

Class	Register Number	Name
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南洋女子中學校
NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2010
Secondary Three

BIOLOGY

1 hour 45 minutes

Paper 2

Theory Paper

0915 - 1100

Thursday

14 October 2010

Additional materials: Writing papers, graph paper

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section A (40 marks)

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Section B (30 marks)

Answer **all** questions including questions **5, 6** and **7 Either** or **7 Or**.

Write your answers on the separate writing paper provided.

At the end of the examination,

1. fasten all your work securely together;
2. tick **7 Either** or **7 Or** in the grid below to indicate which question you have answered.

Hand in Section A and Section B separately.

INFORMATION FOR CANDIDATES

The intended number of marks is given in the brackets [] at the end of each question or part question. You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

Examiner's Use	
Section A	
Section B	
5	
6	
7 Either	
7 Or	
Total	

This document consists of **11** printed pages.

Setters: KHN, OC, BK

NANYANG GIRLS' HIGH SCHOOL

[Turn over

Section A

Answer **all** questions.

Write your answers in the spaces provided.

A1 Fig. 1.1 shows the nutrition information of a brownie.

Nutrition facts	
Serving size 1 each	66 g
Calories	302
Total fat	15g
Saturated fat	5g
Cholesterol	36mg
Sodium	147mg
Total carbohydrate	41g
Dietary fibre	2g
Sugars	28g
Protein	4g

Fig. 1.1

Mr Lim is a teacher in a school. For teachers' day, he received one brownie each from 20 different students. He finished all the brownies within 12 hours of receiving them.

- (a) (i)** Calculate the amount of cholesterol that he has consumed (in grams) within that 12 hours. [1]

- (ii)** State the assumption made in such a calculation. [1]

- (iii)** State one use of cholesterol. [1]

- (b) (i)** One brownie contains 23% of a person's requirement of fat for one day. [1]

What advice would you give to Mr Lim regarding the rate at which he consumes the brownies? Assume that he will finish all the brownies.

- (ii)** State the reason for your answer in **(b) (i)**. [1]

- (c)** Describe how to test for sugars in the brownie. [2]

- (d)** Mr Lim plays basketball regularly. Suggest a suitable diet for him, and state reasons for your suggestions. [3]

Total [10]

A2 (a) Fig. 2.1 shows the stages of holozoic nutrition.

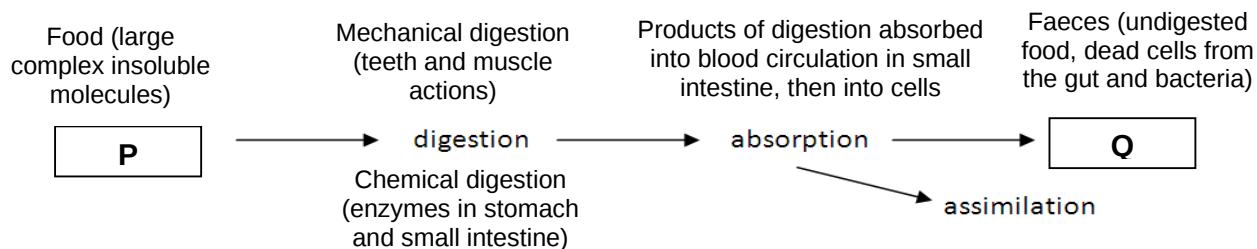


Fig. 2.1

Identify processes **P** and **Q**.

[2]

P _____

Q _____

(b) (i) The table below describes some aspects of digestion. Put a tick (✓) for yes and a cross (✗) for no to indicate if it applies to mechanical and/or chemical digestion. Do not leave blanks.

[2]

Difference	Mechanical digestion	Chemical digestion
There is a change in the chemical composition of food.		
The digestion involves enzyme(s).		

(ii) Is chewing a form of mechanical or chemical digestion?

[1]

(c) The table shows descriptions of some digestive glands. Complete the table with appropriate answers.

[5]

Description Digestive gland	Position of gland in relation to digestive tract (outside or within)	Substances that the digestive gland secretes
salivary gland	outside	salivary amylase
	outside	bile
pancreas	outside	pancreatic amylase, trypsin and _____
gastric gland	within	hydrochloric acid and enzymes like pepsin and _____
		intestinal juice that contains maltase, sucrase, lactase and erepsin

Total

[10]

A3 Fig. 3.1 shows a sectional view of the rib-cage with the structures associated with breathing.

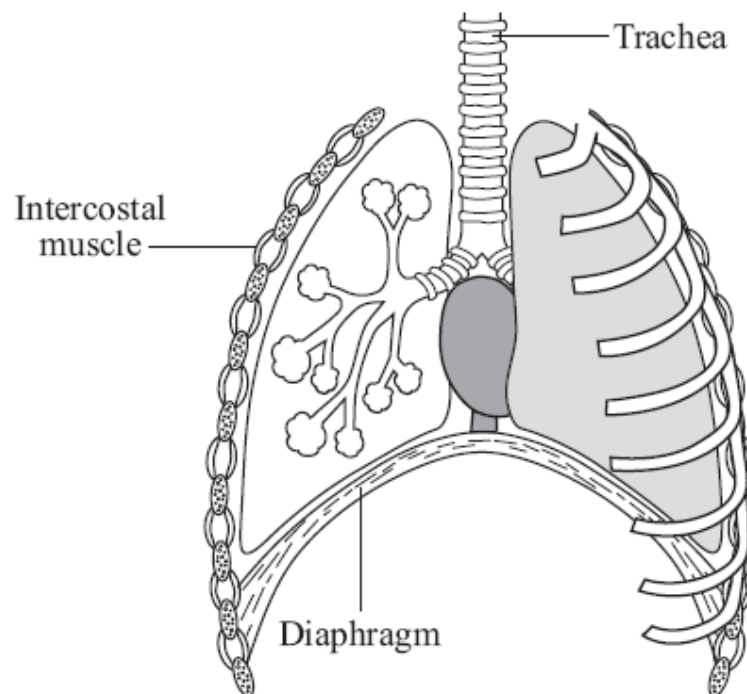


Fig 3.1

- (a)** Describe and explain what causes air to enter the lungs. Use the following words in your answer: diaphragm; intercostal muscles; pressure; volume. [4]

- (b) (i)** The wall of the trachea has rings of cartilage in it. State a function of these rings of cartilage. [1]

- (ii) The lining of the trachea contains ciliated cells. State the function of these cells. [1]

- (c) (i) As air moves into the lungs, it enters the alveoli. Name the process by which oxygen passes from the air in the alveoli to the blood. [1]

- (ii) State **three** ways in which the alveoli in the lungs are adapted for gaseous exchange. [3]

1.

2.

3.

Total [10]

- A4 (a)** The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

Table 4.1 shows the results.

Area	Concentration of sulfate ions in mmol per dm ³
Roots of barley plants	1.2
Soil	0.15

Table 4.1

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion? Explain your answer. [2]

- (b)** Some scientists investigated the amount of sulfate ions taken up by barley roots in the presence and absence of oxygen.

Fig 4.1 shows the results.

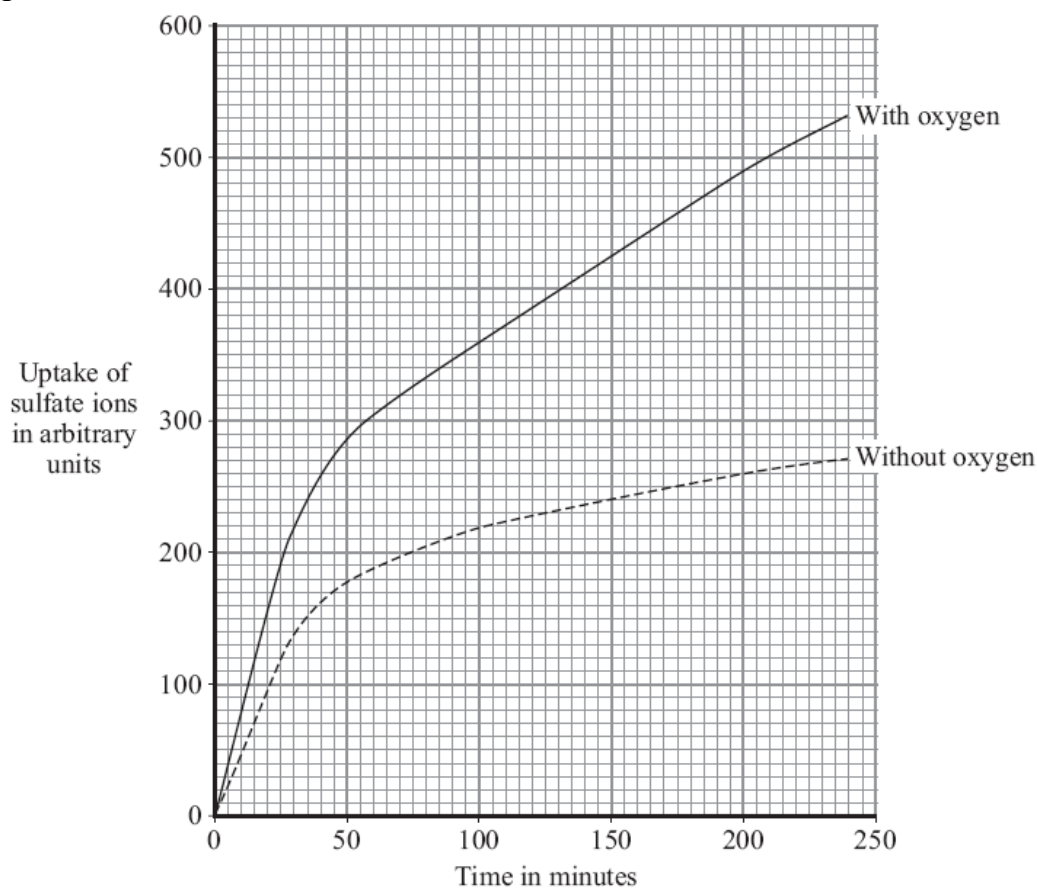


Fig 4.1

- (i) **Fig. 4.1** shows that the rate of sulfate ion uptake between 100 and 200 minutes, without oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, with oxygen, was greater.

Calculate the increase in the rate of uptake. Show your working clearly. [2]

- (ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen. Explain why. [3]

- (iii) Explain the significance of sulfate ion uptake by barley roots with respect to the uptake of water by the barley plant. [3]

Total [10]

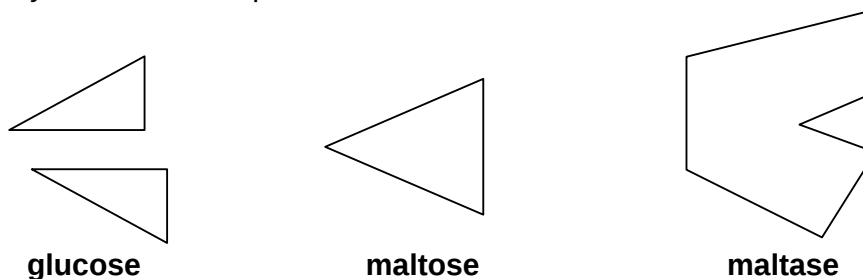
Section B

Answer all **three** questions from this section.

The last question is in the form of either/or and only **one** of the alternatives should be attempted. Each question carries **ten** marks.

B 5 (a) State what is meant by *biological catalyst*. [2]

(b) The symbols below represent glucose, maltose and maltase. Using these [3]
symbols, draw a labelled flow diagram to show the catalytic action of
maltase. You should annotate your diagram with descriptions of how
catalytic action takes place.



(c) **Fig. 5.1** shows the relationship between temperature and rate of enzyme [5]
activity.

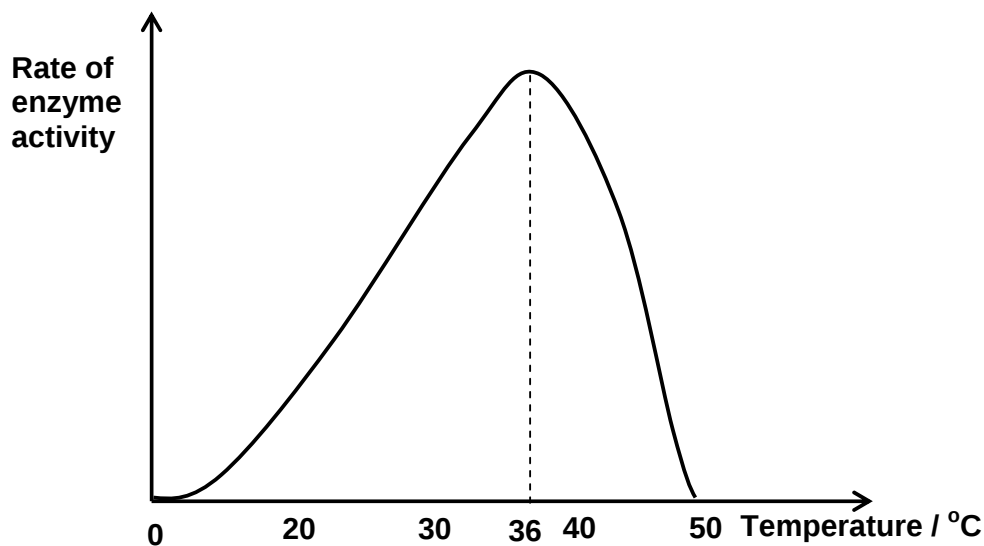


Fig. 5.1

With reference to **Fig. 5.1**, explain the trends shown.

- B6 (a)** An experiment was carried out to investigate the effect of light intensity on the rate of photosynthesis of dumbcane plants.

Table 6.1 below shows the results of the investigation.

Light intensity / lux	Uptake or Release of Carbon Dioxide / $\text{mgdm}^{-2}\text{h}^{-1}$
0	-5.0
5000	0.5
10000	4.5
15000	7.5
20000	13.0
25000	15.0
30000	15.0

Table 6.1

Using the results, plot a graph on the graph paper provided. [5]

- (b)** Describe and explain, how a leaf is adapted for photosynthesis. [5]

B 7 either

- (a)** State two factors that affect the rate of transpiration from a plant. [2]

- (b)** Explain how the structure of the xylem is adapted to its function. [3]

- (c)** You are provided with the following apparatus and materials. [5]

Apparatus	Materials
beaker razor blade X-ray film test tubes bunsen burner and lighter tripod stand and gauze	plants aphids $^{14}\text{CO}_2$ iodine solution hydrochloric acid Benedict's solution supply of hot water

A recent study suggested that hexose sugars are also transported by the phloem of some plants (Van Bel and Hess, 2008). Design an experiment using all or some of the materials above to show that hexose (reducing) sugar is transported in the phloem.

(Source: Van Bell, A. J. E. and Hess, P. H., 2008. Hexoses as phloem transport sugars: the end of a dogma? *Journal of Experimental Botany*, 59 (2), 261-272.)

B 7 or

(a) State two functions of antibodies in the immune response. [2]

(b) Explain why type AB blood cannot be given to a patient of O blood type. [3]

(c) **Table 7.1** shows the blood test results of Patient **K**. [5]

Item	Patient K's results/units	Normal range/units
cholesterol LDL	167 mg/dL	< 130 mg/dL
Total cholesterol	262 mg/dL	150 – 199 mg/dL

Table 7.1

Source: <http://www.flash-med.com/LabNormal.asp>

With reference to **Fig. 7.1**, explain why Patient **K** is at risk of coronary heart disease. Hence, suggest one possible change in his lifestyle to lower this risk.

End of paper

2010 Sec 3 Biology EOY ANSWERS

A1

- (ai) $36 \times 20 = 720\text{mg} = 0.72\text{g}$ [1]
- (a ii) That he has not eaten any other meal besides the brownies/ He has not consumed any other food or drink within that time; [1]
- (a iii) maintain fluidity of cell membrane; used to synthesise hormones; used to synthesise bile; [1]
- (bi) He should eat the brownies over several (5) days / Eat no more than 4 pieces per day / Eat 1 piece a day [1]
- (b ii) This will keep him within the limit of the fat intake per day [since he eats other things in the same day]; [1]
- (c) Mix brownie with water (and decant mixture into a fresh tube); [2]
Add 2ml Benedict's solution to 2 ml sample (accept: equal vol of Benedict's solution to stated volume of sample);
Heat in boiling water bath for (up to) 5 min;
- (d) Diet with more protein content & sugar / diet with eggs, meat, rice; [3]
Protein is needed for building muscles; and sugar is needed for energy;
any other logical answer + rationale;

- A2 (a) P: **ingestion** Q: **egestion** [2]

- (b) (i) (1 mark for each correct comparison, i.e., across the row) [2]

Difference	Mechanical digestion	Chemical digestion
	X	✓
	X	✓

- (b) (ii) Mechanical [1]

- (c) [5]

Description		
Digestive gland		
liver		
		lipase.
		rennin. REJECT: RENIN (different enzyme)
intestinal gland	within	

A3

- (a) Diaphragm contracts and lowers; [4]
Intercostal muscles contract and raise the ribs upwards and outwards;
Both actions increase the volume of the thoracic cavity;
Pressure inside the thoracic cavity falls lower than the atmospheric pressure;
- (bi) Supports the trachea to ensure that it stays open / [1]
Prevents the trachea from collapsing
- (b ii) Cilia of these cells beat continuously to create a wave-like motion to [1]

sweep the dirt and dust particles trapped by the mucus towards the pharynx

(ci) Diffusion [1]

(cii) One-cell thick epithelium; [3]

Surrounded by a network of blood capillaries;

Large surface area to volume ratio;

Thin film of moisture covers the internal surface;

Max [3]

A4

(a) No; [2]

Concentration of sulfate ions in the soil is lower than that in the roots of barley plants

(bi) With oxygen, at 100 min uptake of sulfate ions is 360 arbitrary units, while at 200 min it is 490 arbitrary units. Thus an increase (490 - 360) of 130 arbitrary units. [1]

Thus with oxygen the rate of sulfate ion uptake is 1.3 arbitrary units per min. [1]

Therefore it is greater by $(1.3 - 0.4) = 0.9$ arbitrary units

(bii) The cells in the barley roots use oxygen together with glucose for tissue respiration; to generate ATP / energy; [3]

ATP / energy is required in active transport;

to move sulfate ions from the soil i.e. a lower concentration into the root

cells i.e. a higher concentration / against sulfate concentration/ against conc gradient;

Max [3]

(biii) Active transport of sulfate ions to the root cells increases the osmotic concentration of ions / lowers the water potential inside the root cells; [3]

Therefore the water potential of the soil becomes higher than that of the root cells;

Thus water molecules move into the root cells;

by osmosis hence assisting in the uptake of water through the roots;

B5

(a) catalyst is a chemical that speeds up the rate of reaction without itself being changed at end of reaction; [1]

biological because it is organic in nature / it is a protein (or RNA) / it is made from a living organism or cell; [1]

(b)

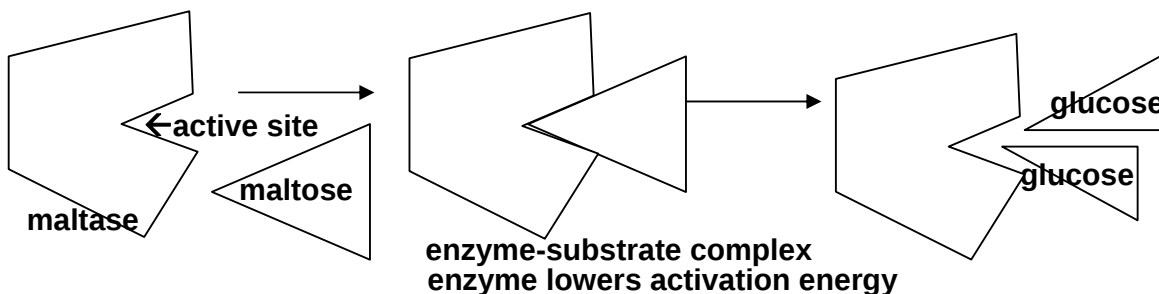


Diagram shows enzyme + substrate at beginning, with active site of enzyme labelled; [3]

diagram shows enzyme-substrate complex, and labelled as such;

diagram shows end products as glucose + glucose;

diagram shows that enzyme is left unchanged at end of reaction;

indicates by annotation that enzyme acts by lowering activation energy;

bonus: diagram includes water molecule as part of initial reactants;

[any 3]

- (c) Between 0 – 20 °C/close to 0°C, enzyme activity is low because enzymes are inactivated;
This is because enzymes and substrates have low kinetic energy/move slowly;
Therefore rate of collision between enzyme & substrates is lower;
As temp increases towards 36°C, rate of enzyme activity increases due to increased kinetic energy/ collisions between enzyme and substrate;
At 36°C rate of reaction is highest because this is the optimum temp (range);
As temp increases from 36 to 50°C, rate of reaction drops because enzymes are denatured;

Bonus: high temperature causes disruption of bonds within enzyme molecule, causing disruption to 3D conformation, leading to enzyme becoming non-functional;

[any 5]

REJECT: student describes trend only – (not answering question)

B6

- (a) Title of graph: Graph showing the effect of light intensity on the rate of photosynthesis of dumbcane plants. [1] [5]
Size of graph: About $\frac{3}{4}$ of graph paper [1]
Both axes are labeled correctly [1]
Units on both axes are correct [1]
Best fit curve [1]

- (b) Describe and explain in detail, how a leaf is adapted for photosynthesis. [5]

Petiole holds the leaf in position to absorb maximum light;
Thin and flat lamina allows maximum absorption of light energy and allow carbon dioxide to reach inner cells rapidly;
Waxy cuticle to prevent excessive loss of water through evaporation from the leaf;
More stomata are present on the lower epidermis of the leaves to allow carbon dioxide to diffuse in and oxygen to diffuse out of the leaf;
Chloroplasts containing chlorophyll in all mesophyll cells absorb and transform light energy to chemical energy used in the reduction of carbon dioxide to glucose;
More chloroplasts are present in the palisade mesophyll cells to absorb more light energy;
Palisade mesophyll cells are closely arranged to increase the absorption of light energy;
Spongy mesophyll cells are loosely arranged with large intercellular spaces to allow rapid diffusion of carbon dioxide into the mesophyll cells;
A network of main vein and branch veins containing xylem and ps sugars away phloem. Xylem to transport water and mineral salts to the mesophyll cells while phloem transports sugars away from the leaf;
Max [5]

B7E

- (a) humidity; temperature; wind speed; [any 2] [2]
(b) lignin in walls is a tough material to provide mechanical support; [3]
lignin is waterproof to prevent all water from leaving xylem as it moves up the stem;

no cross walls to provide continuous lumen for flow of water;
no protoplasm to obstruct passage of water up the stem;

- (c) plant is exposed to aphids, which insert their proboscis (accept mouthparts) into phloem; [5]
cut off aphid with blade leaving the proboscis;
sap that exudes from this is tested;
Benedict's test is used to determine if reducing sugar is present;
green/ yellow/ orange/ brick red ppt indicates presence of reducing sugar;
if solution remains blue on heating, no reducing sugar is present;
repeat experiment 2 more times to ensure reliability of results or use exudate from 3 plants;
determine chemicals in exudate using chromatography;

Alternative answers:

Expose plant to $^{14}\text{CO}_2$;
this will eventually be processed into sugar found in phloem;
(use aphids as above to extract phloem sap)
expose exudate to x-ray film to confirm that it is indeed sap;
(test for RS as above)

B7O

- (a) cause bacteria/foreign bodies to clump together/agglutinate; [2]
recruit phagocytes to engulf bacteria;
destroy bacterial cells directly;
- (b) type AB red blood cells have A and B antigens (on surface); [3]
type O blood has anti-A antibodies and anti-B antibodies in blood plasma (accept serum);
antibodies will bind to antigen (and donated blood is recognised as foreign to body);
thus causing agglutination of red blood cells;
(and also) causing haemolysis/destruction of red blood cells;
- (c) The levels of cholesterol are higher (167, 262) than normal range (130, 199); [5]
This leads to increased fatty deposits/formation of fatty plaques [REJECT: Plaque]
IN the walls of the arteries; [REJECT: on, under, above, around]
Over time, the lumen of the coronary artery becomes narrower;
Blood clots may become lodged at the narrowed part of artery;
Blood carrying oxygen and glucose to heart muscle is reduced/stopped; [REJECT: heart]
Without oxygen and glucose for respiration, heart muscle is unable to contract;
Blockage of coronary artery will lead to heart attack/myocardial infarction;
[any 4]
Change in lifestyle: intake of cholesterol-lowering medicine; encourage Patient K to exercise more regularly; stop smoking; intake of omega fatty acids to reduce blood cholesterol levels; avoid food containing LDL;

Reject: balloon angioplasty; stent; bypass surgery; heart transplant; [because these are if heart disease already diagnosed – but question only refers to *risk of*]