



Examiners' Report June 2024

Int GCSE Biology 4BI1 2B

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Introduction

The examiners were impressed with the very high standard of many of the scripts. Candidates and centres had clearly prepared very thoroughly for the examination and showed very good knowledge and strong examination technique. Most candidates demonstrated strong factual recall, were confident using scientific terminology, had strong mathematical skills and had a good understanding of practical assessment. Some candidates found aspects of data analysis challenging and had a tendency to confuse the requirements of the command words, particularly 'describe' and 'explain'.

For the longer, discussion and evaluate style questions, candidates should be careful to explore all aspects of data thoroughly and use their own knowledge to add explanations. Candidates generally showed a good understanding of core practicals – it is important that candidates have a thorough knowledge of all the core practicals listed in the specification. Generic practical understanding, such as identifying variables, was generally good.

Questions about the comprehension (question 1) were mostly answered very well with most candidates showing a strong understanding of environmental issues. A few candidates did not use key vocabulary accurately, especially when describing mammalian cloning – it is important to always use scientific terminology accurately.

Question 1 (b)

This question required candidates to read the comprehension and recognise that whales were competitors with the megalodon, were better adapted and able to consume more of the food. Strong answers used accurate terminology such as 'competition for food' and went on to explain that the megalodon would have less food, would not survive and so would reproduce less compared with the whales. Weaker answers did not read the passage or question carefully and suggested that the whales were predators of the megalodon and so hunted them to extinction. Many candidates gained at least two marks, with a significant number gaining all three.

- (b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

As they will remain smaller therefore they will have to compete for the same source of food, making them less chance of surviving and therefore fewer reproduction for offspring and no generation



ResultsPlus
Examiner Comments

This answer gained all three marks. The candidate clearly states that the species were competing for food and that the sharks would have less food and so reproduce less.



ResultsPlus
Examiner Tip

Always use technical terms, such as 'competition'.

- (b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

The giant, predatory tooth whales were out-competing the megalodon for its food. Since these whales were enormous, the megalodon most likely could not fight them for food either, so the megalodon starved to death, eventually becoming extinct.



ResultsPlus
Examiner Comments

This is a strong answer that gained all three marks. The candidate clearly states that the whales out competed the megalodon, gives an idea that they were better adapted and ate more of the food.

- (b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

More giant, predatory toothed whales would have eaten the shared sources of food. This means there would not be enough sources of food for the sharks and so they would starve. The whales would reproduce and eat more food and keep doing this till eventually there is no food for the sharks. The sharks didn't get sufficient nutrients and died.



ResultsPlus
Examiner Comments

This answer gained all three marks. The candidate clearly states that the whales obtained more food, survived, and then reproduced.

- (b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

Predatory toothed whales may have had the same diet, and so will have decreased the food supply for megalodons. Also, they may have eaten megalodons, decreasing their population.



ResultsPlus
Examiner Comments

This answer gained one mark for the idea of megalodon having less food. No further credit was awarded.

(b) Scientists think that the giant, predatory toothed whales that replaced the extinct megalodon consumed the same sources of food.

Explain how the evolution of giant, predatory toothed whales may have caused the extinction of megalodon. (lines 5 to 7)

(3)

Due to natural selection ~~The~~ ^{f.} ~~gradua~~ Some factors in the environment enabled the giant, predatory toothed whales to have a survival advantage over the megalodons enabling them to survive while the megalodons were eliminated from the environment. The whales possessed certain traits the megalodons did not enabling them to survive.



ResultsPlus
Examiner Comments

This answer gained one mark for the idea of survival. There is no link to the idea of better feeding adaptations, reproduction, or competition.

Question 1 (c)(i)

This straightforward question was answered well. Candidates were required to describe the consequences of sulfur dioxide release. Most correctly referred to acid rain and a significant number of candidates went on to give a consequence. The question asked for biological consequences – marks were not awarded for references to the erosion of rocks. Weaker answers often referred to acid rain but did not give any more detail other than vague statements such as 'affecting organisms'.

(c) (i) Volcanoes release sulfur dioxide into the atmosphere.

Describe the biological consequences of sulfur dioxide release. (lines 10 to 12)

(2)

Sulfur dioxide is toxic to inhale and causes damage to the lungs and body, and it causes acid rain, which is extremely dangerous and can kill plants and animals.



This answer gained two marks for a correct reference to acid rain and the idea of killing plants.

(c) (i) Volcanoes release sulfur dioxide into the atmosphere.

Describe the biological consequences of sulfur dioxide release. (lines 10 to 12)

(2)

Sulfur Dioxide can dissolve in water to form and then evaporate to form acid rain.



This answer gained one mark for the reference to acid rain.

(c) (i) Volcanoes release sulfur dioxide into the atmosphere.

Describe the biological consequences of sulfur dioxide release. (lines 10 to 12)

(2)

Sulfur dioxide dissolves in rainwater which causes acid rain. Acid rain can end up in waterways and this kills aquatic plants and animals



ResultsPlus
Examiner Comments

This answer gained two marks for the references to acid rain and to killing aquatic animals.

Question 1 (c)(ii)

This question assessed candidates' understanding of energy flow through food chains. Candidates were asked to explain why reduced light intensity would lead to damage to food chains. Strong answers referred to reduced photosynthesis, less production of carbohydrates, less produced growth and a reduction of food for primary or secondary consumers. Weaker answers tended to restate the question, ie stating that reduced light would harm organisms or did not link the loss of light to photosynthesis. Some candidates confused primary consumers with secondary consumers.

- (ii) The release of large amounts of dust into the atmosphere reduced light intensity. ✖

Explain why this would cause a loss of food chains. (lines 9 to 11)

Producer levels fell, increase in atmospheric carbon dioxide, oxygen level falls, less rate of respiration (3)



ResultsPlus
Examiner Comments

This answer gained one mark for the idea of fewer producers. There is no link to photosynthesis or primary / secondary consumers.

- (ii) The release of large amounts of dust into the atmosphere reduced light intensity.

Explain why this would cause a loss of food chains. (lines 9 to 11)

(3)

-light intensity affect the rate of photosynthesis
-As light intensity increase rate of photosynthesis ~~decrease~~ increase
-So since light intensity decreased, rate of photosynthesis will decrease, so more carbon dioxide in the atmosphere and less release of oxygen gas in the atmosphere



This answer gained one mark for the idea of reduced photosynthesis.



When discussing the effect of factors on another variable, always give a direction. For example don't just say, 'less light intensity affects photosynthesis', instead say 'less light intensity reduces photosynthesis.'

- (ii) The release of large amounts of dust into the atmosphere reduced light intensity.

Explain why this would cause a loss of food chains. (lines 9 to 11)

(3)

Because of light intensity the food chain will decrease due to less ~~rain~~ so nothing can be planted amount of water will decrease, so light intensity effect these things



ResultsPlus
Examiner Comments

This answer gained no marks. The candidate has confused light intensity with rainfall.

- (ii) The release of large amounts of dust into the atmosphere reduced light intensity.

Explain why this would cause a loss of food chains. (lines 9 to 11)

(3)

producers such as plants can't photosynthesise ~~at all~~ due to lack of light, so inhibiting growth and oxygen produced therefore reducing respiration causing those plants to die. This then causes the primary consumers to have less food so they also die out, as will secondary consumers as there prey die out, this continues along food chains leading to them being lost



ResultsPlus
Examiner Comments

This answer gained all three marks. The candidate clearly refers to less photosynthesis, less producer growth and less food for primary consumers.

- (ii) The release of large amounts of dust into the atmosphere reduced light intensity.

Explain why this would cause a loss of food chains. (lines 9 to 11)

(3)

Transpiration is water to leave stomata. Light intensity decrease decreases rate of transpiration. As there is less photosynthesis, plants need to photosynthesise to survive as they need glucose ^{to respire} stored as starch. As plants are producers if they die, the primary consumers will not get enough nutrients so population will fall. This continues _{throughout food chain}.



ResultsPlus
Examiner Comments

This answer gained all three marks. The candidate correctly refers to reduced photosynthesis, less glucose production, loss of producers and loss of food.

Question 1 (d)(i)

This question generated a mixed range of answers. Strong answers correctly recognised that if cells were kept in pure water, water would enter the cells due to osmosis causing them to burst. Some candidates incorrectly suggested that the glucose and salt would provide the cells with energy. If a question considers cells being placed into solutions with different concentrations, candidates should think about osmosis occurring.

(d) (i) Explain why the cells in cryozoos are put in salt and sugar solution rather than pure water. (lines 16 to 18)

(2)

Salt solution's water concentration is less than in cryozoos

so due to the difference in water level water may

leave out from cryozoos to the salt solution ^{but} ~~not~~ if not

water enters the cryozoos, they will burst because they

are already filled with water.



This answer gained two marks. The candidate clearly refers to the movement of water (from pure water) into cells, which would cause them to burst.

(d) (i) Explain why the cells in cryozoos are put in salt and sugar solution rather than pure water. (lines 16 to 18)

(2)

Because to prevent water moving into the cell from an area of high to low water potential by osmosis, which would cause the cell to burst.



This answer gained two marks. The candidate clearly states that water would move into the cells by osmosis and would cause them to burst.

(d) (i) Explain why the cells in cryozoos are put in salt and sugar solution rather than pure water. (lines 16 to 18)

(2)

So the cells are in a solution with the same water concentration they are used to (reduce the effect of osmosis)



This answer gained one mark for the reference to osmosis. There is no statement about the movement of water into the cells or the cells bursting.

Question 1 (d)(ii)

This question required candidates to describe the process of mammalian cloning. Strong answers referred to the transfer of a diploid, or body cell, nucleus into enucleated egg cells. They then went on to describe the use of an electric shock to start mitosis, producing an embryo that is then transferred into the uterus of a surrogate mother. Common errors included: not stating that the nucleus was diploid or from a body cell, suggesting that a sperm nucleus would be used, not referring to the production of an embryo, and confusing mitosis with meiosis. Many candidates had clearly learnt this topic well and gained at least three marks. Some candidates, however, gave vague answers or discussed genetic engineering so gained no credit.

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

Surrogate mother.
Donor cell. (4)

Take the banteng cell nucleus and put it in a donor cell.

Use an electrical impulse / electric shock.

Then put the cell in a surrogate mother where she can grow the cloned banteng.



ResultsPlus
Examiner Comments

This answer gained two marks. The candidate correctly states that an electric shock and a surrogate mother are used. Mark point one was not awarded as it is not clear which type of nucleus is being transferred.

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

(4)

Once a cell of ~~of~~ a banteng is obtained, scientists may clone it through mitosis. Place it ~~over~~ jelly and let it create a ~~colais~~, which will mitosis into a ~~was~~ mammoth.



This answer gained one mark for the idea that mitosis is involved in the generation of clones. No further credit is awarded as the candidate has confused mammalian cloning with micropropagation.

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

(4)

Take a nucleus cell from a frozen banteng and then fuse this with other ~~en~~ enucleated cell with a ~~and~~ mild shock. Eventually it will be divided by mitosis and after some cycle it will develop into embryo then put this embryo inside living species uterus, then it will be ~~be~~ produced into a new living ~~be~~ animal.



This answer gained three marks for the use of an electric shock, mitosis and placing the embryo into a uterus.

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

(4)

They could take DNA from 2 banteng cell, then remove DNA from 2 cattle's egg cell and put banteng's DNA into this cell, then make cattle's cell fertilized.



ResultsPlus
Examiner Comments

This answer gained no marks. The DNA from the banteng cell is not clearly from a body cell.

(ii) Describe how scientists could clone a banteng. (lines 18 to 20)

(4)

Take the nucleus of a body cell in the banteng and insert it into an enucleated egg cell. Use electric shock to allow the cell to divide by mitosis and form an embryo. Implant the embryo into the uterus of a surrogate mother and allow the embryo to grow.



ResultsPlus
Examiner Comments

This is an excellent answer that gained all four marks. The nucleus of a body cell is inserted into an empty egg, an electric shock is used to start mitosis. The embryo is then placed into the uterus of a surrogate mother.

Question 1 (e)

This question required candidates to read the passage and extract information to explain why there are positive and negative outcomes to releasing cloned mammoths. Strong answers considered both positives and negatives and went beyond just quoting statements from the passage. Many candidates correctly stated that the lack of predators would mean that populations of mammoths could increase out of control, consume too much food and so affect competitor species. Many also stated that mammoths would release faeces that would decompose, releasing nitrates and encouraging plant growth. Many candidates also identified that mammoths reduce methane release so that could reduce climate change. Weaker answers often recognised that mammoths have no predators and reduce methane release but gave no further explanation. Weaker answers also tended to only consider positives or negatives rather than both – the question asked for both sides.

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

(3)

cloned mammoths lead to less biodiversity and less variation. meaning that ~~there~~ there is less mutations so they won't evolve and are less likely to survive. There are no longer predators for mammoths so they wouldn't be hunted mammoths reduce methane so will help combat global warming



This answer gained one mark for correctly stating that the reduced methane release would reduce global warming. No credit was awarded for stating that there are no predators as it has not been linked to the mammoth population.

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

(3)

cloned mammals have a shorter lifespan, they are all genetically identical, making them vulnerable to disease. However, as there are no predators the population may rapidly expand due to reproduction and a high birth rate. This may decrease other species that they feed on (such as producers) as they will eat them faster than they grow, reducing biodiversity.



ResultsPlus
Examiner Comments

This answer gained two marks for the ideas that populations would become high, reducing food for other species. There are no positive effects suggested.

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

(3)

the positive effect is that an extinct animal came back to life but the negative effect is that the food chain for the mammoth is big it need lots of grass to feed on.



ResultsPlus
Examiner Comments

This answer gained no marks – it is vague and gives no specific explanation of the effects of releasing the mammoths.

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

Disadvantage 2

(3)

~~Because~~ cloned mammoths would not have any predators therefore there will be a large amount of them ~~to~~ which would put the species that mammoths eat in danger and could possibly make them extinct.

Advantage, since mammoths make fertile soil there will be an increase in plants that act as

(Total for Question 1 = 18 marks)

producers therefore helping to sustain the food chain by increasing the primary consumers, therefore also increasing other consumers.



ResultsPlus
Examiner Comments

This answer gained three marks for the idea of overpopulation of mammoths harming the other species and the increased growth of plants.

(e) Explain why releasing cloned mammoths could have negative and positive effects on Arctic biodiversity. (lines 22 to 28)

It would affect the food chains ^{negatively} because there are no predators of the mammoth so their numbers would increase uncontrollably. However, they will slow ⁽³⁾ down the greenhouse effect by trapping methane in the soil and increasing nitrogen in soil for nitrifying bacteria to turn into nitrates for plant growth.



ResultsPlus
Examiner Comments

This answer gained three marks. The candidate explains that the population of mammoths would increase, that there would be less greenhouse effect and that there would be more plant growth.

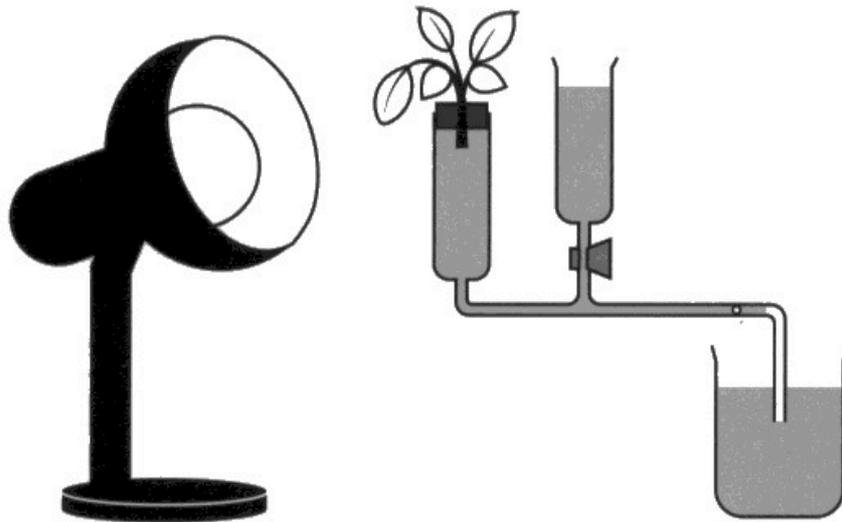
Question 2 (a)(i)

This question required candidates to describe how to use a potometer to investigate the effect of light intensity on the rate of transpiration of a shoot. Many excellent answers were seen and it is clear that most candidates and centres are covering all the core practicals listed in the specification. Stronger answers described measuring the distance the bubble moves in a set time – candidates should always give a reference to time when asked how to make a valid comparison. Stronger answers also described how the light intensity would be changed by moving the lamp and suggested factors that would need to be maintained to enable a valid conclusion to be made. It was pleasing to see that many candidates gave key practical details such as cutting the shoot underwater, drying the leaves and making sure that seals were secure. Some candidates confused the equipment with equipment used to measure rates of photosynthesis and suggested counting the production of bubbles. Weaker candidates often suggested measuring 'water loss' rather than giving a method to measure the loss or uptake of water.

2 Transpiration (water loss) is affected by several environmental factors.

A student investigates the effect of light intensity on water loss from a plant shoot.

The diagram shows some of the apparatus the student uses.



The student predicts that water loss from a plant shoot will increase as light intensity increases.

(a) (i) Describe how to set up and use the student's apparatus to test this prediction.

(4)

Add a ruler to the tube with a bubble, bubble initial position as a 0. Turn on the light and wait for a certain and control time. Measure distance moved and divide by time to get transpiration rate. Repeat with lamp further away from the plant. Compare the transpiration rates



This answer gained three marks for measuring the distance the bubble moved, in a set time, with the lamp at different distances.

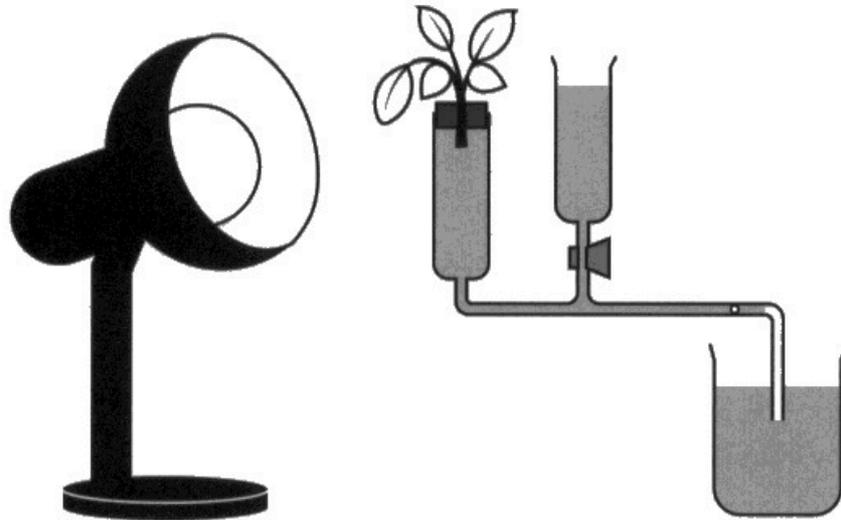


Always give control variables when planning experiments.

2 Transpiration (water loss) is affected by several environmental factors.

A student investigates the effect of light intensity on water loss from a plant shoot.

The diagram shows some of the apparatus the student uses.



The student predicts that water loss from a plant shoot will increase as light intensity increases.

(a) (i) Describe how to set up and use the student's apparatus to test this prediction.

(4)

Cut a plant shoot under water then place it in a tube close the tube with a bung. place a lamp near to the shoot and leave it for 2 hours. Measure the distance moved by the air bubble. Repeat the experiment using different distances of lamp using same species and mass of plant and measure distance moved after same time.



This answer gained all four marks. The candidate describes that the apparatus will be sealed with a bung, the measurement of the bubble movement, a time taken and repeats at different distances.

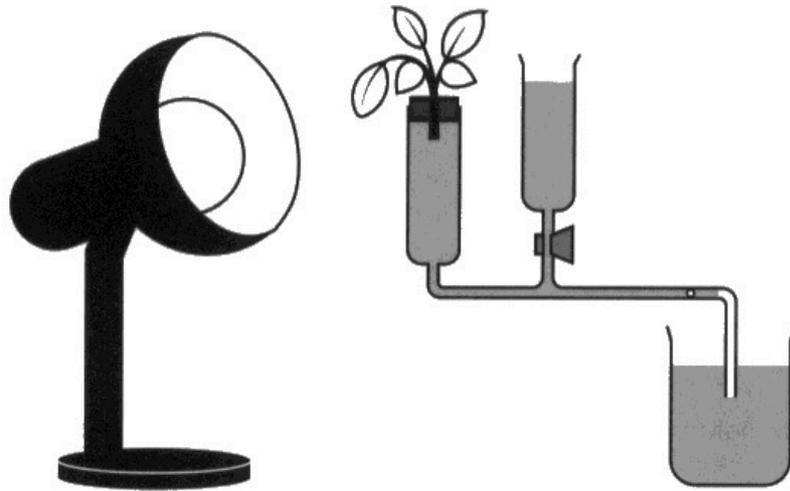


Always include specific practical details, such as sealing the apparatus, cutting the shoot under water.

2 Transpiration (water loss) is affected by several environmental factors.

A student investigates the effect of light intensity on water loss from a plant shoot.

The diagram shows some of the apparatus the student uses.



The student predicts that water loss from a plant shoot will increase as light intensity increases.

(a) (i) Describe how to set up and use the student's apparatus to test this prediction.

(4)

A potometer should be used in this experiment where the shoot should be cut at an angle underwater to stop air entering the xylem and to increase the surface area. The shoot should be inserted into the apparatus underwater and then removed, the tip of the capillary tube placed into a beaker of water. The leaves of the shoot should be dried and the shoot left time to acclimatise, after this the tap should be shut. The tip of the capillary tube should be removed from the beaker until an air bubble forms, and then the tip placed back into the beaker. A ruler should be placed along the capillary tube and the starting distance of the air bubble recorded, and the rate of transpiration can be recorded by the distance travelled by the air bubble per unit of

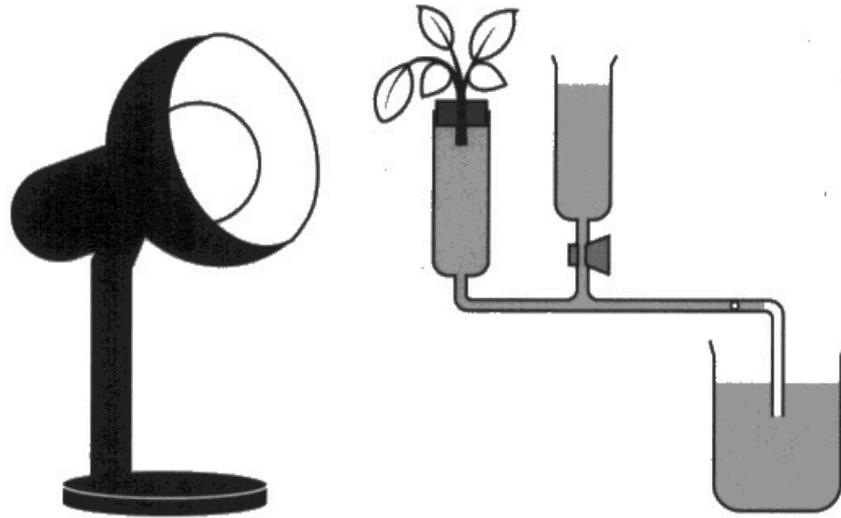


This answer gained four marks. The candidate describes all the experimental precautions, such as cutting the shoot at an angle underwater, drying the leaves and goes on to describe the measurement of the distance moved by the bubble in a set time.

2 Transpiration (water loss) is affected by several environmental factors.

A student investigates the effect of light intensity on water loss from a plant shoot.

The diagram shows some of the apparatus the student uses.



The student predicts that water loss from a plant shoot will increase as light intensity increases.

(a) (i) Describe how to set up and use the student's apparatus to test this prediction.

(4)

- cut the shoot underwater so no air enters the xylem.
- assemble the apparatus underwater so no air gets in.
- remove the apparatus from the water, and dry the leaves, but keep the end of the capillary tube in the beaker of water. Shut the tap.
- lift the end of the capillary tube out of the water until one air bubble forms then put it back in.
- Keep other factors like CO_2 concentration and temp constant.



This answer gained three marks for cutting the shoot underwater, drying the leaves and controlling the temperature.



Make sure that control variables are relevant to the experiment.

Question 2 (a)(ii)

This question required candidates to identify the dependent variable. Most candidates correctly identified the water loss, transpiration or distance moved by the bubble. A few candidates confused the dependent variable with the independent variable and incorrectly stated the light intensity.

(ii) State the dependent variable in this investigation.

(1)

distance moved by bubble, so plant water loss.



ResultsPlus
Examiner Comments

This answer gained one mark for correctly stating that the distance moved by the bubble was the dependent variable.

(ii) State the dependent variable in this investigation.

(1)

~~The light in~~ The water lost



ResultsPlus
Examiner Comments

This answer gained one mark for correctly stating the water lost.

(ii) State the dependent variable in this investigation.

(1)

light



This answer gained no marks – the candidate has confused the dependent and independent variables.



Make sure that you know the differences between the independent, dependent and control variables.

Question 2 (b)(i)

This question about the effect of light intensity on water loss of plants was well answered with most candidates gaining at least one mark. Most candidates recognised that the rate of water loss increased with increasing light intensity and many correctly stated that this would cause the stomata to open more. A few candidates incorrectly discussed photosynthesis and others simply described the patterns rather than referring to the reason for the increased water loss.

(b) Another student uses the apparatus to collect and process the data.

Table 1 shows their results.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	2
5	8
10	12
15	12

Table 1

(i) Explain why light intensity changes the mean volume of water lost by the shoot.

(2)

The higher the light intensity the more water is lost on average because the higher the light intensity the more stomata are open to allow gas-exchange for photosynthesis.



This answer gained both marks for correctly describing the pattern and then explaining how this is due to stomatal opening.

(b) Another student uses the apparatus to collect and process the data.

Table 1 shows their results.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	2
5	8
10	12
15	12

Table 1

(i) Explain why light intensity changes the mean volume of water lost by the shoot.

(2)

This is because as light intensity increase there was more water lost.



ResultsPlus
Examiner Comments

This answer gained one mark for correctly describing the pattern but did not give any explanation.

(b) Another student uses the apparatus to collect and process the data.

Table 1 shows their results.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	2
5	8
10	12
15	12

Table 1

(i) Explain why light intensity changes the mean volume of water lost by the shoot.

(2)

As when light intensity increases more stomata are open there fore more water vapour can diffuse out by transpiration.



This answer gained two marks for correctly stating that more stomata open causing increased transpiration.

Question 2 (b)(ii)

This question presented candidates with unfamiliar data showing the effects of light intensity on the rate of transpiration from a desert plant. Many candidates gave good answers that gained at least one mark. Most recognised that the water loss decreased with increasing light intensity but fewer candidates noticed that the total volume of water lost was lower than the non-desert plant species. Strong candidates went on to explain that the desert plant may have fewer stomata and that they open in the dark unlike non-desert plants. Strong answers also went on to state that the adaptations of the desert plants means that they do not wilt in hot, dry conditions. Weaker answers tended to purely give descriptions of the data and offered no explanation. Weaker answers often confused transpiration with photosynthesis and discussed how photosynthesis would change in the dark and light.

- (ii) The student repeats the experiment with a plant that is adapted to live in desert environments.

Table 2 shows the results for this desert plant.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	6
5	4
10	0
15	0

Table 2

The desert plant has adaptations to survive in desert environments where not much water is available.

Explain why the results for this desert plant, in table 2, are different from the results in table 1.

(3)

As the plant has adapted to survive with not much water, it doesn't use as much when it photosynthesises.



This answer gained no marks. The candidate has confused transpiration with photosynthesis.

- (ii) The student repeats the experiment with a plant that is adapted to live in desert environments.

Table 2 shows the results for this desert plant.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	6
5	4
10	0
15	0

Table 2

The desert plant has adaptations to survive in desert environments where not much water is available.

Explain why the results for this desert plant, in table 2, are different from the results in table 1.

(3)

- because the plant in the first experiment does not have a limited supply of water, whereas in experiment 2, the plant in the desert does
- so even though light intensity increases, ^{in exp 2,} ~~after~~ between 5 and 10 units no more water is lost because the plant must retain this water for photosynthesis ~~and~~ so it can photosynthesise during the night
- so the stomata close to prevent transpiration even as light intensity increases to 10 & 15 units



This answer gained all three marks. The candidate has implied that water loss is lower and that there is more in the dark. They have then gone on to correctly state that this is due to stomata opening in the dark.

- (ii) The student repeats the experiment with a plant that is adapted to live in desert environments.

Table 2 shows the results for this desert plant.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	6
5	4
10	0
15	0

Table 2

The desert plant has adaptations to survive in desert environments where not much water is available.

Explain why the results for this desert plant, in table 2, are different from the results in table 1.

(3)

Desert plants are adapted to close stomata during light and open during dark. They have less stomata, so less water is lost. When light intensity increases, the volume of water lost decreases.



This is a very good answer that gained three marks. The candidate has explained that the plant loses less water and that it will have fewer stomata and open the stomata in the dark rather than the light.

- (ii) The student repeats the experiment with a plant that is adapted to live in desert environments.

Table 2 shows the results for this desert plant.

Light intensity in arbitrary units	Mean volume of water lost by shoot in 10 minutes in mm ³
0	6
5	4
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Explain why the results for this desert plant, in table 2, are different from the results in table 1.

(3)

As the light intensity increases the mean volume of water lost decreases as desert plants are adapted to not lose much water as they have fewer number of stomata than the plant in table one, so less stomata opened and less water lost. They also ~~have~~ have thicker cuticle on their leaves to avoid water loss. So when the light was after 10 units, no water was lost as no stomata opened.



This is an excellent answer that gained all three marks. The candidate clearly states that there is less water lost and that there is more lost in the dark. The candidate correctly explains that the stomata open in the dark / close in the light and that there are fewer stomata.

Question 3 (a)

This question was well answered with many candidates gaining both marks. Most candidates recognised that during exercise the body temperature increases and so sweating increases to lower the temperature due to the evaporation of water. Some candidates incorrectly referred to the production of water from increased respiration.

3 Isotonic drinks are often used to rehydrate athletes after exercise.

(a) Explain why athletes lose water during exercise.

(2)

because when they run they sweat
sweat to cool down their body and
water evaporates



This strong answer gained two marks for correctly stating that athletes sweat to cool down the body.

3 Isotonic drinks are often used to rehydrate athletes after exercise.

(a) Explain why athletes lose water during exercise.

(2)

Because sweat is excreted from their skin due to ~~an~~
exercise, and so their body loses water. This happens as
the heart and breathing rate increases, and adrenaline
is produced, causing sweating.



This answer gained one mark for correctly stating the body sweats but there is no link to cooling.

3 Isotonic drinks are often used to rehydrate athletes after exercise.

(a) Explain why athletes lose water during exercise.

(2)

Excretory product of skin is water and some salts, athletes sweat during exercise to cool the body for homeostasis ^{as heat regulation} causing them to lose water in the process.



ResultsPlus
Examiner Comments

This answer gained two marks for sweating linked to the cooling of the body.



ResultsPlus
Examiner Tip

Make sure that you are specific in your answers. For example, sweating increases to cool the body, not just control temperature.

Question 3 (b)(i)

This question presented candidates with data from an investigation into the effect of rehydration after exercise on the volume and concentration of urine. Many candidates gained at least two marks for this part of the question that asked candidates to explain the low volume of urine produced by an athlete who had no drink. Strong answers explained that the blood water potential (or water concentration) would be very low and that this stimulates the pituitary gland to release ADH, increasing the permeability of the collecting ducts so that more water is reabsorbed into the blood. Candidates should always use precise language, for example, referring to blood water potential (or salt concentration) rather than just 'water levels in the body'. Some candidates incorrectly stated that ADH would reduce permeability of the collecting ducts. Some, weaker answers, simply described the volume and concentration of the urine and gave vague references to the athlete being dehydrated or retaining water. Candidates should use precise, scientific vocabulary wherever appropriate.

(b) Isotonic drinks contain salt and sugar solutions that are the same concentration as normal blood plasma.

A scientist uses this method to investigate how well an isotonic drink rehydrates athletes.

- three athletes exercise for one hour
- one athlete has no drink
- the second athlete drinks 1000 cm^3 of pure water
- the third athlete drinks 1000 cm^3 of isotonic drink
- the volume and colour of urine produced by each athlete are measured one hour later

The table shows the scientist's results.

Drink consumed by athlete	Volume of urine produced in cm^3	Colour of urine
no drink	100	very dark yellow
pure water	750	very light yellow
isotonic drink	500	yellow

(i) Explain the results shown in the table for the athlete who consumed no drink.

(3)

The athlete who consumed no drink had less urine produced due to lots of urea being sweated and breathed out and no water absorbed back in. The colour of the urine is also very dark yellow due to there being not enough water in collecting ducts.



This answer gained no marks. It is an example of an answer that is just a description of the urine – the question asked for an explanation.

- (b) Isotonic drinks contain salt and sugar solutions that are the same concentration as normal blood plasma.

A scientist uses this method to investigate how well an isotonic drink rehydrates athletes.

- three athletes exercise for one hour
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The table shows the scientist's results.

Drink consumed by athlete	Volume of urine produced in cm^3	Colour of urine
no drink	100	very dark yellow
pure water	750	very light yellow
isotonic drink	500	yellow

- (i) Explain the results shown in the table for the athlete who consumed no drink.

(3)

- Low water content in blood detected by the hypothalamus, tells pituitary glands to produce more ADH
- ADH causes the collecting duct to be more permeable, so more water can be reabsorbed into the blood by osmosis
- Less water, less urine produced, urine is more concentrated due to high concentrations of urea.



ResultsPlus
Examiner Comments

This is a good answer that gained all three marks. The candidate refers to blood water content, the role of the hypothalamus, the release of ADH, the effects of ADH and the reabsorption of water.

(b) Isotonic drinks contain salt and sugar solutions that are the same concentration as normal blood plasma.

A scientist uses this method to investigate how well an isotonic drink rehydrates athletes.

- three athletes exercise for one hour
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The table shows the scientist's results.

Drink consumed by athlete	Volume of urine produced in cm^3	Colour of urine
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pure water	750	very light yellow
isotonic drink	500	yellow

(i) Explain the results shown in the table for the athlete who consumed no drink.

(3)

Osmoreceptors in the hypothalamus detected the decrease in water potential which leads to the pituitary gland secreting more ~~ADH~~ of the hormone ADH which increases the permeability of the collecting duct so more water is reabsorbed by osmosis leaving the urine to be more concentrated.



This is an excellent answer that shows confident, accurate use of scientific vocabulary. The candidate correctly refers to osmoreceptors in the hypothalamus, the water potential of the blood, the role of the pituitary gland in releasing ADH, the effects of ADH on the collecting duct and the reabsorption of water.



Always use scientific terms accurately.

Question 3 (b)(ii)

This challenging question required candidates to give an explanation for the difference in urine volume released after drinking a rehydration drink compared with drinking water. Strong answers explained that the athlete who had drunk the rehydration drink would absorb both water and solutes into their blood so the water potential of their blood would be lower than the athlete who had drunk pure water. These strong answers often went on to state that as a consequence, more ADH would be released after drinking the rehydration drink leading to more water reabsorption. Weaker answers tended to simply describe the difference in urine volumes rather than focusing on a reason for the difference.

- (ii) Explain the differences in urine volume and urine colour produced by the athlete who consumed the isotonic drink and the athlete who consumed pure water.

(2)

The athlete who drank pure water had a very low ~~con~~ dilute blood thus more water was excreted, this is why the volume of urine produced is greater and the colour is also very yellow.

(Total for Question 3 = 7 marks)



This answer gained one mark for stating that the water content of blood after drinking pure water would be higher.

- (ii) Explain the differences in urine volume and urine colour produced by the athlete who consumed the isotonic drink and the athlete who consumed pure water.

(2)

Isotonic drink has low water potential than pure water, and it has less low concentration of water, thus less water is in the blood than the athlete who drank the isotonic drink, as ~~the~~ ^{some} water is reabsorbed into the blood from the collecting duct, to ensure they remain hydrated, the urine is yellow as it is small concentration. The person who drank pure water will have a high water potential in their blood, so no ADH is secreted, the collecting duct will be ~~permeable~~ ^{not permeable}, so water will remain in the urine, so the urine will have a larger volume due to more water, and will be light yellow as it is less concentrated as more water.

(Total for Question 3 = 7 marks)



ResultsPlus
Examiner Comments

This is a good answer that gained both marks. The candidate correctly describes the differences in the blood water potentials and goes on to explain how this leads to a difference in release of ADH and water reabsorption.

- (ii) Explain the differences in urine volume and urine colour produced by the athlete who consumed the isotonic drink and the athlete who consumed pure water.

The ^{athlete} ~~athel~~ who drank pure water produced ⁽²⁾ more and lighter urine because their urine is diluted. ~~This is because~~ The ~~athel~~ athlete who drank the isotonic drink produced different urine because his blood concentration was normal.



ResultsPlus
Examiner Comments

This answer gained one mark for the idea that the blood concentration would be normal after drinking the rehydration drink.

- (ii) Explain the differences in urine volume and urine colour produced by the athlete who consumed the isotonic drink and the athlete who consumed pure water.

The athlete who drank pure water ⁽²⁾ ~~contains~~ produced 250 cm³ more urine than the one who drank an isotonic drink. The athlete who drank pure water had very light yellow urine as it contained more water.



ResultsPlus
Examiner Comments

This answer gained no marks – the answer is purely descriptive and no explanation has been given.

- (ii) Explain the differences in urine volume and urine colour produced by the athlete who consumed the isotonic drink and the athlete who consumed pure water.

(2)

The athlete who drank isotonic ~~drink~~ produced 250 cm^3 less urine than the athlete who drank pure water. Also, his ~~urine~~ urine was yellow. This is because more water was reabsorbed due to high concentration of minerals in the blood.



This answer gained two marks – one for the idea of water reabsorption and the second for the idea that the salt concentration in the blood is higher (refers to minerals).

Question 4 (a)(ii)

This question assessed candidates' understanding of the menstrual cycle. Strong answers that gained both marks stated that LH causes ovulation and that it stimulates the release of progesterone. Some candidates confused LH with FSH and suggested that it matures eggs. Some candidates also confused LH with oestrogen and suggested that it maintains the uterus lining. Many candidates gained at least one mark for correctly stating that LH induces ovulation.

(ii) Describe the functions of LH during the menstrual cycle.

(2)

LH stimulates ovulation and stimulates the production of progesterone.



This is a good answer that gained both marks for correctly stating that LH induces ovulation and the release of progesterone.

(ii) Describe the functions of LH during the menstrual cycle.

(2)

It causes eggs to release which starts to travel through uterus.

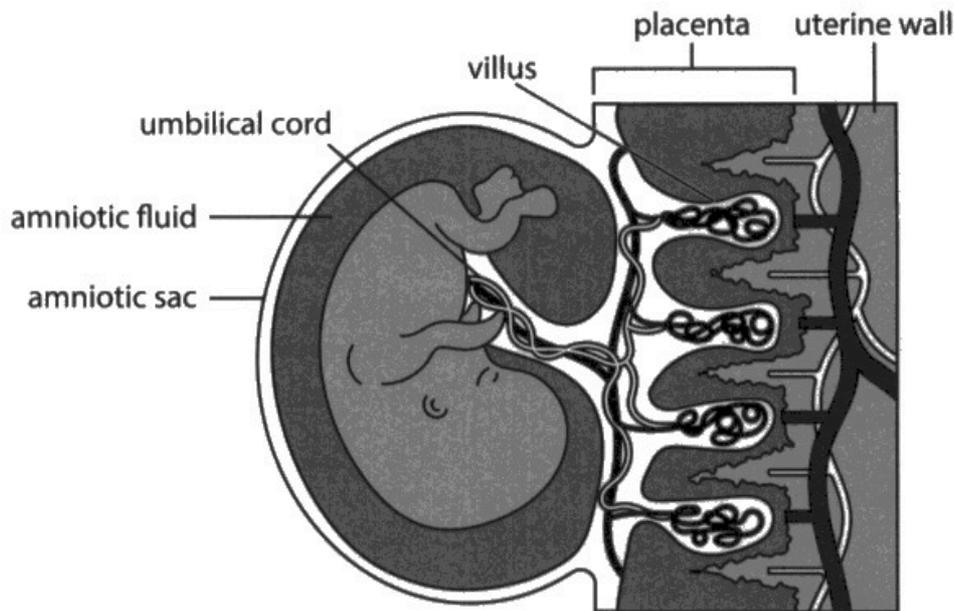


This answer gained one mark for the idea of ovulation. There is no mention of the release of progesterone.

Question 4 (b)

This question assessed candidates' factual knowledge of the roles of the amniotic fluid and placenta. Many excellent answers were seen that gained at least two marks, with many candidates gaining all three. To gain all three marks, candidates needed to explain the functions of both structures. Strong answers stated that the amniotic fluid prevents physical damage to the fetus and that the placenta is responsible for diffusion of substances such as glucose and oxygen from mother to fetus and diffusion of wastes such as carbon dioxide and urea from fetus to mother. Some answers also correctly stated that the placenta enables exchange without the mixing of the bloods. Weaker answers tended to use vague terms such as movement of nutrients or waste. Candidates should always try to name specific substances, such as oxygen, and give a direction of movement, eg from mother to fetus. A few candidates incorrectly suggested that the amniotic fluid transfer nutrients.

(b) The diagram shows a fetus developing in a uterus.



Explain how the amniotic fluid and placenta enable the safe growth of the fetus.

(3)

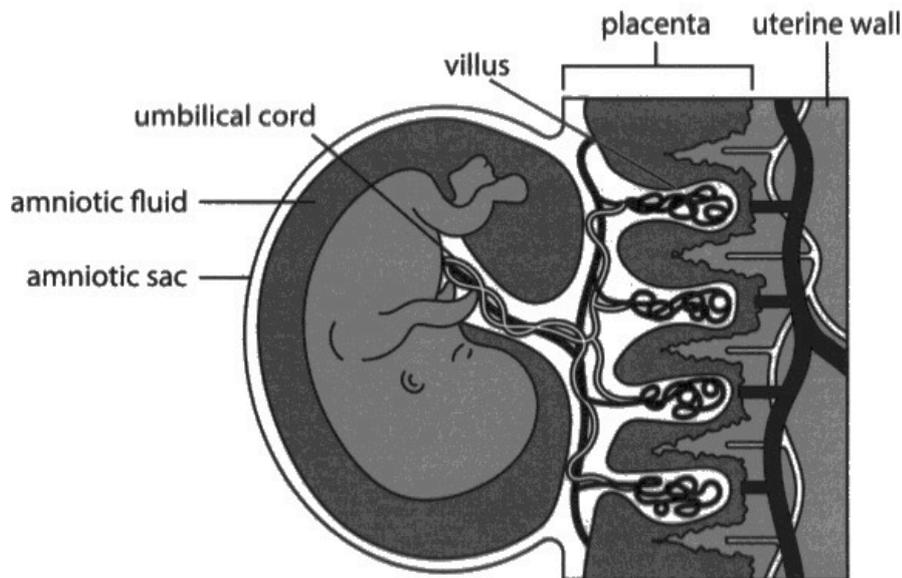
Amniotic fluid is the fluid the baby floats in meaning if the mother bumps her bump the baby should be unharmed. While the placenta ensures the baby gets sufficient glucose and food from the mother to ensure healthy growth. (The placenta also takes waste products from the baby like urine and gives it to the mother.)



ResultsPlus
Examiner Comments

This answer, although not perfectly expressed, gained two marks for the idea of amniotic fluid protecting from bumps and the transfer of glucose from mother to fetus.

(b) The diagram shows a fetus developing in a uterus.



Explain how the amniotic fluid and placenta enable the safe growth of the fetus.

(3)

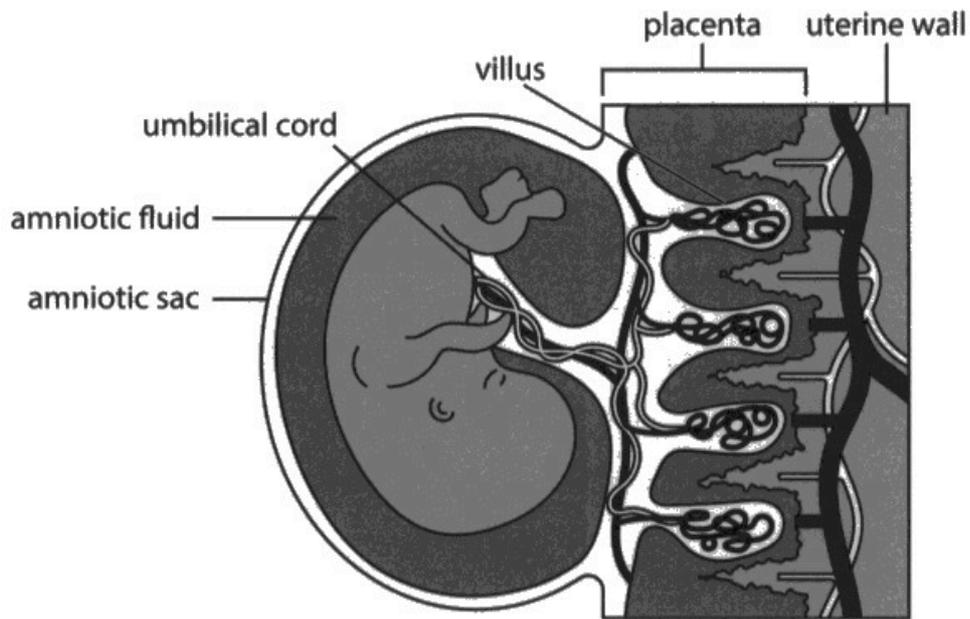
amniotic fluid is shock absorber ~~and~~ prevent adhesion of different body parts of fetus, maintain constant temperature and pressure, also, it is sterile. placenta act as barrier prevent mixing of maternal and fetal blood, prevent agglutination, clumping and rejection due to different blood groups, prevent damaging of fetal blood vessels due to high blood pressure in maternal blood vessels, placenta act as endocrine gland provide the uterus with progesterone and provide to ~~the~~ fetus with oxygen, glucose and antibodies into the umbilical cord by diffusion.



ResultsPlus
Examiner Comments

This is an excellent answer that gained all three marks. The candidate correctly explained that the amniotic fluid acts as a shock absorber, states that the maternal blood and fetal blood do not mix, and that the placenta enables the transfer of glucose, antibodies and oxygen from mother to fetus.

(b) The diagram shows a fetus developing in a uterus.



Explain how the amniotic fluid and placenta enable the safe growth of the fetus.

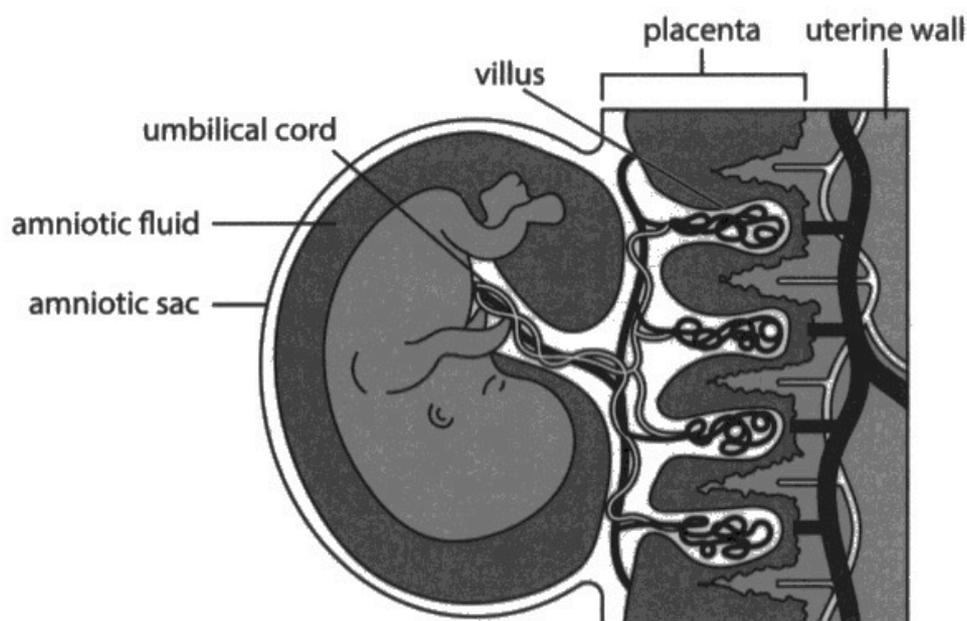
(3)

amniotic fluid keeps the baby
fetus safe from other organs and it is
full of minerals



This answer gained no marks. The comment about the amniotic fluid keeping the fetus safe is too vague.

(b) The diagram shows a fetus developing in a uterus.



Explain how the amniotic fluid and placenta enable the safe growth of the fetus.

(3)

The placenta is used to provide nutrients to the baby during pregnancy through the umbilical cord, and all the capillaries maintain the gradient created by diffusion. This ~~is~~ also happens with gases.



This answer gained one mark for the idea of diffusion. No credit was awarded for the transfer of nutrients as there were no named nutrients.

Question 4 (c)(i)

This three mark calculation required candidates to read two values from a graph, carry out a subtraction and calculate a percentage change. Many candidates were able to complete the calculation and gain all three marks. Common errors were: not giving the final answer to the nearest whole number, dividing by the wrong denominator (the question asked for a comparison with group D), and misreading the graph values.

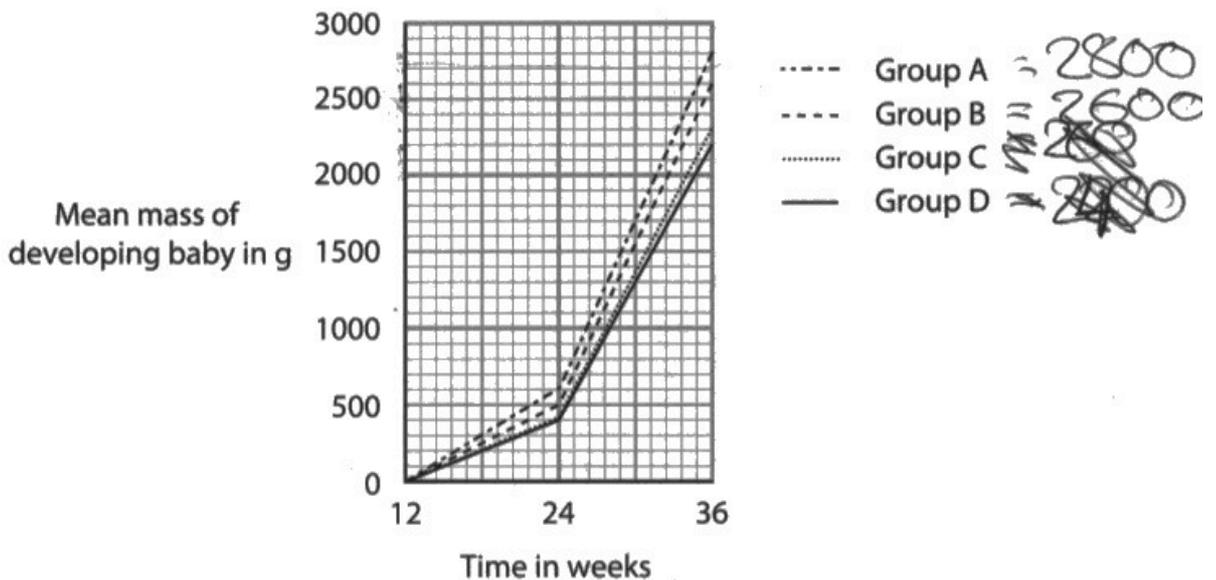
(c) Scientists investigated the effects of tobacco smoking and taking mineral ion supplements on the growth of developing babies during pregnancy.

The scientists looked at four groups of mothers.

- **Group A** non-smokers taking mineral ion supplements
- **Group B** non-smokers not taking mineral ion supplements
- **Group C** smokers taking mineral ion supplements
- **Group D** smokers not taking mineral ion supplements

Group D = 2200
Group C = 2300

The graph shows the mean masses of developing babies at 12 weeks of pregnancy at 24 weeks of pregnancy and at birth (36 weeks).



(i) Calculate the percentage difference at 36 weeks of the mean mass of babies from mothers in group A compared with the mean mass of babies from mothers in group D.

Give your answer to the nearest whole number.

(3)

$$2800 - 2200$$

percentage difference = $\frac{600}{2200} \times 100 = 27.27\%$



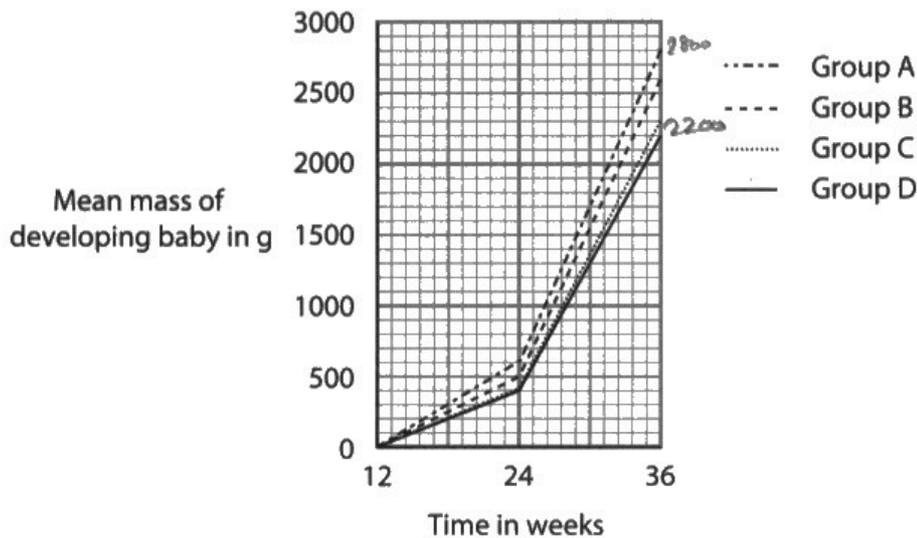
This answer gained one mark for correctly reading the values from the graph and subtracting them (600).

(c) Scientists investigated the effects of tobacco smoking and taking mineral ion supplements on the growth of developing babies during pregnancy.

The scientists looked at four groups of mothers.

- **Group A** non-smokers taking mineral ion supplements
- **Group B** non-smokers not taking mineral ion supplements
- **Group C** smokers taking mineral ion supplements
- **Group D** smokers not taking mineral ion supplements

The graph shows the mean masses of developing babies at 12 weeks of pregnancy at 24 weeks of pregnancy and at birth (36 weeks).



(i) Calculate the percentage difference at 36 weeks of the mean mass of babies from mothers in group A compared with the mean mass of babies from mothers in group D.

Give your answer to the nearest whole number.

Group A: 2800 (3)

Mean mass of developing baby

$$\frac{2800 - 2200}{2200} \times 100 = 27.27\%$$

Group D: 2200
mean mass of developing baby

percentage difference = 27.3 %



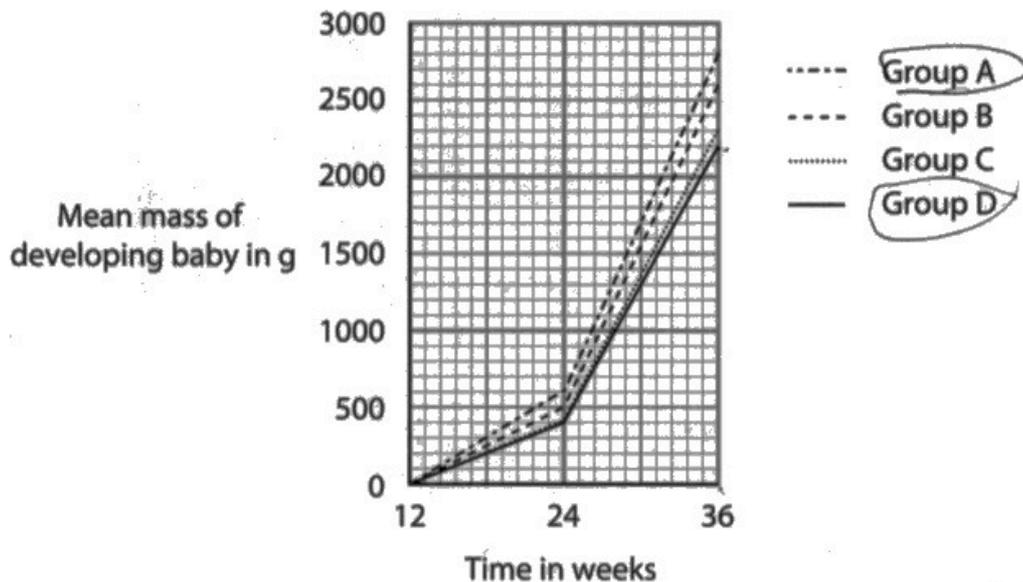
This answer gained two marks. The candidate has correctly subtracted the numbers and divided by 2200 but does not give their final answer to the nearest whole number.

(c) Scientists investigated the effects of tobacco smoking and taking mineral ion supplements on the growth of developing babies during pregnancy.

The scientists looked at four groups of mothers.

- **Group A** non-smokers taking mineral ion supplements
- **Group B** non-smokers not taking mineral ion supplements
- **Group C** smokers taking mineral ion supplements
- **Group D** smokers not taking mineral ion supplements

The graph shows the mean masses of developing babies at 12 weeks of pregnancy at 24 weeks of pregnancy and at birth (36 weeks).



(i) Calculate the percentage difference at 36 weeks of the mean mass of babies from mothers in group A compared with the mean mass of babies from mothers in group D.

Give your answer to the nearest whole number.

$$D = 2200$$

$$A = 2800$$

$$\frac{2800 - 2200}{2200} \times 100 = 27.273$$

(3)

percentage difference = 27 %



This is an example of a correct answer that gained all three marks. The candidate shows their working clearly and so is an example of good practice.



Always show all your working clearly – you may get marks even if the final answer is incorrect.

Question 4 (c)(ii)

This question generated a wide range of scores. Candidates were asked to comment on the effects of smoking and taking mineral ion supplements on the fetal growth. Many candidates scored at least two marks with a significant number going on to score all four. Strong answers described the decrease in growth due to smoking, the increase in growth due to taking mineral ions, and gave reasons for the effects, such as the effect of carbon monoxide and the role of calcium in bone growth. Some excellent answers also recognised that the effect of smoking was more significant than the effect of mineral ions. Weaker answers tended to identify one or two patterns, the fact that non-smokers with minerals had the highest growth but then gave no supporting explanations for the effects. With longer questions, candidates should identify all trends and patterns and use their own knowledge to give explanations. A number of candidates suggested that nitrates would need to be transferred for proteins, which suggests that they confused the mineral requirements of humans with plants.

- (ii) Comment on the effect of smoking and the effect of taking mineral ion supplements on the growth of babies.

Use the graph and your own knowledge to help your answer.

(4)

— smoking reduces growth of baby, because the mother gets less oxygen into the blood, and so the baby does too, so not enough O_2 for respiration.

— taking mineral ions increases growth because then the baby gets more mineral ions to be able to grow bones, so babies whose mothers had taken supplements saw greater growth than their counterparts.

(Total for Question 4 = 13 marks)

→ both babies whose mothers had smoked saw less growth overall, with mineral supplements unable to reverse damage



ResultsPlus
Examiner Comments

This is a good answer that gained four marks for: stating that smoking reduces growth, that minerals increase growth, that smoking reduces oxygen uptake and that oxygen is needed for respiration.

- (ii) Comment on the effect of smoking and the effect of taking mineral ion supplements on the growth of babies.

Use the graph and your own knowledge to help your answer.

(4)

Mothers who smoke grow babies that have less mass.

The babies with mineral supplements also have more mass.

Mothers who smoke also cause the baby to grow at a lesser rate than mothers who do not.

Mothers who take mineral ions cause the baby to grow at a faster rate.

Smoking has a greater impact on baby growth than mineral supplement.



ResultsPlus
Examiner Comments

This answer gained three marks for: identifying the effects of smoking and minerals on growth, recognising that smoking has a bigger impact compared with the mineral ions.

- (ii) Comment on the effect of smoking and the effect of taking mineral ion supplements on the growth of babies.

Use the graph and your own knowledge to help your answer.

(4)

Taking mineral ion helps the fetus grow healthy and breathing oxygen well.

~~Smoking replaces haemo~~

Carbon monoxide replaces haemoglobin in red blood cell forming carboxy haemoglobin making fetus unable to breath and grow healthy



ResultsPlus
Examiner Comments

This answer gained one mark for the effect of carbon monoxide. The reference to healthy growth was not given a mark as it is not the same as 'more growth'.

- (ii) Comment on the effect of smoking and the effect of taking mineral ion supplements on the growth of babies.

Use the graph and your own knowledge to help your answer.

(4)

Smoking has a higher effects on the growth of babies, decreasing the mean mass of the baby. ~~the~~
not taking mineral ions also decreases the mean mass of the baby.
taking minerals will effect the growth and health of the baby but smoking will pass on poisonous and harmful toxins to the baby stunting its growth.



ResultsPlus
Examiner Comments

This answer gained two marks for identifying the effects of smoking and mineral ions on growth. The reference to poisons is too vague as the mark needed a reference to carbon monoxide.

- (ii) Comment on the effect of smoking and the effect of taking mineral ion supplements on the growth of babies.

Use the graph and your own knowledge to help your answer.

(4)

Groups C and D had significantly smaller babies throughout the pregnancy with the ^{mean} weight of ~~their 2 babies~~ their ~~babies~~ babies at 36 weeks (Group C - 2300g, Group D - 2200g) being a couple hundred grams ~~about 400~~ less than groups A and B (Group A - 2800g, Group B - 2600g) at 36 weeks. This means that smoking hinders the growth of your baby. Group D also had a ~~bit~~ little less mass than Group C ~~(C)~~ and the only difference was that Group C was also on mineral iron supplements (and the same is true for Groups A and B with A being on the supplements) so taking mineral supplements increases the weight of your baby albeit by a bit ~~less~~. This is because smoking can lead ^{little}

(Total for Question 4 = 13 marks)

to clogged ~~arteries~~ arteries or even tears in the artery wall from high Blood Pressure so less blood (and less oxygen) will get to the fetus. This in turn leads to less respiration and so less energy produced for growth. Also ~~the~~ mineral supplements are good for the baby as most minerals like iron, calcium or even nitrates are useful for some aspect of growth like blood cells, bones, and amino acids ^{respectively} ~~respectively~~ so mineral supplements lead to more growth.



This answer gained four marks for: identifying the effects of smoking and mineral ions on growth, stating that smoking leads to less oxygen and respiration and stating that iron is needed for red blood cells and calcium for bones. Note that nitrate would not have been accepted as an example of a mineral.

Question 5 (b)(i)

This question required candidates to interpret the data to determine how many other sequences would code for the same sequence of amino acids. Most candidates reached the correct answer. Some candidates suggested the answer was four – the question asked for **other** sequences.

Question 5 (b)(ii)

This challenging question generated a good range of answers. Many excellent, very strong answers were seen that explained that some mutations would lead to the same amino acid which would produce the same protein and that mutations for amino acids not in the active site may have less effect. Some candidates gave excellent answers that explained that some mutations may occur in non-coding DNA or that they may result in recessive alleles that would not have an effect if there was also a dominant allele. Weaker answers tended to focus only on the fact that some amino acids have more than one code and so would not change.

- (ii) Explain why most genetic mutations have no effect on the phenotype of an organism.

Use the information in the table and your own knowledge in your answer.

(3)

some ^{codons} amino acids still code for same amino acid. mutation might be in non-coding section of DNA or on the recessive allele of heterozygous. or the active site is not changed.



ResultsPlus
Examiner Comments

This excellent answer gained all three marks. The candidate clearly states that some codons still code for the same amino acids, that the mutations may occur in non-coding DNA, may be recessive or may not change the active site.

- (ii) Explain why most genetic mutations have no effect on the phenotype of an organism.

Use the information in the table and your own knowledge in your answer.

(3)

Because some amino acids are coded for by the same amino acid known as degenerate and sometimes the active site of enzyme doesn't change and enzyme substrate complex can form active for same protein.



This strong answer gained all three marks for correctly stating that the amino acids may not change, the active site may not change and that the protein is the same.

- (ii) Explain why most genetic mutations have no effect on the phenotype of an organism.

Use the information in the table and your own knowledge in your answer.

(3)

because ~~not~~ some amino acids have multiple types of codons so some protein will be produced like changing nucleotides but same amino acid



This answer gained two marks for correctly stating that the amino acids may not change and that protein will be the same.

(ii) Explain why most genetic mutations have no effect on the phenotype of an organism.

Use the information in the table and your own knowledge in your answer.

(3)

many codons code for the same amino acid
so the same protein is made, so phenotype
does not change
no change in protein shape
protein still complementary to make enzyme-
substrate complexes



This strong answer gained all three marks for correctly stating that the amino acids would remain the same, that enzymes would still bind the substrates and that there is no change in protein structure.

Question 5 (b)(iii)

This question required candidates to identify one factor that would increase the rate of mutations. Most candidates were able to correctly identify one factor, the most common correct factors were: smoking, ultraviolet radiation, X-rays, gamma rays and chemical mutagens.

IN RECESSIVE GENE SO MUTATION SHOW
(iii) State one way that the incidence of mutations can be increased. (1)

Exposure to ionising radiation such as gamma rays.



This answer gained one mark for correctly stating ionising radiation.

5th code for the same problem
(iii) State one way that the incidence of mutations can be increased. (1)

exposure excessive exposure to gamma rays

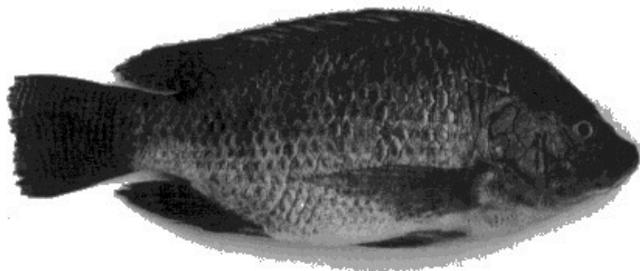


This answer gained one marks for correctly suggesting gamma rays.

Question 6 (a)(i)

This calculation required candidates to determine the ratio of lipid to protein to carbohydrates. Most candidates were able to correctly calculate the ratio. The calculation of ratios is a mathematical skill listed in the specification.

- 6 The photograph shows a fish called tilapia. This type of fish is often grown in fish farms.



(Source: © DAVID NUNUK / SCIENCE PHOTO LIBRARY)

- (a) Tilapia are a good source of nutrients for humans.

The table shows the percentage of the daily requirements for humans of three nutrients provided by a portion of tilapia.

Nutrient group	Percentage of daily requirement provided by a portion of tilapia
lipids	16
protein	38
carbohydrate	16

- (i) Use the table to determine the ratio of lipid to protein to carbohydrate.

Give your answer in the form 1: n : 1

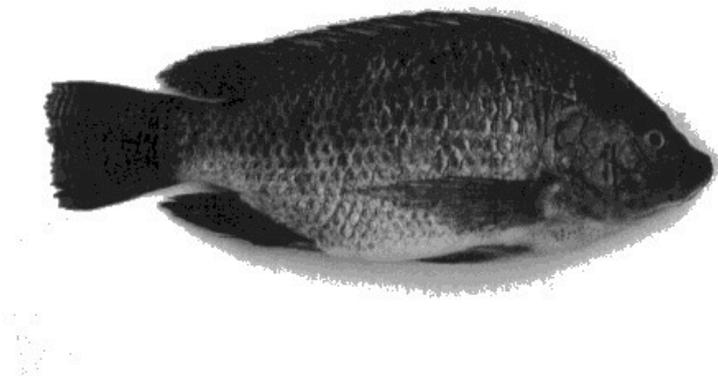
(1)

ratio = 1: 2.375 : 1



This answer gained one mark for correctly stating 2.375.

- 6 The photograph shows a fish called tilapia. This type of fish is often grown in fish farms.



(Source: © DAVID NUNUK / SCIENCE PHOTO LIBRARY)

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The table shows the percentage of the daily requirements for humans of three nutrients provided by a portion of tilapia.

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carbohydrate	16

- (i) Use the table to determine the ratio of lipid to protein to carbohydrate.

Give your answer in the form 1: n : 1

L P C
16 : 38 : 16

(1)

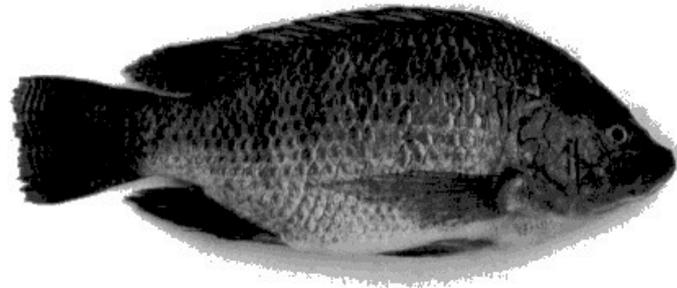
ratio = 1: 2 : 1



ResultsPlus
Examiner Comments

This answer gained one mark for correctly giving the ratio as 1:2:1.

6 The photograph shows a fish called tilapia. This type of fish is often grown in fish farms.



(Source: © DAVID NUNUK / SCIENCE PHOTO LIBRARY)

(a) Tilapia are a good source of nutrients for humans.

The table shows the percentage of the daily requirements for humans of three nutrients provided by a portion of tilapia.

Nutrient group	Percentage of daily requirement provided by a portion of tilapia
lipids	16
protein	38
carbohydrate	16

(i) Use the table to determine the ratio of lipid to protein to carbohydrate.

Give your answer in the form 1: n : 1

(1)

16 38 16
1 19n 1

ratio = 1: 19n : 1



This is an example of an incorrect answer where the candidate has not divided by the correct number.

Question 6 (a)(ii)

This question assessed candidates' understanding of the food test core practicals. There are four practical food tests that candidates need to know: starch, glucose, protein and lipid. This question required candidates to describe how to test a sample of fish for lipids. Most candidates were able to gain at least one mark. Most candidates described the emulsion test that produces a cloudy, white emulsion. A common error was to describe the use of ethanol but without adding water. Some candidates correctly suggested using the Sudan III test along with the production of a red layer of liquid. A few candidates confused the lipid test with the test for protein or the test for sugar.

(ii) Describe how to test a sample of tilapia to show the presence of lipid.

(2)

emulsion test - mix the sample with an equal volume of water and ethanol and shake. A milky white layer will form if lipids are present
* break the sample down with a knife



ResultsPlus
Examiner Comments

This excellent answer gained two marks for: adding water and ethanol, the production of a cloudy white emulsion.



ResultsPlus
Examiner Tip

Make sure you know all four food tests.

(ii) Describe how to test a sample of tilapia to show the presence of lipid.

(2)

Add Sudan III solution. It turns red.



ResultsPlus
Examiner Comments

This answer gained two marks for the use of Sudan III and the red colour that results from it.

(ii) Describe how to test a sample of tilapia to show the presence of lipid.

(2)

by using Sudan II if lipids are present
it will turn orange / ~~white~~ / yellow
green



ResultsPlus
Examiner Comments

This answer gained one mark for the use of Sudan III but the colour change is incorrect so no second mark was awarded.

(ii) Describe how to test a sample of tilapia to show the presence of lipid.

(2)

Add ethanol and a cloudy layer or white layer
~~with~~ will form tilapia can be grinded and put in a test
tube. Add ethanol and a cloudy layer will form on
top of it.



ResultsPlus
Examiner Comments

This answer gained one mark for the positive result of the emulsion test. Mark point one was not awarded as there is no mention of water.

Question 6 (a)(iii)

This straightforward question assessed candidates' factual knowledge of the role of proteins in the diet. Most candidates were able to correctly state that proteins are essential for growth or repair of tissues. A few candidates incorrectly stated that proteins are used for insulation of energy.

(iii) Tilapia has high levels of protein.

State one function of protein in the human body.

(1)

Repair of body tissues.



ResultsPlus
Examiner Comments

This is an example of a correct answer that gained one mark – the use of protein for repair.

(iii) Tilapia has high levels of protein.

State one function of protein in the human body.

(1)

~~building~~ building muscle.



ResultsPlus
Examiner Comments

This answer gained one mark as an equivalent to growth.

Question 6 (b)(i)

This question required candidates to calculate the mean rate of increase in mass of tilapia. Most candidates were able to correctly determine the mean increase and most were then able to go on to divide this by seven to determine the rate of increase. The question asked for the answer to be given to three significant figures which most candidates did correctly. The most common error seen was confusing significant figures for decimal places.

(b) Scientists have produced genetically modified (GM) tilapia that grow faster.

Scientists investigate the growth of these GM tilapia compared with non-genetically modified (non-GM) tilapia.

This is the scientists' method.

- set up two equally sized tanks containing water
- put non-GM tilapia into one tank
- put an equal mass of GM tilapia into the second tank
- feed the fish in each tank the same mass of protein pellets

The mass of each type of fish was measured at the start of the investigation and after seven months.

A measure called the feed conversion index was also calculated for each type of fish.

The table shows the scientists' results.

Type of fish	Total starting mass of fish in g	Total mass of fish after seven months in g	Feed conversion index
non-GM	1250	2830	1.9
GM	1250	3750	1.2

(i) The mean rate of increase in mass of the non-GM tilapia during the seven months is 226 g per month.

Calculate the mean rate of increase in mass, in g per month, of the GM tilapia.

Give your answer to three significant figures.

(2)

$$3750 - 1250 = 2500$$

$$= \frac{2500}{7} = 357.14$$

$$\text{mean rate of increase} = \frac{3750 - 1250}{7} = 357.1429 \text{ g per month}$$



This answer gained one mark for correctly calculating the mean rate of increase. The candidate has not given the answer to three significant figures.



Don't confuse significant figures with decimal places.

(b) Scientists have produced genetically modified (GM) tilapia that grow faster.

Scientists investigate the growth of these GM tilapia compared with non-genetically modified (non-GM) tilapia.

This is the scientists' method.

- set up two equally sized tanks containing water
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non-GM	1250	2830	1.9
GM	1250	3750	1.2

(i) The mean rate of increase in mass of the non-GM tilapia during the seven months is 226 g per month.

Calculate the mean rate of increase in mass, in g per month, of the GM tilapia.

Give your answer to three significant figures.

$$\frac{2830 - 1250}{7} = 225.7 = 226$$

$$\frac{3750 - 1250}{7} = 2500 \div 7 = 357.142$$

mean rate of increase = 357 g per month



This answer gained both marks. The candidate has correctly calculated the mean rate of increase and gone on to give the final answer to three significant figures.

Question 6 (b)(ii)

This question required candidates to extract data from a table and rearrange a formula to calculate the mass of feed pellets given to tilapia. Most candidates were able to correctly calculate the mass and gain the mark. A few candidates rearranged the formula incorrectly.

- (ii) The feed conversion index is a measure of the mass of protein pellets used compared with the increase in mass of tilapia.

It is calculated using this formula.

$$\text{feed conversion index} = \frac{\text{total mass of protein pellets used}}{\text{increase in mass of tilapia}}$$

Use the information in the table to calculate the mass of protein pellets given to the non-GM tilapia.

$$1.9 = \frac{?}{\frac{2830}{1580}}$$

$$\cancel{1.9 \times 2830} = 5377$$

(1)

$$1580 \times 1.9 = 3002$$

$$\text{mass of protein pellets} = \frac{3002}{\cancel{5377}} \dots \text{g}$$



This is a correct answer that gained one mark.

- (ii) The feed conversion index is a measure of the mass of protein pellets used compared with the increase in mass of tilapia.

It is calculated using this formula.

$$\text{feed conversion index} = \frac{\text{total mass of protein pellets used}}{\text{increase in mass of tilapia}}$$

Use the information in the table to calculate the mass of protein pellets given to the non-GM tilapia.

$$\begin{aligned} \text{mass} &= \text{feed conversion} \times \text{increase in mass} \\ &= 1.9 \times 226 = 429.4 \end{aligned} \quad (1)$$

mass of protein pellets = 429.4.....g



This answer is incorrect, the candidate has selected the wrong information from the table.

Question 6 (b)(iii)

This challenging question required candidates to use the equation for feed conversion index and the data in the table to suggest reasons for the lower index for the GM tilapia. Many candidates correctly recognised that a low efficiency meant that the growth of the GM tilapia is higher with the same mass of food. Only a minority of candidates went on to suggest reasons for the higher growth rate, such as the presence of more digestive enzymes, the release of less faeces or a lower respiration rate of the fish. Most candidates gave descriptions of the data without suggesting reasons for the differences.

(iii) Suggest why the GM tilapia have a lower feed conversion index than the non-GM tilapia.

(2)

GM tilapia grows faster. It consumes more pellets faster. Faster protein digested, faster break down of protein into amino acids by peptidase enzyme. More growth and repair. As a result, at the end of 7 months, increase in mass of GM tilapia is greater than that of normal tilapia.



ResultsPlus
Examiner Comments

This is an excellent answer that gained two marks. The candidate has correctly stated that the GM tilapia grows faster and then goes on to suggest reasons such as the faster breakdown with peptidase enzymes.



ResultsPlus
Examiner Tip

The command word 'suggest' means that the context may be unfamiliar but you need to use your own knowledge to think of an answer.

(iii) Suggest why the GM tilapia have a lower feed conversion index than the non-GM tilapia.

(2)

The genetically modified tilapia is adapted to have a lower feed conversion than the non-GM tilapia.



This answer gained no marks. The candidate has not suggested any explanation for the difference in the index and has simply described the difference in efficiency.

(iii) Suggest why the GM tilapia have a lower feed conversion index than the non-GM tilapia.

$$1.2 = \frac{x}{3750-1250} \quad x = 3000911 (2)$$

Because the GM tilapia might need less energy as it doesn't move around much. ~~and~~ It is genetically modified so it grows quickly without much food requirement. The GM is also much larger than the non-GM.



This strong answer gained two marks for correctly stating that the GM tilapia grows faster and that it may move less.

(iii) Suggest why the GM tilapia have a lower feed conversion index than the non-GM tilapia.

(2)

Total mass of fish after seven months in g of non-GM is smaller than GM. Non-GM fish didn't eat enough food.



This answer gained two marks for correctly stating that the GM tilapia would be larger and that the non-GM tilapia may eat less of the food.

(iii) Suggest why the GM tilapia have a lower feed conversion index than the non-GM tilapia.

(2)

Because had a higher increase in mass with the same mass of protein pellets. GM could consume grow faster with same mass of pellets.



This answer gained one mark for stating that the GM tilapia grew more. No other explanation is given so no more marks were awarded.

Question 6 (b)(iv)

This practical skills question asked candidates to give an abiotic factor that would need to be kept constant. Candidates were told in the question stem that the food mass and tank sizes were kept the same and were asked for **other** factors. Most candidates correctly stated temperature, pH or oxygen concentration. A number of candidates incorrectly listed biotic variables such as predator number – candidates should be clear on the difference between biotic and abiotic factors.

(iv) Both groups of fish were fed the same mass of pellets and placed into the same sized tanks of water.

Give **one** other abiotic factor that the scientists should keep constant.

(1)

~~The gender~~ or The number of fishes



ResultsPlus
Examiner Comments

This answer did not gain any marks as the fish number is not an abiotic factor.

(iv) Both groups of fish were fed the same mass of pellets and placed into the same sized tanks of water.

Give **one** other abiotic factor that the scientists should keep constant.

(1)

The ~~water~~ water quality of water



ResultsPlus
Examiner Comments

This answer gained no marks – phrases such as 'water quality' are too vague. Candidates should always give specific factors.

(iv) Both groups of fish were fed the same mass of pellets and placed into the same sized tanks of water.

Give **one** other abiotic factor that the scientists should keep constant.

(1)

Oxygen



This gained one mark – oxygen is a correct abiotic factor.

(iv) Both groups of fish were fed the same mass of pellets and placed into the same sized tanks of water.

Give **one** other abiotic factor that the scientists should keep constant.

(1)

The water pH.



This answer gained one mark – pH is a correct abiotic factor.

(iv) Both groups of fish were fed the same mass of pellets and placed into the same sized tanks of water.

Give **one** other abiotic factor that the scientists should keep constant.

(1)

temperature



This answer gained one mark – temperature was the most common correct answer seen.

Question 6 (b)(v)

This question generated an excellent range of responses. Candidates were asked to evaluate the validity of a conclusion that the GM tilapia would be better for the environment and reduce disease. Strong answers explained that the GM tilapia grow faster and waste less food. Strong answers often went on to state that the feed conversion index shows that the GM tilapia would waste less food and may release less faeces, both of which would reduce decomposition, the chance of eutrophication and the loss of oxygen due to bacterial respiration. Some candidates correctly explained that there was little evidence for a reduction in disease spread from the data and that the GM tilapia would have similar genetics and so may be more susceptible to disease. Many candidates also correctly stated that there was no statement regarding sample size or that the experiment would need repeating. Only a few candidate suggested that the GM tilapia could have other negative environmental impacts, such as escape resulting in competition with wild fish. Many candidates wrote very strong answers that explored the data and included knowledge from the specification and gained at least three marks. Weaker answers tended to gain one or two marks for describing the data patterns, but often gave no evaluation of the conclusion.

- (v) The scientists conclude that farming GM tilapia is better for the environment than farming non-GM tilapia. This is because the GM tilapia would result in less nitrate in the water and cause less spread of disease.

none decompose
escaped breed w/ wild

Evaluate this conclusion.

Use the information in the table and your own knowledge in your answer.

(5)

TRUE: If the GM tilapia use more of the minerals to grow / have higher feed conversion (FC) index, they waste / pass less of what they eat (more nitrates used to build amino acids, used 2 build proteins, used 2 build tissues & growth) is wasted & hence less nitrates are in the water which bacteria/decomposers decompose/break down - thus reducing spread of disease. However, spread of disease could just be controlled by filtering & cleaning / using antibiotics to ^{prevent spread of disease.} ensure fish are ~~diseased~~. ^{however, if} GM tilapia can also GM tilapia are bigger they ^{will/could eat more,} & thus likely produce more/larger faeces. This means that they would actually spread more disease - ^{bacteria have more} more to decompose & reproduce more, increasing spread of disease. Decomposers also ^{decrease} ~~increase~~ the fish's rate of growth by drawing O₂ from ~~water~~ ^{water} to respire & decompose, which reduces O₂ available to fish, reduces fish ^(Total for Question 6 = 15 marks) ability to respire, reduce fish ability to grow / less growth. **TOTAL FOR PAPER = 70 MARKS**

GM tilapia are also not natural - they could have a DNA sequence that codes for disease/is harmful which is also passed into offspring & increase diseased population



This is an excellent answer that gained five marks. The candidate describes that the GM tilapia grow more and eat more food. They also explain that food waste leads to bacterial decomposition and link this to oxygen. The candidate also explains that the GM tilapia genetically may be more susceptible to disease.

- (v) The scientists conclude that farming GM tilapia is better for the environment than farming non-GM tilapia. This is because the GM tilapia would result in less nitrate in the water and cause less spread of disease.

Evaluate this conclusion.

Use the information in the table and your own knowledge in your answer.

(5)

GM tilapia is better and scientists conclusion is right, GM tilapia grow faster meaning there doesn't have to be alot of fish in one place which can spread diseases easily, & GM tilapia will be more immune to diseases and are better because there will be less nitrate in the water meaning less respiration and less expensive farming and less water pollution than non-GM tilapia.



This answer gained two marks for correctly stating that the GM tilapia grow faster and that there is less respiration.

- (v) The scientists conclude that farming GM tilapia is better for the environment than farming non-GM tilapia. This is because the GM tilapia would result in less nitrate in the water and cause less spread of disease.

Evaluate this conclusion.

Use the information in the table and your own knowledge in your answer.

(5)

The GM tilapia ~~will grow~~ resulting in less nitrates means that aquatic plants and algae grow more slowly. This prevents an algal bloom, so plants are able to receive light and photosynthesise. This means that less plants die, so less bacteria will be present which uses up the oxygen content of the water for respiration to decompose organic waste. So, the water doesn't become anoxic and fish don't die. Less bacteria reduces the spread of disease, further increasing the yield of the fish and increasing biodiversity. However, genetic modification reduces variation and the gene pool. Less food is needed for the GM tilapia, so less is wasted and less is decomposed by bacteria.



ResultsPlus
Examiner Comments

This is an excellent answer that gained all five marks. The candidate clearly explains that there would be less plant growth, less bacterial composition, less respiration and oxygen usage. They also described that the GM tilapia are more efficient at eating the food and release less waste.

- (v) The scientists conclude that farming GM tilapia is better for the environment than farming non-GM tilapia. This is because the GM tilapia would result in less nitrate in the water and cause less spread of disease.

Evaluate this conclusion.

Use the information in the table and your own knowledge in your answer.

(5)

GM ~~to~~ tilapia weigh more than Non-GM tilapia so more yield and less amount of food used to reach the same mass as they have a lower feed conversion index. GM tilapia will make less nitrate in water so less ~~algae~~ ^{algae} growth on water surface so more light to plants underwater so more photosynthesis more oxygen in water for aquatic life. less eutrophication. Less spread of disease as they are resistant, ~~and~~ reducing fish death and decomposition.



This answer gained four marks. The candidate correctly states that the GM tilapia are heavier, need less food to reach the same mass, cause less eutrophication, and there is less decomposition.

Paper Summary

Based on their performance on this paper, candidates should:

- Have a full understanding of all the command words listed in the specification.
- Use scientific terminology accurately.
- Read questions thoroughly so that answers relate directly to the questions posed.
- Have a full knowledge of all the required maths skills.
- Have a thorough knowledge of all practical terminology, such as biotic and abiotic factors.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

<https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html>

