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

SECTION 1B

#1 (Total: 3 marks)

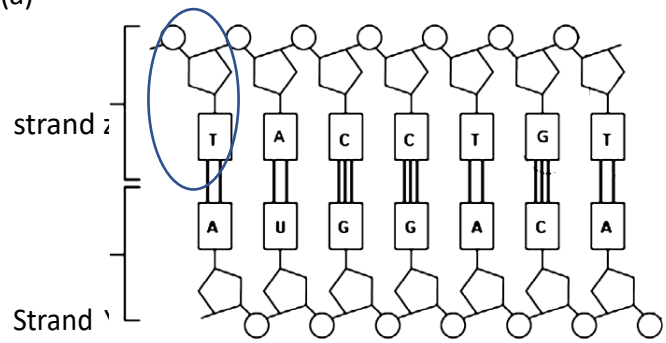
(a) D (1)

(b) C (1)

(c) B (1)

#2 (Total: 5 marks)

(a)



(b) *Nucleus (1)

(c) strand Y. (1)

Strand Y contains *nucleotide with uracil / nitrogenous base U* and it is an *mRNA.* (1)

mRNA involves the translation which is a process to form a polypeptide. (1)

#3 (Total: 5 marks)

(a)

- During infection, plasma cells *increase the production* Of a *particular antibody* for specific immune response. (1)
- C carries the genetic materials (1) coding for the antibodies.
- Transcription takes place in C to produce mRNA. (1)
- which is transported to A for translation / protein synthesis. (1)

  The energy required by protein synthesis is supplied by *structure B* which ***generates ATP by cellular respiration.*** *(I)*

#4 (Total: 7 marks)

(a)

Vena cava (1) → heart → pulmonary artery → lungs (1) → pulmonary vein → heart → aorta (1)

(b)

Through *placenta* fentanyl diffuses from the

(1) maternal *blood* into the foetal *blood* and

(1) carried by *umbilical cord* to the foetus (1)

#5

(a) (Total: 7 marks)

- The population size of the grasshopper will ***decrease.*** (1)
- It is because both caterpillar and grasshopper are the food sources of small bird. When the caterpillar is removed from the food web, ***grasshopper becomes the only food source of small bird.*** (1)
- ***Increasing in predation*** on grasshopper will ***increase its death*** *rate. / More* grasshopper will be ***eaten by*** the small bird. (1)

(b) (i) maize plant → mouse → owl (1)

(ii)

It is the ***shortest food chain / least number of trophic level.*** (1)

least energy will be lost during the transfer between ***successive trophic levels*** (1)

due to ***respiration, metabolic activities, death***. (example of energy loss) (1)

#6 (Total: 7 marks)

(a) It is because the ***increase in interspecific competition between weeds and sorghum plants.*** (1)

for ***light/ water/nutrients /space.*** (1) (example of resources)

The more the sorghum plants, the less likely that weeds will be able to grow due to limited resources; (1)

(b)

- It is because when the sowing density is relatively low, there is ***less intraspecific competition*** (1)
- Sorghum plants ***grow faster*** and ***out compete*** the weeds. (1)

(c) Greatly increase the intraspecific competition. (1) /

High chance of disease transmission. (1) /

Result in mineral depletion of soil. (1)

(any two, 1 mark for each)

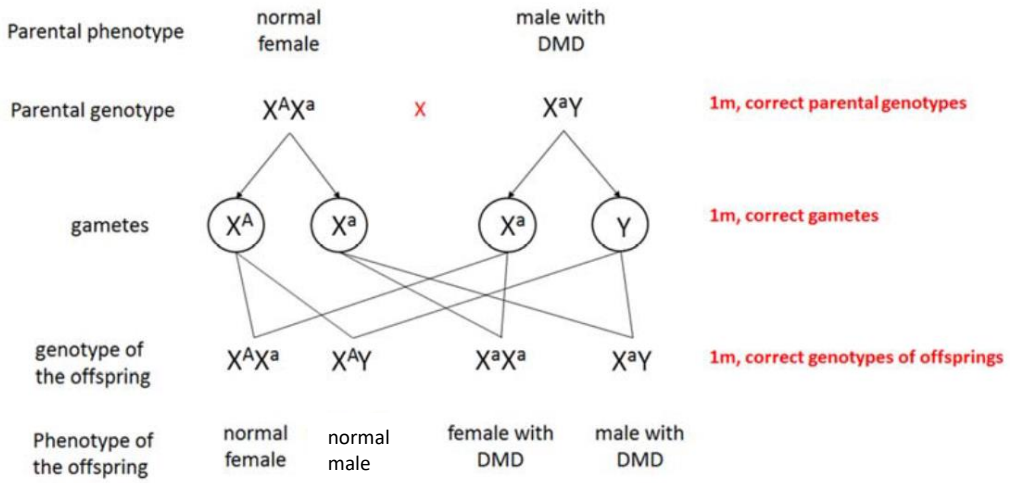
#7 (Total: 10 marks)

(a) **Define genetic symbol** (1)

Let X^A be the X chromosome with normal allele.

Let X^a be the X chromosome with mutated allele

Let Y be the Y chromosome



The probability of the second child to be a normal girl is *25%.* (1)

(b) Heterozygous. (1)

(c)

It is a X-linked recessive genetic disorder.

Male has ***one X-chromosome*** only. (1)

If the only X-chromosome inherited from his mother possesses the mutated gene, they will develop the Duchenne muscular dystrophy. (1)

For female, they have ***two X-chromosomes***. (1)

As the mutated gene is recessive, female individuals develop the Duchenne muscular dystrophy only when their genotype is ***homozygous recessive. /*** they ***possess two X-chromosomes with the mutated gene.*** *(* 1)

Therefore, this disorder primarily affect boy.

#8 (Total: 10 marks)

(a) (i)

- seedlings have ***little stored nutrients*** (1)
  to make sure the growth is highly related to the nitrogenous nutrient solution but not the mineral stored. (1) / increases the ***validity*** of the experiment. (1)

- seedlings have ***faster growth rate*** (1)
  easy to observe the growth response to N supply (1) / grow faster to obtain the result

(ii) nitrates (e.g. ammonium nitrate / potassium nitrate / sodium nitrate) (1)

(iii)

-Large amount of seedlings (100) were used. (1)

-This measure ***reduced the individual differences*** between seedlings, (1)

thus increase the reliability of the experiment.

(iv)

-area of leaf blade increases with the nitrogenous nutrient supply. (1)

-thickness decreases with the nitrogenous nutrient supply. (1)

(b) (i)

- when no CCC was added, increased N supplv increased lodging significantly (1)
- when CCC was added, increased N supply did not increase lodging significantly (1)

(ii) apply nitrogen fertilizer at the ***amount of 80kg per unit area*** and ***apply CCC.*** (1)

#9 (Total: 10 marks)

(a) Curve B (1)

- There is a delay in the insulin increase due to ***time*** is needed for the ***pancreas to*** *detect* the ***increase in blood glucose*** *level / to secrete* **insulin** to the blood. (1)

(b)

- blood glucose and insulin levels ***fluctuates within a narrow range.*** (1)
  due to the ***negative feedback mechanism.*** (1)

(c) (i)

For the curve of insulin: The level of insulin in lower than the healthy person before meal + remains in low level despite the increase in blood glucose level. (1)

For the curve of blood glucose: The blood glucose level is higher than that of a healthy person before meal + increase to a higher level than / drop slower that of a healthy person after meal. (1)

(ii)

The major substance is ***glucagon.*** (1)

After injection of glucagon, high level of glucagon in blood stimulates *liver cells* (1)

to promote the conversion ***of glycogen to glucose.*** (1)

glucose is ***released to bloodstream*** (1) which leads to an increase in blood glucose level. / stop further drops of the blood glucose level.

#10 (Total: 9 marks)

(a)

In the presence of urease, urea can be broken down into carbon dioxide and ammonia.

Ammonia **is *alkali* in** nature which can ***neutralize*** (1)

the ***hydrochloric acid*** present in the stomach. (1)

- This ***prevent the H.*** *pylori* ***being killed*** **by** the hydrochloric acid in the stomach. (1)

(b)

- When urease breaks down urea, some of the $^{13}CO_2$ produced ***diffused into the blood.***(1)
- The blood transports the $^{13}CO_2$ to the ***lungs*** (1)
- and the ***$^{13}CO_2$ diffuses from the blood into the air sacs.*** (1)

(c)

- ***Person X*** is infected with *H. pylori.* (1)
- There is a ***larger change in the concentration of $^{13}CO_2$*** in person X's breath. (1)
- Since ***human body do not produce urease,*** the increase in the concentration of $^{13}CO_2$ in a person's breath will only be due to urease produced from *H. pylori.* (1)

#11 (Total: 11 marks)

How can plant cells ensure that these two processes are not the direct reversal of each other. **Max 2M**

A1: photosynthesis and respiration occur in ***chloroplast and mitochondria*** respectively. (1)

A2: chloroplast and mitochondria are ***membrane bounded organelles*** (1)

which make sure the substrates and products of each process ***will not be mixed together.*** (1)

A3: ***different enzymes*** are involved in the two processes. (1)

Concept of growth: **Max 2M**

BI: Plant grow by ***increasing in cell size*** *(1)* ***or cell number*** *(1)*

B2: Plants increase cell size by ***building up cell contents.*** (1) (e.g. increasing number of organelles.) B3: Plants increase cell number by ***cell division.*** (1)

It is favorable because: **Max 4M**

The carbohydrates produced by the photosynthesis would not be readily converted back to the raw material. for respiration.

D1: Some intermediates of photosynthesis are turned into amino acid which will form ***proteins.*** (1) Proteins build ***enzymes for metabolism / structure proteins.*** (1) (any reasonable example)

D2: Some intermediates of photosynthesis are turned into glycerol and fatty acids which will form ***lipids*** (1). Lipids build up ***cell membrane.*** (1) (any reasonable example)

D3: Some carbohydrates become ***cellulose*** *(1)* ***which builds up cell wall.*** (1)

All these organic molecules are essential for cell division or increases in cell size. If the product formed are converted back to the raw material, this will lead to ***reduced yield or wastage*** (1)

Mark award for communication:

Mark	Clarity of expression anil relevance to the question	Logical and systematic presentation
3	• Answers are easy to understand. They are fluent showing good command of language. • There is no or little irrelevant material.	• Answers are well structured showing coherence of thought and organization of ideas.
2	• Language used is understandable but there is some inappropriate use of words • A little irrelevant material is included, but does not mar the overall answer.	• Answers are organized but there is some repetition of ideas.
1	• Markers have to spend some time and effort on understanding the answer(s). • Irrelevant material obscures some minor ideas.	• Answers are a bit disorganized, but paragraphing is evident. Repetition is noticeable.
0	• Language used is incomprehensible. • Irrelevant material buries the major ideas required by the question.	• Ideas are not coherent and systemic. Candidates show no attempt to organize thoughts.

Paper 2:

Question 1(a)

(i) Peter's rate of heartbeat=75beats per minute,
Paul's rate: 60 beats per minute (1)

(ii) Stroke Volume of:
Peter: 6000 mL per minute / 75 beat per minute = 80 mL per beat (1)
Paul: 6000 mL per minute / 60 beat per minute = 100 mL per beat (1)

(iii) Paul. (1)
because the heart of Paul can pump out more blood in each beat (1)
This implies his heart is stronger/ more muscular (1)
which is a result of regular physical exercise

(iv) During exercise, the cardiovascular centre in the medulla oblongata (1)
stimulates the sympathetic nerve innervating the heart to become more active. (1)
This stimulates the activity of the SA node, (1)
causing both the heart rate and the stroke volume to increase. (1)

(v) The concentration gradient of oxygen between the water film lining the air sacs and the blood becomes steeper. / Oxygen diffuses into the blood at a higher rate. (1)
This allows the concentration of oxygen in the blood maintained high and steady even though more has diffused to the muscle cells.
The extra oxygen allowed respiration to go on at a higher rate to release more energy for muscle contraction. (1)

Question 1(b)

(i) To maintain a constant body temperature in a hot dry climate, more sweat is produced (1)
As a result, water loss through skin is increased leading to a reduced water potential. (1)
To maintain a constant water potential of the body fluids, water loss in urine is reduced. (1)

(ii) increased water loss (1)
because of increased rate of evaporation of water in expired air in a hot and dry climate (1)

(iii) antidiuretic hormone / ADH (1)
it increases the permeability of the collecting duct to water (1)
so more water will be reabsorbed into blood, a smaller volume of urine is produced (1)

Question 2(a)

(i) Beetle banks reduce crop yield as no crops can be grown in them. /
Beetle banks may harbour some pest species. /
Beetle banks allow weeds / diseases to spread through the crops. /
Plants growing in the beetle banks compete with the crops for resources, e.g. water and nutrients. /
Beetle banks restrict the use of machinery.
Any three 1m x3

(ii) Any two methods with explanation:

Use biological control agents. (1)
Introduce the species that feeds on / infects the pests. (1)

Use insecticides / pesticides. (1)
Repeatedly spray the insecticides / pesticides which kill the pests by poisoning them. (1)

Grow genetically modified crops. (1)
Some genes are introduced into the crops for pest resistance. For example, GMO crops can produce toxin to kill the pests that feed on them. (1)

(iii) They can select sampling points at random positions / regularly. (1)
They can use pitfall traps / nets to trap the beetles. (1)
They can use key to identify the species of the beetles. (1)
Repeated sampling is required. (or other reasonable answers) (1)

Question 2(b)

(i) Bacteria content in lower stream is higher than upper stream. Since, Bacteria grow rapidly as the sewage contains organic matters. / Sewage contains bacteria. (1)

(ii) Oxygen in the water is used up by the bacteria for growth and decomposition of organic matters. (1)
The fish die of suffocation. (1)
Toxic substances may also produced by the bacteria during the decomposition of organic matters, which kill the fish. (1)

(iii) Decomposition of organic matters produces nutrients (phosphates, ammonium compounds and nitrates) for the growth of algae. (1)
The dense surface growth of algae prevents sunlight from penetrating deep into the water. Aquatic plants cannot get enough sunlight for photosynthesis and they may die. (1)
The algae use up the oxygen in the water at night. The aquatic organisms may die of suffocation. (1)
When the algae die, they are decomposed by bacteria which further consume the oxygen in water. The aquatic organisms may die of suffocation. (1)

(iv) Set up of a sewage treatment works to reduce the harmful substances in sewage before it is discharged into the river. (or other reasonable answers) (1)

Question 3(a)

(i) A known volume of culture is transferred to a known volume of sterile culture medium. (1)
This process is repeated to give series of cultures of progressively higher dilution. (1)

(ii) The number of cells in the original culture is too great to count. (1)

(iii) Rate of growth = $(420 - 200) \times 10^3$ cm^{-3} / 4 hrs (1)
= 55×10^3 cm^{-3} hr^{-1} (1)

(iv) During the lag phase (0 to 2 hours), the number of bacterial cells increases very slowly as the cells are in a period of adaptation / enzyme production for glucose metabolism. (1)
During the exponential phase (2 to 2.5 hours), the cells divide rapidly / the population increases exponentially as the supply of glucose is adequate. (1)
During the second lag phase (2.5 to 5 hours), the number of bacterial cells levels

off as glucose runs out. (1)

The bacteria produce enzymes (lactase) to break down lactose to glucose so as to support growth during the second exponential phase (5 to 7 hours). (1)

During the stationary phase (7 to 10 hours), the growth rate slows down / population levels off as nutrients begin to run out and metabolic waste accumulates. (1)

Question 3(b)

(i) (1) Antibiotics may have been used to treat cattle so their milk may contain antibiotics. (1)

The antibiotics may inhibit the growth of/kill the bacteria in the starter culture. (1)

(2) The pathogenic bacteria may compete with the bacteria in the starter culture. They will contaminate the yogurt made and cause diseases in humans upon consumption. (1)

(ii) High temperatures would denature enzymes and kill the bacteria, (1)

Cooling the milk provides an optimum temperature for the maximum bacterial growth / for the enzymes to work best. (1)

(iii) The bacteria may carry out anaerobic respiration, (1)

which converts lactose in milk into lactic acid. (1)

(iv) The incubation time would be shortened (1)

as the higher temperature increases the growth rate/ metabolic rate of the bacteria. (1)

Question 4 (a)

(i) (1) DNA probes were used to detect DNA fragments containing specific sequences of the gene of interest. (1)

(2) with sequence complimentary to the gene of interest to make these DNA fragments visible on the photographic film. (1)

(3) Only one of the two X chromosomes in each somatic cell of Jack's mother contains the recessive allele. (1)

Its effect is masked by the dominant normal allele on the other X chromosome and thus she does not suffer from DMD. (1)

(ii)

(1) Cut the DNA fragment containing the normal allele for dystrophin using a restriction enzyme. (1)

Cut the vector using the same restriction enzyme. (1)

Join the DNA fragment and the vector together using a DNA ligase. (1)

(2) The viruses acted as vectors to carry the recombinant DNA into the muscle cells of mice with DMD. (1)

(3) The normal allele was introduced into the somatic cells of the mice (not the gamete-producing cells) (1)
and thus there is no genetic modification of the gametes. (1)

Question 4(b)

(i) The calf carries the same genetic information as the cow with a high yield of milk. (1)

(ii) An ovum has a larger amount of stored nutrients for the development of the fused cell. (1)

(iii) Isolate individual cells from the embryo and grow each of them into an embryo. (1)

Transfer each embryo into a surrogate mother for development into an individual calf.

(iv) Only half of the calf would be cows that produce milk. Bulls do not produce milk. (1)
Not all offspring carries the allele for high milk yield because of random fertilization and independent assortment. / Only half of the genetic information carried in the calf produced is the same as the cow with a high yield of milk. (1)
If the sperm of the bull does not contain an allele for a high yield of milk, the calf may not have a high yield of milk. Finding a bull containing an allele for a high yield of milk is difficult because bulls do not produce milk. (1)

(v) A cloned cow is genetically identical to the cow which donates / provides the body cell. (1)
A genetically modified animal is genetically different from the **organism that** provides the gene of interest, except that they have the gene of interest in common. (1)

(vi) The success rate is low. /
Calves produced may have birth defects or other health problems so that the process is not efficient. / Money should be better spent on other areas. /
Using this method to produce calves may decrease the genetic variations of the population. (any 2 or other reasonable answers)