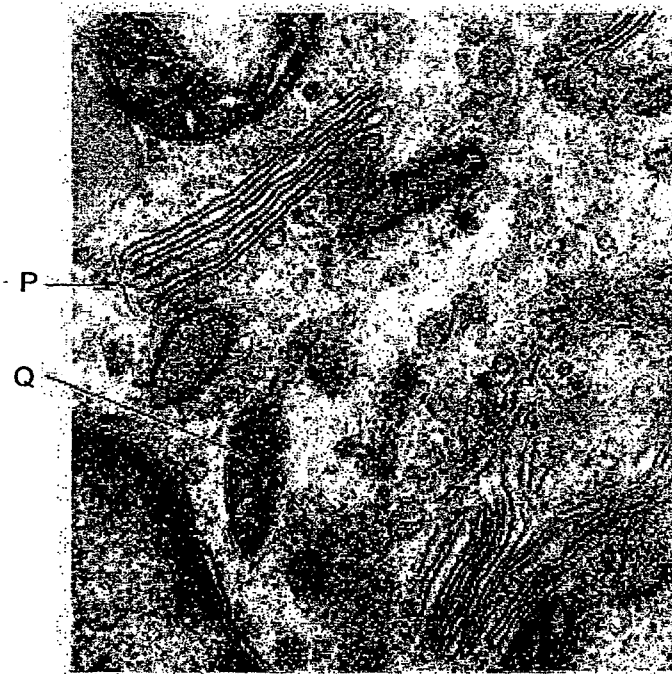


- 1 The cell wall of a plant cell is removed using an enzyme.

What would happen if this cell is then placed in distilled water?

- A It would take longer for the cell to become turgid.
  - B Proteins in the cytoplasm would leave through the cell membrane
  - C The cell would become smaller as water passes out.
  - D The cell would burst as water moves into it.
- 2 The photomicrograph shows a part of an animal cell.



Which of the following functions of structures P and Q are correct?

- |   | structure P                 | structure Q                 |
|---|-----------------------------|-----------------------------|
| A | package and stores proteins | carries out respiration     |
| B | package and stores proteins | controls activities of cell |
| C | synthesises proteins        | carries out respiration     |
| D | synthesises proteins        | controls activities of cell |

3 Samples of milk, honey, butter and meat were tested for their energy content.

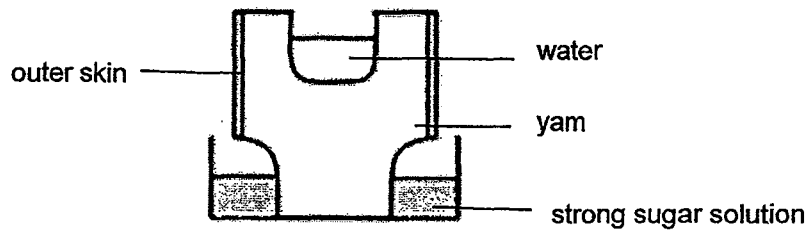
The results are shown below.

	energy / kJ / g
E	3.2
F	12.0
G	13.3
H	37.6

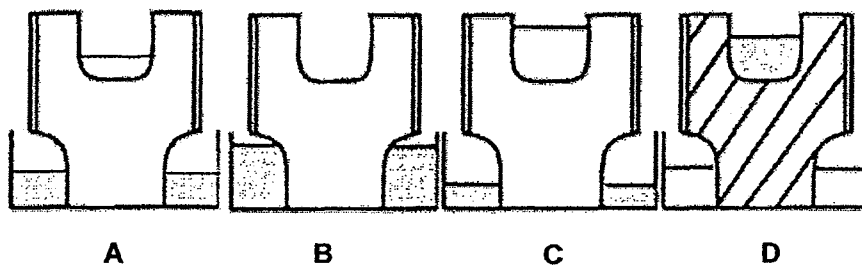
Which substance is butter?

- A E
- B F
- C G
- D H

4 The diagram shows an experiment that was used to investigate osmosis in yam tissue.



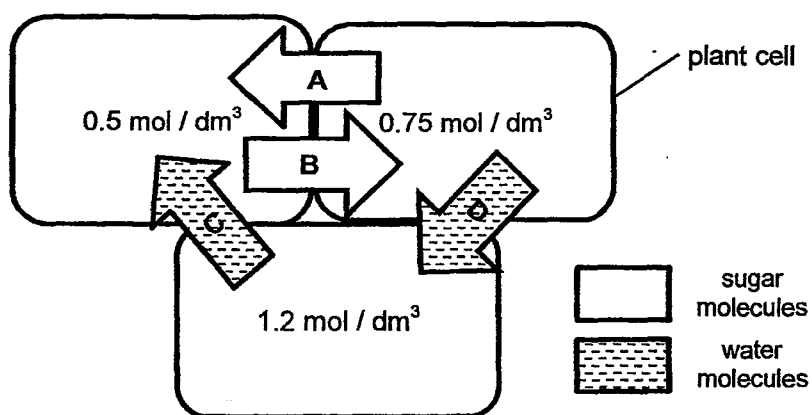
Which of the following diagrams shows the results after twenty-four hours?



- 5 The diagram shows 3 plant cells. The concentration of the cell sap of each cell is indicated.

The arrows show the direction of movement of particles into and out of the cells.

Which arrow represents active transport?



- 6 Enzyme action can be explained by the lock and key hypothesis.

Where is the active site and which substance, enzyme or substrate, acts as the lock or key?

	active site	lock / key
A	on the enzyme	substrate acts as a key
B	on the enzyme	substrate acts as a lock
C	on the substrate	enzyme acts as a key
D	on the substrate	enzyme acts as a lock

- 7 A sample of unknown food substance is tested for the presence of proteins.

Which of the following steps would be needed?

*Shaded box indicates that the step is essential.*

	add benedict's solution	add dilute copper (II) sulphate solution	add iodine solution	add dilute sodium hydroxide solution	heat
A					
B					
C					
D					

8 A starch agar plate has several wells cut into it.

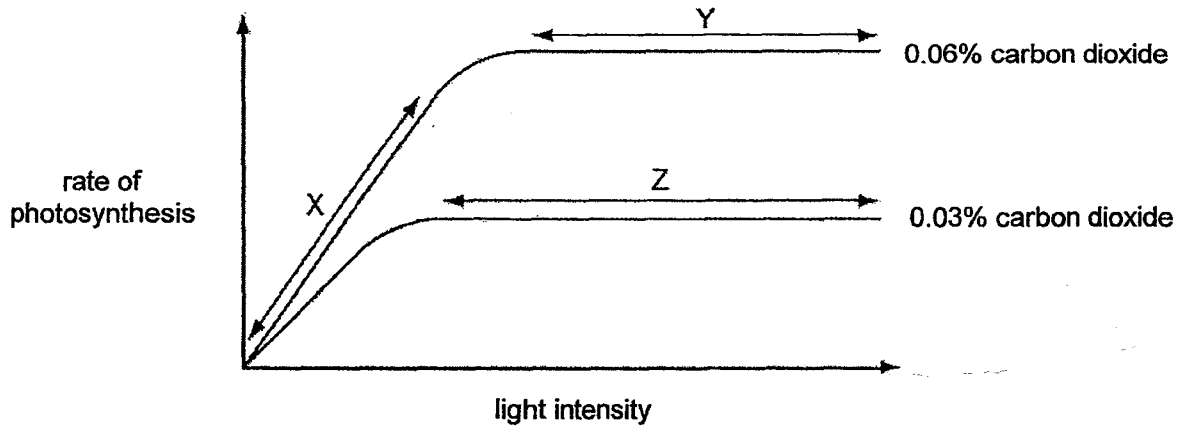
Different solutions are placed in the wells as follows:

well	solution
1	saliva
2	gastric juice
3	pancreatic juice
4	extract from gall bladder
5	small intestinal juice

Which two wells will show starch digestion?

- A 1 and 2
- B 1 and 3
- C 1 and 4
- D 2 and 5

9 The graph shows the rate of photosynthesis of a plant at increasing light intensities at two different carbon dioxide concentrations.



The temperature is kept constant.

What may be limiting the rate of photosynthesis at X, Y and Z?

	X	Y	Z
A	carbon dioxide	light intensity	carbon dioxide
B	carbon dioxide	light intensity	light intensity
C	light intensity	carbon dioxide	carbon dioxide
D	light intensity	carbon dioxide	light intensity

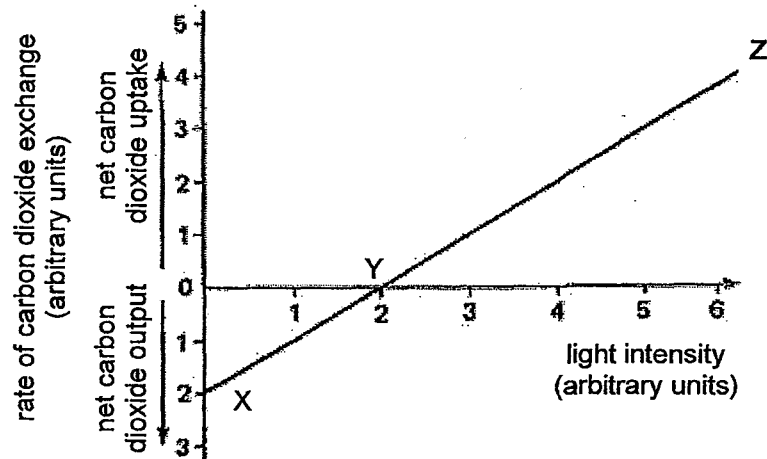
- 10 Heart attacks are a leading cause of death in Singapore and are linked to lifestyle factors.

Which of the following lifestyle factors are often linked to increased chances of heart attacks?

- i diet high in polyunsaturated fats
- ii habit of smoking
- iii lack of exercise

- A i and ii only
- B i and iii only
- C ii and iii only
- D i, ii and iii.

- 11 The graph shows the effect of changing light intensity on the rate of carbon dioxide absorbed or released by green plants.



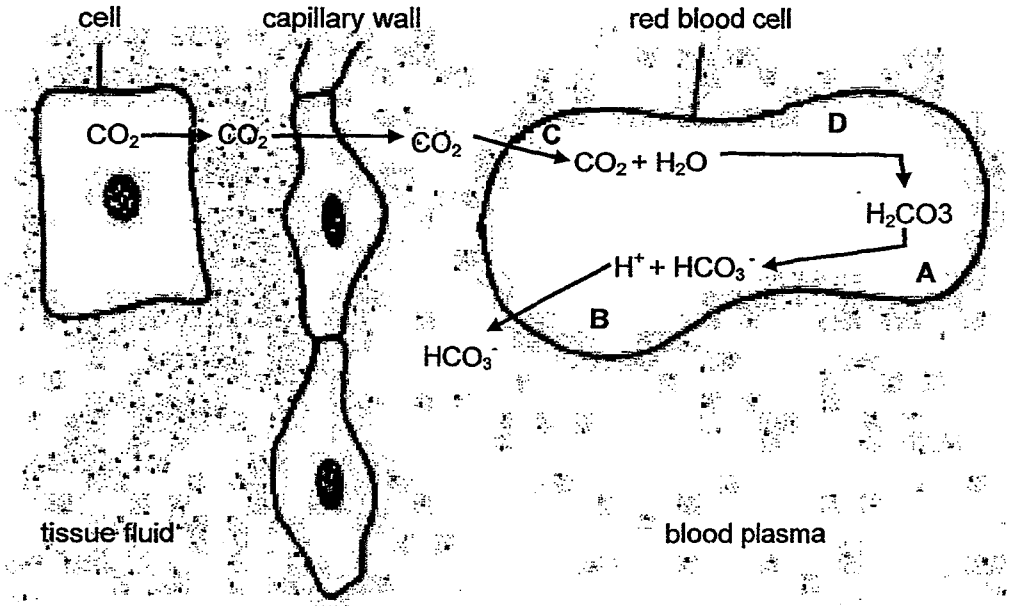
Which of the following statements is/are correct?

- i Between X and Y, the photosynthetic rate is greater than the respiratory rate.
- ii Between Y and Z, the respiratory rate is greater than the photosynthetic rate.
- iii Respiration is occurring at Z.

- A i only
- B iii only
- C i and ii only
- D i, ii and iii

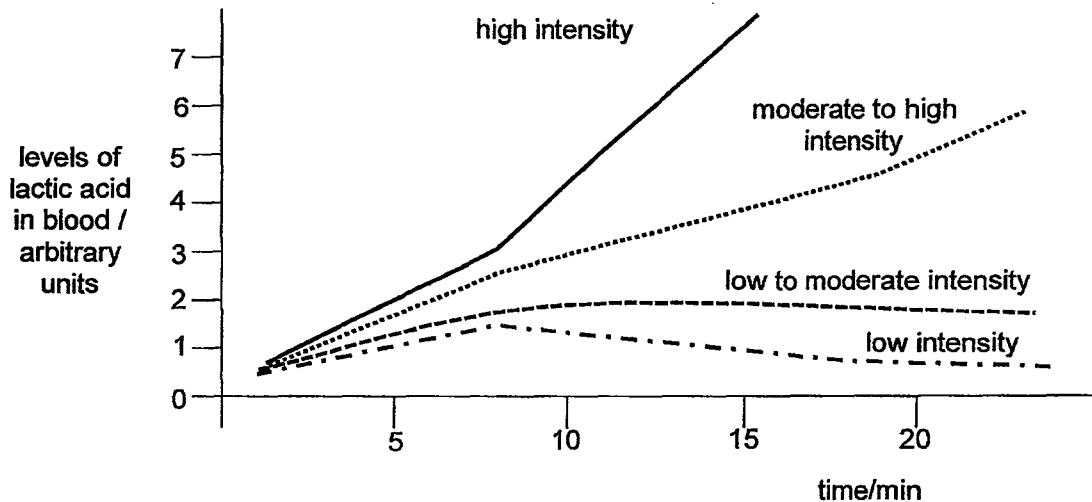
- 12 The diagram represents the relationship between tissue cells and capillaries in the transport of carbon dioxide.

At which point A, B, C or D does carbonic anhydrase act?



- 13 A particular sport allows muscles to work for a longer time before lactic acid levels in the body affect performance.

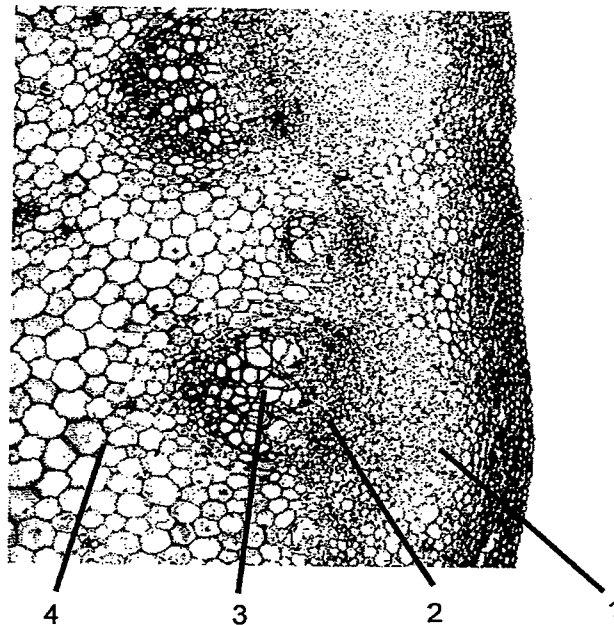
The graph shows the levels of lactic acid in the blood with different exercise intensities.



During which exercise will muscles be mostly carrying out aerobic respiration?

- A low intensity
- B low to moderate intensity
- C moderate intensity
- D high intensity

- 14 The photomicrograph shows part of a sunflower stem.



Which tissue transports water and mineral salts and which tissue transports sucrose?

	water and mineral salts	sucrose
<b>A</b>	1	4
<b>B</b>	2	3
<b>C</b>	3	2
<b>D</b>	4	1

- 15 When Janice was hospitalised, her friends offered to donate blood to her for her operation.

The hospital accepted Mary's and Zarinah's donations but Siew Kim's blood was **not** accepted.

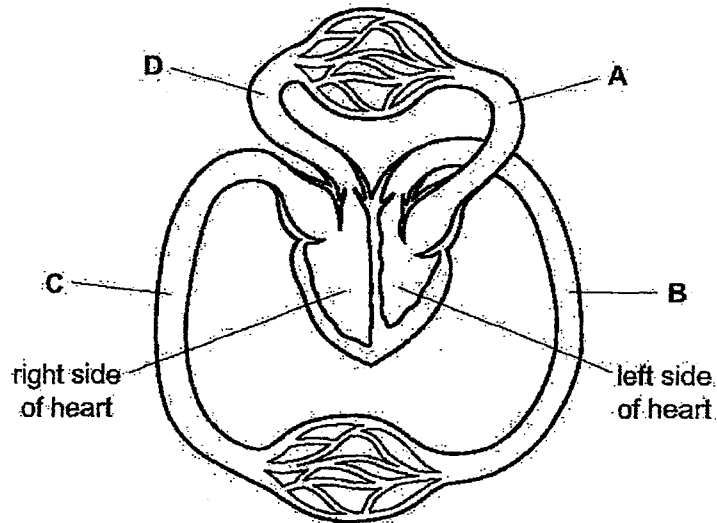
Janice has blood type A.

What are the blood types of Janice's 3 friends?

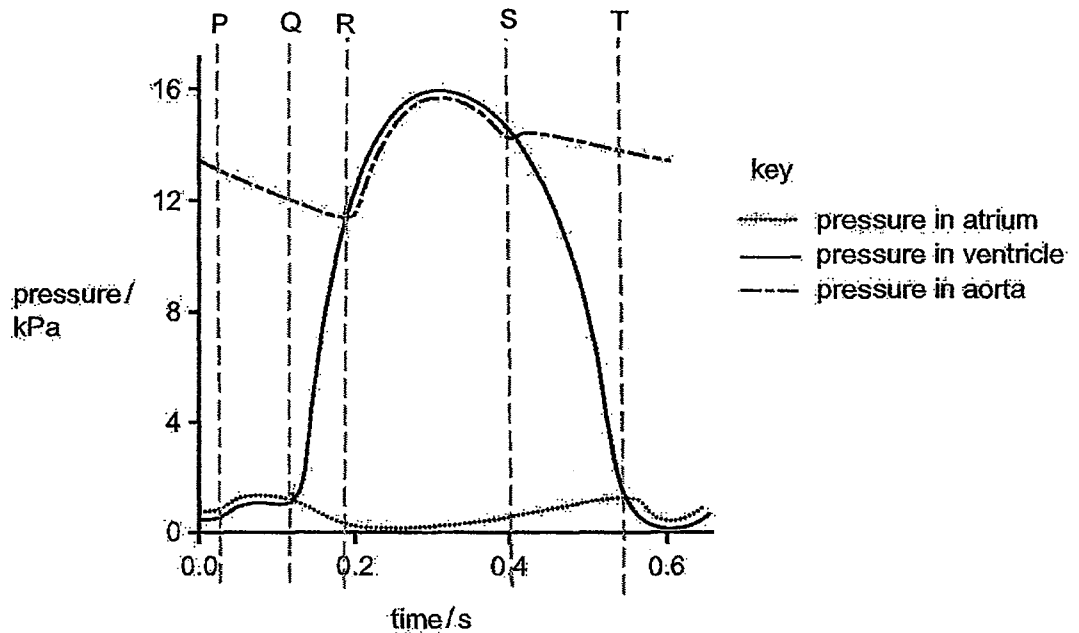
	Siew Kim	Mary	Zarinah
<b>A</b>	A	A	A
<b>B</b>	A	AB	A
<b>C</b>	B	A	O
<b>D</b>	B	B	O

16 The diagram represents part of the human circulatory system.

Where is the blood pressure highest?



17 The graph shows the pressure changes in the aorta, and the left side of the heart in one cardiac cycle.



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



18 Fig. 1 shows the front view of a sheep eye. It is dissected along the dotted lines.

Fig. 2 displays the dissected eye.

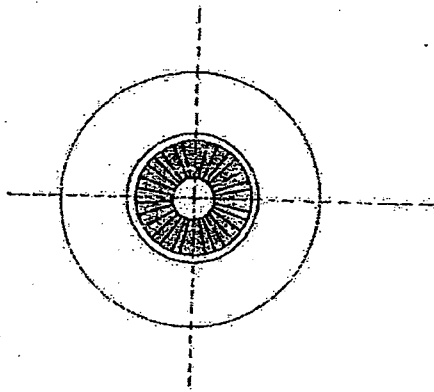


Fig. 1

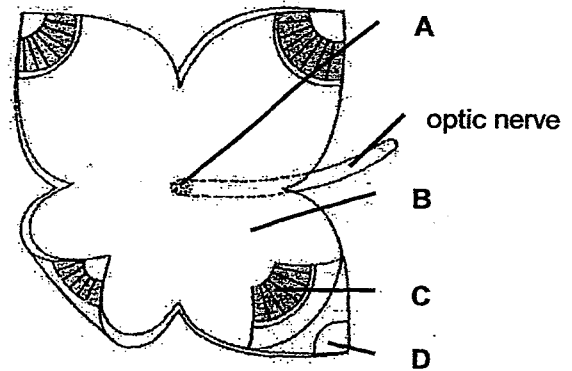


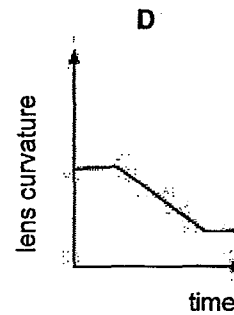
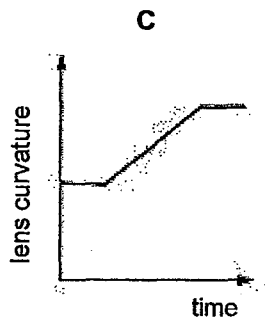
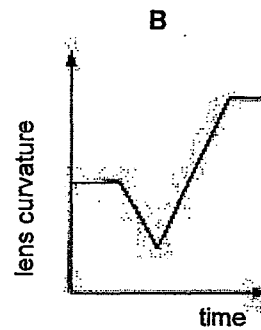
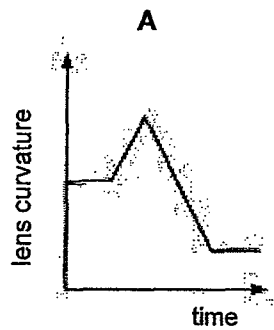
Fig. 2

Which of the following is correctly labelled?

- A yellow spot
- B sclera
- C iris
- D lens

19 A student is looking at an object moving towards her in 10 s.

Which of the following graphs represents the corresponding changes in the curvature of the lens of her eye?

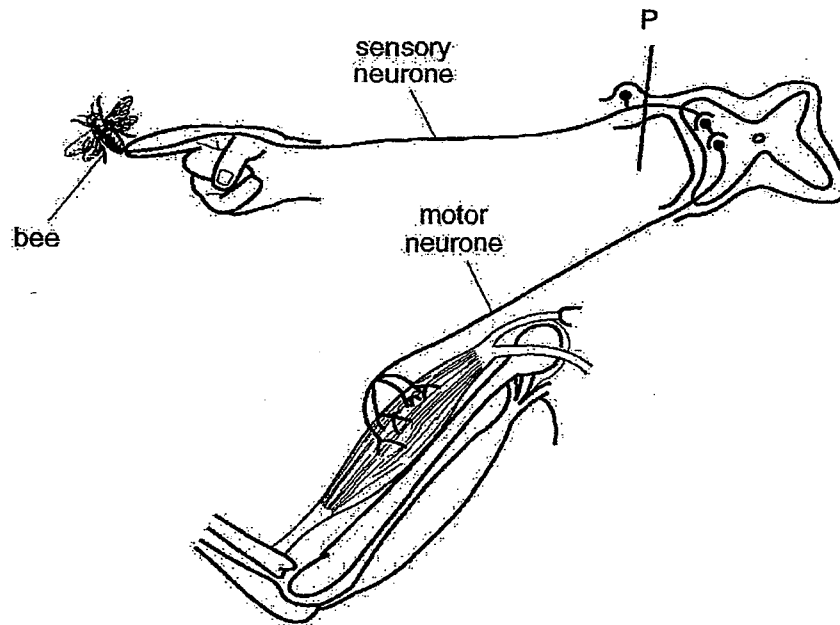


20 Which of the following statements about hormones is correct?

- A They are destroyed by the spleen.
- B They are secreted into ducts.
- C They are secreted under the control of the hypothalamus.
- D They travel around the body by the blood stream .

21 The diagram shows part of a person's nervous system that has been cut at P.

A bee stings the finger as shown.



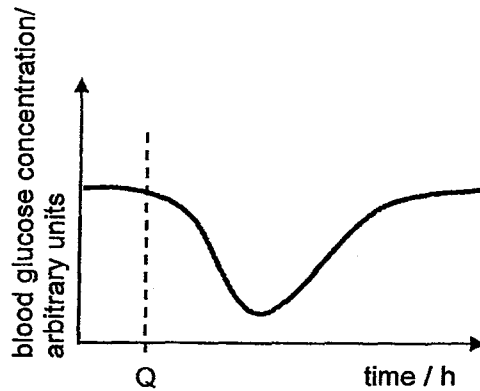
What are the effects of this sting on the person?

	pain felt	arm moved
A	no	no
B	no	yes
C	yes	no
D	yes	yes

22 Which of the following is **not** controlled by homeostasis?

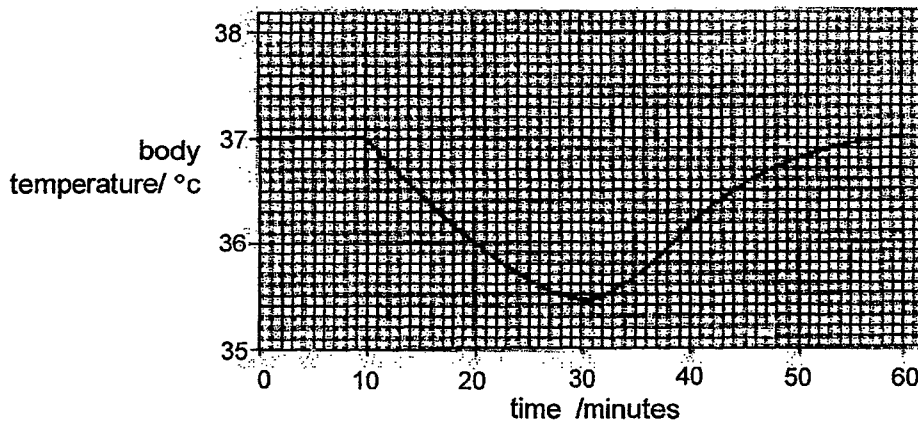
- A absorption of glucose in the small intestine
- B controlling carbon dioxide concentration in blood
- C production of urine by the kidney
- D temperature regulation by the skin

- 23 The graph shows the changes in blood glucose concentration following the injection of a small amount of a substance into the blood of a person at time Q.



Which substance was injected at time Q?

- A adrenaline
  - B glucagon
  - C insulin
  - D anti-diuretic hormone
- 24 The graph shows the body temperature of a person before, during and after taking a cold bath (temperature of the bath was 22 °C)



Which of the following was/were occurring in the skin between 30 and 55 minutes?

- i Arterioles are constricted.
  - ii Sweat glands are active.
  - iii Hair erector muscles are relaxed.
- A i only
  - B i and ii only
  - C ii and iii only
  - D i, ii and iii

- 25 The table shows the composition of liquids found in different locations in the kidney.

location substance	R	S	T
proteins	present	absent	absent
glucose (g /100 cm <sup>3</sup> of water)	0.10	0.00	0.10
urea (g/100 cm <sup>3</sup> of water)	0.03	1.8	0.03
red blood cells	present	absent	absent

Which of the following correctly identifies the location from which the liquids were taken?

	R	S	T
<b>A</b>	glomerulus	Bowman's capsule	collecting duct
<b>B</b>	glomerulus	collecting duct	Bowman's capsule
<b>C</b>	Bowman's capsule	glomerulus	collecting duct
<b>D</b>	Bowman's capsule	collecting duct	glomerulus

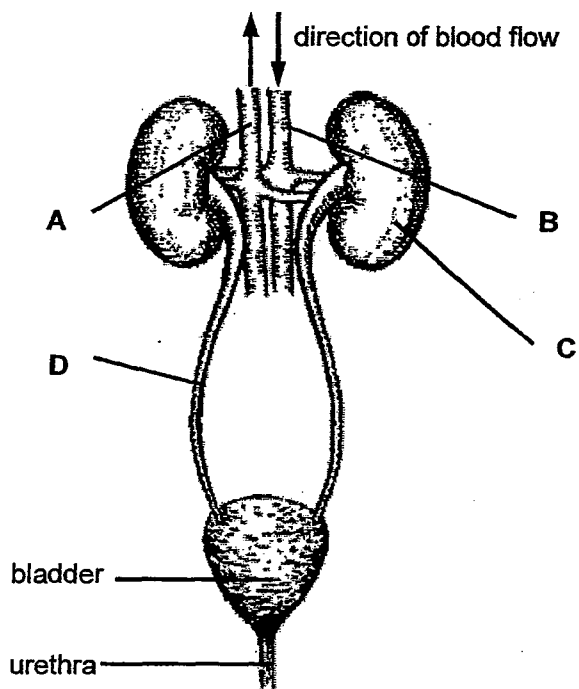
- 26 A woman runs a marathon, sweats profusely and drinks little fluid.

Which line in the table correctly summarises the events that result from this behaviour?

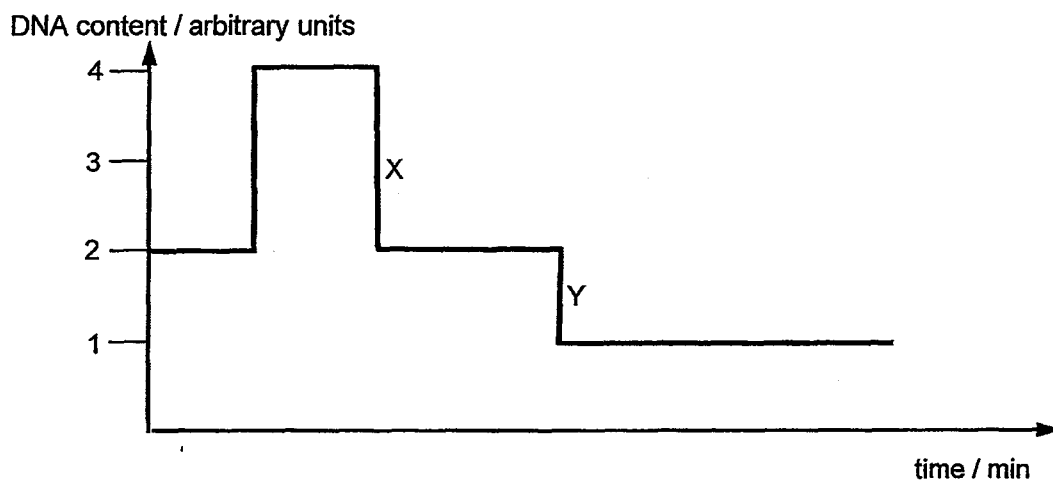
	ADH production	water absorption	urine output
<b>A</b>	increase	increase	decrease
<b>B</b>	increase	decrease	decrease
<b>C</b>	decrease	decrease	Increase
<b>D</b>	decrease	increase	Increase

27 The diagram shows part of the urinary system.

Where is urea most concentrated?



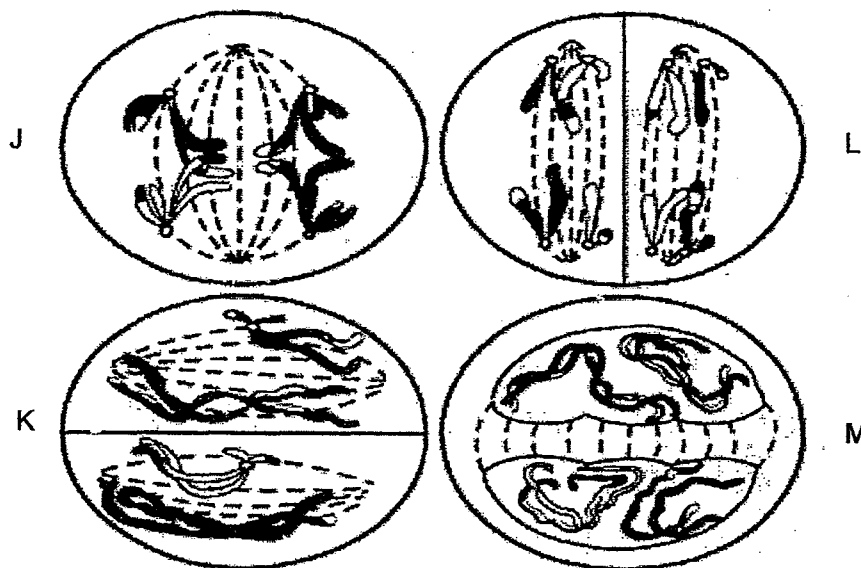
28 The graph shows the amount of DNA present in the nuclei of cells undergoing division in a multicellular organism.



Identify the type of cell division and the phases at X and Y.

	type of cell division	X	Y
A	meiosis	metaphase I	telophase II
B	meiosis	telophase I	telophase II
C	mitosis	anaphase	telophase
D	mitosis	metaphase	telophase

29 The diagram shows four phases of meiosis.



Identify the four phases of meiosis illustrated in the diagram.

	J	K	L	M
A	anaphase I	metaphase II	anaphase II	telophase I
B	metaphase I	prophase II	metaphase II	telophase I
C	prophase I	telophase I	metaphase II	prophase II
D	anaphase I	telophase I	anaphase II	prophase II

30 The base sequence for part of the gene that codes for a particular polypeptide is

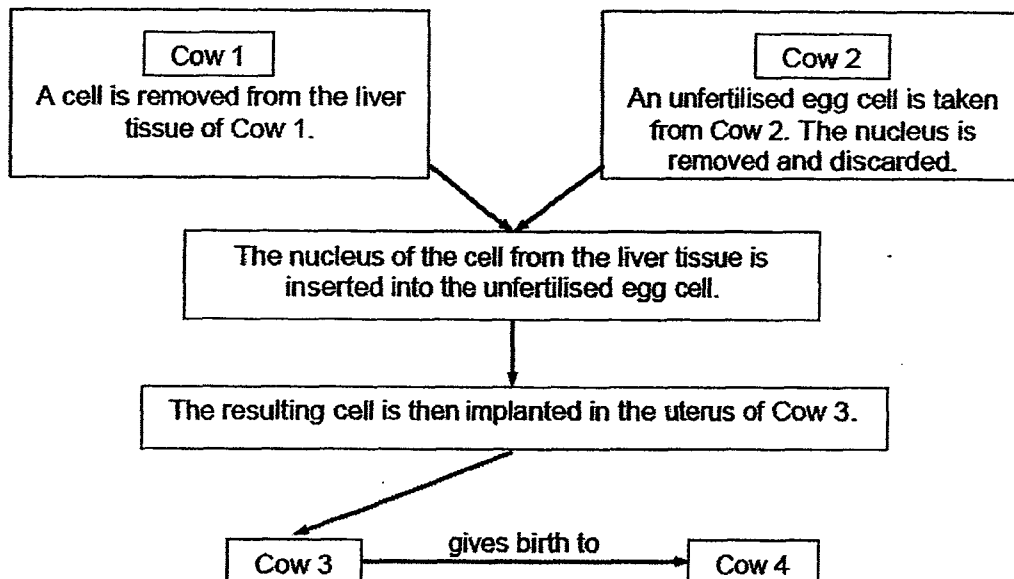
...CTCGTCTTAGGTGTTTCC...

In the mutant form, the underlined base 'T' in the sequence above is missing.

What is the most likely effect of this deletion?

- A No polypeptide will be made at all.
- B One amino acid in the polypeptide will be changed.
- C The polypeptide chain will be shorter.
- D Two chains of polypeptide will be produced.

31 The diagram shows a procedure being carried out on cows.

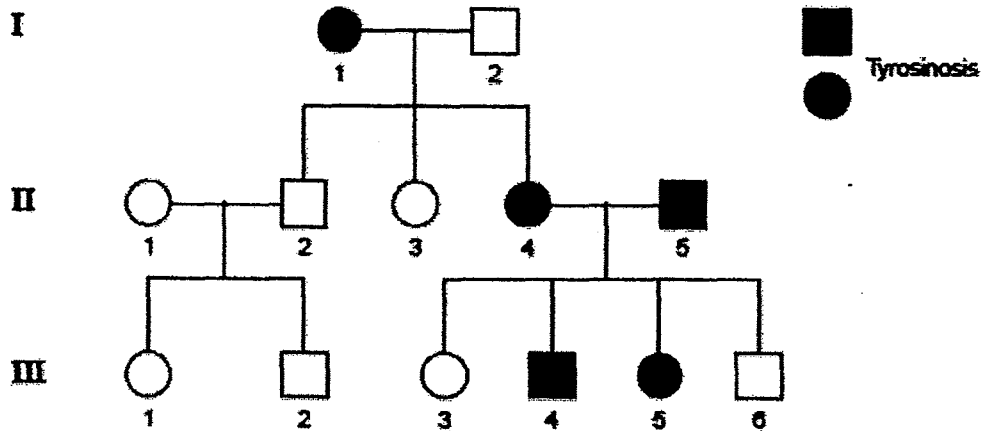


Which cows are genetically identical?

- A Cow 1 and Cow 3
  - B Cow 1 and Cow 4
  - C Cow 2 and Cow 4
  - D Cow 3 and Cow 4
- 32 Which of the following statements does **not** explain why body weight in sheep exhibits continuous variation?
- A Body weight is influenced by availability of food in the habitat.
  - B Body weight is controlled by a few genes in the sheep genome.
  - C In the cold winter months, sheep accumulate fat and put on more weight.
  - D There is a wide range of genotypes that control body weight within a population of sheep.

- 33 In humans, a biochemical disorder known as Tyrosinosis has been investigated.

The diagram shows the inheritance of Tyrosinosis, in one family. The gene for Tyrosinosis is located on an autosome.



The symbol  $T/t$  is used to represent the alleles for Tyrosinosis.

Which of the following is correct?

	Is Tyrosinosis a Dominant or Recessive Trait?	Genotype of individual	
		II - 4	III - 6
A	Dominant	$Tt$	$tt$
B	Recessive	$tt$	$TT$
C	Dominant	$TT$	$tt$
D	Recessive	$Tt$	$Tt$

- 34 A couple who had been unsuccessful in having a baby wished to take advantage of the technique of in-vitro fertilization (commonly called 'test tube baby').

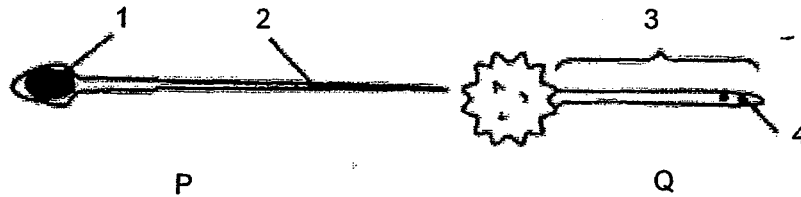
This technique fertilizes the woman's own egg with her husband's sperm outside the body. When the fertilized egg develops successfully into an embryo, the embryo is transferred back to the mother's womb for further development.

Which of the following infertility problems could be most easily overcome in this way?

- A Blocked oviducts from severe infection.
- B Failure of the follicle to mature.
- C Narrow vagina that prevents child birth by natural means.
- D Uterine lining is too thin



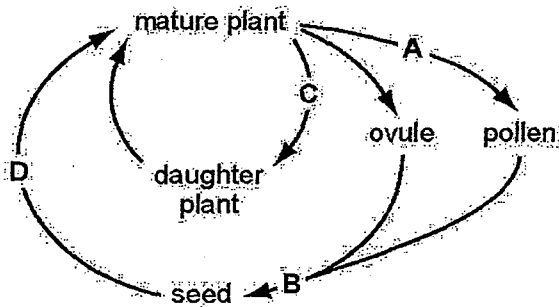
- 35 P and Q in the diagram are the reproductive structures of a mammal and a flowering plant respectively.



Which of the following comparisons between P and Q is correct?

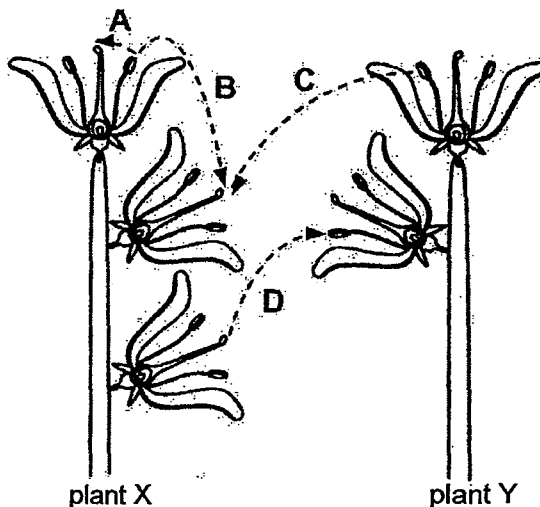
- A Both P and Q are male gametes.
  - B Both structures 1 and 4 carry the Y chromosome.
  - C Both structures 1 and 4 contain the same number of chromosomes.
  - D Both structures 2 and 3 enable the male gamete to meet the female gamete.
- 36 The diagram shows the life cycle of a species of plant.

Which stage will produce genetically identical plants?

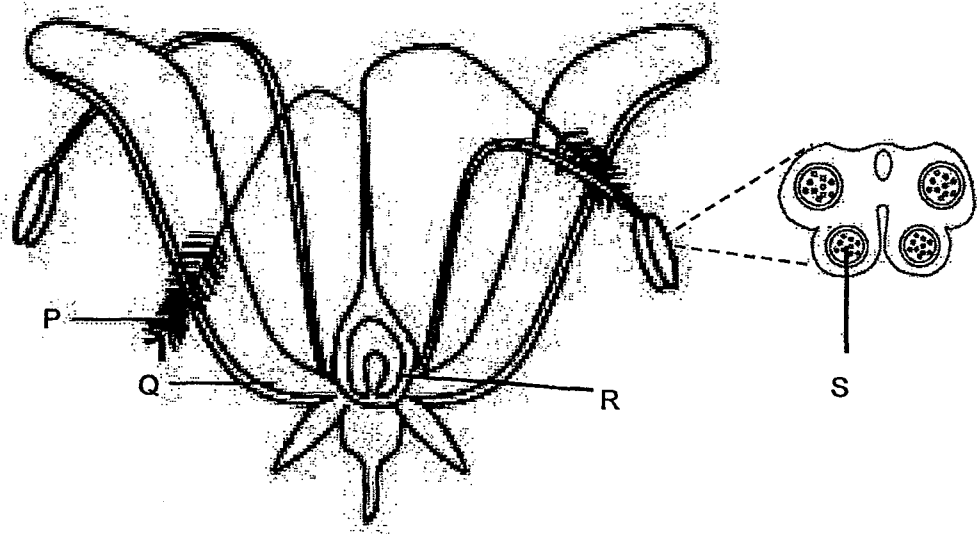


- 37 The diagram shows two plants X and Y, that are the same type of plant.

Which arrow represents cross-pollination?

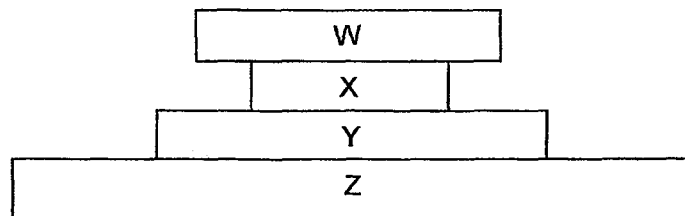


- 38 Which of the following correctly describes the cells of the different parts of the flower shown?



	P	Q	R	S
A	diploid	diploid	diploid	haploid
B	diploid	diploid	haploid	haploid
C	haploid	diploid	haploid	haploid
D	haploid	diploid	haploid	diploid

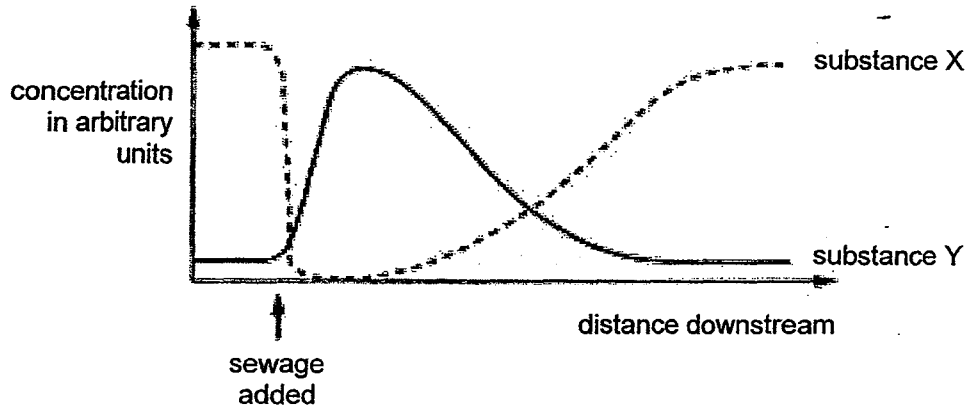
- 39 The diagram shows a pyramid of numbers of a food chain.



Which of the following statements about the organisms in the food chain is true?

- A W can photosynthesise.
- B W is a larger organism than X.
- C Y is the prey of X.
- D Z is a primary consumer.

- 40 The diagram shows changes in the concentration of two substances, X and Y, in the water of a river polluted by sewage.



What are substances X and Y?

	X	Y
A	carbon dioxide	nitrates
B	nitrates	carbon dioxide
C	nitrates	oxygen
D	oxygen	nitrates

END OF PAPER



Section A (50 Marks)

Answer all the questions in this section in the spaces provided.

- 1 Fig. 1.1 is a diagrammatic representation of the small intestine containing three types of food molecule, A, B and C, before they have been digested. The different features have not been drawn to the same scale.

It also shows a lacteal and a capillary.

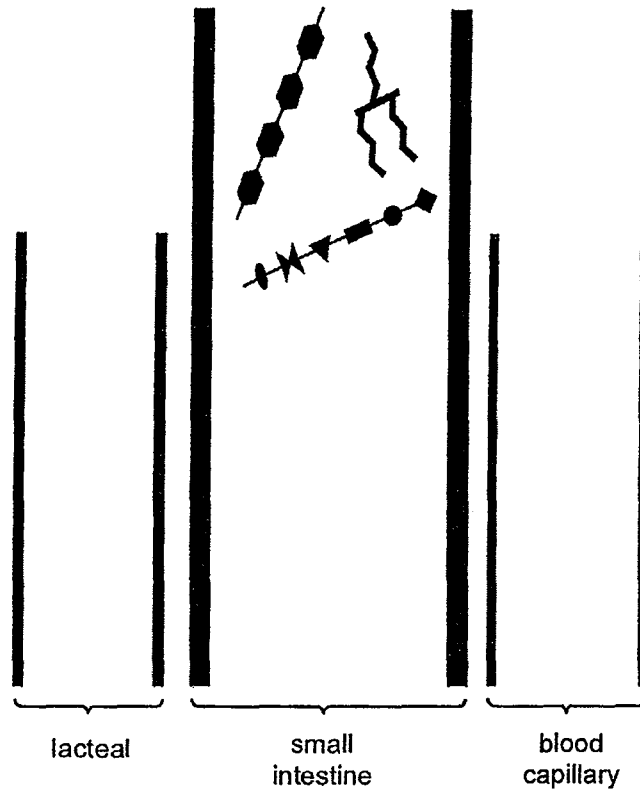


Fig. 1.1

- (a) On Fig. 1.1, draw and label the molecules as they would appear after they have been digested and then absorbed by the lacteal and by the capillary.

[3]

- (b) Regular injections of insulin are administered to diabetics. Insulin cannot be taken orally (eaten as a pill).

Explain why this is not possible.

.....

.....

.....

[2]

[Total: 5 marks]

- 2 Fig. 2.1 shows the apparatus used in an investigation on photosynthesis.

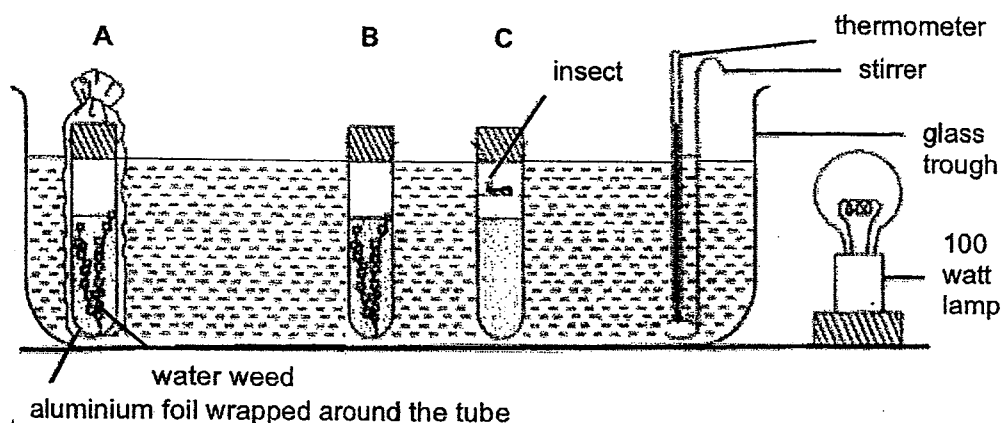


Fig. 2.1

All the test-tubes contain 10cm<sup>3</sup> of bicarbonate indicator solution (red at the beginning of experiment).

The colour changes of the bicarbonate indicator over a fixed period of time give an indication of the concentration of carbon dioxide in the test-tubes. Carbon dioxide is a weak acidic gas which turns bicarbonate indicator yellow when present in higher concentrations and purple in low concentrations.

Colour of bicarbonate indicator:

yellow	red	purple
Acidic	Neutral	Alkaline

- (a) Predict the colour of the indicator solution in test-tubes A and B at the end of the two hours. Explain your prediction.

test - tube	colour of indicator solution after two hours	explanation of prediction
A		
B		

[4]

- (b) In another experiment, some water plants were added into test tube C. The indicator solution changed from yellow to purple.

Explain the results.

.....  
 ..... [1]  
 .....

[Total: 5 marks]

- 3 Fig 3.1 shows a cluster of air sacs in a lung and Fig 3.2 shows a villus in a small intestine. The arrows indicate the direction of blood flow in the capillaries.

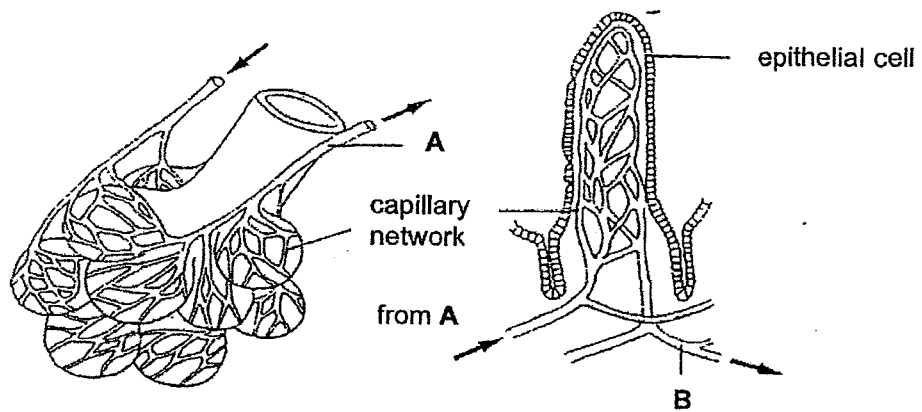


Fig. 3.1

Fig. 3.2

- (a) Both the air sac and the villus are richly supplied with blood capillaries.

State **two** reasons explaining how this feature can speed up the absorption of substances.

.....  
.....  
.....  
..... [2]

- (b) State the change in carbon dioxide content as blood travels from A to B.

Explain why this change occurs.

.....  
.....  
.....  
.....  
..... [3]

[Total: 5 marks]

4 Amanda and Li Xing quietly crept up to Grace who was resting her head on her desk between lessons. They shouted loudly into her ear. Grace gave a shout of surprise and her heart rate sped up.

(a) Describe the pathway in Grace's body that caused her heart rate to speed up.

.....

.....

.....

.....

.....

.....

.....

.....

[4]

(b) Describe how the muscles of the iris in Grace's eye respond during the incident.  
Explain why the response is an advantage to her.

.....

.....

.....

.....

[2]

(c) Secretion of adrenaline often results in increased sweating.

Based on your understanding of the effect of adrenaline on metabolic rate, explain this observation.

.....

.....

.....

.....

.....

.....

.....

[3]



- (d) During an asthma attack, a person's bronchioles constrict. In severe attacks, adrenaline is injected into the bloodstream.

Explain why adrenaline is used as a treatment during an asthma attack.

.....

.....

.....

..... [2]

[Total : 11 marks]

- 5 Fig 5.1 shows a cell in an ovary in the interphase stage of the cell cycle.

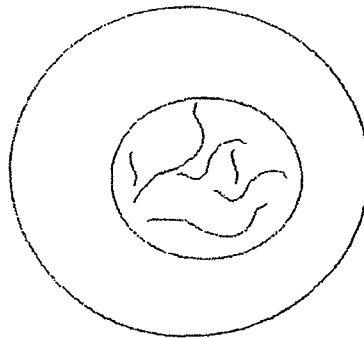


Fig. 5.1

- (a) On Fig. 5.1 label a pair of chromatid threads that have the same genes. [1]
- (b) On Fig. 5.2, draw the chromosome arrangement of this cell in metaphase II.

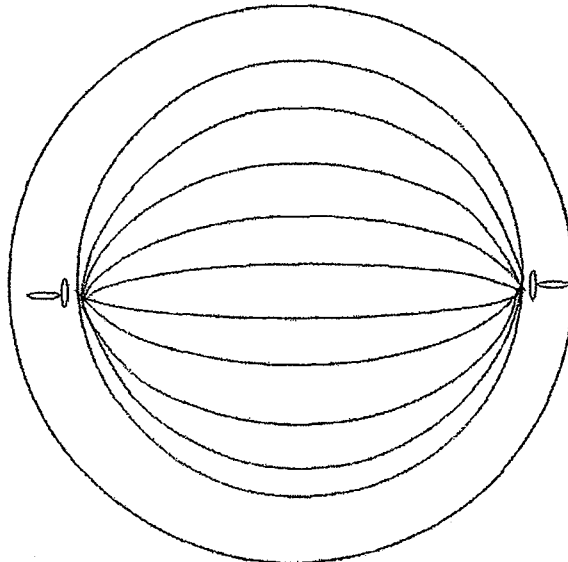


Fig. 5.2

[3]

- (c) State the number of chromosomes which could be found in a haploid cell in this animal.

..... [1]  
.....

- (d) Explain why the ovum produced in the ovary is a haploid cell.

.....  
.....  
.....  
..... [2]  
.....

[Total: 7 marks]

- 6 Fig. 6.1 shows two forms of a moth, the dark coloured and light coloured moth. These moths rest on trees and are eaten by birds.



Fig. 6.1

During the late 19th century when the Industrial Revolution began in Britain, smoke particles produced by the developing industry began to gradually darken the trunks of the trees on which the moths rested.

A survey on the number of dark coloured and light coloured moths was carried out in a polluted area and an unpolluted area.

Moths were collected in the morning, marked on the underside and released. They were collected again later the same day.

The results are shown in the Table 6.1.

area		number of moths	
		light coloured	dark coloured
unpolluted	released	496	473
	recaptured	62	30
polluted	released	64	154
	recaptured	16	82

Table 6.1

Table 6.2 shows the percentage of moths recaptured in these areas.

area	% recaptured	
	light coloured	dark coloured
unpolluted	12.5	6.0
polluted	25.0	53.0

Table 6.2

- (a) (i) Explain why the moths were marked on the underside rather than on the upper side.

[1]

- (ii) Explain the difference in the percentage of light coloured and dark coloured moths recaptured in the unpolluted area.

[3]

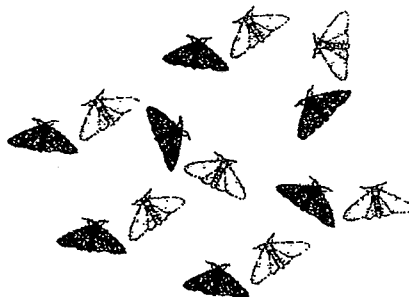
- (b) The dark form of the peppered moth spread rapidly in Britain's 19<sup>th</sup> century industrial and sooty environment. This is a classic example of natural selection.

With reference to the moths, describe the principle of natural selection.

[3]

Scientists have determined that a single gene controls the body colour of the peppered moth. The dark phenotype is controlled by a dominant allele.

**Fig. 6.2** shows a sample of moths in the F<sub>1</sub> generation produced by crossing a black coloured moth and a white coloured moth.



**Fig. 6.2**

- (c) Two black F<sub>1</sub> generation moths from the sample in **Fig 6.2** are randomly chosen and crossed.

An F<sub>2</sub> generation of 60 moths were produced.

Predict the number of dark coloured moths in the F<sub>2</sub> generation.

Explain your answer.

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[3]

[Total: 10 marks]

7 Fig 7.1 shows a flower of the white deadnettle plant.

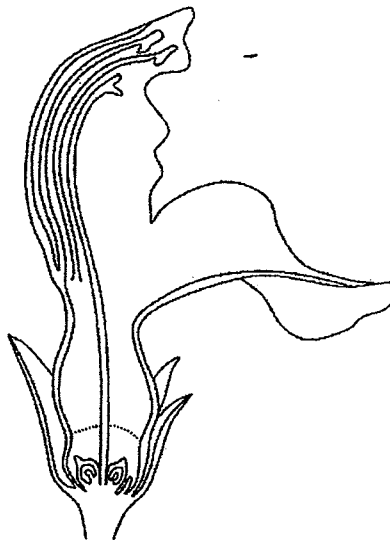


Fig. 7.1

(a) (i) State how white deadnettle flowers are pollinated.

[1]

(ii) Explain your answer based on what is observed in Fig. 7.1.

[2]

(b) Describe the pollen grain produced by the white deadnettle flower.

[2]

(c) (i) Give one reason why self-pollination may be a disadvantage for a plant.

[1]

(ii) State how a plant like the white deadnettle may prevent self-pollination.

[1]

[Total: 7 marks]

Name : \_\_\_\_\_

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**Section B [30 marks]** –

Answer three questions.

Question 10 is in the form of an **Either/Or** question. Only one part should be answered.

- 8 Fig. 8.1 shows an experiment set up to investigate the loss of water in a plant potted in damp soil over a 24-hour period.

**Fig. 8.1**

- (a) Explain the purpose of the plastic bag in the experimental set up.

.....  
 ..... [1]  
 .....

The results of the experiment are shown in Fig. 8.2.

time of day	water loss / cm <sup>3</sup> per hour
0000	0
0200	0
0400	1
0600	3
0800	8
1000	14
1200	20
1400	25
1600	30
1800	23
2000	9
2200	3
0000	0

**Fig. 8.2**

(b) Plot a graph of rate of water loss over a 24-hour period in the grid in .

[2]

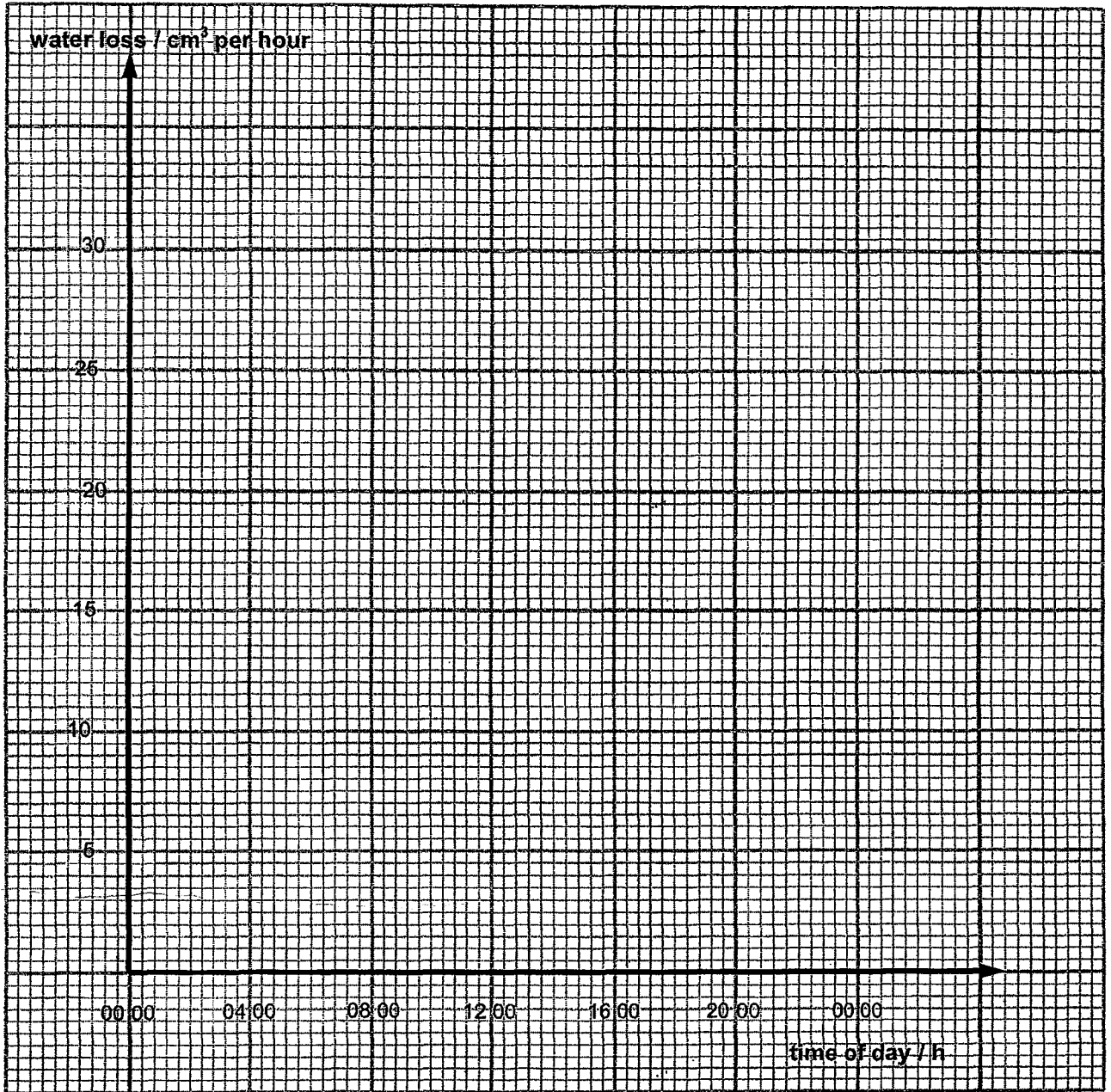


Fig. 8.3



- (c) Explain the rate of transpiration at 0000 h.

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[5]

Fig. 8.4 shows the same plant in a different experiment. The temperature and light intensity that the plant was exposed to were similar to those in Fig. 8.1.

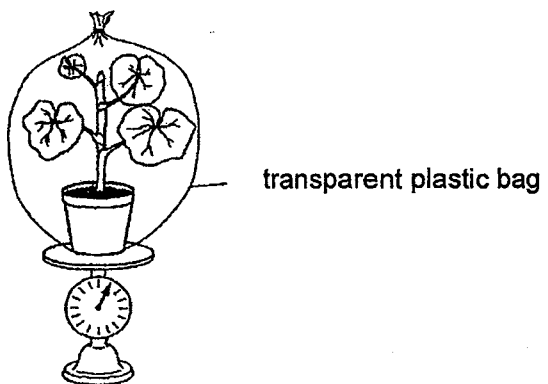


Fig. 8.4

- (d) Sketch on the same axis in Fig. 8.3, the graph that would be obtained from this experiment. [1]
- (e) Suggest one structural difference between the leaves of a desert plant and the leaves from the plant used in this experiment. [1]

.....

[Total : 10 marks]

- 9 (a) Explain what is meant by a *pyramid of biomass*.

.....  
.....  
.....  
.....  
..... [3]

- (b) A farmer had his fields of fruit trees (oranges, and lemons) sprayed with insecticide. Over the years, he found that instead of having a greater yield in crops, his crop yield fell.

In the meantime, his neighbour, who cultivated honey bees also saw a decline in the sizes of his bee hives and thus the production of honey.

- (i) Explain the decrease in yield of **both** farmers' harvests.

.....  
.....  
.....  
..... [2]

- (ii) Researchers who came into the area to study the problem faced by the farmers, discovered that other species like snakes that preyed on insect-eating birds were facing a decline in their population as well.

With the aid of a food chain, explain the declining population of snakes for this situation.

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..... [5]

[Total : 10 marks]

10 Either

Fig 10.1 shows the concentration of two reproductive hormones, X and Y in the blood of an adult female.

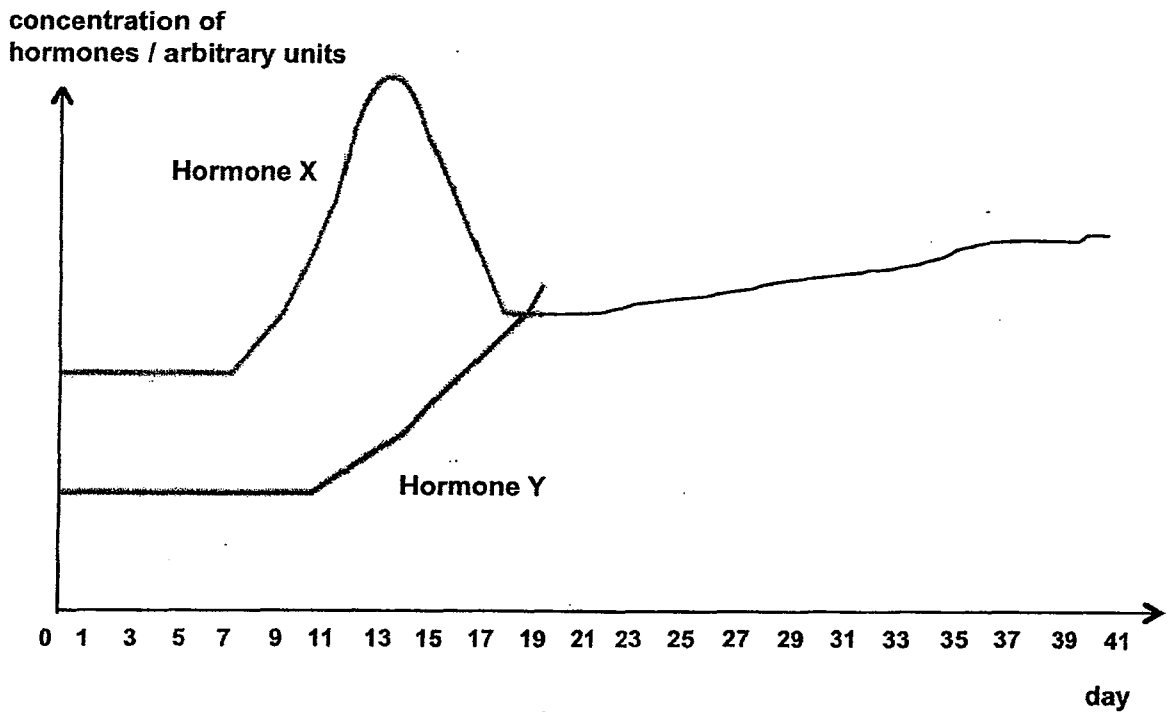


Fig 10.1

(a) With reference to Fig 10.1, describe how the concentration of hormone X and Y affects the thickness of the endometrium from

(i) day 1 to 7

.....

.....

.....

.....

[2]

(ii) day 11 to 19

.....

.....

.....

.....

[2]

- (b) On day 15, the ovum was fertilized and the resultant zygote developed into an embryo. By day 20, the embryo was implanted into the endometrium.

Complete and explain the graph in Fig 10.1 for hormone Y from day 19 to 41.

.....  
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[3]

- (c) In the first 8 weeks of pregnancy, the ovary is responsible for regulating the concentration of hormone Y. After the 8<sup>th</sup> week, the placenta takes over this role.

Describe three **other** functions of the placenta.

.....  
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[3]

[Total : 10 marks]

10 OR

- (a) Define the term *genetic engineering*.

.....  
.....  
.....  
.....

[2]

- (b) European corn borer is a butterfly caterpillar that feeds on the leaves and corn of maize plants and affects the corn yield of farmers.

It was discovered that bacterium, *Bacillus thuringiensis* (Bt) makes a toxin that kills the European corn borer. The gene can be isolated and inserted into the maize plant chromosome so that the recombinant plant can secrete toxins to kill the caterpillars feeding on its leaves.

Describe how the gene for Bt toxin can be transferred to the maize plant so that the plant can become resistant to the European corn borer.

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[4]

- (c) Describe **two** advantages and **two** disadvantages of growing pest resistant plants as described in (b).

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.....  
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.....

[4]

[Total : 10 marks]

End of Paper



1	D	11	B	21	A	31	B
2	A	12	D	22	A	32	B
3	D	13	A	23	C	33	A
4	B	14	C	24	A	34	A
5	B	15	C	25	B	35	D
6	A	16	B	26	A	36	C
7	C	17	C	27	D	37	C
8	B	18	C	28	B	38	A
9	C	19	C	29	A	39	C
10	C	20	D	30	C	40	D

Section A (50 Marks) + 1

Answer all the questions in this section in the spaces provided.

- 1 Fig. 1.1 is a diagrammatic representation of the small intestine containing three types of food molecule, A, B and C, before they have been digested.

Fig. 1.1 also shows a lacteal and a capillary.

The different features in Fig. 1.1 have not been drawn to the same scale.

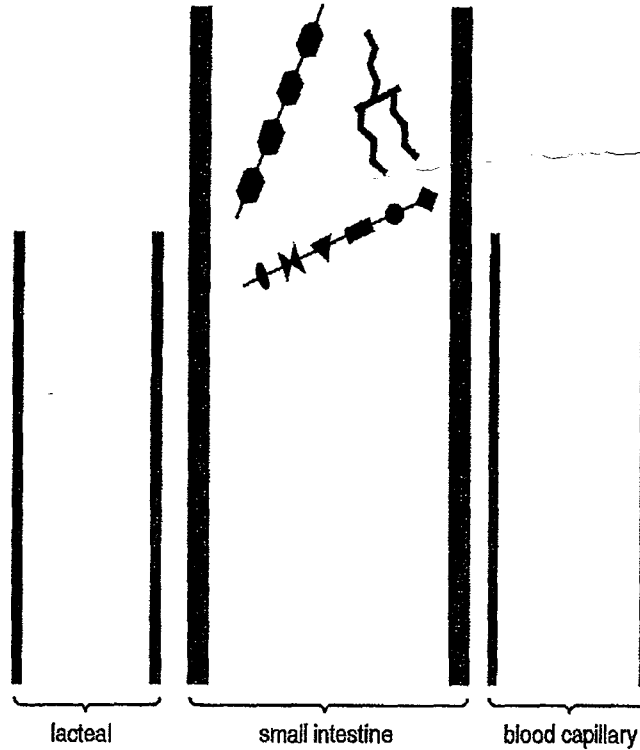


Fig. 1.1

- (a) On Fig. 1.1, draw and label the molecules as they would appear after they have been digested and then absorbed by the lacteal and by the capillary.

Protein – individual amino acids (must follow shape in diag.) in blood capillary

Starch - individual sugar molecules in blood capillary

Fats – still as fat molecule in lacteals

1 m each

-1m if all info correct but no labels

[3]

- (b) Name the secretion other than pancreatic juice and intestinal juice that is secreted into the small intestine.

Bile

[1]



- (c) Regular injections of insulin are administered to diabetics. Insulin cannot be taken orally (eaten as a pill).

Explain why this is not possible.

Insulin is a hormone and is protein in nature

If it is eaten, it will be digested by the enzymes in the stomach/ denatured by acid in stomach and will not be absorbed as insulin into the bloodstream

[2]

[Total: 6 marks]

- 2 Fig. 2.1 shows the apparatus used in an investigation on photosynthesis.

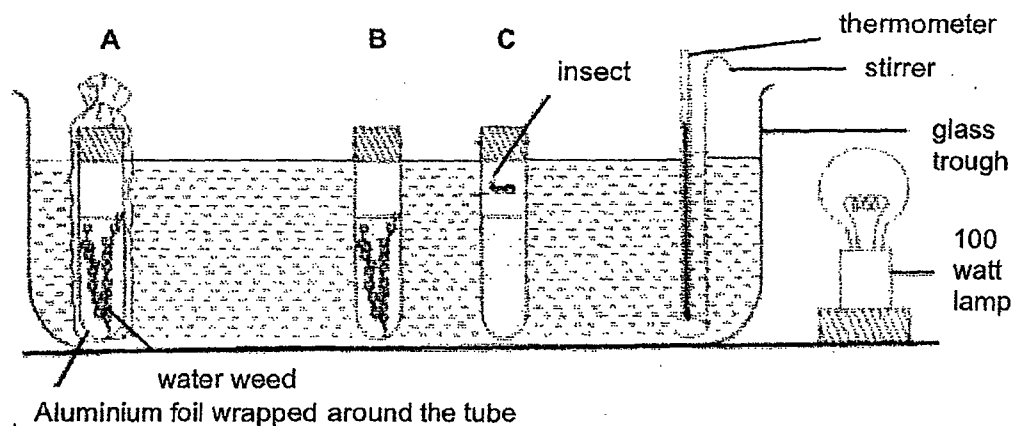


Fig. 2.1

All the test-tubes contain  $10\text{cm}^3$  of bicarbonate indicator solution (orange at the beginning of experiment). The colour changes of the bicarbonate indicator over a fixed period of time give an indication of the concentration of carbon dioxide in the test-tubes at the end of the experiment.

Carbon dioxide is a weak acidic gas which turns bicarbonate indicator yellow when present in higher concentrations and purple in low concentrations.

Colour of bicarbonate indicator:

yellow	red	purple
Acidic	Neutral	Alkaline

- (a) (i) Predict the colour of the indicator solution in test-tubes A, B and C at the end of the two hours. Explain your prediction.

test - tube	colour of indicator solution after two hours	explanation of prediction
A	Yellow	<i>In the <u>absence of light</u>, <u>no photosynthesis</u> takes place. Only <u>respiration that produces carbon dioxide</u>.</i>
B	Purple	<i>In <u>bright light</u>, the <u>rate of photosynthesis</u> exceeds the <u>rate of respiration</u>. Therefore rate of uptake of carbon dioxide is faster than it is released resulting in <u>lower concentration of carbon dioxide</u>.</i>

- marks not awarded for colour of indicator. 2 marks for each explanation.

[4]

- (ii) In another experiment, some water plants were added into test tube C. The indicator solution changed from yellow to purple.

Explain the results.

*Some amount of carbon dioxide produced by the respiration of the insects will be absorbed by the plant for photosynthesis.*

*[There will be lesser carbon dioxide concentration than without water plants which causes the colour change]*

[1]

[Total: 5 marks]

- 3 Fig 3.1 shows a cluster of air sacs in a lung and Fig 3.2 shows a villus in a small intestine. The arrows indicate the direction of blood flow in the capillaries.

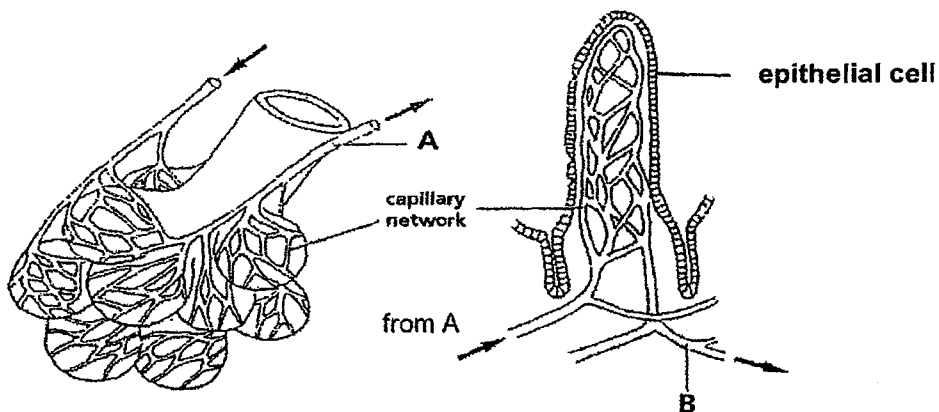


Fig. 3.1

Fig. 3.2

- (a) Both the air sac and the villus are richly supplied with blood capillaries.

State **two** reasons explaining how this feature can speed up the absorption of substances.

- more total surface area for diffusion or active transport to occur;
- Create a constant flow to carry away diffused substance. This creates and maintains a constant diffusion gradient /

[2]

- (b) State the change in carbon dioxide content as blood travels from A to B. Explain why this change occurs.

- There is lower carbon dioxide concentration in A than in B. This is due to the diffusion of carbon dioxide out of blood into the alveolus during exhalation.
- As blood travels to B, the carbon dioxide concentration increases. This is due to tissue respiration of the living cells along the way.
- At B, in the small intestine, active transport may occur and as this process requires energy, rate of respiration will increase producing more carbon dioxide.

[3]

[Total: 5m]

- 4 Amanda and Li Xing quietly crept up to Grace who was resting her head on her desk between lessons. They shouted loudly into her ear. Grace gave shout of surprise and her heart rate sped up.

- (a) Describe the pathway in Grace's body caused her heart rate to speed up.  
Sound is sensed/detected by receptors in the ear which generates an electrical impulse  
.....  
Impulse carried by sensory neurone to brain and  
.....  
Transmitted across and synapse to a relay neurone in hypothalamus  
.....  
Relay neurone then passes impulse to a motor neurone which brings it to the adrenal gland,  
.....  
causing it to secrete adrenaline into the bloodstream where it will be transported to heart muscles (which contract more faster) [4]  
.....  
\*Must be in correct order of events.

- (b) Describe how the muscles of the iris in the Grace's eye respond during the incident. Explain why the response is an advantage to her.  
*response of muscles of iris* Circular muscles will relax while the radial muscles will contract  
.....  
*advantage* Causes pupil to dilate, allows more light into eye  
Enhances vision/ clearer vision [2]  
.....  
*big reason?*

- (c) Secretion of adrenaline often results in increased sweating.

Based on your understanding of the effect of adrenaline on metabolic rate, explain this observation.

Adrenaline causes rate of respiration to increase in order to release energy  
 Increased respiration is accompanied by increased release of heat  
 Increased heat will result increased sweating to increase heat loss by evaporation to cause body temperature to return to normal

[3]

- (d) During an asthma attack, a person's bronchioles constrict. In severe attacks, adrenaline is injected into the bloodstream.

Explain why adrenaline is used in an asthma attack.

Adrenaline causes bronchiole muscles to relax

Bronchioles widen, allowing more air to rush in and out of lung

[2]

[Total : 11 marks]

- 5 Fig 5.1 shows a cell in the interphase stage of the cell cycle.

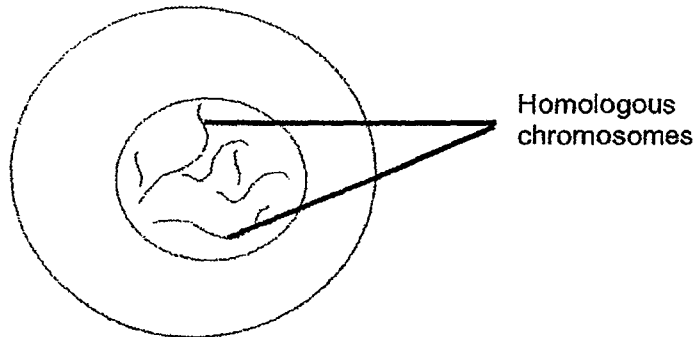
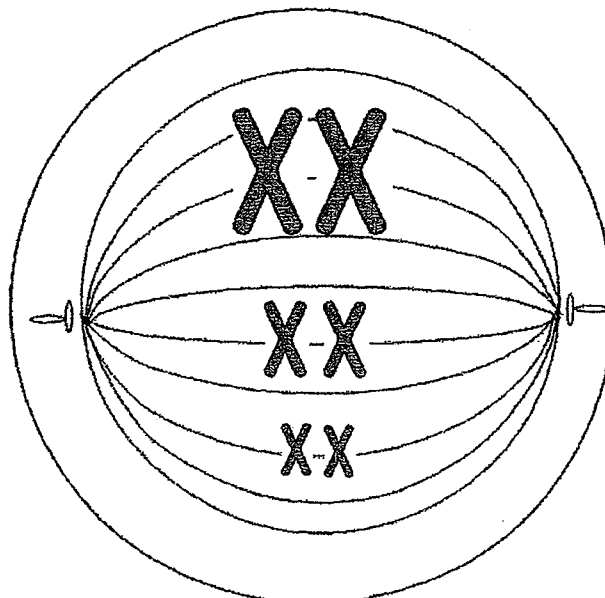


Fig. 5.1

- (a) On Fig. 5.1 label a pair of chromatins threads that have the same genes. [1]  
 (b) In Fig. 5.2, draw the chromosome arrangement of this cell in metaphase II.



[3]

Fig. 5.2

- (c) State the number of chromosomes which could be found in a haploid cell in this animal.

3 [1]

- (d) Explain why haploid cells need to be produced during a life cycle which includes sexual reproduction.

*need to maintain , constant / normal , number of chromosomes (for individual / species) ; gametes fuse ; if diploid cells fuse results in doubling of chromosomes ; doubling each generation ; fusion of haploid cells produces normal number of chromosomes ;*

[2]

[Total: 7m]

- 6 Fig. 6.1 below shows two form of a moth, the dark coloured and light coloured moth, which rests on trees.

These moths are eaten

by birds.

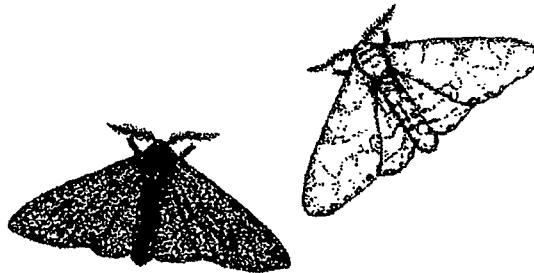


Fig 6.1

During the late 19th century when the Industrial Revolution began in Britain, smoke particles produced by developing industry began to gradually darken the trunks of the trees on which the moths rested.

A survey of dark coloured and light coloured moths was carried out in a polluted area and an unpolluted area.

Moths were collected in the morning, marked on the underside and released. They were collected again later the same day.

The results are shown in the Table 6.1.

area		Number of moths	
		Light coloured	Dark coloured
unpolluted	Released	496	473
	Recaptured	62	30

polluted	Released	64	154
	Recaptured	16	82

**Table 6.1.**

**Table 6.2** shows the percentage of moths recaptured in these areas.

area	% recaptured	
	Light coloured	Dark coloured
unpolluted	12.5	6.0
polluted	25.0	53.0

**Table 6.2**

- (a) (i) Explain why the moths were marked on the underside rather than on the upper side.

*Moths are marked on the underside so that their mark does not make them more visible to predators / bird (R: affect camouflage) [1]*

- (iii) Explain for the difference in the percentage of light coloured and dark coloured moths recaptured in the unpolluted area.

- In the unpolluted area, tree trunks are covered in green (lichens) making them pale [1];*
- Light coloured moths are well camouflaged, so they are more likely to survive [1];*
- Dark coloured moths are easily seen, so they are more likely to be eaten by predators [1]*

[3]

- (b) The dark form of the peppered moth, which spread rapidly in 19<sup>th</sup> century Britain's industrial, sooty environment, is a classic example of natural selection.

With reference to the moths, describe the principle of natural selection.

- There is variation, individuals within a population are different in phenotype due to spontaneous mutations [1];*
- The better adapted /healthier organisms / with certain qualities / favourable characteristics within the population will survive (selection advantage, i.e. well suited to their environment) when **environmental** conditions **change** (eg drought) [1];*
- And continue to reproduce more offsprings / more likely to survive and breed / They will have offspring like themselves (survival of the fittest) while the weaker organisms perish [1]*

- (c) Scientists have determined that a single gene controls the body colour of the peppered moth. The dark phenotype is controlled by a dominant allele.

Fig. 1.2 below shows a sample of moths in the F1 generation produced by crossing two parent moths by crossing a black coloured moth and a white coloured moth.

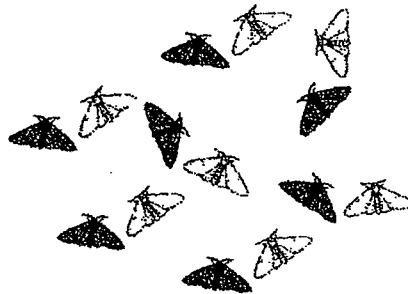


Fig. 6.2

Two black F1 generation moths from the sample in Fig 6.2 are randomly chosen and crossed.

An F2 generation of 60 moths were produced.

Predict the number of dark coloured moths in the F2 generation. Explain your answer.

*45 dark colour moth [1]*

*Both dark colour F1 generation are heterozygous [1]. When 2 heterozygous organisms are crossed the F2 generation will be 3 dark: 1 white. This means  $\frac{3}{4}$  of 60 files are dark colour [1].*

7 Fig 7.1 shows a flower of the white deadnettle plant.

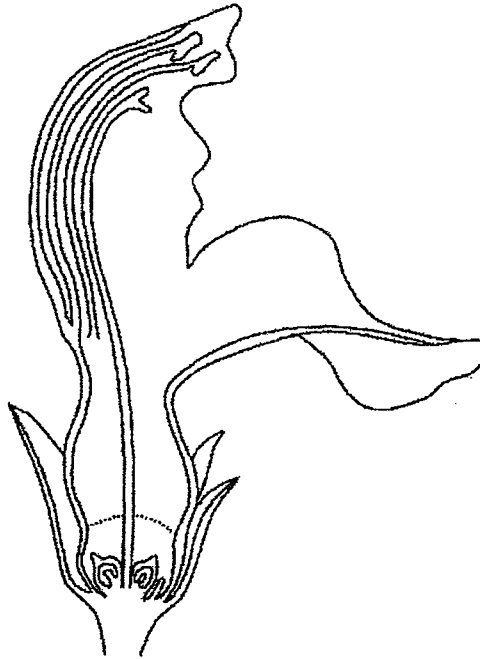


Fig. 7.1

- (a) (i) State how white deadnettle flowers are pollinated.  
insect pollinated [1]
- (ii) Explain your answer based on what is observed in Fig. 7.1.  
Anthers do not protrude from petals  
Stigma is compact  
Relatively large petals [2]
- (b) Describe the pollen grain produced by the white deadnettle flower.  
Rough surface, relatively large, and heavy [2]
- (c) (i) Give one reason why self-pollination may be a disadvantage for a plant.  
Leads to less genetic variety in offspring/ fewer, viable seeds [1]
- (ii) Suggest how a plant like the white deadnettle may prevent self-pollination.  
Anther and stigma mature at different times [1]

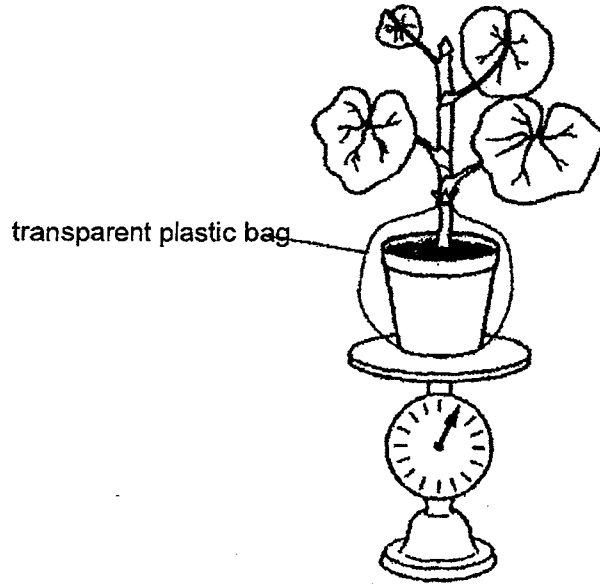
[Total: 7 marks]



**Section B [40 marks]**

Answer all the questions in this section in the spaces provided.

- 8 Fig. 8.1 shows an experiment set up to investigate the loss of water in a plant potted in damp soil over a 24-hour period.



**Fig. 9.1**

- (a) Explain the purpose of the plastic bag in the experimental set up.  
ensures that loss is mass is caused by water loss through leaves and not evaporation from soil

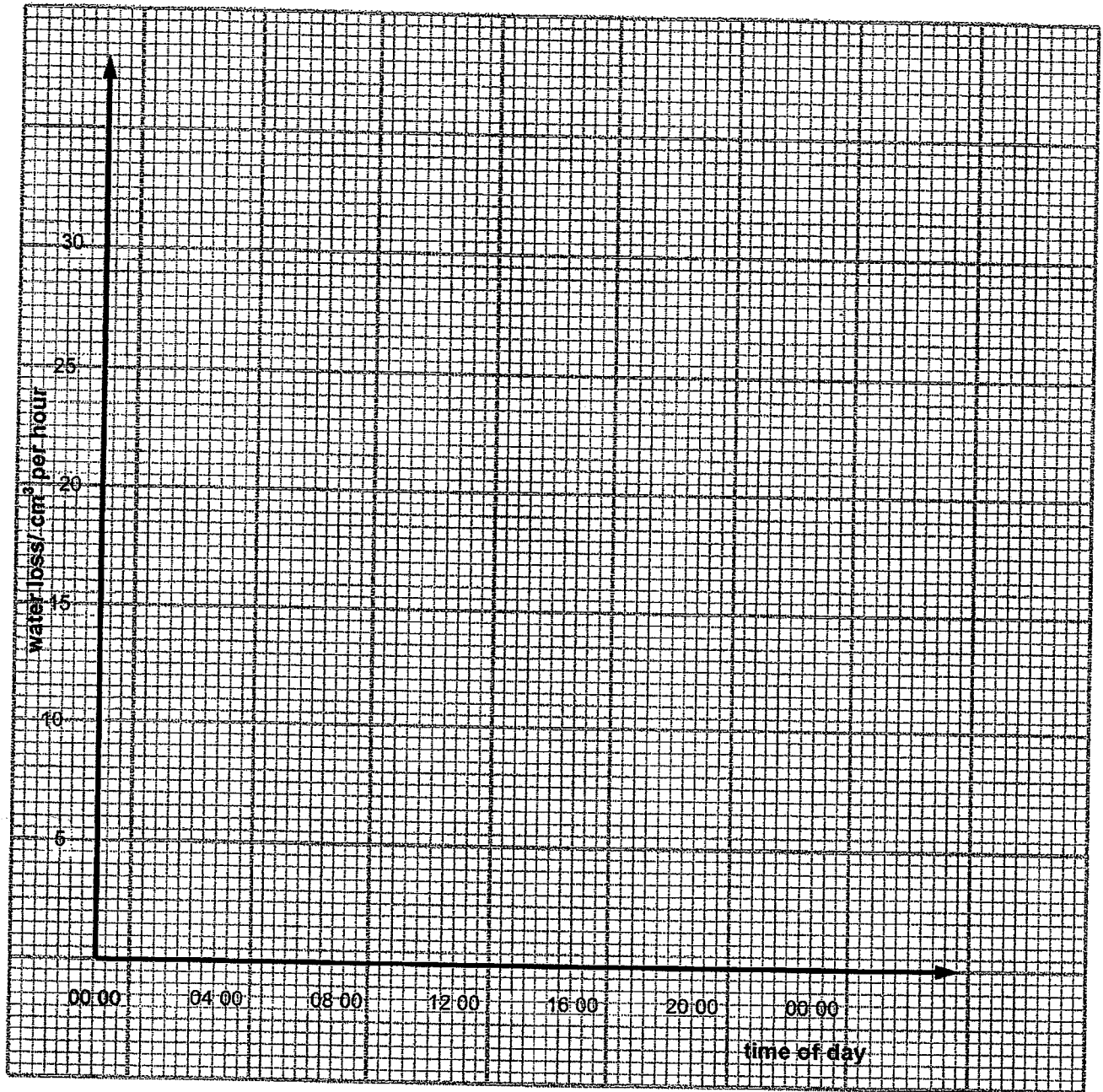
[1]

The results of the experiment are shown in Fig. 8.2 below.

time of day	water loss/ cm <sup>3</sup> per hour
0000	0
0200	0
0400	1
0600	3
0800	8
1000	14
1200	20
1400	25
1600	30
1800	23
2000	9
2200	3
0000	0

**Fig. 8.2**

(b) Plot a graph of rate of water loss over a 24-hour period in the grid below.



Points plotted  
Best fit

[2]

(c) Explain the rate of transpiration at midnight (0000 h).

At midnight , there is no sunlight, Guard cells will not photosynthesis

Thus with lack of energy,  $K^+$  ions will leave the cells/ glucose is not produced and thus will

raise the water potential of the cell , Cell has higher water potential than neighbouring cells and water leave the cells,

becomes flaccid, Stomata closes,

gases (water vapour) does leave through the stomata

[5]

(d) Fig. 8.3 shows the same plant in a different experiment. The temperature and light intensity that the plant was exposed to were similar to those in the first experiment.

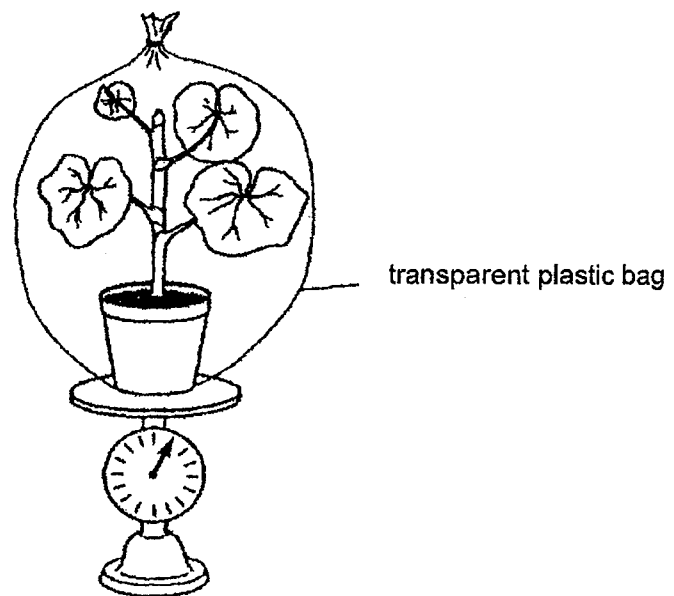


Fig. 8.3

Sketch on the same axis, the graph that would be obtained from this experiment.

[1]

Graph should show the same pattern but with lower values / or a flat graph (higher humidity in the plastic bag lowers the rate of transpiration)

(e) Suggest one way leaves of a desert plant may differ from leaves from the plant used in this experiment.

Leaves may have

- Have very small leaves / reduced to spiny leaves
- Very thick cuticle
- Sunken stomata
- Stomata surrounded by hairs

Any 1 suggestion

- 9 (a) Explain what is meant by a pyramid of biomass.  
 (Marking points are available on an annotated drawing)  
 shows the mass of organisms at each (trophic) or named level at a particular time ;  
 width / length of band indicates the biomass;  
 Typically large at the bottom of the pyramid and narrow at the top  
 correct ref. to two technical terms from the following :  
 producers / consumers / herbivores / carnivores / trophic level;  
 (R named example)  
 in food chain / web / ecosystem (R habitat / named e.g. of a food web);

[max 3 marks]

[3]

- (b) A farmer had his fields of fruit trees (oranges, and lemons) sprayed with insecticide. Over the years, he found that instead of having a greater yield in crops, his crop yield fell.

In the meantime, his neighbour, who cultivated honey bees also saw a decline in the sizes of his bee hives and thus the production of honey.

- (i) Explain the decrease in yield of both farmers' crops. [2]

Bees die because they collect nectar from the flowers of fruit trees which have been sprayed with insecticide.

Fruit crop decreased because of the lack of pollinators (bees) and thus fertilization and formation of fruits does not happen.

- (ii) Researchers who came into the area to study the problem faced by the farmers, discovered that other species like snakes that preyed on insect-eating birds were facing a decline in their population as well.

Construct a food chain for this situation.

Explain the declining population of snakes. [5]

Fruit tree → bees → bird → snake

Insecticide that is sprayed on fruit trees is absorbed by bees when they visit the trees

Since the insecticide is not biodegradable, it is accumulated in the body of the bee.

Bio amplification occurs as subsequent trophic levels prey on organisms in lower levels and multiply the amount of insecticide in the organism

In the snakes, the insect has accumulated to toxic levels and thus they die.

1 Fig 10.1 shows the concentration of two reproductive hormones, X and Y in the blood of an adult female.

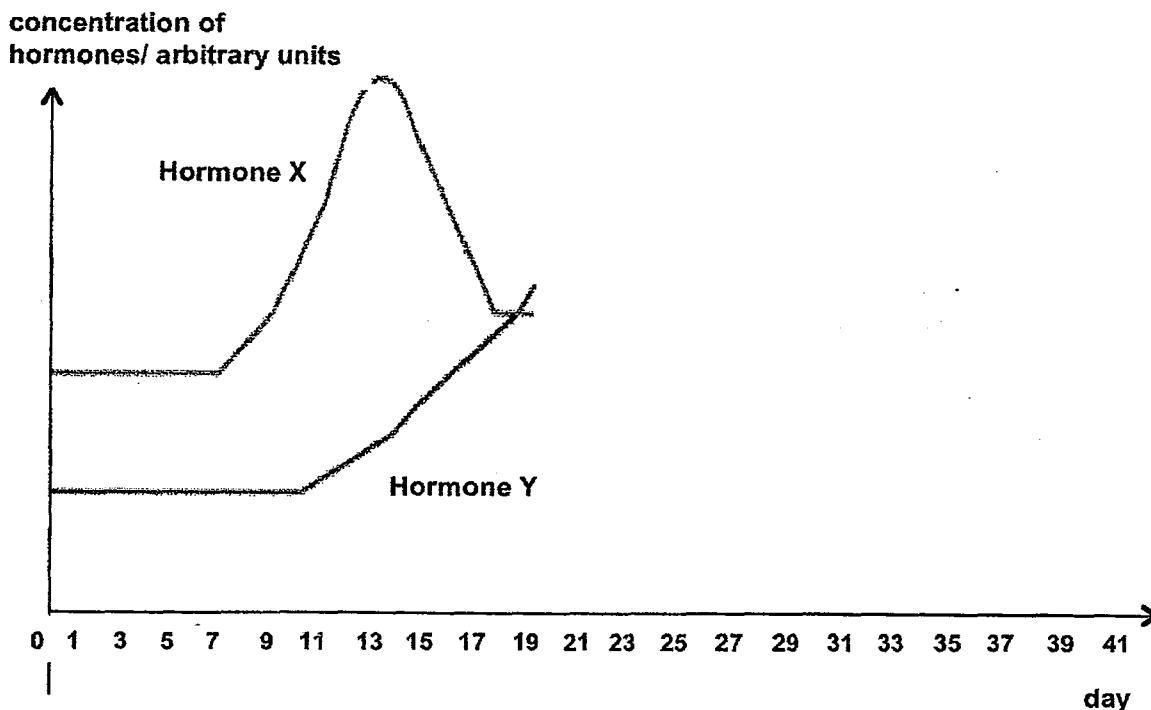


Fig 10.1

(a) With reference to Fig 10.1, describe how the concentration of hormone X and Y affects the thickness of the endometrium from

(i) day 1 to 7

.....  
*Low level of hormone Y causes the breakdown of endometrium [1]*

*Menstruation occurs [1]*  
 .....

[2]  
 .....

(i) day 11 to 19

.....  
*Increased concentration of hormone X causes the repair of endometrium [1]*

*Endometrium thickens with blood vessels[1]*  
 .....

[2]  
 .....

(b) On day 15, the ovum was fertilized and the resultant zygote developed into an embryo. By day 20, the embryo was implanted into the endometrium.

Complete and explain the graph in Fig 10.1 for hormone Y from day 19 to 41.

*Graph drawn should show gradual increase of hormone Y all the the way until Day 41 + level above hormone X. [1]*

*Progesterone continues to be secreted by ovary/ progesterone level increases [1] caused thickening of uterine lining to support growth of embryo [R: foetus] [1]*  
 .....

.....  
.....  
.....  
.....  
.....  
.....  
[3]

- (c) In the first 8 weeks of pregnancy, the ovary is responsible for regulating the concentration hormone Y. After the 8<sup>th</sup> week, placenta takes over this role.

Describe three **other** functions of placenta.

*-Allows oxygen and dissolved food substances (name 2) to diffuse from mother's blood to fetal blood.[1]*

*-It allows metabolic waste or excretory products (name 2) to diffuse from fetus's blood into the mother's blood [1]*

*Allows protective antibodies to diffuse from the mother's blood into fetal blood.[1]*

.....  
.....  
.....

[3]

[Total : 10 marks]

- 11 (a) Define the term genetic engineering.

.....  
.....  
.....  
.....  
[2]

- (b) European corn borer is a butterfly caterpillar that feeds on the leaves and corn of maize plants and affects the corn yield of farmers.

It was discovered that bacterium, *Bacillus thuringensis* (Bt) makes a toxin that kills the European corn borer. The gene can be isolated and inserted into the maize plant chromosome so that the recombinant plant can secrete toxins to kill the caterpillars feeding on its leaf.

Describe how the gene for Bt toxin can be transferred to the maize plant so that the plant can become resistant to European corn borer.

*Use restriction enzymes to cut the Bt gene from the bacterial DNA to produce sticky ends +*

*Use same restriction enzyme to cut plasmid to produce complementary sticky*

.....



