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Examiners' Report
June 2013

GCE Biology 6BI02 01

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Introduction

Overall, many candidates demonstrated a relatively good standard of biological knowledge, but the standard of communication often let them down. Poor spelling, punctuation and grammar led to many marks being lost. Apparent inability to read questions carefully and actually use information presented on the question paper cost many candidates vital marks.

There was evidence of good recollection of the stages of mitosis, clinical trials for drug testing and familiarity with core practicals. The processes involved in the fertilisation of a mammalian egg were less well understood - especially those stages following the acrosome reaction. The role of captive breeding programmes in zoos was grasped by many, although not all were able to identify the aspects that maintained genetic diversity in endangered species. Many candidates interpreted data from tables and graphs effectively, remembering to use appropriate units and realising that manipulation of data to support statements will gain extra marks. However, there were examples where candidates had misread graphs, or failed to define trends in data with sufficient precision to gain marks.

A significant minority also had handwriting which was very difficult to read. There were indeed a few entries where virtually no marks could be awarded as the writing was illegible – those candidates would have benefited from the use of a scribe or the opportunity to word process their responses. Centres should bear in mind that examiners have not had the opportunity to become accustomed to the quirks of an individual's handwriting and that responses have to be readable.

Frequently candidates were unable to articulate their answer in a way that correctly answered the question. This is something that can be addressed by centres, especially through encouraging correct use of key vocabulary and practising exam technique.

Question 2 (a)

The question specifically asked for a description and explanation of the 'events following the acrosome reaction' that prevent polyspermy.

However, many candidates misread the question and wasted time giving long descriptions of the acrosome reaction describing the acrosome reaction itself. Space was lost due to candidates giving information on fertilisation and the acrosome reaction despite having been instructed to describe the events 'following the acrosome reaction'. This left candidates trying to squeeze the actual answer in at the end, many ended up with just a few lines left which led to a brief and rather superficial discussion of the cortical reaction. Candidates must take care when reading the question and give only the information requested.

The best answers described the cortical reaction and mentioned cortical granules, describing how they fused with the surface membrane of the egg and thickened the zona pellucida. However, several made reference to the cortical granules but were not really sure where they were and what exactly they did. Very few candidates referred to the fusing of the cortical granules or exocytosis. Many candidates talked about the membrane or wall hardening rather than zona pellucida or jelly layer.

Others explained why the zona pellucida thickened rather than how. There was also some confusion between enzymes involved in the acrosome reaction and those in the cortical reaction.

Fewer lost marks for misspelling than in recent years, but those that did were due to referring to 'cortisol' or 'corticle' instead of 'cortical' along with several variations on 'zona pellucida' including the inventive 'pollum zollum'.

2 Several processes lead up to fertilisation in animals and plants.

*(a) Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.

(4)

Once the acrosome burst the sperm cell can fuse with the cell membrane of egg cell. This process is species specific by a certain protein receptor. Now the sperm cell can release the male nucleus inside the ~~ovary~~ egg cell. Once the male nucleus enters the ~~ovary~~ egg cell, cortical granules which is present in the cytoplasm of egg cell will migrate near the cell surface. It fuses with the cell membrane and thus release its chemicals to zona pellucida which ~~makes~~ hardens the zona pellucida. So no more sperm can enter the egg cell and prevent polyspermy

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Examiner Comments

A good clear answer, gaining full marks for sperm cell fusing with cell membrane of egg cell for mp1, followed by a good account of what happens with the cortical granules for mp2, mp3, mp5 and then mp6.

ResultsPlus
Examiner Tip

Short sentences each describing a specific event make it easier for candidates to construct their responses and for examiners to mark them.

2 Several processes lead up to fertilisation in animals and plants.

*(a) Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.

(4)

During the acrosome reaction, the jelly layer of the egg gets hydrolysed. Cell surface membrane of sperm and egg cell fuse enabling haploid nucleus from sperm to enter the cytoplasm of egg cell. Special vesicles (cortical granules) move towards and fuse with the cell surface membrane. They release their contents (enzymes (through exocytosis) which causes changes in surface layers of egg cell (the zona pellucida hardens) preventing other sperm from entering the egg cell.

ResultsPlus
Examiner Comments

Another good example, gaining mp1, mp2, mp3, mp4, mp5 and mp6.

2 Several processes lead up to fertilisation in animals and plants.

*(a) Describe and explain how, in mammals, events following the acrosome reaction prevent more than one sperm fertilising an egg.

(4)

The acrosome in the sperm swells and burst once Sperm come in contact with the secondary oocyte cellmembrane. of The enzymes digest the zonal pellucida and follicle cell so that sperm nuclei nucleus can enter the secondary Oocyte cell and fuse with mature egg nuclei. During this time the cortical granules release its enzymes to the and hardens zona pellucida once sperm enter nucleus enter the ovum and prevents other sperm enbring the ovum

ResultsPlus
Examiner Comments

This is an example of a response that does not gain any marks until the final sentence. mp2 for cortical granules is not given due to misspelling (this is a QWC question), but mp 5 and 6 are gained.

ResultsPlus
Examiner Tip

Make sure the answer addresses the question.

Question 2 (b)

This was generally poorly answered, with a majority of candidates receiving one mark for mentioning both crossing over and random assortment. Many candidates clearly picked up the clue of '2 marks', correctly offering the words independent assortment and crossing over, but failed to pick up on the other clue: that there was plenty of space in which to write, and that therefore more explanation was expected. Explanations of how the two processes provide genetic variation were generally very poor. Generally, crossing over was described more successfully than independent assortment, although a fair number did not get the 'exchange' idea across in their writing. The usual lack of understanding relating to 'genes and alleles' added another layer of pitfalls; it is an exchange of alleles of the same gene that occurs, rather than an exchange of genes between chromatids, that brings about genetic variation in the gametes.

Some students discussed mutation and random fertilisation, having misinterpreted the question as referring to variation as a whole. Many students discussed the events of fertilisation that give rise to variation, rather than confine their answers to the events in meiosis.

Common descriptions that did not gain credit included:

- crossing over gives rise to different sets of alleles
- genes get mixed up by crossing over
- different alleles are produced
- genetic material is mixed up by crossing over.

Terms like 'genes', 'allele', 'chromatid' and 'chromosome' tended to be used interchangeably, which did lead to jumbled, imprecise explanations.

(b) Animals produce haploid gametes by meiosis.

Explain how meiosis gives rise to genetic variation in gametes.

(2)

Meiosis gives genetic variation due to the process of independent assortment and crossing over. In independent assortment, there is random aligning of chromosomes' homologous pairs giving a different selection of paternal and maternal chromosomes. In crossing over, the end parts of the chromatids separate and rejoin in the ~~sister chromatids~~ non sister chromatids, leading to variation, during metaphase.

ResultsPlus
Examiner Comments

This response gets the first mark for listing both independent assortment and crossing over. It also gets a mark for a good description of independent assortment. There is also a reasonably good account of crossing over.

(b) Animals produce haploid gametes by meiosis.

Explain how meiosis gives rise to genetic variation in gametes.

(2)

• Crossing over: non-sister chromatids paired up as bivalent tetrads exchange sections of DNA at chiasmata in prophase 1 & metaphase - 1. This creates variation & is coupled with
• Independant assortment: The random distribution of chromatids from maternal & paternal origins ~~of~~ when the gametes are formed, ~~[illegible]~~ therefore each gamete ~~[illegible]~~ has a unique combination of alleles for various genes.

ResultsPlus
Examiner Comments

Although a bit messy, this response is still readable.

Marks can be given for crossing over and independent assortment and also for a description of crossing over.

(b) Animals produce haploid gametes by meiosis.

Explain how meiosis gives rise to genetic variation in gametes.

(2)

By the help of independent assortment of the homologous pairs of chromosomes.

By the crossing-over that takes place between the chromosomes.

ResultsPlus
Examiner Comments

This response gains one mark only for listing independent assortment and crossing over.

ResultsPlus
Examiner Tip

Look at the 'command' words in a question. The word 'explain' requires just that - an explanation.

'How do the processes of crossing over and independent assortment give rise to genetic variation?'

(b) Animals produce haploid gametes by meiosis.

Explain how meiosis gives rise to genetic variation in gametes.

(2)

meiosis gives rise to genetic variation by the proccess of crossing over and independent assortment.

ResultsPlus
Examiner Comments

This response gets just one mark - note there is no indication here of what is crossing over or what is being assorted independently!

Question 2 (c) (i)

This was quite well answered on the whole, with many achieving full marks. However, the majority of candidates scored just one mark on this question for discussing either the control of variables or mentioning that temperature would affect growth. There was much confusion between the terms 'controlled' and 'control'. The majority referred to temperature as a 'control variable'. A 'control' is conducted for the purpose of comparison, whereas variables that would affect the investigation have to be controlled.

The other major error was to refer to 'reliability of the results' or 'validity of results' rather than 'validity of investigation'.

Many candidates obviously had an understanding of what was wanted, but expressed themselves badly. It must be taken on board that 'fair testing' is not an appropriate phrase to use at this level and will not be credited; although the concept of making an investigation a 'fair test' is something that students find easy to grasp, the means by which this is achieved must be understood. There was little evidence that the terms 'accurate', 'reliable', 'precise' and 'valid' were understood or used correctly.

However, it was pleasing to note that most candidates clearly grasped the connection between temperature and growth rate, and that some associated that with enzyme activity.

(i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

It is the controlled variable, so that the temperature would have no effects on the growth of pollen tube. Only the concentration of methylpurine would influence the growth of the pollen tube.

ResultsPlus
Examiner Comments

Correct use of the phrase 'controlled variable'. This gains 2 marks for stating that the reason for controlling temperature is so that growth of the pollen tube is only affected by the methylpurine.

(i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

To make sure any change in the dependent variable is only caused by a change in the concentration and not by temperature.
Because temperature affects growth

ResultsPlus
Examiner Comments

This candidate clearly grasps the fact that the 'dependent variable' should only be affected by a change in the (methylpurine) concentration and not by temperature.

Also one mark for 'temperature affects growth'.

(i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

Temperature affects the growth of pollen tube ie at high temperatures the tube grows more and vice - versa.

ResultsPlus
Examiner Comments

This only gains one mark for stating that temperature affects growth.

(i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

To keep the experiment accurate .

ResultsPlus
Examiner Comments

No marks for this - accuracy not understood.

(i) The investigation was carried out at a constant temperature of 22.5 °C.

Suggest why the temperature was kept constant.

(2)

For fair test and results obtained and to increase the reliability of the experiment.

ResultsPlus
Examiner Comments

This gains no marks. 'Reliability' not understood correctly.

ResultsPlus
Examiner Tip

Do not use the term 'fair test' at this level. Investigations should be made valid, results should be reliable, measurements should be precise or accurate.

Fair test will not gain any marks - it is not a precise term.

Question 2 (c) (ii)

The question was well answered, it does seem that many more students are accurately manipulating data but there are still those that only quote figures from the table. The best answers described the increase and then decrease in length using relevant data to support these observations.

Problems, however, were still encountered with poor mathematical technique: rounding figures seemed to present problems to some, as did subtraction and calculating percentages. Too many students thought that just quoting the numbers between which things happen would get the manipulation of data mark. Many answers failed to score as they didn't specify what they were describing. Carelessness in decimal points spoilt a lot of what would have been good answers!

Words such as 'range', 'increase' and 'decrease' were sometimes misused. The idea of the greatest change was rarely seen – though quite a few had the right idea but worded the answer incorrectly – giving a comparative term rather than an absolute.

(ii) Using the information in the table, describe the effect of methylpurine concentration on the mean length of pollen tubes from lily flowers.

(3)

Slight increase in mean length from 0 to 0.0001 mol dm^{-3} methylpurine. The highest mean length would be the result at 0.0001 mol dm^{-3}. There is a decrease in mean length from 0.0001 to 0.0100 mol dm^{-3}. Overall, there is a decrease in mean length of 66 mm from 0 to 0.0100 mol dm^{-3}.

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Examiner Comments

One mark for a slight increase from 0 to 0.001 mol dm^{-3} methylpurine.

One for decrease from 0.0001 to 0.01 mol dm^{-3} methylpurine.

One mark for decrease by 66mm between 0 to 0.01 mol dm^{-3} methylpurine.

3/3

ResultsPlus
Examiner Tip

A nice clear well-written response.

(ii) Using the information in the table, describe the effect of methylpurine concentration on the mean length of pollen tubes from lily flowers.

(3)

At 0.000 concentration of methylpurine the mean length of pollen tube was highest which is 94 mm. At 0.0001 con. of methylpurine the mean length of pollen tube is 95 mm which is the highest. At 0.0010 concentration of methylpurine the mean length of pollen tube is 90 mm. And at 0.0100 concentration of methylpurine the mean length of pollen tube is 28 mm. So that means two higher concentration of methylpurine stunt the growth of pollen tube, and the optimum concentration of methylpurine is 0.0001.

ResultsPlus
Examiner Comments

This response gains no marks - all the candidate has done is to repeat figures from the table. No trends have been described and there has been no manipulation of data.

ResultsPlus
Examiner Tip

Simple repetition of data from either tables or graphs will not gain marks. Try to describe any trends in the data and attempt to manipulate the figures.

Question 2 (c) (iii)

A majority of candidates appeared to have grasped the relationship between mRNA and protein synthesis, and the link between proteins and growth. Good answers linked mRNA inhibition to reduced transcription and therefore reduced translation.

Although most had a good understanding that mRNA was involved in protein synthesis, there was much confusion as to the actual process. Poor answers included the misconception that the inhibition of mRNA would alter the structure of the protein produced and lost marks by discussing the idea of the wrong or different protein being produced. These errors were linked to some candidates not seeming to know what 'inhibits' means, appearing to interpret it as meaning 'mutation' and the formation of a different polypeptide and a non-functional protein rather than non-production.

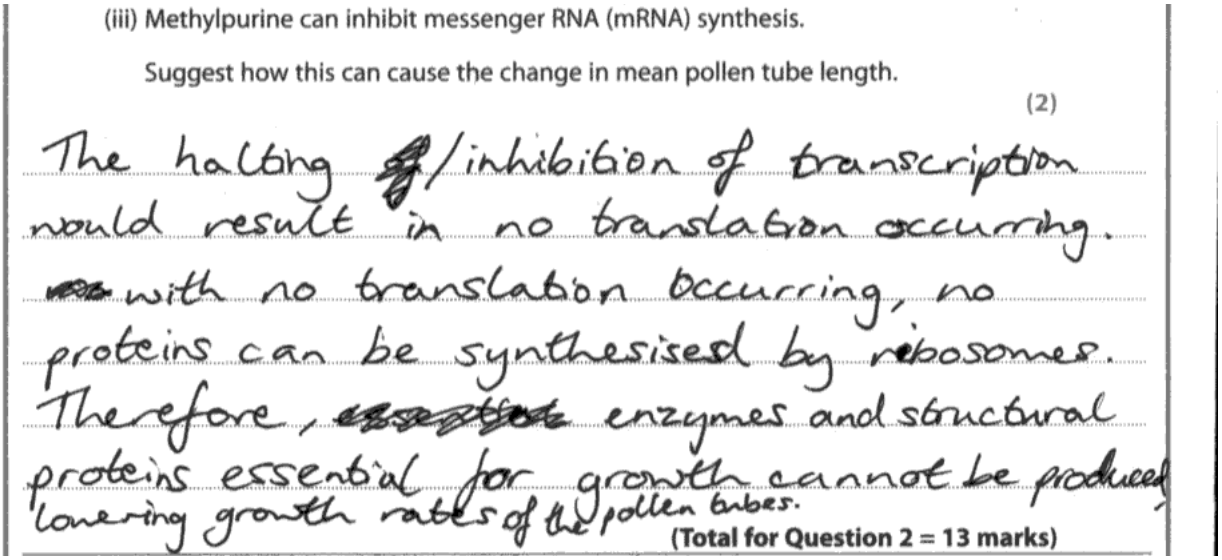
Several responses referred to proteins being transcribed.

A number talked about wrong amino acids being made – a common mistake as there were many examples of amino acids and proteins being mixed up; for example, a few described translation as the formation of amino acids. Others confused protein synthesis with DNA replication and the cell cycle.

Many answers suggested that pollen tubes are chains of cells so enzymes were required for mitosis or that poor growth was due to fewer cells due to lack of mitosis.

Many wrote that fewer enzymes were made, which meant that the tissues of the style were not broken down, so the pollen tube could not grow. Credit was given for this.

Others, trying not to commit to 'increase' or 'decrease' referred to 'effect' hoping to gain marks. In order to gain marks there had to be reference to **reduced** translation, **reduced** protein synthesis and therefore **less** growth of the pollen tube.



(iii) Methylpurine can inhibit messenger RNA (mRNA) synthesis.

Suggest how this can cause the change in mean pollen tube length.

(2)

The halting of/inhibition of transcription would result in no translation occurring. with no translation occurring, no proteins can be synthesised by ribosomes. Therefore, enzymes and structural proteins essential for growth cannot be produced, lowering growth rates of the pollen tubes.

(Total for Question 2 = 13 marks)

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Examiner Comments

A good answer, recognising a halting or inhibition of transcription, leading to no translation and therefore no synthesis of proteins. Then this is linked to the lack of enzymes and structural proteins required for the growth of the pollen tubes.

This shows a clear grasp of the subject and an understanding of the question.

(iii) Methylpurine can inhibit messenger RNA (mRNA) synthesis.

Suggest how this can cause the change in mean pollen tube length.

(2)

Inhibiting mRNA synthesis reduces protein synthesis, reducing growth and therefore reducing the ~~easy~~ change in mean pollen tube length. mRNA carries the transcribed genetic code to the ribosome where it is translated and proteins are made. ~~So~~ Proteins are used for growth so inhibiting mRNA and ~~so~~ therefore protein production, inhibits growth (the change in mean pollen tube length).

ResultsPlus
Examiner Comments

A good answer describing reduced protein synthesis and therefore inhibiting growth.

(2)

* When mRNA is inhibited, no more protein synthesis occur.

*

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Examiner Comments

This answer starts well, linking mRNA inhibition to lack of protein synthesis, which gains one mark. However, it would appear that the candidate could not fill in the gaps to gain a second mark.

(2)

It can cause a change in the DNA sequence, change in tertiary and 3D shape of proteins, therefore this ~~effect~~ can increase the pollen tube length ~~or decreased it.~~ since more mRNA is produced.

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Examiner Comments

This response is an example of the type of misconception concerning the role of mRNA.

This answer suggests that mRNA affects DNA sequence and hence the structure of proteins produced.

No marks were given for this response.

Question 3 (a)

Although this was a straightforward question, candidates are still losing marks as a consequence of not reading the instructions.

3 (a) William Withering tested the use of digitalis to treat a heart condition. The table below describes some of the stages he could have used.

Place a tick (✓) in the box if he used this stage in his test and place a cross (✗) in the box if he did not.

(3)

Description of stage	Tick / cross
He tried to isolate digitalis from foxglove plants.	✓
He tested digitalis on healthy humans.	✗
He used a placebo to make sure digitalis worked.	✗

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Examiner Comments

There should be either ticks or crosses in the boxes. If a candidate changes their mind, they should cross through the answer they don't want marking and replace it with one they do want to be marked.

A crossed through tick like this can be read as 'not a tick', but it doesn't automatically mean that the candidate intends it to be a cross.

Examiners are instructed to mark this as an incorrect response.

ResultsPlus
Examiner Tip

Do not cross through a tick and not add another cross to make it clear you intend you answer to be a cross.

3 (a) William Withering tested the use of digitalis to treat a heart condition. The table below describes some of the stages he could have used.

Place a tick (✓) in the box if he used this stage in his test and place a cross (✗) in the box if he did not.

(3)

Description of stage	Tick / cross
He tried to isolate digitalis from foxglove plants.	
He tested digitalis on healthy humans.	
He used a placebo to make sure digitalis worked.	✓

ResultsPlus
Examiner Comments

This gains no marks - the only box completed is incorrect - it should be a cross.

ResultsPlus
Examiner Tip

A blank space in a table, when the instruction is to place a tick or a cross is not interpreted as a cross, but as an indication that the candidate does not know the answer.

Blank spaces rarely gain marks!

Question 3 (b) (i)

Most candidates understood the concept of a placebo. The most common marking point scored was a description of the placebo effect and a few candidates defined the placebo, although there was a tendency to incorrectly refer to the 'emotional' effect. Surprisingly few answers included the fact that a placebo is inactive. There were very many (different) creative ways of spelling 'psychological'!

Many answers talked about checking if the drug was effective rather than the idea of a comparison or control. Although many discussed comparison they did not always say what they were comparing the placebo to.

Incorrect descriptions of a placebo included: 'placebos are animals used for testing in place of humans' and 'placebos could be used as a cheaper alternative for the drug'.

(b) (i) Explain why placebos are used to test the efficiency of new drug treatments.

(2)

Placebos are an inactive form of a drug. They look & feel exactly like the actual drug so they can be used alongside it in a study to see how effective the new drug actually is compared to no medication or the 'placebo effect'.

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Examiner Comments

One mark for 'inactive form of the drug' and one for reference to comparison.

(b) (i) Explain why placebos are used to test the efficiency of new drug treatments.

(2)

placebos look just like the drug tested except that it lacks the active chemical, sometimes placebos have effects on patients as they believe that it will cause improvement, and so this improvement is measured and ~~subtracted~~ subtracted from the measure of improvement of the real drug being tested.

ResultsPlus
Examiner Comments

Full marks for this response. A creditworthy description of a placebo, followed by reference to psychological effect and then an indication that the candidate understands how this would be used to measure the relative effectiveness of the drug.

(b) (i) Explain why placebos are used to test the efficiency of new drug treatments.

(2)

To see what would happen ~~without~~ to the patients health without the drug, so the ~~pati~~ placebo group are used as a control.

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Examiner Comments

One mark for description of the placebo group as a control.

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Examiner Tip

If this response had explained that the placebo contained no active drug it would have gained full marks.

Make sure there are enough relevant details.

Question 3 (b) (ii)

Generally a well answered question. Most students were aware that a double blind trial reduces bias or prevents the medical staff influencing the results in some way. Fewer candidates mentioned that patients were split into two groups, referring to individuals, rather than considering the actual drug trial.

Some students lost marks because they mentioned that the patients did not know the concentration or dose of the drug being administered instead of saying that neither patient nor doctors know who has been given the real drug or the placebo. There were also some responses mentioning that patients and doctors do not know what the patients are being treated for. Other odd responses described a trial in which the patients were blindfolded or trials on blind patients.

Grammar caused problems for candidates here, with a large variety of grammatical misuse of the word *bias*, for example as a verb or referring to 'biasness'. Another difficulty for many candidates was constructing a sentence to satisfy mp2: the *neither – nor* construction proved elusive to many.

(ii) Explain what is meant by a **double blind trial**.

(2)

Neither the patients nor the doctors know which The large group is split into 2 and one is given a placebo and the other is given the drug treatment. But, neither the patients nor the doctors know which group has been given the placebo and which one has the drug. This is done to reduce bias.

(Total for Question 3 = 7 marks)

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Examiner Comments

This gains full marks - a very good answer gains all 3 marking points : one for 2 groups of patients, one for one group given the placebo and one the drug, neither doctor nor patients knowing who has the placebo and one for reduction of bias.

A double blind trial is when you have two groups one receives the actual drug and one receives the placebo. You can then compare the results from each group.

ResultsPlus
Examiner Comments

This just receives one mark for description of two groups of patients, one given the placebo and one the actual drug.

Question 4 (a)

For some reason this question created much confusion with other core practicals including the root tip squash practical and the investigation into mineral deficiency. Many gave detailed descriptions of the processes involved in the root tip squash procedure followed by an examination of cells under the microscope for totipotency.

Quite a few students thought this experiment could be done using seeds and then went to suggest that if the seeds grew into plants/seedlings/plantlets, then that would prove totipotency. The idea that whole seedlings would naturally grow into whole plants did not seem to occur to them.

However, this was well answered on the whole, with many being awarded 3 marks, as many candidates showed an excellent understanding of the procedure as they had either carried out this core practical or made general statements that were creditworthy. References to the use of agar as a growth medium, including growth hormones, prepared in aseptic conditions were all common correct points made by the majority of candidates.

Many candidates did not seem to know what a seedling was, some started by germinating the seedlings and others described how seedlings could be cut from a plant. An interesting, and not infrequent, misspelling of explants as 'Xplants' cropped up (maybe these are grown in Xboxes?). At the other extreme a nuclear transfer or the use of single cells was frequently described.

One examiner did report that one candidate thought that an explant would differentiate into a red blood cell. Perhaps this provides yet another example of candidates learning past paper mark schemes and then failing to apply their knowledge to the actual question.

(a) Describe how you could use a plant tissue culture technique to show totipotency in cotton plant seedlings.

(4)

First you could prepare damp cotton wool and sprinkle it with seeds. You would then leave these seeds to incubate for three to four days to germinate. You could then mix 2.5g of agar with 250ml of water using a glass rod. You would pour this molten agar into test tubes and leave them to set in a test tube rack. You could the carefully cut the top from the seedlings using a pair of scissors to create explants, before placing it in a test tube containg agar and covering the lid with cling film to prevent contamination by micro-organisms. When left, the explants will grow to form complete plants, demonstrating totipotency

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Examiner Comments

This response eventually gains full marks in the bottom half of the answer. No marks given for describing how to make up agar or how to grow seedlings. However, marks given for explants described, also for use of agar and covering to prevent contamination by micro-organisms. Final sentence gains the fourth mark for 'form complete plants.

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Examiner Tip

Avoid providing irrelevant details which gain no marks.

(a) Describe how you could use a plant tissue culture technique to show totipotency in cotton plant seedlings.

(4)

An explant should be cut from the cotton plant. It should then be placed in agar jelly, which has been mixed using aseptic techniques (e.g. heating to kill bacteria) and contains an even spread of nutrients and possibly growth regulators. The container in which the agar & explant is in should be covered with clear material to prevent bacteria from entering (resulting in the growth of harmful pathogens) but allowing in light. The tube should be placed in controlled settings (e.g. warm temperature with plenty of light) and left for a week. After this time, we can identify totipotency. If a new plant (roots, stem, leaves) has/is developing, the cells from that region are totipotent.

Safety: Cut away from the body when cutting the explant to avoid cutting into the skin.

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Examiner Comments

An excellent response, scoring marks for each single marking point.

Everything here is relevant, clearly written and easily readable.

(a) Describe how you could use a plant tissue culture technique to show totipotency in cotton plant seedlings.

(4)

Take plant seedlings from a plant that is genetically similar by age or height.
Place plant into a callus and add nitrate concentration ranging from a medium concentration to a high concentration.
repeate to ensure reliability aswell using different amount of concentration.

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Examiner Comments

This response is typical of those that indicated lack of familiarity with the practical. Some points are recalled from mark schemes for questions on the effect of mineral ion concentrations on the growth of seedlings - but no marks can be given.

0/4

Question 4 (b) (i)

Most candidates achieved full marks for this question, with some accurate manipulation of data. Those that lost marks often did so for not pointing out that the decrease in totipotency was only observed up to 21 days and that the increase was for seedlings over 21 days old. The interpretation of the trends shown by the data was difficult for many students so they resorted to quoting data from the table which is not enough to gain marks. A number of candidates made sweeping statements without really analysing the data and checking the accuracy of their assumptions.

Very few referred to the result at 28 days being a possible anomaly.

(i) Describe the effect of age on the percentage of seedlings showing totipotency.

(2)

As the age of seedlings increases until 21 days, the percentage of seedlings showing totipotency decreases by 36%. However, at 28 days, the percentage increases by 20% from 40 to 60%.

ResultsPlus
Examiner Comments

A very good response, not only recognising a fall in totipotency up to 21 days and an increase at 28 days, there are also 2 examples of correct manipulation of data.

(i) Describe the effect of age on the percentage of seedlings showing totipotency.

(2)

As age increases from 7 days to 21 days, the % totipotency decreases.
7 days = 76% 14 days = 56% 21 days = 40%.
As the age increases from 21 days to 28 days, the % totipotency increases from 40% to 60%

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Examiner Comments

Although, on first glance this appears to be a very good answer, and it does gain full marks, there are no marks for manipulation of data. This shows an example of copying out the figures without attempting to manipulate them in any way.

Marks are given for recognising a decrease in totipotency from 7-21 days and an increase at 28 days.

(i) Describe the effect of age on the percentage of seedlings showing totipotency.

(2)

As age increases the totipotency of seedlings decreases. At 7 days old the seedling had the totipotency of 76%. At 21 days old the seedling had the totipotency of 40%

ResultsPlus
Examiner Comments

This response gains no marks. Although the candidate states that totipotency falls with age, there are no parameters provided for the age range over which this occurs. No marks can be given for simply repeating data from the table regarding levels of totipotency at 7 and 21 days.

ResultsPlus
Examiner Tip

This could have gained full marks had the candidate rephrased as follows:

'As age increases *from 7-21 days* the totipotency of seedlings decreases'.

'At 7 days the seedling had a totipotency of 76%, *which was 36% more than the 40% at 21 days*'.

Greater precision gains marks.

Question 4 (b) (ii)

This question was well answered by the majority of candidates. Most candidates were able to state that the experiment needed to be repeated. However, very few were able to state specifically that it was the 28 day group that appeared to be anomalous and should be repeated. Many candidates appreciated the need to increase the number of ages over which the seedlings were tested and some appreciated that the experiment should be extended above 28 days.

Some candidates struggled to explain the idea of repeating everything, and also failed to explain that there should be more seedlings 'in each group' rather than just 'more seedlings' unqualified.

The most common mark-*losing* strategy was to suggest controlling variables, which would have improved the validity of the investigation, rather than increasing the reliability of the data. Although most candidates seemed to have a good understanding of what reliability means in an investigation they struggled to express it clearly.

(ii) The scientists were concerned about the reliability of the data.

Suggest how the data could have been made more reliable.

(2)

Make the intervals between each age of seedlings smaller. Repeat the exact experiment at least twice and calculate the mean percentage showing totipotency.

ResultsPlus
Examiner Comments

Two marks given here - one for smaller intervals of age between the seedlings and one for repeating the experiment at least twice.

(ii) The scientists were concerned about the reliability of the data.

Suggest how the data could have been made more reliable.

(2)

The experiment could be repeated at each age of seedling about 5 times. Plus The seedlings could have been taken from only one parent plant, to ensure genetic consistency.

ResultsPlus
Examiner Comments

Only one mark here for repeating **at each age** of seedling about 5 times.

No mark for stating all seedlings should come from the same plant.

(ii) The scientists were concerned about the reliability of the data.

Suggest how the data could have been made more reliable.

(2)

If they were to record it more the once a week maybe every 3 days would be more reliable and they would collect more data in the same amount of time.

ResultsPlus
Examiner Comments

Just the one mark here for reference to using more ages of seedlings.

ResultsPlus
Examiner Tip

Note the number of marks - for 2 marks, more than one idea is needed.

Question 4 (c)

A large number of candidates apparently did not grasp what this question was asking for. Of those that did, many got the right idea but did not refer to time so did not answer the question precisely and therefore failed to score. Some, presumably in response to the part of the question that said 'give evidence', simply stated the figures from the graph and/or table.

It was the need to provide data with date ranges that meant many did not score marks for part (i). In part (ii) the difficulty was in stating that the totipotency 'increased'. However, there was a good deal of evidence of amendment to answers for (i) after the clues given by answering (ii).

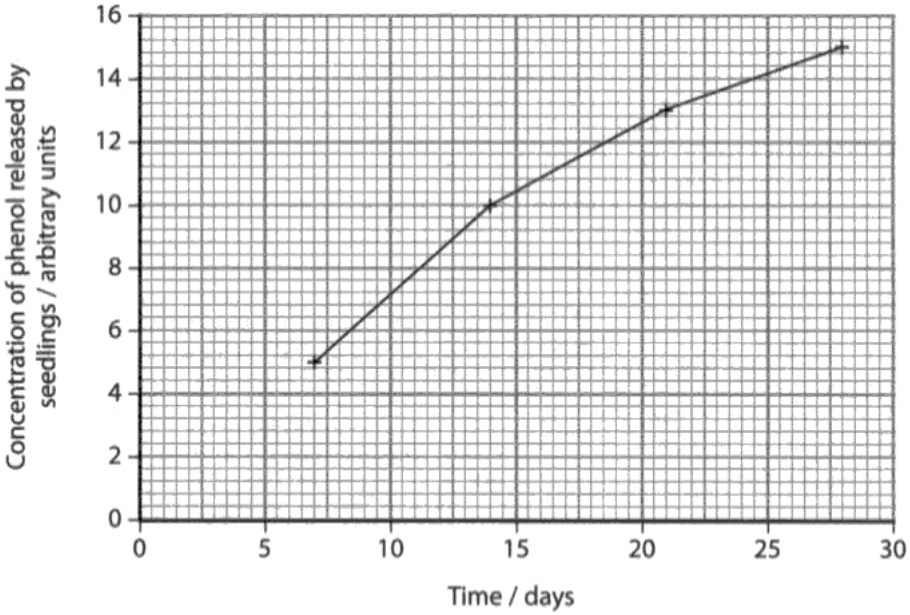
(i) Many candidates had difficulty in identifying specific evidence and were unable to give both trends and dates. There were some who described a positive correlation between age and phenol, or a relationship between age and totipotency, but failed to make the next step and describe the link between phenol and totipotency. However, most could tell that as phenol increased the totipotency reduced, but the vast majority of candidates failed to state over which days the phenol increased and the totipotency decreased (many just saying over a period of time). Some also claimed that this relationship continued up to 28 days.

(ii) This was answered very well. Most candidates were able to state that the 28th day (or between 21 and 28 days or after 21 days) showed increased phenol as well as an increased totipotency.

(c) As cotton plants grow, they release a substance called phenol.

In another investigation, the scientists measured the concentration of phenol released by seedlings.

The results are shown in the graph below.



(i) Using the information in the table in part (b) and the graph, give evidence to support the hypothesis that phenol reduces totipotency.

(1)

As the concentration of ~~pota~~ phenol increases between days 7 and 21, the totipotency percentage of the seedlings decreases from 76% to 40%

(ii) Using the information in the table in part (b) and the graph, give evidence that does **not** support the hypothesis that phenol reduces totipotency.

(1)

Between days 21 and 28, the concentration of phenol is still increasing, but with this the table shows that the percentage of totipotent seeds increases from 40% to 60%, showing that as phenol concentration increases, so does totipotency.

ResultsPlus
Examiner Comments

(i) - Nice clear answer, stating that as concentration of phenol increases from day 7 to day 21, the totipotency decreases.

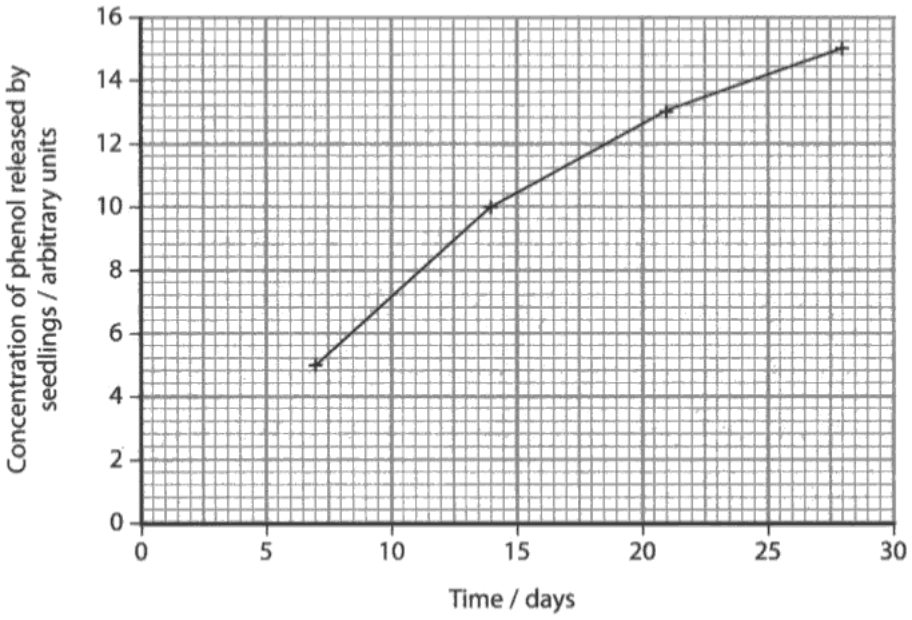
(ii) - clearly stated that from days 21 to 28, phenol is still rising in concentration, yet the totipotency increases.

2/2

(c) As cotton plants grow, they release a substance called phenol.

In another investigation, the scientists measured the concentration of phenol released by seedlings.

The results are shown in the graph below.



(i) Using the information in the table in part (b) and the graph, give evidence to support the hypothesis that phenol reduces totipotency.

(1)

phenol reduces totipotency as over time the concentration of phenol released is increased while the percentage of seedlings showing totipotency decreases.

(ii) Using the information in the table in part (b) and the graph, give evidence that does **not** support the hypothesis that phenol reduces totipotency.

(1)

After 28 days the concentration of phenol is at its highest but the percentage of seedling showing totipotency increased.

ResultsPlus
Examiner Comments

(i) no marks here as there is no time scale provided, simply a statement that phenol reduces totipotency 'over time'.

(ii) 1 mark is given here as there is a clear recognition that at 28 days the concentration of phenol is at its highest yet the totipotency of the seedlings increased.

ResultsPlus
Examiner Tip

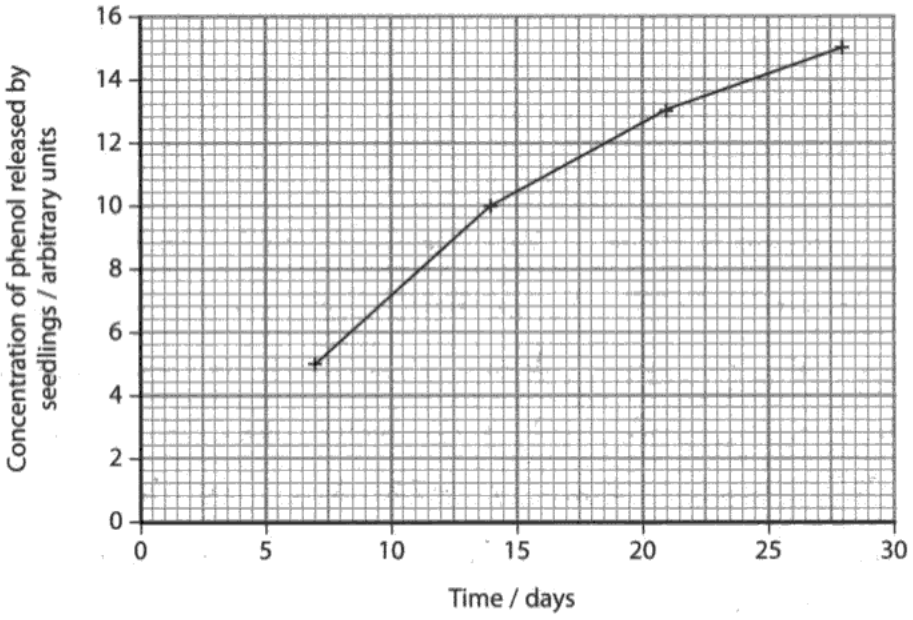
Read the instructions with care - this question clearly states 'Using the information in the table in part (b) and the graph.'

Make sure that these instructions are followed, and if asked to provide evidence from tables or graphs, look at the figures and use them!

(c) As cotton plants grow, they release a substance called phenol.

In another investigation, the scientists measured the concentration of phenol released by seedlings.

The results are shown in the graph below.



(i) Using the information in the table in part (b) and the graph, give evidence to support the hypothesis that phenol reduces totipotency.

(1)

From 7 days the concentration of phenol increases as the percentage of totipotent cells decrease.

(ii) Using the information in the table in part (b) and the graph, give evidence that does **not** support the hypothesis that phenol reduces totipotency.

(1)

At 28 days the totipotency is higher that at 21 days, however the graph shows that concentration of phenol still increases during this time.

ResultsPlus
Examiner Comments

No mark here for part (i) - however, if the candidate had written 'From 7 days to 21 days...', they would have gained the mark.

(ii) gains the mark for recognising the fact that at day 28 totipotency was higher than at 21 days although phenol levels were still rising.

Question 4 (d)

Answers to this question ranged from the highly competent to the extremely garbled. Poor use of language caused students to lose marks here. Many candidates failed to correctly use the phrases 'differentiate to become' or 'give rise to'. Instead they used terms such as 'produce / turn into / develop into / become / grow into / divide into / form'. Stem cells divide to give rise to more stem cells as well as differentiated cells, if they 'became' specialised cells, there would eventually be no stem cells left.

On this paper, the incorrect terminology was only penalised once, allowing candidates to achieve one mark rather than zero. This permitted marks to be gained by those who knew the difference but phrased their answers poorly.

The vast majority understood the general difference between totipotency and pluripotency, although a large proportion of candidates seemed to have difficulty differentiating between 'embryonic' cells and 'extra-embryonic' cells. This cost marks depending on the context, for example those stating that 'pluripotent cells give rise to all cells except embryonic cells' did not score that marking point.

(d) Human stem cell research involves the use of both totipotent and pluripotent stem cells.

Describe the differences between a totipotent stem cell and a pluripotent stem cell.

(2)

Totipotent cells can rise to all cell types (including extra embryonic cells). Pluripotent cells can give rise to most cell types, except for extra-embryonic and totipotent cells.

ResultsPlus
Examiner Comments

This is a very good answer, gaining full marks. Correct use of terminology even though the word 'give' has been missed out of the first line.

The fact that pluripotent stem cells could not give rise to totipotent cells is also creditworthy.

(d) Human stem cell research involves the use of both totipotent and pluripotent stem cells.

Describe the differences between a totipotent stem cell and a pluripotent stem cell.

(2)

Totipotency is when a stem cell can give rise to anything in the body, whereas a pluripotent stem cell is when the cell can give rise to many things, but not everything.

ResultsPlus
Examiner Comments

Despite the use of the phrase 'give rise to', no marks could be given here. The phrases 'anything in the body' and 'many things, but not everything' are far too vague to be worth credit at this level.

If the word 'thing' had been replaced with the word 'cell', full marks could have been awarded to this response.

ResultsPlus
Examiner Tip

Remember to use correct biological vocabulary and avoid the word 'thing'!

Question 5 (a) (i)

Many candidates seemed to be trying to recall their own results from when they carried out this investigation rather than looking at the table, as their descriptions didn't always reflect the data provided. Another issue was simply quoting data from the table instead of organising it into trends and then those who got the trends right often failed to provide relevant data to support them. Typical responses said that as mass increased, distance X increased 'up to a point', but didn't state what that point was. It was often stated that 'as mass increased so did distance until 250g when it broke'.

Most candidates did not appreciate that the distance only increased up to 150g, however, most were able to state that the distance remained constant from 150g to 200g. Also many candidates incorrectly stated that the greatest increase was from 50g to 100g because it doubled in length.

(i) Describe the effect on distance **X** of increasing the mass.

(2)

The distance X will increase as the mass increases, eventually it will reach its highest distance and then ~~it will snap and~~ the plant fibre will break.

ResultsPlus
Examiner Comments

A typical response that gained no marks. A general statement that does not describe the effect on distance X of increasing the mass.

(i) Describe the effect on distance **X** of increasing the mass.

(2)

Increasing the mass, increases the distance X. When the mass was 0g, the distance was 0cm. However, when it was increased to 50g, the distance increased to 2cm.

ResultsPlus
Examiner Comments

No marks for a general statement followed by repetition of the first two sets of data from the table. No trend has been identified or described.

(i) Describe the effect on distance **X** of increasing the mass.

(2)

Distance X increases as mass increases up until ~~the~~ a certain mass breaks the fibre, in this case 250g. However, 150g and 200g both had a distance of 5cm suggesting that as you get closer the mass that breaks the fibre they distance can't increase, it's at its maximum tensil strength.

ResultsPlus
Examiner Comments

No mark for stating that the distance X increases with mass up to 250g, but one mark is given for '150g and 200g both had a distance of 5cm'.

ResultsPlus
Examiner Tip

Check the data with care - make sure that sweeping statements are correct. A close look at the table of data shows no further increase above 150g.

(i) Describe the effect on distance **X** of increasing the mass.

(2)

from the mass being increased from 0g to 150g the distance X was increased by 5cm however from 150g to 200g the distance X did not increase any further and at 250g the fibre broke therfore there is a positive correlation : As the ~~Force Strength increase~~ weight increases the Distance X increases

ResultsPlus
Examiner Comments

A good response - one mark for 'as mass ... increased from 0g to 150g the distance X was increased' and one mark for 'however from 150g to 200g the distance X did not increase any further'.

Question 5 (a) (ii)

This was very well answered by the majority of the students. Some excellent answers were seen which suggested they started with 10g increments and then set about refining the result with 1g increments.

Some gained 2 marks by stating that the experiment should be repeated at masses including 210g, 220g, 230g, 240g and 250g.

A minority suggested measuring distance X to the nearest mm, which indicated poor interpretation of the question. Others suggested using a Newton meter and one inventive candidate described attaching a beaker of water to the fibre and gradually adding more water until the fibre broke.

(ii) Another student thought that the data did not show the mass needed to break the fibre. He suggested that it could be anywhere between 200 g and 250 g.

Suggest how a more accurate result could be determined.

(2)

Smaller weights e.g 10grams could be added to see when the fibre breaks. This will be more accurate as it will give it to the nearst 10g rather than the nearest 50g.

ResultsPlus
Examiner Comments

This response gains one mark for suggesting the use of 10g masses.

(ii) Another student thought that the data did not show the mass needed to break the fibre. He suggested that it could be anywhere between 200 g and 250 g.

Suggest how a more accurate result could be determined.

(2)

After 200g, add masses of 10g to get the mass need to break the fibre to the nearest 10g. This produces more precise results. Measure distance x to a smaller scale.

ResultsPlus
Examiner Comments

This answer gains both marks - one for using masses of 10g, and the other mark for using these smaller masses after 200g has been added.

Question 5 (b)

Few candidates achieved full marks on this question, with candidates making the same point several times rather than being able to give a well-balanced description; however, many earned 4 out of 5 marks. All marking points were seen, but not usually within one response. Generally, the question was answered well by the majority of candidates, with marks being gained for description of variables to be controlled, standardised method of applying masses and repetition. Although repeats were often mentioned many forgot that these allowed mean results to be calculated, although several candidates 'created' averages!

Most candidates got the idea that masses should be added until the fibre breaks, although many talked about measuring extension only. Named procedures were very vague - usually restricted to 'use same' masses or same distances. A new mass was also spotted in a number of papers, 'the 0 gram weight'.

(b) Suggest how you would use this apparatus to enable a valid comparison of the tensile strength of fibres from two different plants.

(5)

Collect ~~fibres of~~ 2 different plants and leave to soak in water for a few days to make fibre extraction easier. Measure fibre length using a ruler, ensuring all fibres are the same length. connect between 2 clamp stands and add mass in middle of fibre. Ensure you add the same mass each time. Add mass until fibre breaks and record breaking mass. Make sure you use fibres of the same plant so they have the same genotype. Wear goggles to protect eyes when fibre breaks. Repeat each fibre 3 times to make experiment reliable. Do the same with the other plant and calculate a mean of your results. Compare both means of plants. The greater the breaking mass, the stronger the plant fibre.

(Total for Question 5 = 9 marks)

ResultsPlus
Examiner Comments

This response just gains 4 marks, although the points are not always clearly made.

Marks awarded: mp3 for adding the same masses each time to the middle of the fibre; mp4 for adding masses until the fibre broke; mp7 for wearing goggles to protect the eyes and mp5 for reference to repeats being used to calculate means.

mp1 was not given, although there was a reference to fibres being of the same length, there needed to be two relevant variables about the fibres to gain the mark and stating that they should be from the same plant is not relevant in an investigation comparing 2 different plants!

(b) Suggest how you would use this apparatus to enable a valid comparison of the tensile strength of fibres from two different plants.

(5)

By obtaining the same length fibre and same diameter of fibre from the same part of the plants, the masses at intervals of 10g ~~each~~ starting from 0 and adding the 10g mass one by one will determine the strength. The mass at which each fibre breaks will be recorded and repeated three times to get an average. ~~of~~ The averages can be compared and the fibre that needed more mass to break it would be more strong. All other variable must be kept constant, like temperature and ~~as~~ length of fibre ~~to~~ and mass of fibre to ensure accurate results.

ResultsPlus

Examiner Comments

This is a well written response, clearly describing the procedure.

Marks awarded as follows: mp1 for fibres of same length, diameter and part of plant extracted from; mp3 for 10 g masses used; mp4 - recording mass taken to break fibre; mp5 repeats to calculate averages and mp2 for keeping temperature constant.

Question 6 (a)

This question caused some confusion for some candidates. For those that knew the structure of cellulose and realised that cellulose microfibrils consisted of bundles of cellulose molecules held together by hydrogen bonds, full marks were readily achieved. However, there were a significant minority that thought both contained alpha-glucose. Most knew that there were only 1,4 - glycosidic bonds in both and there did appear to be some guesswork applied to the presence of hydrogen bonds. At least most candidates did put ticks or crosses in each space available - very few blank spaces.

(a) The Eukarya domain includes the plant kingdom.
Plants are different from other groups of organisms in the Eukarya domain as they have cellulose cell walls. The cellulose molecules in the cell wall are arranged in microfibrils.

The table below gives four features of a cellulose molecule and a cellulose microfibril.

If the feature is present place a tick (✓) in the box and if it is absent, place a cross (✗) in the box.

(4)

Feature	Cellulose molecule	Cellulose microfibril
Alpha (α) glucose	✗	✗
1,4-glycosidic bonds	✓	✓
1,6-glycosidic bonds	✗	✓
Hydrogen bonds	✓	✗

ResultsPlus
Examiner Comments

Mistakes made here with the 1,6- glycosidic bonds and the hydrogen bonds. Neither contains 1,6- glycosidic bonds and there should have been hydrogen bonds in the cellulose microfibril.

2/4

Question 6 (b)

The names of the 3 domains have cropped up in many past papers and the specification does refer to the taxonomic grouping in the three domains. There was a lot of guesswork at play here by those who had not learnt the names of these groups.

(b) Eukarya is one of the three domains.

Name the other **two** domains.

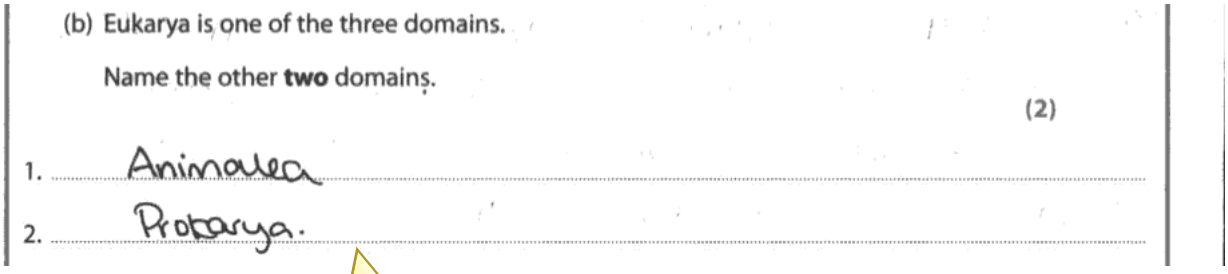
(2)

1. Archea

2. Prokarya

ResultsPlus
Examiner Comments

One mark for the more obscure Archaea domain, but nothing for 'Prokarya' (Both the Archaea and Bacteria have prokaryotic cellular organisation)



(b) Eukarya is one of the three domains.

Name the other **two** domains.

(2)

1. Animalea

2. Prokarya.

ResultsPlus
Examiner Comments

No marks here for Animalia or Prokarya - both are indeed taxonomic groups, but neither are domains.

.

Question 6 (c)

Many candidates found this question very difficult to answer; there were many examples that suggested candidates knew the answer but struggled to express it clearly. Many focused on separating organisms into the taxonomic hierarchy. Quite a few just listed out the order of the different taxonomic groups from kingdom to species and some explained how species and genus names are assigned to an organism. There was often reference to placing organisms into Woese's three domains.

Most candidates gained just one mark for the detail of how a characteristic would be judged, because they had restated the stem of the question – 'they can be classified into groups by...'

Candidates were able to say how to classify but failed to actually talk about putting organisms into groups. Several referred to classifying by looking at similarities and differences, but unfortunately some good definitions were spoilt by omitting to say that organisms were grouped in this way.

The key to this question is the command word 'explain' that has been used rather than 'describe' - those who did well showed an awareness of the difference in these instructions.

(c) Scientists classify organisms into taxonomic groups, such as the three domains.

Explain how organisms can be classified into taxonomic groups.

(2)

there is a classifying system. which is as follows.

- domain
- kingdom
- phenus
- ~~genus~~ class
- order
- family
- species

kingdoms

ResultsPlus
Examiner Comments

This is an extreme example, but does show the type of response referring simply to the levels of taxonomic classification. Although 'phenus' is not a recognised taxonomic group - a combination of phylum and genus presumably.

This contains no explanation.

0/2

(c) Scientists classify organisms into taxonomic groups, such as the three domains.

Explain how organisms can be classified into taxonomic groups.

(2)

Organisms can be classified according to their anatomical and physiological similarities; such as if they can breed to produce fertile off spring, which means they are of the same species.

ResultsPlus
Examiner Comments

This example gains one mark for the description of anatomical and physiological similarities. If the candidate had gone on to explain that organisms sharing these features would be placed in the same group they would have achieved full marks.

(c) Scientists classify organisms into taxonomic groups, such as the three domains.

Explain how organisms can be classified into taxonomic groups.

(2)

They can be classified into these groups according to shared / similar characteristics. ~~Thes~~ These characteristics can either be grouped by ~~notified~~ identifying ~~observing~~ the organisms phenotype (observable characteristics) or via DNA profiling.

ResultsPlus
Examiner Comments

This gains 2 marks - one for placing organisms into groups according to shared characteristics and one for using DNA profiling to identify these characteristics.

Question 6 (d)

There were plenty of candidates gaining full marks for this question, which either named or described peer review as well as a discussion of scientists repeating the experiment. However, a sizeable majority seemed to misinterpret or misread the question as 'why' rather than 'how' Woese's work was critically evaluated. The word 'critical' was also interpreted as referring to other scientists being unfavourable or derogatory with regard to Woese and his theory. This suggested that only the first part of the question was read properly or that the process of 'critical evaluation' was not fully appreciated. It is vital that candidates read all parts of the question.

The biggest issue with this question was a failure to understand what the question was asking. Too many students explained why the theory wasn't accepted and talked about the domains themselves. Again, the mention of domains in the stem of the question apparently caused some candidates to go off at a tangent and discuss classification, rather than the scientist. Correct answers were avoided by quite a lot of candidates. Evidently Woese made good use of the internet and he also seems to have kept a journal! There was also a creative response that imagined a gathering of scientists examining cells under a microscope before all agreeing with Woese and then having a party!

(d) When Carl Woese first suggested that all organisms could be classified into one of the three domains, his ideas were not accepted.

Suggest how Woese's idea was critically evaluated.

(3)

Other scientists repeated his experiment to check if data is reliable.
Other scientists peer reviewed it.
Other scientists checked if similar study was conducted before to compare results.

ResultsPlus
Examiner Comments

Typical of many responses - this gains 2 marks for reference to peer reviewing and repeating of his experiments.

(d) When Carl Woese first suggested that all organisms could be classified into one of the three domains, his ideas were not accepted.

Suggest how Woese's idea was critically evaluated.

(3)

- peer review → experts in his specific field evaluate his idea by observing and critising his methodology and reproducing his experiments which led to his conclusion.
- he may have presented his idea at a conference where it could be discussed.

ResultsPlus
Examiner Comments

A very good response describing peer review, replication of experiments and presentation of ideas at a conference for discussion.

(d) When Carl Woese first suggested that all organisms could be classified into one of the three domains, his ideas were not accepted.

Suggest how Woese's idea was critically evaluated.

(3)

⇒ First, woese's ideas would be recorded in a scientific journal.
⇒ by peer review. Other scientists reviewed his findings and may have repeated his experiments to see whether his results are reliable and valid.
⇒ The scientists who reviewed woese's findings would have been in his field of science.
⇒ Then if the idea would be published in a scientific magazine.

(Total for Question 6 = 11 marks)

ResultsPlus
Examiner Comments

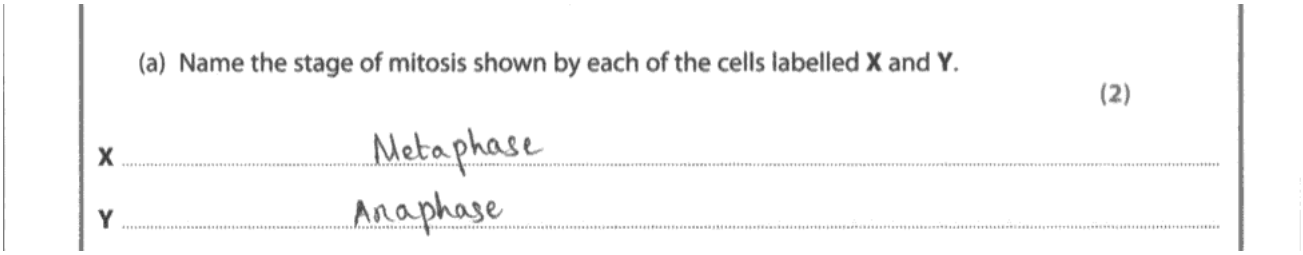
Lots of ideas crammed in here ... sufficient for 3 marks. This response covers the ideas of publication in a scientific journal, peer review and repetition of experiments.

Question 7 (a)

Although this seemed to be a straightforward question asking candidates to identify stages of mitosis from a photomicrograph, only just over half of all responses gained full marks.

The main problem appeared to be that many candidates did not check which cells were actually labelled X and Y.

Cell X was often claimed to be undergoing prophase, even though the chromosomes were quite clearly gathered along the equator of the cell.



(a) Name the stage of mitosis shown by each of the cells labelled **X** and **Y**.

(2)

X Metaphase

Y Anaphase

ResultsPlus
Examiner Comments

A correct response - gaining 2 marks.

ResultsPlus
Examiner Tip

Double check the letters on the diagram when asked to label structures or name stages in mitosis.

Question 7 (b)

The vast majority of candidates scored highly on this question, suggesting that the stages of mitosis are generally well known. Most candidates were able to state at least four of the events of prophase and were thus able to achieve full marks. Although most candidates managed to express themselves using appropriate vocabulary, occasionally a lack of precision in language caused problems, e.g. 'nucleus breaks down', rather than 'nuclear membrane breaks down'. The spelling of nucleolus was a challenge to many, with the hybrid 'nucleous' making several appearances. Some candidates did not appear to be able to differentiate between the words 'chromatin', 'centrioles' and 'centromeres'.

There were also some instances of marks being lost due to describing the 'supercoiling' of the DNA.

However, it was obvious that many candidates had thoroughly learnt all the events that occur during the different stages of mitosis.

(b) Describe what occurs during prophase.

(4)

The chromosomes coil and condense so that they become visible. The nuclear membrane breaks down along with the nucleolus, allowing the chromosomes to move freely. The centroles then migrate to the opposite poles of the cell and begin to form the spindle. The chromosomes are now chromatids joined at the centromere.

ResultsPlus

Examiner Comments

A good answer gaining marks for condensing of chromosomes, break down of nuclear membrane and nucleolus, migration of centrioles to the poles of the cell and the formation of the spindle.

5 possible marks for a maximum of 4/4

(b) Describe what occurs during prophase.

(4)

during prophase, ~~an~~ nucleolus breaks, envelope breaks down, spindle fibre forms, chromosomes are ~~reeee~~ pulled to the opposite poles, chromosomes condense becoming fatter and shorter.

ResultsPlus
Examiner Comments

This is a jumbled answer, indicating a muddled knowledge of the events at the separate stages of mitosis.

Marks can be given for condensing of chromosomes, break down of nucleolus (but not envelope without more detail), and formation of spindle.

However, had this been a QWC question where either spelling or logical sequencing were being assessed, this would not have scored 3 marks - nucleolus is misspelt and the chromosomes are not pulled to the poles during prophase.

Question 7 (c)

A substantial number of responses correctly identified interphase, but very few were able to give a coherent reason; some candidates wrote quite a lot without saying anything useful. Several said the nuclear membrane was present although it wasn't realistically visible on the photo or went on to describe the details of DNA replication or organelle synthesis rather than the visible clues.

Cytokinesis was the most common incorrect response as they thought the cell was splitting. Many candidates were under the impression the cell had only just formed the cell wall between it and the one next to it in the image. Other incorrect responses listed other stages of the cell cycle having looked at the wrong cell in the picture.

There was a clue in the stem of the question, where it was clearly stated 'Cell Z is not undergoing mitosis' and then asked for suggestions for 'which stage of the cell cycle it is undergoing', this really doesn't leave much option if the cell cycle and stages of mitosis are known.

(c) Cell **Z** is not undergoing mitosis.

Suggest which stage of the cell cycle it is undergoing.
Give a reason for your answer.

(2)

Undergoing interphase as all DNA and organelles appear to be synthesising.

ResultsPlus
Examiner Comments

One mark for interphase, but nothing for 'all the DNA and organelles appear to be synthesising' - these details are not visible and would not provide a reason for choosing this stage.

(c) Cell **Z** is not undergoing mitosis.

Suggest which stage of the cell cycle it is undergoing.
Give a reason for your answer.

(2)

Telophase, because ~~I~~ cytoplasm is divided ~~2 dau~~ 2 ~~dau~~ daughter cells present, 2 nuclei present.

ResultsPlus
Examiner Comments

No marks for telophase.

ResultsPlus
Examiner Tip

Read the instructions with care - the question states 'cell Z' implying a single cell and not 2 cells.

(c) Cell **Z** is not undergoing mitosis.

Suggest which stage of the cell cycle it is undergoing.
Give a reason for your answer.

(2)

Cell Z is ~~going~~ undergoing cytokinesis. It has completed the telophase of mitosis and has formed identical two daughter cells.

ResultsPlus
Examiner Comments

No marks here - again, this candidate has not clearly read the question which refers to a single cell.

Question 8 (a)

There was a good general understanding of the topic by most candidates.

Although there were many excellent answers, most students seemed to struggle to understand what the question was driving at and gave vague, often irrelevant discussions of gene pools and adaptation. Candidates also discussed points of a captive breeding programme that would not increase genetic diversity, such as the zoo protecting the ferrets from predators, indicating that they missed the point of the question.

Although the question asked how captive breeding programmes maintain genetic diversity, many described how this could be increased, with little or no understanding that the number of alleles remains the same unless there are losses or mutations. They also did not recognise that, although the alleles present can be shuffled to give different combinations, this alone does not constitute an increase in genetic diversity or the gene pool of a population.

Answers often did not contain sufficient information to achieve full marks, suggesting that they had not checked how many marks it was worth. There were many incorrect references to 'interbreeding' rather than 'inbreeding', although sometimes it was evident that the candidate intended the latter and not the former. Some candidates used the term 'species' from the stem of the question to make statements that would have been incorrect, had the mark scheme not allowed for the use of the term in this context, for example: 'more of the species were produced'.

Better answers discussed stud books, selection of mates and transfer of ferrets between zoos. There were also very good answers including all the concepts of 'inbreeding depression and genetic drift'. A surprisingly small number mentioned that captive breeding actually increased the size of the population.

Overall the questions included a lot of explanation that did not apply to the question and most answers included relevant content, but they were often over-complicated and poorly focused.

Meanwhile, we have learnt that black-footed ferrets appear to be 'captivated' by living in the zoos, zoo exchanges were a good idea as the ferrets 'would get bored and depressed stuck in one zoo all the time' and 'zoos clean the females to make them more attractive for mating'.

*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

- They breed with same species.
- They do not breed with animals who are related (incestuously)
- They encourage animals back in the wild when ready.
- Provide animals with a realistic and natural habitat.
- Little or no human contact.
- Encourage them to work for food instead of simply handing it to them.

ResultsPlus
Examiner Comments

This response gains only one mark for suggesting that the ferrets are not bred with close relatives ('incestually').

The points about how zoos prepare animals for re-introduction to the wild are not relevant to the actual question.

ResultsPlus
Examiner Tip

Bullet points are a good idea and this candidate has made sure they have made 6 separate points in an attempt to gain full marks - unfortunately they are not all relevant.

Do not rush into answering a question without reading it thoroughly - not all questions on captive breeding in zoos require the same answer!

*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

*In captive breeding, the ferrets will be assigned a mate and they will breed – this can be interchangable within the zoo as well as ~~out~~ ~~the~~ ~~zoos~~, i.e. between the different zoos. This means that the gene pool will get bigger as the genes of each ferret will mix with anothers, and as they change mates ~~the~~ more genes will get mixed, ~~so~~ meaning more different alleles and so more genetic diversity.

*Genetic diversity is the number of different alleles within a species' population.

ResultsPlus
Examiner Comments

This gains just 2 marks for implying mate selection and then describing movement of ferrets between zoos - although both poorly worded.

However, stating that this will make the 'gene pool ... bigger' and lead to 'more different alleles' is incorrect. The question is about 'maintaining genetic diversity' and not increasing it. Starting with a population of only 18 individuals the gene pool cannot be increased, and the only way different alleles could be introduced would be as a consequence of mutations.

ResultsPlus
Examiner Tip

When underlining key words in a question, try to refer to them when writing a response.

*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

The ferrets are only not allowed to inbred which increases the genetic diversity as there is a greater number of alleles in the gene pool. Ferrets are transferred to other zoos and they record a stud book.

ResultsPlus
Examiner Comments

This response gains two marks for reference to transfer of ferrets between zoos and the use of studbooks.

As this question was assessed for QWC, the reference to 'not allowed to inbred' does not gain the mark, the reason for this is the incorrect context in which the phrase is used. The candidate states that by preventing inbreeding, genetic diversity will increase as a consequence of a greater number of alleles being in the gene pool - as this is incorrect, the point for prevention of inbreeding cannot be awarded.

ResultsPlus
Examiner Tip

Check for questions assessed for Quality of Written Communication (QWC) - they have an asterisk * next to them.

For these questions it is really important that key words are spelt correctly and that the answer is in a logical sequence.

*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

This can ~~be~~ maintain genetic diversity because it prevents inbreeding depression and genetic drift which are where the gene pool is minimised or alleles are lost. The six zoos will also be able to transfer the animals between them in order preserve the genetics of the animal. The zoos will also keep studbooks which can help keep a log of which animal has been bred with who and what their status is. The programme may also increase the population of that animal or even increase its chances of survival if it is released back into the wild as it may have a better range of ~~gene~~ genes.

ResultsPlus

Examiner Comments

Full marks for these points:

prevention of inbreeding mp6; prevention of genetic drift mp7; interzoo transfer of animals mp5; use of studbooks mp3; increase population mp2.

A good answer clearly written showing a good grasp of the subject matter.

*(a) Suggest how this captive breeding programme in the six zoos ensures that genetic diversity is maintained in this species.

(5)

The zoos can control which animal breeds with which, with the use of studbooks (records of past breeding pairs) they ensure that as little in-breeding between related pairs occurs. This ensures that as many different alleles are kept within the population as possible. If two animals cannot breed together techniques such as IVF can be used to artificially ensure that to mixtures of genes are combined and to keep as varied a gene pool as possible. Hopefully this will eliminate genetic drift, and DNA analysis and gel electrophoresis can also be used by zoos to isolate which alleles are present in an individuals genome and thus make informed decisions regarding breeding pairs.

ResultsPlus
Examiner Comments

Full marks here for :

use of studbooks mp3; reduction of inbreeding mp6; IVF mp8; eliminate genetic drift mp7 and DNA profiling described mp).

ResultsPlus
Examiner Tip

Note that this candidate has correctly underlined 'ensures' and 'genetic diversity' - correctly identifying the point of the question.

Question 8 (b) (i)

The vast majority appreciated that there too few ferrets to be released. Many candidates were then able to link this with the fact that there would not be enough ferrets to maintain the breeding programme.

Many also stated that the ferrets would not be able to survive in the wild due to predators or they were not adapted to their environment. However, this did not gain credit unless a correct context was given, such as by stating that the ferrets were either not mature enough or that they had not been given the correct behaviour training by the zoos.

Candidates frequently made reference to maintaining the gene pool and ensuring the ferrets did not interbreed or that the gene pool was not large enough to allow the ferrets to adapt successfully to changing conditions. Reference was also made to the danger of inbreeding due to low numbers.

(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.

Suggest why no black-footed ferrets were released into the wild before 1991.

(2)

They were endangered, and therefore at a high risk of becoming extinct if released into the wild.

ResultsPlus
Examiner Comments

No marks for this response as it doesn't consider the impact of birth rate on release into the wild.

(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.

Suggest why no black-footed ferrets were released into the wild before 1991.

(2)

There wasn't a large enough number of the ferrets to put them at risk in the wild. Less than 200 would have been available meaning they all would have been released. There would be a risk of extinction

ResultsPlus
Examiner Comments

This response gains just one mark for reference to low numbers of ferrets.

(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.

Suggest why no black-footed ferrets were released into the wild before 1991.

(2)

They weren't released into the wild because the birth rates were too low, if they had been released too early there wouldn't have been enough in captivity to increase the population, and due to deaths in the wild there would be less to reproduce ~~to~~ in the wild too. This would hinder the progress of the programme, and increase the amount of time waited before the population was high enough to be reintroduced, wasting time and money.

ResultsPlus
Examiner Comments

This gains two marks in the first (long) sentence - one for reference to birth rate being too low and one for stating that there would not be enough left in captivity to increase the population.

ResultsPlus
Examiner Tip

Try for shorter, more precise sentences - it helps both candidate and examiner. When sentences start to ramble on it becomes difficult to determine where one point ends and another starts. That's why this candidate kept writing.

(i) Each year since 1991, 200 black-footed ferrets have been released into the wild.

Suggest why no black-footed ferrets were released into the wild before 1991.

(2)

~~The number of ferets~~ The population of ferets were too low before 1991, ~~and the~~ eg at 1987 only around 5 and 1990 only around 90 although a 85 number increase from 1990 - 1991 the increase was much higher (130 more ferets). Therefore they were more likely to survive if released ~~220-90~~ and some could still be kept to carry on captive breeding

ResultsPlus
Examiner Comments

This response gains 2 marks - one in the first sentence for 'population of ferrets ... too low before 1991' and the other mark for reference to keeping some to carry on captive breeding squashed into the lower corner of the page.

ResultsPlus
Examiner Tip

Repeating data from graphs will not gain marks - e.g. 'at 1987 only around 5'.

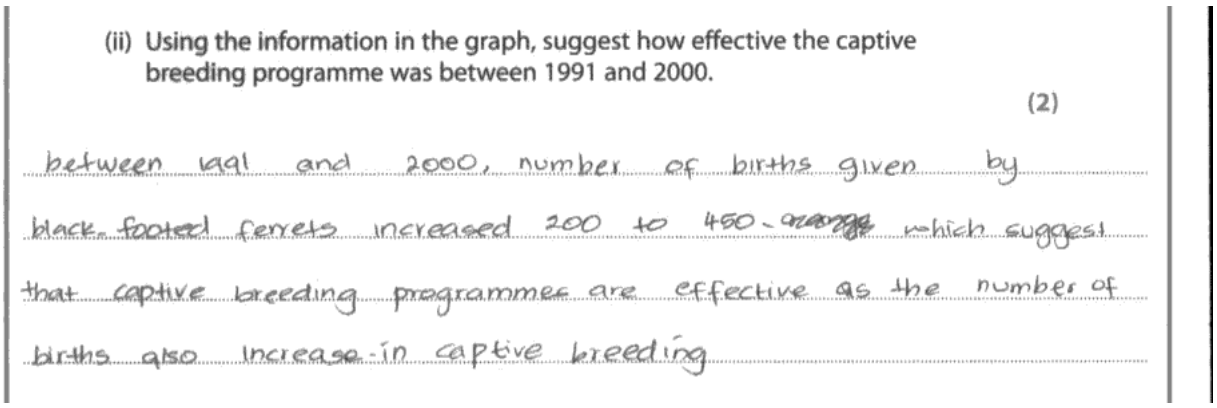
Squeezing answers into a corner is a gamble - this was just visible on this occasion. If you are running out of room to write your answer, or you've made a mess of your response, continue on an extra sheet. That way it will definitely be seen by an examiner.

Question 8 (b) (ii)

The main problem with this question arose from failing to read the labelling on the y axis of the graph, which showed number of births and not population size. However, the majority of candidates were able to state that either the number of births or the population of ferrets rose from 1991 to 2000, and that it fell in either 1994 or 2000. The best answers described the increase in births and qualified this with the actual size of the increase, they also correctly identified when the number of births decreased.

Some candidates scored low marks as they didn't specify what was increasing or decreasing or had mis-read the labels on the axes of the graph. 'Number' was often referred to but not clearly linked to either births or population.

There were a surprising number of candidates who could not subtract 220 from 450 and get the right answer, and some claimed that 450 was less than twice 220. Others attempted a manipulation of the data by referring to births increasing by 'more than double' rather than using actual figures. However, there was also evidence of accurate and meaningful manipulation of data.



(ii) Using the information in the graph, suggest how effective the captive breeding programme was between 1991 and 2000.

(2)

between 1991 and 2000, number of births given by black-footed ferrets increased 200 to 450 - [illegible] which suggest that captive breeding programmes are effective as the number of births also increase in captive breeding

ResultsPlus
Examiner Comments

This gains one mark only for an increase in births from 1991 to 2000. Careless misreading of the graph gives the wrong figures - instead of 200 and 450, it should be 220 and 450 - however, even if the figures had been correctly quoted this would not have been enough to gain the second mark.

ResultsPlus
Examiner Tip

Read the axes on graphs with care - make sure the scale is being interpreted correctly. Don't just quote figures, manipulate them!

(ii) Using the information in the graph, suggest how effective the captive breeding programme was between 1991 and 2000.

(2)

There was an overall increase* between 1991 and 1999 however the numbers of ferrets dropped drastically between 1999 and 2000

*in births.

ResultsPlus
Examiner Comments

Luckily this candidate realised that the phrase 'in births' was needed to gain the mark!

ResultsPlus
Examiner Tip

Checking your answers is important.

(ii) Using the information in the graph, suggest how effective the captive breeding programme was between 1991 and 2000.

(2)

The number of black-footed ferrets kept increasing hence it was effective. From 1991 to 1999, the number of births increased by about 445 but between 1999 and 2000, the numbers reduced by 170 which is a big number.

ResultsPlus
Examiner Comments

This gains one mark for increase in births from 1991 to 1999 mp1- however, the calculation of the increase is incorrect, the difference between 220 and 450 is 230 and not 445!

But this candidate still gains full marks as they go on to state that the population fell from 1999 to 2000 mp4, by 170 mp5 for a correct manipulation of data.

ResultsPlus
Examiner Tip

It's worth carrying out more than one manipulation of data to compensate for mistakes!

Question 8 (c)

The great majority of candidates gained all three marks and showed a good understanding of the factors affecting population size. Where full marks were scored the most common answers were explanations about lack of food, possibility of eating either poisoned prairie dogs or the actual poison and the likelihood of further loss of habitat.

Where candidates failed to gain all three marks it was often for re-stating the same point with a different example, for example: lack of food **and** lack of prairie dogs, hunters **and** predators, or two separate descriptions of how habitat may affect the population.

Poor answers confused prairie dogs with dogs and suggested that they would attack the ferrets rather than being their prey, or that the farmers would poison the ferrets to protect their 'pets', having misread the word 'pest' in the description of prairie dogs. Although several candidates identified competition as a factor they did not specify the type of competition. Very few mentioned disease or the idea of there being too few ferrets released to produce a viable breeding population. Many alluded to a loss of habitat but failed to get the mark because they were repeating the phrase in the question by stating that 'only 1% of the prairie is left undisturbed'.

Some students interpreted 'suggest' as 'list' and scored poorly as they answered with a series of single word answers, rather than sentences to explain the factor properly.

A surprising number of answers commented on the 'closeness' of the reintroduction sites or the smallness of the 1% of the prairie left undisturbed, demonstrating a limited understanding of the size of the USA.

Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

(3)

1 when farmers poison prairie dogs, number of food for ferrests will decrease.

2 If ferrests eat poisoned prairie dogs, they will die.

3 If ferrets go to farmers to eat prairie dogs farmers could poison them or hunt them

ResultsPlus
Examiner Comments

This example focuses on the poisoning of the prairie dogs, yet still gains full marks - one less food for the ferrets (although 'number of food for ferrests will decrease' is awkwardly worded); one for implying that the ferrets will die if they eat poisoned prairie dogs; and one for the ferrets being hunted - although it seems unlikely they will 'go the farmers to eat prairie dogs'.

ResultsPlus
Examiner Tip

Try to use precise language that makes gaining marks a certainty - don't rely on the goodwill of examiners!

Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

(3)

1 Competition - Areas where there are a high population of ferrets will create competition between them and create the 'Survival of the fittest'

2 Disease - where there is only one group of ferrets could cause inbreeding depression resulting to a disease

3 Predation - Cause endanger to the population of ferrets by reducing population

ResultsPlus
Examiner Comments

This gains 3 marks - one for competition between ferrets, one for description of disease (caused by inbreeding, yet still relevant) and one mark for reference to predation.

A nice variety of factors here - and not one concerning the poisoned prairie dogs!

Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

(3)

1 Competition for resources.

2 Environment conditions change so a change in selection pressures

3 They have ~~a~~ disease.

ResultsPlus
Examiner Comments

Only one mark can be given here, even though the candidate has some good ideas. This is because there is lack of sufficient detail. The one mark is given for reference to 'disease'.

Competition for resources needs to be clarified - is it with other ferrets (intraspecific competition) or with other species (interspecific)?

The reference to a change in selection pressures suggests the candidate is thinking of natural selection rather than survival of a species reintroduced to the wild.

ResultsPlus
Examiner Tip

If there are 3 lines available for each factor, the examiner is expecting more than one word for an acceptable answer.

Suggest **three** factors that could affect the survival chances of black-footed ferrets when they are reintroduced to the sites shown on the map.

(3)

1 Physiological. The reintroduction site is ~~not~~ on the original range. So they are trying to ~~not~~ stay there.

2 Anotomical. The colour of the black-footed ferrets will remain same, that is black.

3 Behavioral. The ~~it~~ will like to stay there as the reintroduction site is present.

ResultsPlus
Examiner Comments

This candidate has interpreted the question as asking about the types of adaptation that will affect the survival of the ferrets. Sadly, this has resulted in no marks being awarded.

ResultsPlus
Examiner Tip

Double check the context of the question, do not 'skim read' - make sure you have read every word and not filled in the gaps from practice papers you've attempted. Questions may appear similar, but there are often subtle differences. Answer the question you're faced with, not the ones you've practised.

Paper Summary

In order to improve their performance candidates should:

- read all of the details in the questions carefully making sure that they consider the context before writing their answers;
- develop a familiarity with the subject specific vocabulary encountered at this level and learn how to use key words and phrases with precision;
- review all of the recommended core practicals with particular reference to laboratory procedures, ensuring that there the objectives of investigations are clearly understood;
- gain practice at interpreting information presented graphically and in tables;
- practice simple mathematical calculations – subtractions, and % differences;
- practice writing longer responses to develop skills in expressing ideas using appropriate scientific terminology.

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