

NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2015

Secondary Three

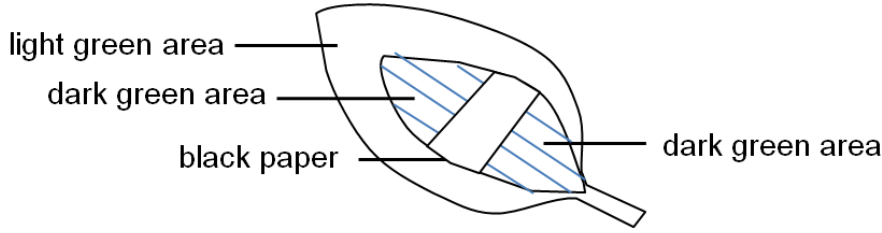
BIOLOGY

Paper 1

1	B	7	C	13	A	19	C	25	A
2	C	8	B	14	D	20	A	26	C
3	C	9	D	15	B	21	B	27	C
4	D	10	A	16	C	22	C	28	D
5	B	11	A	17	C	23	C	29	D
6	C	12	B	18	C	24	B	30	D

Qn	Answer	Explanation																									
1	B	The functions of mitochondrion is to release energy by oxidising glucose to release energy molecules; ribosome is to synthesise protein; vacuole is to store substances such as water and food substances; and rough endoplasmic reticulum is to transports proteins to the Golgi apparatus, hence is answer is B.																									
2	C	P – chloroplast; Q – cell wall; R – nucleus; S – mitochondrion; T - large central vacuole R & S are common features found in an animal cell. In the options given, only C, which are R & S, are features found in an animal cell.																									
3	C	Water moves from a region of less negative (more water) to a region of more negative (less water). <table><tr><td></td><td>beaker</td><td>thistle funnel</td><td>direction of net water movement</td><td>Increase / decrease of water level in thistle funnel</td></tr><tr><td>A</td><td>5% sucrose (more negative)</td><td>distilled water (less negative)</td><td>thistle funnel to beaker</td><td>decrease</td></tr><tr><td>B</td><td>10% sucrose (more negative)</td><td>5% sucrose (less negative)</td><td>thistle funnel to beaker</td><td>decrease</td></tr><tr><td>C</td><td>5% sucrose (less negative)</td><td>10% sucrose (more negative)</td><td>beaker to thistle funnel</td><td>increase</td></tr><tr><td>D</td><td>distilled water (zero negative)</td><td>distilled water (zero negative)</td><td>no net movement</td><td>same</td></tr></table>		beaker	thistle funnel	direction of net water movement	Increase / decrease of water level in thistle funnel	A	5% sucrose (more negative)	distilled water (less negative)	thistle funnel to beaker	decrease	B	10% sucrose (more negative)	5% sucrose (less negative)	thistle funnel to beaker	decrease	C	5% sucrose (less negative)	10% sucrose (more negative)	beaker to thistle funnel	increase	D	distilled water (zero negative)	distilled water (zero negative)	no net movement	same
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4	D	Active transport is the process in which energy is used to move the particles of a substance across a membrane against its concentration gradient, that is, from a region where the particles are of lower concentration to a region where they are of higher concentration. In the sodium ions (Na +), the ions move out of the cell to the plasma, hence explains the low number (18) in the cell and high number (149) in the plasma. In the potassium ions (K +), the ions move from the plasma into the cell, hence explains the low number (6) in the plasma and high number (154) in the cell. Chloride ion moves by facilitated diffusion. Hence, the answer is D.																									

5	B	The diagram shows a lipid molecule / triglyceride. A lipid molecule is made up of a glycerol molecule and 3 fatty acids. Hence B is the answer.
6	C	When the temperature increases by 10 °C (from 20 °C to 30 °C), the rate of reaction increases. Hence the likely amount is 0.45 g.
7	C	Benedict's test is a test for reducing sugar; biuret test is a test for protein; ethanol emulsion test is a test for fat, and iodine test is a test for starch. Food that shows presence of both food protein and starch will show positive for biuret test and iodine test, hence the answer is C.
8	B	At low temperature, enzyme activity is low but increases as temperature rises till an optimum is reached (most enzymes have the optimum temperature of about 40 °C to 45 °C). Above the optimum temperature, enzyme activity decreases as enzymes become denatured.
9	D	Amylase digests away starch. During the iodine test, it will show brown indicated by the zone around the well (i.e. starch is absent / digested away by salivary amylase). In solution IV, pH 6.5 does not interfere the action of salivary amylase, so it will digest starch and the zone around the well will be brown. In solutions I and III, pH 5 and alkali pH 7.5 affect the action of amylase, so amylase will not digest starch as much as solution IV. Both zones showing brown should be similar in diameter to each other. In comparison, solution IV will have the widest zone showing brown, hence well Y. Solutions I and III can be either X and Y or Y and X. In solution II, amylase is denatured by strong acid, so it cannot digest starch. Thus the area outside the well will show blue-black (i.e. starch is present). Hence the well should be W. In considering all these, the answer is D.
10	A	Photolysis of water gives oxygen (P) and hydrogen ion (Q). The hydrogen ion (Q) produced in photolysis is used to reduce carbon dioxide (R) to carbohydrates such as glucose ($C_6H_{12}O_6$) (given), giving water as a by-product (S).
11	A	Only certain wavelengths of light are used for photosynthesis by pigment X . Light of blue and red wavelengths are most effectively absorbed by pigment X and produce the highest rates of photosynthesis. Hence the answer is A.
12	B	Light of green wavelength produces the lowest rate of photosynthesis, hence the answer is B.

13	A	As the distance between the water plant and lamp increases, rate of photosynthesis decreases.
14	D	The brown colouration indicates absence of starch, hence, region of light green leaf. The blue-black colouration indicates presence of starch, hence, region of dark green leaf. The centre where it showed brown must be where the black paper was placed (no light absorbed in this area, hence no photosynthesis occurred and therefore no starch made, showing brown upon iodine test).  light green area dark green area black paper dark green area
15	B	The xylem tissue can be described as a 'star' shaped structure at the centre of the root, and the phloem tissue is found between the arms of the xylem tissue. The epidermis of the root is the outermost layer of cells.
16	C	Cell 1 is an epidermal cell, which does not contain chloroplast. Cell 2 is palisade mesophyll cell; Cell 3 is spongy mesophyll cell; and Cell 4 is a guard cell. These cells contain chloroplasts and therefore photosynthesise.
17	C	The stronger the wind, the higher the rate of transpiration.
18	C	Still room: $0.6 - 0.1 = 0.5$ $0.5 \times 1 = 0.5$ $0.5 \times 2 = \underline{1.0} \text{ cm}^3 \text{ per hour}$ light: $0.8 - 0.1 = 0.7$ $0.7 \times 1 = 0.7$ $0.7 \times 2 = \underline{1.4} \text{ cm}^3 \text{ per hour}$ fan: $1.1 - 0.1 = 1.0$ $1.0 \times 1 = 1.0$ $1.0 \times 2 = \underline{2.0} \text{ cm}^3 \text{ per hour}$
19	C	Structure 1 is trachea. Structure 2 is esophagus. Structure 3 is small intestine. Structure 4 is large intestine. Trachea is part of the respiratory system and does not experience peristalsis. The structures that have peristalsis are 2, 3 and 4. Hence answer is C.
20	A	Structure P is a lacteal / lymphatic capillary, functions to transport fats. Structure Q is the villus, which consists of epithelial cells having numerous microvilli to increase surface area to volume ratio to absorb nutrients

21	B	The amino group is converted to ammonia (P) and converted into urea (Q), which is removed in urine. The carbon residue is converted into glucose (X) and converted into glycogen (Y), which is stored in liver and muscles.
22	C	In the absence of oxygen, the absorption of glucose dropped from 6.4 to 2.5 arbitrary units. Likewise for amino acids, the absorption of amino acids dropped from 5.7 to 1.9 arbitrary units. These showed that glucose and amino acids are absorbed by active transport, which requires oxygen. However, in the absence of oxygen, absorption of glycerol and fatty acids are not affected.
23	C	Starch is not digested in the stomach and colon. It is only digested in the ileum (in this question). Hence the answer is C.
24	B	Recipient 1: Recipient's blood group A has antibody b in serum; when recipient receives donor's blood which is B (presence of antigen B), antibody b (recipient) will bind to antigen B (donor's red blood cell). Hence there will be agglutination. Recipient 3: Recipient's blood group O has both antibodies a and b in serum; when recipient receives donor's blood which is AB (presence of antigens A and B), antibodies a and b (recipient) will bind to antigens A and B (donor's red blood cell). Hence there will be agglutination.
25	A	Low plasma potential and low blood pressure pull water into the venous end. As substances leave the blood plasma, its water potential decreases. This enables water to enter by osmosis at the venous end when the tissue fluid has a higher water potential. As blood flows through the capillaries, its pressure decreases.
26	C	C is the median septum. Median septum runs down the middle of the heart and prevents the mixing of deoxygenated blood in the right side with the oxygenated blood in the left side.
27	C	When the ventricle begins to relax, the aortic valve closes to prevent backflow of the blood into the ventricle.
28	D	Number of heart beats in 1 minute = $60 \div 0.6$ = 100
29	D	Cell X is a gland cell, which secretes mucus to trap dust particles and bacteria in the air that is channeled to the lungs.
30	D	At Point X , deoxygenated blood (low in oxygen and high in carbon dioxide) flows through the blood capillary. Alveolar air has a higher concentration of oxygen than blood. So the oxygen diffuses from the alveolar air into the blood capillaries. Blood becomes oxygenated. So at Point Y , blood is oxygenated (high in oxygen and low in carbon dioxide) and transported to the heart and enters the systemic circulation.

Paper 2

Section A

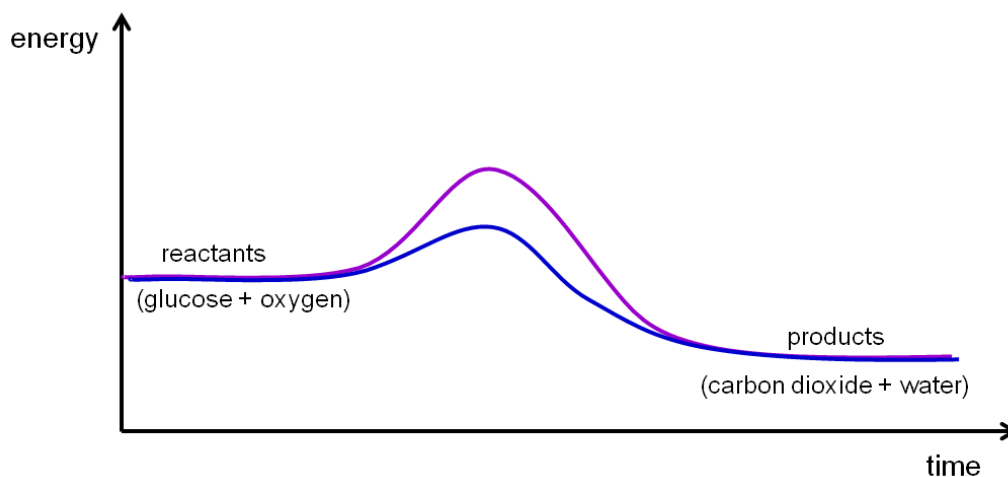
1	(a)	(i)	mitochondrion	[1]
		(ii)	nucleolus	[1]
		(iii)	(Y is Golgi apparatus). It chemically modifies substances made by the endoplasmic reticulum, stores and packages these substances in vesicles to be secreted out of the cell.	[2]
	(b)	(i)	8.3 cm (accept answer from 8.1 / 8.5 cm)	[1]
		(ii)	Length of PQ divided by Actual length of PQ = Magnification of cell Therefore Actual length of PQ = $8.3 \text{ cm} \div 10250$ = $(0.083 \text{ m} \div 10250)$ multiplied by 10^6 $\cong 8 \text{ } \mu\text{m}$ Answer = <u>8</u> micrometres	[2]
2	(a)	(i)	In endocytosis, the cells <u>absorb</u> large molecules or ‘bulk materials’ from outside the cell to inside the cell whereas in exocytosis, the cells <u>eject</u> waste products or cell products from the interior of the cell to outside the cell.	[2]
		(ii)	Feeding by amoeba or paramecium / phagocytosis	[1]
		(iii)	Secretion of protein from cells / Secretion of waste material from cells	[1]
	(b)	(i)	$0.34 \text{ g per } 100\text{cm}^3$ or $0.34 \text{ g } 100 \text{ cm}^{-3}$ (units must be given)	[1]
		(ii)	Zero / 0 % Carrot cells are plant cells. Plant cells have cell walls, which are tough to withstand the increase in pressure / cell walls prevent bursting.	[2]
3	(a)	enzymes speed up chemical reactions / enzymes are required in minute amounts / enzymes are specific in action (any two)	[2]	

- (b) Similarity: [2]
 in both models substrate binds to active site /
 in both models an enzyme - substrate complex is formed (any two)

Difference:

In lock-and-key hypothesis, the substrate fits exactly into the active site of enzyme whereas in induced fit hypothesis, the active site of enzyme alters slightly to fit the substrate

- (c) [1]



- 4 (a) It allows people who are lactose intolerant / have difficulty digesting lactose to consume dairy products / [2]
 Galactose and glucose are monosaccharides and hence can be absorbed readily when consumed /
 Galactose and glucose are monosaccharides and hence are relatively more soluble than lactose.

- (b) reduces bacterial growth / reduces (milk) spoilage / [2]
 allows products to form more slowly / to control the rate of reaction /
 lower energy costs / less energy to achieve 5 °C compared to 48 °C.

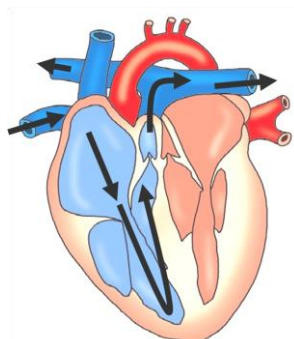
- 5 (a) (i) [2]

Difference in	Cell X (palisade mesophyll cell)	Cell Y (spongy mesophyll cell)
Shape	elongated / regular	round / irregular
Number of chloroplasts	many / more	few / less

- (ii) [2]
 [This is a sunken stoma. It appears as if the guard cells (arrows) are part of the mesophyll, but they are epidermis cells (without exception, guard cells form only in the epidermis).] Air in the depression is slightly protected from wind.
 Any molecule of water that escapes from the stoma may remain in the depression long enough to actually diffuse back into the leaf rather than being blown away.

- (b) (i) Soda lime is used to absorb carbon dioxide from the air entering the bell jar whereas the dish of potassium hydroxide in the jar absorbs the carbon dioxide from the jar. [1]
- (ii) The control can be set up using pebbles instead of soda lime and water in the dish in the bell jar instead of potassium hydroxide. [2]
- (c) The weed killer is absorbed through the root hair cell through diffusion [1]. [2]
 The weed killer is then diffused from cell to cell in the root until it reaches the xylem.
 The weed killer travels up the xylem all the way to the leaf [1].
 Here, the weed killer diffuses out of the xylem in the leaf into the mesophyll cells where photosynthesis occurs, which is the site of action of weed killers.

6 (a) (i) [1]



- (ii) The oxygenated blood in the systemic circulation will mix with the deoxygenated blood in the pulmonary circulation. [1]
- (iii) Less oxygen is available for these babies, thus, they would produce / release / convert less energy for growth. [1]

[A]: Less nutrients (because of lower pressure) for building of new protoplasm / cell reproduction.

- (b) (i) Diet rich in cholesterol / rich in saturated fat / smoking / stress / atherosclerosis / thrombosis [1]
- (ii) The cardiac muscles / cells will be deprived of oxygen / nutrients OR Coronary artery bursts because of high blood pressure [2]

A prolonged lack of oxygen causes the heart muscles to die eventually / angina (chest pain) / heart attack.

- (c) $720 - 240 = 480 \text{ cm}^3$ [2]
 $480 \div 240 \times 100\% = 200\%$
 Answer = 200 %

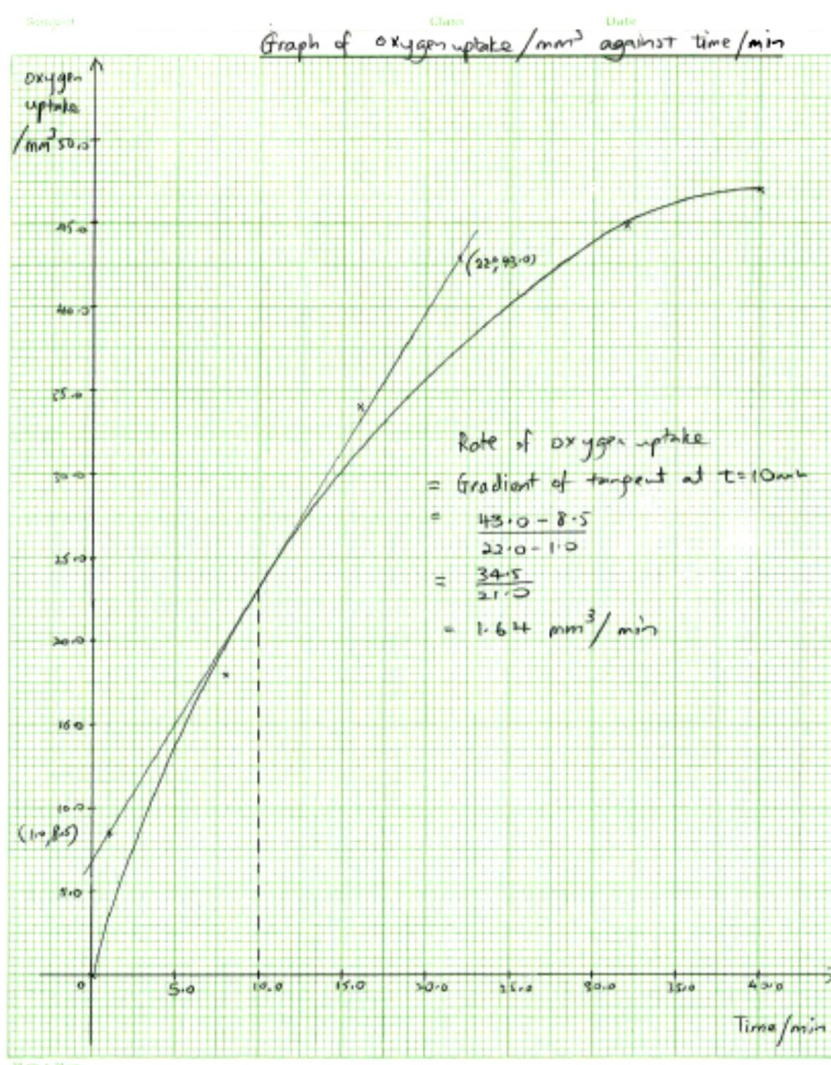
Section B

- 7 (a) Table + suitable heading with unit [2]
5 readings recorded accurately from diagram

Time/min	oxygen uptake/ mm^3
0	0
8	18
16	34
32	45
40	47

Note: Independent variable should be placed in the first column

- (b) S – Appropriate scale, at least $\frac{3}{4}$ size [4]
P – Accurate plotting of points
L – Best fit line
A – x and y axes correctly labelled with appropriate units
T – Appropriate title
[max 4]



Common errors:

- Failed to include units in the title
- Using brackets for units instead of a slash
- Not marking the major grids on the axes
- Unequal intervals on the scale
- Use of odd scale (scales going up in 2s, 5s or 10s are usually best; scales going up in 3s, 7s and even 4s are awkward to use)
- Not drawing a best fit curve/line.
- In this case, the line/curve should pass through the origin

(c) *Gradient = $\frac{y_2 - y_1}{x_2 - x_1}$; answer with accurate units [2]

* Must draw tangent on grid

Comments:

When finding gradient of the tangent, the points you use to find the gradient (ie the triangle) must be as far apart as possible. The triangle should cover more than half the area of the data points.

- (d) Maximum rate of respiration/ Limit to how much an organism can take in oxygen/resting/ sleeping/ lacking glucose. [1]

[A]: depleting levels of oxygen in the tube/H₂O bath might have cooled down/stimulus for breathing is CO₂, thus lack of CO₂ in air caused a decrease in rate of breathing

- (e) Level of liquid in the tube increased/ Result is the same as the set up for larva. [1]
[R]: level of liquid in the tube will remain unchanged

- 8 (a) At 7 am, blood glucose concentration is low [5]
(Islets of Langerhans) in the pancreas secrete glucagon (*must have*)
Liver converts glycogen into glucose (*must have*) in the presence of glucagon
to supply energy to start the day's activities

The carbohydrate-rich meal can only yield high glucose to body around 10am to cause blood glucose concentration to increase

(Islets of Langerhans) in the pancreas secrete insulin (*must have*)

Liver converts the excess glucose into glycogen (*must have*)

Blood glucose concentration decreases back to normal

Max 5

- (b) (i) *Experiment I:* [4]
 Substance X (insulin) is needed to decrease the blood glucose concentration / prevent diabetes by converting excess glucose to glycogen.
Experiment II:
 Substance X (insulin) is protein in nature and the protease increases rate of digestion of substance X so it can no longer prevent diabetes.
Experiment III:
 Substance X is not made of fats so lipase does not have an effect on it.
Experiment IV:
 Substance X is digested in the stomach and duodenum in the presence of proteases (pepsin, trypsin and erepsin) hence, diabetes cannot be prevented.
- (ii) Use Benedict's solution to test for reducing sugar in the urine. [1]

9 Either

- (a) Chemical energy can be used by other living organisms to carry out life processes. [2]

It maintains the concentrations of oxygen and carbon dioxide constant in the atmosphere.

[R]: Photosynthesis purifies air.

It produces oxygen for living organisms to respire.

Max 2

- (b) Expose the plant only to radioactive carbon dioxide ($^{14}\text{CO}_2$) molecules. [4]
 (OR Remove carbon dioxide by using soda lime / calcium hydroxide in set-up.)

Any of 2 of the following

Provide the plant with optimum temperature

Provide the plant with optimum sunlight

Place another plant in normal air as control

3 repeats and 3 replicates

After x min, using an x ray film, observe for radioactivity in the transverse sections of the leaves.

(OR After x min, test for starch in the leaves by using the iodine solution test.)

- (c) (i) Rate of photosynthesis increases rapidly from 4 to 45 arbitrary units as water uptake increases from 2 to 8 mm³ per min. [3]

It increases gradually from 45 to 60 arbitrary units as water uptake increases from 8 mm³ to 16 mm³ per min.

Beyond 16 mm³ per min of water uptake, the rate of photosynthesis remains constant at 60 arbitrary units.

- (ii) C4 plant has a higher rate of photosynthesis at lower rate of water uptake. [1]

9 Or

- (a) thrombokinase, thrombin / prothrombin [2]
[R]: fibrinogen because it is a plasma protein, does not catalyse chemical reactions

- (b) (i) As temperature increases from 10 °C to 35 °C, clotting time gradually reduced from 86 seconds to about 24 seconds. [3]
[A]: Fastest at 40°C when clotting time is 30 s.

This is because blood clotting is dependent on various enzymes whereby increasing temperature would increase kinetic energy / increase the rate of effective collision between enzyme and substrate.

As the temperature increases further from 35 °C to 45 °C , the rate clotting time gradually increase as the enzymes starts to denature.

- (ii) • Concentration of substrate involved in blood clotting process – Higher concentration of substrate would increase the rate of enzyme-substrate complex formation / effective collision, hence decreasing the time required for blood clot. [4]
- Concentration of enzyme involved in blood clotting process – Higher concentration of enzyme would increase the rate of enzyme-substrate complex formation / effective collision, hence decreasing the time required for blood clot.
- Potential change in pH values – changes to optimal pH values would affect the shape/conformation of enzymes' active site, hence altering the rate of enzyme-substrate complex formation and the clotting time.
- OR Extreme pH denatures enzyme molecules.

- Presence of Ca ions - for conversion of prothrombin to thrombin.
- Pressure of blood flow is high - Fibrin mesh cannot form.
- Low platelet count - leading to less production of thromobokinase.

Any 2 of the above points with accurate explanation

- (c)** Move the muscles of the lower limbs frequently / Wear compression stockings / Wriggle the toes frequently to squeeze the blood in the veins forward. [1]