Section 1A: (36 marks)

1	2	3	4	5	6	7	8	9	10
A	D	A	C	A	D	A	B	C	A
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	C	D	C	A	C	B	D	D	C
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
C	C	B	C	C	C	D	B	A	C
31	**32**	**33**	**34**	**35**	**36**				
C	A	B	D	A	A				

Section 1B: (84 marks)

1. C (1) E (1) A (1)

2 (a) When travelling upward on a high speed elevator, the air pressure outside structure W decreases quickly and becomes lower than that in the middle ear. (1)
Structure W bulges outward, causing pain. (1)

(b)During swallowing, structure Z/Euchancian tube opens to allow air to enter the middle ear (1)
The air pressure on either side of structure W becomes equalized. (1)

3. (a) Sun leaf is smaller than shade leaf (1)

- Reduce surface area for the sun leaf to prevent excess water loss due to the heating effect of being directly under the sunlight on the top of the tree(1)

Shade leaf is darker green in colour than sun leaf (1)

- Darken green colour represent more chloroplast packing/ more chlorophyll which can maximize the amount of light to be absorbed when light falling onto the bottom or penetrate to the interior of the tree canopy (1)

(b) Having a lower compensation point means the rate of photosynthesis will be the same as the rate of respiration at a lower light intensity than the sun leaf (1)
Even they are blocked by the sun leaf and receives lower light intensity, the rate of photosynthesis can be higher than the rate of respiration (1)
There can still be easily to have a net food production and support the growth and development of the leaf / plant (1)

4. (a) quadrats* (1)

(b) belt transect (1)

(c) It cannot be used for sampling organisms that move rapidly. (1)

(d) Nitrogen fixing bacteria are present in the root nodules of *Mimosa*. (1)
The bacteria can convert nitrogen gas in soil air to ammonium compounds (1)
Plant can absorbed the ammonium compound and this allows nitrogen to enter food chains to complete the nitrogen cycle (1)

5 (a) Due to the formation of the Isthmus of Panama, the ancestral population was separated into two groups and the two groups became isolated from each other / could not meet to interbreed and gene flow stopped. (1)
Each isolated group was subjected to a different set of environmental conditions. (1)
The two groups evolved differently due to natural selection. / Different characters favourable to those particular environmental conditions were selected by natural selection. (1)
Over time, their genetic compositions became so different that they could no longer interbreed to produce fertile offspring even if they met again. They became two different species. (1)

(b) 1 a Without a vertical black stripe through the eye …….. 2
1 b With a vertical black stripe through the eye ……... 3
2 a Without two vertical black stripes behind its head (or other reasonable answers) ..… Fish P
2 b With two vertical black stripes behind its head (or other reasonable answers) ...…… Fish Q
3 a Body with horizontal stripes ……..... Fish R
3 b Body with vertical stripes …… Fish S

(3)

6 (a) To remove any substance present on the seeds that may inhibit germination / may interfere with the results of the experiment. (1)

(b) Oxygen should be present so that the seeds can carry out respiration to release energy for growth. /
A warm environment should be provided so that the enzymes in the seeds can work efficiently. (1)

(c) Repeat step 4 to prepare an identical set-up except that distilled water would be used instead of the extract of tomato fruit wall (1)
and carry out the experiment under the same environmental conditions. (1)
This ensures any inhibition on seed germination in the experimental set-up is due to the extract of tomato fruit wall only. (1)

(d) This ensures that seed germination will only occur after the fruit is eaten by animals or decomposed / allows enough time for seed dispersal. (1)

7 (a) The water tank prevents heat emitted by the table lamp from heating up the dilute sodium hydrogencarbonate solution.(1)
This helps ensure that temperature is kept constant during the experiment and the difference in the rate of photosynthesis is due to the independent variable only. (1)

(b) By using dilute sodium hydrogencarbonate solutions of different concentrations.
(or other reasonable answers) (1)

(c) This allows time for the aquatic plant to equilibrate / adapt to a new concentration of carbon dioxide. (1)

(d) As the carbon dioxide concentration increases from 0% to 0.4%, the rate of photosynthesis increases (1)
because there is more carbon dioxide available for the Calvin cycle. (1)
As the carbon dioxide concentration increases beyond 0.4%, the rate of photosynthesis levels off (1)
because it is limited by other factors (e.g. light intensity or temperature). (1)

8 (a) Mucus secreted by mucus-secreting cells on the inner wall of the respiratory tract may trap *M. tuberculosis* in inhaled air. (1)
Cilia of ciliated epithelial cells beat to sweep the mucus with trapped *M. tuberculosis* towards to pharynx for coughing or swallowing. (1)

(b) The tubercles replace some air sacs. The surface area for diffusion of gases is reduced. (1)
Hence, the rate of diffusion of oxygen into blood decreases. The patients experience shortness of breath due to low blood oxygen levels. (1)

(c) The capillaries in the lungs rupture / are damaged. (1)

(d) (i) This ensures that bacteria which are resistant to a particular antibiotic can be killed by another antibiotic that they are sensitive to. (1)

(ii) Complete the whole course of treatment even symptoms have disappeared. (1)
Take the right dose of antibiotics at the right time. (1)
(or other reasonable answers)

(e)(i) Cover our nose and mouth with tissue paper when coughing or sneezing and dispose of nasal and mouth discharge properly. /
Wear a face mask if we have any respiratory symptoms and seek treatment promptly. /
Wash our hands with liquid soap and water, especially after coughing or sneezing. /
Receive vaccination against TB according to immunization schedule.
(or other reasonable answers) (1)

(ii) Establish and implement immunization programmes for TB. /
Carry out disease surveillance for TB. /
Educate the public about the importance of taking preventive measures against TB.
(or other reasonable answers) (1)

9 (a) Amino acid X is constantly formed as the proteins in food are broken down by proteases. (1)
However, as no functional enzyme P is produced in the patients, amino acid X cannot be converted to amino acid Y. Therefore, amino acid X accumulates to a high level, (1)
while the level of amino acid Y in blood becomes low as amino acid Y is used for the synthesis of pigments and cannot be formed from amino acid X. (1)
As a result, the ratio of amino acid X to amino acid Y in blood in the patients becomes significantly higher than that in healthy people. (1)

(b)The patients can still obtain a certain amount of amino acid Y from their diet as the proteins in food are broken down.
However, as the patients do not have functional enzyme P for converting amino acid X into amino acid Y, amino acid Y cannot be formed in their bodies. (1)
Therefore, the supply of amino acid Y for the synthesis of pigments is reduced and most patients have a lighter skin and hair colour than healthy people. (1)

(c)(i) Cindy has the genetic disease. She must be homozygous recessive. (1)
She must have received one recessive allele for the disease from Mr Wong and one from Mrs Wong. (1)

Mr Wong is normal. He must have at least one normal allele. (1)
Therefore, Mr Wong is heterozygous. (1)

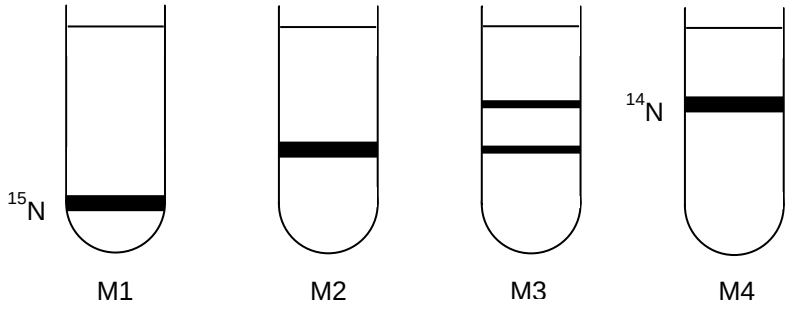
(ii)Partially agree.
The probability of Elaine being normal is 50% because she could have inherited a normal allele or a recessive allele from Mr Wong. (1)
However, the probability of Elaine having the disease or not is not determined by her siblings' phenotype.(1)

10 (a) The adenine to thymine ratio is roughly 1 : 1.
The cytosine to guanine ratio is also roughly 1 : 1. (1)

(b) The same amount of adenine and thymine, and cytosine and guanine provided hints to the complementary base pairing(1)
in which adenine pairs with thymine, and cytosine pairs with guanine. (1)

(c)(i) Correct position of DNA sample from M2 bacterial culture (1)

Correct positions of DNA sample from M3 bacterial culture (1)



(ii) When the bacteria in M2 culture divided, the two strands (one heavier ^{15}N strand and one lighter ^{14}N strand) of DNA molecules separated, each of them acted as a template for the synthesis of a new DNA strand. (1)

In M3 culture containing only lighter ^{14}N, new lighter ^{14}N strands were synthesized using the heavier ^{15}N strand as template, forming DNA molecules which were as dense as M2 bacterial DNA. (1)

While new lighter ^{14}N strands were synthesized using the lighter ^{14}N strand as template, forming DNA molecules which were as dense as M4 bacterial DNA. (1)

(d)

Nature of Science	Elaboration
Scientists build on the work of other scientists.	Watson and Crick built on Levene, Chargaff Franklin and Wilkins's work and worked out the three-dimensional model of DNA structure. (1)
Science is affected by the technology and the types of equipment available at the time.	Franklin and Wilkins could not reveal the helical structure of DNA without X-ray crystallography developed by Sir William Henry Bragg and Sir William Lawrence Bragg. (1)

11. Contrast of the structures and components: (Max 4)

	Flowering plants	Humans	
System(s) involved	The transport system is composed of vascular bundles.	The transport system is composed of the circulatory system (C.S.) and the lymphatic system(L.S.).	1
Organs involved	stems, roots, and leaves.	C.S.: Heart, blood vessels; L.S. : lymph vessels	1
Tissues involved	Vascular bundles or Xylem and phloem.	C.S.: Blood L.S. : Lymph	1
Cells involved	Xylem vessel, xylem tracheid, Sieve tubes, companion cells	Red blood cells	1
Are the cells involved alive?	Xylem vessels are made up of dead cells. Phloem is made up of living sieve tubes and companion cells.	Blood vessels and lymph vessels are made up of living cells. RBCs are involved mainly in transporting oxygen.	1
Transporting medium	Water	C.S.: Blood; L.S. : Lymph	1
Diameters of conducting vessels	Diameters of xylem vessels and sieve tubes are fixed.	Diameters of arterioles can be changed.	1
Structure inside the conducting vessels	Sieve plates are present in phloem.	Valves are present in veins and lymph vessels.	1
Tactics to reduce resistance	Conducting vessels are made hollow by cell apoptosis.	Vessels are greatly branched to form numerous small vessels to give a large total cross sectional area.	1
Tactics to transport materials	Lignified cell wall with holes at certain places to increase efficiency	A high pressure is generated by the heart to maintain a quick flow of blood	1
Types of system	An open system with hollow tubes.	C.S. : A Close system of circulation.	1

Comparison of mechanisms: (Max 4)

	Flowering plants	Humans	
Nature of driving force	A passive force	An active force	1
Origin of driving force	Leaves as the organs to generate driving force.	The heart acts as a pump to drive blood throughout the body.	1
	Transpiration pull is the main force that draws water up the xylem vessels.	Contraction of nearby skeletal muscles drives the blood in veins and the lymph in lymph vessels forward.	1
		Elastic fibres in blood vessels recoil to maintain a blood pressure and drive blood forward.	1
		Valves are present in veins and lymph vessels and also the heart to prevent the backflow of blood and lymph.	1
		The initiation of cardiac muscle is myogenic, while the regulation of the cardiac output can be neurogenic or hormonal.	

Effective communication (max 3) (QT 11 m)