Christian Alliance S. C. Chan Memorial College
Mock exam 2020-21
Biology Paper 2 Suggested Answer

1.(a)(i) *right atrium (1)

(ii) Both the ventilation rate and cardiac output increased (1)

(iii)
- more sympathetic nerve impulses will be sent to the SA node (1)
- for faster and stronger contraction of heart (1)
- that increases the heart rate and stroke volume (1)

Note: osmoreceptor is in hypothalamus themoregulatorycentre is in hypothalamus, respiratory centre is in medulla, cardiovascular centre is in medulla, FSH & LH are secreted by pituitary gland

(iv) Heart rate = cardiac output / stroke volume (1)
= 16/0.144 = 111.1 beats/min (1)

(v) Training increases the size of cardiac muscle (1)
Contraction of the heart can generate a greater force to pump the blood (1)

1.(b)(i) (1) The thermoreceptors in the hypothalamus detects that the blood temperature is lower than the elevated required set point (1)
the heat gain centre in the hypothalamus is stimulated to send out nerve impulses (1)
to skeletal muscles to cause the uncoordinated contraction (1)

Markers' comment:
✗ a drop in body temperature

(2) • the respiration rate of muscle increases (1)
• to produce more heat (1) to increase body temperature

(ii) alcohol evaporates quickly (1)
thus carries heat away from the skin to lower the body temperature (1)

(iii) (1) The temperature difference (gradient) between the skin and 15℃ water is greater (1)/
15℃ water absorb heat from the body / blood (more) by conduction
15℃ water cools the body / blood (more)

(2) Bathing in very cold water causes vasoconstriction in skin surface / blood vessels or arterioles in the skin to constrict [✗ constriction of capillaries] (1)
Less blood is carrying heat to the skin surface (1)
Heat loss is reduced by conduction, convection and radiation (1)
Bathing in very cold water cause shivering/ muscle contract that cause more respiration / generates heat (1)

Any three

Markers' comment:
✗ answer about 35℃ water

4.(a)(i) (1) The restriction site is not affected / Cut at same base sequence as same enzyme used (1)
Fragments are same length / size (1)

Markers' comment
Refer to the example below. Different recognition site of different restriction will bring different effect.
- If the restriction enzyme recognises the DNA sequence **ATGGT**, the resulting fragments will be of different sizes.
- If the restriction enzyme recognises the DNA sequence **CTGAG**, the resulting fragments will be of different sizes.

	1	24	
normal allele [A]:	ATG GTG CAC CTG ACT CCT GAG GAG ……		(non-template strand)
	1	24	
mutated allele [S]:	ATG GTG CAC CTG ACT CCT GTG GAG ……		(non-template strand)

(2) Single base occurs many times (1) single base can be found at many other locations in the genome. A DNA probe containing only one base will bind to other locations in the genome.
Sequence of 20 unlikely to occur elsewhere (1) / sequence of 20 will attach on a specific site containing the β-thalassaemia allele accurately

Markers' comment:
× if the probe is only one base long, it can randomly attach to a base
✓ probe will only attach to the complementary base

× if the probe is only one base long, it is too short and is difficult to observe
✓even if the probe is only one base long, it won't be difficult to observe, since each band is made up of a large number of DNA fragments.

(ii) Both the mother and father have one normal allele and one β-thalassaemia, they are heterozygous (1)

(iii) (1) as DNA polymerase and substrate are added at the very beginning, DNA polymerase used in PCR cycle should be able to withstand high temperature (~90℃) during the breaking of DNA molecules to single strand (1)

Marker's comment

× polymerase has to withstand the high temperature during the extension stage

✓ polymerase has to withstand the high temperature during the DNA denaturation stage, since this stage involve the highest temperature (95 ° C). Also, the moderately high temperature of extension stage (~70 ° C) is not the temperature that polymerase has to withstand, it is actually the optimum temperature of polymerase.

(iv) (2) More probe binding/ more disease allele means more light; (1)
DNA (with disease allele) doubles each (PCR) cycle; (1)
So light (approximately) doubles/curve steepens more and more (each cycle) /curve goes up exponentially/ increases even faster; (1)

Markers' comment:

× compare X & Y

× there are 2^n copies of DNA after n cycle of PCR

✓ there are 2^n copies of DNA after n cycle of PCR, if it start from starting from a single DNA segment

(3) Individual X has two copies of the diseased allele while individual Y has only one copy (1)

Therefore, in the reaction mixture containing the DNA sample of individual X, the amount of DNA probes binding to the target sequence is doubled, and so the intensity of green light detected is doubled (1)

4. (b) (i) If the gene is inserted into a cell within a whole plant, only this cell will produce toxin (1)

But if the gene is inserted into isolated cells, the cells can be cloned to produce new plants and all cells in new plants can produce toxins (1)

Markers' comment:

× to ensure that the target gene is inserted into correct position of genome

- No matter inserted into an isolated cell or in a cell within a whole plant, the Bt gene is randomly inserted into plant genome

(ii) Any **two** of the following:

- Bt toxin is toxic to leaf-eating caterpillars ***specifically*** (1) / has ***no toxic effect*** on vertebrates including humans, whereas insecticides may be toxic to vertebrates / humans
- Bt toxin has no residual effect, while insecticides have residual effect (1)
- Bt toxin does ***not accumulate along the food chain***, whereas insecticides may accumulate to a toxic level and kill top consumers in the food chain (1)
- Bt plants are ***protected throughout their life*** without the re-introduction of the Bt gene, while insecticides have to be regularly applied in order to protect the plants (1)
- the ***cost*** of growing Bt plants is ***lower*** because of reduced insecticide application (1)

Markers' comment:

-students don't understand "residual effect" and "toxin accumulate along the food chain"

- residual effect: Residual insecticides remain effective where they are applied for some length of time.
- accumulate along food chain: e.g.
  - The insecticide in crop is passed to a cow. As the cow feeds on many crop, and the insecticide can neither be excreted nor broken down by the cow. The insecticide would be accumulated to a high level in the cow.

- For your information

Residual insecticides remain active in amounts sufficient to kill pests for at least a week, several weeks, or even years after application. These residual insecticides act by keeping a toxic insecticide residue on a surface that the insect will contact.

Conversely, non-residual insecticides (=Contact insecticides) breakdown rapidly after application. Residual insecticides are useful when insects are a continual problem or when you need to make an application in advance of an expected problem. Contact insecticides control the pest on contact. Contact insecticides are applied directly to the insect which is killed after is comes in contact with the insecticide. Very little toxic residue remains on a surface after spraying a contact insecticide. Most aerosols and foggers are contact insecticides.

×answers on disadvantages of insecticides only

× Bt toxin will not speed up development of resistant insect
∵ Bt toxin will select the resistant insect

×No more toxin will be left in crop
✓Toxin can be found in crops, and this allows permanent protection to crops. Just that the toxin will not accumulate along the food chain, as it can be broken down by the organisms.

(iii)Genetic variations exist among insects in their resistance against the Bt toxin (1)
The increase exposure to Bt toxin kills the non-resistance form while the resistance form survive and reproduce. (1)
Thus the <u>number</u> and hence the <u>proportion</u> of resistant form of insects increases

Markers' comment:
× expression like "insects become resistant after the appearance of Bt plant"
✓ most insects are killed and only the more resistant insects survive→ speed up development of resistant insect

(iv) to encourage the mating of Bt-resistant pests with non-resistant pests, instead of mating with Bt-resistant pests (1)
This is to slow down the development of Bt resistance in the pest population (1)

Markers' comment:
× to increase competition of food between Bt resistant pest and non-resistance pest, so that the number of resistant pest is reduced
- Since we are not simply introduce more non-resistant pests to the original crop field, the competition does not increase

× non-resistant pest is selected to survive and reproduce in the non-Bt crop field
✓ non-Bt crop field does not impose any selective pressure on the resistance of pest. Both resistant pest and non-resistant pest have same survival chance in the non-Bt crop field.

End of paper