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June 2023

GCE Biology A 9BN0 02

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Introduction

This paper offered a diverse array of question styles and opportunities for candidates to demonstrate their knowledge and understanding. Many candidates clearly rose to this challenge and it was most pleasing to see a good number of very accomplished and thorough candidate responses. Much thanks and congratulations should go to both the candidates and to those centres that have taught and helped prepare them for this examination.

Question 1 (b)

This question required candidates to explain how genetic variation can be established through crossing over. Whilst many candidates appreciated that there was an exchange of genetic material, not all made it clear where the exchange occurred.

This is a strong answer which gains full marks.

(b) Meiosis is involved in the production of sperm cells.

Crossing over during meiosis can result in genetic variation.

Explain how crossing over can lead to genetic variation.

(3)

crossing over occurs between non-sister chromatids of a pair of homologous chromosomes. the chromatids overlap and exchange a section of DNA / alleles leading to a different allele ending up in each daughter cell, increasing the genetic variation

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Examiner Comments

The candidate has informed us that genetic material is being swapped and has correctly told us where the exchange has occurred. This is in the order of the second, then third marking points on the first and second lines, and subsequently the first marking point on the third into the fourth line.

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Examiner Tip

Be careful not to just repeat what is in the question. The last line here refers to genetic variation rather than different allele combinations which would not be an alternative for the last marking point.

This example did not achieve any marks, and illustrates a common confusion shown by many candidates.

(b) Meiosis is involved in the production of sperm cells.

Crossing over during meiosis can result in genetic variation.

Explain how crossing over can lead to genetic variation.

(3)

Crossing over ~~was~~ includes genes on two different chromosomes swapping. This can occur at any loci on the chromosome. Crossing over increases the amount of different possible outcomes when genes swap, and therefore increasing the genetic variation.

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Examiner Comments

Initially the candidate refers to genes swapping over. This was not considered an alternative for the first marking point. The reference to different chromosomes would have needed to be suitably qualified to gain the second marking point.

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Examiner Tip

Make sure that the difference between gene and allele is fully appreciated.

Question 2 (b)(i)

This question asked candidates to describe the term operon. Many candidates recognised that it related to DNA but only a minority appreciated that it involved several genes or that it was under the control of an operator.

This response did not gain any marks.

(b) The lac operon is found in some prokaryotes.

(i) Describe what is meant by the term **operon**.

(2)

A section of a gene that codes for a protein that can be either activated or inhibited by the attachment of a protein.

ResultsPlus
Examiner Comments

The gene reference was singular so was not an equivalent to the first marking point, so no marks awarded.

This response gains both marks.

(b) The lac operon is found in some prokaryotes.

(i) Describe what is meant by the term **operon**.

(2)

Found at the beginning of a DNA sequence. Contains transcription factors and structural genes. A cluster of genes. Also contains promoter region.

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Examiner Comments

The candidate has referred to a cluster of genes along with the presence of a promotor region, hence both marks can be awarded.

ResultsPlus
Examiner Tip

Make sure that you can define technical terms.

Question 2 (b)(ii)

This question required candidates to describe how the presence of lactose sugar affected the lac operon. It was most encouraging to note that many candidates recognised that lactose enabled the lac operon to function and were able to offer appropriate detail.

This is a sound response which was awarded two marks.

(ii) Describe the effect of lactose on the lac operon.

(3)

· If lactose is present, ~~lac operon~~ repressor molecule is removed from promoter region. Transcription factors aggregate and RNA polymerase binds to promoter region. Transcription occurs. ~~and lac operon is produced~~. Protein is produced.

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Examiner Comments

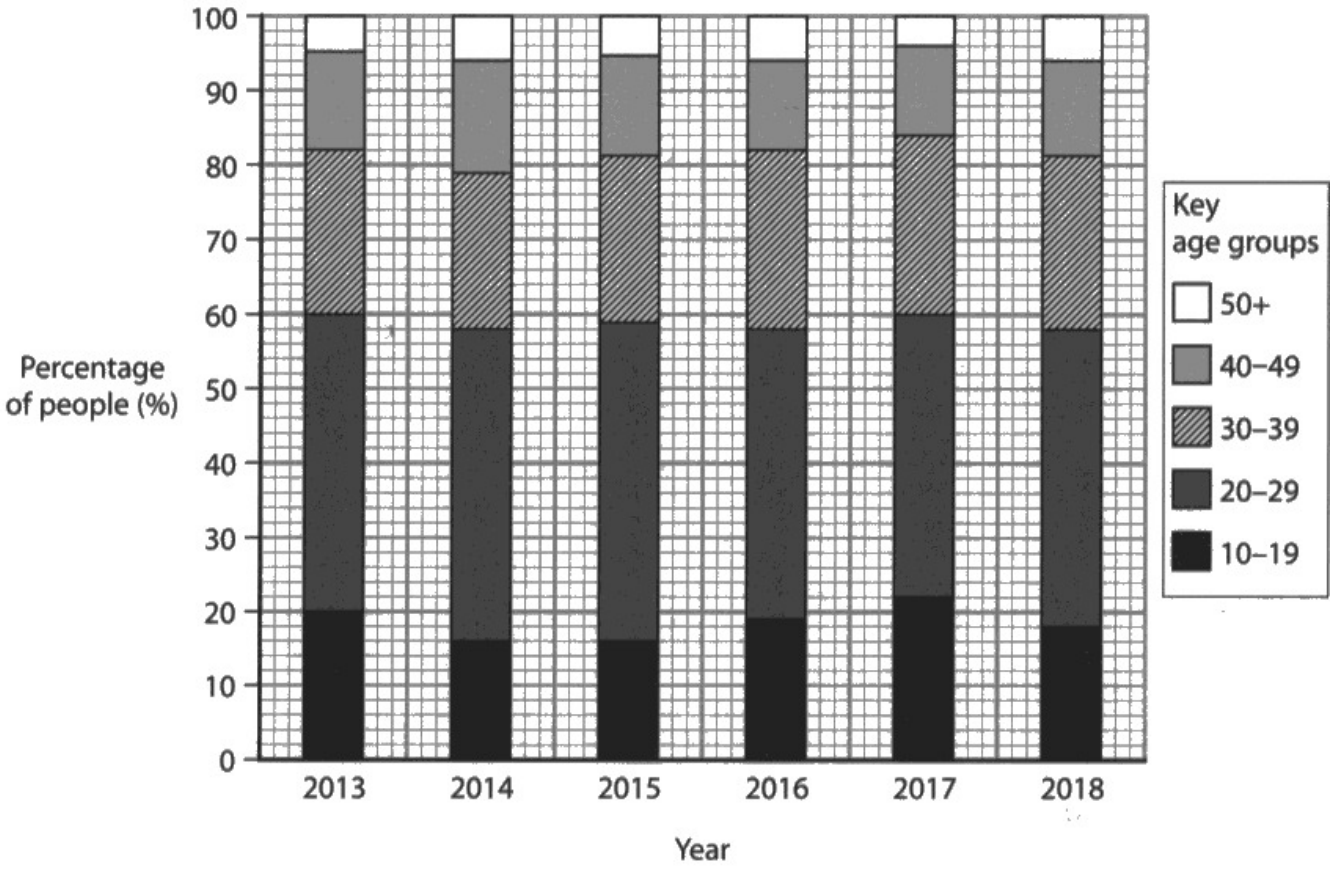
The second marking point is seen in the second sentence as it links RNA polymerase to the promotor. The third marking point is seen at the start of the fourth line, but the reference to protein synthesis is insufficient for the final marking point.

Question 3 (b)

In this question, candidates had to consider graphical data relating to the percentage of people, in different age cohorts, who had anterior cruciate ligament (ACL) surgery. Whilst many candidates delivered clear and focused comments on the data, it was not unusual for candidates to only consider one element, despite a mark allocation of three.

This answer offers the most commonly seen awardable answer for one mark.

(b) The graph shows the percentage of people in the UK who had ACL surgery from 2013 to 2018.



Comment on the effect of age on the percentage of people who had ACL surgery from 2013 to 2018.

(3)

20-29 have the greatest percentage of people ~~with~~ with surgery which is consistent from 2013 to 2018. However, as with an increase in age, the percentage with surgery decreases with 50+ having the lowest percentage consistently ~~for~~ from 2018 to 2018.

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Examiner Comments

The first line and a half gains the second marking point. Later the alternative is also offered. This marking point was the most commonly seen response.

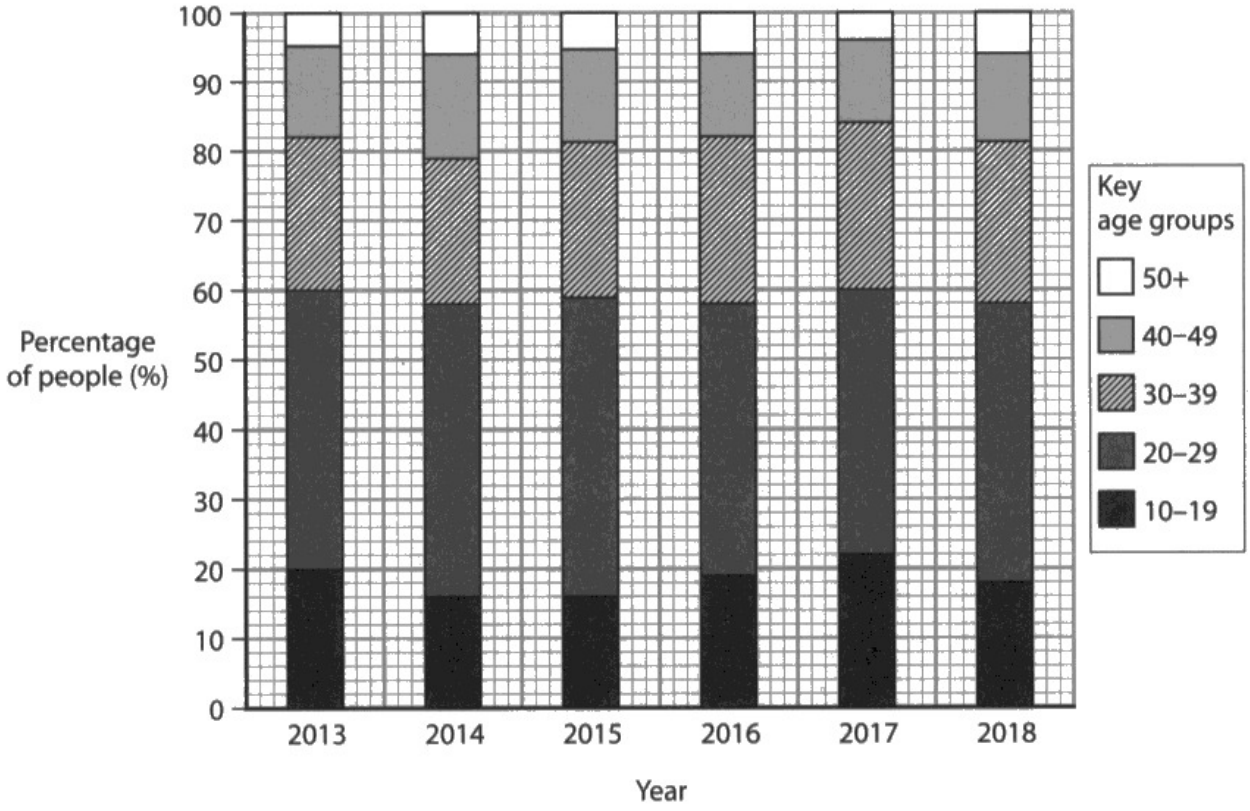
The reference to increasing age decreasing ACL surgery was not the last marking point as this is only true from the 20-29 age group. Likewise the comment about little variation only relates to two age group cohorts so it was not awarded the first marking point.

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Examiner Tip

Make sure your answers are very precise when referring to graphical data eg 'as age increases, the percentage of people having ACL surgery decreases' would not gain the first marking point. However, adding in 'from the age group of 20-29' component would then allow this mark to be given.

An answer that accurately considers two aspects of the data presented.

(b) The graph shows the percentage of people in the UK who had ACL surgery from 2013 to 2018.



Comment on the effect of age on the percentage of people who had ACL surgery from 2013 to 2018.

(3)

in all years, ~~largest~~ 20-29 had ~~most~~ largest % of people who had surgery. in all years, 50+ had least % of surgery. A decrease in % of ppl with surgery as they get older. increase until 20-29, then a decrease. As age increases, % of people with ACL surgery decreases from 20-29.

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Examiner Comments

Initially this candidate offers the second marking point. They then start to consider the last marking point but not in sufficient detail. However, the last two sentences, from lines three to five, clarify their statement and the third mark point can be awarded. This response, therefore, gains two marks.

Question 3 (c)(i)

Candidates were asked to use the given data to produce a ratio. The majority were able to successfully deliver the answer, both in terms of the requirement to do so to one significant figure (so 0.00505 : 1 was not credited in the answer), and in the format of wound infections to number of open surgeries.

Question 3 (c)(ii)

Candidates were invited to explain why there was a larger ratio of wound infections in open surgery for treatment of anterior cruciate ligament damage than when the surgery was keyhole. It was most gratifying to see that many candidates were able to link the idea of wound size and increased possible access by pathogens leading to infection.

Whilst this candidate has the correct idea, there is insufficient clarity in their answer to award both marks.

(ii) Explain why there is a greater ratio of wound infections in open surgery compared with keyhole surgery.

(2)

Theres a greater ratio of wound infection in open surgery as it increase the risk of pathogens entering the wound the if improper asyeptic technique is used, due to the ~~[illegible]~~ size of the open wound and length of operation

(Total for Question 3 = 7 marks)

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Examiner Comments

The candidate's comment about increased risk is a creditworthy alternative for the second marking point. However, despite the reference to size and length of wound, the candidate has not identified that the open surgery wound would be larger or that the keyhole surgery incision would be smaller, so the first marking point was not achieved.

ResultsPlus
Examiner Tip

If a question refers to larger or smaller, increased or decreased, make sure this is followed through in the answer. For example, 'there is a greater wound ratio in open surgery as the is a larger incision made in this type of operation'.

This response scored both marks by offering a suitable alternative for the second marking point.

(ii) Explain why there is a greater ratio of wound infections in open surgery compared with keyhole surgery.

(2)

In open surgery, the surgical site area and size of incision made is much larger compared to keyhole surgery. Therefore, there is a greater likelihood of microbes such as bacteria entering the blood stream via the incisions made.

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Examiner Comments

The first sentence correctly identifies the larger incision size in open surgery. The idea that this could lead to a greater probability that pathogens could enter was viewed as suitable explanation for the greater ratio in open surgery.

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Examiner Tip

Remember that an explanation command word is essentially asking for the science behind a result.

Question 4 (a)

This question required candidates to offer both similarities and differences between pre-implantation genetic diagnosis (PGD) and amniocentesis. Whilst there were many outstanding responses, there were a number of candidates who appeared to discuss chorionic villus sampling rather than PGD.

This is a clear answer that offers three salient points so gains 75% of the available marks.

4 There are different types of genetic screening available.

Each year, about 30 000 prenatal genetic screening tests are carried out.

(a) Compare and contrast the use of pre-implantation genetic diagnosis (PGD) and amniocentesis.

(4)

PGD tests lab made embryoes used for IVF. ~~Amino~~ Amniocentesis ~~Kids~~ tests the ~~fluid~~ amniotic fluid inside the womb of a pregnant woman. PGD occurs sooner than Amniocentesis. PGD tests cells straight from the embryo whereas amniocentesis tests free floating cells in the amniotic fluid. They both ~~have a risk~~ increase the risk of a miscarrige. Both can identify genetic disorders.

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Examiner Comments

The first two sentences make it clear what is being tested so the fourth marking point can be awarded. The third sentence correctly gives a comparative time related statement for when the procedure can be done, which elicits the second marking point.

The final sentence then offers a suitable similarity for the first marking point, so this candidate gains three marks out of a possible four.

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Examiner Tip

Do not forget that in any 'compare and contrast' request, full marks cannot be achieved unless both similarities and differences are considered.

Question 4 (b)

In this question, candidates considered two social issues relating to PGD use. Many were able to offer creditworthy answers, most often focusing on the first two marking points.

An answer that considers one social issue from two stand points for one mark.

(b) Describe **two** different social issues related to the use of PGD.

(2)

Can lead to the destruction of a viable embryo if a genetic disorder is identified. All embryos ~~humans~~ have a right to life after fertilisation. PGD avoids the risk of abortion because it is done outside the womb.

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The first two sentences consider the first marking point.

This response gains both marks, offering perhaps the most commonly seen examples.

(b) Describe **two** different social issues related to the use of PGD. amniotic fluid.

(2)

PGD can lead to designer babies → screening the embryo's for desired characteristics. Embryo's who have the faulty allele can be discarded and thrown away which is seen as some to be a human life hence

ResultsPlus Examiner Comments

This candidate, like many, referred to 'designer babies'. They then refer to the discarding of some embryos so the third and second marking points can be awarded.

Question 4 (c)

Many candidates demonstrated a most pleasing level of knowledge in relation to the effect of cystic fibrosis (CF) on digestion. However, it was not uncommon for candidates to not differentiate between the process of digestion and that of absorption.

This candidate answer gained two marks, but it also illustrates a common comment that was not awarded.

(c) Genetic screening can be used to test for conditions such as cystic fibrosis.

Explain why cystic fibrosis affects digestion.

(3)

1. Cystic fibrosis (CF) is a condition where Cl ions can't enter mucus to attract water via osmosis and so mucus is abnormally dense & sticky. CF affects the digestive process by blocking the tube from the pancreas with Mucus, preventing digestive enzymes being released to the small intestine. CF affects the digestive process by lining the intestines with Mucus which prevents the absorption of consumed food & Nutrients.

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Examiner Comments

Like a number of candidates, there was an initial description of how the mucus of people with CF becomes sticky. The end of the second line and into the third line is the first marking point. The end of the third line, through to the fifth line is a good explanation relating to the second marking point. However, the reference to a change in absorption rather than to digestion was not the third marking point.

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Examiner Tip

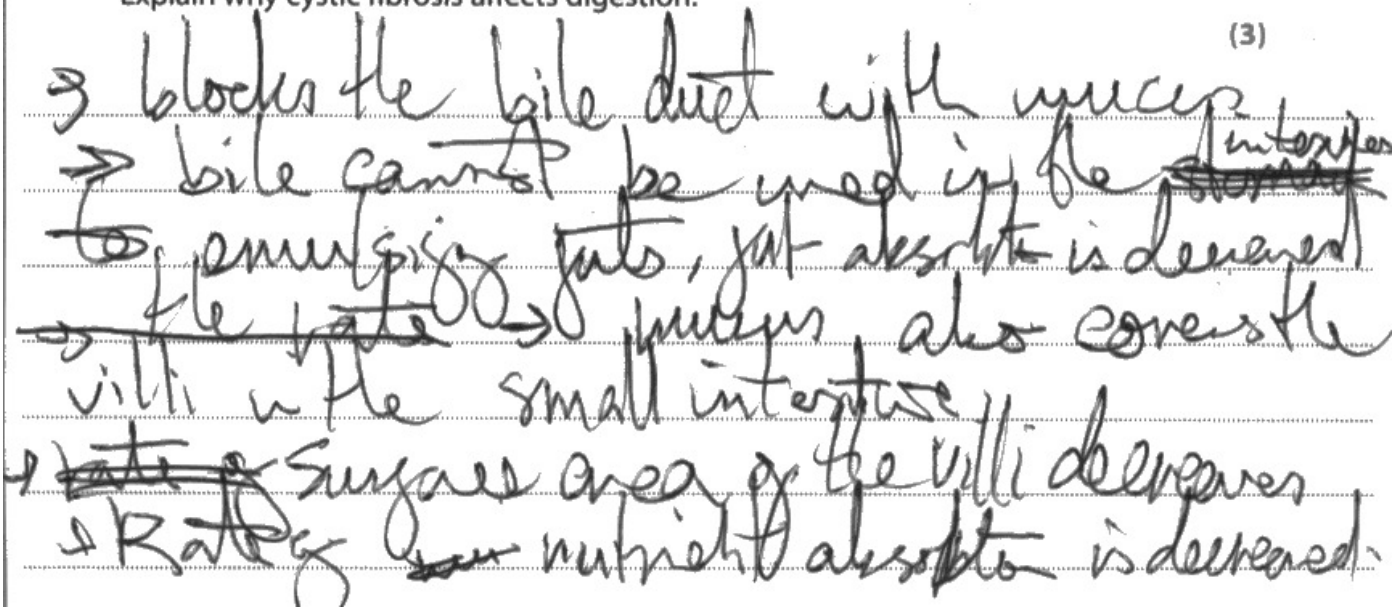
Make sure that the rubric of the question is fully followed. In this case, the question specifically asks how digestion is affected, rather than absorption.

This answer focuses on bile but the context enables two marks to be gained.

(c) Genetic screening can be used to test for conditions such as cystic fibrosis.

Explain why cystic fibrosis affects digestion.

(3)



ResultsPlus
Examiner Comments

Only a minority of candidates considered the effect of the sticky mucus on the bile duct.

In this response the candidate has not informed us that the mucus is sticky, so the first marking point is not available. However, the reference to blocking the bile duct reducing fat emulsification gains the fourth and third marking points respectively.

Question 5 (a)

In this question, candidates were supplied with various numerical data and were asked to calculate the width of E.coli DNA. Whilst many of the candidates were able to suitably manipulate the data, a sizable minority either only calculated the true width of the bacterium or failed to take account of the units in their answer.

This response offers the most common answer that did not gain full marks.

5 The bacterium *Escherichia coli* (*E. coli*) makes up about 1% of the human gut flora. Some strains of this bacterium aid our digestion but some strains are pathogenic.

(a) The width of the *E. coli* DNA is 250 times smaller than the width of the bacterium.

An image of *E. coli*, at a magnification of 20 000, had a width of 10 mm.

Calculate the width of its DNA.

Give your answer in micrometres (μm) and in standard form.

(3)



10mm

10,000 μm

10,000 / 20,000

0.5 μm

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Examiner Comments

The candidate has suitably calculated the width of the E.coli for one mark.

ResultsPlus
Examiner Tip

Make sure that all aspects of the question are thoroughly considered.

A clear answer that gained all marks.

5 The bacterium *Escherichia coli* (*E. coli*) makes up about 1% of the human gut flora. Some strains of this bacterium aid our digestion but some strains are pathogenic.

(a) The width of the *E. coli* DNA is 250 times smaller than the width of the bacterium.

An image of *E. coli*, at a magnification of 20 000, had a width of 10 mm.

Calculate the width of its DNA.

Give your answer in micrometres (μm) and in standard form.

(3)

$\frac{10}{20\,000} = 0.0005$ mm

$= 0.5$ nm

$\frac{0.5}{250} = 2 \times 10^{-3}$ nm

2×10^{-3} μm

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Examiner Comments

The first line of this candidates answer shows the width of the bacterium in millimetres. They then convert it to micrometres. Subsequently they take account of the information that the E. Coli DNA is 250 times smaller than the bacterial width.

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Examiner Tip

Always take note of the units when provided.

Question 5 (b)(i)

In this component, candidates were expected to draw the expected results of two different DNA replication mechanisms. Many candidates gave clear answers, but it was not uncommon to see responses that did not offer all the daughter DNA molecules produced.

This answer illustrates the point that, on one occasion, insufficient DNA molecules were drawn.

(b) Meselson and Stahl used *E. coli* to investigate the nature of DNA replication.

They initially grew an *E. coli* population in a medium containing heavy nitrogen (^{15}N) until all the bacteria had DNA containing heavy nitrogen.

They then transferred the bacteria into a medium containing light nitrogen (^{14}N).

The bacteria were sampled after the first replication and after the second replication.

(i) Complete the table to show the expected DNA after *E.coli* had been grown in ^{14}N, for two possible types of DNA replication.

(3)

Type of DNA replication	DNA before first replication	DNA after first replication in ^{14}N	DNA after second replication in ^{14}N
Conservative			
Semi-conservative			

Key

 = one strand of DNA containing heavy / ^{15}N

 = one strand of DNA containing light / ^{14}N

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Examiner Comments

No marks could be awarded for the conservative row second DNA replication. For the semi-conservative row, the candidate appreciated that the first replication produced two daughter DNA molecules, each comprising one original strand and one newly synthesised one. However, for the second replication in the semi-conservative row, there is one DNA double helix molecule missing. Therefore, a total of one mark can be awarded.

A clear answer that achieved all marks.

(b) Meselson and Stahl used *E. coli* to investigate the nature of DNA replication.

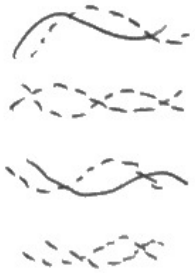
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They then transferred the bacteria into a medium containing light nitrogen (^{14}N).

The bacteria were sampled after the first replication and after the second replication.

(i) Complete the table to show the expected DNA after *E.coli* had been grown in ^{14}N, for two possible types of DNA replication.

(3)

Type of DNA replication	DNA before first replication	DNA after first replication in ^{14}N	DNA after second replication in ^{14}N
Conservative			
Semi-conservative			

Key

 = one strand of DNA containing heavy / ^{15}N

 = one strand of DNA containing light / ^{14}N

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Examiner Comments

This candidate offered all of the DNA molecules produced. For example, two after the first replication and four after the second.

Question 5 (b)(ii)

In this question, candidates were expected to define semi-conservative DNA replication. Whilst there were a pleasing number of complete and thorough answers, many responses focused on the 'semi-conservative' aspect and failed to consider the 'replication' component.

A pleasing response that offered both the most commonly awarded mark point and the least often seen mark point.

(ii) This study enabled Meselson and Stahl to show that DNA replication was semi-conservative rather than conservative.

Explain what is meant by the term **semi-conservative DNA replication**.

(2)

amount of DNA increases / doubles after each replication. each new DNA molecule is made of one original parent strand and one new strand. both DNAs are genetically identical to each other and to the original parent DNA molecule. It is used in mitosis.

genetically identical

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Whilst the question included 'DNA replication' very few candidates offered the first marking point, unlike this candidate who achieved the mark on the first line.

The second mark was awarded for the third marking point which was supplied on the second and third line. This was the most often seen marking point.

ResultsPlus Examiner Tip

When asked to explain a phrase, make sure all aspects of that phrase are considered.

Question 5 (c)

There were many excellent candidate responses to this question which required an explanation as to why an E.coli-STEC infection increases the time for a blood clot to form due to a reduced blood platelet concentration. Many candidates demonstrated a clear grasp of the context of the question so delivered answers that related to the consequence of a reduction in platelet density. However, a sizable minority gave a more general discussion of the blood clotting process and limited their maximum score.

A clear and logical response that gained full marks.

(c) A pathogenic strain of this bacterium, *E. coli*-STEC, produces a toxin that reduces blood platelet concentration.

Explain how an *E.coli*-STEC infection increases the time taken for a blood clot to form.

(3)

E·coli - STEC produces the toxin which reduces blood platelet concentration. Therefore, when the endothelium of an artery is damaged and collagen is exposed, less platelets bind to the collagen. This means less thromboplastin is released. This means less prothrombin is converted to thrombin (despite ~~constant~~ constant calcium salt concentration). This means less fibrinogen is converted to fibrin. Less fibrin fibres bind to ~~platel~~ the platelets so it takes longer for a mesh to form so it takes longer for a sufficient number of red blood cells to be trapped and for a clot to form.

(Total for Question 5 = 11 marks)

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Examiner Comments

This explanation begins with justifying why less thromboplastin is released (first marking point) and then follows the clotting cascade sequence in order to gain the second and then third marking point.

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Examiner Tip

When explaining a sequential process, consider answering it in the sequence of that process. By using this approach it is likely that important details are not missed.

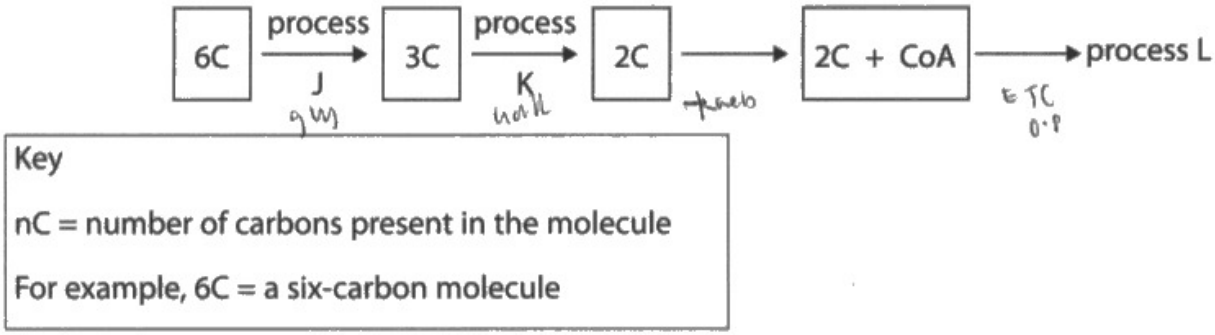
Question 6 (a)(i)

In this question candidates had to initially identify that process J was glycolysis and so the three-carbon compound was pyruvate. They were then asked to name two products of glycolysis, other than pyruvate. Whilst many candidates were able to do so, a surprising number were tempted to try and offer more than two products.

This response shows a commonly seen answer that was not creditworthy.

6 Cellular respiration is a metabolic process essential for life.

(a) The diagram represents part of aerobic respiration in a muscle cell.



(i) Name two products, other than the three-carbon molecule (3C), that are formed by process J.

(1)

CO_2, NAD ~~REDUCED~~ ATP, NAD

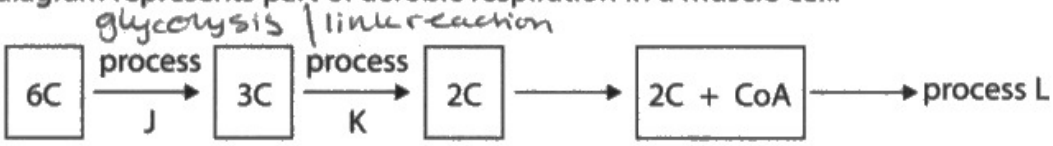
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Examiner Comments

This candidate correctly offered ATP as one product, but the oxidised form of NAD could not be awarded. No mark given for this answer.

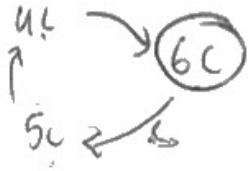
An example of a response that gained the mark.

6 Cellular respiration is a metabolic process essential for life.

(a) The diagram represents part of aerobic respiration in a muscle cell.



Key
nC = number of carbons present in the molecule
For example, 6C = a six-carbon molecule



(i) Name two products, other than the three-carbon molecule (3C), that are formed by process J.

(1)

Red NAD and ATP

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Examiner Comments

Two correct products were offered for the mark.

Question 6 (a)(ii)

In this question, candidates had to consider the diagram and then describe what would happen to pyruvate if the link reaction did not occur. Whilst there were many splendid and thorough answers, a number of candidates appeared to answer a different question.

This answer illustrates a common response that did not gain marks.

(ii) Describe what would happen to the three-carbon molecule (3C) if process K stopped.

(2)

The three-carbon molecule is pyruvate. If process K stopped then ~~the~~ pyruvate would not be broken down into a 2-carbon molecule and carbon dioxide. Therefore, it will not enter the Link reaction and as a result neither the Krebs cycle would occur.

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Examiner Comments

The candidate has described what would not happen to pyruvate, rather than what would happen to this molecule.

ResultsPlus
Examiner Tip

Make sure that the answer thoroughly matches the question being asked.

A short, but targeted answer, that gained both marks.

(ii) Describe what would happen to the three-carbon molecule (3C) if process K stopped.

(2)

The 3C molecule is pyruvate, if process k stopped which is the link reation, the pyruvate could be used in anaerobic respiration fermentation producing lactate

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Examiner Comments

This candidate told us what process K was, and from there deduced that if it stopped pyruvate would have a different fate. They correctly offered the first and third marking point.

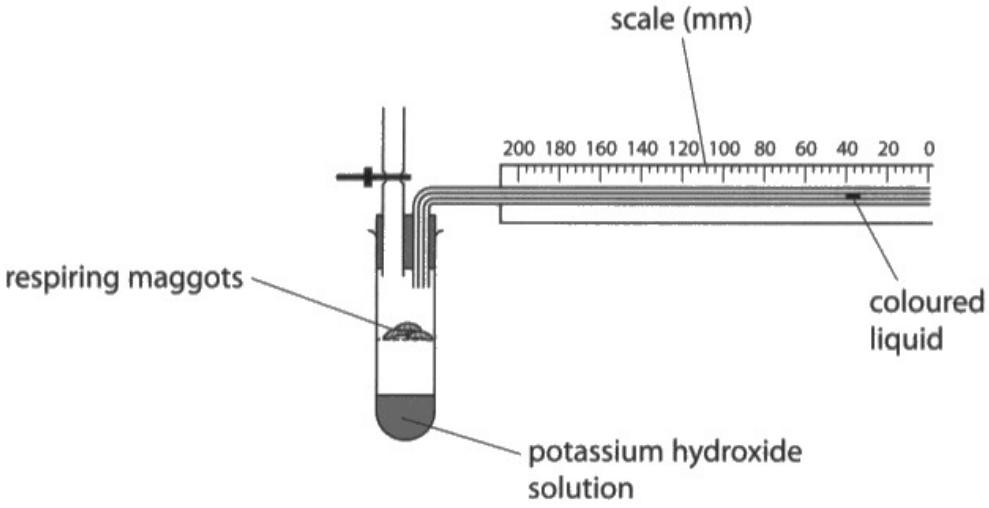
Question 6 (b)

This question tested candidates understanding of the principles behind the respirometer. It was a pleasure to note that many candidates had a thorough grasp of this.

An answer that gained half of the available marks.

(b) Respiration in maggots is similar to respiration in humans.

In an investigation, three maggots were placed in a respirometer as shown.



The maggots respired aerobically for 20 minutes in this respirometer.

Explain why the coloured liquid moved to the left during the 20 minutes of this investigation.

(2)

The products of respiration are absorbed by potassium hydroxide, decreasing the volume of ~~air~~ air inside which sucks the liquid towards the maggots.

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Examiner Comments

Unfortunately the gas released during respiration was not given so the third marking point could not be awarded. However, the candidate has made it clear that there is a decrease in air volume in the system for the first marking point.

Question 6 (c)

In this question candidates had to devise an investigation, using a respirometer, to identify the optimum temperature for maggot respiration. Many candidates were able to plan such an investigation in most encouraging detail. However, a number of answers were seen which lacked the necessary precision, such as offering a temperature range which would have not been suitable.

This candidate has delivered a detailed and considered answer that gained full marks.

(c) Devise an investigation, using a respirometer, to find the optimum temperature for respiration in maggots.

(5)

- set up a range of water baths (5°C, 10°C, 15°C, 20°C and 25°C)
- place 5g of maggots into a capsule (open) and place into a test tube above soda lime (potassium hydroxide).
- label each test tube for the temperatures and place into their water baths, wait for 5 mins for acclimatisation.
- place the bung in for each test tube with the tap closed and the coloured liquid at 0.00mm on the scale.
- start the timer and record the coloured liquid movement every 5 mins for 20 mins for each test tube.
- Repeat 3 times at each temperature and calculate mean values, use a T test to compare results.
- keep species and age of the maggots the same as well as weight

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Examiner Comments

The initial reference to setting up water baths would gain the penultimate mark. The temperature range given was suitable for the first marking point.

Offering a mass of maggots was the second marking point, while the acclimatisation reference would have been a suitable alternative for the fifth marking point (but this had already been awarded).

The candidate links time and distance for the third marking point and then refers to carrying out three repeats at each temperature for the final marking point.

The last bullet point would have been awarded the second marking point had it not already been achieved.

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Examiner Tip

This response gave the repeat point in sufficient detail to gain the mark.

Question 7 (a)

Candidates were presented with a table providing data on two types of muscle fibre. They were then asked to explain why both types are needed by marathon runners, and also why the proportions of the two types should be different. There were many excellent and detailed answers, though a number of candidates either simply repeated the data in the table or did not answer in the context of the question.

A sound answer that gained three marks out of a possible five. However, not all aspects of the question were considered (ie the differing proportion of the two types of muscle fibre referred to).

7 Muscles and eyes are examples of organs found in the human body.

(a) Skeletal muscle tissue contains several types of muscle fibre that have different properties. Two of these are shown in the table.

Properties	Muscle fibre	
	Type I	Type II
Speed of contraction	slow	four times the speed of type I
Time taken to fatigue	long	short
Concentration of mitochondria	high	low
Level of anaerobic respiration carried out	low	high

The proportion of type I and type II muscle fibres in the skeletal muscle of long distance runners and sprinters is different.

Explain the advantages for long distance runners of having both type I and type II muscle fibres, but not in equal quantities.

(5)

Type I muscle fibre refers to slow twitch muscle fibres which allow the long distance runner to have great endurance while going long distances as they take a long time to fatigue. These muscle fibres have lots of mitochondria which means they can produce more energy as mitochondria are the site of aerobic respiration. However it is an advantage ~~of~~ to long distance runner to have both types of muscle fibres (type II being fast twitch muscle fibres) as when the runner gets to the end or near the end they will need a short burst of sprinting to potentially overtake any competition and type II muscle fibre allow them to do this as they contract at four times the speed of type I and can carry out high levels of anaerobic respiration.

ResultsPlus
Examiner Comments

The first sentence links type I muscle fibres at the start of the sentence to being slow to fatigue at the end for the second marking point.

The second sentence correctly refers to many mitochondria carrying out aerobic respiration for the fifth marking point.

Then towards the end of the response, the candidate has considered how some type II muscle fibres are advantageous to the marathon runner for the final mark point.

ResultsPlus
Examiner Tip

Make sure that all aspects of a question are dealt with in the answer.

Question 7 (b)(iii)

This question proved challenging for a number of candidates. The question considered the use of genetic modification of human eye cells to treat a recessive genetic condition. Many candidates felt that this changed the genetic composition of the other areas of the body including the gametes.

This response illustrates the above and gains one mark.

(iii) Explain why a person successfully treated using a genetically modified virus may still have a child with this recessive condition.

(3)

Because the parent could still be heterozygous for the condition, meaning if the other parent is also heterozygous, there is a 25% probability of a recessive condition in their offspring.

ResultsPlus
Examiner Comments

The question informs candidates that the GM virus can be used to treat people with a homozygous recessive condition, so the first part of this answer is incorrect. However, for a child to have the condition, the other parent must supply a recessive allele, perhaps as they are heterozygous. The answer considers this and gains the third marking point.

Question 8 (a)

In this question, the candidates needed to explain the role of ATP in allowing impulses to travel along neurones. Whilst many candidates gave clear and considered answers, it was not uncommon to read detailed responses about diffusion of ions across the membrane or/and neurotransmitters across the synapse.

This general response was typical of many seen.

8 The nervous system contains different types of cell including neurones and Schwann cells.

(a) Mitochondria in the cytoplasm of neurones synthesise adenosine triphosphate (ATP).

Explain the role of ATP in the transmission of impulses along neurones.

(2)

ATP is an energy carrier and so can provide the impulses with energy to travel along neurones faster.

ResultsPlus
Examiner Comments

The answer lacked detail relating to ion movement up a concentration gradient. No marks could be given.

This answer can be awarded the first marking point.

8 The nervous system contains different types of cell including neurones and Schwann cells.

(a) Mitochondria in the cytoplasm of neurones synthesise adenosine triphosphate (ATP).

Explain the role of ATP in the transmission of impulses along neurones.

(2)

• ATP provides energy for the cell to create these impulses along the neurone

• It provides energy for the sodium ion / potassium ion pump transferring the ions into and out of the membrane

• allowing an action potential to form and depolarisation to occur creating an impulse

ResultsPlus
Examiner Comments

The second bullet point suitably refers to the sodium-potassium pump for one mark. Unfortunately it then, in the third bullet point, considers depolarisation.

Question 8 (b)(i)

This question considered how actin and myosin enable a mitochondrion to move along a neurone axon. The context of this interaction was fully appreciated by many candidates. However, a number of candidates responded by offering the process that would occur within a muscle sarcomere, limiting their maximum score.

This answer offers the process that occurs within a sarcomere when it contracts.

(b) Mitochondria move along the length of the axon in the cytoplasm.

The axon cytoplasm contains actin along its length. There is myosin on the surface of the mitochondria.

(i) Explain how the myosin head could move mitochondria along the axon.

(3)

Ca^{2+} ions bind to troponin, which displaces tropomyosin, exposing myosin binding-site on actin. Myosin head then binds to actin, forming actin-myosin cross bridge. Actin filaments slide over myosin. Hence, sarcomere shortens. Ca^{2+} ions also active the enzyme ATPase. This allows myosin head to have movement for mitochondria along the axon.

ResultsPlus
Examiner Comments

The first two sentences can be awarded the first mark. However, subsequently, the context of the answer is such that it does not explain how a mitochondrion moves along an axon, so no further marks can be awarded.

ResultsPlus
Examiner Tip

Whilst this question is set in an unfamiliar context, the behaviour of actin, myosin and ATP is familiar. Just make sure that an answer is suitably contextualised.

Question 8 (b)(ii)

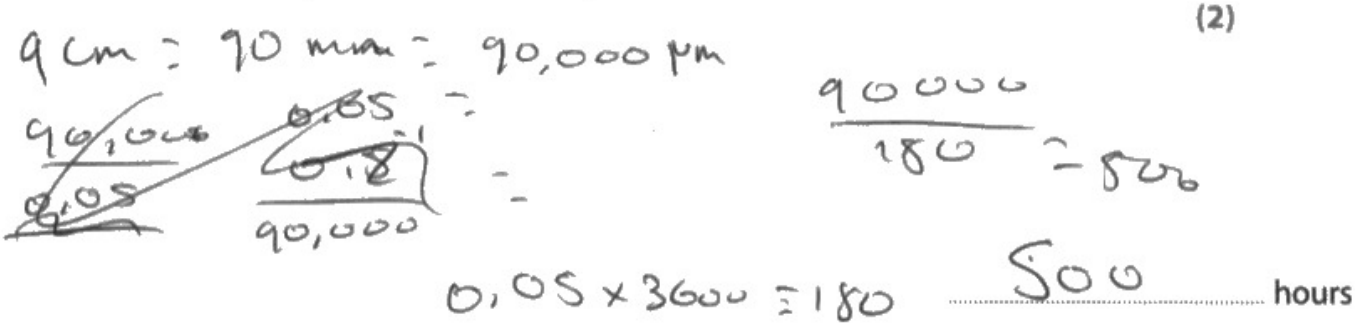
Many candidates dealt very well with this calculation. However, included in the process was the requirement to convert time and distance units. A number of candidates did not carry out at least one of these conversions.

The candidate was out by an order of magnitude so could only gain half the available marks.

(ii) In an axon that is 9 cm long, the speed of mitochondrial movement was recorded as 0.5 $\mu m\, s^{-1}$.

Calculate the time it would take a mitochondrion to move the length of this axon. Give your answer in hours.

(2)



ResultsPlus
Examiner Comments

In this calculation all aspects were correctly applied except that the candidate divided by a speed of 0.05, rather than 0.5 micrometres per second. This error was carried forward, hence one mark given.

A clear answer that gained both marks.

(ii) In an axon that is 9 cm long, the speed of mitochondrial movement was recorded as 0.5 $\mu m\ s^{-1}$.

Calculate the time it would take a mitochondrion to move the length of this axon. Give your answer in hours.

(2)

0.09m
$5 \times 10^{-7}\ ms^{-1}$

Speed = distance / time

distance / speed = time

$\frac{0.09}{5 \times 10^{-7}}$ = 180000 seconds

$\frac{180,000}{3600}$ = 50

50 hours

ResultsPlus
Examiner Comments

This answer was logically laid out and offered the correct answer for two marks.

Question 8 (c)

This indicative content six mark item required candidates to consider the relative importance of two molecule types, when given data about the percentage composition of the molecules in the cell surface membranes of two cell types. Many candidates offered a good level of understanding about the role of lipids in Schwann cells, but some seemed less secure on the roles of both lipids and proteins in neurones.

A Level 1 response which was awarded two marks.

(c) The table shows the proportion of two components found in the cell surface membrane of two cells of the nervous system.

Cell of the nervous system	Percentage composition of the cell surface membrane (%)	
	lipid	protein
Motor neurone	50	40
Schwann cell	70	30

Discuss the relative importance of lipids and proteins in the cell surface membranes of motor neurones and Schwann cells.

(6)

Lipids and proteins are important because they can provide an aid to impulses when they are being sent. Lipids are relatively more important in the Schwann cell because they can help insulate the axon which in turn helps speed impulse movement while ensure it doesn't break up. Similarly with motor neurone lipids are relatively more important than protein. Protein help the growth of the neuron which is also very important however lipids are have a higher importance.

ResultsPlus
Examiner Comments

In this response, the candidate has offered a correct function for Schwann cells and made the link between lipid content and its insulating properties. However, as no detail has been supplied about the function of the neurone, this answer is within Level 1.

This is a sound Level 2 answer gaining four marks.

*(c) The table shows the proportion of two components found in the cell surface membrane of two cells of the nervous system.

Cell of the nervous system	Percentage composition of the cell surface membrane (%)	
	lipid	protein
Motor neurone	50	40
Schwann cell	70	30

Discuss the relative importance of lipids and proteins in the cell surface membranes of motor neurones and Schwann cells.

(6)

Motor neurons have a higher proportion of protein in the cell surface membrane than Schwann cells (40% > 30%). This may be due to the fact that motor neurons must carry impulses to effectors, meaning that the neuron must propagate action potentials. As a result, it would have to have a higher proportion of proteins in the membrane for functions such as sodium and potassium channels, which enable the neuron to depolarise / repolarise. By comparison, the role of a Schwann cell is to insulate an

axon*, therefore they do not regulate need to depolarise/repolarise themselves and do not require the proteins to allow for this. This explains the low protein to lipid ratio (30:70) in the Sbc Schwann cell, as the cell requires more lipids for its insulating properties.

* by preventing depolarisation at areas they cover.

ResultsPlus
Examiner Comments

The function of both cell types is considered along with the role of the predominant molecule found in the cell surface membrane of each cell. However, there is insufficient detail offered and no discussion of how Schwann cells and their high lipid composition led to saltatory conduction, nor a consideration as to why both cell types have lipids present in their membranes. As a consequence, this is a Level 2 response.

This is a detailed and accurate Level 3 answer.

*(c) The table shows the proportion of two components found in the cell surface membrane of two cells of the nervous system.

Cell of the nervous system	Percentage composition of the cell surface membrane (%)	
	lipid	protein
Motor neurone	50	40
Schwann cell	70	30

Na+ channels
↗
→ Na+/K+ pump

Discuss the relative importance of lipids and proteins in the cell surface membranes of motor neurones and Schwann cells.

(6)

- schwann cells contain a highe proportion of lipids than protien (more than double)

- ~~schwann cell~~ This is important as schwann cells insulate the neurone, due to its high proportion of lipid (myelin). The lipids make the neurones (motor) impermeable to ions, so ~~the neurone cannot~~ an action potential cannot be generated at myelinated areas. This means action potentials can only be generated at non myelinated areas, nodes of ranvier. This increases the speed of nerve impulse transmission as nerve impulses jump from node to node (saltatory conduction) without this, nerve impulse transmission would be much slower as every part of axon membrane would need to be depolarised

- The membrane of the motor neurone contains a higher proportion of proteins than in the schwann cells (10% higher) this is because they need carrier proteins and channel proteins for the transport of ions across the axon membrane to generate an action potential. The sodium potassium pump establishes the resting membrane potential and is involved in the refractory period (active transport of Na+ and K+ ions). Voltage gated sodium ion channels open during depolarisation of the motor neurone (and transport Na+ into the motor neurone via facilitated diffusion). Voltage gated potassium ion channels transport potassium ions out of the motor neurone via facilitated diffusion during repolarisation of the motor neurone

ResultsPlus
Examiner Comments

This candidate has given a comprehensive discussion on the role of lipids in the Schwann cells in terms of acting as an insulator of ion movement leading to saltatory condition. They then follow this through with a detailed consideration of proteins within neurones. This answer achieved all six marks.

Question 9 (a)(ii)

This question, about protein structure, was given in the context of two forms of rhodopsin. A pleasing number of candidates tackled it in this context but other candidates did not and so they limited the marks available to them.

This answer was not creditworthy.

light bleached rhodopsin → opsin + retinal

(ii) Rhodopsin is made of protein and retinal. The structure of rhodopsin can be studied by measuring the ratio of light absorbed at 280 nm and at 500 nm.

The table shows the absorbance ratio of the rhodopsin from two people, one with RP and one without.

Rhodopsin from	Absorbance ratio (280 nm : 500 nm)
person without RP	2.0 : 1
person with RP	5.6 : 1

Explain why a gene mutation causes the difference in the absorbance ratio for a person with RP.

(3)

Gene mutation causes the difference in the absorbance ratio for a person with RP because there is a larger ratio of people absorbing rhodopsin (5.6:1) compared to 2:1 with people without RP. RP affects the functioning of rhodopsin but gene mutation would have caused the differences because light bleaches rhodopsin which converts to opsin and retinal.

ResultsPlus
Examiner Comments

The first four lines tended to repeat the question and data supplied rather than offering an explanation for the difference in the absorption ratio.

Whilst the last line refers to opsin, it does not tie this in with this component of rhodopsin being the protein.

ResultsPlus
Examiner Tip

Know what a command word is expecting. In this case, the explain command word is essentially asking for the scientific explanation why a gene mutation alters the ratio of rhodopsin absorbing light of two different wavelengths.

Question 9 (b)

Candidates were asked to describe how the movement of sodium ions in a rod cell affects depolarisation in a bipolar neurone. There were many very commendable answers, but a minority of candidates did not seem to appreciate that the question related to two named cells.

The candidate has offered an answer set in both possible situations and gains full marks.

(b) Rod cells form synapses with bipolar neurones.

Describe how movement of sodium ions in a rod cell affects depolarisation in a bipolar neurone.

(4)

In a rod cell so cation channels can either be open or closed if open Na^+ (sodium ion) diffuses into the cell if they are closed it doesn't. Na^+ is always actively transported out of the rod cell. If the cation channels are open the rod cell is depolarised so a neurotransmitter is released from its inhibitory synapse meaning the cation channels in the bipolar neurone stay closed so there is no depolarisation. If the cation channels are open in the rod cell it becomes hyperpolarised so no neurotransmitter is released therefore the cation channels in the bipolar neurone stay open

ResultsPlus
Examiner Comments

Whilst the candidate has not referred to presence or absence of light, they have considered, at the start of the first sentence, the situations when the sodium ion channels are open or closed. The end of the first sentence gains the first marking point.

The second sentence partially considers the export of the sodium ions but does not refer to the location, hence does not achieve the second marking point.

The third sentence then delivers, in sequence, the third, fourth and fifth marking points, for a total score of four marks.

Question 9 (c)(i)

Candidates were invited to describe the role of phytochrome in long-day plant flowering. It was clear that many had an excellent grasp of this topic area and delivered thorough answers. However, it was not uncommon to read responses that referred to plant growth rather than flowering.

This is a sound response that was able to gain both marks and offers the two most frequently seen mark points.

(c) Some plants only flower when the days are long and the nights are short. They are known as long-day plants.

(i) Describe the role of the photosensitive pigment phytochrome in the flowering of long-day plants.

(2)

In long day plants, where light is present for many hours a large amount of Pr is converted into Pfr

plants can use the large amounts of Pfr as an indication to flower

ResultsPlus
Examiner Comments

The first four lines detail the correct phytochrome conversion in the presence of light for the second marking point.

The last two lines identify that a high level of phytochrome far red is required to trigger flowering, hence the third marking point can be credited here.

Question 9 (c)(ii)

In this question, candidates were asked to devise an investigation to identify whether a plant was long-day or short-day. A number of candidates provided clear and complete answers but many did not offer suitable time periods of light/dark exposure. Likewise, a sizable minority of the cohort referred to growth rather than flowering.

This answer illustrates a commonly seen response that did not achieve any marks.

(ii) Devise an investigation to find out if a species of plant is a long-day plant or a short-day plant.

(3)

Set the Plants up in light or dark conditions and Measure the rate of flowering. If the flowering is more successful in darker conditions it's a short day plant and uses more PFR, however if the plant flowers more during the day it's a long day plant and therefore uses more PR

ResultsPlus
Examiner Comments

The reference to light and dark was too general to be awarded the first marking point. The second sentence refers to the level of flowering success rather than whether it flowers or not, so would not gain the third marking point.

A suitable answer that was awarded all of the available marking points for three marks.

(ii) Devise an investigation to find out if a species of plant is a long-day plant or a short-day plant.

(3)

~~Get two of the~~ Get multiple batches of the same species of plant. Put one batch under a light for more than 12 hours every day and put the other for less the 12 hours. Make sure to control other factors that could affect flowering for example water, soil nutrition and minerals. If the plants flowers when exposed to more than 12 hours of light it is a long day plant. If it flowers when exposed to less than 12 hours it is a shot day.

(Total for Question 9 = 13 marks)

ResultsPlus
Examiner Comments

The reference to more or less than 12 hours of light is the first marking point, whilst the statement about controlling water and minerals would gain the second marking point. The final two sentences can be credited with the final mark point.

Question 10 (a)(i)

To tackle this calculation, candidates had to identify the mass of unsaturated lipid present. This alluded a minority of candidates but many were able to do so, and then follow through the calculation to gain the mark.

A clearly laid out calculation.

10 Doctors believe that about 28% of the adult population in the UK are obese. This can lead to a number of health-related conditions including coronary heart disease.

(a) Food packaging often contains nutritional information.

The table shows some nutritional information about chocolate biscuits.

Component	Four biscuits contain	Percentage of total recommended daily intake (%)	Recommended daily intake (RI)
Energy content	700 kJ	8	
Fats	7.6 g	11	70 g
of which are saturated	4.7 g	23	20 g
Sugars	20.3 g	23	90 g

(i) Calculate the percentage of fat present in the biscuits that contains carbon to carbon double bonds.

(1)

$7.6 - 4.7 = 2.9$

$\frac{2.9}{7.6} \times 100$

38.2%

ResultsPlus
Examiner Comments

This answer gains the available mark for its correct answer.

Question 10 (a)(ii)

In this calculation candidates had to work out the number of biscuits needed to exceed the recommended daily sugar intake. Many took this in their stride and also realised that a whole number was needed.

A calculation that gained 50% of the available marks.

(ii) Calculate the number of biscuits needed to exceed the recommended daily intake (RI) for sugar.

(2)

~~90 x 23 / 100~~ =

1 biscuit : 20.5 / 4 = 5.075 g x 90 = 456.75 J

465.75 x 23 / 100 =

Answer 105

ResultsPlus Examiner Comments

This candidate correctly worked out the mass of sugar in each biscuit for the first marking point.

ResultsPlus Examiner Tip

Remember that it is always worth showing working, as a proportion of the marks may still be achievable, even when the answer is incorrect. This example shows that the candidate still gained half of the marks on offer.

A comprehensive response that gained both marks.

(ii) Calculate the number of biscuits needed to exceed the recommended daily intake (RI) for sugar.

(2)

20.3 ÷ 4
= 1 biscuit
= 5.075g

90 g

90 / 5.075 = 17.73...
= daily recommended
= 18 exceeds.

Answer 18

ResultsPlus
Examiner Comments

This candidate appreciated that the question asked for the number of biscuits need to exceed the sugar RI, so suitably rounded up to 18, for both marks.

ResultsPlus
Examiner Tip

Make sure that all aspects of the question are complied with, such as the number of biscuits in this case.

Question 10 (a)(iii)

Candidates were required to use the data provided in the table to calculate the daily recommended intake of energy. Many were able to successfully achieve the answer but some candidates did not give their value in standard form as requested.

Unfortunately this candidate response gained no marks.

(iii) The energy content for four biscuits and the percentage of total recommended daily intake can be used to calculate a recommended daily intake.

Calculate the daily recommended intake of energy from the data in the table. Give your answer in joules and in standard form.

(2)

8750 J

ResultsPlus
Examiner Comments

Whilst this answer offered 8750, this could not be given the first marking point as their answer is given in the context of joules rather than kilojoules.

ResultsPlus
Examiner Tip

Always be mindful of the units being used.

A nicely laid out answer that included units at all stages.

(iii) The energy content for four biscuits and the percentage of total recommended daily intake can be used to calculate a recommended daily intake.

Calculate the daily recommended intake of energy from the data in the table.
Give your answer in joules and in standard form.

(2)

700 kJ = 8%

(700 ÷ 8) x 100

= 8750 kJ

x 1000 = 8,750000 J

8.75×10^6 ~~0.875 x 10~~ J

ResultsPlus
Examiner Comments

This answer gained both marks for the correct answer.

Question 10 (b)(i)

In this question, candidates were expected to consider the data provided in the table so they could then describe the effect of BMI and age on the development of coronary heart disease in women. It was most gratifying to note that the majority of candidates were able to do this so clearly.

This answer only focused on the relationship between BMI and the incidence of CHD.

(b) The Million Women Study was set up in 1996 and considered aspects of the health of UK women.

Using data from this study, scientists investigated the effects of various factors on coronary heart disease (CHD).

The scientists selected one million women who had not had CHD before the study started.

The women provided information on the following:

- BMI
- smoking habits
- alcohol intake
- level of physical activity
- age at the start of the investigation.

The women were monitored for five years and the development of CHD was recorded. The data were used to estimate the likelihood of any woman developing CHD.

The table shows the effect of age and BMI on the development of CHD in women.

Age range / years	Percentage incidence of CHD over 5 years for different BMI values (%)			
	BMI 22.5	BMI 27.5	BMI 32.5	BMI 37.5
55–59	1.0	1.5	1.8	2.2
60–64	1.9	2.4	3.0	3.5
65–69	3.0	3.7	4.3	4.8
70–74	4.5	5.1	5.8	7.1

(i) Describe the effect of age and BMI on the development of CHD in women.

(2)

The higher the BMI the more likely to develop coronary heart disease. For example at age 60-64, BMI % incidence the ~~chance~~ of having CHD was 1.9% at a BMI of 22.5 whereas it was 3.5% at a BMI of 37.5. This is because the higher BMI, the more prone to obesity and likely a higher fat intake.

ResultsPlus
Examiner Comments

The answer could be awarded the second marking point for one mark.

An answer that gained both marks.

(b) The Million Women Study was set up in 1996 and considered aspects of the health of UK women.

Using data from this study, scientists investigated the effects of various factors on coronary heart disease (CHD).

The scientists selected one million women who had not had CHD before the study started.

The women provided information on the following:

- BMI
- smoking habits
- alcohol intake
- level of physical activity
- age at the start of the investigation.

The women were monitored for five years and the development of CHD was recorded. The data were used to estimate the likelihood of any woman developing CHD.

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55–59	1.0	1.5	1.8	2.2
60–64	1.9	2.4	3.0	3.5
65–69	3.0	3.7	4.3	4.8
70–74	4.5	5.1	5.8	7.1

(i) Describe the effect of age and BMI on the development of CHD in women.

(2)

youngest age range of 55 - 59 with the lowest BMI of ~~22~~ 22.5 showed a % incidence of CHD of 1.0 (the lowest) compared to the oldest age range, 70-74 with the highest BMI of 37.5 showed the highest % of CHD of 7.1 suggesting a higher age and BMI increaseses the incidence of CHD

ResultsPlus
Examiner Comments

Much of this response was essentially a repeat of the data. However, the last sentence, on the last two lines, can be credited with the first and then second marking points respectively.

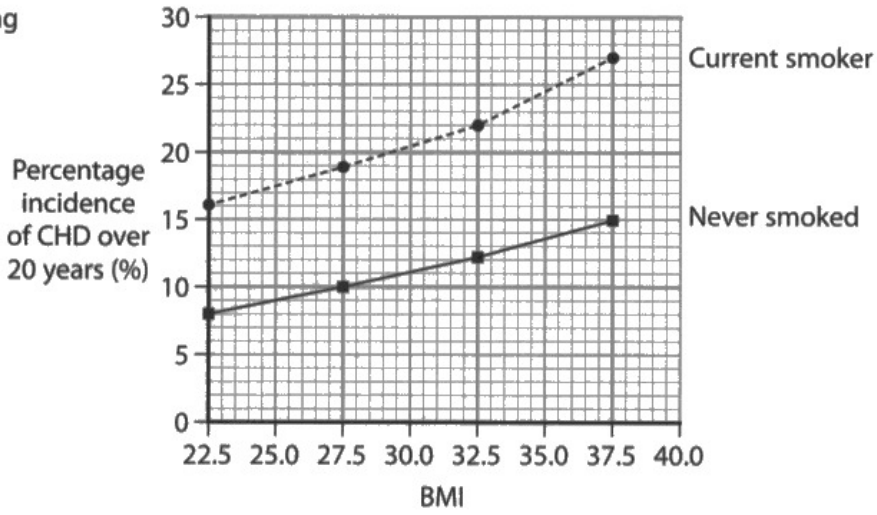
Question 10 (b)(ii)

This was a six mark indicative content item in which candidates were asked to evaluate data provided in both a table and three graphs. Many candidates were able to demonstrate their ability to analyse the two plots on each of the three graphs but it was less common for candidates to also then include age and BMI data from the table in their response.

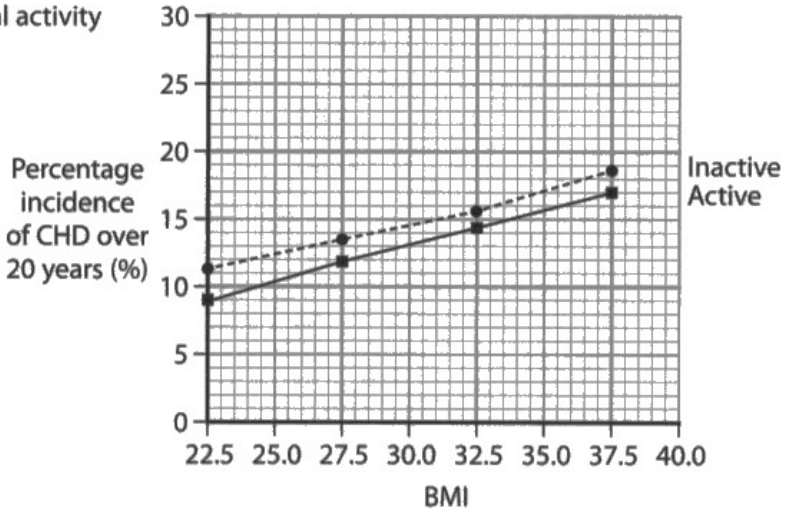
This is a Level 1 response.

*(ii) The graphs show the effect of three different lifestyle factors on the development of CHD in women.

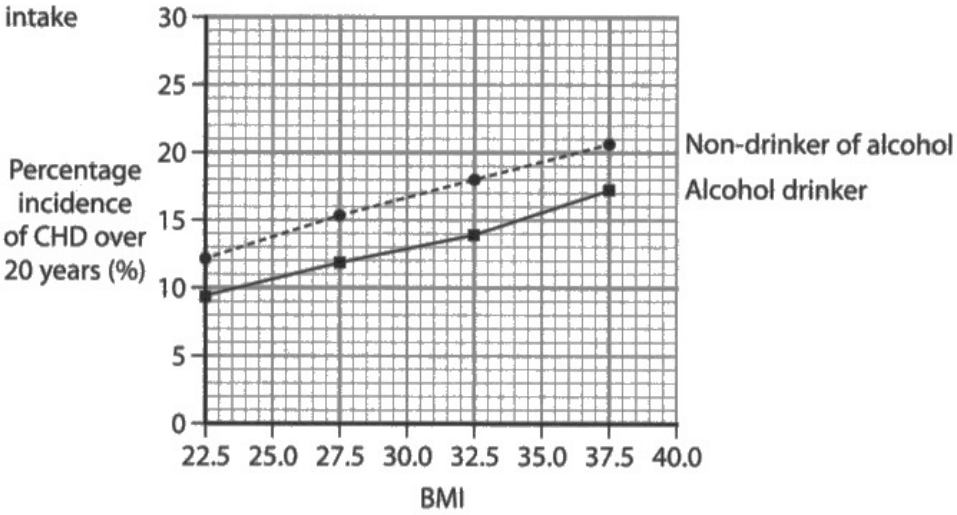
A: By smoking



B: By physical activity



C: By alcohol intake



Evaluate the information provided in the table and graphs to determine which factors are most likely to increase the risk of CHD in women.

(6)

% (percentage)

- smoking increases, incidence of CHD more than physical activity and alcohol do
- all of the mentioned habits affect BMI
- highest percentage of obese women in smoking

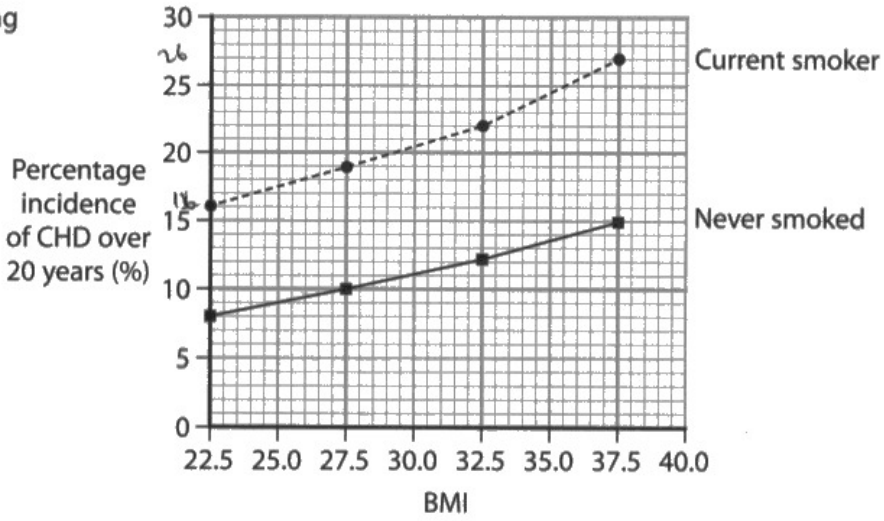
ResultsPlus Examiner Comments

The candidate makes a valid, but general, evaluation between smoking, activity level and alcohol intake. The BMI reference does not relate to CHD. As a consequence, this response gained one mark.

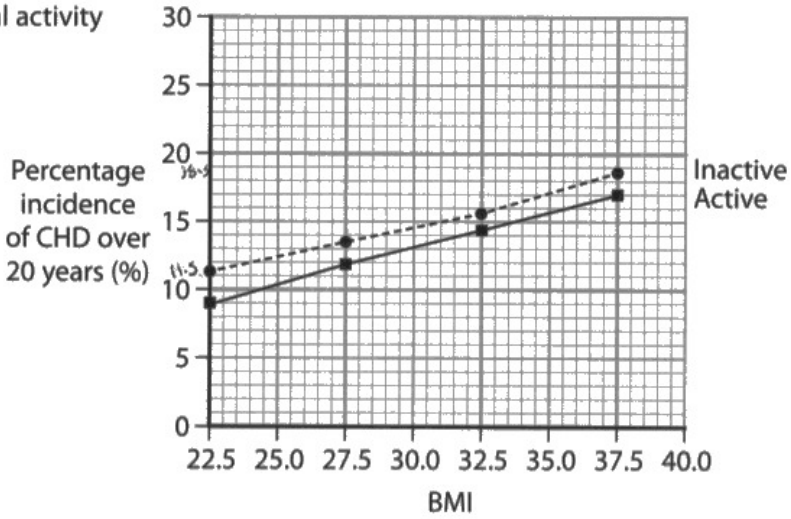
The candidate has offered an encouraging Level 2 response.

*(ii) The graphs show the effect of three different lifestyle factors on the development of CHD in women.

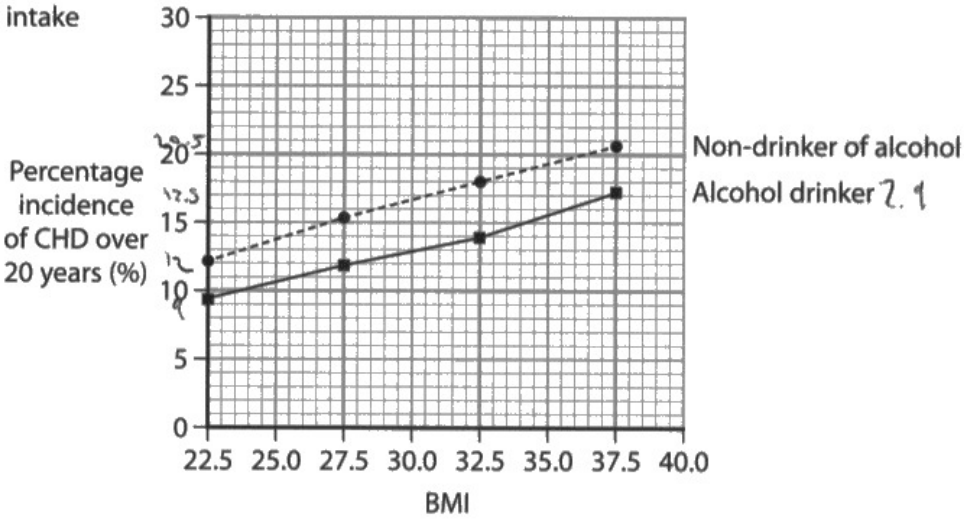
A: By smoking



B: By physical activity



C: By alcohol intake



Evaluate the information provided in the table and graphs to determine which factors are most likely to increase the risk of CHD in women.

(6)

The factor most likely to increase risk of CHD in women is smoking with a ~~10%~~ 11% increase from 16% to 27% incidence of CHD over range of BMI increasing. In all tables, as BMI increases, so does ~~size of~~ in percentage incidence of CHD. High 37.5 BMI combined with ~~s~~ current smoking proves the highest ~~%~~ percentage incidence of CHD compared to any other factors presented. ~~For all~~ Drinking alcohol is the only factor that has a lower percentage of incidence ~~%~~ of CHD than not drinking, with not drinking increasing rate of incidence of CHD by the second largest amount over range of increasing BMI, at around 8.5% increase. Being inactive has the smallest ~~negative~~ effect on increasing incidence of CHD over increasing BMI. ~~Being active~~ Drinking alcohol has the most positive effect in decreasing ~~%~~ percentage of incidence of CHD over ~~increasing~~ increasing BMI at around only 7.8% increase. Being active and inactive have the smallest difference between percentage incidence of CHD over increasing BMI with the largest difference being 2.4% at 22.5 BMI. The largest difference in percentage incidence ~~v~~ between current smokers and non-smokers at 12.1 difference at BMI of 37.5, further highlighting how smoking is the most impacting and most likely to increase risk of CHD. Drinking alcohol is most likely to decrease risk of CHD.

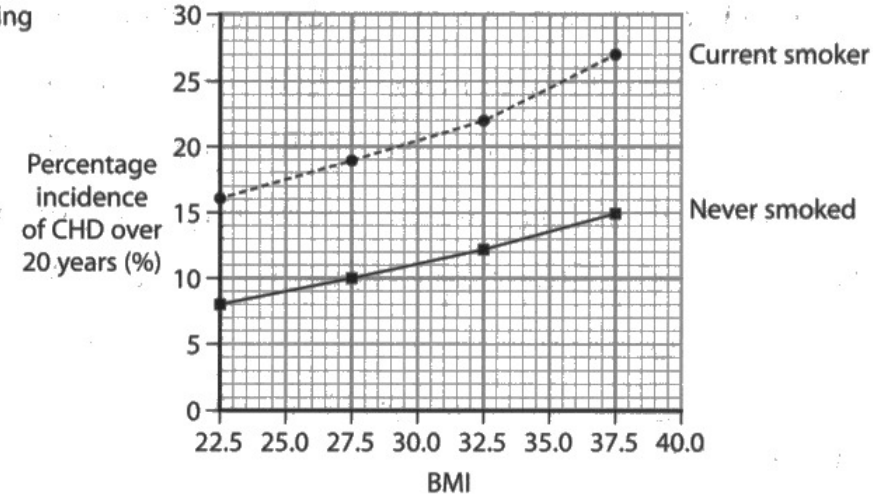
ResultsPlus
Examiner Comments

This answer tackles, in pleasing detail, and with manipulation of the data, smoking versus non-smoking, activity level and alcohol intake as well as BMI on CHD incidence in women in the Million Women Study. Four marks can be given.

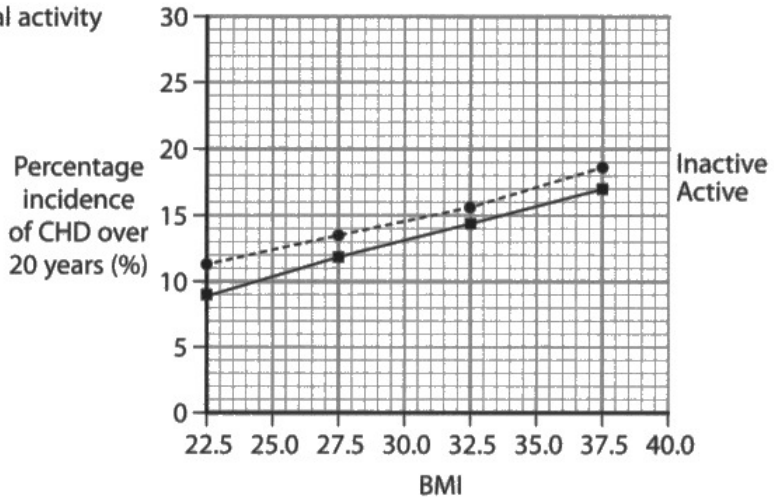
As this answer includes an evaluation of all three lifestyle factors, BMI and age it falls within the Level 3 band.

*(ii) The graphs show the effect of three different lifestyle factors on the development of CHD in women.

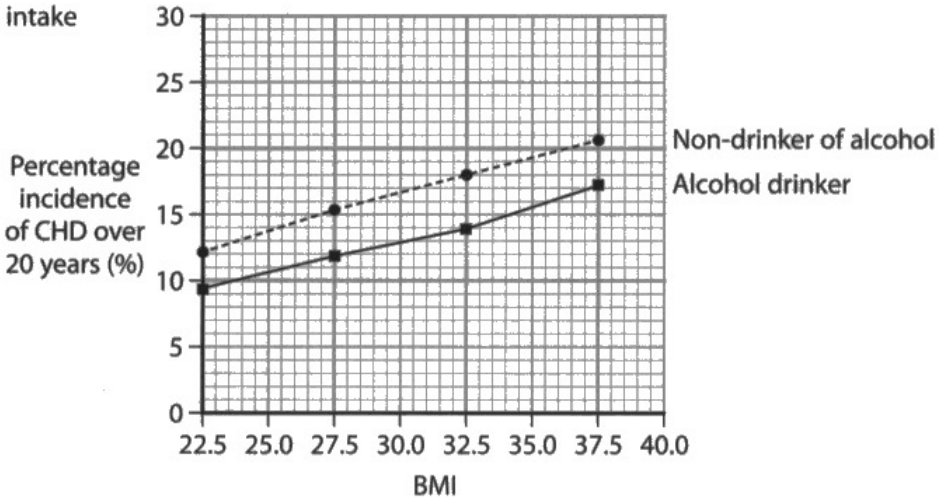
A: By smoking



B: By physical activity



C: By alcohol intake



↑ conclusion

Evaluate the information provided in the table and graphs to determine which factors are most likely to increase the risk of CHD in women.

(6)

In the table we can see that older age and ~~increased~~ higher BMI are factors that increase the risk of CHD in women, as the group with the highest incidence of 7.1 was women aged 70-74 with a BMI of 37.5. From the graphs, all 3 have a positive correlation over 20 years again suggesting that age is a factor for CHD risk. Smoking has the greatest impact out of the 3 environmental factors as the current smoker remains consistently with 8% higher incidence than the non-smoker suggesting smoking is a large risk factor for developing CHD. Graph B shows that an inactive individual has a greater risk of developing CHD as the % incidence of an inactive person remains roughly 1-2% above that of an active person. This smaller difference suggests lack of physical activity is not that significant of a risk factor. Graph C shows that non-drinkers of alcohol have a higher % incidence of developing CHD than alcohol drinkers, with incidence ~~remaining~~ suggesting alcohol is not a factor likely to increase CHD. Age is the greatest.

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Whilst all the various factors are evaluated, and the numerical data is manipulated, the reference to BMI and age lacks detail as does the conclusion, hence five marks given rather than six.

Paper Summary

Based on their performance on this paper, candidates should:

- Make sure they fully appreciate the meaning of the command word being used in each question to help target their response.
- Check the mark value for each question item as this can help inform the level of detail required in the response.
- Look to tailor answers to the context of the questions.
- Consider showing their working in calculation questions, including making sure that any conversions between units are taken into account.
- Make sure that handwriting is sufficiently clear.

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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