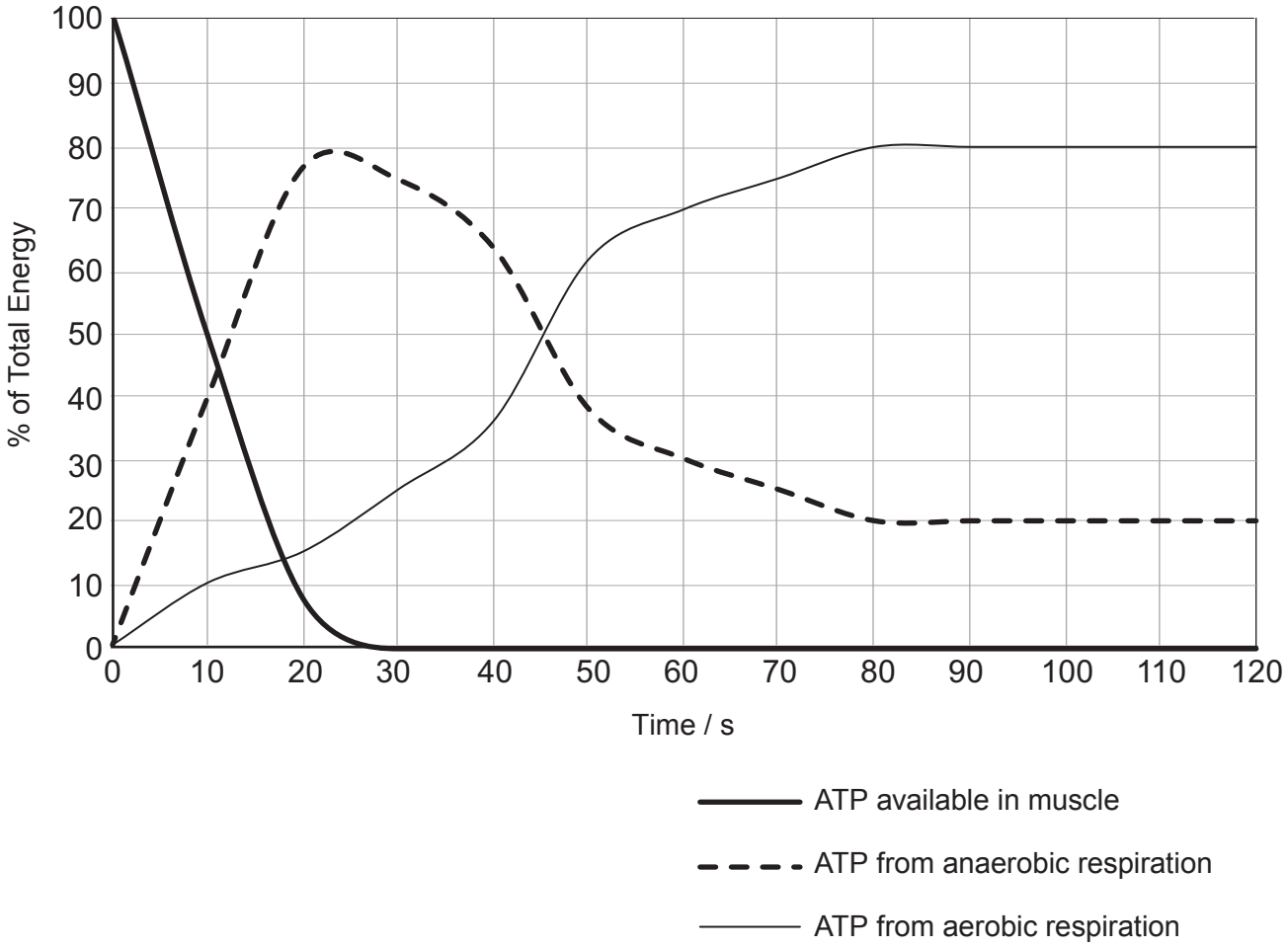
3. *(a)* The graph below shows how the source of energy for muscle contraction changes over a two minute period of exercise in the human body.



(i) State the equation for aerobic respiration. [2]

.....

(ii) State the equation for anaerobic respiration in humans. [1]

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(b) (i) Use the graph to compare how the source of energy for muscle contraction changes over the time shown. [3]

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(ii) Use the graph and your own knowledge to explain why a long-distance runner mainly relies on aerobic respiration. [3]

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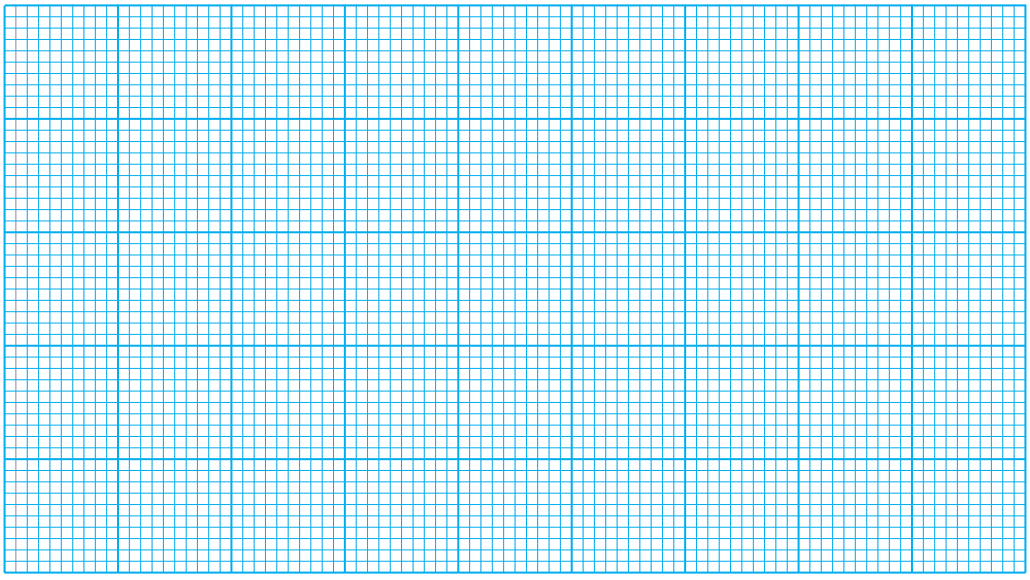
4. A group of students produced a pyramid of biomass for a field. A number of $1\,m^2$ samples were taken. The plant material in the $1\,m^2$ samples was cut to ground level and weighed. The animals were caught, sorted into carnivores and herbivores and weighed. The animals were then released.

The results are shown below.

Organisms	Mean biomass ($g\,m^{-2}$)
green plants	1400
herbivores	200
carnivores	20

(a) Use the data to draw a labelled pyramid of biomass on the grid below. Your diagram should be drawn to scale. [3]



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(b) (i) State **two** reasons for the loss of biomass between the different trophic levels. [2]

.....

.....

(ii) Calculate the percentage efficiency of biomass transfer between the trophic levels. Identify which transfer is the more efficient and give a reason for the difference in efficiency. Clearly show your working. [3]

First to second trophic level = ... %

Second to third trophic level = ... %

More efficient transfer .....

Reason .....

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(iii) Suggest **one** reason why only a small proportion of the energy falling on green plants is converted to chemical energy in biomass. [1]

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(c) (i) Identify **two** limitations in the sampling method that could have led to errors in calculating the data for the pyramid of biomass. [2]

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(ii) State how the students could use this method to study long term trends in biomass for this field. [1]

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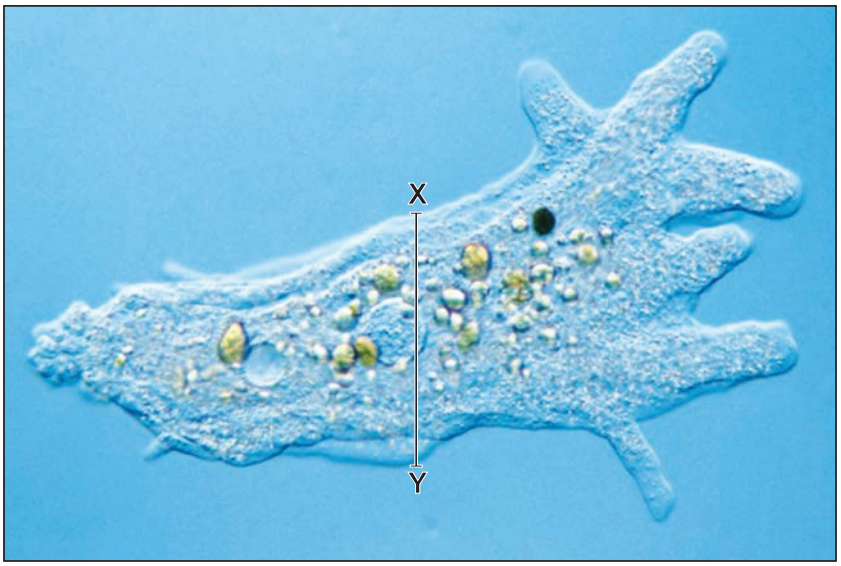
5. The photograph shows the unicellular organism, *Amoeba proteus*, as seen under a light microscope.



(a) The actual width of the *Amoeba* of **X** – **Y** is 400 µm. Calculate the magnification of the drawing. [3]

Magnification = × .....

(b) Unicellular organisms such as *Amoeba* exchange gases with their environment, but they do not have specialised exchange surfaces.
State the name of the process by which the *Amoeba* carries out gas exchange. [1]

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(c) The table shows the surface area and volume for *Amoeba proteus*, an earthworm and a human.

Organism	Surface area (m^2)	Volume (m^3)	Surface area: volume ratio
Amoeba	5.03×10^{-7}	3.35×10^{-11}	15000 : 1
earthworm	2.48×10^{-3}	3.86×10^{-6}	.....
human	2.07	80.3	0.03 : 1

(i) Calculate the surface area to volume ratio for the earthworm.
Write your answer in the table. [2]

Space for working

(ii) Use the data from the table to explain the importance of specialised exchange surfaces in large multicellular organisms. [2]

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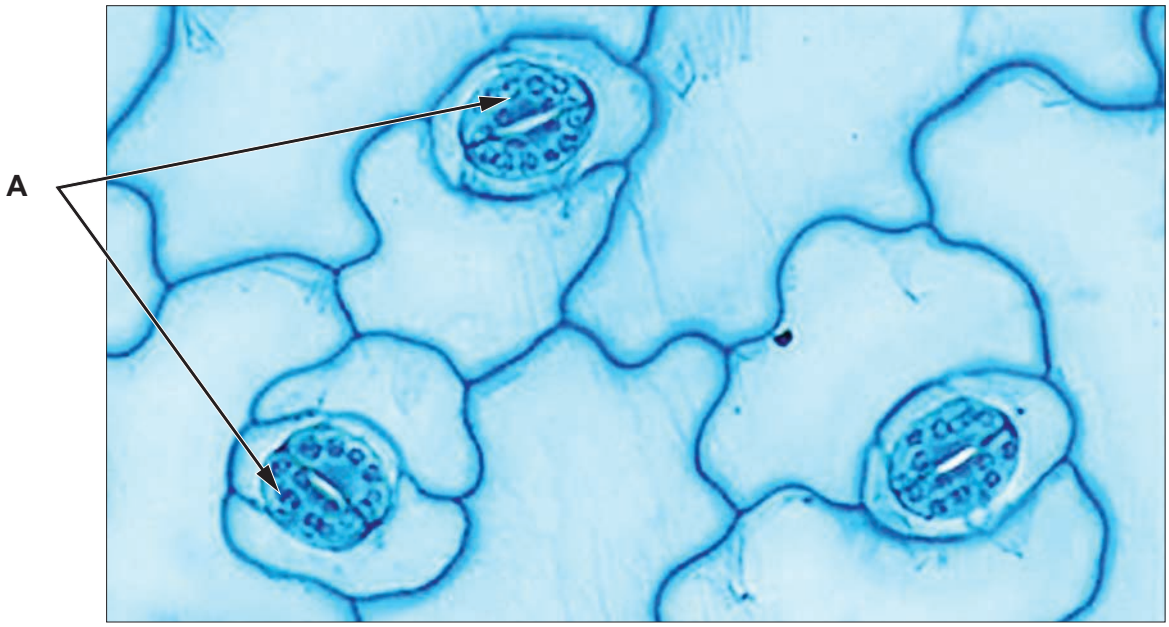
6. The photograph shows the lower epidermis of a kalanchoe leaf (*Kalanchoe sp.*).



(a) State the name of cells **A**. [1]

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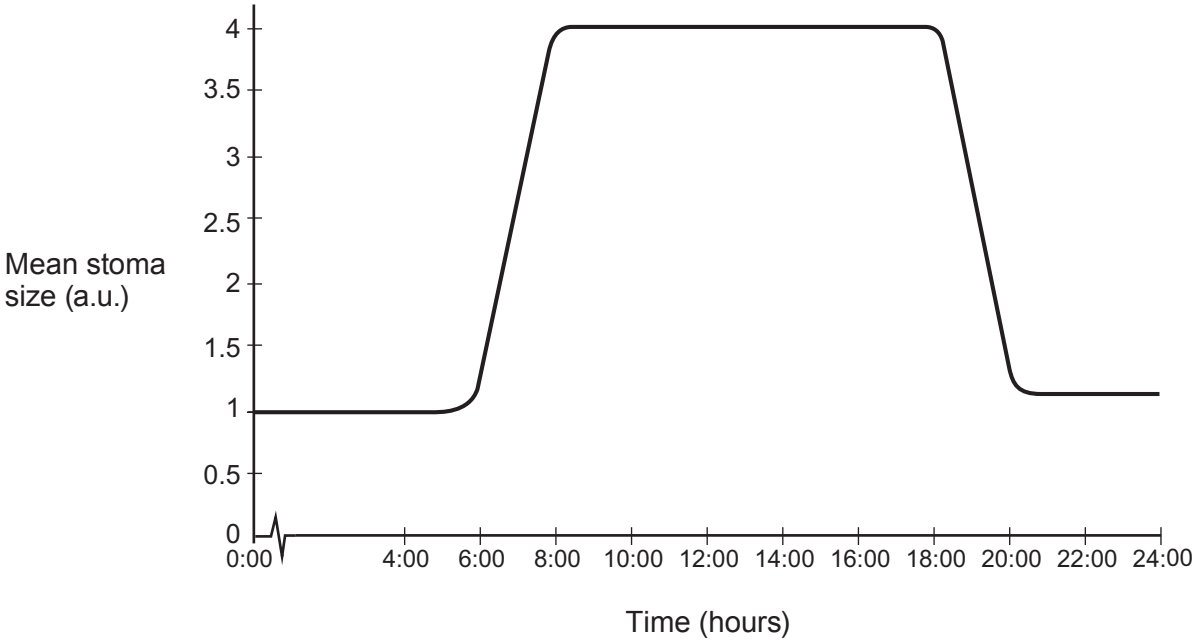
(b) An investigation was carried out into the changes in the mean stoma size of a well-watered plant left on a windowsill over a 24 hour period. The results are shown in the graph.



(i) State the conclusion that can be drawn about the change in stoma size from the information provided by the graph. Explain why this change is important for plants. [3]

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(ii) State **one** factor that should have been kept constant to ensure a fair test. Describe an appropriate control for the investigation that would show that the results were due to the effect of light on the plant. [2]

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(c) A computer simulation was used to show the effect of stoma size on transpiration rate. The results are shown below.

Mean stoma size (a.u.)	Rate of transpiration (µg/h)
40	100
80	105
120	110
140	117
160	120
200	120

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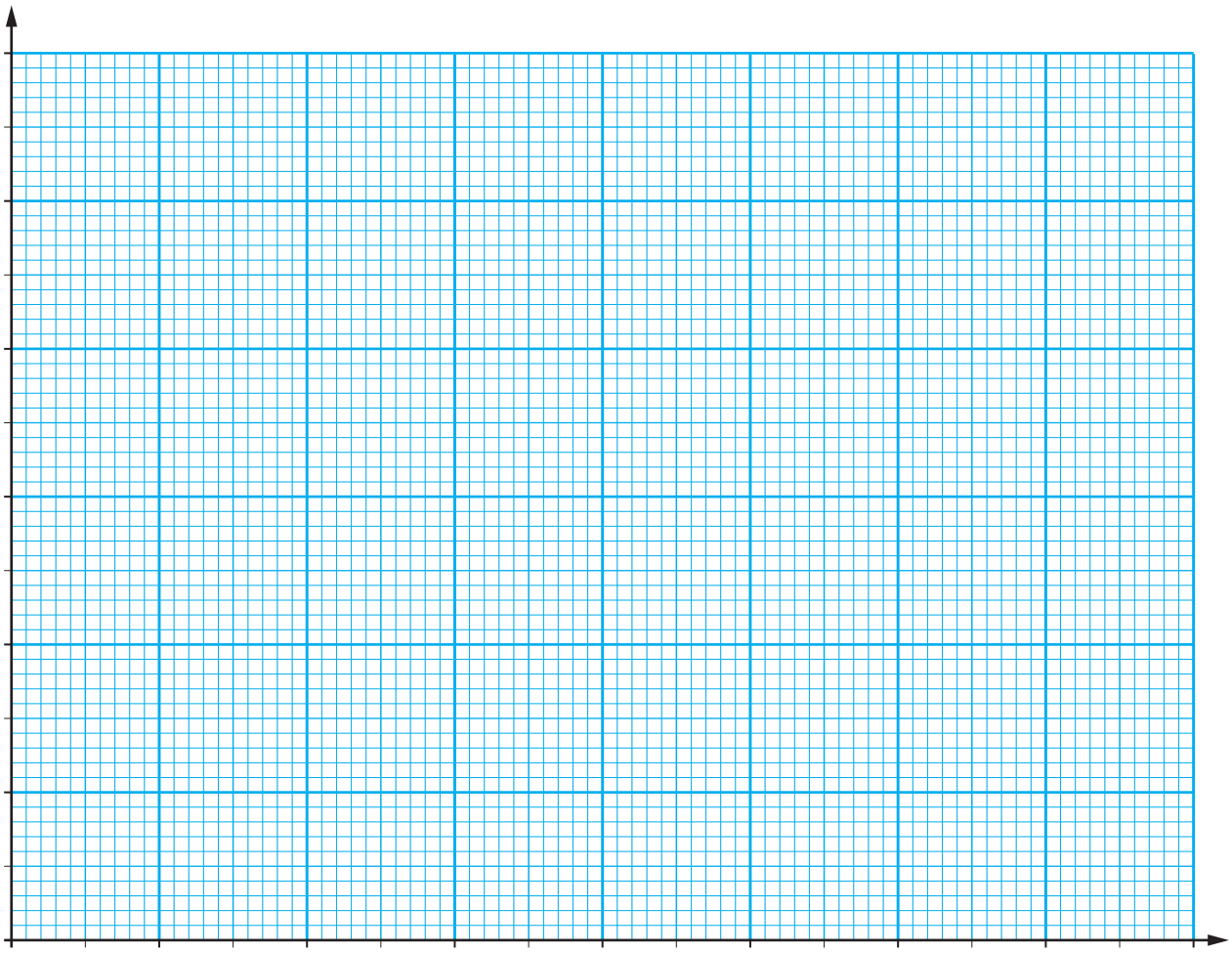
(i) Draw a graph of the results on the grid below. [5]



(ii) Explain the effect of increasing stoma size on the rate of transpiration. [3]

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7. Melanocytes are specialised skin cells. They make two forms of the pigment melanin, called eumelanin and pheomelanin. These two pigments help determine the colour of a person's hair and skin. The production of these pigments is controlled by the MC1R gene which has two alleles.

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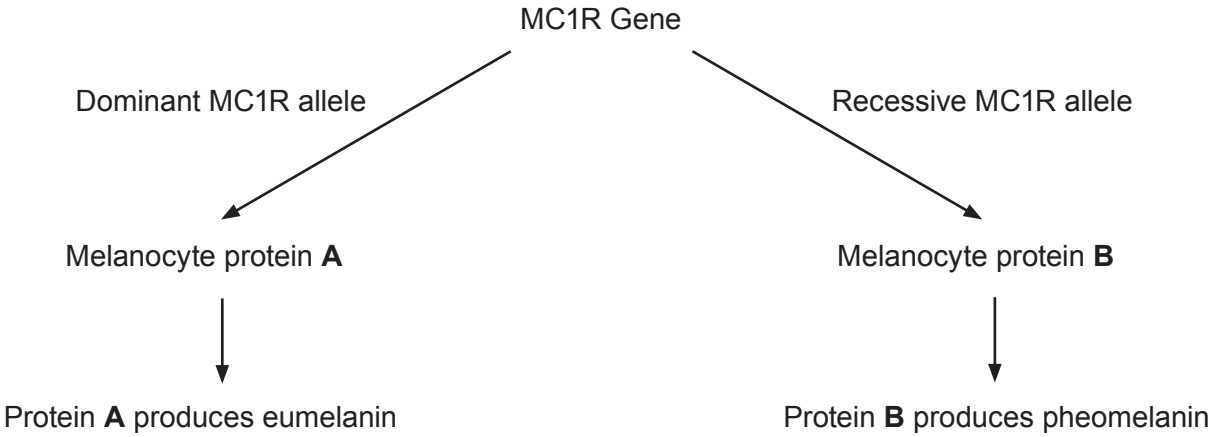
The flow chart shows how the two different alleles for the MC1R gene work.



People who produce eumelanin tend to have darker skin. Eumelanin protects skin from damage caused by ultraviolet (UV) radiation in sunlight. People who produce pheomelanin tend to have lighter skin. Pheomelanin does not protect skin from UV radiation, so people with pheomelanin have an increased risk of melanoma skin cancer, caused by exposure to the sun.

(a) (i) State what is meant by the terms:

I. recessive; [1]

.....

II. allele. [1]

.....

(ii) Name the type of cell division linked to cancer. [1]

.....

(iii) Describe and explain how the different MC1R alleles lead to the production of different proteins, such as protein **A** or protein **B**, through the process of protein synthesis. [5]

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(b) (i) Construct a Punnett square in the space below and use it to calculate the probability of two heterozygous individuals producing a child who has a higher than normal risk of developing mutations linked to skin cancer. Use the letters given below to represent the dominant and recessive alleles. [5]

Key: **R** represents dominant MC1R allele
r represents recessive MC1R allele

Phenotype ..... × .....

Genotype ..... × .....

Probability = ...

(ii) Suggest how a homozygous recessive individual could try to reduce the potential harmful effects of the MC1R allele. [1]

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8. In 1996 the World Food Summit set the target for eradicating hunger in all countries, with an immediate view to reducing the number of undernourished people to half the present level no later than 2015.
The Food and Agriculture Organization (FAO) of the United Nations (UN) has developed food security indicators to estimate the extent of undernourishment in countries around the World. One such indicator is average dietary energy supply (ADES). This expresses the dietary energy supply (DES) as a percentage of the average dietary requirement. Percentages less than 100 indicate undernourishment.
A sample of data from Africa is shown below.

Regions / subregions	Average dietary energy supply (%)				
	1990-92	1996-98	2002-04	2008-10	2014-16
Africa	107	109	111	115	117
Northern Africa	138	139	139	143	148
Sub-saharan Africa	100	102	105	109	111
Eastern Africa	89	90	94	98	101
Middle Africa	101	94	93	95	95
Western Africa	107	115	118	124	125

(a) State the conclusions that you can draw from the data in the table about food supply in the different regions of Africa. Describe the challenges facing African regions in ensuring an adequate level of food security in order to reduce the number of undernourished people.
[6 QER]

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(b) Vitamin A deficiency is considered to be one of the most harmful forms of malnutrition in the developing world. It can cause blindness, limit growth and weaken the body's immune system. It is probably the leading cause of blindness in developing nations.
Golden rice is a variety of rice (*Oryza sativa*) genetically engineered to produce ß-carotene, which is needed to produce vitamin A.

A gene from the daffodil (*Narcissus*) and a gene from the soil bacterium (*Erwinia uredovora*), can be inserted into the rice genome. The two genes cause the rice to produce ß-carotene.

(i) Outline the main steps scientists could have used to produce golden rice. [4]

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(ii) Suggest why the use of Golden Rice is opposed by some environmental groups. [1]

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9. In 2017, the US Centre for Disease Control and Prevention reported that a woman who died in Nevada was infected with a strain of *Klebsiella* bacteria. This strain of *Klebsiella* was resistant to 26 different antibiotics.

(a) (i) Suggest an explanation for the evolution of antibiotic resistant *Klebsiella*. [5]

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(ii) State **two** possible causes of the spread of antibiotic resistance in *Klebsiella*. [2]

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(b) In 2016, scientists in the USA announced the discovery of Teixobactin, the first new antibiotic in 30 years.
Outline the process scientists will need to follow before Teixobactin can be licensed for use by doctors and suggest why this is the first antibiotic discovered in 30 years. [5]

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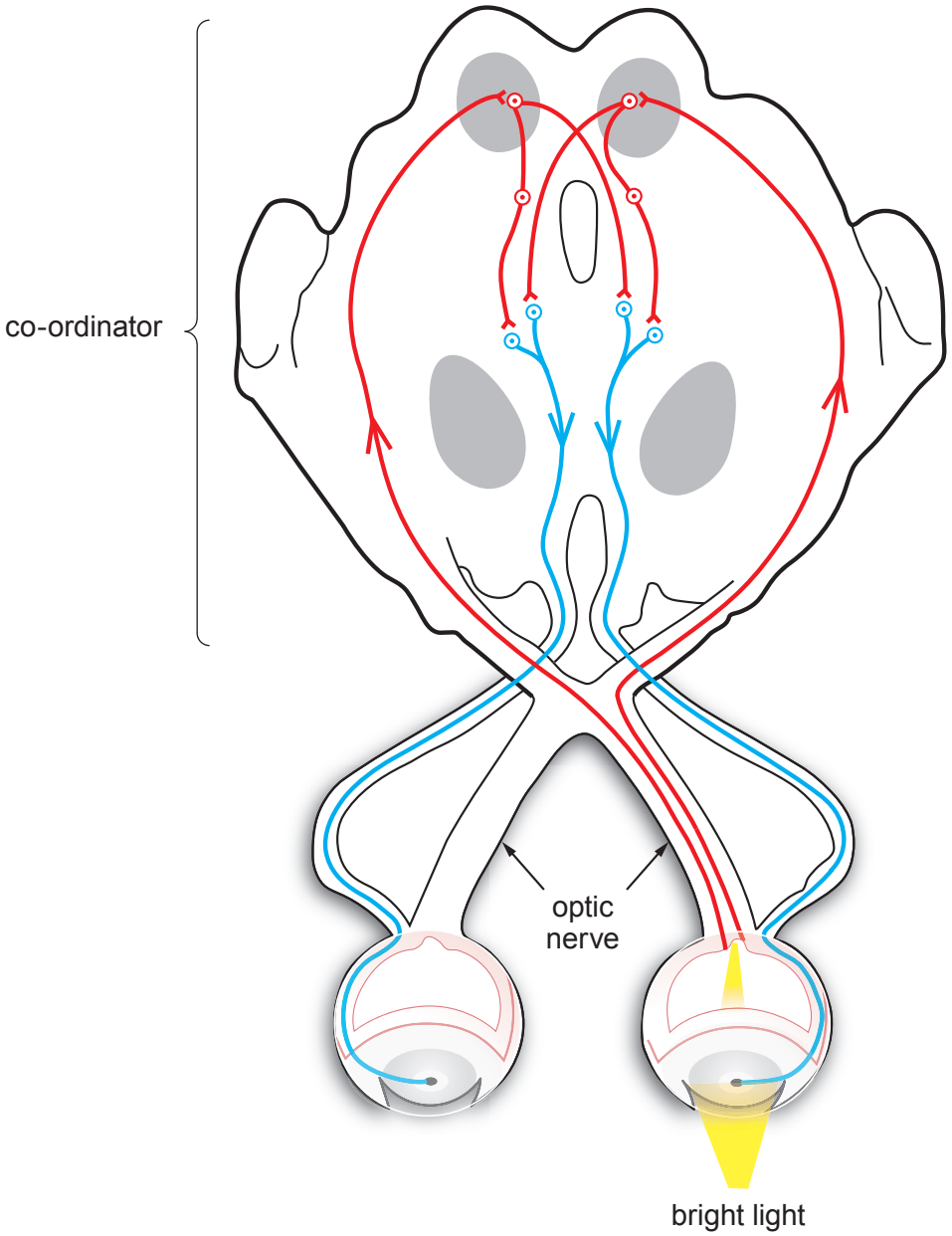
10. The changes in pupil diameter in the right and left eye are linked. Shining a bright light into one eye leads to a change in the diameter of both pupils.



(a) (i) **On the diagram above, label** a synapse and a sensory neurone. [2]

(ii) In the reflex action shown above, state the name of:

I. the co-ordinator; ..... [1]

II. the effector. ..... [1]

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(b) Suggest why this reflex action is particularly fast. [1]

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(c) Use the diagram and your own knowledge to explain how shining a light in the left eye brings about a change in the diameter of **both** pupils. [5]

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END OF PAPER

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