ThePiqueLab
learning centre

The Pique Lab Learning Centre
2019 P6 CCI™ Science Programme
Answer Booklet

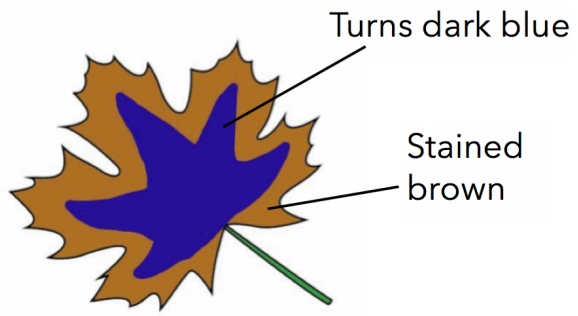
CONTENT PAGE

2019 CCI™ SCIENCE PROGRAMME

TOPIC: CELLS

Technique: Use the function of cell part to expand your answer.

Usage of the technique:
BOLD – Cell Part
UNDERLINE – Function of the Cell Part

Qn	Answer
Q1 (a)	**Choose:** Cell A. **Use Data:** It has **chloroplasts**, **Explain Data:** which contain chlorophyll to trap sunlight for photosynthesis to make food. Chlorophyll is the green pigment that gives the leaf its green colour.
Q1 (b)	
Q2 (a)	**Choose:** No. **Use Data:** Cell X has a **cell wall**, **Explain Data:** to give the cell a regular shape, which is found only in plant cells. Hence, Cell X cannot be a cheek cell, which is an animal cell.
Q2 (b)	**Choose:** Cell X. **Use data:** It has a cell wall but does not have chloroplasts. **Explain data:** The root cell of the plant is found underground and is not exposed to sunlight. Thus, it does not carry out photosynthesis and would not require **chloroplasts**, which contain chlorophyll to trap sunlight for photosynthesis to make food, which is similar to Cell X.
Q2 (c)	Cell Y has a **cell wall** to give the cell a regular shape and prevent it from bursting when it is placed in the sugar solution, unlike Cell Z.

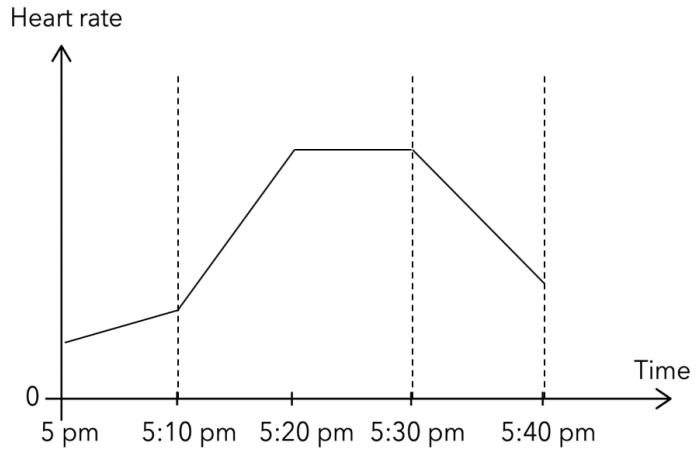
Q3 (a)	**Choose:** Part B. **Use data:** Part B has a **nucleus**, **Explain data:** which contains genetic information and controls all the activities in the cell such as cell division for growth of the organism, unlike part A, which would eventually die.
Q3 (b)	Cell Y's cell membrane controlled the movement of substances in and out of the cell. It allowed water to enter the cell but not Substance Q.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: BODY SYSTEMS

Techniques:

1) 3 ways on how the 5 systems work together
2) Apply template answers - Heart rate/breathing rate/pulse rate
3) Increased exposed surface area (Chewing/Air sacs/Villi)
4) Graph for oxygen/ carbon dioxide in the circulatory system
5) Inhaled Air VS Exhaled Air

Qn	Answer
Q1 (a)	
Q1 (b)	As Faith was running, her body needed more energy. Thus, her heart rate increased to pump blood containing more oxygen and digested food through the blood vessels to all parts of the body, where they are used for respiration to release more energy and carbon dioxide at a faster rate.
Q1 (c)	**Choose:** Sample B. **Use Data:** It had less oxygen and more carbon dioxide than Sample A. **Explain Data:** As Faith was running, her body needed more energy. Thus, more oxygen was used by her body to carry out respiration at a faster rate to release more energy and carbon dioxide.

Q2 (a)	Mouth, stomach and small intestine.
Q2 (b)	There are numerous folds found on the inner walls of the small intestine. They increase the exposed surface area of the walls of the small intestine in contact with the digested food, for faster absorption of digested food into the bloodstream.
Q2 (c)	The digestive juices released by the digestive system were not able to break down some of the undigested food into simpler substances, causing them to remain as undigested food.
Q3	During extreme coldness, the blood vessel near the skin become very thin, causing very little blood to be transported to the surface of the skin. Thus, the skin cells receive insufficient amount of oxygen and digested food from the blood for respiration to release energy and die.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: HEAT ENERGY

Techniques:

1) HPC Structure of writing

Qn	Answer
Q1 (a)	The puddle (H) gained heat from the warmer surrounding air to (P) evaporate (C) and form water vapour.
Q1 (b)	Greater wind speed and the larger exposed surface area of the water puddle.
Q1 (c)	The presence of wind from the breeze caused the water in the sweat on Tim's body to (H) gain heat faster from his body to (P) evaporate faster, causing his body to lose heat faster and cool faster.
Q2 (a)	The warmer water vapour from the surrounding air came into contact with the cooler outer surface of the cups, (H) lost heat to them and (P) condensed (C) to form water droplets.
Q2 (b)	Cup A is made of a better conductor of heat than cup B. Thus, cup A lost heat faster to the cold water in it and decreased in temperature faster (colder). **Recall the temperature difference:** The warmer water vapour from the surrounding air (H) lost heat faster to the cooler outer surface of Cup A and (P) condensed faster (C) to form more water droplets.
Q2 (c)	**Choose:** Cup A. **Use Data:** There were more water droplets on the outer surface of Cup A than Cup B. **Explain Data:** This shows that the material used to make Cup A is a better conductor of heat, allowing heat from the hot coffee to be lost/conducted to the cooler surrounding air at a faster rate and the coffee to cool faster.

Q3 (a)	Yes. The metal lid is a better conductor of heat than the glass bottle. Thus, the metal lid would (H) gain heat faster from the hot water and (P) expand faster than the glass bottle, allowing the metal lid to loosen and be removed more easily.
Q3 (b)	When the jam jar was placed in iced water, the outer surface of the jar lost heat faster to the iced water than the inner surface of the jar, causing the outer surface of the jar to contract faster than the inner surface of the jar. The difference in the rate of contraction between the outer and inner surface of the jar caused it to crack.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: WATER CYCLE

Qn	Answer
Q1 (a)	**Clouds:** Water droplets **Water from water bodies:** Hot water **Cooler surrounding air:** Plastic sheet
Q1 (b)	**Plastic sheet:** The plastic sheet allows the warmer water vapour to come into contact with the cooler inner surface of the plastic sheet, (H) lose heat to it and (P) condense (C) to form tiny water droplets. **Ice cubes:** The plastic sheet loses heat to the ice cubes and becomes cooler. This allows the warmer water vapour that comes into contact with the cooler plastic sheet to (H) lose heat faster to it and (P)condense faster (C) to form more water droplets.
Q1 (c)	Water droplets would form on the outer surface of the beaker instead of the inner surface of the plastic sheet. When water at 5°C was used, the beaker would lose heat to the cooler water and decrease in temperature. The warmer water vapour from the surrounding air would then come into contact with the cooler outer surface of the beaker, (H) lose heat to it and (P) condense (C) to form water droplets.
Q2 (a)	There were holes in terrarium B. Thus, the water from the soil that evaporated was able to escape through the holes into the surrounding air. This caused the soil to become dry and the roots were no longer able to absorb water for photosynthesis to make food and died.
Q2 (b)	The water from the moist soil gains heat from the sun to evaporate and form water vapour. Water is also lost through the stomata as water vapour in the process of transpiration. The warmer water vapour then rises and comes into contact with the cooler inner surface of terrarium A, loses heat to it and condenses to form water droplets. The water droplets fall back to the soil and the cycle repeats itself.

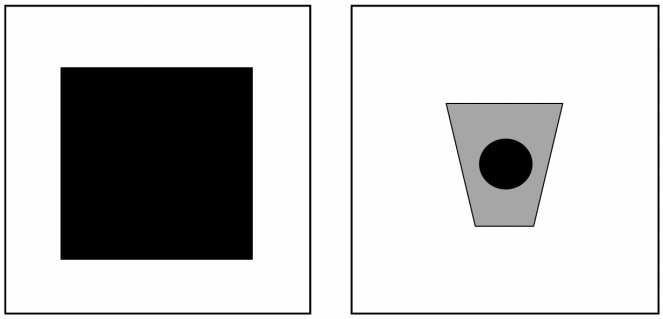
Q2 (c)	**Benefit 1:** The snail carries out respiration, releasing carbon dioxide for the plants to take in through the stomata for photosynthesis to make food. **Benefit 2:** The waste passed out from the snail decomposes and returns to the soil as nutrients, acting as fertiliser for the plant.
Q3 (a)	The water in the sea water (H) gains heat from the Bunsen burner to (P) boil and (C) form steam. The steam rises and passes through the delivery tube, where it (H) loses heat to the cooler inner surface of the delivery tube and (P) condenses (C) to form tiny water droplets. The water droplets drip into the beaker to be collected as pure water.
Q3 (b)	The cold cloth and delivery tube gained heat from the steam to become warmer. This causes the warmer steam to (H) lose heat slower to the cooler inner surface of the delivery tube and (P) condense (C) to form less water droplets, causing less water to be collected in the beaker from the 10th minute onwards.
Q3 (c)	Salt will be left behind in the conical flask as it is unable to evaporate.

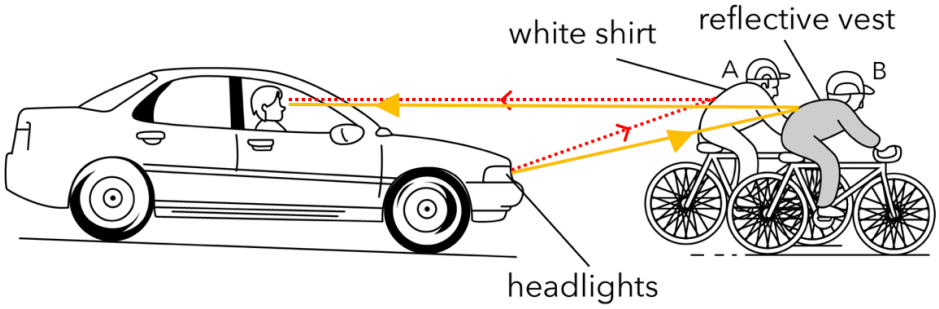
2019 CCI™ SCIENCE PROGRAMME

TOPIC: LIGHT

Techniques:

- Apply light template answer
- Apply shadow template answer

Qn	Answer
Q1 (a)	1
Q1 (b)	Light travels in a straight line.
Q1 (ci)	The shadow of the puppet is formed when light from the light source, which travels in a straight line, is blocked by the puppets, which are opaque.
Q1 (cii)	If a rejected object is used, the shadow formed on the screen facing the audience may be too faint for them to see the shadow clearly.
Q1 (d)	Bring the puppets closer to the screen.
Q1 (e)	When the puppets are closer to the screen, the size of the shadows formed on it would decrease. The audience may not be able to see the movement of the smaller shadows easily.
Q2 (a)	 **Box 1** **Box 2**
Q2 (b)	Material P is opaque. Thus, light from the torch could not pass through material P and <u>Use Shadow Template</u> no light from the torch, which travels in a straight line, would be blocked by the mirror, preventing a shadow from being cast on the screen.

Q3 (a)	
Q3 (b)	**Choose:** Cyclist B. **Use Data:** Cyclist B is wearing a reflective vest, unlike Cyclist A. **Explain Data:** Thus, more light from the headlights of the car would be reflected off Cyclist B into the driver's eyes, allowing the driver to see Cyclist B more easily.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: MAGNETISM

Techniques:

1) 3 Golden Rules
2) Unlike poles → attract
3) Like poles → repel
4) Attract object with a GREATER magnetic force.

Qn	Answer
Q1 (a)	Place the magnet beside the bottom right of the plastic tank. (1) The magnet's magnetism will act at a distance and (2) pass through the plastic tank and the oil, which are non-magnetic objects, to (3) attract the iron disc, which is made of magnetic material. Move the magnet towards the small opening with the iron disc still attracted to it.
Q1 (b)	No, aluminium is a non-magnetic material and would not be able to be attracted by the magnet.
Q2 (a)	**Choose:** The steel rod would move towards iron rod Y. **Use data:** Circuit B has more batteries, **Explain data:** causing iron rod Y to become an electromagnet with a greater magnetic strength and attract the steel rod with a greater magnetic force than iron rod X.
Q2 (b)	When the switch is closed, there would be a closed circuit, allowing electric current to pass through the circuit. This causes the iron core to become an electromagnet and (1) act at a distance (2) to attract the steel block, which is made of a magnetic material. This exerts a pull force on the steel block, causing it to move downwards, lifting the barrier arm up.

Q3 (a)	The moving belt carries the metals towards the roller with a magnet in it. The magnet attracts only the magnetic metals, causing them to remain on the moving belt while the non-magnetic metals fall off the belt and are collected in Container B. As the magnetic metals move towards Container A, (*add on) ***P5 Answer:** they move further away from the magnet, causing the magnetic metals to fall into Container A to be collected. ***P6 Answer:** the magnetic force of attraction acting on the magnetic metals was no longer able to overcome the gravitational force acting on the magnetic metals, causing them to drop.
Q3 (b)	**P5 Answer: (Use magnets to explain)** Some of the magnetic metals were too heavy. Thus, the magnetic force of attraction was not strong enough to attract the magnetic metals, causing them to fall into Container B. **P6 Answer: (Use forces to explain)** The magnetic force of attraction acting on the magnetic metals was not strong enough to overcome the gravitational force acting on the magnetic metals, causing them to fall into Container B.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: PLANT CYCLE

Commonly tested processes:

1) Germination
2) Photosynthesis
3) Respiration
4) Transpiration
5) Types VS agents of pollination (Special characteristics of the flower)
6) Seed Dispersal
7) Each time an adaptation is mentioned, it is mandatory to EXPLAIN the adaptation.

Qn	Answer
Q1 (a)	A, C, B, D
Q1 (b)	**Decrease in the mass of the seed leaves:** The food in the seed leaves is used for respiration to release energy for growth of the seedling until its true leaves are formed. **Increase in the mass of the seedling:** The seedling carries out respiration to release energy for growth. As the seedling grows, the seedling increases in size/height and mass of the seedling will increase.
Q1 (c)	At Stage D, the plant has developed its true leaves, which contain **chloroplasts** that contain chlorophyll to trap sunlight in the process of photosynthesis to make its own food.
Q2 (a)	**Choose:** P **Use Data:** Only the part of the stem above the 1-cm ring in Diagram P swelled. **Explain Data:** When the 1-cm ring was removed, the food-carrying tubes were removed. Thus, the food made by the leaves in the process of photosynthesis could not be transported past the 1-cm ring down to the roots. The food accumulated at part B, causing only part B of the stem to swell.

Q2 (b)	When the 3-cm ring was removed, both the food-carrying tubes and the water-carrying tubes were removed. * Thus, the leaves above part A could not receive water for photosynthesis to make food and died. *The water absorbed by the roots could not be transported up the stem past the part where the 3-cm ring was removed.
Q3 (a)	**Choose:** Fruit A. **Use Data:** Fruit A has a pod-like structure, **Explain Data:** which shows that it disperses its seeds by splitting. Thus, its seeds are dispersed nearer to the parent plant, as shown in the graph. This is unlike fruit B, which disperses its seeds by wind, causing its seeds to be dispersed further away from the parent plant.
Q3 (b)	It is likely that the fruits of the plants on Island S have a fibrous husk that traps air, allowing them to float on water to reach island T. Under suitable conditions, the seeds in the fruit germinated, causing new plants of the same species to grow on Island T.
Q4 (a)	It prevents / decrease/ slows down water loss (through the stomata).
Q4 (b)	1. When the stomata close, carbon dioxide is not able to enter the stomata and the rate of photosynthesis would decrease. OR 1. When the stomata reduce in size, less carbon dioxide enters the stomata and the rate of photosynthesis decreases. 2. When the amount of water absorbed decreased / no water is absorbed, the rate of photosynthesis decreases. The plant does not have enough water for photosynthesis.
Q5	The plants at the upper layers block the sunlight from reaching the forest floor. Thus, the plants at the forest floor could not trap enough sunlight for photosynthesis to make food. Less food was available for respiration to release energy, which is needed for growth and reproduction, causing fewer plants to be observed.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: PLANT & ANIMAL REPRODUCTION

Commonly asked questions:

- Advantage of having 2 ovaries/testes.
    - Why are many sperms released at once?
    - Why do insects lay many eggs at once?
- What is the similarity/difference between the process of fertilisation in plants and animals?
- Note that some teachers prefer their students to use "nucleus of sperm to fuse with nucleus of egg" while others simply require "sperm fuses with egg".

Qn	Answer
Q1 (a)	**Flower A is pollinated by:** Wind **Reason:** Its anthers are dangling outside the flower so that the wind can carry the pollen grains away easily.
Q1 (b)	**Flower B is pollinated by:** Birds/Insects **Reason:** Its anthers are enclosed within the flower so that the pollen grains will be stuck to the insect's body easily. OR The flower has large petals to attract insects.
Q2 (a)	Cutting the flower at point A removes the stigma. Thus, there would not be any stigma for the pollen grains to land on for pollination to take place, preventing fertilisation from occurring.
Q2 (b)	No. Cutting the flower at point B and C removes the anthers. However, the stigma is still present and can receive pollen grains from the anthers of other flowers of the same species. Thus, pollination can still occur, allowing fertilisation to continue to take place.
Q2 (c)	Sealing the fallopian tubes would prevent sperms released in the female's body from reaching the egg in the fallopian tubes to fuse with the egg in the process of fertilisation.

Q2 (d)	If one of the ovaries were damaged, the other would still be able to function to produce and release the mature eggs to fuse with the sperm in the process of fertilisation, ensuring the continuity of our kind. *Fertilisation takes place in the fallopian tubes.
Q2 (e)	Fertilisation in the human female reproductive system takes place at the fallopian tube while fertilisation of the flower takes place in the ovary.
Q3 (a)	**Choose:** Flower A. **Use data:** The flower has brightly coloured petals **Explain data:** to attract insects. **Use data:** Additionally, its stigma is not removed. **Explain data:** The pollen grains on the body of the insects will land on the stigma for pollination to take place. Thus, fertilisation would occur and the flower will develop into a fruit.
Q3 (b)	The male bees will be attracted to the Bee Orchid. The pollen grains on the body of the male bees would land on the stigma of the Bee Orchid for pollination to occur.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: ENERGY

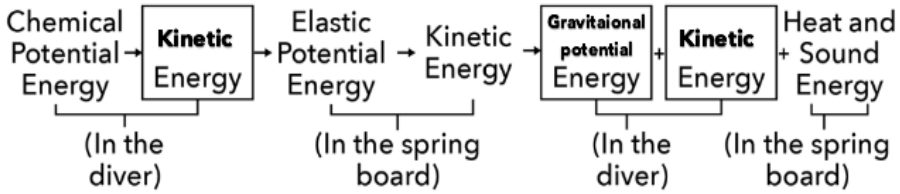
Techniques:

1) Kinetic energy template
2) "Energy conversion" structure of writing

Abbreviations:

- GPE: Gravitational Potential Energy
- KE: Kinetic Energy
- CPE: Chemical Potential Energy
- EPE: Elastic Potential Energy

Qn	Answer
Q1 (a)	Step 1. **State the factor:** Step 1 is at a greater height from the ground. **Use energy conversion:** Thus, there will be more gravitational potential energy possessed by acrobat B, which is converted to more kinetic energy. She will land on the see-saw with a greater force, transferring more kinetic energy to acrobat A, which would then be converted to more gravitational potential energy, allowing acrobat A to jump to a greater height.
Q1 (b)	**State the factor:** Acrobat C has a greater mass. **Use energy conversion:** Thus, acrobat C possessed more gravitational potential energy, which was converted to more kinetic energy. Acrobat C landed on the see-saw with a greater force, transferring more kinetic energy to acrobat A, which was then converted to more gravitational potential energy, allowing acrobat A to jump to a greater height.

Q2 (a)	Chemical Potential Energy → Electrical Energy → Heat Energy
Q2 (b)	When the switch was closed, chemical potential energy in the batteries was converted to electrical energy in the circuit, which was then converted to heat energy in the nichrome wire. The air surrounding the nichrome wire gained heat from it and rose. The kinetic energy of the rising air was then transferred to the piece of paper, causing it to move.
Q2 (c)	Some of the kinetic energy of the paper was converted to heat and sound energy to overcome air resistance. The piece of paper came to a stop when all the kinetic energy of the paper had been converted to heat energy and sound energy.
Q3 (a)	
Q3 (b)	**State the factor:** This allows the spring board to bend more **Use energy conversion:** and store more elastic potential energy, which is converted to more kinetic energy of the diver, which is converted to more gravitational potential energy of the diver, allowing the diver to jump to a greater height.

ThePiqueLab learning centre

2019 CCI™ SCIENCE PROGRAMME

TOPIC: FORCES

Techniques:

1) Use "acting on" and "overcome" in the "Forces" answering method
2) Friction → between _____ & _____.
3) "Elasticity" of objects template answer

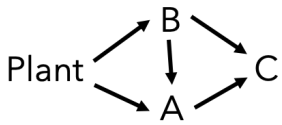
Qn	Answer
Q1 (a)	Gravitational force, frictional force
Q1 (b)	The push force acting on the object caused the stationary object to start moving.
Q1 (c)	When pushing the object from A to B, his push force acting on the object only needed to overcome friction between the object and the surface. From B to C, his push force acting on the object needed to overcome both friction between the object and the surface and gravitational force when pushing the object up. Hence, more force was needed.
Q1 (d)	By adding wheels or adding a lubricant such as oil to the surface, there is now less friction between the surface and the object, allowing it to move more easily.
Q2	Object A is a magnet. Object A's and Magnet Z's like poles are facing each other, causing them to repel. The magnetic force of repulsion between the magnets is able to overcome the gravitational force acting on object A, causing it to float.
Q3 (a)	Spring Y: 60cm Spring Z: 25cm
Q3 (b)	Spring Y is more elastic. When 60g is (For the same mass of the load) hung on the springs, spring Y has a larger extension.
Q3 (c)	When loads greater than 80g were hung on Spring Y, Spring Y became fully stretched/stretched to its elastic limit. Hence, an increase in the mass of the load hung on it does not increase the length of Spring Y.

2019 CCI™ SCIENCE PROGRAMME

TOPIC: INTERACTIONS (WEB OF LIFE)

Techniques:

1) Relationship between organisms
2) Describe Population Change
3) Effect

Qn	Answer
Q1 (a)	**Producer:** H **Predator:** B **Prey & Predator:** D, E, F
Q1 (b)	I agree with Sally's conclusion. Organism C has only one source of food, which is organism H, unlike organism B, which has three food sources - organisms H, D, and F. Thus, when organism H was removed, organism C would not have any food to feed on, unlike organism B, which is still able to feed on organisms D and F.
Q2 (a)	Producer: B Consumer: C Decomposer: A
Q2 (b)	Decomposition
Q2 (c)	The earthworms feed on dead matter (leaves) and pass them out through their wastes, breaking down the dead matter into smaller pieces. This increases the exposed surface area of the dead matter for decomposers, such as bacteria and fungi, to act on the dead matter faster, increasing the rate of decomposition.
Q3 (a)	
Q3 (b)	**Relationship:** Organism C is the predator of organism B. **Population Change:** When the population of B decreases, the population of C also decreases **Effect:** as there would be less food for organism C to feed on.

Q4 (a)	The population of fish would decrease. When the pond surface became covered with floating plants, the fully submerged plants are unable to trap sufficient light for photosynthesis to make food and release oxygen for the fish, causing the population of fully submerged plants to decrease. A decrease in the population of the fully submerged plants would cause less oxygen to be provided for the fish for respiration to release energy, causing the population of the fish to decrease.
Q4 (b)	**Relationship:** The fish are consumers of the submerged plants. (Given) **Population Change:** When the population of the submerged plants decreases, the population of fish would also decrease **Effect:** as there would be less food for the fish to feed on.
Q4 (c)	Benefit 1: The fish release carbon dioxide in the process of respiration, which is taken in by the submerged plants for photosynthesis to make food. Benefit 2: The waste of the fish is decomposed and is returned to the soil as nutrients, which act as fertiliser for the plants.
Q5