St. Stephen's Girls' College
F.6 Biology Final Examination 2015-2016
Suggested Solutions

Paper 1:
Section A

1	2	3	4	5	6	7	8	9	10
D	C	A	D	A	B	A	B	B	A

11	12	13	14	15	16	17	18	19	20
C	B	C	B	A	A	B	A	D	C

21	22	23	24	25	26	27	28	29	30
C	C	C	B	A	D	B	D	C	D

31	32	33	34	35	36				
D	B	B	D	C	D				

Section B

(1) C (1) B (1) A (1)

(2)(a)(i) 4 (1)
(ii) Change in sequence of amino acids in enzyme; (1)
Alters conformation of active site of enzyme; (1)
Substrate cannot bind to active site of enzyme/ no enzyme-substrate complexes form; (1)

(b) Lack of skin pigment / pale skin / albino; (1) Lack of coordination / muscles action affected; (1)

(c)(i)two parents without PKU (6 and 7) produce a child with PKU (10) (1)
(ii) This is because during the production of gametes by meiosis, independent assortment of homologous chromosomes, segregation of alleles and crossing-over take place. (1)
The gametes produced have genetic combinations different from one another. (1)
Together with random fertilisation, there are genetic variations among the siblings (i.e. individual 5 and 6). (1)

(3)(a) Different subsets of genes are expressed in different cells. / Not all the genes in a cell will be expressed. (1)
Depending on the genes expressed, different gene products will be obtained after transcription and translation in different cells. (1)
These gene products can be structural proteins (e.g. proteins making up muscles, proteins making up a gland etc.) that make up different body cells. (1)
(b) Through placenta (1)
nutrients diffuse from the maternal blood into the foetal blood (1)
and carried by the umbilical cord to the foetus (1)
(c) Structure Y - intra-uterine device (1) It prevents implantation of the embryo (1)

(4)(a) (T): Title: A graph showing the uptake of potassium ions in different initial concentration of potassium chloride solution at 4ºC and 18ºC. (1)
(A):Correct axis, axes line drawn, appropriate scaling, key/ labels for each temperature curve; concentration on *X* axis, labelled with units of measurement; *y* axis labelled with units of measurement; (1.5)
(P): points accurately plotted and joined; (2)*:* concentration on *X* axis, labelled with units of measurement; *y* axis labelled with units of measurement;
(b) Uptake occurs against a concentration gradient; (1)
(c) Increased temperature increases the rate of respiration/enzyme activity;
so greater availability of ATP for active processes and thus faster uptake; (1)
(d) Rubidium ions 'compete' for the site of attachment on the carrier molecule; (1) so less carrier protein is available for uptake of potassium

(5)(a) (i) To ensure that the volunteers were free from the dengue virus before the experiment. / It is difficult to ensure that volunteers in a dengue affected area are free from dengue virus before the experiment. (1)
(ii) The phagocytes will try to engulf/ eliminate the viruses by phagocytosis. (2)
(iii) During the first infection, memory cells register the antigens on the particular subtype of dengue virus. (1)
Upon second infection of the same subtype of dengue virus, the memory cells recognise the same antigen and trigger the immune system to produce a large number of antibodies / killer T cells within a short period of time. (1)
The invading viruses are eliminated before they can reproduce to a large enough number inside the body to cause any illness. (1)

(b)(i) The incidence of dengue fever rises with increasing global temperatures. (1)
(2) A higher air temperature favours the growth of the vector mosquito population. (1)
With global warming, more areas are expected to become warmer and become suitable for mosquitoes to survive. / With global warming, mosquitoes will be found in places where they could not be found before. (1)
Dengue fever will cover a wider area in the world. (1)

(6)(a) It does not involve the cerebrum. (1)
(b) Y (1) Nerve impulses are sent to the biceps/ flexor muscles to trigger muscle contraction. (1)
Contraction of the biceps and relaxation of the triceps allow bending of the forearm at the elbow joint to move upwards. (1)
(c) There are synapses between the neurones in the nervous pathway. (1)
It takes time for neurotransmitter to diffuse across the synaptic clefts. (1)

(7)(a) Urea; kidney
(b) glucose would continue to be taken up by cells / liver / muscle (results in low blood glucose)
glucose is continually converted into glycogen / would store too much glucose as glycogen **;**
blood glucose concentration would fall too low / below normal level **;** (1)
as less available glucose in blood**;** mitochondria eventually cannot release enough energy / generate enough ATP/ coma / death ; (1)
(c) crista(e) / inner mitochondrial membrane **;** (1)
(d) production of bile (1) to emulsify lipid (1)

(8) (a) chlorophyll (1)
(b) Specimen A: Kingdom Plantae (1) Specimen B: Kingdom Protista (1)
Specimen C: Kingdom Fungi (1)
(c) In sunlight, specimen A carries out photosynthesis at a higher rate than respiration. (1)
Rate of oxygen uptake in photosynthesis is lower than rate of oxygen release in respiration, (1) thus there is a net release of oxygen.
In darkness, only respiration takes place in specimen A. (1)
No carbon dioxide uptake by photosynthesis but CO_2 is released up respiration. (1) Thus a net release of carbon dioxide
(d) Specimen C/ fungi break down the organic matter in decaying wood to simple inorganic matter (1)
which is then absorbed and used by specimen A to make protein for growth (1)

(9)(a) Peter did not put the test tube containing enzyme into a water bath at the temperature being investigated before mixing the enzyme and the substrate solution. (1)
(b) Enzyme activity is affected by pH. (1)
A pH buffer should be added to the reaction mixture. (1)
(c) Concentration of the milk suspension (1)
Concentration of the protease solution (1)
(d) Carry out the experiment at smaller temperature intervals between 40 °C and 80 °C. (1)

(10)(a) Prevent damage to mitochondria caused by osmosis; (1)
(b) Glucose is broken down during glycolysis in cytoplasm/not in mitochondria; (1) Glucose cannot cross mitochondrial membrane/does not enter mitochondria; (1)
(c) Terminal/final acceptor (in electron transport chain) / used to make water; (1)

(11)Adaptation for obtaining carbon dioxide, the raw material for carbon fixation

Spongy mesophyll consists of loosely packed cells with many air spaces to allow carbon dioxide to diffuse freely. (1)

Numerous stomata allow gases to diffuse into the leaf. (1)

Adaptation for obtaining water, the raw material for photolysis

Upper and lower epidermis are covered by waxy cuticle to reduce water loss. (1)

Guard cells control water loss through stomata. (1)

Midrib and network of veins transport water from the root to the leaf for photosynthesis. (1)

significance of photolysis to carbon fixation

In photolysis, the hydrogen released from water is taken up by a NADP to form NADPH, (1) which will act as a reducing agent in carbon fixation to reduce 3C compound/CO2 to 3C sugar. (1)

importance of photolysis and carbon fixation for the continued life of humans:

3C sugar produced from carbon fixation is used to make carbohydrate which is an important organic food source for human; (1)

Oxygen released from photolysis (1) is used for aerobic respiration to oxidize the organic food (1) to release ATP to drive various life processes such as active transport. (1)

Mark award for communication:

Mark	Clarity of expression and 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 organisation of ideas.
2	• Language used is understandable but there is some inappropriate use of words. • A little relevant material is included, but does not mar the overall answer.	• Answers are organised, 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 disorganised, 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 systematic. Candidates show no attempt to organise thoughts.

Paper 2:

Question 1(a)

(i) Peter's rate of heartbeat=75beats per minute,

Paul's rate: 60 beats per minute

(ii) Stroke Volume of:

Peter: 6000 mL per minute / 75 beat per minute = 80 mL per beat

Paul: 6000 mL per minute / 60 beat per minute = 100 mL per beat

(iii) Paul. ,

because the heart of Paul can pump out more blood in each beat

This implies his heart is stronger/ more muscular

which is a result of regular physical exercise

(v) During exercise, the cardiovascular centre in the medulla oblongata

stimulates the sympathetic nerve innervating the heart to become more active.

This stimulates the activity of the SA node,

causing both the heart rate and the stroke volume to increase.

(iv) 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.

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.

Question 1(b)

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

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

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

Question 2 (a)

i (1) DNA probes were used to detect DNA fragments containing specific sequences of the gene of interest.
(2) with sequence complimentary to the gene of interest
(3) to make these DNA fragments visible on the photographic film.
(4) Only one of the two X chromosomes in each somatic cell of Jack's mother contains the recessive allele.
Its effect is masked by the dominant normal allele on the other X chromosome and thus she does not suffer from DMD.

ii (1) Cut the DNA fragment containing the normal allele for dystrophin using a restriction enzyme
Cut the vector using the same restriction enzyme.
Join the DNA fragment and the vector together using a DNA ligase.
(2) The viruses acted as vectors to carry the recombinant DNA into the muscle cells of mice with DMD.
(3) The normal allele was introduced into the somatic cells of the mice (not the gamete-producing cells) and thus there is no genetic modification of the gametes.

Question 2b

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

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

iii. Isolate individual cells from the embryo and grow each of them into an embryo.
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.
Not all offspring carries the allele for hilk milk yield because of random fertilisation 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.
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.

v. A cloned cow is genetically identical to the cow which donates / provides the body cell.
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.

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)