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June 2022

GCSE Combined Science 1SC0 1BH

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Introduction

The Pearson Edexcel GCSE (9-1) Paper 1 Combined Science (Higher tier) paper is the first of six papers taken as part of the GCSE (9-1) Combined Science qualification. This is the fifth assessment of the GCSE (9-1) but the first time it had been examined in the summer since 2019. The autumn sittings in 2020 and 2021 had much lower entries. To compensate for lost learning as a result of the covid pandemic and in line with the other awarding organisations, candidates had access to an advanced information document for this paper which detailed some of the content that would be included in the exam and some that was not included. It also identified key core practicals. It was only the specification points that were given and not the questions.

The Combined Science specification and the qualification follow a linear assessment model whereby candidates must complete the six papers in the same single year of certification. For the Biology section: Paper 1: Biology (Higher tier) is awarded a total of 60 marks and it is assessed by a variety of question types, including multiple-choice questions, short-answer questions, calculations, and extended open response questions. Candidates should answer all questions in a time period of 1 hour and 10 minutes. The extended open response questions are identified by an asterisk (*) in the question paper to indicate that marks are also awarded for the ability to structure a response logically. There are two in this paper. In addition, the GCSE (9-1) Combined Science qualification assesses practical knowledge and maths skills; the requirements of which are given in the specification. Furthermore, there are 6 mandatory Biology core practicals that candidates must complete prior to the examination, as aspects of working scientifically are also assessed in questions throughout the paper.

Paper 1: Combined Science: Biology (Higher tier) contains questions assessing the content from Topics 1 to 5, as identified in the specification. In this examination series, candidates were required to respond to questions that tested their knowledge and understanding of DNA structure and extraction, STIs transmission and prevention, the evolution of antibiotic resistance and the development of new drugs, mitosis and cancer, and genetic engineering and stem cells. Questions designed to assess practical work included writing a plan to test the effectiveness of antiseptics which included the identification of variables and controls, as well as the preparation of a microscope slide to view cells going through mitosis and the action of the enzyme lipase on fat which included some theoretical application of enzyme function. The maths skills assessment in this paper related to questions requiring calculations of infection numbers per 1000 of a population and mitotic index where the equation was given in the questions.

Question 1 (a)

This question was answered to a high level by most candidates who gave weak hydrogen bonds as the mechanism for bonding base pairs together. Many also gave the pairings of A-T and C-G and the idea that there were complementary base pairs. Some detailed responses gave the number of bonds between the base pairs which exceed the demand of the specification.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) DNA molecules contain base pairs.

Describe how the base pairs are bonded together in a DNA molecule.

(2)

The base pairs are bonded together with weak hydrogen bonds in a double helix structure.

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Examiner Comments

Note this is about how the pairs bond not about the structure of a DNA molecule. This candidate scores 2 marks for weak hydrogen bonds. There are no marks for the term double helix.

Answer ALL questions. Write your answers in the spaces provided.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 (a) DNA molecules contain base pairs.

Describe how the base pairs are bonded together in a DNA molecule.

(2)

In an DNA Molecule the base pairs are bonded by double helix bonds as guanine and cytosine have 3 hydrogen bonds and Adenine and thymine have 2

ResultsPlus
Examiner Comments

We can ignore the comment about double helix. The candidate has scored 1 mark for guanine bonding with cytosine or adenine with thymine. They have also said hydrogen bonds for the second mark.

Question 1 (b)(i)

Most candidates gave the correct sequence for the complementary strand for the DNA molecule. Incorrect responses included those who gave the transcribed mRNA sequence and those who repeated the DNA sequence. Candidates must take care when forming letters that a C and a G can be distinguished.

Question 1 (c)(i)

This question was more challenging with many candidates recognising that protease digests proteins but linked this to the idea that it allowed the DNA to be extracted which forms part of the introduction to the question. Where the explanation was linked it was most frequently to the idea of breaking down the membrane of the cell or the nucleus. Responses were credited where they clearly referred to breaking down the proteins associated with the DNA as well as breaking down enzymes that could degrade the DNA. Knowledge of histones is not required at this stage.

(c) A student wanted to extract the DNA from fresh peas.

The student crushed the peas and added washing up liquid and water.

The enzyme protease was then added to this mixture.

(i) Explain why the enzyme protease was added to the mixture.

(2)

enzyme protease breaks down the cell's membrane, so ~~the~~ that DNA is then released.

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Examiner Comments

Although this candidate has not linked protease to the breaking down of protein, they have linked it to breaking down the cell membrane so 1 mark can be awarded.

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Examiner Tip

When answering questions on enzyme action be sure to match the correct enzyme with the correct substance that is broken down and what it is broken down into eg protease breaks down proteins into amino acids.

(c) A student wanted to extract the DNA from fresh peas.

The student crushed the peas and added washing up liquid and water.

The enzyme protease was then added to this mixture.

(i) Explain why the enzyme protease was added to the mixture.

(2)

Enzyme are biological catalysts that speed up the rates of reaction without being changed or used up. The student used the enzyme protease to sped up the extraction of the DNA.

ResultsPlus
Examiner Comments

This candidate has not identified protease breaking down proteins or that these are in the cell membrane etc. They do not mention destroying enzymes so no mark can be awarded.

ResultsPlus
Examiner Tip

It is important to make sure you are being specific when answering questions about enzymes.

(c) A student wanted to extract the DNA from fresh peas.

The student crushed the peas and added washing up liquid and water.

The enzyme protease was then added to this mixture.

(i) Explain why the enzyme protease was added to the mixture.

(2)

The enzyme protease was added to break down any of the proteins within the DNA. As such, this will leave the DNA as ~~them~~ individual strands instead.

ResultsPlus
Examiner Comments

We can award this candidate 1 mark for recognising that protease breaks down proteins. In the DNA is incorrect but we do not negatively mark against the first marking point.

Question 1 (c)(ii)

The majority of candidates knew that ice cold ethanol is used to precipitate the DNA or to make it visible. To extract the DNA was not credited as it was given in the question. Other incorrect ideas that were seen included the idea of cooling the mixture or denaturing enzymes which are not why the ethanol is added to the filtrate.

(ii) The mixture was then heated and filtered.

Finally, the student poured the filtrate into a test tube and ice cold ethanol was poured down the side of the test tube into the filtrate.

State why ice cold ethanol was poured into the filtrate.

(1)

To make the DNA visible

ResultsPlus
Examiner Comments

This is worth 1 mark as shown in the additional guidance under accept and is why we add ethanol so the DNA can be seen to be extracted.

Question 2 (a)(i)

There were several issues with this question in that many candidates did not know the meaning of the term median and calculated either the mode or mean and therefore came up with the incorrect answer. The answer should have been gonorrhoea. The median is calculated by putting the values in order and taking the middle value.

Question 2 (a)(ii)

Errors were made on this calculation when candidates did not know the value of a million. This meant that they could not determine that 66 000 should be multiplied by 3.7. One mark was awarded for the answer being given to the incorrect order of magnitude to acknowledge that only one error had been made in the calculation. Alternative methods to obtain the answer were credited and full marks were awarded for correct answers without working.

(ii) The population of the UK in 2017 was 66 million people.

Calculate the total number of people diagnosed with chlamydia in the UK in 2017.

Percentage = Diagnosed / 1000 people ×100 = 3.7 / 1000 ×100 (2)

= 0.37

66 000 000 × 0.37 = 24420000

24420000 people

ResultsPlus Examiner Comments

This candidate has done the correct calculation but has incorrectly divided so they have the incorrect order of magnitude. 1 mark can be awarded for the correct calculation to the wrong order of magnitude

ResultsPlus Examiner Tip

Always check orders of magnitude in calculations to avoid errors. Remember million has 6 zeros.

(ii) The population of the UK in 2017 was 66 million people.

Calculate the total number of people diagnosed with chlamydia in the UK in 2017.

(2)

66,000,000 ÷ 1000 = 66 000

66 000 x 3.7 = 244,200

244,200 people

ResultsPlus
Examiner Comments

Correct calculation using the first method highlighted in the mark scheme for 2 marks.

Question 2 (a)(iii)

This question was answered well by most candidates who recognised that communicable diseases can be passed from person to person. Candidates were also credited when they applied the term to chlamydia and stated that it could be passed on through body fluids or by sexual contact. Some candidates recognised that communicable diseases are caused by pathogens. Responses that just stated that communicable diseases could be passed on without further clarification were not credited.

(iii) State why chlamydia can be described as a communicable disease.

(1)

because it can be passed on from one person to another

ResultsPlus
Examiner Comments

Passed from one person to another is acceptable for 1 mark.

Question 2 (a)(iv)

Most candidates understood that transmission of chlamydia can be prevented by using a condom or abstaining from sex. Using barrier methods of contraception was credited but the idea of protection alone was insufficient for the mark. Some candidates scored the mark for giving details on screening and treating people who are infected, which will prevent transmission.

(iv) Give **one** way the transmission of chlamydia can be prevented.

(1)

performing abstinency

ResultsPlus
Examiner Comments

We can accept the spelling for abstinence for 1 mark.

(iv) Give **one** way the transmission of chlamydia can be prevented.

(1)

Wearing a condom.

ResultsPlus
Examiner Comments

Wearing a condom is enough for 1 mark.

Question 2 (a)(v)

This question requires candidates to recall that chlamydia is caused by bacteria and that antibiotics inhibit cell processes in bacteria, they were also credited for antibiotics killing bacteria. Where candidates scored one mark this was often because they repeated the stem of the questions, stating that chlamydia was caused by a bacteria, so it could be treated with antibiotics which lacks the linked explanation.

(v) Explain why chlamydia can be treated with antibiotics.

(2)

antibiotics can kill ~~fight~~ virus like chlamydia.

ResultsPlus
Examiner Comments

Chlamydia is not a virus but it is both a bacterium as well as a disease. In this case 0 marks can be awarded as the answer is incorrect.

(v) Explain why chlamydia can be treated with antibiotics.

(2)

It is a bacteria so the antibiotics can to destroy the toxins and the bacteria cells

ResultsPlus
Examiner Comments

This can be awarded both marks, chlamydia is a bacteria for 1 mark and antibiotics destroy the bacterial cells for 1 mark. Note we ignore the reference to toxins.

Question 2 (b)

Most candidates had a good idea of the effect of HIV on the immune system or that it destroys white blood cells, combining these two points in a linked explanation enabled both marks to be awarded. Some candidates stated that you can catch AIDS suggesting that the link between HIV infection and the development of AIDS is not fully understood.

(b) HIV is another sexually transmitted infection.

Explain how HIV can lead to the onset of AIDS.

(2)

HIV attacks white blood cells in the body, leading to a weakened immune system. A weaker immune system can ~~[illegible]~~ lead to the onset of AIDS.

ResultsPlus
Examiner Comments

Both marks can be awarded for the effect on both white blood cells and on the immune system. Please note the idea of attacking the immune system was not accepted.

(b) HIV is another sexually transmitted infection.

Explain how HIV can lead to the onset of AIDS.

(2)

HIV is a human immunodeficiency virus which destroys the human immune system this can lead to AIDS causing the to deteriorate the immune system so it means humans are more susceptible to infections so AIDS deteriorates the immune system

(Total for Question 2 = 9 marks)

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Examiner Comments

This is awarded 1 mark for the effect of AIDS on the immune system. They have made no mention of the effect on white blood cells so only 1 mark awarded.

Question 3 (a)(i)

A linked explanation of how *Klebsiella* bacteria develop resistance to antibiotics was required for this item. Marks were awarded for evolution or natural selection, which relies on mutation or variation in the population. This leads to some bacteria surviving treatment with antibiotics allowing them to reproduce with offspring inheriting the resistance trait. Some candidates gave the idea that bacteria could become immune to antibiotics which is not creditworthy or that the human body can become immune. The idea that bacteria are strong or weak was not credited, responses needed to refer to bacteria that are resistant to antibiotics.

3 (a) In 2017, a new strain of *Klebsiella pneumoniae* bacteria was discovered that was resistant to 26 different antibiotics.

(i) Explain how *Klebsiella pneumoniae* bacteria developed resistance to antibiotics.

(4)

Klebsiella pneumoniae bacteria developed resistance through natural selection. For example, overtime, through survival of the fittest, the surviving bacteria from the antibiotic was able to pass on it's alleles of resistance against the bacteria onto it's offsprings, and again overtime the future generation of klebsiella pneumonia bacteria was able to develop resistance to antibiotics. The antibiotic can no longer inhibit or kill the bacteria replication.

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Examiner Comments

4 marks awarded. Natural selection for 1 mark. The surviving bacteria from the antibiotic is equivalent to the resistant bacteria for 1 mark. Passes the alleles for resistance onto the offspring is also a mark, this could also be given for the accept bacteria have the allele for resistance.

ResultsPlus
Examiner Tip

Note it is not the quantity of writing that is important for the marks but the quality of the answer.

3 (a) In 2017, a new strain of *Klebsiella pneumoniae* bacteria was discovered that was resistant to 26 different antibiotics.

(i) Explain how *Klebsiella pneumoniae* bacteria developed resistance to antibiotics.

(4)

- people who had it may not have finished their antibiotics as they might have felt good.
- then the bacteria that wasn't killed off mutated and spread with a resistance to antibiotics.

ResultsPlus
Examiner Comments

2 marks awarded. Bacteria mutated for 1 mark. The course of antibiotics not finished so bacteria weren't killed off for 1 mark.

3 (a) In 2017, a new strain of *Klebsiella pneumoniae* bacteria was discovered that was resistant to 26 different antibiotics.

(i) Explain how *Klebsiella pneumoniae* bacteria developed resistance to antibiotics.

(4)

Natural selection, This means that natural breeding in bacterias will result in Klebsiella pneumoniae to be resistance. This is because not all of the bacteria will be killed at once. Therefore those bacterias which have just been weakened will breed with other bacterias. This will result in that ~~resistance~~ bacteria will increase with a resistance of antibiotic. As a result that type of bacteria won't be affected by ~~not~~ weak antibiotics as it has already been resistance to it.

ResultsPlus
Examiner Comments

1 mark awarded for Natural selection. The candidate has not given enough detail for any of the other marks.

Question 3 (a)(ii)

This question asked about how the use of antibiotics contributed to the development of resistance in bacteria. The mark was awarded for the idea of over-use, not finishing a course, or incorrect use for non-bacterial illness. Examples such as those used in agriculture were also credited. Some incorrect responses described the mechanism of evolution rather than answering how the use of antibiotics made a contribution.

Question 3 (b)

Many candidates gained at least two marks on this item with many getting full marks. Responses that used the terms pre-clinical and/or clinical testing were more likely to give the details of testing on cells, animals, and humans and gain all three marks. Some detailed responses referred to double-blind trials or described the use of a placebo. Blind trials were not credited but the single blind was sufficient.

(b) New antibiotics are being developed to treat the disease caused by *Klebsiella pneumoniae*.

Describe the stages of antibiotic development that would occur after the discovery of a new antibiotic.

(3)

Firstly, the antibiotic would be tested on plant or bacteria cells. If these trials are safe and successful, the trials move on to animals, for example rats. If this is successful, the trial would be taken out on healthy humans, who would be given a blind test.

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Examiner Comments

This candidate is awarded 2 marks. Testing on cells/animals for 1 mark, we can ignore the reference to the type of cells. Testing on healthy volunteers. No marks for blind test, must be single blind or double blind or an explanation of double or single blind testing.

(b) New antibiotics are being developed to treat the disease caused by *Klebsiella pneumoniae*.

Describe the stages of antibiotic development that would occur after the discovery of a new antibiotic.

(3)

Firstly, the antibiotic would need to be tested on live cells to see the effect under a microscope. Next it would be used on an living organism. Doctors hold process for the public to take part in. Each person is given either a placebo pill or the real antibiotic. This is done so none of the doctors or patients knows what pill they haven't taken and so that no-one can be bajist and effect results.

ResultsPlus
Examiner Comments

This candidate is awarded 3 marks. Testing on cells 1 mark. We can award 1 mark as the double blind trial is testing on humans. A description of a double-blind trial is also 1 mark.

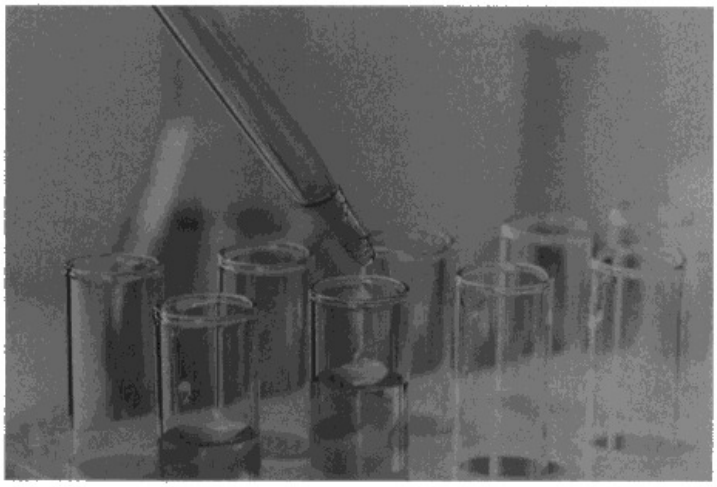
Question 4 (a)

This question introduced a practical which required the application of knowledge as it was not the core practical. Candidates who did not read the introductory information carefully for questions like this one will score lower. Responses to this question either gave the reason that the milk B drop rose to the surface was due to the fat content or related to the idea of being less dense than water. Some incorrect answers referred to it being lighter.

4 A student investigated the fat content of two types of milk: milk A and milk B.

Before starting the investigation, the student added a drop of oil from a pipette into a test tube of water as shown in Figure 3.

The drop of oil rose to the surface of the water.



(Source: © Nana_studio/Shutterstock)

Figure 3

(a) The student then placed a drop of milk A into one test tube of water and a drop of milk B into a different test tube of water.

The drop of milk A sank to the bottom and the drop of milk B rose to the surface.

Give **one** reason for the drop of milk B rising to the surface.

(1)

It contains ~~more~~ (lipid) fat in milk B

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Examiner Comments

This candidate is awarded 1 mark for the idea that milk B had a higher fat content.

4 A student investigated the fat content of two types of milk: milk A and milk B.

Before starting the investigation, the student added a drop of oil from a pipette into a test tube of water as shown in Figure 3.

The drop of oil rose to the surface of the water.

(Source: © Nana_studio/Shutterstock)

Figure 3

(a) The student then placed a drop of milk A into one test tube of water and a drop of milk B into a different test tube of water.

The drop of milk A sank to the bottom and the drop of milk B rose to the surface.

Give **one** reason for the drop of milk B rising to the surface.

(1)

Because Milk B have more oil in it, and oil don't deserve in the water, it stay on the water.

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Examiner Comments

Milk B has more oil in it is equivalent for the mark.

Question 4 (b)(i)

Lipase digests fats into fatty acid and glycerol which will reduce the pH of a mixture or make it more acidic. This is what was required to explain the change from pH 7 to pH 5. Most candidates obtained the mark for recognising that the pH has reduced or become more acidic with many also recognising that fat is the substrate for lipase. Some candidates suggested that the product of fat digestion was amino acids or lactic acid.

(b) 5 cm^3 of milk B and 1 cm^3 of lipase were added to a different test tube.

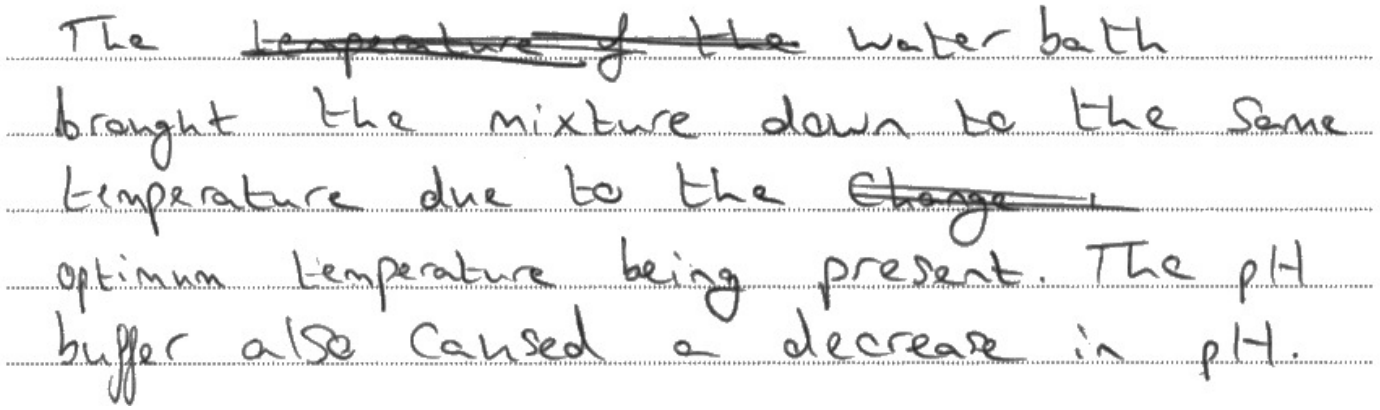
The pH of this mixture was pH 7.

This test tube was placed in a water bath for 10 minutes.

The pH of the mixture changed from pH 7 to pH 5.

(i) Explain what caused this change in pH.

(3)



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Examiner Comments

This was a common response where the candidate was unable to link the lower fat content to fewer fatty acids being produced.

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Examiner Tip

Always read the question carefully before attempting to answer. The question just mentioned a water bath not that the temperature was optimum, too low or too high.

(b) 5 cm^3 of milk B and 1 cm^3 of lipase were added to a different test tube.

The pH of this mixture was pH 7.

This test tube was placed in a water bath for 10 minutes.

The pH of the mixture changed from pH 7 to pH 5.

(i) Explain what caused this change in pH.

(3)

AS there is alot of fat in milk B, the mixture when heated would change from pH 7 to pH 5, the lipase and milk B together denature

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Examiner Comments

Although this candidate has stated that the pH has changed from pH 7 to pH 5, we are ignoring this as it is just a rewording of the question.

ResultsPlus
Examiner Tip

Rewording the question will not gain any marks.

(b) 5 cm^3 of milk B and 1 cm^3 of lipase were added to a different test tube.

The pH of this mixture was pH 7.

This test tube was placed in a water bath for 10 minutes.

The pH of the mixture changed from pH 7 to pH 5.

(i) Explain what caused this change in pH.

(3)

The Lipase would have broken down the fat in milk by (Lipids) and would release acid as a by product increasing the PH.

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Examiner Comments

1 mark awarded for lipase breaking down the fat in the milk.

Question 4 (b)(ii)

Candidates needed to recall that milk B did not rise in water indicating that it did not contain fat, or contained less. Therefore, the pH did not change as fatty acids were not produced. Some candidates recognised that there was no substrate for the lipase or that there was no fat and those with a good knowledge of enzymes recognised that a lack of fatty acid production meant the pH didn't change. Some candidates incorrectly linked this to the previous question suggesting that the enzyme had already reacted.

(ii) This procedure was repeated with milk A.

There was no change in the pH of this mixture after 10 minutes.

Explain why there was no change in the pH of the mixture containing milk A.

(2)

There was nothing for the lipase to react with, so the pH didn't change and stayed neutral.

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Examiner Comments

No marks awarded, we must have no substrate for the third marking point and fewer fatty acids produced is needed for the second marking point.

(ii) This procedure was repeated with milk A.

There was no change in the pH of this mixture after 10 minutes.

Explain why there was no change in the pH of the mixture containing milk A.

(2)

Because lipase enzymes break down lipids (oil and fat) and the milk didn't contain any oil (lipid molecules) therefore nothing happens as there is nothing to break down.

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Examiner Comments

1 mark awarded for milk A does not contain oil/lipids.

Question 4 (b)(iii)

This question was generally answered well with most candidates recognising that the enzyme has been denatured so the active site had changed shape which allowed them to obtain at least 2 marks. Some candidates extended this to include the idea that the substrate could not bind or that fatty acids were not produced. Some candidates gave incorrect responses suggesting that the cooling had reduced the temperature below the optimum and so the enzyme would not react.

(iii) The student repeated this procedure with lipase that had been boiled and left to cool.

This was added to another sample of milk B.

Describe why the pH did not change in this mixture.

(3)

The lipase didn't react and as a result didn't break anything down. It didn't react because it had denatured so it wasn't complimentary to the fat

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Examiner Comments

The enzyme didn't react because it was denatured is the second marking point. A mark can also be awarded for the statement it wasn't complementary to the fat. 2 marks awarded in total.

(iii) The student repeated this procedure with lipase that had been boiled and left to cool.

This was added to another sample of milk B.

Describe why the pH did not change in this mixture.

(3)

Because lipase is an enzyme and changing the temperature of an enzyme to a point that its too hot means that its gone over optimum temp and the active site begins to denature. The substrate can no-longer fit and the enzyme doesn't work so there is no breakdown into acid so change pH

(Total for Question 4 = 9 marks)

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1 mark can be awarded for temperature going above the optimum. The active site begins to denature is both the second and third marking point. A mark could also be awarded for the substrate can no longer fit in the enzyme. A full 3 marks awarded.

(iii) The student repeated this procedure with lipase that had been boiled and left to cool.

This was added to another sample of milk B.

Describe why the pH did not change in this mixture.

(3)

There Stockport was no change in pH because the temperature for the enzyme lipase was not at its optimum temperature therefor the substrate active complex couldnt be made as the active site being denatured. This is why there was no change

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This candidate cannot be awarded the first marking point as the temperature needs to be above the optimum not merely at the optimum. We can give the mark for active site denatured meaning the active site changes shape but they have not said denaturing the enzyme active site.

1 mark in total awarded.

Question 5 (a)

This 4 mark question combined practical skills knowledge with subject knowledge on mitosis. Most candidates gave the practical details on how to prepare a microscope slide but few applied the question to knowledge on mitosis, that the meristem or the tip of the root was needed. Most candidates recognised the need for a stain and a coverslip. Many stated that it needed to be a thin slice. Many candidates gave details on using the microscope, which was not credited as it doesn't answer the question.

5 (a) A student was investigating mitosis in the roots of a garlic plant.

Describe how the student could prepare a microscope slide to show mitosis in the growing roots of a garlic plant.

(4)

The student should place the root of the garlic plant onto a slide and secure it in place. They should then place the slide onto the stage of the microscope and clip it into place. Next the student should look through the eye piece lense of the microscope and decide which magnification and resolution is needed in order to see the specimin clearly.

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Unfortunately this candidate has not specified a thin slice or cells or crushing the root so this mark cannot be awarded. They have then described the use of a microscope rather than the preparation of the cells; this is not creditworthy.

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Examiner Tip

Look to the number of marks awarded for the question, in this case 4 marks. Therefore 4 marks about the preparation of the slide needed to be given.

5 (a) A student was investigating mitosis in the roots of a garlic plant.

Describe how the student could prepare a microscope slide to show mitosis in the growing roots of a garlic plant.

(4)

- The student could take a sample from the near ~~root~~ end of the root of the plant which is where mitosis is present due to the 2 undetected daughter cells causing it to 'grow'.
- While under the microscope, have the flashlight on to see clearly
- Use magnify x40 as would be hard to see with x10
- Use only a thin segment of sample so it is visible.

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Examiner Comments

Taking a sample from the end of the root is worthy of a mark. Use only a thin sample is also worthy of the third marking point. 2 marks awarded.

5 (a) A student was investigating mitosis in the roots of a garlic plant.

Describe how the student could prepare a microscope slide to show mitosis in the growing roots of a garlic plant.

(4)

- place iodine on one glass slide
- Place the roots on the slide
- Place another glass slide on top
- Place on the microscope ~~stid~~ bed
- Ajust the eye piece, so you get Zoomed in
- Then ajust the dial to get a higher resolution, so the root isnt blurry and is in high definition

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Examiner Comments

Place iodine on the slide is acceptable for a named stain. Place another glass slide over the top is a description of a cover slip so 2 marks can be awarded.

Question 5 (b)

Marks were awarded for two cells being produced, that were genetically identical and diploid. Some candidates have details of 23 pairs of chromosomes or 46 chromosomes which was credited although the question is not specifically about human cells. Some candidates confused diploid and haploid and some just gave the idea that the cells were identical without reference to the genetic material which was insufficient. Comparisons with meiosis were also seen which was a question on a previous paper and not required here.

(b) Describe what is produced when a single cell divides by mitosis.

(3)

When a single cell divides by mitosis it produces two identical daughter cells, through asexual reproduction and the cells are haploid cells.

ResultsPlus Examiner Comments

Only 1 mark awarded for 2 daughter cells. To award the second marking point the candidate must state genetically identical or a description of this, not merely identical. Haploid is incorrect.

(b) Describe what is produced when a single cell divides by mitosis.

2, diploid

(3)

Mitosis is asexual reproduction. When a cell divides by mitosis the genetic information is copied, leaving the daughter cells ~~as~~ as genetically identical. 2 cells are formed, in which they are diploid.

ResultsPlus Examiner Comments

2 daughter cells, 1 mark. Genetically identical, 1 mark. Diploid cells, 1 mark. All three marks awarded.

Question 5 (c)

The equation for calculating mitotic index was provided but candidates needed to recognise that interphase is not part of mitosis. The first mark was for totaling the stages of mitosis, the second was for the calculation and then the final mark was for the answer being given to three significant figures. An error carried forward was applied when the number of cells was incorrectly calculated, allowing the maths skills marks to be obtained. The most frequent errors seen were the selection of one or two phases of mitosis but not all four or using interphase.

(c) The student observed 89 cells on the microscope slide.

Figure 4 shows the number of cells at each stage of the cell cycle.

stage of cell cycle	number of cells
Interphase	44
Prophase	12
Metaphase	6
Anaphase	18
Telophase	9

Figure 4

Use this equation to calculate the mitotic index for this slide.

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

Give your answer to three significant figures.

(3)

Mitotic index .....

ResultsPlus
Examiner Comments

This candidate has correctly selected 45 cells for 1 mark. They have not correctly calculated the answer for the equation unfortunately. They have not calculated to 3 significant figures effectively so only 1 mark can be awarded.

ResultsPlus
Examiner Tip

For maths questions always check your calculation twice and then check the question to see if there are any further requests, such as the number of significant figures.

(c) The student observed 89 cells on the microscope slide.

Figure 4 shows the number of cells at each stage of the cell cycle.

stage of cell cycle	number of cells
Interphase	44
Prophase	12
Metaphase	6
Anaphase	18
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Figure 4

Use this equation to calculate the mitotic index for this slide.

$$\text{mitotic index} = \frac{\text{number of cells in mitosis}}{\text{total number of cells}} \times 100$$

Give your answer to three significant figures.

(3)

$\frac{2}{89} \times 100 = 2.\dot{2}4$

mitosis produces two daughter cells

Mitotic index 2.$\dot{2}$4

ResultsPlus
Examiner Comments

This candidate has incorrectly selected 2 cells so the first marking point cannot be awarded. They have correctly applied the equation using their figure so can be awarded the calculation mark. They have not correctly rounded the answer so this mark cannot be awarded. 1 mark awarded.

Question 5 (d)

Cancer causes cells to divide uncontrollably and most candidates obtained this mark by stating this or giving the idea of rapid cell division. References to mutation or tumour were ignored as they do not answer the question.

(d) The mitotic index is often used in the diagnosis of cancer.

State the effect of cancer on cell division.

(1)

It becomes uncontrollable and it over produces cells

ResultsPlus
Examiner Comments

It becomes uncontrollable is enough as the question asks about cell division in cancer. 1 mark awarded.

(d) The mitotic index is often used in the diagnosis of cancer.

State the effect of cancer on cell division.

(1)

cancer increases the rate of cell division

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Examiner Comments

Increases the rate of cell division is also in the additional guidance under accept for 1 mark.

Question 6 (a)(i)

This question required careful reading of the introductory information as well as the question. The pig is engineered not to produce pig's kidneys as they cannot be used in humans, would be rejected or ideas around them interfering with the growth of the human kidneys. It was not so they could grow human kidneys which is achieved by implanting stem cells.

6 There is a shortage of kidneys for organ transplants.

Scientists are investigating how to grow kidneys using genetically modified pig embryos.

Figure 5 shows this process.

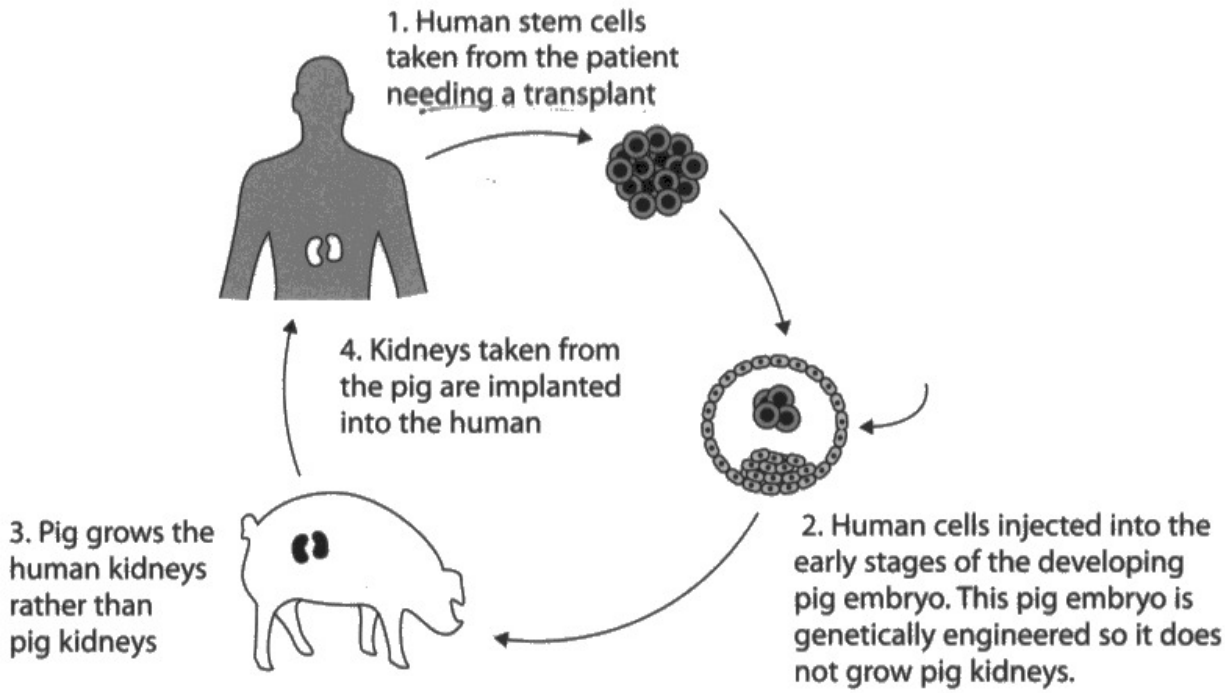

Figure 5

(a) (i) State why the embryo of the pig must be engineered so it does not grow pig kidneys.

(1)

otherwise there would be pig kidney or a mix of pig / human kidney

ResultsPlus
Examiner Comments

This response is insufficient for the mark. Please note 'it grows human kidneys' is shown on the diagram so is not worthy of a mark.

6 There is a shortage of kidneys for organ transplants.

Scientists are investigating how to grow kidneys using genetically modified pig embryos.

Figure 5 shows this process.

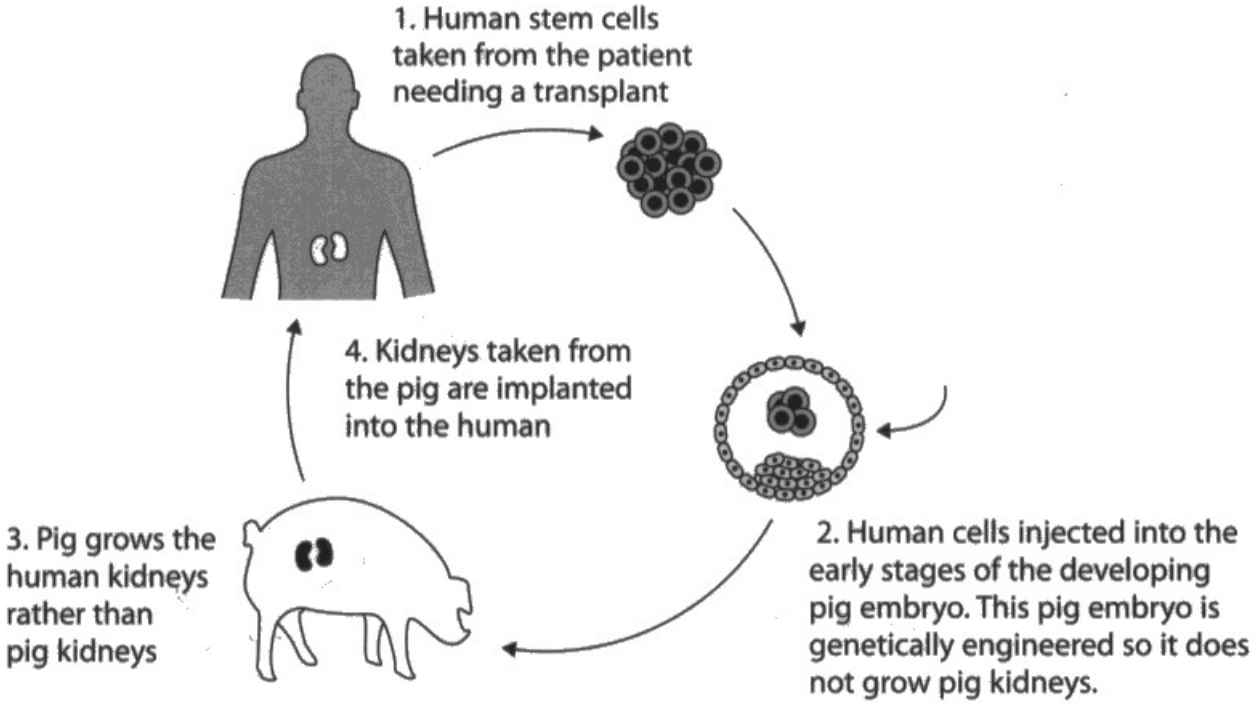

Figure 5

(a) (i) State why the embryo of the pig must be engineered so it does not grow pig kidneys.

(1)

so the human doesn't have pig kidneys, as it won't function

ResultsPlus
Examiner Comments

This is equivalent to the additional guidance pig kidneys cannot be used in humans so can be awarded 1 mark.

Question 6 (a)(ii)

Human stem cells were used because stem cells are undifferentiated cells and can become specialised so they would be able to form human kidney cells or human kidneys and that, if transplanted, there is less chance of rejection. Most candidates answered this question well, applying the knowledge they had learned to a specific context.

(ii) Explain why human stem cells are used for this process.

(2)

human Stem Cells are used because they are adaptable and can be used to easily genetic engineer into other organs, such as kidneys

ResultsPlus Examiner Comments

Adaptable is not sufficient for the mark. Stem cells are not genetically engineered to produce organs so no marks can be awarded. Here we were looking for the idea of them differentiating into human kidney cells.

(ii) Explain why human stem cells are used for this process.

(2)

Human stem cells are undifferenciated So they have the opportunity to become a specific type of cell. For example a ~~foot hair~~ muscle cell.

ResultsPlus Examiner Comments

Human cells are undifferentiated is fine for the first marking point but become a specific cell is not enough for the second marking point, it must be kidney, kidney cells or kidney tissue for this mark. 1 mark awarded.

Question 6 (b)(i)

Extracting information from graphs and data tables is a key scientific skill. Candidates need to ensure they provide an answer that fits with the command word, in this case, 'compare'. There are several comparisons that can be made between the number of donors available and the number of transplants needed. The number of donors only increases by a small amount. The number of transplants needed increases rapidly until a peak in 2014/2015 and then decreases. Candidates were told to use information from the graph and a mark was available for comparative data. To get this mark they had to compare data at the same point between the number of donors available and the number of organ transplants.

(b) Figure 6 shows the number of organ transplants needed and the number of donors available in the USA from 1991 to 2018.

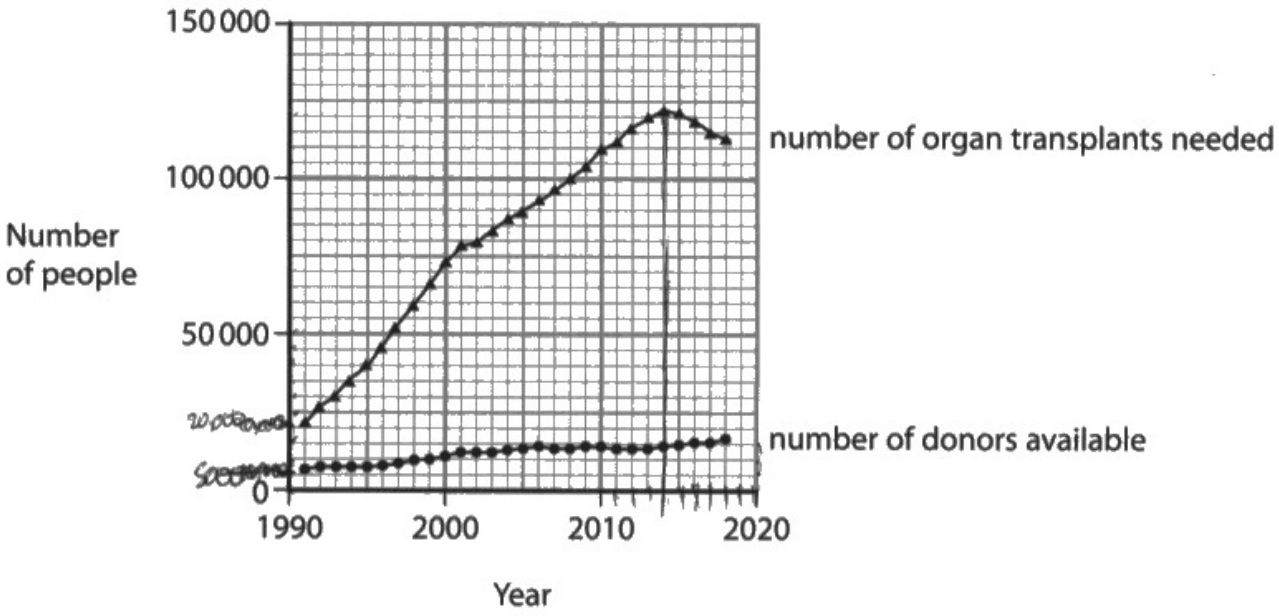

Figure 6

(i) Compare the number of donors available with the number of organ transplants needed from 1991 to 2018.

Use information from the graph to support your answer.

(3)

- ~~There are more organ transplants needed compared to donors available~~ 1991
- ~~In 1990, the lowest number~~ was the lowest amount of organ transplants ~~needed with and a lowest number of donors available.~~
- There are more organ transplants needed compared to donors available
- In 1991, the lowest amount of organ transplants were needed, 20,000 people, and the lowest number of donors ~~available~~, available, 50,000.
- In 2014, the highest amount of organs transplants were needed, 120,000
- In 2018, the highest amount of donors available, 15,000

This candidate can be awarded the accept mark for the third marking point for 'there are more transplants needed than organs are available'. The second marking point can be awarded as they talk about the highest amount of transplants in 2014 which is the same as the peak. A final mark can be awarded for the comparative data. They are comparing data for the two peaks, this is unusual but nevertheless an appropriate comparison. 3 marks awarded.

When answering questions about comparative data always include quoted numbers or calculated comparisons in your answer.

(b) Figure 6 shows the number of organ transplants needed and the number of donors available in the USA from 1991 to 2018.

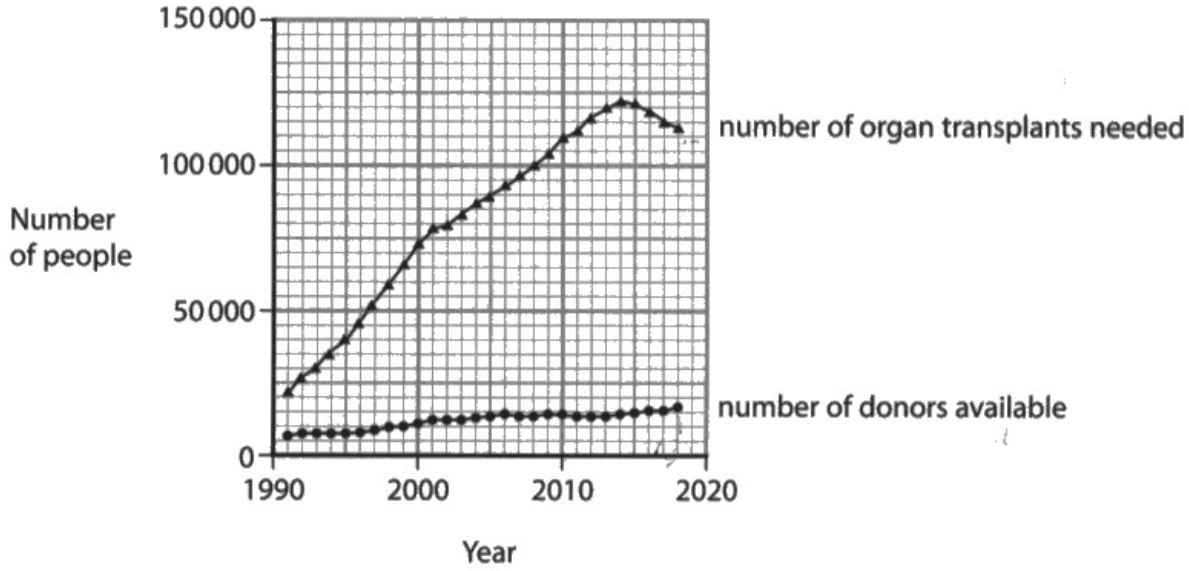

Figure 6

(i) Compare the number of donors available with the number of organ transplants needed from 1991 to 2018.

Use information from the graph to support your answer.

(3)

There is a steep increase of organ transplants from 20,000 needed from 1991 and peaks at 2014 at 120,000 to to 10,000 and slowly declines after that to 2018. The number of donors available is very flat as from 1991 to 2018 7,500 donors in 1991 to 15,000 in 2018. This could be as during 1991 - 2014 it was common for people to smoke causing lung/organ damage whereas now it is on a

ResultsPlus
Examiner Comments

This candidate gave a comparison for both donors and transplants in the first 4 lines for 1 mark. Peaks at 2014 is in the accept for the second marking point. There is comparative data for both donors and transplants so the last marking point can be awarded for 3 marks in total.

(b) Figure 6 shows the number of organ transplants needed and the number of donors available in the USA from 1991 to 2018.

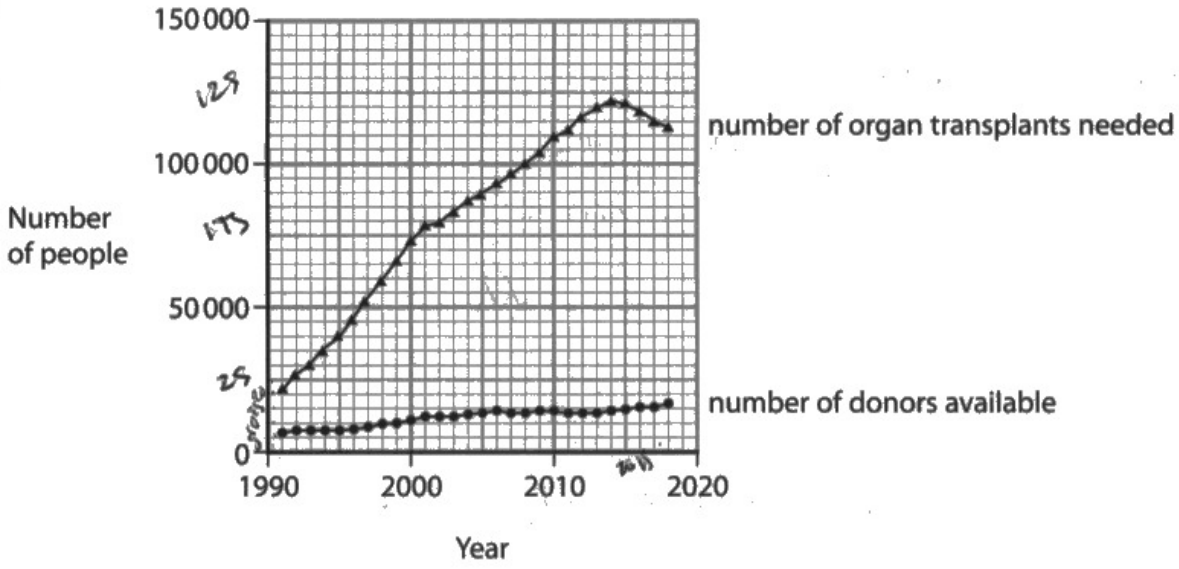

Figure 6

(i) Compare the number of donors available with the number of organ transplants needed from 1991 to 2018.

Use information from the graph to support your answer.

(3)

In the 1990's, at just below 20,000 people needed organs transplants, and only 5,000 could donate. Therefore the demand was slightly easier to manage however the technology wasn't to developed at this time, so the number of people needing transplants continued to increase dramatically. Although, in 2014, the number of people began to decrease at a similar rate to how it was increasing showing that new technology and more donors has helped, with just under 20,000 donors in 2018

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Examiner Comments

The last marking point can be awarded in the first line for comparative data over time. The second marking point can be awarded for 'the number of people decreased' as this is linked to the sentence before where they talk about transplants. 2 marks awarded.

Question 6 (b)(ii)

The reason that scientists are genetically engineering animals for organ transplants is that there is a shortage of donors. Most candidates were able to obtain this mark.

(ii) State why scientists are genetically engineering animals for organ transplants.

(1)

because they can grow the organs needed using animals because they are similar to humans.

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Examiner Comments

The idea that animals are similar to humans is not creditworthy here.

Question 6 (c)

The only extended open response question on this paper was on the production of a genetically engineered bacterial cell which can produce human insulin. The indicative content included the details of the enzymes involved in the process as well as sticky ends, these are listed in the specification for this content. Most candidates demonstrated some knowledge on the process including the role of some enzymes. Confusion occurred when the response indicated that the human was being genetically engineered and there were some responses where the recombinant plasmid was constructed but not inserted into the bacteria which limited the level which could be awarded.

- recombinant - ligase - restriction enzyme

*(c) Bacteria have been genetically engineered to produce human insulin since 1978.

Explain how bacteria can be genetically engineered to produce human insulin.

(6)

The bacteria's DNA (plasmid) is cut using restriction enzymes and to form sticky ends
The insulin's DNA is also cut using the same restriction enzyme in order to form complementary sticky ends
These complementary sticky ends are joined together by ligase enzymes and the insulin is inserted into the plasmid or the bacteria.
The bacteria is the genetically engineered to produce human insulin as it has the insulin within its DNA meaning its offsprings shall also produce the same.

This has then formed the recombinant bacteria

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Examiner Comments

4 marks awarded. This candidate has removed the gene for insulin and inserted it into the bacterial plasmid. They have linked this to the correct use of an enzyme so can be awarded the top of level 2. The candidate has not put the recombinant plasmid back into the bacteria so cannot get into band 3.

ResultsPlus
Examiner Tip

For extended open response questions always attempt an answer.

*(c) Bacteria have been genetically engineered to produce human insulin since 1978.

Explain how bacteria can be genetically engineered to produce human insulin.

(6)

Cut open the plasmid using the restriction enzymes and leave behind the sticky ends. Cut the gene for the characteristic to produce insulin from the DNA of human using the restriction enzymes and also leaving the sticky ends. Join the sticky ends using the ligase enzymes. Insert the combiant gene into the plasmid and insert the plasmid into the bacterium.

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Examiner Comments

The candidate is awarded 6 marks. They have correctly removed and inserted the human gene into the plasmid and returned it to the bacterial cell. They have correctly used both restriction and ligase enzymes and mentioned leaving sticky ends.

ResultsPlus
Examiner Tip

Note all six marks can be achieved without writing a long essay style answer.

*(c) Bacteria have been genetically engineered to produce human insulin since 1978.

Explain how bacteria can be genetically engineered to produce human insulin.

(6)

Bacteria 's plasmid will be taken out, and insulin will also be taken out to isolate. The restriction enzyme would cut a piece of plasmid, then insulin will be inserted in to the cut. Then, ~~be~~ the plasmid with a human ~~tsuti~~ insulin gene will be put back the bacteria cell. This process is genetically engineering a bacteria cell to produce human insulin as some of the genes of human insulin have been insert to bacteria cell.

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Examiner Comments

This candidate has scored 5 marks. Although the candidate starts talking about insulin, they qualify that this is the insulin gene on the fifth line. They have therefore removed the insulin gene, inserted it into the plasmid and returned it to the bacterium so all three parts are correct. Please note they only have to mention the insulin or human gene once in the right context to allow this to be marked correctly. They have not mentioned both enzymes or sticky ends so cannot be awarded 6 marks.

Paper Summary

The publication of an advanced information document gave candidates a focus on topics to revise ahead of the examination and this included the relevant core practicals. There was evidence that, particularly candidates of higher ability, had a high level of understanding of the topics assessed in this paper, reflecting that they were able to target their revision.

Based on their performance on this paper, candidates should:

- recognise that the word 'explain' means additional scientific information is needed that is linked to the answer given.
- understand that the command word ‘compare’ requires the answer to make comparisons between two sets of data or two concepts. Language used in responses should be comparative – 'greater', 'faster', 'quicker' etc.
- read the information given in the introduction to the question but avoid repeating it in the answer as it will not gain credit.
- ensure that methods for core practicals are understood including the differences between controls and control variables.
- avoid using terms like stronger or weaker organisms survive/die when explaining evolution and link answers to the specific adaptation the question is based upon.
- ensure they consistently apply rules for rounding up numerical answers and understand recurring numbers.
- read mathematical questions carefully to note whether an answer is required in standard form or to a specified number of significant figures.
- always show the mathematical working when doing calculations, as a mark can be awarded for errors carried forward.
- consider the context of the question to ensure they apply their scientific knowledge to the situation they are being asked about.
- check the number of marks given for the question and ensure that they have included enough facts to match the marks awarded.

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

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