Extended Response Questions (Topics 1 and 2): Edexcel SNAB A Level Biology Exam Questions

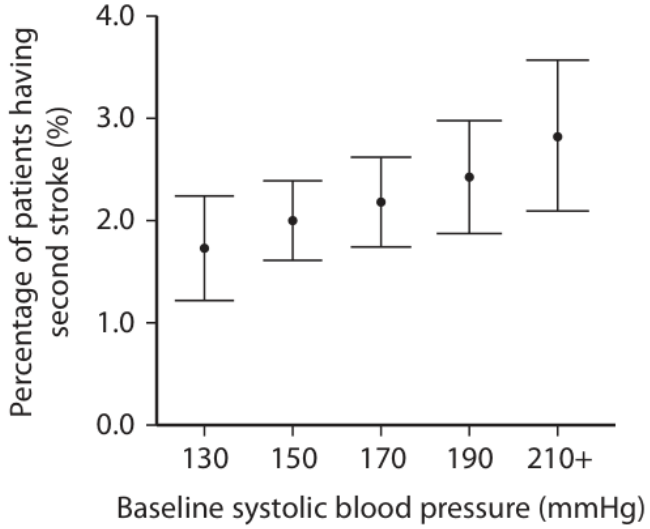
12 questions · 78 marks · about 94 minutes. Answer in the spaces, then check the mark schemes at the end.

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Question 1 · AS Paper 1 · June 2019 · Q8(d) · 6 marks

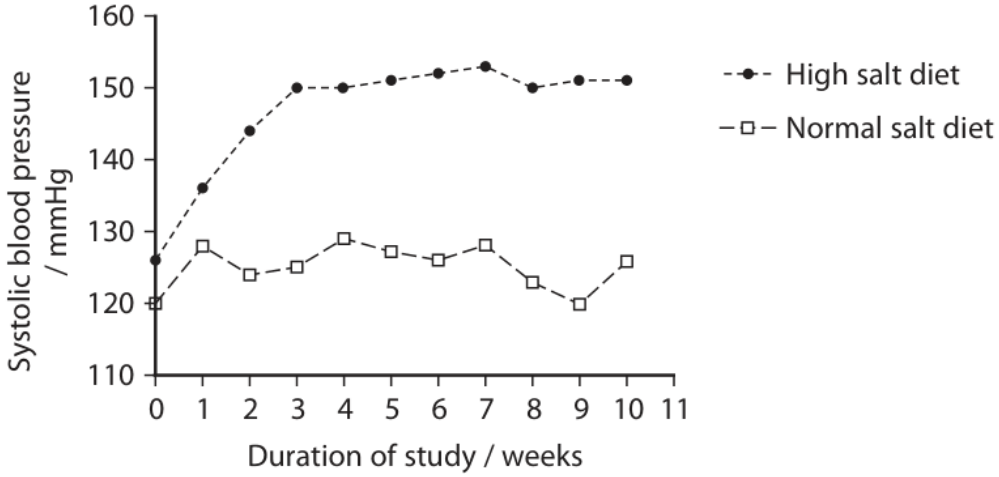
*(d) Graph A shows a correlation between systolic blood pressure and the percentage of stroke patients having a second ischaemic stroke within a few months.

Graph A



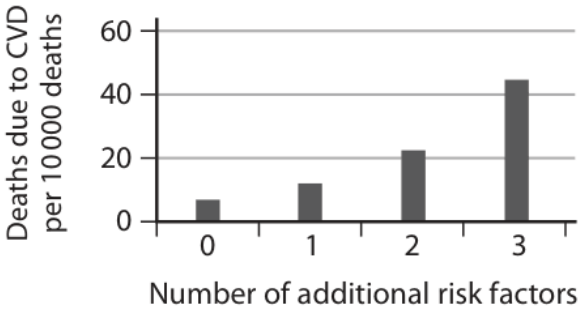
Graph B shows the effect of a high salt diet on systolic blood pressure.

Graph B



Graph C shows the effect of additional risk factors on the number of deaths due to cardiovascular disease (CVD).

Graph C



Men who smoke have an increased risk of having an ischaemic stroke.

Analyse the data to discuss what advice could be given to a smoker, who has had one ischaemic stroke, to reduce his risk of having another stroke.

(6)

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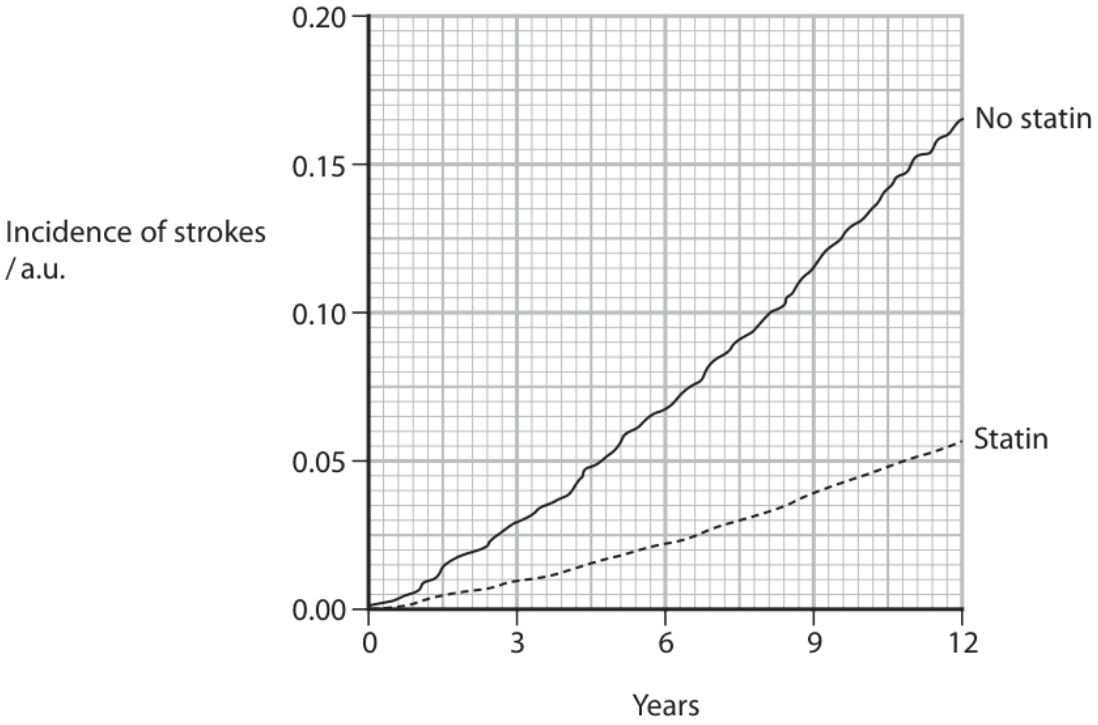
Question 2 · AS Paper 1 · June 2022 · Q8(b) · 6 marks

*(b) Heart attacks and strokes can occur when an artery is blocked. The risk of this can be reduced by treatment with antihypertensives, statins and anticoagulants.

The graphs show results from two separate investigations using statins and anticoagulants.

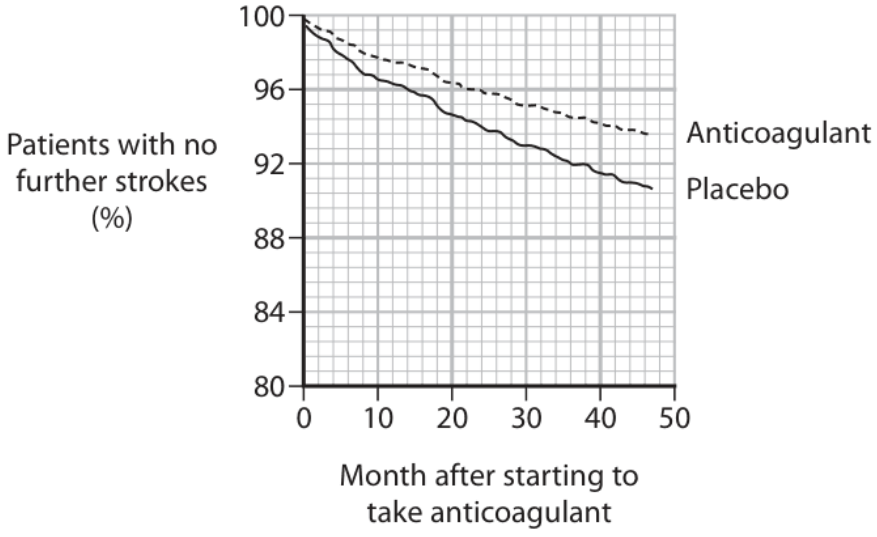
Graph A shows the incidence of stroke in people in the 12 years after starting to take statins compared with a control group.

Graph A



Graph B shows the percentage of people who have no further strokes in the 50 months after starting to take an anticoagulant compared with a control group.

Graph B



Discuss the benefits and risks of using antihypertensives, statins and anticoagulants to treat cardiovascular disease (CVD).

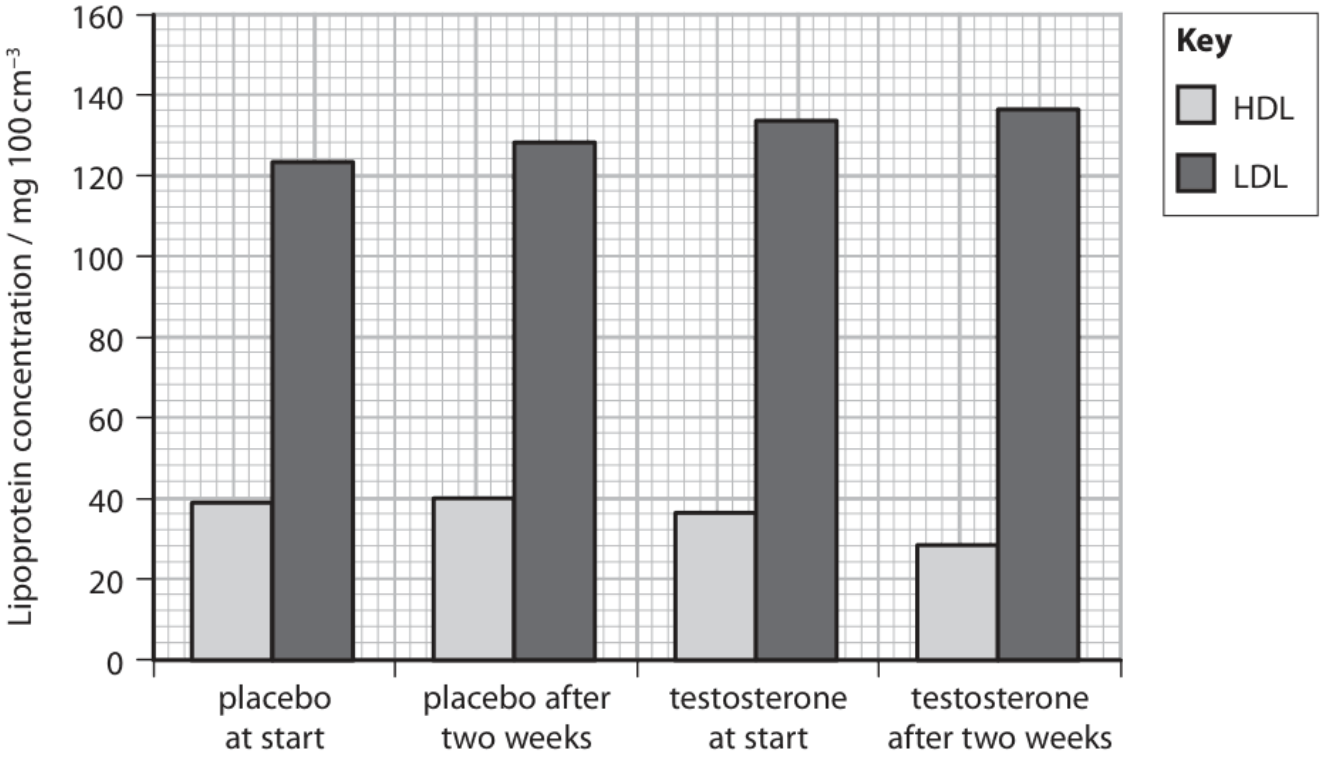
(6)

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Question 3 · information from earlier in the question

(b) In another investigation, groups of men were given either a placebo or 300 mg of testosterone per week for two weeks. The concentrations of different lipoproteins (HDL and LDL) in the blood were measured at the start of the investigation and after two weeks.

The results of the investigation are shown in the graph.



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Question 3 · A level Paper 2 · June 2018 · Q6(b)(ii) · 6 marks

*(ii) Doses of testosterone are used to enhance performance in sports by increasing muscle mass and therefore strength.

- Testosterone increases the activity of an enzyme in the liver that breaks down HDL.
- The production of cholesterol is catalysed by the enzyme HMG CoA reductase (HMGCR).
- Testosterone increases levels of mRNA for HMGCR.

Explain why using testosterone as a performance-enhancing drug is unacceptable in terms of risks to health.

(6)

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(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.

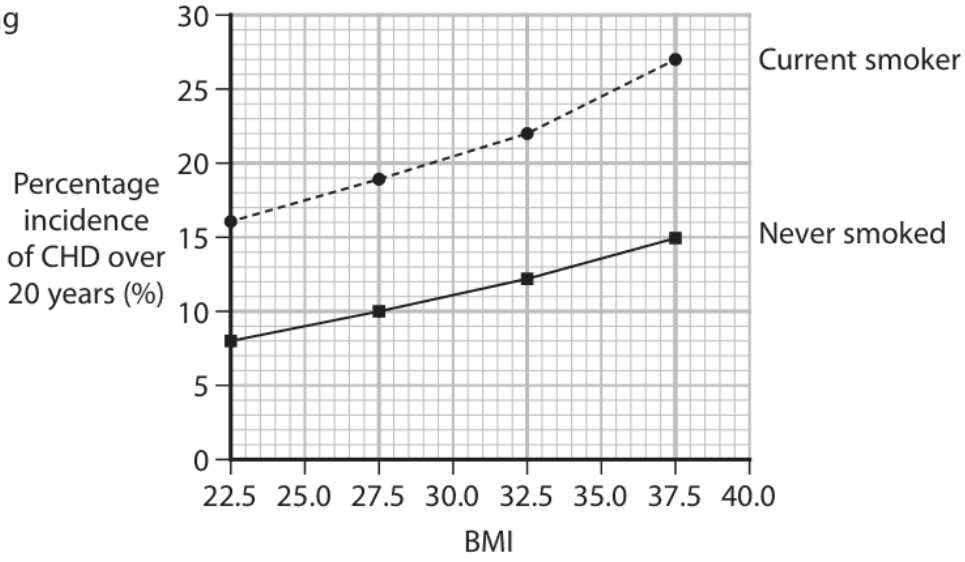
The table shows the effect of age and BMI on the development of CHD in women.

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

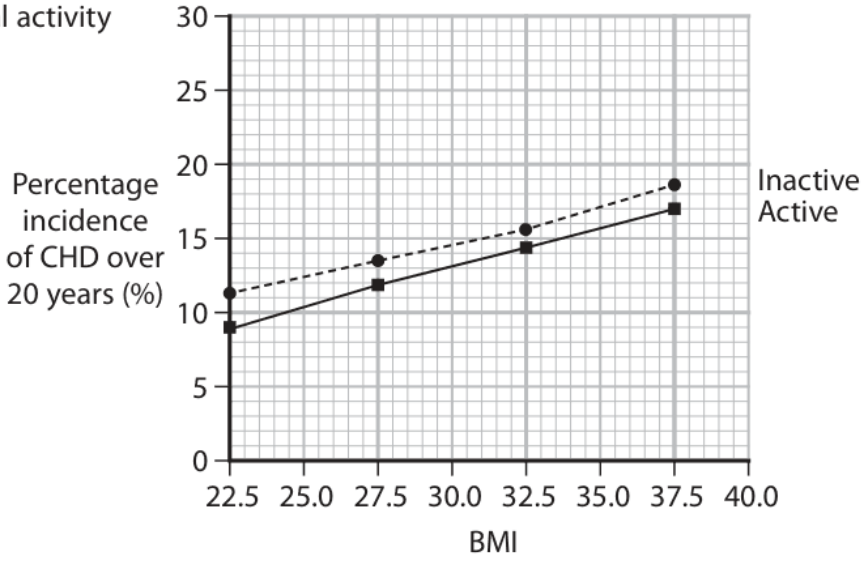
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*(ii) The graphs show the effect of three different lifestyle factors on the development of CHD in women.

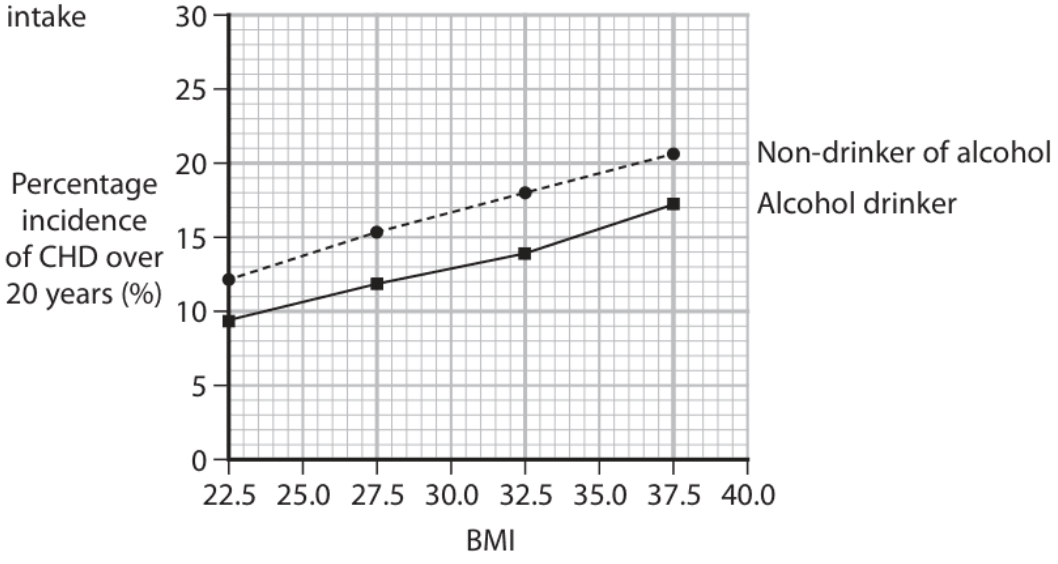
A: By smoking



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)

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Question 5 · information from earlier in the question

(b) The effect of inhaling nicotine on the circulatory system of rats was investigated.

In this investigation, three variables were considered:

- the concentration of nicotine in blood plasma
- the diameter of the lumen of one artery
- blood pressure

Two groups of rats were treated as shown in the table.

Group	Number of rats in group	Nicotine dose / mg
A	6	1.0
B	6	0.1

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(ii) The diameter of the lumen of one artery, in each of the 12 rats, was measured when the rats were resting. The blood pressure of each rat was also measured and the mean blood pressure calculated.

The diameter of the lumen of the artery and the blood pressure of each rat were then recorded at intervals, for a total of 30 minutes. The rats inhaled nicotine for the first minute (0.0 to 1.0).

The table shows the results for the mean diameter of the lumen of the artery.

Time / minutes	Mean diameter of lumen / μm	
	Group A (1.0 mg nicotine)	Group B (0.1 mg nicotine)
0.0	48	48
0.5	44	44
1.0	49	45
2.0	52	48
5.0	57	52
10.0	55	48
15.0	49	48
30.0	49	48

Determine the effect of nicotine concentration on the percentage change in lumen diameter in the first minute.

(2)

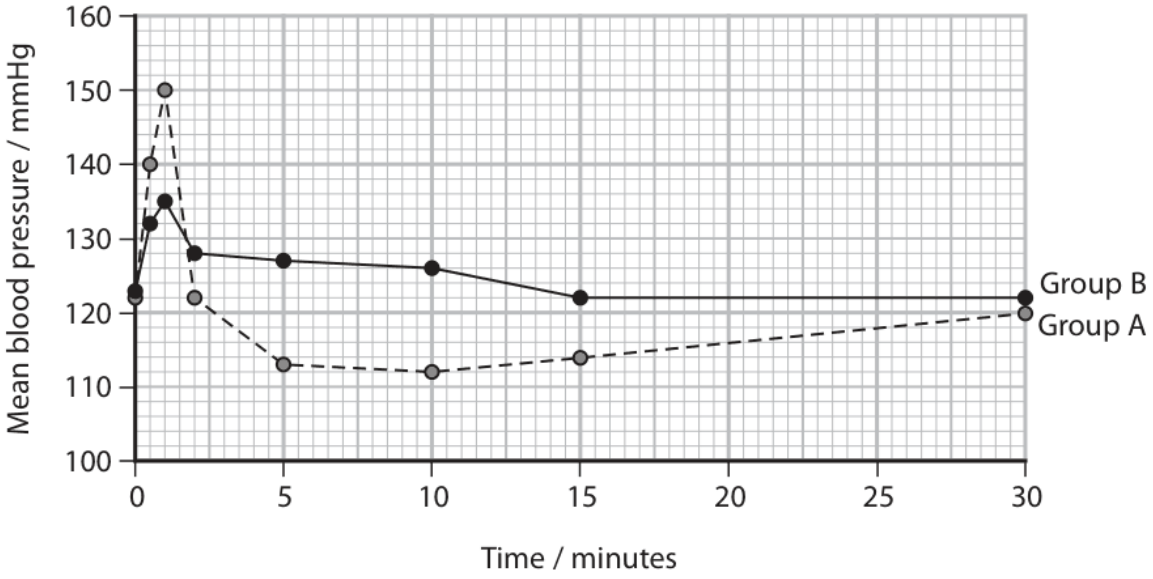
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Question 5 · A level Paper 2 · October 2020 · Q9(b)(iii) · 6 marks

*(iii) The graph shows the results for the mean blood pressure for the two groups of rats. Nicotine was inhaled for the first minute.



It has been stated that:

'Nicotine gained from smoking cigarettes in humans causes an increase in blood pressure and a decrease in the lumen of arteries.'

Analyse all the data from this investigation using rats to evaluate the validity of this statement.

(6)

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Question 6 · A level Paper 3 · June 2018 · Q6(b) · 9 marks

*(b) The carbohydrate content of vegetables ranges from 3 to 35%. However, meat contains little to no carbohydrate. Milk is the only food source from animals that contains a significant amount of carbohydrate.

Although plant material contains a higher proportion of carbohydrate than animal tissues, it has been claimed that carbohydrates are more important to animals than they are to plants.

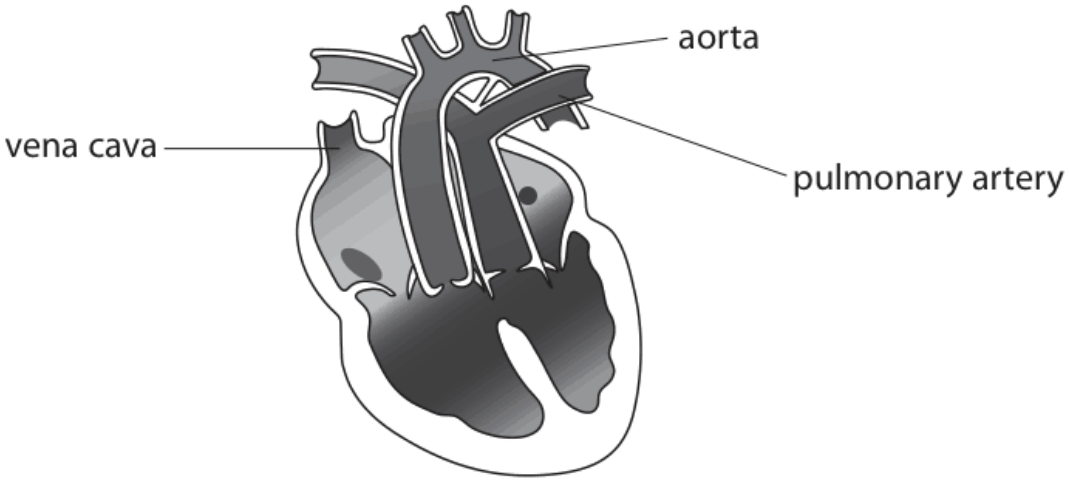
Assess the relative importance of carbohydrates to plants and animals.

(9)

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Question 7 · information from earlier in the question

(b) A baby was born with an abnormal heart. The diagram shows the heart of this baby. There is a hole in the septum between the two ventricles.



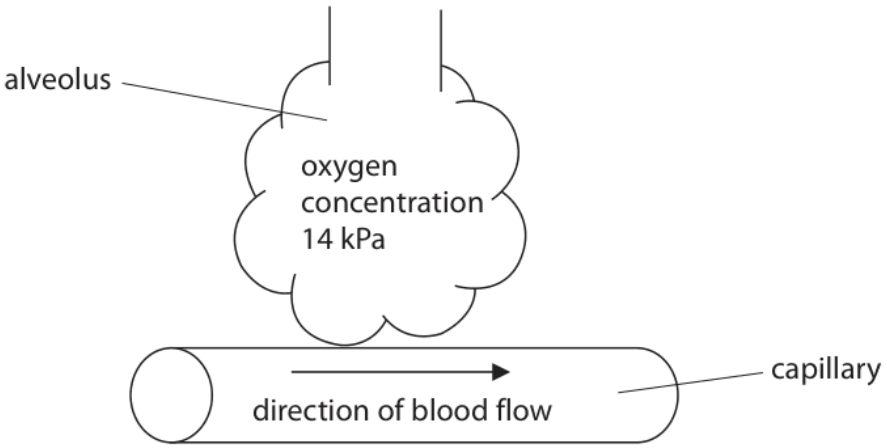
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(iii) Oxygen diffuses between the alveoli of the lungs and the blood.

Fick's Law shows how three factors affect the rate of diffusion:

$$\text{Rate of diffusion} = \frac{\text{surface area} \times \text{concentration difference}}{\text{diffusion distance}}$$

The diagram and the table give information about the oxygen concentration in the alveoli and in the blood.



Heart	Oxygen concentration / kPa	
	Blood entering the lungs	**Blood leaving the lungs**
Normal	5	13
With hole in the septum between the ventricles	8	10

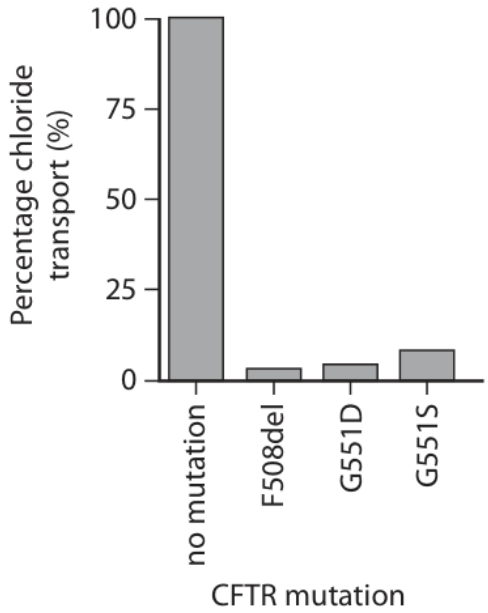
*Assess the effect of this heart defect on the rate of oxygen diffusion between the alveoli and the blood.

(6)

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Question 8 · AS Paper 1 · June 2018 · Q8(d) · 6 marks

*(d) The graph gives information about chloride transport in the human respiratory system with the normal allele for the CFTR protein and with the three mutated CFTR alleles.



The table gives information about the CFTR protein produced by cystic fibrosis (CF) sufferers with mutated alleles.

Mutation	Estimated percentage of CF sufferers who have one or more alleles with this mutation	Problem with CFTR protein channel
F508del	90	Reduced quantity / no CFTR protein
G551D	4	Reduced function
G551S	<1	Reduced function

Assess the effect that these mutations have on the human respiratory system.

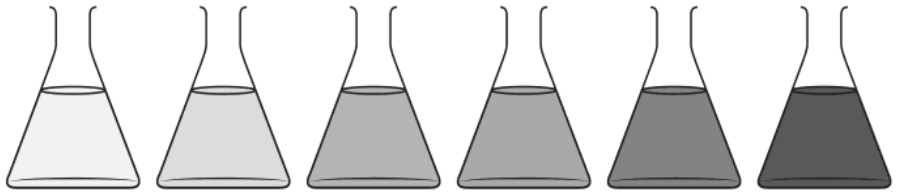
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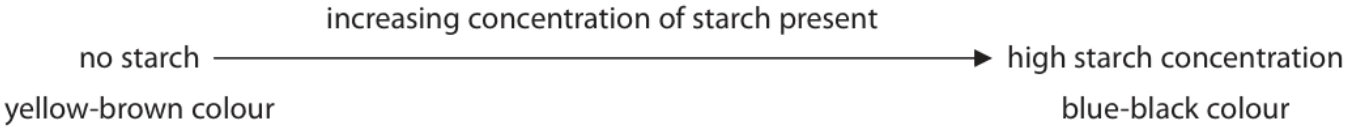
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Question 9 · AS Paper 1 · June 2024 · Q6(b)(i) · 6 marks

(b) Amylase breaks down starch into maltose.

The diagram shows the effect of adding iodine to flasks containing different concentrations of starch.





The effect of amylase concentration on the rate of reaction, at two different temperatures, was investigated.

The table shows the results of this investigation.

Enzyme concentration / mmol dm^{-3}	Rate of reaction at 30 °C / a.u.	Rate of reaction at 45 °C / a.u.
0	0	0
1	31	16
2	41	25
3	69	36
4	82	42
5	92	47
6	98	54
7	100	62
8	100	70

*(i) Explain how to carry out a valid investigation to collect the data shown in the table.

(6)

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Question 10 · A level Paper 1 · June 2019 · Q11(c) · 6 marks

*(c) Genetic testing can be used to identify individuals who have genetic disorders such as Batten disease.

The table shows examples of some types of genetic screening and examples of where they may be used.

Type of screening	Method	Example
Blood test to identify risk of a disease	DNA from a blood sample is examined	Identifying presence of BRCA1 and BRCA2 mutations where there is a family history of breast cancer
Blood test to identify carriers of a genetic disease	DNA from a blood sample is examined	Establishing if a person is heterozygous for a recessive condition such as cystic fibrosis (CF)
Amniocentesis	Fetal DNA from amniotic fluid is tested	Identifying genetic disorders in the fetus
Chorionic villus sampling (CVS)	Fetal DNA from placental tissue is tested	Identifying genetic disorders in the fetus
Non-invasive prenatal diagnosis (NIPD)	Analysis of fetal DNA fragments from blood samples from the mother	Identification of chromosomal disorders and a small number of single gene disorders in the fetus
Pre-implantation genetic diagnosis (PGD)	Combined with IVF to test embryo at 8-cell stage	Ensures only embryos without a genetic disorder such as CF are implanted

Assess the advantages and disadvantages of these types of screening for genetic disorders.

(6)

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Question 11 · A level Paper 2 · June 2022 · Q9(b) · 6 marks

*(b) There is a gene in humans similar to the mouse coat colour gene.

This human gene comprises 74 775 base pairs. The mRNA produced from this gene codes for a protein made up of 132 amino acids.

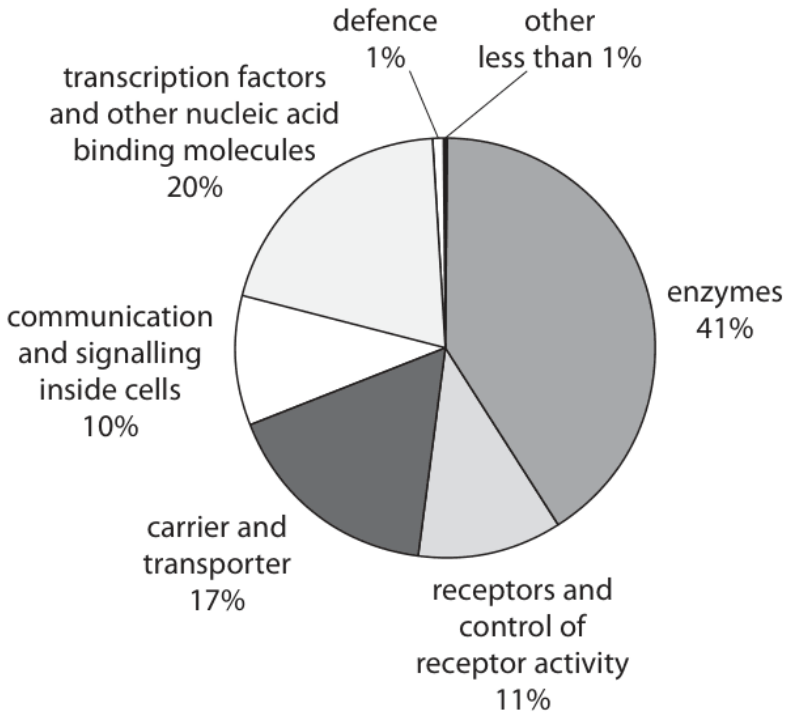
Explain the differences in the gene coding for this protein and the mRNA produced from it.

(6)

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***7** The human genome codes for approximately 20 000 different proteins.

The pie chart shows the proportion of proteins carrying out different functions.



The 20 amino acids used to make proteins can be classified according to the properties of their side chains (R groups).

Table 1 shows the number of amino acids with these properties.

Property of the side chain group	Number of amino acids with the property
Non-polar	9
Polar, uncharged	6
Negatively charged	3
Positively charged	2

Table 1

Table 2 shows three amino acids, used to synthesise proteins, that have unique properties.

Amino acid	Comment on structure
Cysteine	The side chain contains a thiol group (–SH) that is chemically reactive.

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Mark schemes

Question 1 · AS Paper 1 · June 2019 · Q8(d) · 6 marks

Question Number	Answer
8*(d)	Answers will be credited according to candidate's knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • reduce blood pressure • analysis of data to show higher blood pressure increases risk of second ischaemic stroke • analysis of data to discuss variability in data • antihypertensive drugs • reduce / stop smoking as smoking increases BP • reduce salt in diet • analysis of data to show effect of high salt diet on blood pressure effect of reducing additional risk factors on deaths due to CVD • reduce blood cholesterol levels • reduce saturated fat in diet / take statins • anticoagulants • reduce BMI • increase exercise **(6)**

Level 0	0	No awardable content	
Level 1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Discussion of how to reduce one risk factor with reference to one of the graphs OR Discussion of how to reduce at least two risk factors without reference to the graphs
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Discussion of how to reduce two risk factors with reference to two of the graphs Demonstrates analysis of data
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Discussion of how to reduce three risk factors with reference at least two of the graphs. Demonstrates analysis of data

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Question 2 · AS Paper 1 · June 2022 · Q8(b) · 6 marks

Question Number	Answer	Additional Guidance	Mark
*8(b)	Answers will be credited according to candidate's knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic benefits • anticoagulants reduce the number of patients with no further strokes • antihypertensives reduce blood pressure • (graph A shows) use of statins reduces the incidence of stroke • quantitative data used to evidence points Risks • risk of anticoagulants use e.g. bleeding, nausea, • risk of antihypertensive use e.g. low blood pressure, fainting • risk of statin use e.g. liver damage, muscle pain, headache, low blood platelet count, nausea, dizzy Linkage • description of how anticoagulants would reduce risk of stroke e.g. reduce blood clotting therefore reducing risk of strokes • description of how antihypertensives would reduce risk of stroke – ie lowering blood pressure reduces chances of damage to blood vessels in the brain • description of how statins would reduce risk of CVD e.g. statins lower {LDL / blood cholesterol} which reduces risk of {atherosclerosis / blockage of artery} **(6)**		

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Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	Some benefits and/or risks for at least one of the types of drug.
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Benefits and/or risks for at least two of the types of drug.
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Benefits and risks discussed for all three types of drug, including linkages between the mode of action of the drug and the benefits.

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Question 3 · A level Paper 2 · June 2018 · Q6(b)(ii) · 6 marks

Question Number	Indicative content
*6(b)(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic information • testosterone increases production of { LDL / cholesterol } • testosterone {increases breakdown of / reduces } HDL • { high cholesterol / LDL } associated with increased risk of {CVD / atherosclerosis} Evidence for linkages • role of HDL in transporting cholesterol from the bloodstream to the liver • role of LDL in accumulation of cholesterol and development of atherosclerosis Evidence for sustained scientific reasoning • testosterone associated with increased synthesis of the enzyme HMGCR which is involved in cholesterol production • { performance enhancing drugs / testosterone } can harm the health of an athlete by increasing risk of CVD

Level	Mark	Descriptor
Level 0	Marks	No awardable content
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
Level 3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

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Question 4 · A level Paper 2 · June 2023 · Q10(b)(ii) · 6 marks

Question Number	Answer	Mark
*10(b)(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content 1. **Comment on design of study** • Comment on design of study Large cohort e.g only for the age range 55-74 /using a form could lead to over or under estimates /unreported incidents of CHD 2. **Comment on data** • Age-related data only for 5 year incidence whereas rest is for 20 years • Graphs give no information about the age of the women in the study • Reliability comment due to cohort size/longevity of study • Likelihood of CHD increases with increasing BMI (for all factors) and with age • Likelihood of CHD increases if smoke, do not drink alcohol, or/and are inactive (for all BMI levels) 3. **Discussion of relative likelihood of CHD occurring** • From table: increasing age appears to increase likelihood more than increasing BMI • From graphs: relative likelihood is greatest if a smoker (for all BMI's) and least for inactivity / data could be used (e.g. there is a 27% likelihood that a woman will have CHD at some point between the ages of 55-74 if she is a smoker with a BMI of 37.7 compared to a non-smoking, but inactive, woman of the same BMI)	**[6]**

Level 0	Marks	No awardable content	Additional Guidance
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths / weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Basic conclusion made from data concerning the effects of at least one lifestyle factor (smoking, inactivity, alcohol) on CHD incidence. A conclusion made: e.g. smoking / physical inactivity/ not drinking alcohol increases risk of CHD.
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	At least 2 lifestyle factors discussed plus either BMI or age considered. Data from table or graphs discussed. Conclusion – e.g. greatest increase in risk comes from smoking, little increase in risk for being inactive compared to being active, risk increases with rise in BMI for all lifestyle factors.
Leve3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	All lifestyle factors, BMI and age to be considered. Data from table and graphs discussed Conclusion - e.g risk for smokers at lowest BMI doubles, whereas greatest percentage increase in risk is for smokers with the greatest BMI .

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Question 5 · A level Paper 2 · October 2020 · Q9(b)(iii) · 6 marks

Question Number	Indicative content
*9(b)(iii)	Answers will be credited according to candidates' deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is relevant. Additional content included in the response must be scientific and relevant. Give examples of relevant biological knowledge and understanding: <u>Validating the statement</u> • Investigation involved rats inhaling nicotine which humans do during smoking • Rats are mammals so can extrapolate to humans <u>Not validating the statement</u> • Nicotine inhaled (for both nicotine concentrations) leads to vasoconstriction and then vasodilation and then returns to original diameter • Blood pressure for 1mg nicotine concentration increases and decreases but drops below original value • Presence of nicotine leads to noradrenaline release which increases heart rate • Blood pressure (for both nicotine concentrations) increases and decreases • No reference to rats inhaling smoke, only nicotine • Rats are not the same as humans • Sample size too small to make a valid statement <u>Comment</u> • whether agree or disagree with statement

			Additional guidance
Level 0	Marks	No awardable content	
Level 1	1-2	Limited scientific judgement made with a focus on mainly just one method, with a few strengths/weaknesses identified. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	An answer that refers to just one piece of evidence – either lumen size or blood pressure Simple conclusion drawn from the evidence
Level 2	3-4	A scientific judgement is made through the application of relevant evidence, with strengths and weaknesses of each method identified. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	An answer that refers to evidence concerning both lumen size and blood pressure Links made between lumen size, vasoconstriction and blood pressure
Level 3	5-6	A scientific judgement is made which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	An answer that refers to data about vasoconstriction and vasodilation and links it to effect of nicotine on the release of noradrenaline and therefore on blood pressure Conclusion made considering validity of data collected from rats and how it can be applied to humans

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Question 6 · A level Paper 3 · June 2018 · Q6(b) · 9 marks

Question Number	Indicative content
***6(b)**	Answers will be credited according to candidates' deployment of knowledge and understanding of material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is relevant. Additional content included in the response must be scientific and relevant. Give examples of relevant biological knowledge and understanding: Evidence of isolated elements of biological knowledge: • glucose for respiration in both • starch for energy storage in plants /glycogen for energy storage in animals • cellulose for cell walls in plants Evidence of adequate biological knowledge with linkages made • starch composed of amylose and amylopectin in plants • sucrose as a transport sugar in phloem in plants, glucose in animals • lactose in milk for energy • a judgement on the importance of carbohydrates in plants and animals is made e.g. cellulose as a structural carbohydrate in plants therefore a greater proportion of carbohydrate in plants than animals or animals require more energy, therefore need more carbohydrate Evidence for comprehensive biological knowledge and understanding with sustained linkages • pentose sugars ribose and deoxyribose { in nucleic acids / DNA/ RNA / ATP} in both • ribulose as part of the Calvin cycle in plants • glycoprotein in { mucus / receptors on cell surface membranes /antibodies} • glycolipids in cell membranes • a supported judgement on the relative importance of carbohydrates in plants and animals is given e.g. animals store more energy in lipids than carbohydrate, therefore carbohydrate more important as a storage molecule in plants **or** the idea of carbohydrates as part of complex molecules **or** the proportion of carbohydrates present is not the same as importance

Level	Mark	Descriptor	Additional guidance
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Glucose for respiration Polysaccharides for energy storage Cellulose for plant cell walls Simple conclusion made
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Branched storage molecules for rapid energy release in starch Roles of sucrose, lactose A judgement on the importance of carbohydrates in plants and animals is made
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	All of the above plus discussion of carbohydrates as part of complex molecules A supported judgement on the relative importance of carbohydrates in plants and animals

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Question 7 · AS Paper 1 · June 2016 · Q8(b)(iii) · 6 marks

Question Number	Answer	
8 (b)(iii)	Answers will be credited according to candidate's knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • rate of diffusion would be lower with abnormal heart • blood entering lungs from an abnormal heart has more oxygen, 8kPa, than blood entering lungs from a normal heart, 5kPa • oxygen in blood increased by only 2kPa instead of 8kPa with abnormal heart • resulting in a smaller difference in concentration between the alveoli and the red blood cells i.e. 14-8/14-5 or 6 and 9kPa • the surface area of the alveoli and distance for diffusion are not affected • Fick's law states that concentration gradient is proportional to rate of gas exchange • a lower concentration gradient for oxygen between the alveoli and the blood results in a lower rate of oxygen diffusion **NOTE** – 'the pieces of scientific information provided' could be any from: the information about the defective heart / diagram of alveolus / table of data	
Level	Mark	Descriptor
0	0	No awardable content
1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of the pieces of scientific information provided. The explanation shows some linkages and lines of scientific reasoning with some structure.
3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of the pieces of scientific information provided. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

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Question 8 · AS Paper 1 · June 2018 · Q8(d) · 6 marks

Question Number	Answer	
8 (d)	Answers will be credited according to candidate's knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic information • cilia struggle to move mucus out of lungs • increased risk of lung infections • 100% chloride ion transport without mutation • all three mutations reduce chloride transport • F508del results in lower chloride transport than {the other mutations / G551D / G551S } • G551S mutation is less severe than G551D Evidence for linkages made • F508del mutation results in { no / fewer } CFTR protein channels being produced • G551D and G551S have higher chloride transport (than F508del) because { the correct number of protein channels are produced / CFTR protein present but function reduced } • {no/fewer} CFTR protein channels results in less transport of chloride ions • effects of thicker mucus on gas exchange in the respiratory system explained e.g. increased diffusion distance, reduced surface area, reduced concentration gradient Evidence for sustained scientific reasoning • with the G551D and G551S mutations the CFTR protein channels have an incorrect shape • incorrect shape of CFTR protein results in reduced function (of transporting chloride ions) • a different part of the protein structure is affected in G551S which interferes less in the transport of chloride ions • mutation may affect the tertiary structure of the CFTR protein e.g. the positioning of hydrophilic parts of the protein channel **(6)**	

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An answer may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Basic description of the effects of the mutations on CFTR protein production. E.g. comparisons between mutations and no mutations on CFTR production Effects of CFTR protein problems on mucus described
Level 2	3-4	An answer will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Explanation of how the different types of mutation will have different effects on CFTR and chloride ion transport. Effects of CFTR protein problems on respiratory system described
Level 3	5-6	An answer is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Explanation of effects of mutations related to shape of protein produced. Reasons for reduced function of CFTR protein related to G551S and G551D mutations.

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Question 9 · AS Paper 1 · June 2024 · Q6(b)(i) · 6 marks

Question Number	Answer
*6(b)(i)	Answers will be credited according to candidate's knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Basic • use of range of enzyme concentrations • use of given range i.e. 0-8 mmol dm^{-3} • reference to both given temperatures – 30°C and 45°C • relevant safety aspect Linkages • variables controlled e.g., volume of {amylase/starch/iodine} solution, concentration of starch solution, pH, temperature, time • explanation of how a stated variable would be controlled e.g. use of water bath to maintain temperature / stated volume of solution • replicates / repeats Sustained • method to measure rate of reaction e.g., time taken for iodine solution to remain yellow-brown / use of colour standards for comparison / reference to use of regular sampling to test with the indicator / reference to use of colorimeter • description of how to calculate rate of reaction e.g. calculate gradient, 1/t **(6)**

		Additional Guidance	
Level 1	1-2	An explanation of how the investigation should be modified may be attempted but with limited analysis, interpretation and/or evaluation of the scientific information. Generalised comments made. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	A basic method described with reference to range of enzyme concentrations and use of starch and iodine solutions. Consideration of one of the following: • performed at both temperatures – 30°C and 45°C • variables to be controlled • how to control at least one variable • how to measure rate of reaction • how to calculate rate of reaction
Level 2	3-4	An explanation of how the investigation should be modified will be given with occasional evidence of analysis, interpretation and/or evaluation of the scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Level 1 plus Consideration of two more of the following: • performed at both temperatures – 30°C and 45°C • variables to be controlled • how to control at least one variable • how to measure rate of reaction • how to calculate rate of reaction
Level 3	5-6	An explanation of how the investigation should be modified is given which is supported throughout by evidence from the analysis, interpretation and/or evaluation of the scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.	A detailed method for a valid investigation which also includes how to calculate rate of reaction from the dependent variable data

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Question 10 · A level Paper 1 · June 2019 · Q11(c) · 6 marks

Question Number	Answer
11*(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. <u>Indicative content</u> Adult screening advantages and disadvantages • Identifies risk of developing a particular disease in the future so choices can be made e.g. extra screening for breast cancer or preventative mastectomy/screening and lifestyle changes for some types of CVD • Identification of carriers so choices can be made about family planning – both partners tested, risk can be identified and have prenatal screening • May not want to know if you have a high likelihood of developing a disease, if one person is tested it may give other family members information they would chose not to know, may potentially affect life insurance
	Prenatal screening advantages and disadvantages • Amniocentesis – prepares parents for child with disease/gives choice of abortion • Chorionic villus sampling – as amniocentesis, carried out earlier in pregnancy • Some of the conditions tested for are very unpleasant and may be life limiting • NIPD non-invasive, less traumatic procedure, no increased risk of miscarriage • PGD only implant healthy embryos, do not have to make decision about abortion • Both amniocentesis and CVS carry increased risk of miscarriage, especially CVS (although it can be carried out earlier in the pregnancy) • Can't cure the disease, only choice is to have an abortion-not acceptable to everyone • For conditions such as CF, where there is more than one possible mutation, test is only for most common mutations so there may be false negatives • NIPD currently only available for chromosome disorders such as Down's syndrome • PGD involves IVF, which can be emotionally traumatic and only has about 30% success rate • All pre-natal screening has a risk of false positives with abortion of a healthy fetus. • Procedures involving IVF can be regarded as unethical because many embryos are discarded • Invasive nature of some of the tests

Level	Mark	Descriptor	Additional Guidance
0	Mark	No awardable content	
1	1-2	Limited scientific judgement made with a focus on one side of the argument only. A conclusion may be attempted, demonstrating isolated elements of biological knowledge and understanding but with limited evidence to support the judgement being made.	Only considered one benefit or one risk without further explanation beyond a brief description. A generalised discussion without focusing on the details of specific types of screening
2	3-4	A scientific judgement is made through the application of relevant evidence to both sides of the argument. A conclusion is made, demonstrating linkages to elements of biological knowledge and understanding, with occasional evidence to support the judgement being made.	Considers at least two types of screening One advantage and one disadvantage of each type of screening discussed.
3	5-6	A scientific judgement is made, which is supported throughout by sustained application of relevant evidence from the analysis and interpretation of the scientific information. A conclusion is made, demonstrating sustained linkages to biological knowledge and understanding with evidence to support the judgement being made.	Advantages and disadvantages of blood tests and pre-natal tests discussed fully. Discussion of blood tests to identify adults with genetic disorders. Conclusion or judgement made, e.g. identifying genetic disorders by blood tests in adults is better as the disadvantages have less impact than disadvantages of genetic testing on

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Question 11 · A level Paper 2 · June 2022 · Q9(b) · 6 marks

Question Number	Answer	Mark
*9(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content For DNA • Double stranded so more stable • Allows for a template strand • Larger as includes promotor / site for transcription factors to bind For mRNA • Ribose rather than deoxyribose and uracil rather than thymine • Smaller as not bound to other genes / fewer bases (minimum of 396) • So can {exit the nucleus / move through the nuclear pore} • Single-stranded • So {bases / codon} exposed to (tRNA's with) complementary anticodons / bases can bind • Amino acids {brought/joined} in the correct sequence	(6)
	• Removal of introns / post-transcriptional modification	

Level 0	Marks	No awardable content	Additional guidance
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	Basic description of differences between DNA and mRNA
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	Reasons provided for differences in structure of DNA and mRNA.
Level 3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Explanation for differences in the gene described and the mRNA – greater number of bases in DNA than in the mRNA. Reference to removal of introns and post transcriptional changes to RNA before it is translated.

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Question 12 · A level Paper 3 · June 2022 · Q7 · 9 marks

Question number	
*7	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. **Indicative content** Information • there are 20 000 different proteins • these proteins carryout different functions • there are a {large number of / 20} different {R groups / amino acids} • most R groups are non-polar, some are polar a few have a charge Linkage to **s**tructure • R groups determine {3D shape / structure} of proteins • {large number of / 20 R groups} • many combinations of amino acids required to give wide variety of protein structures • R groups can form bonds to stabilise 3D structure (e.g. cysteine) • role of R-groups in structure of haemoglobin • role of R-groups in structure of collagen • location of cysteine allows formation of disulfide bonds Linkage to **f**unction • R groups variety of protein shapes are required to allow proteins to carry out wide range of functions • examples of functions that require specific structure e.g. antibodies specific to an antigen / enzymes specific for a substrate / receptors e.g. neurotransmitters and (acetylcholine) and ion-gated channels • polar / ionic R groups increase solubility • non-polar R groups will be on outside of insoluble proteins / structural proteins / collagen / proteins inserted into membranes • role of R-groups in function of haemoglobin • role of R-groups in function of collagen Linkage to **l**ocation • polar R groups will be in aqueous environment /non-polar regions in a non-aqueous environment • polar /ionic R groups soluble in {plasma/ tissue fluid / cytoplasm} / line the inside of ion channels / found on the outside of soluble proteins such as hormones / transport proteins / immunoglobulins / cytokines • role of R-groups in location of haemoglobin • role of R-groups in location of collagen

Level	Marks		
0	0	No awardable content	
1	1-3	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context.	Selection of some information from the table – little or no linkage
2	4-6	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure.	Linkage between R groups and two aspects from structure, function and location
3	7-9	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	Linkage between R groups and all three aspects (structure, function an location)

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