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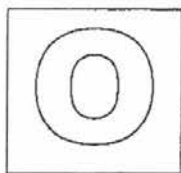
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GAN ENG SENG SCHOOL
Preliminary 2 Examination 2016



**CANDIDATE
NAME**

CLASS

**INDEX
NUMBER**

BIOLOGY

Paper 1 Multiple Choice

5158/01

30 August 2016

1 hour

Sec 4 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Write your name, class and index number on the OTAS. Shade your index number on the OTAS.

There are forty questions in this paper. Answer **all** questions. For each question there are four possible answers **A, B, C, and D**.

Choose the one you consider correct and record your choice in **soft pencil** on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

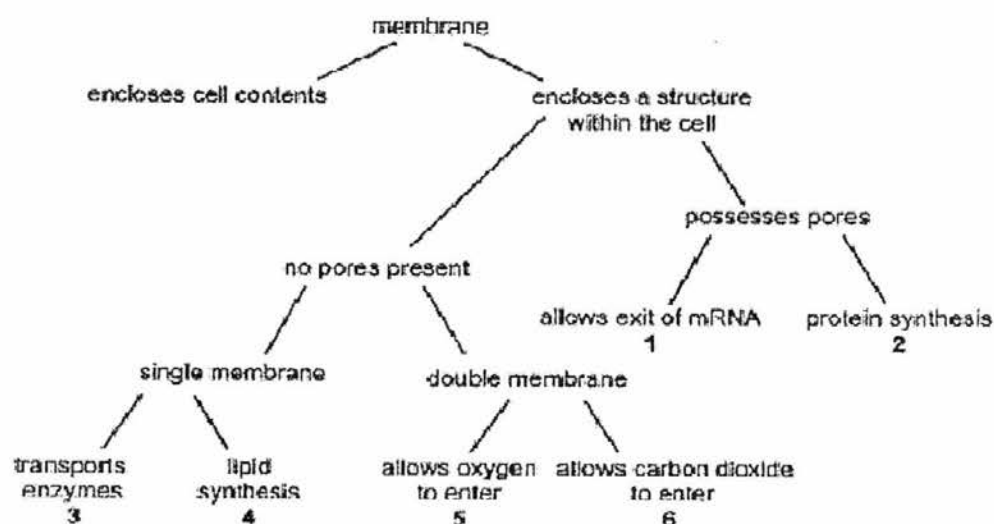
Read the instructions on the OTAS very carefully.

Any rough working should be done in this booklet.

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

Total Marks
40

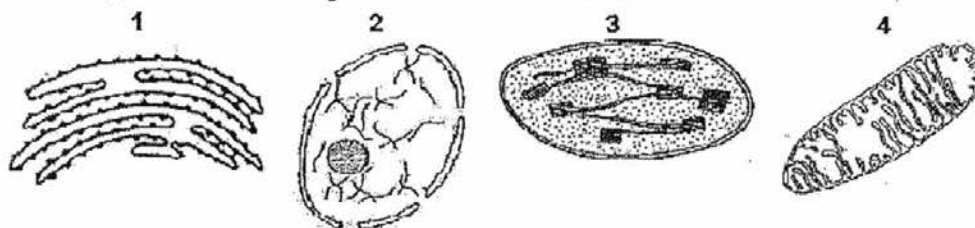
- 1 Membranes within and at the surface of cells have different roles. The diagram allows for the identification of the various organelles within the cell, by describing the membrane structure and function.



Which of the outcomes shown below correctly identifies the organelles that have the membrane and functions concerned?

	A	B	C	D
1	Chloroplast	Nucleus	Nucleus	Nucleus
2	Vesicle	Rough ER	Rough ER	Smooth ER
3	Smooth ER	Vesicle	Vesicle	Mitochondrion
4	Rough ER	Smooth ER	Smooth ER	Rough ER
5	Nucleolus	Nucleolus	Mitochondrion	Vesicle
6	Mitochondrion	Mitochondrion	Chloroplast	Chloroplast

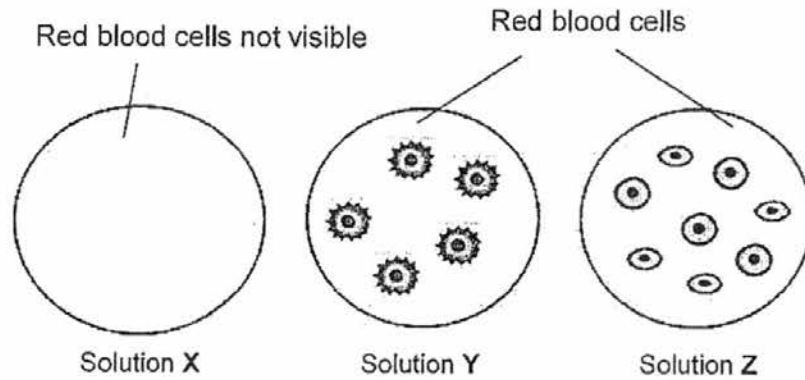
- 2 The diagrams below are organelles found inside cells.



Which row identifies the typical distribution of these organelles?

	Both animals and plants	Plants
A	1 and 2 only	3 and 4 only
B	2 and 3 only	1 and 4 only
C	2 and 4 only	1 and 3 only
D	1, 2 and 4 only	3 only

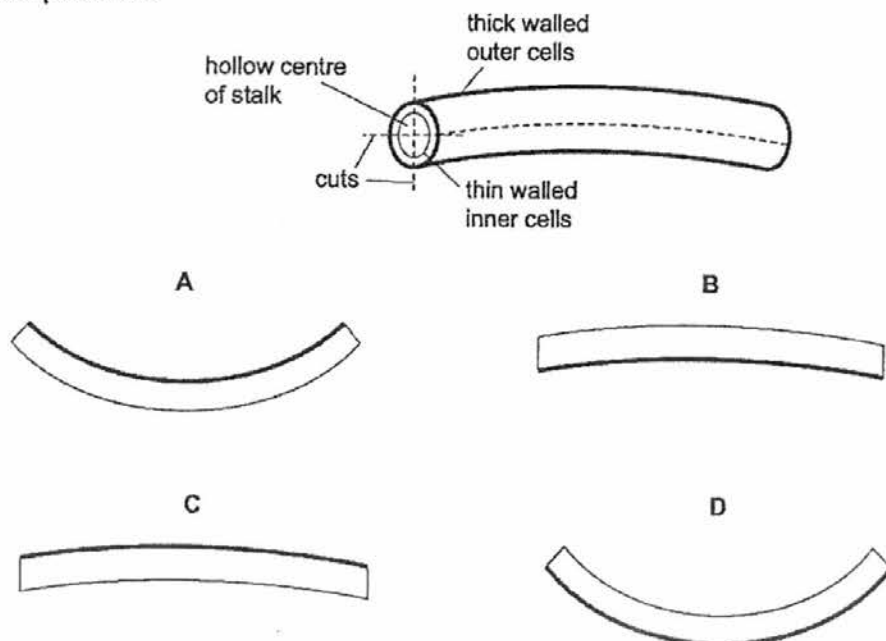
- 3 A student placed some red blood cells in three different salt solutions of varying concentrations: 0.01 g/dm^3 , 1.0 g/dm^3 and 10.0 g/dm^3 respectively. After ten minutes, he observed them under the microscope. The diagram below shows his observation.



What is the correct concentration of solution X, Y and Z respectively?

	Concentration of Solution X (g/dm^3)	Concentration of Solution Y (g/dm^3)	Concentration of Solution Z (g/dm^3)
A	0.01	1.0	10.0
B	0.01	10.0	1.0
C	1.0	10.0	0.01
D	10.0	0.01	1.0

- 4 The stalk of a *Ipomoea aquatica* (local name: kang kong) is a hollow tube. Pieces of the stalk are cut as shown and placed in sucrose solutions of different water potential. Which diagram shows the piece that is placed in the sucrose solution with the highest water potential?



- 5 A student was asked to identify two compounds in a solution using food tests. The following table showed his results.

Test tube	Reagents added to test-tube		
	Sodium hydroxide and copper(II) sulfate solution	Benedict's solution	Iodine solution
1	Purple	Brick red	Brown
2	Blue	Blue	Blue-black
3	Purple	Blue	Blue-black

Which conclusion is consistent with the results?

- A Egg white and starch has been placed in tube 1.
 B Egg white and starch has been placed in tube 3.
 C Glucose and egg white has been placed in tube 2.
 D Glucose and starch has been placed in tube 1.
- 6 Four students were asked to design an investigation to determine the effect of pH on the activity of an enzyme. Which table shows the most appropriate design?

A

test tube	contents	pH	temp /°C
1	E	3	20
2	E	7	20
3	E	12	20
4	S	3	20
5	S	7	20
6	S	12	20

B

test tube	contents	pH	temp /°C
1	E + S	3	20
2	E + S	7	20
3	E + S	12	20
4	DW + S	3	20
5	DW + S	7	20
6	DW + S	12	20

C

test tube	contents	pH	temp /°C
1	E + S	3	10
2	E + S	7	20
3	E + S	12	30
4	S	3	10
5	S	7	20
6	S	12	30

D

test tube	contents	pH	temp /°C
1	E + S	7	10
2	E + S	7	20
3	E + S	7	30
4	DW + S	7	10
5	DW + S	7	20
6	DW + S	7	30

E = Enzyme

S = Substrate

DW = Distilled Water

- 7 The table shows the conditions set up in an experiment.

Tube 1	1 ml of oil	5 ml of lipase	0.05 g of bile salts	5 ml of pH 9 buffer
Tube 2	1 ml of oil	5 ml of water	0.05 g of bile salts	5 ml of pH 9 buffer
Tube 3	1 ml of oil	5 ml of lipase	-	5 ml of pH 9 buffer

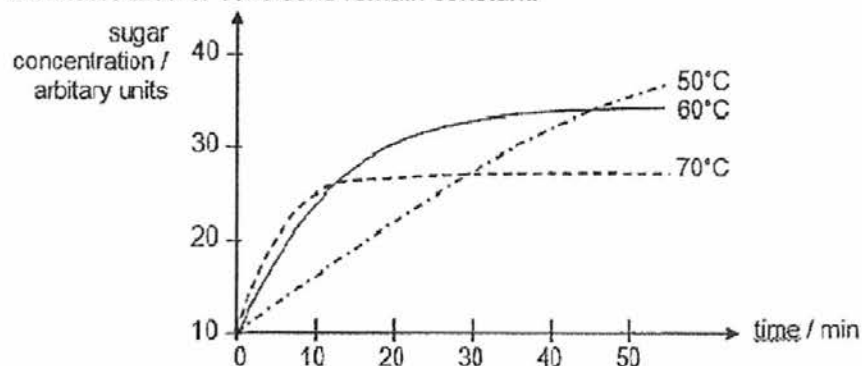
Three drops of pH indicator was added to each test tube. The colour changes for the pH indicator are as follows.

pH 3	pH 5	pH 7	pH 9
Red	Pink	Orange	Yellow

What colour would you expect to see in the test-tubes after 30 minutes?

	Tube 1	Tube 2	Tube 3
A	Red	Red	Yellow
B	Orange	Yellow	Pink
C	Pink	Yellow	Red
D	Red	Yellow	Pink

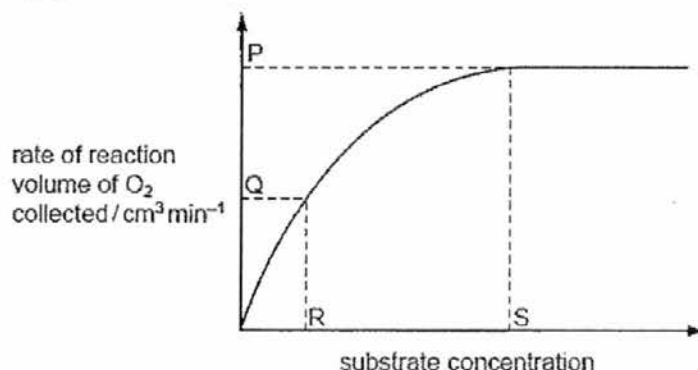
- 8 In beer making, enzymes present in barley hydrolyse starch into sugar. The graph shows the production of sugar at three different temperatures over a period of 50 minutes. All other conditions remain constant.



What can be deduced from the graph?

- A At 60°C, all the starch is hydrolysed within 30 minutes.
- B At 70°C, the enzymes are denatured before hydrolysis is complete.
- C Sugar is absent from the barley before reaction.
- D The optimum temperature for the enzyme is 50°C.

- 9 The enzyme catalase breaks down the substrate hydrogen peroxide into water and oxygen. The effect of hydrogen peroxide concentration on the rate of reaction is shown in the graph.



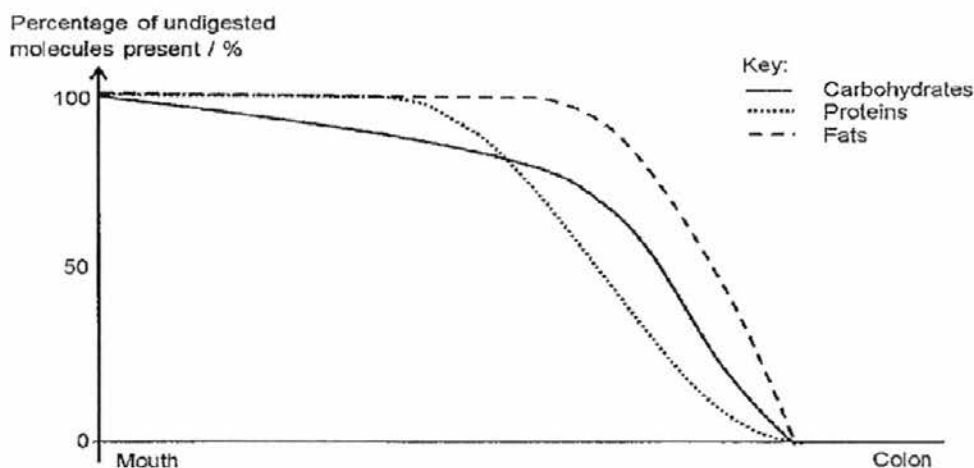
Which of the following statements about this reaction are correct?

- I. At P, the rate of reaction is limited by the concentration of enzyme.
- II. At Q, all of the enzyme active sites are occupied by substrate molecules.
- III. At R, the rate of reaction is limited by the concentration of the substrate.
- IV. At S, substrate molecules occupy all of the enzyme active sites.

- A I and III only
C I, III and IV only

- B II and IV only
D II, III and IV only

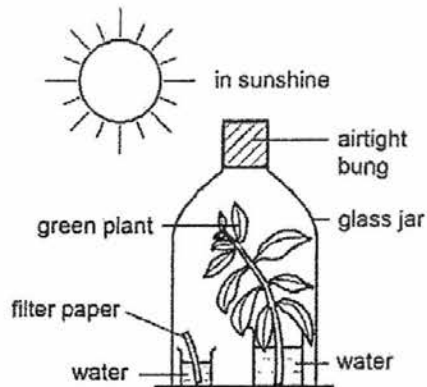
- 10 The following graph shows the percentage of undigested carbohydrates, proteins and fats through successive parts of the alimentary canal.



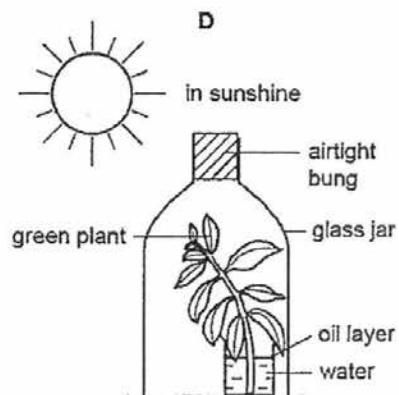
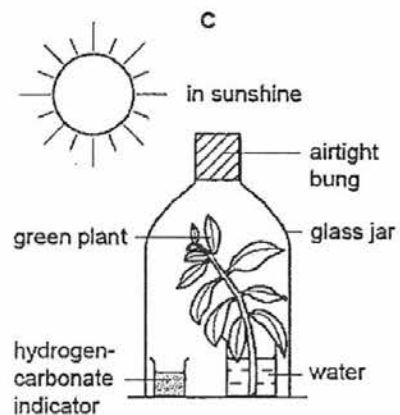
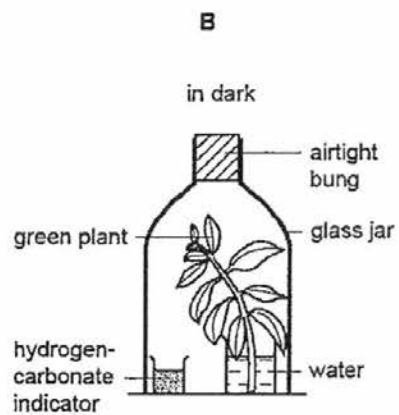
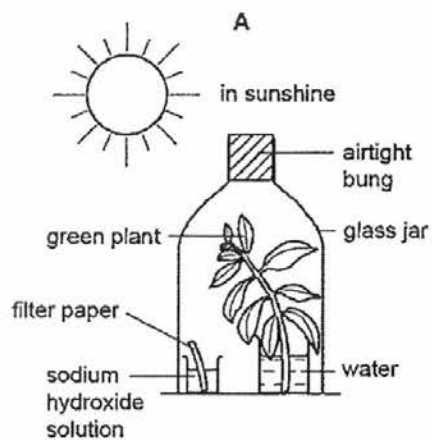
Why is this graph an inaccurate representation of the percentage of undigested molecules in the human alimentary canal?

- A Carbohydrates should not be the first to be digested.
- B It is impossible for all molecules to be completely digested.
- C The digestion of all molecules should not be completed at the same time.
- D Proteins should not be digested at a faster rate than carbohydrate and fats.

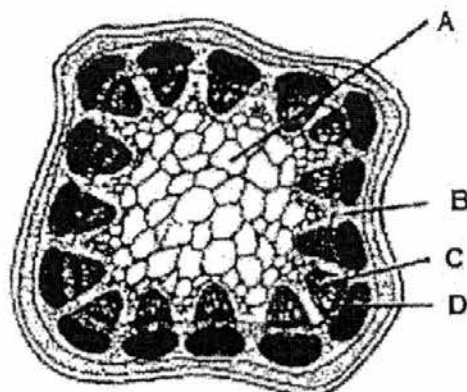
- 11 The diagram shows a green shoot photosynthesising inside a glass jar. This was used as a control experiment in a laboratory investigation.



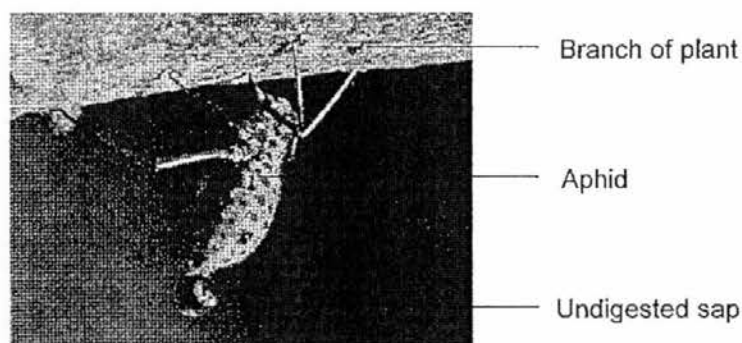
Which diagram shows the other experiment that should be done to investigate the need for carbon dioxide in photosynthesis?



- 12 A plant was placed in a bell jar which contained radioactive carbon dioxide. After an hour, thin slices were cut from the stem and placed on X-ray film which becomes black when exposed to radioactivity. Which of the labelled regions will become black when placed on the film?



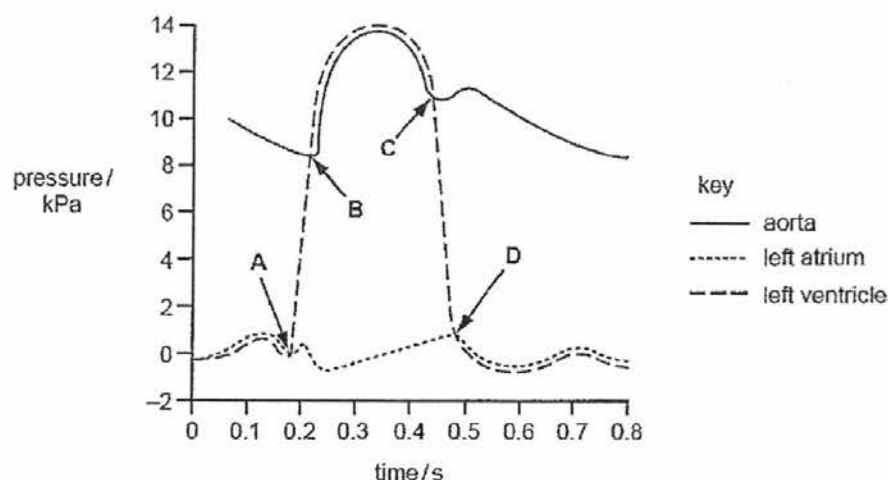
- 13 The photograph shows an aphid feeding on a branch of a plant. The fluid extracted by the aphid consists of sieve element sap. The high turgor pressure in the sieve element forces the cell contents through the food canal of the aphid. Once every 30 minutes, a droplet of undigested sap exits from the aphid. Plants exhibiting extensive aphid damage have a variety of symptoms, such as decreased growth rates, stunted growth, low yields and death.



Which of the following pairs of observation and explanation is **not** correct?

	Observation	Explanation
A	Sieve element sap	Rich in solutes, especially sucrose and amino acids
B	High turgor pressure in sieve element	Numerous mitochondria in sieve tubes to carry out active transport
C	Undigested sap	Product of egestion and not excretion
D	Variety of symptoms	Due to low levels of manufactured food substances left for the plant

- 14 The graph shows pressure changes in the aorta, left atrium and left ventricle during one beat of the human heart. At which point do the semi-lunar valves begin to close?

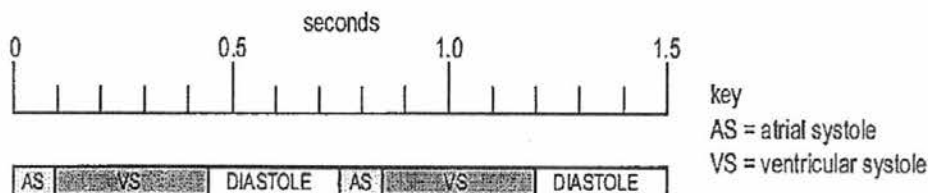


- 15 The table refers to blood vessels in the human body. What are P, Q, R and S?

Vessel	Blood carried		Oxygen content
	From	To	
Aorta	P	All organs except lungs	Oxygenated
Pulmonary vein	Lungs	Heart	Q
Hepatic artery	Aorta	R	Oxygenated
Hepatic portal vein	Alimentary canal	Liver	S

	P	Q	R	S
A	Left ventricle	Deoxygenated	Kidney	Deoxygenated
B	Left ventricle	Oxygenated	Liver	Deoxygenated
C	Right ventricle	Deoxygenated	Kidney	Oxygenated
D	Right ventricle	Oxygenated	Liver	Oxygenated

- 16 The diagram shows two cardiac cycles of a student, with the sequence of events set against a time scale.



How many times per minute is the student's heart beating?

- A 72 B 75 C 80 D 90

- 17 Student 1 is a healthy girl. Blood samples from three veins (X, Y and Z) in her body were taken and the concentrations of carbon dioxide, oxygen and urea were measured. The results, in arbitrary units, are shown in the following table.

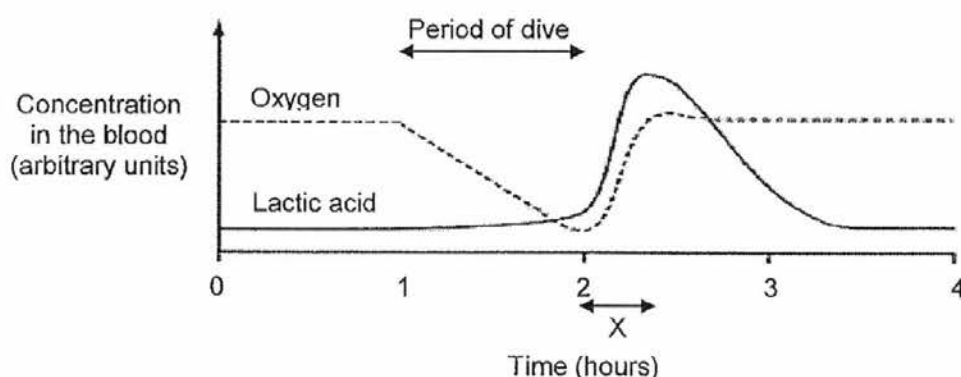
Vein	CO ₂ concentration (arbitrary units)	O ₂ concentration (arbitrary units)	Urea concentration (arbitrary units)
X	45	34	0.3
Y	48	37	6.8
Z	33	98	5.1

Student 2 is suffering from some illness and his blood samples from the same type of veins (X, Y and Z) were taken and the concentrations of the substances were measured. The results are shown in the following table.

Vein	CO ₂ concentration (arbitrary units)	O ₂ concentration (arbitrary units)	Urea concentration (arbitrary units)
X	43	33	2.9
Y	47	35	6.6
Z	33	97	5.3

What could Student 2 be suffering from?

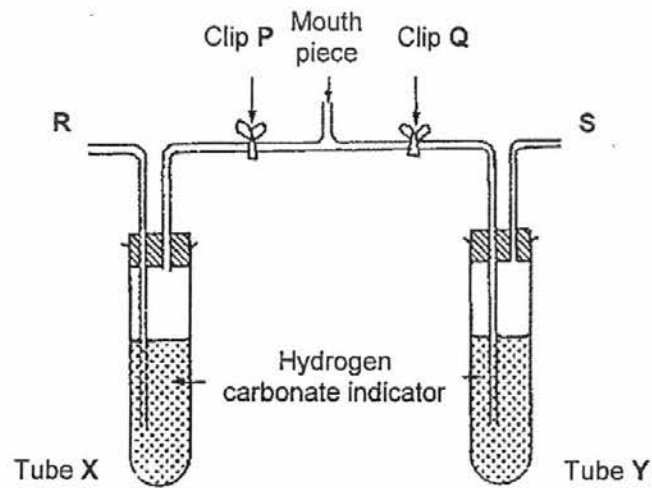
- A Atherosclerosis
 B Kidney failure
 C Diabetes mellitus
 D Emphysema
- 18 The graph shows the concentration of lactic acid and oxygen in the blood of a seal before, during and after a dive.



What explains the change in lactic acid concentration during time X?

- A Increased lactic acid is oxidised
 B Increased blood flow to muscles
 C Increased aerobic respiration rate
 D Lowered anaerobic respiration rate

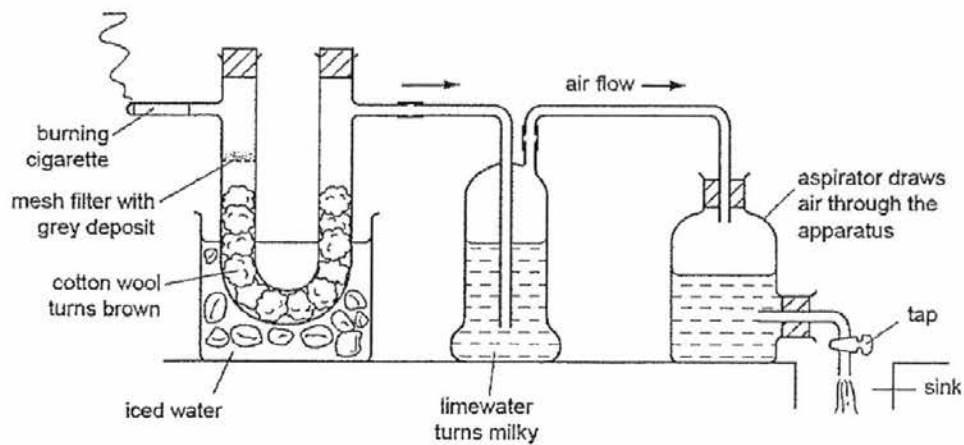
- 19 The diagram below shows an experiment used to compare the amount of a certain gas component in inspired and expired air.



When the boy expires out several times through the mouthpiece, which of the following combinations is correct?

	Air outlet	Clip P	Clip Q	Colour of hydrogen carbonate indicator solution in	
				Tube X	Tube Y
A	S	Closed	Open	Red	Yellow
B	R	Open	Closed	Yellow	Red
C	S	Closed	Open	Yellow	Yellow
D	R	Open	Closed	Red	Yellow

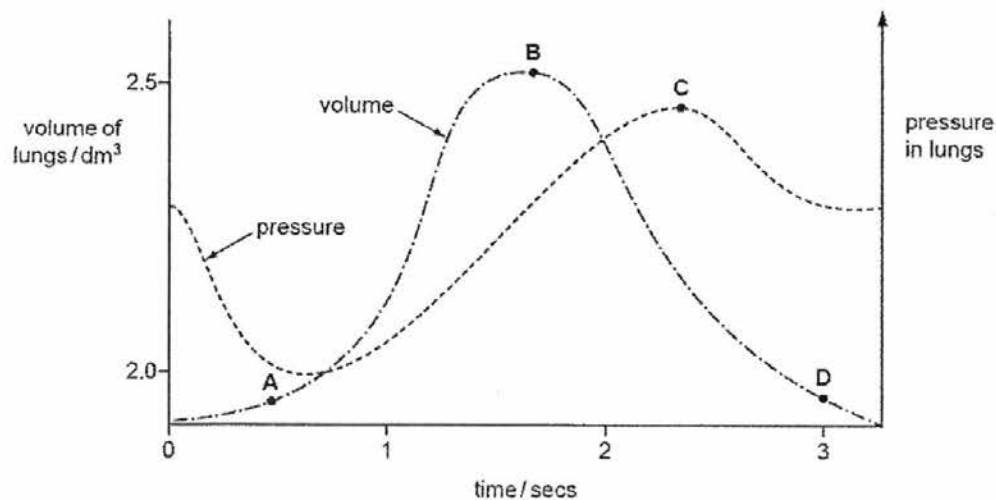
- 20 The diagram shows the apparatus used to show some of the materials in cigarette smoke. The labels indicate the results after five minutes.



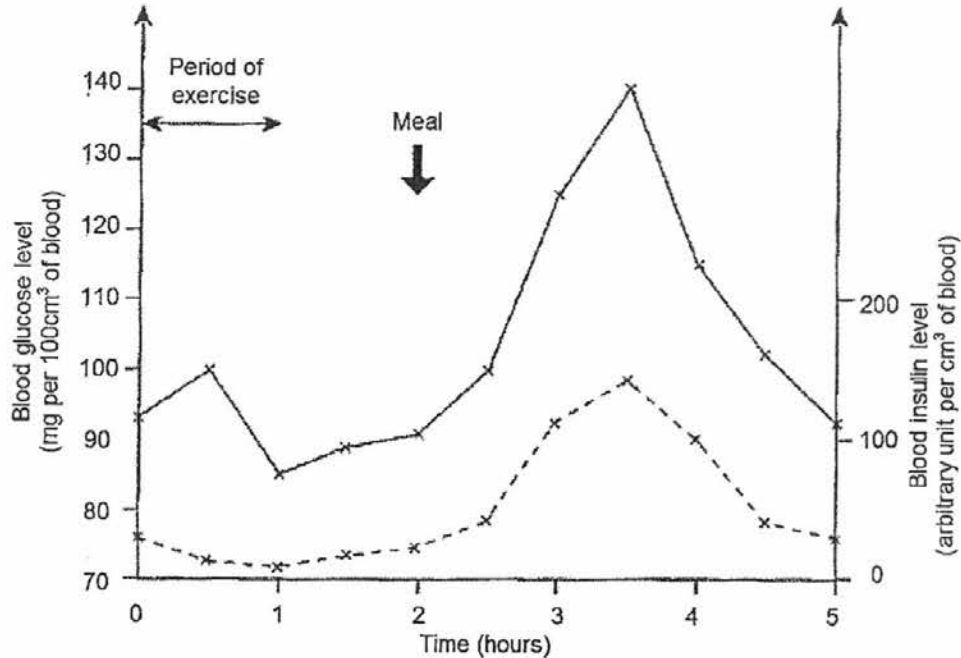
Which materials that are in cigarette smoke did this apparatus detect?

	Grey deposit on mesh filter	Cotton wool turns brown	Limewater turns milky
A	Nitrates	Nicotine	Carbon dioxide
B	Nitrates	Tar	Carbon monoxide
C	Particles	Nicotine	Carbon monoxide
D	Particles	Tar	Carbon dioxide

- 21 The graph shows how the pressure and volume inside the lungs change during one complete breath. At which point are the muscles of the diaphragm starting to contract?



- 22 The graph shows how the levels of blood glucose and insulin change over time. Which of the following best explains the changes in blood glucose levels shown in the graph?



- A Adrenaline was secreted at the start of the period of exercise.
 B Glucagon was secreted to increase the blood glucose concentration above set point at the start of the period of exercise.
 C Insulin began to be secreted 1 hour after the meal was taken in order to decrease the blood glucose concentration.
 D Glucagon secretion decreased after the meal was taken in order to prevent blood glucose levels decreasing below set point.
- 23 Many people enjoy watching movies. When the air temperature in the cinema is cold, moviegoers tend to visit the washroom more frequently to urinate. Which of the following best explains this phenomenon?
- A The brain gets colder, thus the nervous system is affected.
 B The urinary bladder contracts, thus pressure in the bladder builds up.
 C Sweat production is reduced, thus more water is excreted through urine.
 D Blood flows slower, thus lesser water is re-absorbed back into the blood.

- 24 Four people, W, X, Y and Z had the following descriptions with regards to their body and dietary conditions:

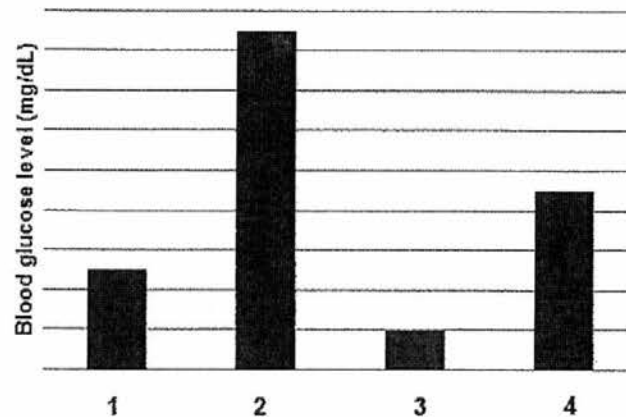
W: Normal; has not eaten for 24 h

X: Normal; before lunch

Y: Normal; 3 h after lunch

Z: Diabetic; 3 h after lunch

They were then tested for their blood glucose levels. The graph below shows the blood glucose levels of the 4 people.



Which shows the correct match of the people to their blood glucose level?

	1	2	3	4
A	W	Z	X	Y
B	X	Y	W	Z
C	X	Z	W	Y
D	Y	Z	W	X

- 25 An experiment was set up using four groups of insect-pollinated flowers in a field. In each group different parts of the flowers were removed, as shown in the table below, and insects were allowed to visit all the flowers freely. Which group of flowers would be most successfully cross-pollinated?

	Stigma	Anthers	Petals
A	Remained	Removed	Remained
B	Remained	Remained	Removed
C	Removed	Remained	Removed
D	Removed	Removed	Remained

- 26 The figure shows the side view of the female reproductive system and the early stages of reproduction in humans.



Fig. 1

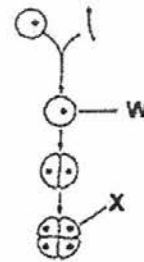
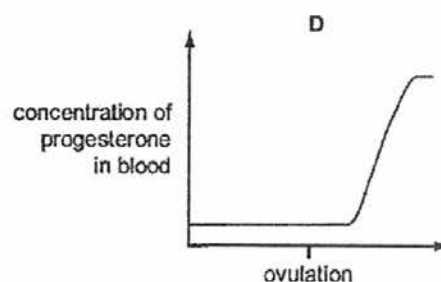
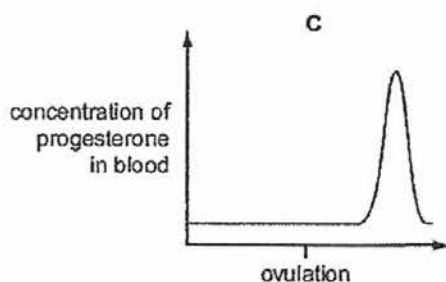
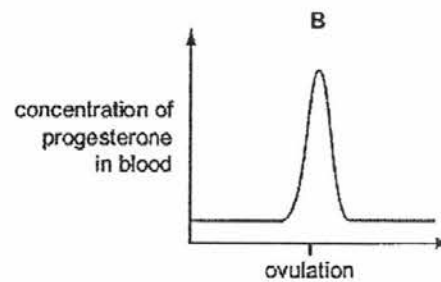
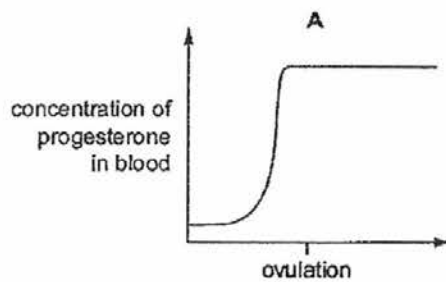


Fig. 2

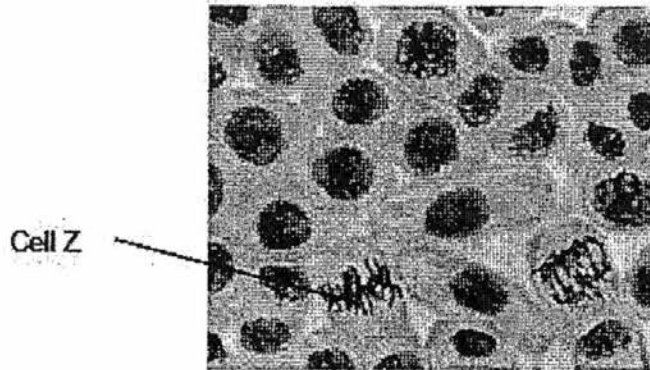
In which numbered parts of the female reproductive system will the stages **W** and **X** be found respectively?

- A 1 and 2 B 2 and 1 C 3 and 2 D 1 and 4
- 27 The graphs show the concentration of progesterone in the blood of a female during a 28 day cycle. Which graph shows the changes in concentration of progesterone if pregnancy occurs during the cycle?



- 28 A toxic chemical causes malfunction of the centrioles in animal cells. Which process in meiosis is likely to be directly affected by the chemical?
- A Crossing over between homologous chromosomes
 B Migration of chromosomes to opposite poles of the cell
 C Pairing of homologous chromosomes
 D Replication of centromeres

- 29 The photomicrograph shows the cells in an onion root tip undergoing cell division.

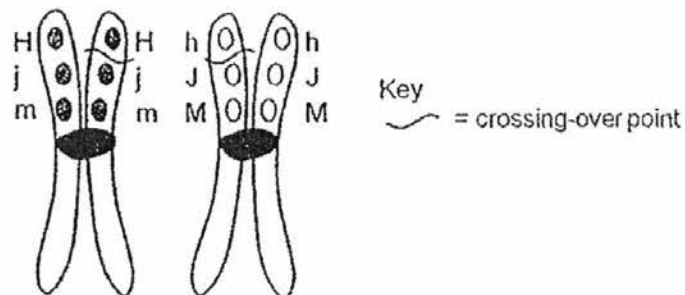


Which of the following statements correctly describes what is occurring in Cell Z?

- A DNA is replicating.
 - B Homologous chromosomes are pairing up.
 - C Sister chromatids are separating.
 - D Chromosomes are lining up at the equator.
- 30 Which of the following correctly identifies the type(s) of cell division that occur(s) in the liver and testes?

	Liver	Testes
A	Mitosis	Mitosis
B	Mitosis	Mitosis and meiosis
C	Meiosis	Meiosis
D	Meiosis	Mitosis and meiosis

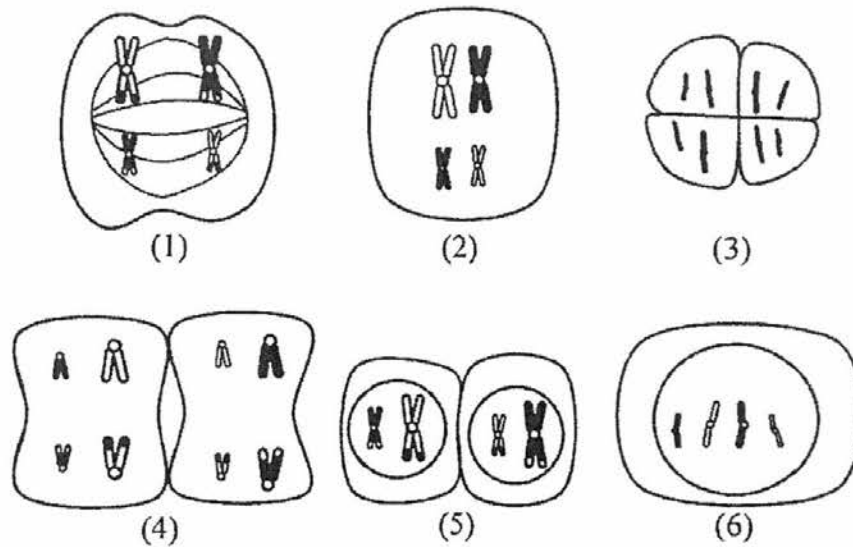
- 31 The diagram below shows a pair of homologous chromosomes in a cell undergoing meiosis. Crossing over occurs and random segregation takes place.



What are two of the possible genotypes of the resulting gametes?

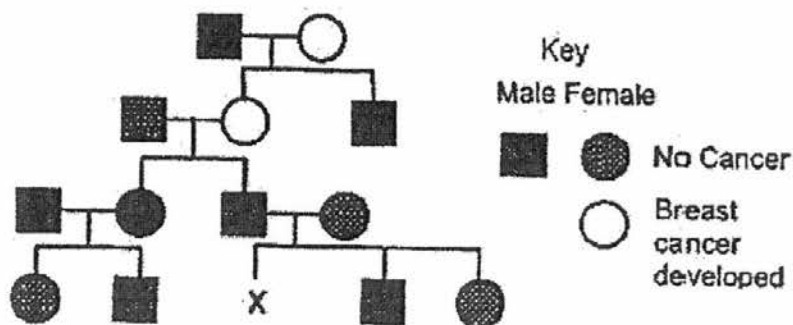
- A hJM and Hjm
- B Hjm and hjm
- C HJM and hJm
- D HJM and HJM

- 32 The diagram shows different stages of nuclear division in a cell.



Which is the correct sequence showing the nuclear division?

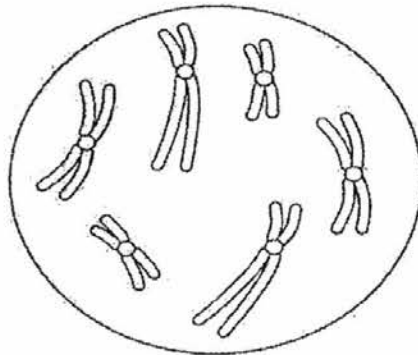
- A 2 → 1 → 5 → 4 → 6 → 3
 B 2 → 1 → 6 → 4 → 5 → 3
 C 6 → 1 → 2 → 5 → 4 → 3
 D 6 → 2 → 1 → 5 → 4 → 3
- 33 A variety of cows inherit a disease caused by a recessive gene. Calves born with this disorder do not get up after birth and soon die. Two heterozygous cows are mated. What is the probability that a surviving cow of the next generation is a heterozygous?
- A 0.00 B 0.25 C 0.50 D 0.67
- 34 The diagram shows the inheritance of a form of breast cancer associated with the presence of just one allele of the BRCA 1 gene.



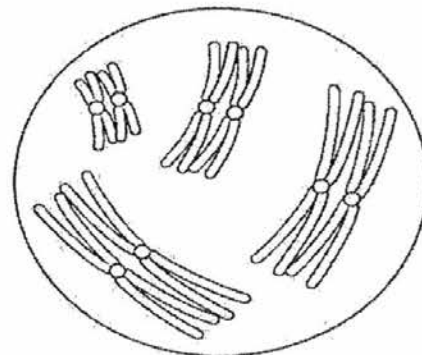
What is the probability that the woman X inherits the BRCA 1 allele that is associated with breast cancer?

- A 0.00 B 0.25 C 0.75 D 1.00

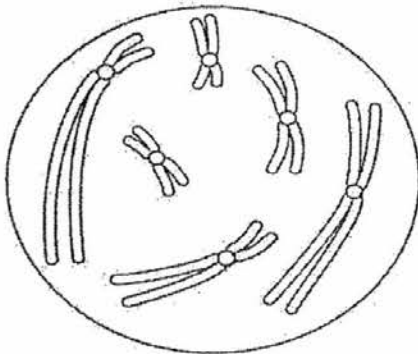
- 35 The following diagrams show different nuclei undergoing mitosis or meiosis. Which one of the diagrams shows a cell undergoing prophase II of meiosis?



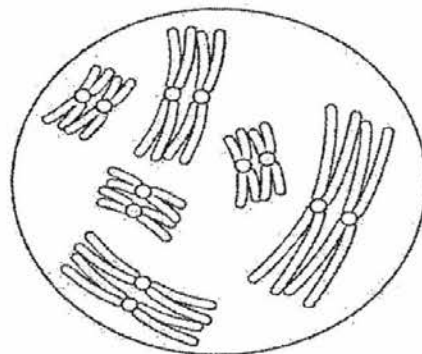
A



B



C



D

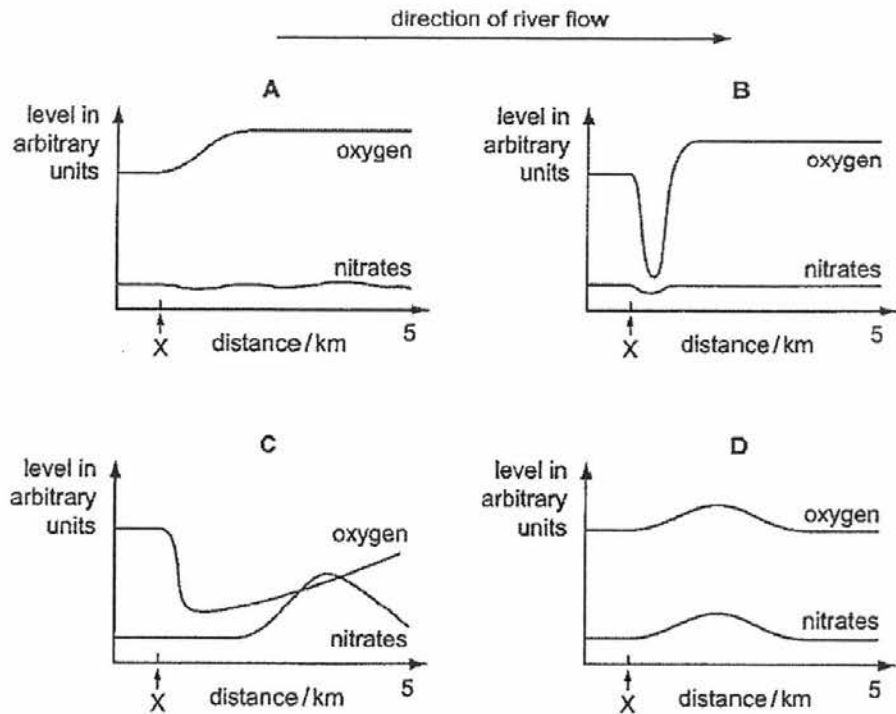
- 36 A laboratory experiment was done to show the effects of organic waste on the dissolved oxygen (DO) content in water. Five tanks were set up, each containing fresh water and a small amount of single-celled green algae. Specified amounts of organic waste were added to the tanks. The results below show the amount of DO in each tank after a period of one week.

	Tank 1	Tank 2	Tank 3	Tank 4	Tank 5
Initial DO (ppm)	10	10	10	10	10
Amount of organic waste (g)	0	10	20	30	40
DO after one week (ppm)	10	10	8	5	0

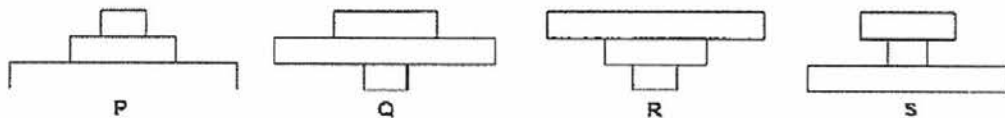
Why did the dissolved oxygen after one week decrease as the amount of waste increased?

- A The algae could not consume the waste fast enough.
- B The turbidity of the water increased, and the algae population increased.
- C The algae multiplied and then died and decomposed.
- D The carbon dioxide concentration increased due to algal respiration.

- 37 The graphs show how the levels of dissolved oxygen and nitrates change along the length of a river. Which graph shows the effect of sewage entering the river at the point marked X?



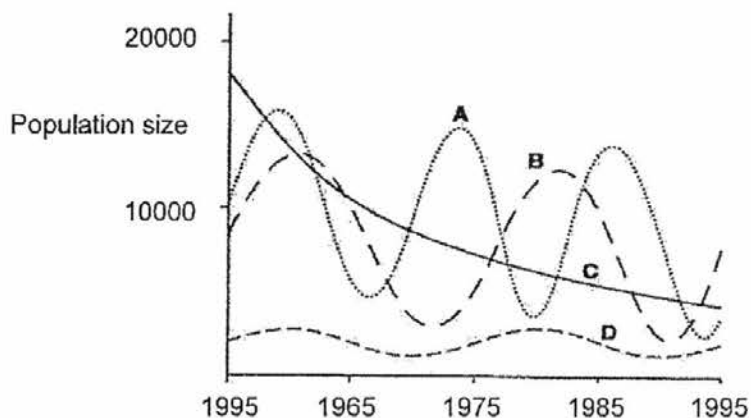
- 38 In a particular community, a papaya tree provides food for caterpillars, and these caterpillars in turn become food for a few birds.



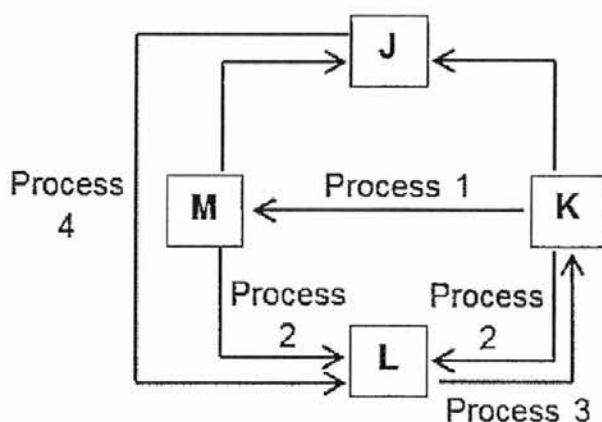
Which of the following pyramids accurately represent the pyramid of numbers and pyramid of energy for the food chain described above?

	Pyramid of numbers	Pyramid of energy
A	P	S
B	Q	P
C	R	S
D	S	Q

- 39 The population sizes of four different species of insects were monitored over a period of 40 years. The results are shown in the graph below. Which species is in the greatest danger of extinction?



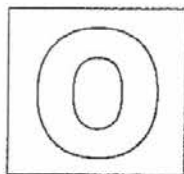
- 40 The carbon cycle can be illustrated using the following diagram. Processes 1, 2, 3 and 4 represent the processes involved in the flow of carbon compounds.



Which one of the following would most likely happen if process 4 does not occur?

- A The population of the grass would increase.
- B Carbon cycling would occur in the reverse direction.
- C Carbon dioxide levels in the atmosphere would decrease.
- D The rate at which carbon dioxide is released would increase.

END OF PAPER



GAN ENG SENG SCHOOL
Preliminary 2 Examination 2016



**CANDIDATE
NAME**

CLASS

**INDEX
NUMBER**

BIOLOGY

Paper 2

5158/02

25 August 2016
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on the cover page.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer **three** questions. Write your answers in the spaces provided on the Question Paper.
Question 9 is in the form of Either/Or question. Only one part should be answered.

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

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

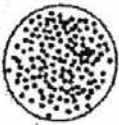
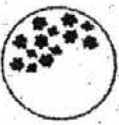
The number of marks is given in brackets [] at the end of each question or part question.

For Examiner's Use	
Section A	
Section B	
7	
8	
9 Either/Or	
Total	80

This paper consists of **17** printed pages including the cover page

SECTION A (50 Marks)Answer all the questions in this section.

- 1 (a) The victim of a traffic accident, Peter, suffered significant blood loss. A blood transfusion could save his life. Before a blood transfusion, Peter's blood group needs to be determined. Samples of his blood plasma is taken and placed onto a white tile. The samples of blood plasma are then tested with drops of blood from donors having different blood groups. The results are recorded in the table.

	Blood samples from donors of different blood groupings			
	W	X	Blood group B	Y
Serum from Peter				

- (i) Predict the possible blood group of donor Y. [1]

- (ii) Hence, predict Peter's blood grouping. [1]

- (iii) Explain why Peter is not able to receive blood from the donor with blood group B. [2]

- (b) In an experiment, three samples of red blood cells from an identical source were mixed with equal volume of different solution. After half an hour, the sample was examined with a microscope. The observations were recorded in the table below.

Sample	Solution added	Observation
A	5% sugar solution	No apparent change observed in the cells.
B	Distilled water	No cells seen. Slide appears a uniform pale red colour.
C	15% sugar solution	Diameter of the cells appears smaller.

- (i) Name the process that caused the changes in samples B and C. [1]

- (ii) Explain the observations in samples A and B. [4]

- 2 When newspaper is recycled, the printing ink has to be removed. Printing ink contains lipid-based compounds. The ink is removed by grinding the paper into a pulp and mixing it with lipase for several hours. Scientists discovered that the marine bacterium, *Vibrio alginolyticus*, produces lipase. They carried out an investigation to find out whether using *V. alginolyticus* to remove ink from paper pulp was as effective as mixing it with a solution of lipase. The bacterium was found to be more effective at removing the ink from the paper pulp than using the solution of lipase.

- (a) Suggest why it is more effective to use bacterium to remove the ink. [2]

- (b) The scientists added liquid **K** to the paper pulp before adding lipase to speed up the process of ink removal. Suggest the nature of liquid **K** and explain its function. [2]

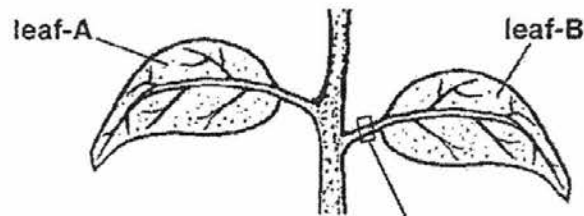
- (c) Explain why the tank containing the mixture of paper pulp and bacteria has to be sprayed with cool water at regular intervals. [3]

- (d) Explain why it is important to recycle paper rather than burn it. [2]

- 3 (a) Describe how phloem is adapted for its function.

[4]

- (b) An experiment was done to investigate the effect of heat treatment on translocation of manufactured food substances in plants. In this experiment, two similar leaves growing on the same plant were used. The petiole of one of the leaves (leaf B) was exposed to a quick jet of steam, as shown in the figure below. The plant was then left under the sun for 24 hours.



Petiole of leaf B exposed to quick jet of steam

- (i) The two leaves were plucked off the plant and tested for the presence of starch. Leaf B was found to have a significantly higher concentration of starch than leaf A. Explain how this could have happened.

[4]

- (ii) It was also found that the heat treatment did not disrupt transportation of water to the leaves. Explain how this can be possible. [2]

- 4 The table shows the clearance time of some substances for a patient who was undergoing kidney dialysis at three different times of the dialysis process.

Substance in blood	Concentration in blood (mg per litre)		
	At the start	After 30 minutes	After 6 hours
Urea	176	144	126
Creatinine	3.4	2.7	2.5
Glucose	134	128	138
Potassium	4.3	4.1	4.1
Sodium	143	137	135
Chloride	108		107

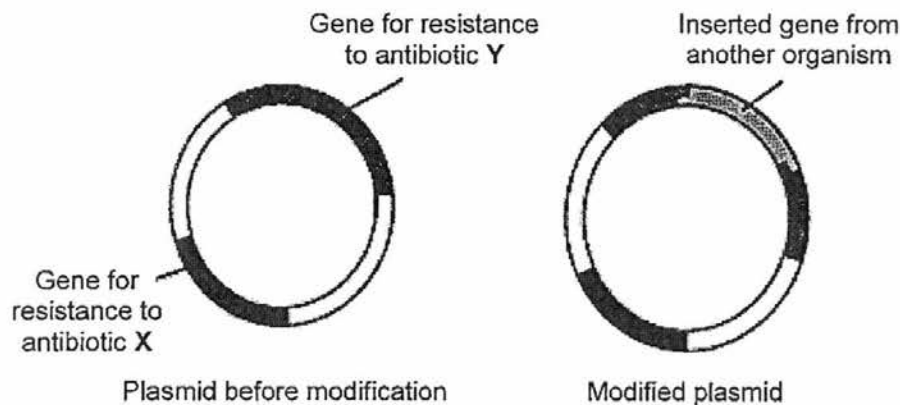
- (a) Complete the estimated concentration of chloride after 30 minutes of dialysis. [1]
- (b) Calculate the average hourly rate at which urea is removed from the blood of the kidney dialysis patient. Show your working. [2]

- (c) Explain the results for potassium after six hours of dialysis. [2]

- (d) The table did not show the concentration of proteins in blood. Predict how the trend of proteins would look like between the start to 6 hours after dialysis. Give a reason for your answer. [2]

- (e) During each treatment, a patient has to undergo dialysis for a few hours. Suggest one way the time can be shortened. Explain your answer. [2]

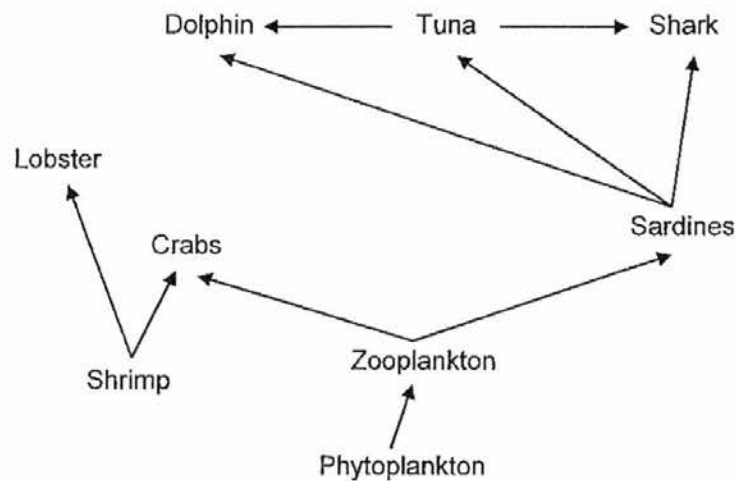
- 5 The figure shows a plasmid that underwent modification by inserting a gene from another organism. The plasmid initially contains two genes for resistance to antibiotics before modification.



- (a) Two different enzymes are required to produce the modified plasmid. State the roles of the **named** enzymes in the modification. [3]

- (b) Bacteria took up these modified plasmids. They were exposed to both antibiotics X and Y. Suggest and explain which antibiotic the bacteria will be resistant to. [3]

- 6 The figure shows part of a food web that is found in the ocean.



- (a) Name the top predator(s) in this food web. [1]

- (b) In the space below, sketch a pyramid of biomass of a food chain that involves 4 trophic levels. [1]

- (c) Lobsters were over-hunted by fishermen. Based on the food web, there should be fewer sardines. However, the population of sardines was not affected. Suggest a reason for this. [1]

- (d) Describe how the ocean acts as a carbon sink. [3]

- (e) Recent studies have suggested that sharks act as carbon sink. Suggest a reason for this conclusion. [1]

END OF SECTION A

Section B (30 Marks)Answer **three** questions in this section.Question 9 is in the form of an either/or question. Only **one part** should be answered.

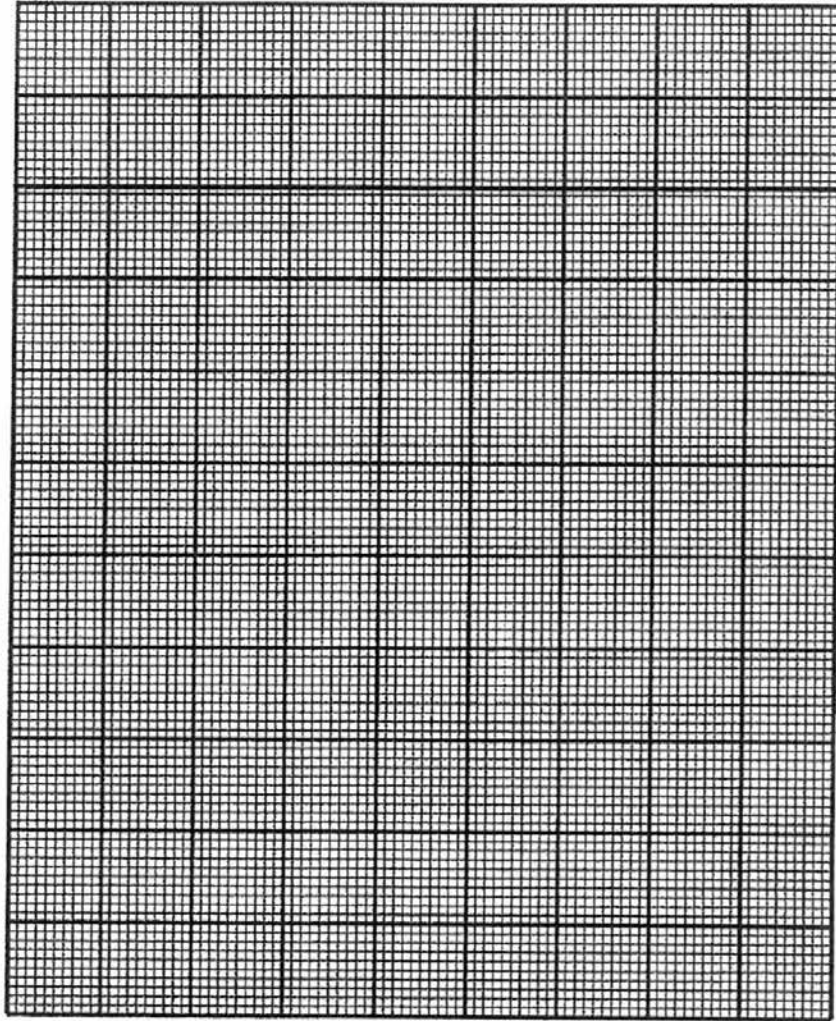
- 7 (a) It was reported in the recent news that temporary blindness is tied to the use of smartphones in the dark. A patient described that he was looking at his phone with one eye while resting on his side in bed in the dark, while his pillow was covering the other eye. After he placed his phone down, he could not see with the 'phone' eye. Explain how this could have resulted. [3]

- (b) Acetaminophen is a common pain-killing drug. When metabolised, the drug produces a toxic residual molecule, which is converted by the body to a harmless product before being excreted in the urine. Two radioactive-labelled forms of acetaminophen are prepared and administered to two groups of volunteers. Each volunteer will receive a single dose that is either injected into his vein or taken orally. Each dose of acetaminophen has 30 radioactive arbitrary units. Urine samples are collected and analysed from both groups of volunteers every 2 hours over 12 hours. The average radioactivity values of the two groups are shown in the table below.

Time (h)	Radioactivity (arbitrary units)	
	Vein	Oral
0	2.0	0.0
2	4.0	0.5
4	10.0	1.5
6	6.0	4.0
8	4.0	4.5
10	2.0	5.0
12	1.0	4.0

- (i) Plot the data in the graph below.

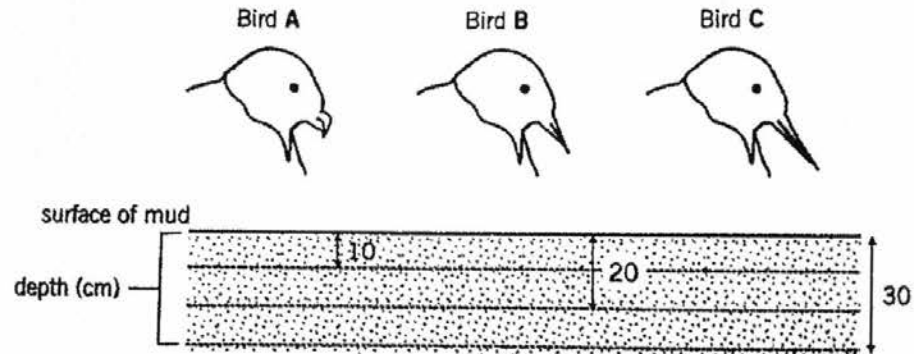
[4]



- (ii) With reference to the graph, compare and explain the trends as a result of the two modes of drug delivery. [3]

8

Three birds, **A**, **B** and **C** prey on the organisms buried underneath the mangrove mudflats. Birds **A** and **B** belonged to the same species whereas Bird **C** is a closely related species. The figure shows the different types of beaks for each bird and the depth each bird can reach.



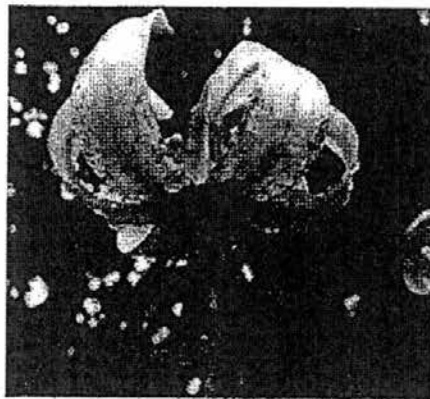
- (a) A single pair of alleles controls the shape of the beak. When Bird **A** with curved beak is crossed with Bird **B** with straight beak, all of the offspring have straight beaks. Assuming that the parent birds are purebred, draw a genetic diagram to illustrate the cross between Bird **A** and **B**. Use appropriate letters to represent the alleles. [4]

- (b) Based on the figure above, explain how competition between the three birds is reduced. [2]

- (c) DNA testing and tracing performed on Bird C show that it is likely to share a common ancestor with Bird B. Explain how competition may have played a part in the evolution of the type of beak found in Bird C. [4]

9 Either

- (a) The figure shows a flower of *Lilium polyphyllum*, a lily that grows in the Himalayan mountains. This species is cross-pollinated by insects.



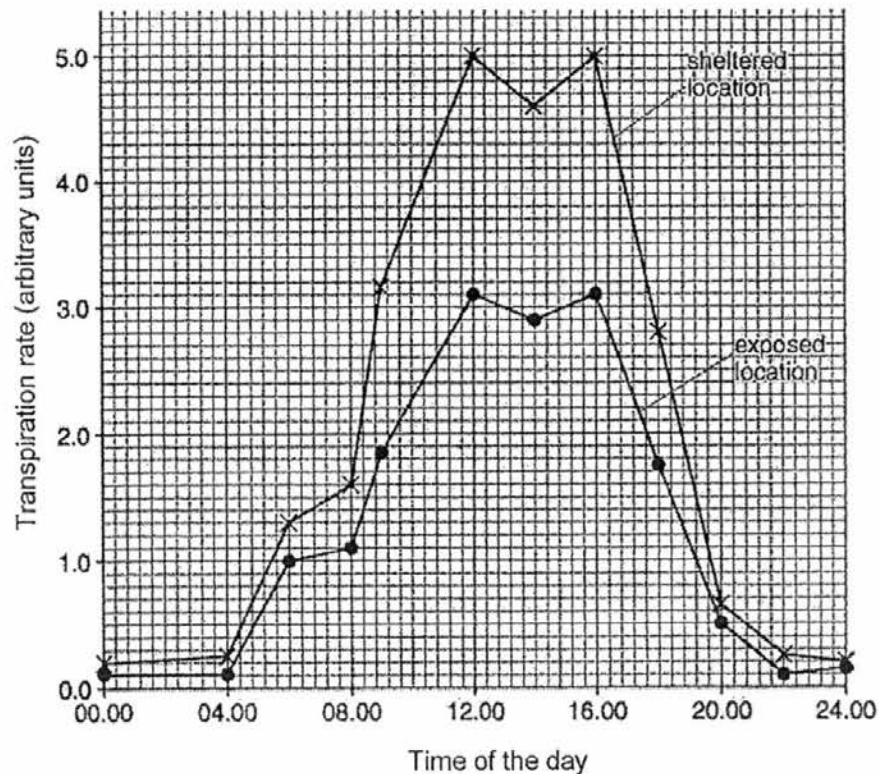
- (i) Explain what is meant by cross-pollination. [1]

- (ii) State one visible feature in the figure that helps in insect pollination. [1]

- (iii) *Lilium polyphyllum* that grow at low altitudes produce flowers 60 days before the plants of the same species that grow at high altitudes. [2]
Suggest two environmental reasons why lilies that grow at lower altitudes flower earlier than the lilies at higher altitudes.

- (iv) Explain why flowering time is an example of continuous variation. [2]

- (b) The buttonwood tree, *Conocarpus erectus*, grows in coastal areas of America. A study was carried out on its ability to survive on Socorro Island off the Pacific coast of Mexico. The island is exposed to high winds, which can lead to high rates of transpiration. The transpiration rates of trees at sheltered and exposed locations at the same altitude on Socorro Island were compared.



- (i) Based on the graph, state the conclusion from the results of this study. [1]

- (ii) The leaves of the buttonwood trees at the exposed site were significantly smaller than those at the sheltered site. Describe three ways, other than small size, in which leaves are adapted to reduce rate of transpiration. [3]

9 Or

The figure shows a section through the skin of a person at two different environmental conditions.

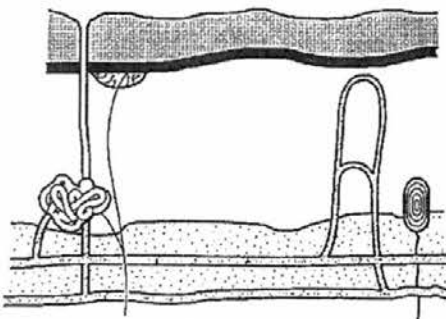


Figure 9.1

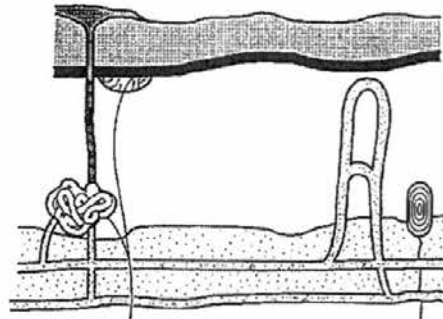
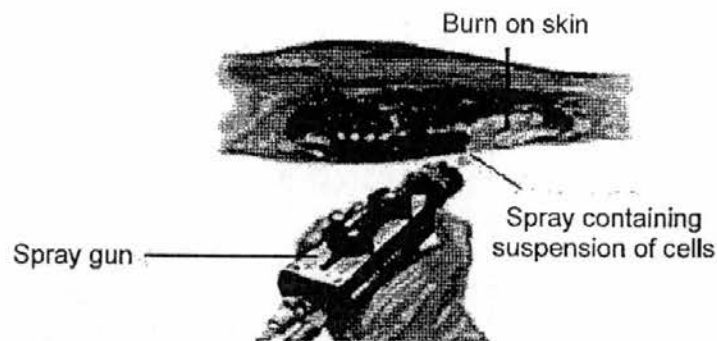


Figure 9.2

- (a) (i) On Figure 9.1, identify and label the sweat gland and temperature receptor. [2]

- (ii) State and explain what happened to the body to cause the changes shown in Figure 9.1 compared with Figure 9.2. [3]

- (b) Treatment of burns has been improved by the use of 'spray-on-skin'. In this treatment, a suspension of young individual skin cells from the patient is sprayed directly onto the burnt area as seen in the figure below. These cells then grow and divide rapidly to produce a continuous layer of skin cells. 'Spray-on-skin' results in rapid healing of the burnt area.



- (i) Explain why burn patients often lose their ability to regulate their body temperature. [2]

- (ii) Suggest one advantage that 'spray-on-skin' has over older methods such as skin grafting. [1]

- (c) Describe the protective functions played by the blood in the event of an injury. [2]

END OF PAPER

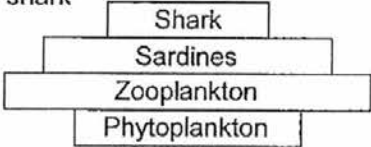
Answers for Secondary 4 Express Biology Prelim 2 P1 2016

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

Answers for Secondary 4 Express Biology Prelim 2 P2 2016

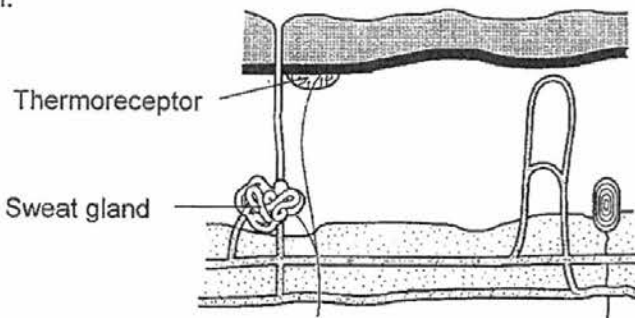
1	(a) i. Blood group AB; ii. Blood group A; iii. Blood group B would contain antigen B on the red blood cells while Peter's blood plasma contains antibody b; This would result in agglutination between antigen B and antibody b which would be fatal; (b) i. Osmosis; ii. A – Water potential in cytoplasm same as sugar solution; No net movement of water molecules via osmosis; B – Water potential in cytoplasm lower than distilled water; Net movement of water into cells via osmosis across partially permeable membrane, causing cells to expand and burst in the absence of cell wall;	[1] [1] [3] [1] [4]	
2	(a) Bacteria can reproduce rapidly unlike a solution of lipase; Hence, the concentration of enzyme lipase produced increases over time which would increase rate of reaction while the concentration of enzymes in the solution cannot be changed; (b) K is an emulsifier; It increases the surface area to volume ratio of lipids to speed up the reaction with lipase (c) Bacteria are living organisms which undergo aerobic respiration to release energy for cellular processes; Energy released during aerobic respiration could be lost as heat to the surrounding, which then increases the temperature in the reaction tank; Spraying water lowers the temperature to stop denaturation of bacterial enzymes (d) Burning causes air pollution / global warming OR New paper is obtained by cutting down trees, causing loss of forests (any other effects deforestation); Less energy is needed to recycle paper than making papers from trees; Trees are non-renewable resources hence recycling results in lesser wastage; (Accept any two)	[2] [2] [3] [2]	

3	(a) Presence of many mitochondria in the companion cells; Release energy needed for the companion cells to load sugars from mesophyll cells into sieve tubes by active transport; Perforations or holes in sieve plates; Allow rapid flow of manufactured food substances; (b) i. Steam treatment at leaf B kills companion cells due to high temperature; Hence, no energy released via respiration due to absence of mitochondria; Manufactured food (sucrose) produced photosynthesis in leaf B cannot be loaded into the phloem; Excess sucrose is converted back starch and stored in the leaf; ii. Xylem vessels are made of dead cells, hence unaffected by heat; Energy from living cells are not required since water transport is a passive process and dependent on transpiration pull;	[4]	
4	(a) Accept 106 to 108; (b) Rate = $50/6 = 8.33 \text{ mg/dl h}^{-1}$ Correct working; Correct answer with units; (c) The bath fluid contains the same concentration of mineral salts; No net movement of these substances; (d) Trend should show a straight horizontal line/constant; Proteins are too large to pass through the tubing, hence no change in concentration; (e) Increase the number of coils of cellophane tubing; Larger surface area to speed up diffusion of urea;	[1] [2] [2] [2] [2]	
5	(a) Restriction enzyme – to isolate the inserted gene and to open up the plasmid; DNA ligase – to join the inserted gene and the plasmid together; 1 mark for correct naming of enzymes; (b) The bacteria will be resistant to antibiotics X as gene for resistance to antibiotics X is still present and the protein to resist antibiotic X can be produced.	[3] [3]	

	The gene for resistance to antibiotics Y is disrupted by the inserted gene; Hence, the required protein to resist antibiotic Y cannot be produced or a different polypeptide would be produced instead;		
6	(a) Dolphins, sharks, crabs and lobsters; (all must be correct) (b) Inverted pyramid for phytoplankton → zooplankton → sardines → shark  <pre> graph TD Shark[Shark] Sardines[Sardines] Zooplankton[Zooplankton] Phytoplankton[Phytoplankton] Shark --- Sardines Sardines --- Zooplankton Zooplankton --- Phytoplankton </pre> (c) High replacement rate/reproduction rate of zooplankton, so competition for food is not an issue; (d) Oceans are able to store carbon for an indefinite period and it stores more carbon than it releases; Dissolved carbon dioxide is used by aquatic plants for photosynthesis which remove carbon dioxide but all organisms respire which then contributes to increase carbon dioxide in oceans; The carbon is then passed down from one organism to the other down the food chain due to feeding; Decomposition of dead organisms releases carbon dioxide which dissolves in the water, adding carbon to the ocean; Also, dead organisms buried in the sea bed form fossil fuels over time, resulting in an increase in carbon in the ocean; (Any three points, one mark each) (e) Sharks store huge amounts of carbon in their bodies due to their large mass. When they die, they sink to the bottom of the ocean and are consumed by scavengers;	[1] [1] [1] [3] [1]	

7	(a) When looking at the phone, the high light intensity from the phone was detected by the photoreceptors on the retina; This triggered the circular muscles to contract and the radial muscles to relax, resulting in a decrease in pupil size; When the phone was put down, the light intensity decreased but more light is hindered from entering the eye due to the small pupil size, hence time is needed for the person to adjust to the change in light intensity before he can see with both eyes; (b) i. Correct axes labelled with units; Graph covers at least half of space without odd scales; Correct plotting of all points; Line of best fit for both lines; ii. The radioactivity increases quickly and drastically to 10 units within 3 hours when it was injected, while it took 10 hours for the radioactivity to only increase to the maximum of 5 units; As the drug was injected into the bloodstream, it can be rapidly transported to the target organs to be metabolized and the by-products can be discharged through the urine within a shorter time; However, when taken orally, time is required for digestion and absorption, hence it took longer to be transported to the target organs but can be sustained over a longer period of time;	[3]	
8	(a) Parental phenotype Curved beak Parental genotype bb Gametes b b Offspring genotype Bb Bb Bb Bb Offspring phenotype Straight Straight Straight Straight Parental phenotype; Parental genotype; Gametes; Offspring genotype; (Reject use of different letters) (b) Different species have different beak lengths; Allows for the different species of birds to feed on organisms at different depth in the mudflat;	[4]	

(c)	Genetic variation in beak length for birds with straight beaks occurred due to mutation; Those with longer beaks may be at a selective advantage as they can access more food at greater depths; Hence, they are able to better survive and reproduce; Thus, they pass on the favourable gene/alleles coding for longer beaks/ favourable trait to the offspring;	[4]
9E (a)	i. Transfer to pollen grains from the anther of a flower on one plant to the stigma of the flower of another plant; [1] ii. Presence of large petals to attract insects; [1] iii. Lower altitudes with higher temperature and warmth, hence plant able to grow better as enzymes are closer to optimum temperature; Presence of more water, wind and insects at lower altitudes, hence allowing increased frequency of pollination and flowering; [2] iv. Influence by genes and environment; No distinct flowering times / presence of a range of flowering times; [2]	
(b)	i. Trees at sheltered location has higher rate of transpiration than those at exposed location; [1] ii. The stomata remained close for longer duration or when the conditions are hot and dry to reduce surface area for water loss / presence of sunken stomata in underside of the leaves to increase humidity around leaves to reduce concentration gradient and diffusion of water vapour / presence of hairs or trichomes increase humidity around leaves to reduce concentration gradient and diffusion of water vapour / low number of stomata per unit area to reduce surface area for water loss / presence of thick cuticle and epidermis to reduce water lost from the leaves due to evaporation; (Accept any three, one mark each) [3]	

90 (a)	i.	[1]
	 Thermoreceptor Sweat gland	
	ii. Body temperature decreases and sweat glands become less active to secrete lesser sweat; Vasoconstriction of arterioles to allow lesser blood to flow to capillaries nearer the skin surface; Lesser heat can be lost to the surrounding to regulate temperature;	[3]
(b)	i. Loss of sweat glands which secrete sweat that cools down the body via evaporation of water in sweat; Loss of thermoreceptors hence unable to detect external temperature changes;	[2]
	ii. Easy to cover uneven areas / spraying allows for less scarring;	[1]
(c)	The damaged tissues and blood platelets produces thrombokinas which converts prothrombin to thrombin enzyme; Thrombin catalyses the conversion of soluble fibrinogen to insoluble fibrin threads, allow a blood clot to be formed, to prevent excessive loss of blood;	[2]