Anglo-Chinese School (Independent)
PRELIMINARY EXAMINATION
YEAR FOUR EXPRESS

CANDIDATE NAME									
CENTRE NUMBER						INDEX NUMBER			

BIOLOGY **6093/02**

Paper 2 **12 August 2024, Monday**
1 hour 45 minutes

Candidates answer on the Question Paper
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer only **ONE** question in this section.
Write your answers in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.

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

For Examiner's Use	
Section A	
Section B	
Total	/ 80

This document consists of **21** printed pages, including this cover page.

[Turn Over

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Section A

Answer **all** questions.
Write your answers in the spaces provided.

1 Fig. 1.1 shows blood pressure changes as blood flows through part of the circulatory system, beginning at the right atrium, travelling to the lungs, and ending in the pulmonary vein.

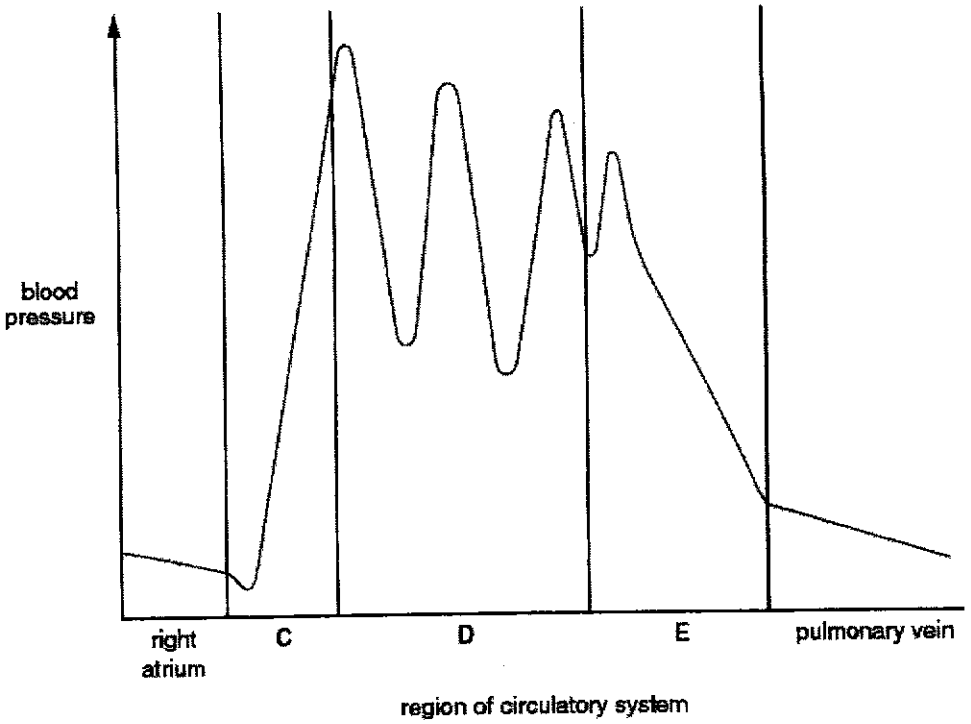


Fig. 1.1

(a) Identify the chamber of the heart represented by **C**.

Chamber **C** .....[1]

(b) Explain the reasons for the regular changes in blood pressure in region **D**.

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.....[2]

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(c) Important exchange of substances take place in the blood as it passes through region **E**.

(i) Identify organ **E**.

.....[1]

(ii) Identify and describe the exchange of substances that take place.

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.....[2]

(ii) State **two** features of organ **E** and explain how they help to improve the efficiency of the rate for exchange of substances.

Feature 1 .....

Explanation .....

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Feature 2 .....

Explanation .....

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.....[4]

[Total: 10]

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2 The yields of corn grown in open fields in India are low compared to the yields of corn grown in the glasshouses in The Netherlands.

In a study, scientists in India grew corn plants in glasshouses and in open fields nearby. The growth of the plants and the yields of the corn were recorded.

The results are shown in Table 2.1

Table 2.1

	location corn plants grown in	
	glasshouse	open field
mean final height of corn plants / cm	84.1	68.0
mean number of leaves per corn plant	132.0	83.0
mean fresh mass of corn plants / g	978.5	485.2
mass of corn per plant / g	2853.0	832.4
mean fresh mass of corn / g	98.0	86.5

(a) The mean fresh mass of corn grown in glasshouses was greater than the mean fresh mass of corn grown in open fields.

Calculate the difference in mean fresh mass as a percentage of the mean fresh mass of corn grown in open fields.

Show your working. Give your final answer to a whole number.

.....% [2]

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(b) Suggest how an increase in the height of the plants **and** the number of leaves on each plant affect the yield of corn.

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.....[3]

(c) The scientists ensured that the only differences between the two groups of plants were the result of the protection provided by the glasshouses.

Suggest **two** factors that the scientists should have kept constant for the two groups of plants in this investigation.

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.....[2]

(d) The growth and final yields of crops grown in open fields are often limited by environmental factors.

Describe how these factors are controlled in a commercial glasshouse to give high yields of crops such as corn.

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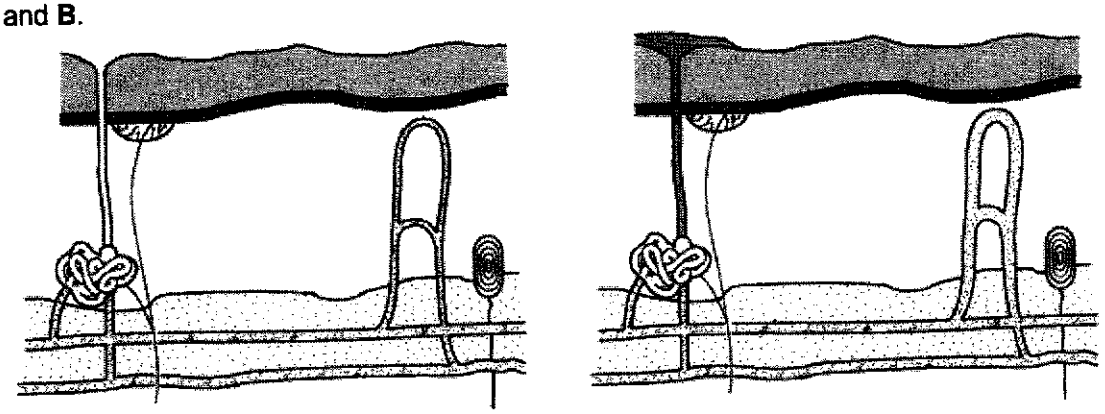
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.....[3]

[Total: 10]

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3 Fig. 3.1 shows a vertical section through the skin in two different environmental conditions, **A** and **B**.



skin in environmental condition **A**

skin in environmental condition **B**

Fig. 3.1

(a) On Fig. 3.1 under condition **A**, label each of the following:

- A sweat gland
- An arteriole. [2]

(b) Using the information in Fig. 3.1, suggest how environmental condition **B** is different from environmental condition **A**.

.....

.....[1]

(c) With reference to Fig. 3.1, state and explain two differences between the skin in environmental condition **A** and the skin in environmental condition **B**.

1.....

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2.....

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.....[4]

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(d) (i) State the change in the level of anti-diuretic hormone (ADH) in a person if the person is to stay in environmental condition **B** for a period of time without access to drinking water.

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.....[1]

(ii) Explain how the change in ADH level stated in **(d)(i)** affects the urine production of the person.

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.....[2]

[Total:10]

4 The dominant allele for the ability to smell the scent of a particular flower is represented by **A**. The recessive allele, which does not allow a person to smell the scent of the flower, is represented by **a**.

(a) (i) Using these letters, indicate each of the following:

the genotype of a woman who is unable to smell the flower: .....[1]

(ii) the possible alleles found in the gametes of a woman who can smell the flower.

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

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(b) Fig. 4.1 represents some alleles on part of the sex chromosomes of a woman and of a man.

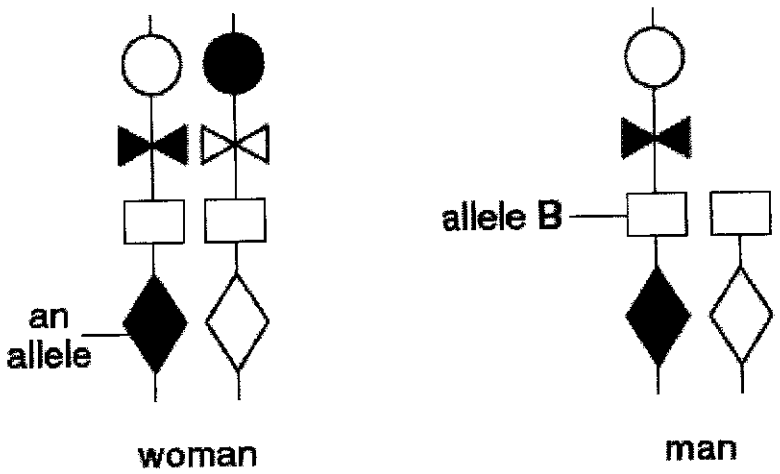


Fig. 4.1

In the space below, draw the possible alleles as they might be carried in sperm cells.

[2]

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(c) Fig. 4.2 shows how the alleles on one of the chromosomes might appear in a liver cell in the man's body. Allele **B** shows a mutation.

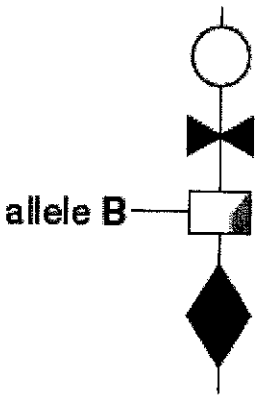


Fig. 4.2

Suggest **two** possible causes of the mutation.

1.....

2.....[2]

(d) Mutated alleles such as that shown in Fig. 4.2 are usually recessive.

Use your knowledge of genetics to explain why society discourages marriages between closely-related people.

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[Total: 10]

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5 (a) Define the term, *sexual reproduction*.

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Progesterone is a hormone involved in the control of the menstrual cycle.
Fig. 5.1 shows the level of progesterone in the blood of three women, labelled **X**, **Y** and **Z**, for 30 days.

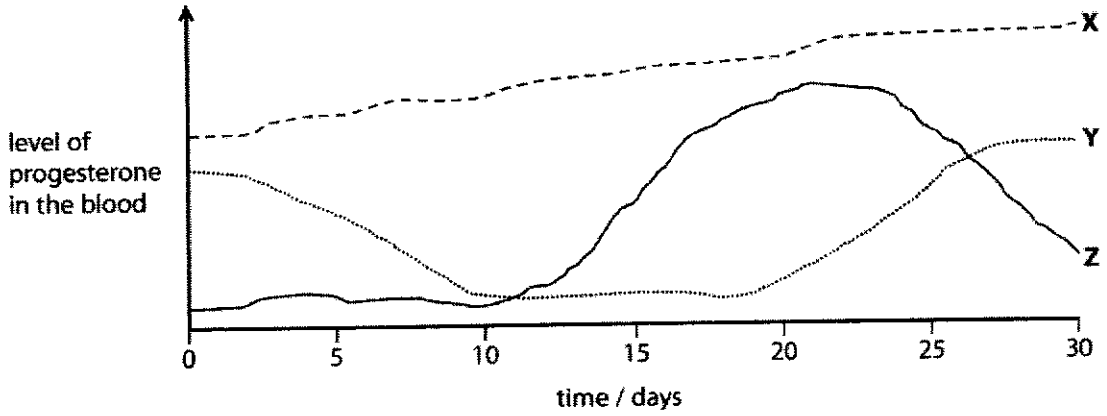


Fig. 5.1

(b) (i) Name the stage of the menstrual cycle that is occurring for person **Y** on day 10.

.....[1]

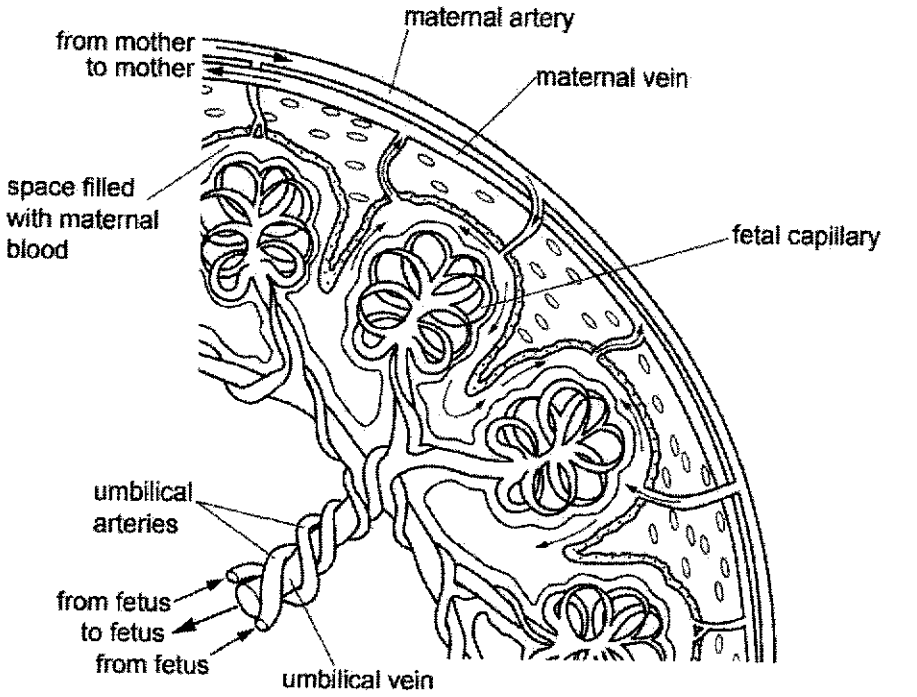
(ii) Suggest a reason for the increasing progesterone level of person **X**.

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.....[1]

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Fig. 5.2 shows a drawing of a section of a human placenta. The arrows show the direction of blood flow.



not to scale

Fig. 5.2

(c) Using the information in Fig. 5.2, suggest how the placenta is adapted for efficient diffusion.

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(d) The placenta is often described as the 'lung and kidney' of the fetus. Explain why this is a valid description.

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[Total: 10]

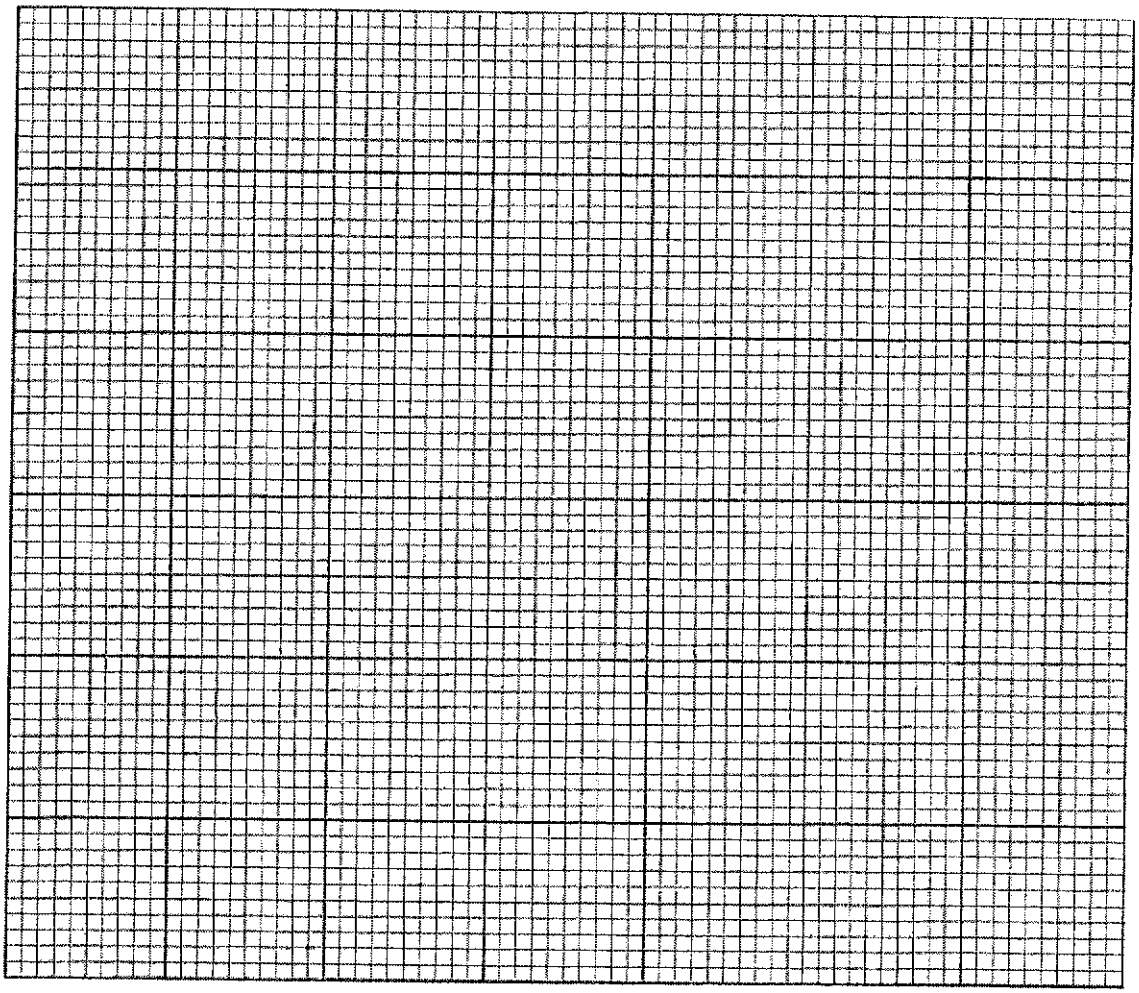
6 Table 6.1 shows the results of an investigation to find out how temperature affects the activity of two protease enzymes.

Table 6.1

temperature / °C	enzyme activity / arbitrary units	
	enzyme A	enzyme B
0	0	0
5	10	2
10	24	8
15	60	12
20	98	22
25	80	38
30	66	62
35	52	94
40	40	34
45	30	10
50	20	0
55	10	0
60	0	0

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(a) Plot the two graphs on the same axes in the grid provided.



[6]

(b) Using information from Table 6.1, determine which of the two enzymes is obtained from a human. Explain your answer.

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.....[2]

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(c) Explain the activity shown by enzyme **A** at temperatures above 20 °C.

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.....[2]

[Total: 10]

7 Bacteria may be classified as pathogenic and non-pathogenic.

(a) Describe **two** features of a bacterial cell that are different from an animal cell.

1.....

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2.....

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.....[2]

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(b) Non-pathogenic bacteria can be used in the field of genetic engineering.

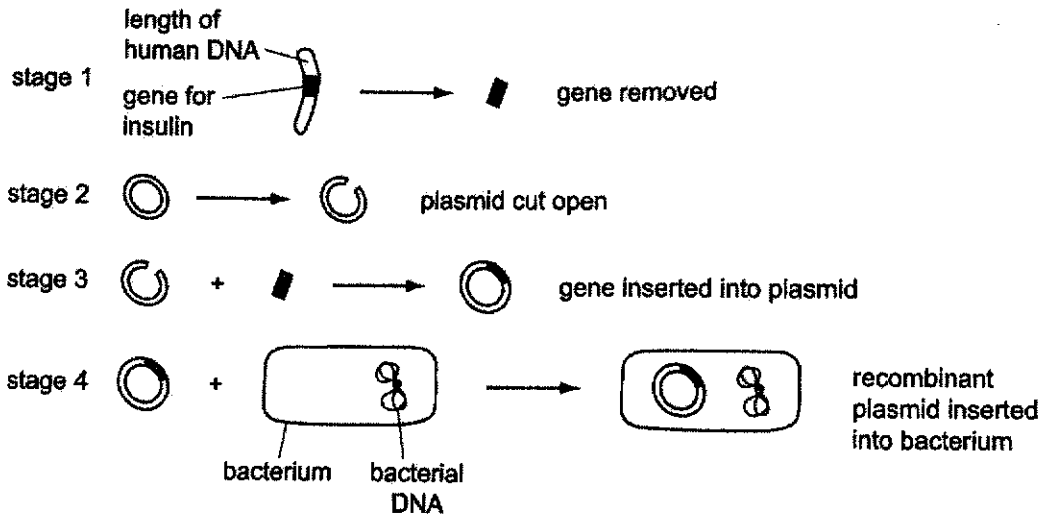


Fig. 7.1

With reference to Fig. 7.1, describe how bacteria can be genetically engineered to produce human insulin.

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(c) Pathogenic bacteria species like *Streptococcus pneumoniae* cause pneumococcal diseases in humans which may lead to death.

Vaccines and antibiotics are used in different ways to reduce the number of deaths from pneumococcal disease.

Explain the different ways in which vaccines and antibiotics are used.

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[Total: 10]

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Section B

Answer only **ONE** question from this section.
Write your answers in the spaces provided.

8 Fig. 8.1 shows the Institut Pierre Simon Laplace model, which is a prediction of how carbon emissions may be distributed in the environment from 1920 to 2100.

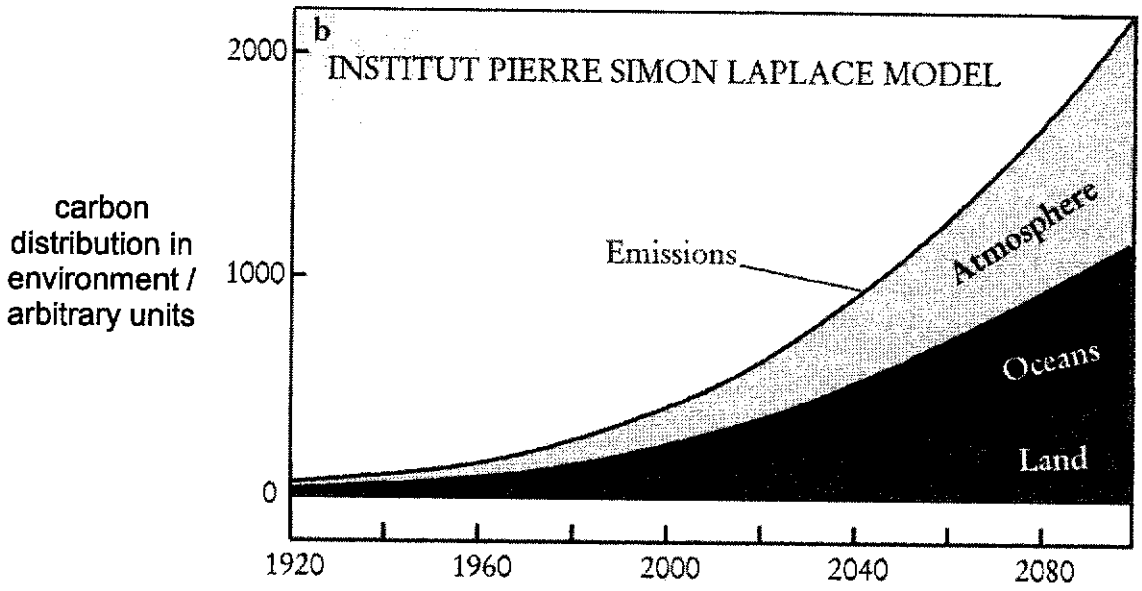


Fig. 8.1
[adapted from Physics Today 55, 8, 30 (2002)]

(a) Describe **two** human activities that cause an increase in carbon emissions observed in Fig. 8.1.

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2.....

.....[2]

(b) With reference to Fig. 8.1, explain why the carbon distribution in both oceans and land increases as carbon emissions increases.

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(c) Describe **three** human actions that can reduce the effects of global warming.

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[Total: 10]

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9 (a) Fig. 9.1 shows two locations, **X** and **Y**, on the Earth.

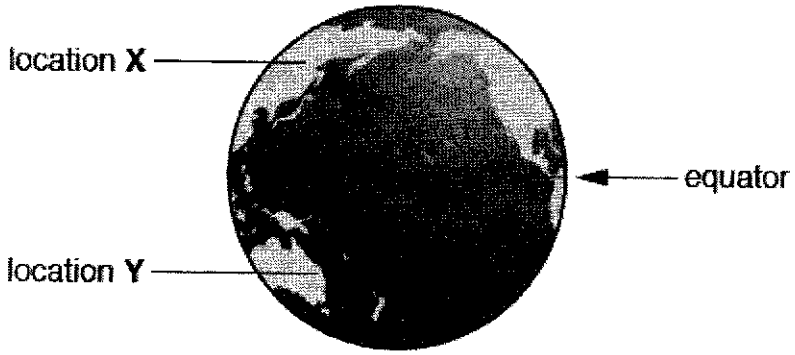


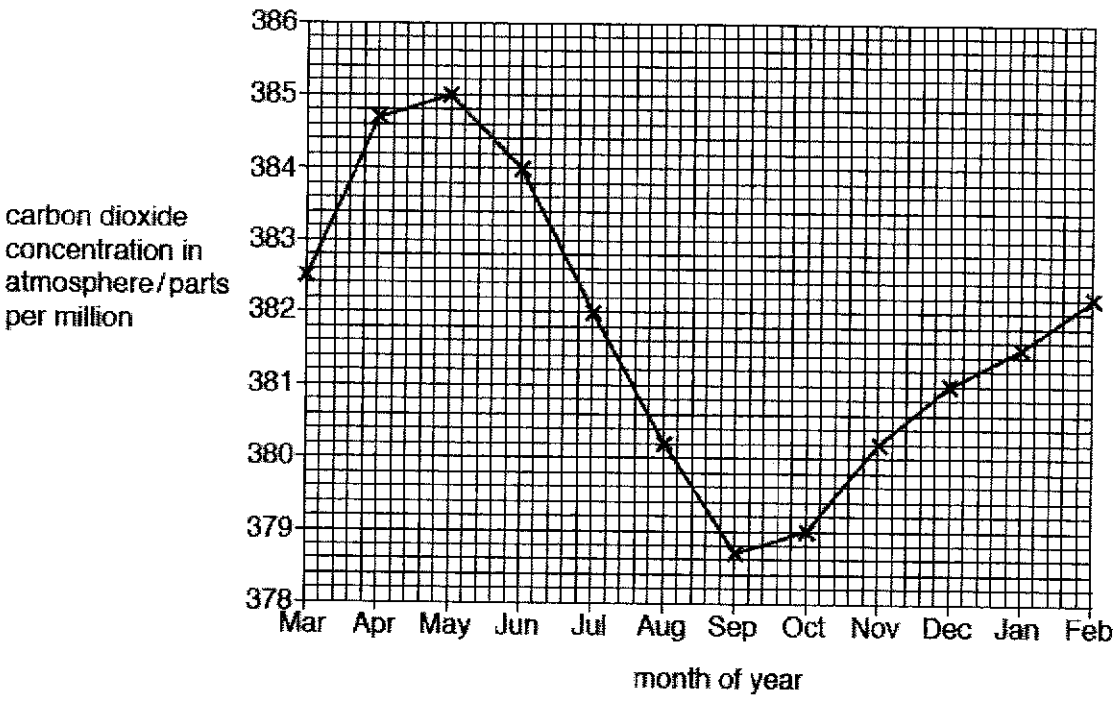
Fig. 9.1

Table 9.1 shows the length of daylight at each location during a year.

Table 9.1

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
length of daylight at location X	medium			long			medium			short		
length of daylight at location Y	medium			short			medium			long		

Graph 9.1 shows the changes in carbon dioxide concentration in the atmosphere measured during one year at location **X**.



Graph 9.1

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(i) With reference to Graph 9.1, suggest an explanation for the pattern of changes in the concentration of carbon dioxide in the atmosphere at location **X**.

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(ii) Sketch a line on Graph 9.1 to suggest the change in carbon dioxide concentration in the atmosphere during the year at location **Y**. [2]

(b) Fig. 9.2 shows two possible uses of the same area of land to produce food.

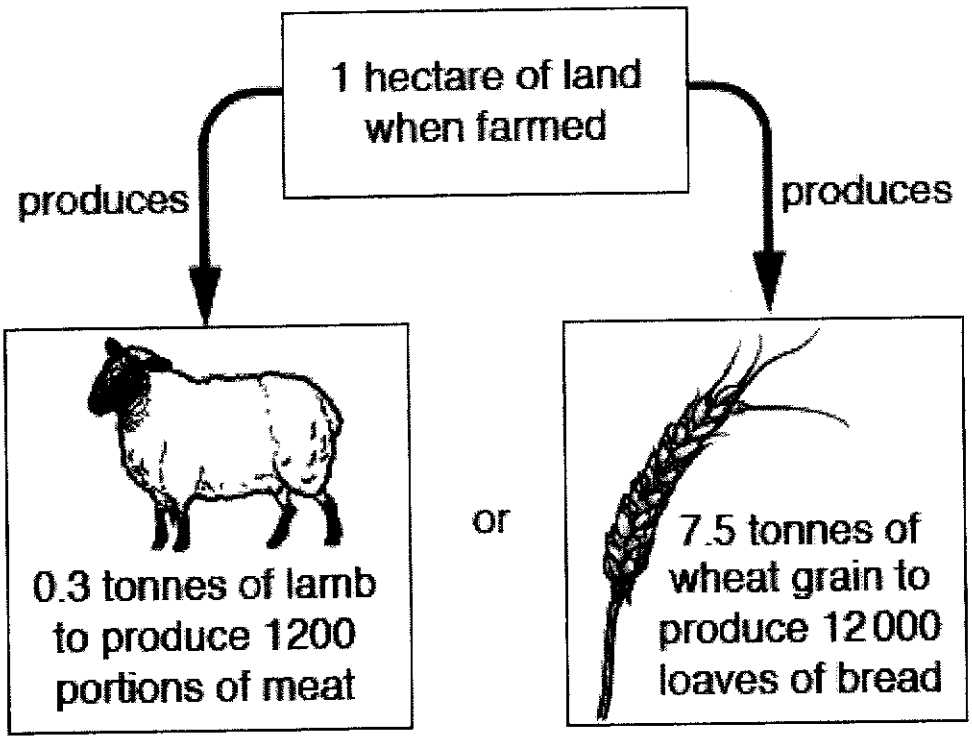


Fig. 9.2

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With reference to Fig. 9.2, and your own knowledge, explain why it is possible to feed a greater number of people if the area of land is used to farm crops rather than to farm animals.

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[Total: 10]

--- End of Paper ---

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2024 YEAR 4 EXPRESS BIOLOGY PRELIMINARY EXAMINATION

PAPER 2 MARK SCHEME

Section A

1a) right ventricle;

1b) increases when heart / ventricle + contracts/systole;
decreases when heart / ventricle + relaxes/diastole;

1ci) lung;

1cii) Oxygen diffuse from the air spaces in the alveoli/lung to the blood capillaries;
Carbon dioxide diffuse from the blood into the air spaces in the alveoli/lung;

1d) clusters of alveoli -> increase SA:V
single cell epithelium/ thin wall -> reduce distance travelled
constant blood flow -> maintain concentration gradient (any 2 pairs)
Reject: Moist surface-> allow gases to dissolve (does not increase efficiency)

2a) Percentage difference in mean fresh mass = (98.0-86.5/86.5)x100%=13(whole number)

2b) **Increase in height →**
more sunlight can be absorbed;
allow more room for corn to form/grow;
Increased number of leaves →
increases the surface area exposed to sunlight;
increases the amount of gaseous exchange;
increases amount of chloroplast/chlorophyll; (any 3)

leading to increases the yield of corn;

2c) Reject: Light intensity/Temperature/Carbon dioxide concentration/humidity (all these factors will change in the glass house)
Accept: amount of water, type of corn seeds, space between corn plant, type of soil, nutrients/fertilizer level, number of plants for experiment

2d) Light intensity: lights can be installed to provide light to the plants under low light conditions (e.g. at night, early morning);

Temperature: heater may be installed to provide sufficient heat for enzymes to function close to their optimum temperature for photosynthesis;

Carbon dioxide: Any valid method to increase carbon dioxide levels. E.g. burning of candles, rearing of pets / livestock in glasshouse;

3a) correct label on the diagram

3b) hotter/warmer/higher temperature;

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3c) Sweat glands more active/more sweat secreted;
More latent heat (of vapourisation) removed from body due to evaporation of water in the sweat;

Skin arteriole dilated;
more blood reaches the skin arterioles, resulting in more heat lost through the surface of the skin via through convection, radiation and conduction;

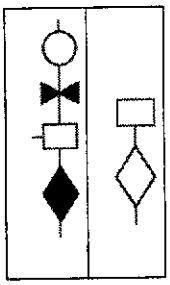
3di) ADH increased

3dii) Walls of the collecting duct more permeable to water, more water selectively reabsorbed via osmosis from the lumen of the collecting duct back into blood;
Lesser volume and more concentrated urine produced;

4ai) aa;

4aii) A and a OR A and a.
Reject a and a, AA, Aa

4b)



*Correct shading required

4c) *State one type of*
chemical, e.g. tar;
radiation, e.g. ultraviolet radiation

4d) closely related people possess similar genotype
Higher chance of homozygous genotype
Recessive condition will be expressed

5a) the process involving the fusion of nuclei of male and female gametes to form a zygote; and the production of genetically dissimilar/ different/ non-identical offspring;

5bi) menstruation

5bii) pregnancy

5c) large surface area to volume ratio for exchange of substances;
thin walls/ membranes leading to shorter diffusion distance;
richly supplied with blood capillaries / highly vascularised to maintain a steep concentration gradient;

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5d) Functions like 'lungs':
- Allow oxygen to diffuse from maternal blood into fetal blood;
- Helps to remove carbon dioxide which diffuse from the fetal blood into the maternal blood;

Functions like 'kidneys'
- helps to remove removes excretory products such as urea which diffuses from the fetal blood into the maternal blood for removal;

6a) S: Scale of both graphs are more than >50% of the size of the grids
L1: Best-fit line for enzyme A
L2: Best-fit line for enzyme B
A: Axes labelled with units correctly for x and y axes + graphs are labelled A and B.
P1: Points plotted correctly for enzyme A.
P2: Points plotted correctly for enzyme B.

6b) Enzyme B is obtained from a human;
as its optimum temperature is close to that of human blood temperature of 37 °C;

6c) Enzyme molecules begin to denature;
Active sites unfold/ deformed / lost their shapes and are no longer complementary to the shape of the substrate molecules, leading to lower frequency of effective collisions and less enzyme-substrate complexes formed.

7a) Any 2:

bacterial cell	**animal cell**
cell wall present	cell wall absent
nucleus / nuclear envelope absent	nucleus / nuclear envelope present
membrane bound organelle absent e.g. RER, SER, Golgi body, vacuole	membrane bound organelle present e.g. RER, SER, Golgi body, vacuole

Reject: animal cells have no flagellum (sperm cells exist).

(b) Insulin gene is isolated by cutting with restriction enzyme to produce sticky ends and plasmid is cut with the same restriction enzymes;
To generate complementary sticky ends;
DNA ligase is used to repair the sugar-phosphate backbone / seal the recombinant plasmid
Transformation via heat shock or electric shock / Bacterial ribosomes synthesise insulin protein;
Reject: bacteria cells produce insulin (as this is repeating the question), recombinant plasmid is inserted into bacterial cell (this is repeating the words in the Fig.)

7c)

Vaccines	**Antibiotics**
used to prevent infectious diseases	used to treat **bacterial** diseases
effective against bacterial and viral diseases	effective only against bacterial diseases
stimulates white blood cells to produce antibodies	chemical that disrupts bacterial cell structure (cell wall, cell membrane, ribosomes, enzymes) to kill cell

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Section B

8a) Burning/combustion of fossil fuels;
Deforestation/ cutting down trees in forests;
other valid answer but **process** must be clearly stated

8b) The oceans function as a carbon sink (or) The land contains forests, which can function as a carbon sink.

A carbon sink is an area that functions as a reservoir that accumulates and stores more carbon (compounds) than it releases.

The waters of the oceans can function as a solvent and dissolve carbon dioxide.

Large amounts of phytoplankton (producers) in the ocean can carry out photosynthesis (or) Trees in forests can carry out photosynthesis, which is a process that removes carbon dioxide from the atmosphere to form glucose.

The oceans and seas consist of coral reefs / bodies of marine organisms can store carbon compounds. The calcium carbonate skeleton of corals can help store carbon thus removing it from the environment. (or) The bodies of trees can store carbon compounds.

The dead bodies of aquatic organisms can sink to the bottom of the sea and become fossilised, where they are converted into fossil fuels. Fossil fuels found at the bottom of oceans and seas also store (sequester) carbon from the environment. / The dead bodies of trees can be buried and converted into fossil fuels (charcoal). [max: 5]

8c) Cycle, walk, take public transport (instead of driving);
Use fans instead of aircon;
Eat more fruits and vegetables (instead of meat);
other valid answer [max:3]

9ai) relate long daylight (June – Sep) to decreasing concentrations of carbon dioxide;
Rate of photosynthesis higher than respiration, more carbon dioxide used up
Data cited from graph;

9aii) peak between Jun – Aug
Trough between Dec – Feb
Smooth line for entire graph otherwise max: 1

9b) more food produced ;
comparative data manipulation ;
fewer levels in food chain AW ;
correct reference to herbivore / carnivore + human ;
correct reference to primary / secondary + consumer ;
less energy lost / more efficient ;
example of energy not lost (e.g. through movement); [max: 5]

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