

2017 S3 IP BIOLOGY EOY MARK SCHEME
PAPER 1

Qn	Ans	Explanation
1	D	Fact. Water is the main constituent of protoplasm.
2	D	In cold climates, hibernating animals will store fats for warmth. Vacuoles are the storage organelles of the cell.
3	C	Potato has live cells which have partially permeable membranes. Thus osmosis will occur from the water into the potato cells and move from cell to cell to enter the sugar solution, down a water potential gradient.
4	C	The diagram shows substance in a vesicle fusing with the membrane and releasing the substance outside the cell. This is exocytosis.
5	B	only B shows positive food test results for two nutrients (reducing sugar and fats). The others show positive observations for 3 nutrients, or all negative results
6	A	Sugars are preferentially used by the body as a quick source of energy. Fats and proteins are not metabolised as quickly. The substance with the highest amount of reducing sugar is shown by brick-red ppt (because Benedict's test is a semi-quantitative test)
7	A	digestion of starch by amylase gives maltose, which are disaccharides. Maltose is then digested by maltase into glucose (basic units).
8	C	Using the lock and key hypothesis, Z is the lock (enzyme) and X and Y are the keys (substrates: phenylalanine and hydroxyl group). W has an active site that does not fit the substrates, and so must be the defective enzyme.
9	A	PAH is a human enzyme, so optimum activity should be around 37°C. Slow increase in activity at low temp (due to inactivation of enzyme) and sharp decrease in activity after 37°C (due to denaturation)
10	C	Light energy is used in the photolysis of water molecules into protons and oxygen.
11	B	During the day, rate of photosynthesis exceeds that of respiration. Hence, the plant appears to give out oxygen and take in carbon dioxide.
12	C	Plant photosynthesises in light and oxygen is produced. Bubbles of oxygen displaces the water.
13	A	Dilute sodium bicarbonate solution supplies the plant with additional carbon dioxide, hence photosynthetic rate increases, thereby increasing the rate of oxygen production.
14	B	Q and S. Increasing light intensity results in an increase in rate of photosynthesis.
15	A	(y-x) g: change in mass is due to photosynthesis. (y-z) g: plant respire instead of photosynthesise in the dark and respiration requires breakdown of starch to provide energy.
16	A	Water is able to form hydrogen bonds with other molecules (cohesion) and with the walls of xylem (adhesion). Water being polar means it cannot pass through phospholipid bilayer easily. Not 4: Low molecular mass is a result of adding the mass of individual atoms that make up water.
17	D	both 1 and 2 are xylem, as seen by the striped patterns of lignin. Therefore, they transport water and mineral ions.
18	D	radioactive carbon dioxide is taken into leaves and used for photosynthesis, to make radioactive sugar. Radioactive sugar enters the phloem and reaches the root. A shows the position of STEM phloem. B shows STEM xylem. C shows ROOT xylem. D shows ROOT phloem.

19	C	Buccal cavity, P: ingestion Stomach, Q: digestion Small intestines, R: absorption
20	B	Gall bladder stores bile produced by liver. Bile emulsifies fats; so removal of gall bladder affects fat digestion. Bilirubin in bile cause faeces to have a dark color. The absence of bile would cause faeces to be a lighter color. Amino acids absorption does not depend on bile/gall bladder. Liver is the organ that produces bile.
21	C	Hepatic portal vein delivers absorbed nutrients e.g. glucose from small intestines to liver for storage, hence less glucose exits the liver through hepatic vein.
22	D	Only small soluble molecules can be absorbed without further digestion.
23	C	Heart muscles will be affected during a heart attack.
24	C	Blood cells are forced to move in a single file due to the narrow lumen of the capillaries, not because of low blood pressure and velocity.
25	C	On the graph, regions of smaller cross-sectional area correspond to higher blood velocities.
26	D	Both elastic recoil of vessel wall and pumping action of heart create high pressure due to the force generated.
27	B	Carbon dioxide produced by cells travel in the blood vessel to the lungs where it exits the capillary into the alveolus. The alveolus leads into the bronchiole, bronchus, trachea and then larynx.
28	C	Alveoli are the sites of gaseous exchange in the lungs. The lesser the alveoli, the smaller the surface area available for gaseous exchange.
29	A	Breathing is a process that involves inhalation and exhalation. Out of all the time periods, V to W is the only one that registers a complete inhalation and exhalation.
30	A	Cilia helps to sweep dust and mucus up the trachea. The sweeping motion of cilia requires energy produced by mitochondria.

PAPER 2

1ai Guard cells [1]

1aii The guard cells control the opening and closing of the stomata, thereby regulating [1]
the passage of oxygen and carbon dioxide in and out of the the leaf.

OR

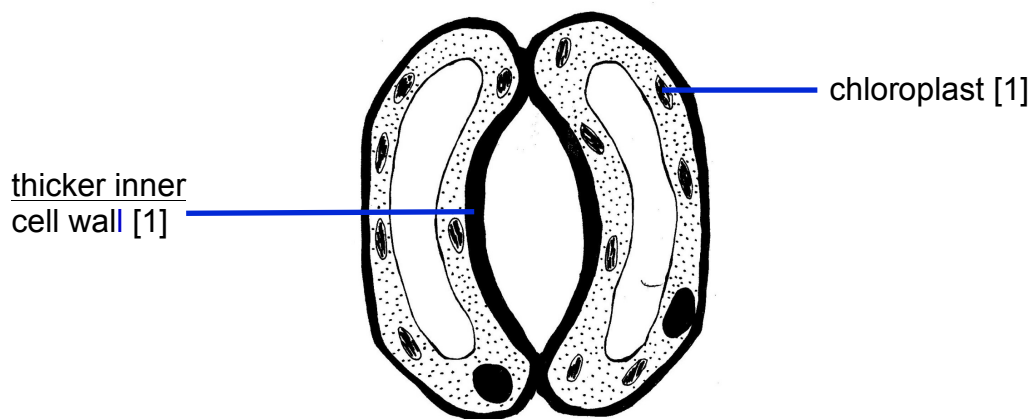
The guard cells control the opening and closing of the stomata, allowing the exchange of oxygen during respiration and carbon dioxide during photosynthesis.

REJECT

- × gaseous exchange only (incomplete)
- × exchange of carbon dioxide and oxygen only (incomplete)

1bi

[2]



Reject

- × plural form of chloroplast if student only labels one chloroplast
- × cell wall (without mentioning "thicker", "inner")

1bii During the day, the guard cells photosynthesise, converting light energy to chemical energy. The chemical energy is used to pump potassium ions (K^+) from neighbouring epidermal cells into the guard cells. [4]

As the result, the water potential of the guard cells is lowered. Water from neighbouring epidermal cells then enters guard cells by osmosis.

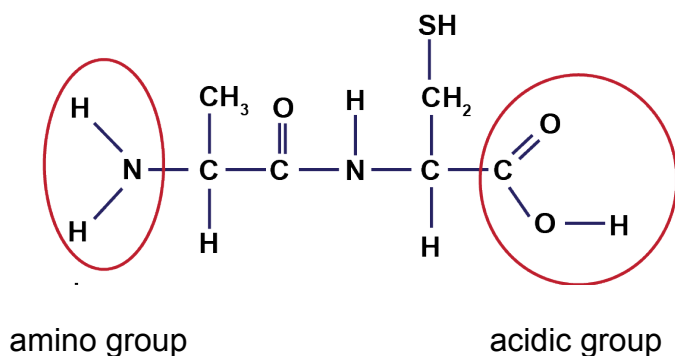
This causes the guard cells to swell and become turgid.

The guard cells have a thicker cell wall on one side of the cell (the side around the stomatal pore). This causes the swollen guard cells to curve more than the thinner outer cell wall, and results in the opening of the stomatal pore.

[Total: 8]

2ai

[1]



2aii peptidase

[1]

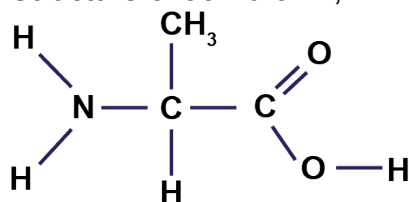
aiii inability to digest dipeptide to amino acids leads to less amino acids absorbed and eventually malnutrition / protein deficiency

REJECT

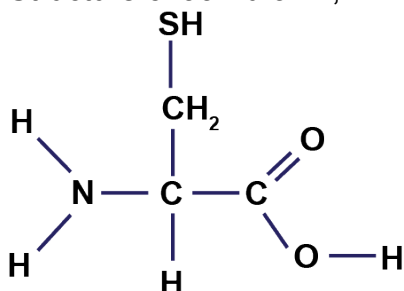
dipeptide not digested to amino acids (stating the obvious)

[1]

2b Structure of aa1 drawn;



Structure of aa2 drawn;



[2]

Total [5]

3a Mean change in volume = $(1.3 - 0.1 + 2.6 - 1.3 + 3.7 - 2.6) / 3$
 = $(1.2 + 1.3 + 1.1) / 3$
 = 1.2 ml

[2]

Mean transpiration rate = $1.2 / 30 = 0.04 \text{ ml / min}$

3b volume of water into plant is assumed to be water lost by transpiration
 rate of transpiration is the same as rate of absorption
 It is assumed that plant does not use water for photosynthesis
 It is assumed that plant does not retain more water taken in in its cells

[2]

REJECT the rate of transpiration of the plant was the same for all the 3 trials (this is not necessary)
 (Trial 1 is 0.04 ml/min
 Trial 2 is 0.0433 ml/min
 Trial 3 is 0.0367 ml/min)

3ci

Set-up	Transpiration rate/ arbitrary units
B	2
A	8

[1]

3cii states & explains any 2 factors that affect the rate of transpiration

[2]

Set-up A has higher transpiration rate because

- plant has more leaves which increases surface area for transpiration
- air conditioner decreases humidity of the computer lab which increases rate of diffusion of water vapour
- there is wind from the air-conditioner, which blows away the water vapour that accumulates outside the stomata
- there is light from the lamp, which causes the stomata to open

ciii Any 2 points:

[2]

- The number of leaves / surface area of leaves is inconsistent
- The wind / air flow is inconsistent
- The humidity between the 2 rooms is inconsistent
- The light intensity is inconsistent

- The temperature in the classroom can fluctuate / is not constant

	Total	[9]
4a Blood vessel X only has an endothelium, whereas blood vessels Y and Z have muscular and elastic tissues in addition to an endothelium. Blood vessel Y has more muscular and elastic tissue than blood vessel Z .		[2]

Accept:

Blood vessel Y has more muscular tissues than Z (and X)

Blood vessel Y has more elastic tissues than Z (and X)

Blood vessel Y and Z have a lot more muscular and elastic tissues than endothelium tissues whereas blood vessel X has only endothelium tissues (or has more endothelium than muscular and elastic tissues)

Note: X does NOT have muscular nor elastic tissues, however, we accepted the above answers as some of you might have interpreted the small bar in the graph as indicative of presence of such tissues

- 4b** Unlike blood vessels **Y** and **Z**, blood vessel **X** allows for the efficient exchange of materials between blood and the surrounding tissues due to its single-cell layered endothelium.

Blood vessel **Y** probably needs to transport blood at greater/higher pressure than blood vessel **X** and **Z**.

[2]

Accept:

Blood vessel Y carries/transport blood at high pressure away from the heart while Z transports blood towards the heart

Blood vessel Y and Z transport blood whereas blood vessel Z is for exchange of substances (between blood and surrounding tissues)

REJECT

- × Blood vessel pumps blood
- × Blood vessel Y transports oxygenated blood as it can withstand higher pressure whereas blood vessel Z transports deoxygenated blood
- × Blood vessel X allows substances to diffuse out
- × Blood vessel X is not meant for transport but for exchange of substances

- 4ci** Given blood vessel **Y**'s anatomy, curve **1** corresponds to the blood pressure in blood vessel **Y** because it shows pressures similar to left ventricular pressures during systole, which is very high in the human body.

[1]

OR

Curve 1 corresponds to the blood pressure in blood vessel **Y** because **Y** is an artery and curve **1** reflects the aortic pressure.

Accept:

Curve 1 shows consistently high pressure and blood vessel Y has more muscular and elastic tissues in its wall to withstand the high pressure

- 4cii** The ventricular pressure curve for the right ventricle will have the same shape but a lower peak/maxima of less than 120 mm Hg, as compared to the left ventricular pressure curve.

This is because:

The walls of the left ventricle contract to pump blood into the systemic circulation which is of a longer distance and higher blood volume.
The walls of the right ventricle contract to pump blood into the pulmonary circulation which is of a shorter distance and lower blood volume.

[3]

Accept:

The right ventricle pumps blood to the lungs which is closer to the heart
The walls of the right ventricle is thinner and hence generate a smaller force
Blood pressure in the pulmonary circulation is relatively lower so that blood flows more slowly through the lungs, allowing sufficient time for the blood to be well oxygenated
Blood is pumped out of the left ventricle at higher pressure so that oxygenated blood is distribute to the body tissues more quickly

REJECT

- × The left ventricle has thicker walls to withstand higher pressure
- × Right ventricle receives deoxygenated blood and hence has lower pressure

[Total: 8]

5a 40000 cm³, 19600 cm³, 12100 cm³, 10000 cm³ [2]
(1 mark each for any two correct answers)

[2]

5b Volume of air breathed in per minute increased by 20400 cm³.
The muscles require more energy during running than walking.
Thus more oxygen taken in to allow for faster rate of cellular respiration to release the additional energy required.

[2]

REJECT

- × More oxygen is required for running than walking (without explaining the link between oxygen and cellular respiration or energy)
- × More oxygen converted to energy

5c If the amount of oxygen intake is not able to meet the oxygen demand of the muscles during respiration, an oxygen debt results.
Anaerobic respiration takes place in order to provide the energy needed.
Anaerobic respiration produces lactic acid which will accumulate in muscles and cause fatigue and muscular pains.

[3]

Accept:

If the person continues running after reaching his maximum breathing rate, there will be insufficient oxygen delivered to the muscles

REJECT

- × the person will experience oxygen debt (without explaining what it means)
- × insufficient oxygen to repay the oxygen debt
- × the person will feel muscle pain (without explaining the link to accumulation of lactic acid)

5d	Inhalation	Exhalation
	External intercostal muscles contract, internal intercostal muscles relax	Internal intercostal muscles contract, external intercostal muscles relax
	Ribcage swings upwards and outwards	Ribcage swings inwards and downwards
	Diaphragm contracts and flattens	Diaphragm relaxes and arches upwards
	Volume of thorax increases	Volume of thorax decreases
	Air pressure in thorax decreases	Air pressure in thorax increases

Each pair of accurate comparison. [1] (max: 3)

[3]

REJECT

- ✗ during exhalation, diaphragm moves up, while during inhalation, diaphragm moves down
- ✗ use of the term “lung cavity” instead of “thoracic cavity”

Very common mistake: incorrect spelling for intercostal muscles – intercoastal muscles

[Total: 10]

- 6a** Transporters needed in root hair cell to take in water by osmosis
In ileum for absorption of water
In ileum for absorption of glucose and other nutrients
Protein transporters can also be used in active transport in the following ways...
Pumping K⁺ ions into guard cells to open stomata
Pumping solutes into sieve tube cells for transport of food substances
Pumping mineral ions into root hair cells for uptake of nutrients from soil
Absorption of glucose at the ileum

[3]

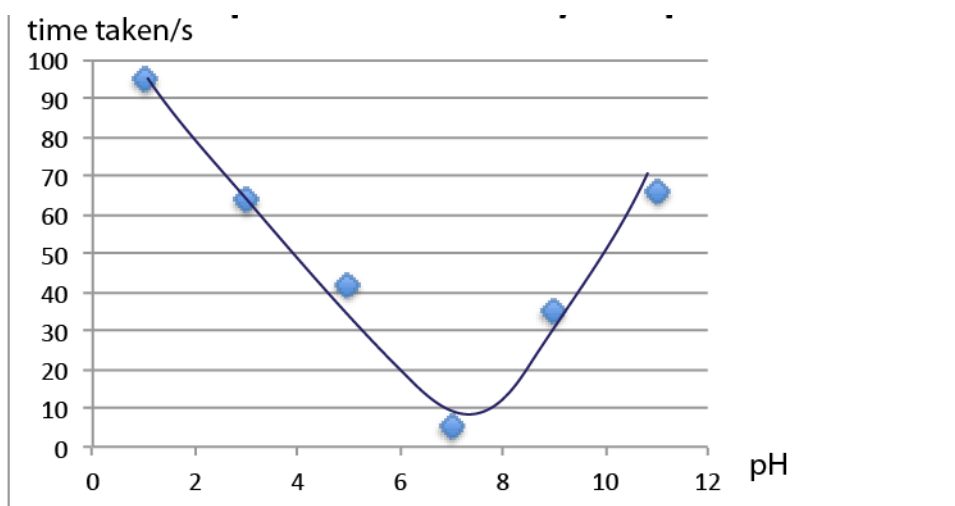
Any other logical answers

REJECT

- ✗ answers that make no specific reference to what is being transported and the life process involved.

- 6bi** Points plotted accurately AND
Line of best fit AND
Axes labelled with units, no odd scale, IV (x-axis) DV (y-axis)
- Scale covers $\frac{3}{4}$ graph paper
OR
Title with units: Graph of time taken/s against pH
(1 mark max)

[4]



- 6bii** DESCRIBE: Curve that reaches a minimum at pH 7 [1]
 EXPLAIN: Enzyme worked optimally at pH7 whereas at extreme pH levels, denaturation occurs as bonds within enzyme are disrupted, disrupting its 3D shape. [1]

REJECT

- ✗ description of changes in time taken without any indication that graph is a curve

- 6biii** Read off from student's graph [ECF] with dotted lines shown as working; [1]

[Total: 10]

- 7a** A person with blood type O has both anti-A and anti-B antibodies that can bind to antigen A and B on the surface of red blood cells from donors of other blood types.
 This causes agglutination/clumping of red blood cells, hence the statement "a person with blood type O can only receive blood transfusion from donors of the same blood type" is valid. [2]

- 7bi** Septum / interatrial septum / interventricular septum / Muscle separating the atria or ventricles [1]

- 7bii** The deoxygenated blood in the right ventricle will mix with oxygenated blood in the left ventricle.
 This results in oxygenated blood from the lungs returning back to the heart to be pumped back to the lungs again.
Deoxygenated blood returning to the heart from the other body tissues will also be pumped out of the heart to the body again. [3]

Note: If the location of the "hole" is stated to be in interatrial septum (from 7bi), then student has to say here that it allows for the mixing of blood between the atria.

- 7c** When blood vessels are damaged, the damaged tissues, together with platelets, release an enzyme called thrombokinase.
 Thrombokinase converts prothrombin into thrombin in the presence of calcium ions.

Thrombin converts soluble fibrinogen into insoluble threads of fibrin.
The fibrin threads forms a mesh that traps blood cells and platelets to form a blood clot.

[4]

[Total: 10]

Either

8ai ileum

[1]

8aii There are numerous villi in the ileum that increase the total surface area for the efficient absorption of nutrients.

Each epithelial cell of the villus has numerous microvilli which further increase the surface area for efficient absorption of nutrients.

The epithelium consists of only a single layer of cells, thereby minimising the distance across which nutrients pass through. (REJECT single layer of cells, thus easy to pass through.)

Each villus is richly supplied with a network of blood capillaries so that nutrients can be transported away fast to maintain a high concentration gradient of nutrients for efficient absorption.

Each epithelial cell has many mitochondria to provide energy/ATP for the absorption of nutrients via active transport. [5]

8b Pancreas secretes digestive enzymes such as trypsin, amylase and lipase.
They are transported from the pancreas to the duodenum/small intestine via the pancreatic duct.
When the pancreatic duct is blocked, lesser enzymes are available, thus slowing down the digestion of proteins, starch and fats.
This negatively impacts a person's health by lowering his energy levels as less nutrients are available.

OR

When the pancreatic duct is blocked, the pancreas will continue to produce digestive enzymes such as trypsin, amylase and lipase.

High concentrations of these enzymes will damage the pancreatic tissue.

Pancreas will not be able to produce (enough) insulin.

This negatively impacts a person's health as excess blood glucose cannot be converted to glycogen for storage, resulting in diabetes. [4]

[Total: 10]

Or

8a Photosynthesis is the process by which plants make food from simple raw materials. To photosynthesise, plants need carbon dioxide, water, light and chlorophyll in chloroplasts to produce oxygen, water and glucose.

Photosynthesis takes place in two stages:

In the light-dependent stage, chlorophyll traps light energy from the sun and uses it to split water molecules into protons and oxygen. It takes place in the granum.

In the light-independent (dark) stage, protons are used to reduce carbon dioxide

to glucose. It takes place in the stroma.

[6]

- 8b** Adaptations of the leaf e.g. mesophyll cells with wet surfaces and large total surface area allow carbon dioxide to diffuse into the leaf cells easily for photosynthesis. However, due to this feature, water is lost easily during transpiration.

Also large intercellular and substomatal air spaces in the leaf that allow carbon dioxide to diffuse easily also allow water to be lost easily.

The greater the number of stomata, the greater is the rate of water loss through transpiration.

The greater the size of stomatal opening, the greater the water loss through transpiration.

[4]

[Total: 10]

End of paper