南洋女子中学校
NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2020
Secondary Three
IP BIOLOGY

Paper 1

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

1. B	Chloroplast is a double membrane bound organelle, Cell membrane has a phospholipid bilayer.
2. C	Fact.
3. B	Largest and heaviest organelle is the nucleus, this is followed by mitochondria and then lysosome all of which are membrane-bound organelles. Lastly ribosomes is the smallest and lightest.
4. A	Fact. A nucleotide consists of 3 components: deoxyribose, phosphate group and a nitrogenous base.
5. B	UCG CGC CGG UCG GCG CGC CGC UUA Find GCG from the coding strand.
6. C	A gene codes for one polypeptide. Since there are 2 different polypeptides, 2 different genes are involved. 3 consecutive bases on the mRNA codes for 1 amino acids. Hence to code for a polypeptide consisting of146 amino acids, the gene required will be 438 bases long.
7. C	If there are 7 adenines on strand 2, this would mean there are 7 thymines on strand 1. If there are 3 guanines on strand 2, this would mean there are 3 cytosines on strand 1. Since each strand consists of 27 bases, then the number of guanines present in strand 1 = 27 – 11 -7 – 3 = 6

8. C	Gametes do not consist of homologs. A pair of homologous chromosomes can have different alleles e.g. the allele for blood type found on the maternal chromosome is I^B but that found on the paternal chromosome is I^A. But on the same position on both the maternal and paternal chromosome, the gene there codes for blood type.
9. B	Only during prophase does the nuclear membrane breaks down and spindle fibres formed.
10. A	T is in metaphase, hence anaphase should follow. P is in anaphase and decondensing of chromosomes only happen during telophase.
11. B	Ratio of long wing: short wing produced is 1:1. Hence number of long-winged flies is also 150.
12. C	People who are heterozygous for sickle-cell anaemia are not resistant. They have a higher chance of surviving malaria than people who do not have the mutated allele. Diet does not cause sickle-cell anaemia.
13. B	P(non-taster) x P(boy) = 0.5 x 0.5 = 0.25
14. D	Good solvent property (water is a universal solvent) is important as it allows mineral salts to dissolve so that they can be transported up the xylem. High latent heat of vaporisation is not important for the function of transport in the xylem. Having high adhesive forces (between unlike molecules) and cohesive forces (between like molecules) allow water to flow as a stream up the xylem.
15. B	5 peptide bonds are formed; hence 5 condensation reactions. Since there are 5 different amino acids, there will be 5 different R groups. Amino group and carboxyl groups are common for all amino acids; what they differ in is the R group.
16. B	Sucrose is a non-reducing sugar.
17. C	Having a high concentration of magnesium ions in the cell sap will reduce diffusion rate.
18. B	When there is no net osmosis, the concentration of the solution that the strip is immersed in will correspond to the concentration of the cell sap. If there is no

	change in the length, then the final length: initial length is 1. So read, when y=1, x = 0.25.
19. C	Osmosis occurs. Net movement of water into the potato cells, resulting in a rise in the volume of the sugar solution.
20. B	Enzyme is the lock and substrate is the key.
21. A	Denaturation is an irreversible change.
22. B	1: as substrate concentration increases, the rate of reaction continues to increase. This shows that substrate concentration is limiting. 2: cannot be concluded since there was no mention of change in temperature or pH. 3: further increase in concentration of substrate no longer increases the rate of reaction. This means that other factor is limiting the rate of reaction.
23. D	Fact.
24. D	X: lacteal Y: blood capillary Lacteal transports fat while blood capillary transports water soluble nutrients.
25. D	Fact.
26. A	The tube with enzyme and alkali shows the greatest rate of digestion. Duodenum is the part of our alimentary canal that is alkaline.
27. C	When packed together these cells will form air spaces within the leaf. Hence it is a spongy mesophyll cell.
28. C	At Q and S, with the increase in light intensity, the rate of photosynthesis increases. Hence light is still the limiting factor.
29. D	Calcium hydroxide is used to remove carbon dioxide.
30. B	Rate of oxygen production indicates the rate of photosynthesis. Rate of production of oxygen is highest at red and violet light and lowest in green light.

Paper 2

<table>
<tr><th></th><th>Answer</th><th>Guidance</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><th>Structure A</th><th>Function</th></tr>
<tr><td>Nucleus</td><td>Controls activities of the cells</td></tr>
<tr><td>Nuclear envelope/nuclear membrane</td><td>Controls the movement of substances into and out of the nucleus</td></tr>
</table>
<table>
<tr><th>Structure C</th><th>Function</th></tr>
<tr><td>Lysosome</td><td>Contains enzymes to digest substances</td></tr>
<tr><td>Vacuole</td><td>Stores food substances</td></tr>
<tr><td>Vesicle/Secretory vesicle</td><td>Transports substances for secretion out of the cell</td></tr>
</table>
</td><td>1 for correct structural identification and correct function

1 for correct structural identification and correct function

Both identification and function must be correct for each organelle</td></tr>
<tr><td>(b)</td><td>Mitochondria are oriented in different directions/ planes with respect to one another</td><td>1</td></tr>
<tr><td>(c)</td><td>Magnification
= Length of DE/ Actual Length of DE

Actual Length [acceptable length is 2.1 cm ± 0.1 cm]
= 2.1 cm/10 000
= 0.00021 cm</td><td>1 for substitution of measurement with correct precision

1 final answer</td></tr>
<tr><td></td><td></td><td>total: 5</td></tr>
</table>

	Answer	Guidance
2(a)	cell J: anaphase cell K: metaphase	**1** for both stages correctly identified **R** spelling error
(b)	spindle fibres <u>shorten</u> sister <u>chromatids are pulled apart</u> with centromeres leading sister chromatids/ daughter chromosomes migrate to <u>opposite poles</u> of the cell	**1** **1** **1**
		total: 4

	Answer	Guidance
3(ai)	The sudden spontaneous change in gene structure/ sequence of gene or chromosome number	**1**
(aii)	Exposure to radiation e.g. UV rays/ gamma rays Exposure to chemical mutagens e.g. tar in cigarette smoke/ mustard gas/ formaldehyde/ cancer causing agents	**1** **1**
(b)	Infant B has one more chromosome than infant A/ Infant B has 47 chromosomes while infant A has 46 chromosomes. Infant B has 3 chromosome 13, infant A has 2 chromosome 13. Infant B has 2 X chromosomes while infant A has 1 X and 1 Y chromosome.	**1** for number **1** for chromosome type **R:** infant B is a female and infant A is a male.
		total: 5

	Answer	Guidance
4(a)	Let X^H represents the normal allele Let X^h represents the allele that causes Duchenne Muscular Dystrophy Parental Phenotype: normal, female x normal, male Parental Genotype: X^HX^h x X^HY Gametes: X^H X^h X^H Y Offspring Genotype: X^HX^H X^HY X^HX^h X^hY Offspring Phenotype: normal, female normal, male normal female affected, male	**1** for defining the alleles **1** for identifying genotype x must be written once **1** gamete + show random fertilisation **1** genotype **1** matching phenotype R: carrier as phenotype
(bi)	0.50 or 50% or 1/2	**1**
(bii)	Fertilisation is random/ The sample size is too small so the actual ratio is different from the expected	**1**
		total: 7

	Answer	Guidance
5(a)	The molecules are too large to pass through the transport proteins/ A lot of the enzymes are required in the lumen, transport by transport proteins is too slow to meet needs	**1** accept other possible answers
(b)	Exocytosis (Secretory) vesicles containing the digestive enzymes fuse with the cell membrane to release the enzymes into the intestinal lumen.	**1** **1**

(ci)	Draw a strip which curves with the epidermis on the inside (i.e. cortex on the outside of the curve)	**1** labels should be present on student's answer
(cii)	Cell sap of cortex cells has a more negative water potential than the distilled water ora Water molecules enter the cortex cells by osmosis through the partially permeable cell membrane [1] Water is unable to enter the epidermal cells (due to cuticle), hence the epidermal cells remain the same length while the cortex cells increase in length/ hence the length of the epidermis remains the same but the length of the cortex increases	**1** **1** **1** something to the effect of one tissue increasing in length but not the other **R** cortex grows
		total: 7

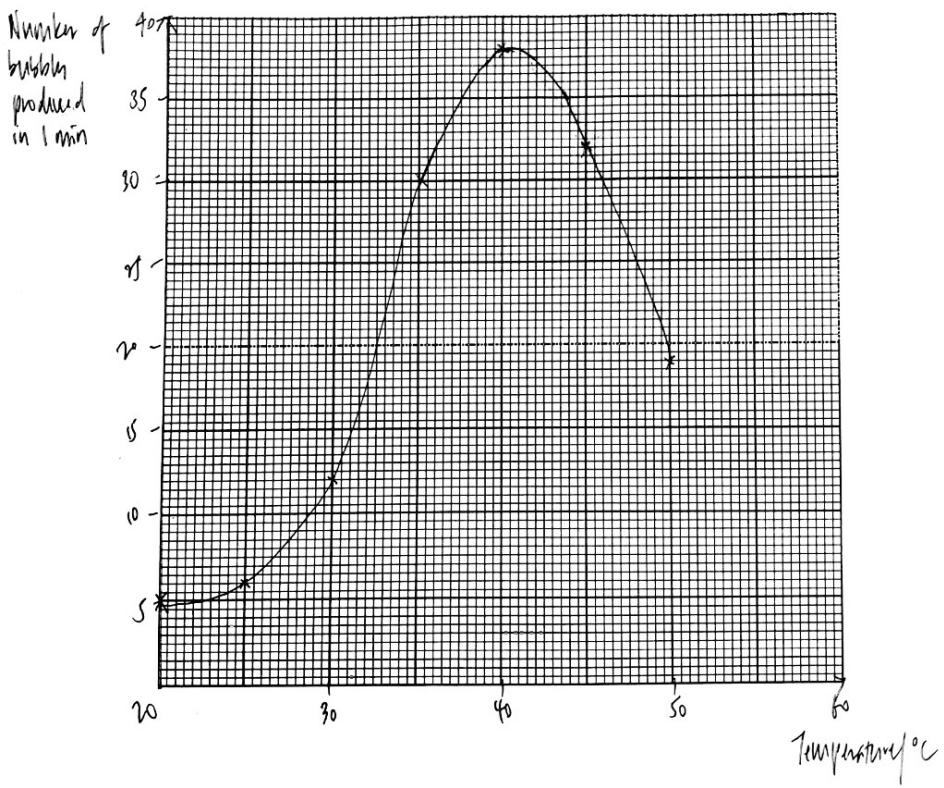
	Answer	**Guidance**
6(a)	No digestion/ hydrolysis of starch occurs as amylase is denatured by the acidic pH	**1**
(b)	Describe: There is a larger clear region around well 3 than 2 ora Digestion of starch results in maltose which is soluble, resulting in the clearing Rate of digestion/ hydrolysis of starch is higher in well 3 than 2. pH 8 is (closer to) the optimum pH of pancreatic amylase than pH 5, thus amylase works at a higher rate/ rate of reaction/hydrolysis/digestion is higher	**1** **1 bonus** **1** **1**
(c)	distilled water/ boiled amylase	**1**

(d)	Conduct the experiment described/ Repeat the experiment using pancreatic amylase with buffer solution at pH 7, 8, 9. If the optimum pH is 8, then the clear region around the well (pH8) will be larger than that surrounding the other two wells ora	**1** has to choose a pH around the pH to be tested; narrow range **1**

	Answer	**Guidance**
7(a)	carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{(sun)light}}$ glucose + oxygen	**1** **1** include the conditions as stated in question
(bi)	trend: The rate of photosynthesis is higher in B than A data: When the light intensity increases from 0 to 50 lux, the rate of photosynthesis in Plant B is 52 arbitrary units while that of Plant A is 40 arbitrary units trend: From 5 to 30 lux, the increase in rate of photosynthesis in B is higher than in A data: When the light intensity increases from 10 to 20 lux, the rate of photosynthesis increases by only 4 arbitrary units in Plant A but photosynthesis rate increases by 18 lux in B trend: As light intensity increases from 40 to 50 lux, the increase in photosynthesis rate is decreasing for Plant B but it is still increasing for Plant A. data: the rate photosynthesis in Plant A increases by 11 arbitrary units (29 to 40) but that for plant B increases by only 3 arbitrary units (49 to 52)	**trend (1) and correct data (1) to support trend for 2**
(bii)	Plant B. Rate of photosynthesis is higher at lower light intensity	**1**

	or Maximum rate of photosynthesis is achieved at lower light intensity.	
		total: 5

	Answer	**Guidance**
8(a)	Enzymes are **<u>biological catalysts</u>** that is made up of mostly **<u>proteins</u>**. They **<u>speed up</u>** the **<u>rate of chemical reaction</u>** while **<u>remaining chemically unaltered</u>** at the end of the reaction.	**1** remarks: All underlined keywords are required to be awarded full marks.
(bi)	S – at least 75% of the grid provided P – all plots are correct L- best fit A – labelled with units	**R** large x or coloured dots **R** main points on axes not marked **R** brackets

		remarks: Graphs that plotted number of bubbles produced in 5 min interval were also accepted. Marks were not awarded for odd divisions (penalised from A) Graphs with odd divisions tended to have wrongly or inaccurately plotted points (penalised from P)
(bii)	1. At low temperatures, rate of photosynthesis represented by the number of bubbles was low, as **enzymes were inactive**. 2. As temperature increases, the **kinetic energy** of the **enzyme and substrate molecules** **increases** and the **frequency of effective collisions** to **form enzyme-substrate complexes**. [1]	**1** **1** **R** reactant / particles remarks: precision in language required, specific reference to enzyme and substrate ***molecules*** required. **1**

	3. 40°C is the **optimum temperature of the enzymes**. The frequency of **effective collisions** to form enzyme-substrate complexes is the highest at this temperature 4. At temperatures above optimal temperature of enzyme, enzymes begin to **denature**, their **active site** becomes **deformed / loses its 3 dimensional conformation**, no longer **complementary to substrate / unable to form enzyme-substrate complex**.	**R** highest kinetic energy of enzyme and substrate molecules **1** remarks: marks are awarded only if the term denaturation of enzyme is explained.
(c)	Shape of the graph is the same but **shifted upwards** / shows a **higher rate of photosynthesis** / **higher number of bubbles per unit time**	**1** **R** values increase; lacks precision, as it is not clearly stated if the x or y-axis values increase
		total: 10

	Answer	**Guidance**
9(ai)	1. [chemical elements] contains the elements carbon, hydrogen and oxygen / higher proportion of hydrogen atoms compared to oxygen atoms. 2. [subunits] consists of 1 molecule of glycerol and 3 molecules of fatty acids 3. Each fatty acid molecule is joined to the glycerol by an **ester bond** / **ester linkage**	**1** **1** **1**

	4. The fatty acid molecule is joined to the glycerol by a **condensation reaction** 5. The fatty acids can be **saturated** or **unsaturated** remarks: many students confused phospholipids and trigylcerides. Also note that triglycerides are hydrophobic molecules while phospholipids are amphipathic molecules	**1** **1** **any 4**
(aii)	1. To 2 cm^3 of the sample, add 2 cm^3 of ethanol. Shake well to mix. 2. Add 2 cm^3 of distilled water to the mixture 3. White emulsion is obtained if fats are present remarks: correct and appropriate volumes must be stated; note the capacity of a test tube is approximately 10 cm^3.	**1 R** ethanol **solution** **1** **1 R** white precipitate
(b)	1. Glycogen is insoluble in water and thus can be stored in large amounts without affecting the water potential of the **cells**. 2. Glycogen is a large **molecule** so it cannot diffuse across the cell membrane and be lost from the **cell**.	**1** **R** water potential of **body**; lack of precision in describing. **1** **R** if molecular size is not mentioned. **R** lost from **body**; lack of precision in describing.

	3. Glycogen has a **compact** shape / molecule, **large amounts can be stored in a small volume**. 4. Glycogen can be **readily hydrolysed into glucose**, to be used as a **raw material of respiration / regulate blood glucose levels**. general remarks: Some students wrote a long paragraph about how blood glucose is regulated in the human body, this is not relevant and does not answer the question.	**1** remarks: need to explain what it means when glycogen is a compact molecule **1**
		total: 10

Either	Answer	Guidance
10(a)	In stomach: 1. Churning / Mechanical / Physical digestion in the stomach breaks up the food into smaller pieces. / Food is also mixed with gastric juice to form chyme / hydrochloric acid causes proteins in chicken to unfold 2. Pepsin in gastric juice digests proteins found in the chicken fillet into polypeptides In small intestine: 3. Bile released into the duodenum emulsifies fats/ break up large fat globules/droplets into small fat droplets	**1** **1** **R** pepsinogen; as it is inactive **R** proteins hydrolysed into amino acids **1**

	4. Lipase found in pancreatic juice and intestinal juice **hydrolyses** fats into fatty acids and glycerol 5. Trypsin found in pancreatic juice **hydrolyses** proteins to **polypeptides**, peptidase found in intestinal juice hydrolyses polypeptides to **amino acids** 6. Pancreatic amylase hydrolyses starch into **maltose**, and maltase hydrolyses maltose into **glucose**. remarks: avoid using the term "break down" to describe chemical digestion; the most ideal term to use is "hydrolyse". Do not use the term "catalyse" and "hydrolyse" interchangeably; this is incorrect. E.g. pepsin catalyse proteins into polypeptides – this statement is **wrong**.	**1** **1** **1** Source of enzymes and where the enzymes work should be properly stated.

(b)

Adaptations	Explanation
1. <u>Long</u>	Provide sufficient time for absorption
2. **<u>Folds</u>** present on the inner walls	Increase surface area to volume ratio for faster absorption of digested food
3. Numerous **<u>villi</u>**, which are **<u>finger-like projections</u>**	Increase surface area to volume ratio for faster absorption of digested food
4. **<u>Epithelium</u>** of villus is **<u>one cell thick</u>**	**<u>Short distance for diffusion</u>** + faster absorption rate
5. Presence of **<u>microvilli</u>** on **<u>epithelial cells</u>**	Increase surface area to volume ratio for faster absorption of digested food
6. Network of capillaries and lacteals	Capillaries to transport the water soluble digested food substances away Lacteals to transport fats away This maintains **<u>steep concentration gradient</u>** for faster absorption of digested food products

1

1

1

1
R villus is one-cell thick
R epithelium is thin

1

1

max 5

total: 10

Or	Answer	Guidance
10(a)	1. Cuticle on epidermis prevents excessive evaporation of water from the tissues/ Epidermis protects the inner photosynthetic tissue from mechanical injury	**1**
	2. Palisade mesophyll **cells** are closely packed + contains many chloroplasts to maximise absorption of sunlight for photosynthesis.	**1**
	3. Spongy mesophyll **cells** are irregular in shape and are loosely packed, forming numerous air spaces + Air spaces present in the spongy mesophyll layer allow diffusion of carbon dioxide into the mesophyll cells	**1**
	4. **Thin film of moisture** on the **surface** of spongy mesophyll cells dissolve carbon dioxide before it diffuses into the cells in solution.	**1**
	5. Xylem present transports water, the raw material of photosynthesis from the roots to the leaves	**1**
	6. Phloem transports sucrose from the leaves to other parts of the plant	**1 R** glucose
	7. Lamina (or leaf blade) is **thin**, this creates a short diffusion distance for gases like carbon dioxide to enter the leaf via diffusion.	**1**
	8. Lamina (or leaf blade) is **flattened / broad**, this crease a **large total surface area** of the leaf for it to be exposed to maximal amount of sunlight.	**1**
	9. Petiole (or leaf stalk) positions the leaf away from the stem, allow the leaf to be exposed to maximal amount of sunlight.	**1**
	10. Guard cells present on lower epidermis create stomata, which controls gaseous exchange, allowing **carbon dioxide** to diffuse into the leaf. Reject: leaf arrangement; this question requires you to describe the structural adaptations (internal and external features) of a **single** leaf.	**1** remarks: entry of carbon dioxide into leaf must be stated

(b)

Steps	Explanation
1) Boil the leaf in <u>boiling</u> **<u>water</u>** for 5 min	Stop all chemical reactions/ denature enzymes
2) Place the leaf in hot **ethanol**.	To decolourise the leaf/ to remove chlorophyll from the leaf
3) Place the leaf in **warm** water.	To soften the leaf so that it is more permeable to iodine solution
4) Add iodine **<u>solution</u>** to the leaf.	For testing for starch. If starch is present, <u>iodine **solution**</u> changes from brown to **blue-black**; indicating that photosynthesis has occurred. If iodine solution remains brown, the absence of starch indicated that photosynthesis has not occurred

1

1

1

1 how to test using iodine solution + result interpretation
R iodine; it must be iodine **<u>solution</u>**

total:10