FUKIEN SECONDARY SCHOOL
S4 Final Examination (2020-2021)
Biology
(1 hour 30 minutes)

Date: 11th June 2021 Name:_____
Time: 10:30a.m. - 12:00p.m. Class: _____ No.: _____

Instructions to students:
1. Write your name, class and class number on both the question paper and the answer sheets.
2. Answer ALL questions.
3. Write down all the answers on the answer sheets.
4. Hand in the question paper and the answer sheets at the end of the examination.
5. The total mark of the paper is 80.

I. Multiple Choice Questions (40 marks)

1. In the 18th century, smallpox was a very common disease in the UK.

A doctor called Edward Jenner discovered a way of protecting people from contracting smallpox. The following shows the process of his investigation.

- Jenner noticed that milkmaids often caught cowpox from cows.
- He also noticed that the milkmaids did not catch smallpox.
- He made a hypothesis.
- To test his hypothesis, Jenner took some pus from the blisters of a cowpox patient and scratched the pus into the skin of a healthy boy.
- The boy got infected and recovered in a few days.
- Jenner then scratched some pus from the blisters of a smallpox patient into the skin of the boy.
- The boy did not develop smallpox.

Which of the following is the hypothesis of Jenner's investigation?
A. Cowpox was often found in milkmaids
B. Cowpox was common in UK.
C. All milkmaids would not develop smallpox.
D. If people are exposed to cowpox, then they will be immune to smallpox.

2. Which of the following is / are the functions of proteins in human bodies?

(1) making antibodies
(2) making the cell membrane
(3) providing energy

A. (1) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

3. Which of the following combinations about the function of the mineral is ***incorrect***?

	Mineral	***Function***
A.	calcium	for forming teeth
B.	magnesium	for blood clotting
C.	phosphate	for forming nucleic acids
D.	iron	for forming haemoglobin

Directions: Question 4 to 6 refer to the table below, which shows the relative amount of sub-cellular structures in four cell types P, Q, R and S.

Cell type	***Relative amount of sub-cellular structure***		
	Chloroplast	***Mitochondrion***	***Endoplasmic reticulum***
P	–	–	–
Q	–	+++	+
R	–	+	+++
S	+++	+++	+

Key: number of '+' indicates the relative amount of sub-cellular structure
'–' indicates the absence of the sub-cellular structure

4. Which of the following cell types is P?

A. root epidermal cell
B. bacterial cell
C. ovum
D. neurone

5. According to the table, which of the following statements ***best*** describes cell type R?

A. It is actively participated in protein synthesis.
B. It can carry out photosynthesis.
C. It can carry out both aerobic and anaerobic respiration.
D. It is active in cell division.

6 Which of the following cell type would be produced in the testes?

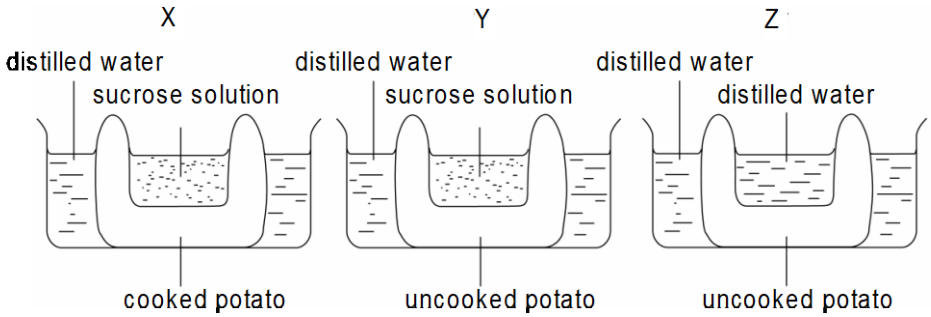
A. P

B. Q

C. R

D. S

Directions: Questions 7 to 9 refer to the diagram below which shows an experiment on osmosis. In the experiment, three peeled potatoes X, Y and Z were prepared. X has been cooked in boiling water. A central cavity was left in each potato by scooping out the tissue. The potatoes were then put in small troughs of distilled water. Sucrose solution was put in cavities of X and Y while the cavity of Z was filled with distilled water.



7. Which of the following correctly shows the permeability of the cell membranes of the cells in potato cups X and Y?

	Potato cup X	***Potato cup Y***
A.	impermeable	differentially permeable
B.	freely permeable	freely permeable
C.	freely permeable	differentially permeable
D.	differentially permeable	impermeable

8. What would be the observation after 12 hours?

A. Only the level of sucrose solution in the cavity of potato Y would have risen.

B. The level of distilled water surrounding potatoes X and Y would have risen.

C. The level of sucrose solution in the cavities of potatoes X and Z would have dropped.

D. The levels of sucrose solution and distilled water in the cavities of potatoes X, Y and Z would remain unchanged.

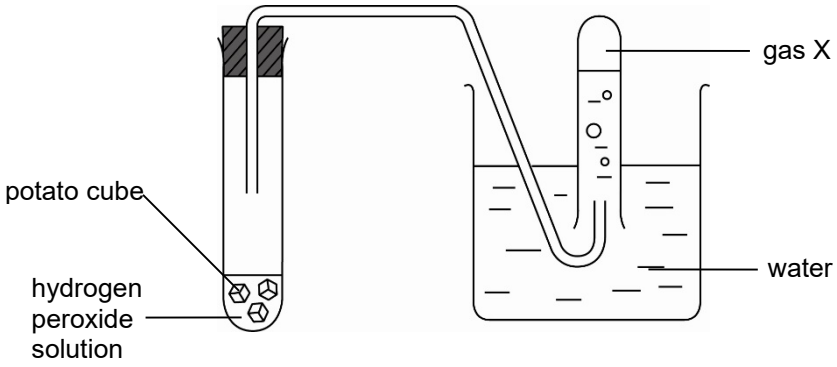
9. The results of this experiment were as shown in (8) because

(1) potatoes were impermeable so water could not pass through.
(2) osmosis occurred in living tissues only.
(3) osmosis did not occur when there was no difference in the water potential on the two sides of the living tissue.

A. (1) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

10. Which of the following statements about enzyme is correct?
A. The denatured enzyme can resume its activity under optimum conditions.
B. The optimum temperature of most enzymes is 37 ^{o}C.
C. Enzymes can decrease the activation energy of chemical reactions.
D. Enzymes are made up of carbohydrates and proteins.

Directions: Questions 11 to 13 refer to the diagram below which shows an experimental set-up. In the experiment, 2 cm^3 potato cubes are prepared and added into hydrogen peroxide solution.



The experiment was performed under six different sets of conditions. The potato cubes are treated differently before adding into hydrogen peroxide solution and different numbers of potato cubes are added into the solution, as shown in the following table.

Condition	Treatment of potato cubes	Number of potato cubes
A	chilled in the refrigerator at 4ºC	5
B	chilled in the refrigerator at 4ºC	10
C	kept at room temperature	5
D	kept at room temperature	10
E	boiled	5
F	boiled	10

11.Which of the following is a property of gas X?

A. It relights a glowing splint.
B. It gives a 'pop' sound in the presence of a burning splint.
C. It turns lime water milky.
D. It puts out a burning splint.

12. Under which of the following condition is gas X produced most rapidly?

A. condition B
B. condition C
C. condition D
D. condition F

13. Which of the following can be shown from this experiment?

(1) the presence of catalase in potato tissues
(2) the effect of temperature on the activity of catalase
(3) the effect of substrate concentration on the activity of catalase

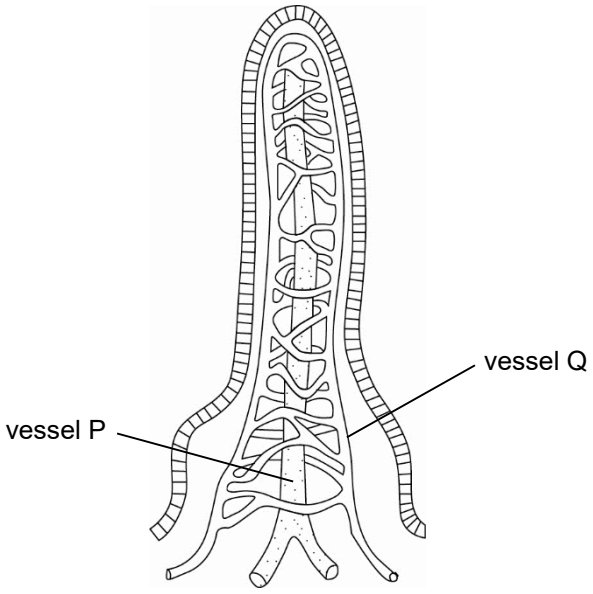
A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

14. Which of the following statements about vitamin D are correct?

(1) Vitamin D is a fat-soluble vitamin.
(2) Vitamin D is one of the essential components of bones.
(3) Vitamin D can be formed in the skin.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

15. The following diagram shows the section of an intestinal villus.



Which of the following correctly states the food substances that are absorbed mainly into vessels P and Q respectively?

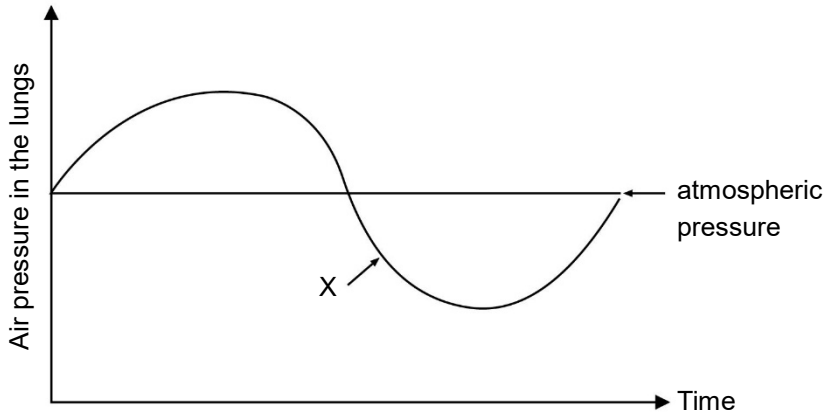
	Vessel P	***Vessel Q***
A.	vitamin D	amino acids
B.	lipids	vitamin D
C.	amino acids	glucose
D.	glucose	lipids

16. A man is suffered from a pancreatic disease and his pancreatic duct is blocked.
Which of the following are the effects of such condition?

(1) The chyme in the duodenum remains acidic.
(2) The lipid content of the faeces increases.
(3) The digestion of protein in the small intestine is less effective.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

17. The graph below shows the change in air pressure in the lungs of a man in one normal breath.



What of the following correctly shows the states of the diaphragm muscles and rib cage at time point X?

	Diaphragm muscles	***Rib cage***
A.	contract	moves upwards
B.	contract	moves downwards
C.	relax	moves upwards
D.	relax	moves downwards

18. Mist is formed when a person breathes on a mirror. Which of the following is/are the correct explanation(s) of such phenomenon?

(1) Exhaled air is warmer than the mirror.
(2) Exhaled air is saturated with water vapour.
(3) Exhaled air has more carbon dioxide than the atmospheric air.

A. (1) only
B. (2) only
C. (1) and (2) only
D. (2) and (3) only

19. Which of the following statements about the lungs is/are correct?

(1) Lungs control the rate of breathing.
(2) Lungs are spongy due to the presence of many air sacs.
(3) Lungs can contract and relax during ventilation.

A. (2) only
B. (1) and (2) only
C. (1) and (3) only
D. (2) and (3) only

20. Which of the following is a correct description of the difference between lymph vessels and veins?

A. Valves are present in veins but not in lymph vessels.
B. Lymph vessels are blind ended while veins are not.
C. Blood flow in veins is maintained by the pumping force of heart while flow of tissue fluid in lymph vessels is maintained by muscle contraction.
D. Veins carries blood towards the heart while lymph vessels carries lymph away from the heart.

21. Which of the following factors determine(s) the rate of blood flow in humans?

(1) the diameter of the lumen of the blood vessels.
(2) the intensity of the pumping action of the heart.
(3) the oxygen content of the blood.

A. (2) only
B. (3) only
C. (1) and (2) only
D. (1) and (3) only

22. Which of the following comparisons between artery and vein is / are correct?

	Artery	***Vein***
(1)	more elastic fibres in the wall	less elastic fibres in the wall
(2)	deep inside the body	near the body surface
(3)	all carries oxygenated blood	all carries deoxygenated blood

A. (1) only
B. (2) only
C. (1) and (2) only
D. (2) and (3) only

23. Which of the following statements about the hepatic portal vein are correct?

(1) During fasting, it carries blood with the highest concentration of glucose.
(2) It has blood capillaries at both ends.
(3) It carries blood from the small intestine to the liver.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

24. Many passengers find that their feet swell after a long flight (e.g. over 12 hours). Which of the following best explains this phenomenon?

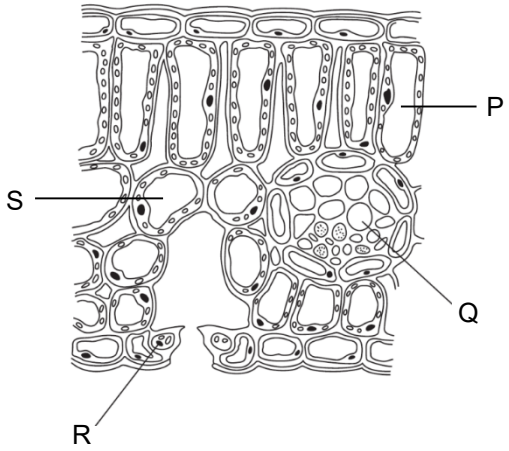
A. The atmospheric pressure is getting lower with the increase in the altitude. The decrease in the atmospheric pressure makes most water in the tissue fluid more difficult to return to the capillaries.

B. In the plane, less oxygen is carried in the blood and so the heart pumps faster. Therefore, the water of the tissue fluid cannot return to the blood as fast as the blood flow.

C. The lack of skeletal muscle contractions reduces the blood flow rate in the veins, leading to the accumulation of blood in the legs.

D. The lack of skeletal muscle contractions reduces the flow rate of lymph in the lymph vessels, leading to the accumulation of excess tissue fluid in the legs.

25. The diagram below shows the transverse section of a leaf.



Which of the following cells has the highest rate of carbon dioxide uptake during daytime?

A. cell P

B. cell Q

C. cell R

D. cell S

26. Which of the following elements is/are required by plants for making chlorophyll?

(1) nitrogen
(2) phosphorus
(3) magnesium

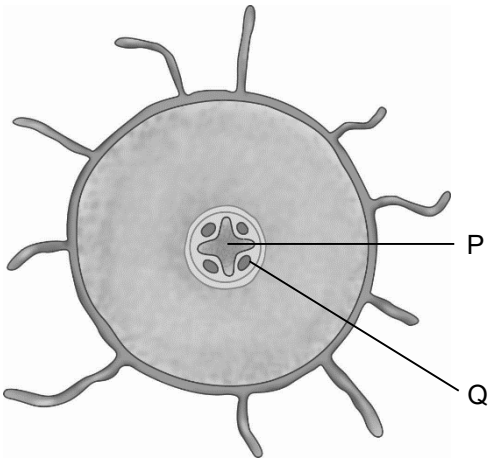
A. (3) only

B. (1) and (2) only

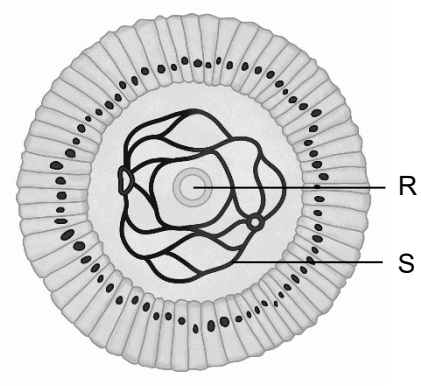
C. (1) and (3) only

D. (2) and (3) only

27. The following figures show the cross sections of a root and a villus of the small intestine.



Root



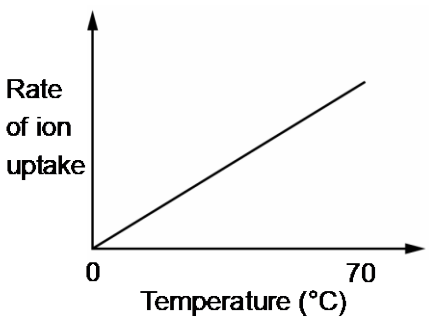
Villus of small intestine

Which of the following combinations correctly states the structures that are responsible for the uptake of water in plants and humans?

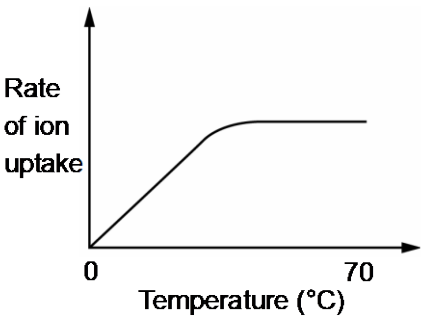
	Plants	***Humans***
A.	P	R
B.	Q	S
C.	P	S
D.	Q	R

28. Which of the following graphs ***best*** shows the effect of increasing temperature on the rate of uptake of mineral ions by root cells?

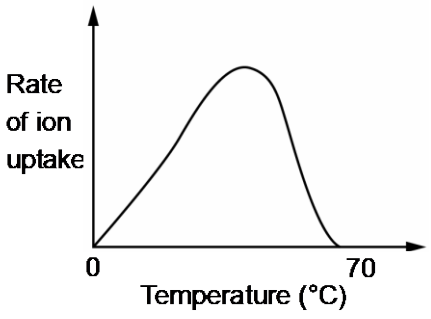
A.



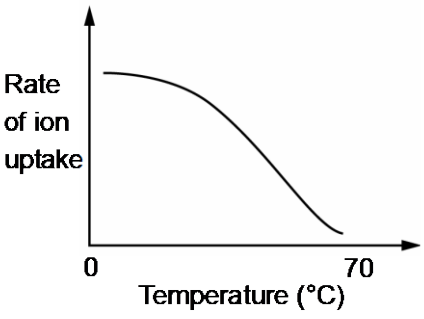
B.



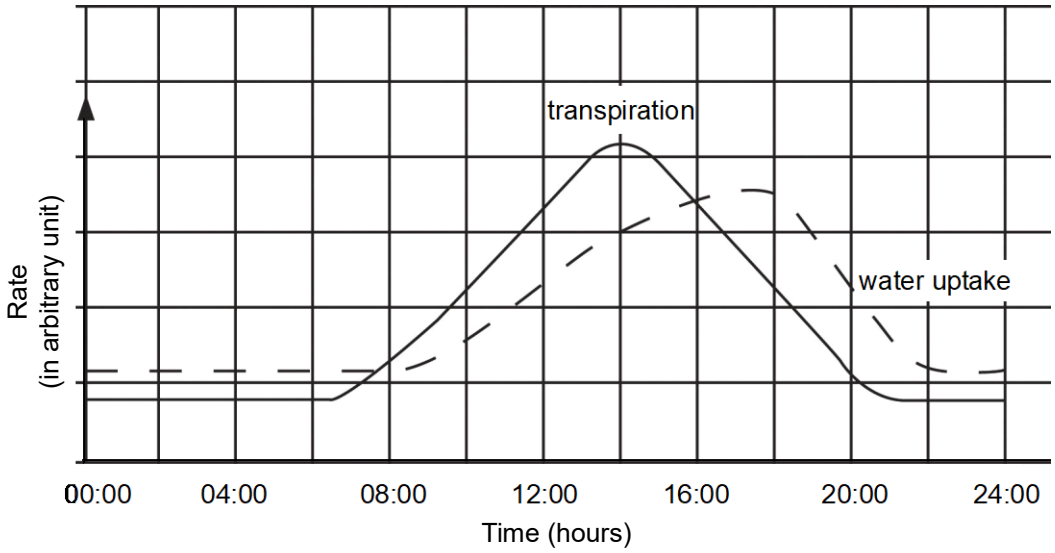
C.



D.



Directions: Questions 29 and 30 refer to the graph below which shows the rate of transpiration and water uptake by a leafy plant during a 24-hour period.



29. At which time is the rate of water uptake equal to the rate of transpiration?

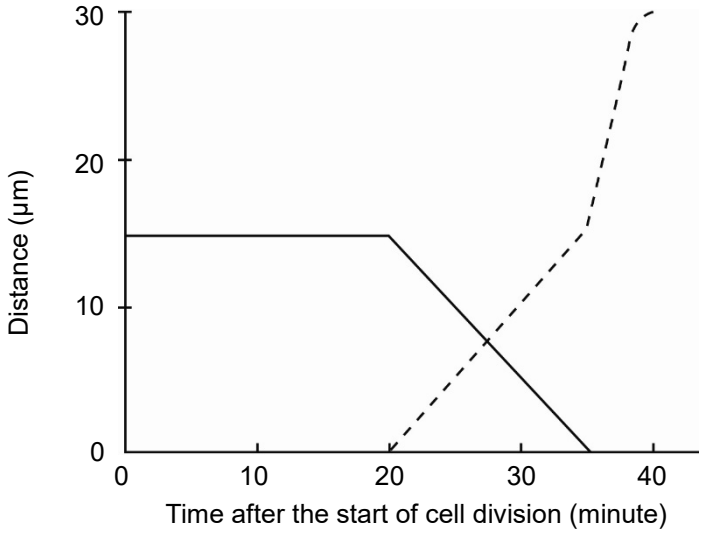
A. 00:00 and 07:50
B. 00:00 and 14:00
C. 07:50 and 16:00
D. 14:00 and 17:50

30. Which of the following statements correctly explain the increase in water content of the plant during the time interval from 22:00 to 06:00?

(1) More water is taken up than is lost.
(2) Transpiration stops in darkness.
(3) Stomata are closed at night.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

Directions: Question 31 and 32 refer to the graph below which is concerned with mitosis.

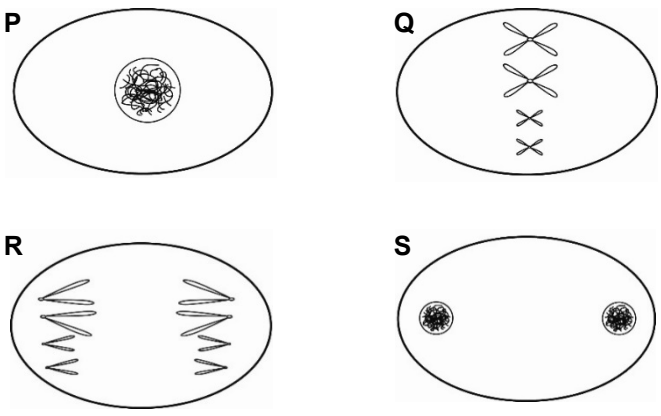


- Solid line represents the distance between daughter chromosomes and the poles towards which the chromosomes are moving.
- Broken line represents the distance between daughter chromosomes.

31. How long after the start of cell division do the chromosomes split into two daughter chromosomes and begin their movement towards the poles?

A. 0 minutes
B. 20 minutes
C. 27.5 minutes
D. 35 minutes

32. Which of the following diagrams shows the arrangement of the chromosomes at 15 minutes?



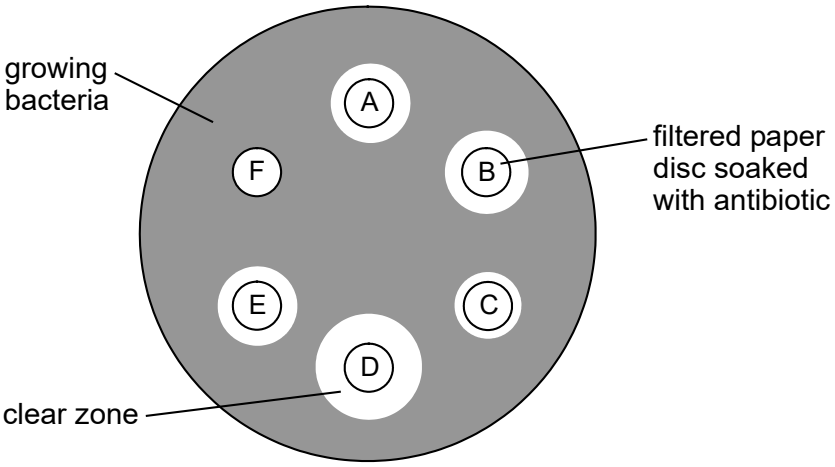
A. P
B. Q
C. R
D. S

33. Scientists are concerned for the possibility that avian flu could infect humans and is then widely spread. If this happens, which of the following can help prevent the spread of the disease?

(1) reduce air flights
(2) kill all poultry
(3) prescribe antibiotics to treat patients with avian flu

A. (2) only
B. (1) and (2) only
C. (2) and (3) only
D. (1), (2) and (3)

34. In an investigation, scientists studied the effect of different antibiotics on a bacterial species. The following diagram shows the results of the investigation.



Which of the following can be found from the results?

A. This bacterial species is resistant to antibiotic F.
B. Antibiotic F is the most effective antibiotic against this bacterial species.
C. Antibiotic B is less effective against this bacterial species than antibiotic C.
D. This bacterial species is resistant to all of the six antibiotics.

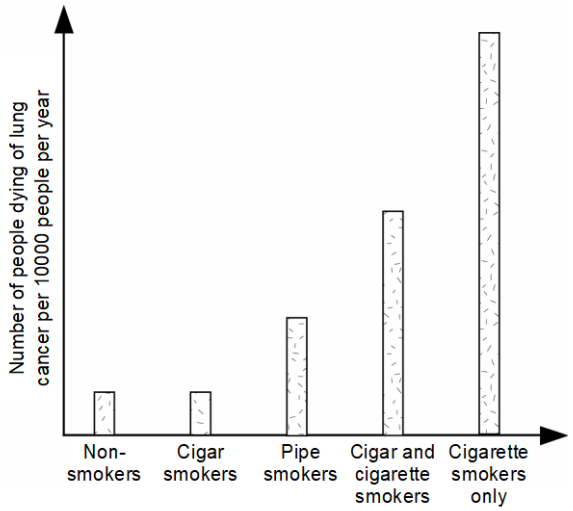
35. The table below shows the relationship between the years after giving up smoking and the number of deaths from lung cancer.

Years after giving up smoking	***Number of deaths from lung cancer per 100,000 people per year***
0	127
5	67
10	35
15	20
20	17
25	16
non-smokers	7

Which of the following conclusions ***cannot*** be drawn from the table?

A. The chance of death from lung cancer decreases by almost half in persons who have given up smoking for 5 years.
B. The longer the people who have given up smoking, the less likely they will die of lung cancer.
C. The chance of death from lung cancer is almost the same in persons who have given up smoking for 20 years and 25 years.
D. Lung cancer cannot be found in persons who never smoke.

36. The graph below shows the number of people dying of lung cancer per 10,000 people per year.



Which of the following can be concluded from the graph?

A. Non-smokers do not develop lung cancer.
B. Cigar smokers have a higher chance of death from lung cancer when compared with non-smokers.
C. The chance of death from lung cancer increases by 3 times if a cigar smoker also smokes cigarettes.
D. The number of people dying of lung cancer depends on the type of smoking.

37. Which of the following is ***not*** the action of antibodies?

A. make holes on the surfaces of pathogens
B. kill pathogens by phagocytosis
C. neutralise the toxins secreted by pathogens
D. cause pathogens to clump together to prevent the reproduction of pathogens

38. Which of the following combinations ***incorrectly*** compares phagocytes and lymphocytes?

	Phagocytes	***Lymphocytes***
A.	belong to the non-specific defence mechanism	belong to the specific defence mechanism
B.	involved in inflammatory responses	not involved in inflammatory responses
C.	produced in the bone marrow	produced in the thymus
D.	with a lobed nucleus	with a round nucleus

39. Antigens are found on the surfaces of

(1) bacteria.
(2) red blood cells.
(3) virus.

A. (1) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

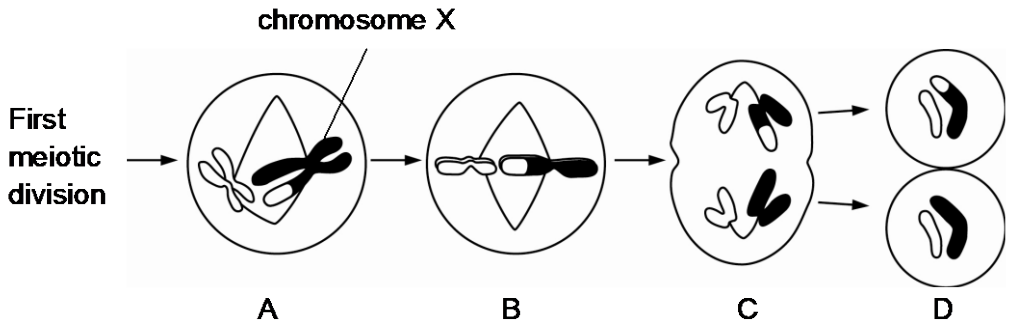
40. Which of the following statements about the inflammatory response is ***incorrect***?

A. Tissue fluid accumulates at the wound.
B. More mast cells are squeezed through the blood capillary wall into the tissue fluid.
C. More phagocytes engulf the invading pathogens.
D. The blood flow to the wound increases.

End of Section I

II. Structured Questions (40 marks)

1. The following diagram shows the stages that occur during the second meiotic division.



(a) Identify stages B and C. Give the evidence from the diagram that you used to identify the stage. (4 marks)

(b) In the above diagram, chromosome X contains a section of genetic material from the chromosome that was homologous to X. The two homologous chromosomes exchanged genetic material during the first meiotic division.

(i) Identify the stage in the first meiotic division in which the exchange of genetic material occurs. (1 mark)

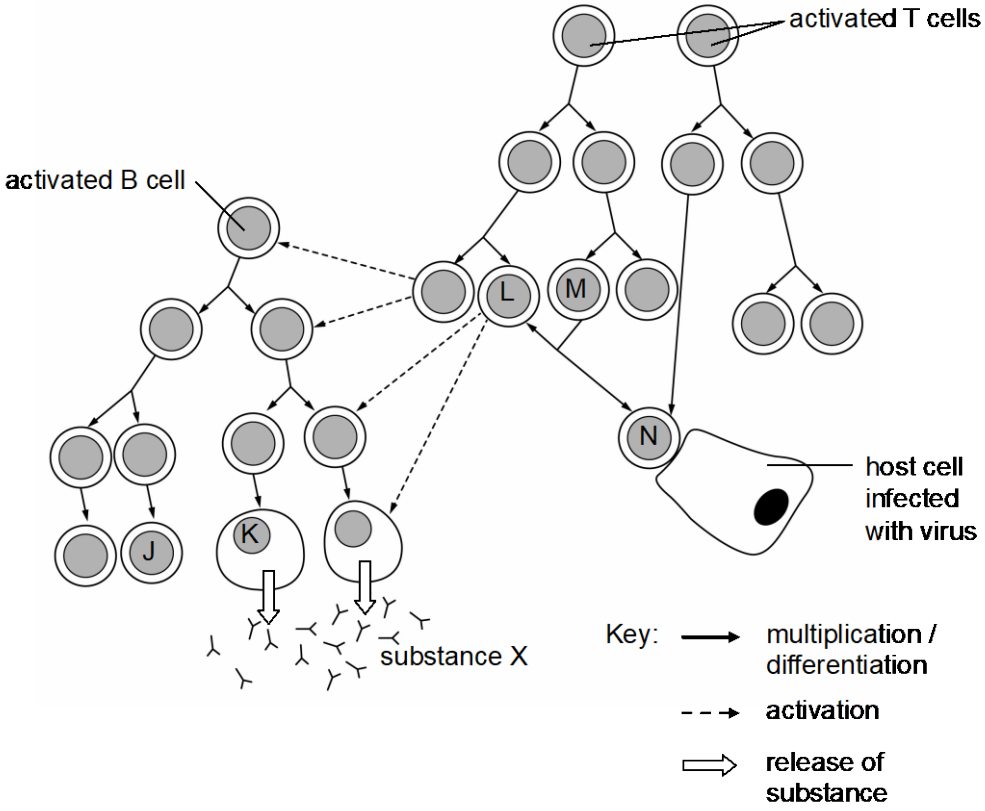
(ii) What is the significance of the exchange of genetic material? (1 mark)

(c) Colchicine is a drug used to treat gout. However, colchicine has been found to be able to prevent the formation of spindle fibres during cell division.

(i) Describe how colchicine may affect the second meiotic division and hence lead to chromosome mutation in the gamete formation. (2 marks)

(ii) Describe how Down syndrome occurs as a result of chromosome mutation in the gamete formation? (1 mark)

2. The following diagram illustrates the changes that occur in B cells and T cells during the infection of a virus.



(a) Which cell do B cell and T cell originate from? (1 mark)

(b) Name cell K and substance X. (2 marks)

(c) (i) Describe the functions of cell M. (2 marks)

(ii) Using the letter in the diagram, state ***one*** cell that has similar functions as cell M. (1 mark)

(d) State how cells L and N help to fight against viral infection. (4 marks)

(e) After vaccination, one may still be infected with the virus. Try to give one of the possible reasons. (1 mark)

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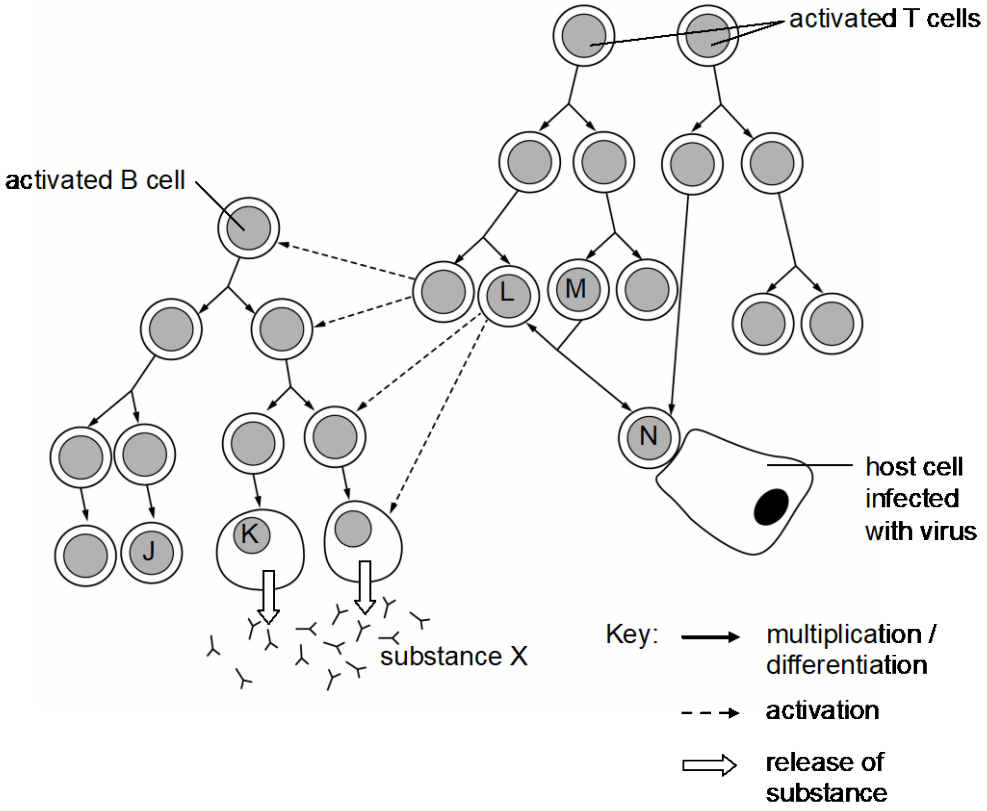

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(b) Name cell K and substance X. (2 marks)

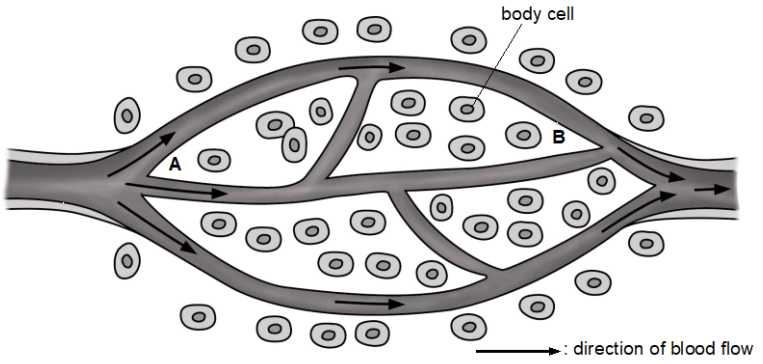
(c) (i) Describe the functions of cell M. (2 marks)

(ii) Using the letter in the diagram, state ***one*** cell that has similar functions as cell M. (1 mark)

(d) State how cells L and N help to fight against viral infection. (4 marks)

(e) After vaccination, one may still be infected with the virus. Try to give one of the possible reasons. (1 mark)

2. The following diagram shows some body cells and the capillary bed.



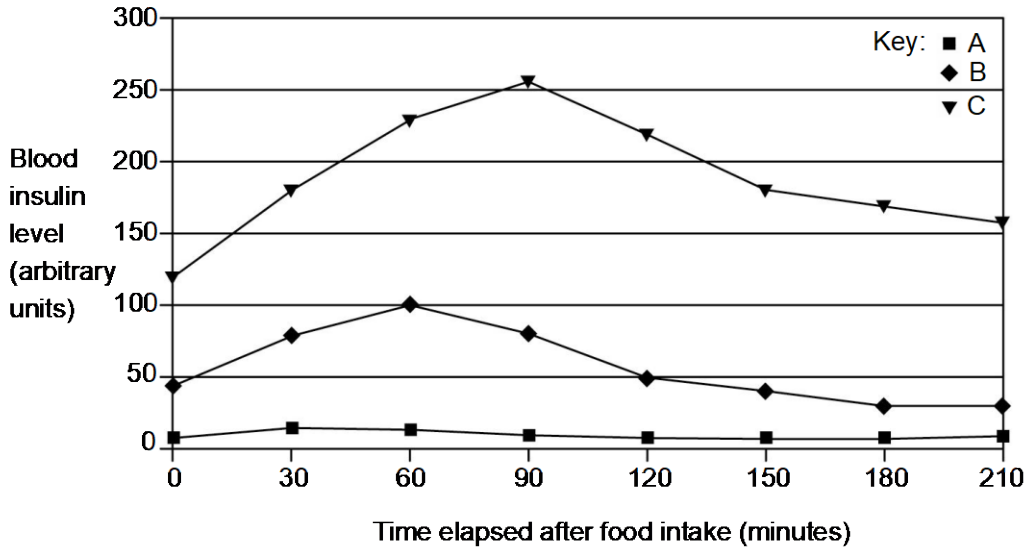
(a) Name ***two*** metabolic wastes that enter the bloodstream from the body cells. (2 marks)

(b) State and explain the difference between the blood at point A and point B in terms of oxygen content. (3 marks)

(c) (i) Name the fluid surrounding the body cells. (1 mark)

(ii) Explain ***one*** difference in composition between the blood and the fluid named in (c)(i). (2 marks)

3. The graph below shows the changes in the blood insulin level of persons A, B and C after food intake. It is known that person B is healthy and persons A and C have a blood glucose level higher than normal.



(a) With reference to the above graph, which diseases are persons A and C likely to be suffering from respectively? Explain your answers. (6 marks)

(b) Suggest ***one*** medical treatment for persons A and C respectively. (2 marks)

(c) Describe and explain the changes of the blood insulin level and the blood glucose level after food intake in person B. (4 marks)

End of Paper