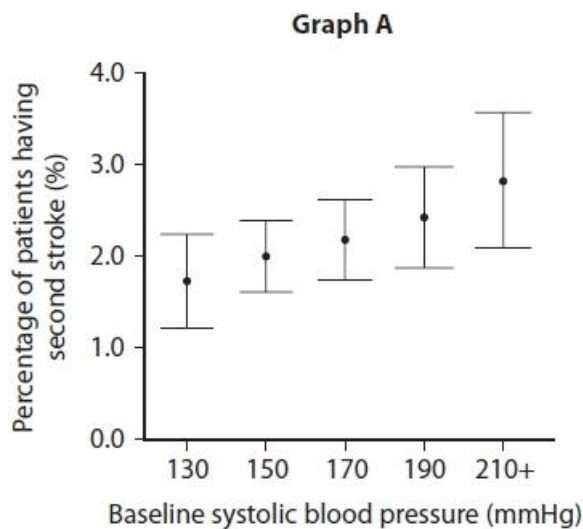# Edexcel Biology A-level - Data Collection and Analysis

Questions

Q1.

*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).
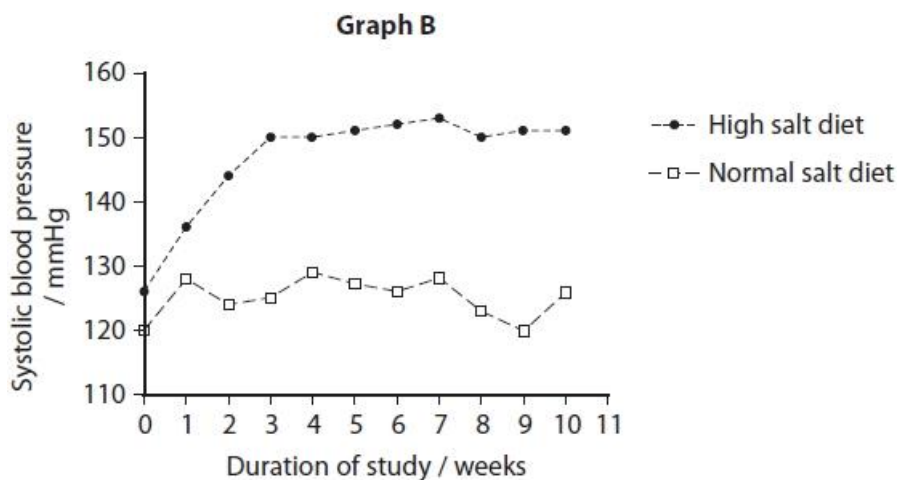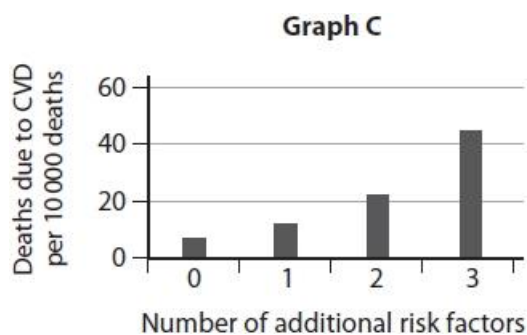
Graph C

Edexcel Biology A-level - Data Collection and Analysis

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.

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(Total for question = 6 marks)

Q2.

The food we eat contains carbohydrates, lipids and proteins.

Carbohydrates, lipids and proteins can be used as sources of energy.

The table shows the average daily energy requirements for boys and girls aged 13 to 18.

Age / years	Daily energy requirement / kJ	
	Boys	Girls
13	10090	9292
14	10989	9789
15	11787	9990
16	12389	10090
17	12886	10291
18	13187	10291

(i) Calculate the percentage increase in the average daily energy requirements for boys aged 17 compared with their energy requirements aged 13.

(2)

Answer .... %

(ii) Many foods are labelled in kilocalories (kcal). One calorie is equal to 4.18 joules.

Which of the following is the average energy requirements for girls aged 13 in kilocalories (kcal)?

(1)

☒ **A**   2.223 kcal
☒ **B**   222.3 kcal
☒ **C**   2223 kcal
☒ **D**   2 223 000 kcal

(iii) State what will happen to the additional energy if an individual takes in more energy than is required.

(1)

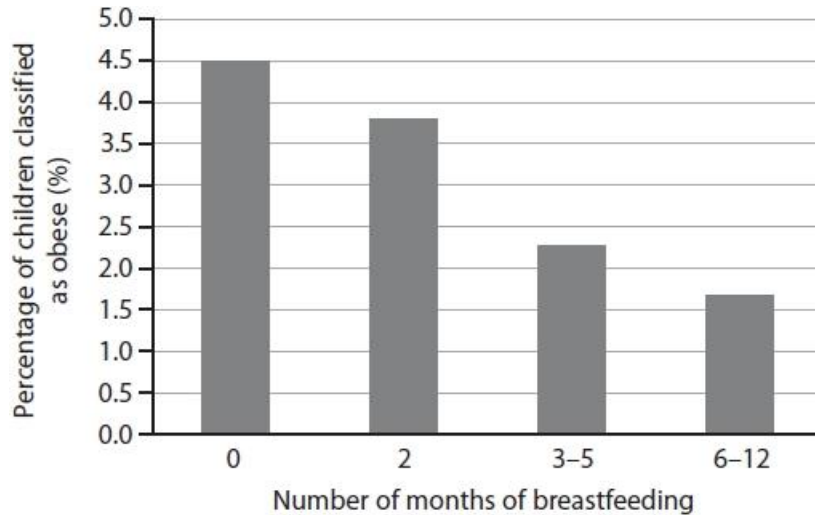...

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(Total for question = 4 marks)

Q3.

The development of childhood obesity is affected by many factors.

Breastfeeding can affect the development of childhood obesity.

The graph shows the relationship between obesity in six-year-old children and the number of months that they were breastfed as babies.

(i) Describe the relationship between the number of months of breastfeeding and childhood obesity.

(2)

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(ii) A six-year-old child can be classified as obese based on their body mass index (BMI) being over 19 kg m^{-2}.

BMI is calculated using the following formula.

$$\text{Body mass index (BMI)} = \frac{\text{body mass}}{\text{height}^2}$$

A six-year-old child is 115 cm tall with a BMI of 20.
Calculate the mass of this child to one decimal place.

(2)

Answer ....
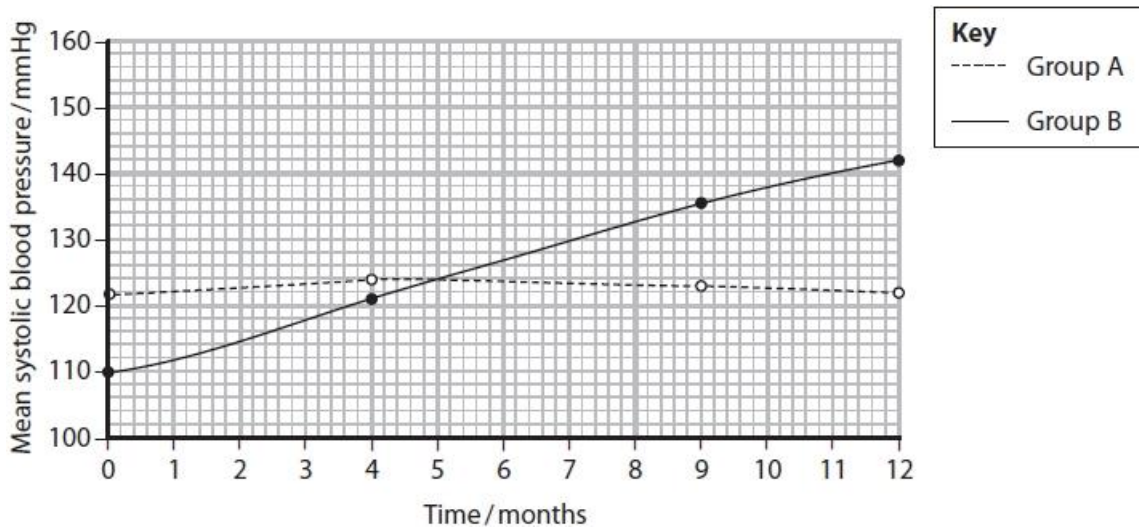
(Total for question = 4 marks)

Q4.

The effect of salt in the diet on blood pressure was investigated.

This investigation involved 15 males and 5 females, all between 20 and 30 years old. They were split into two groups, A and B, each of 10 people.

Group A had a diet containing 3 g of salt per day. Group B had a diet containing 9 g of salt per day.

The systolic blood pressures, measured in mmHg, were recorded during one year.

The results are shown in the graph.

Explain how the validity of this investigation could be improved.

(3)

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(Total for question = 3 marks)

Q5.

The incidence of obesity is increasing in some populations.

High levels of sugars, such as fructose, in processed food could be contributing to this increase.

Explain why high levels of sugars in a person's diet could lead to obesity.

(3)

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(Total for question = 3 marks)

Q6.

Studies have provided evidence for a link between heart rate when a person is at rest and various medical conditions.

In one study, the relationships between resting heart rate and the percentage incidence of coronary heart disease and cancer were investigated.

The results are shown in the table.

Range of resting heart rate / beats per min	Number of individuals in each range	Percentage incidence of condition (%)	
		Coronary heart disease	Cancer
< 59	961	4.2	1.0
60–69	2277	6.0	1.5
70–79	2120	7.5	2.0
80–89	1202	8.0	2.5
90–99	576	8.2	4.0
> 99	379	7.9	3.8

(i) Comment on the evidence for a link between resting heart rate and the percentage incidence of coronary heart disease and cancer.

(5)

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(ii) Give two reasons why there were different numbers of people in each resting heart rate group.

(2)

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(iii) Give two reasons why the number of people in each resting heart rate group did not affect the validity of this investigation.

(2)

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(Total for question = 9 marks)

Q7.

Cardiovascular disease (CVD) is a major cause of death and disability in the UK.

The relationship between magnesium ions in the diet and CVD has been studied.

In one study, magnesium ions were added to the diets of a group of men. The effect of this on the relative risk of CVD was recorded.

The mean normal dietary intake of magnesium ions is 269 mg day^{-1}.

The results of the study are shown in the graph.
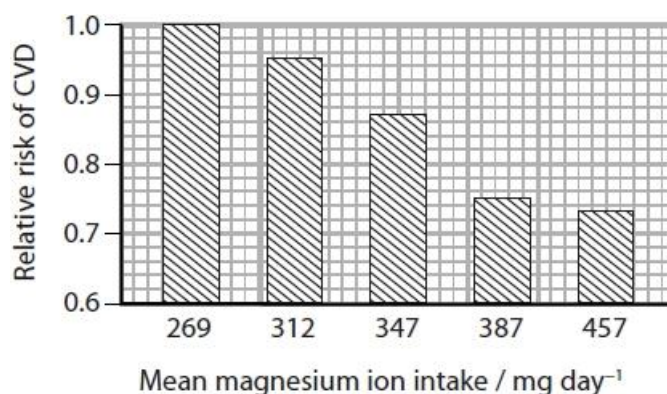
(i) Which of the following statements can be made about the relationship between an increased magnesium ion intake and the risk of CVD in this study?

(1)

An increased magnesium ion intake

☒ **A**   causes an increase in CVD

☒ **B**   causes a reduction in CVD

☒ **C**   is correlated with an increase in CVD

☒ **D**   is correlated with a reduction in CVD

(ii) What is the daily increase in magnesium ion intake that reduces the relative risk of CVD by 0.13?

(1)

☒ **A**   43 mg day^{-1}

☒ **B**   78 mg day^{-1}

☒ **C**   118 mg day^{-1}

☒ **D**   347 mg day^{-1}

(Total for question = 2 marks)

Q8.

Scientists studied how perception of risk differs from the actual risk.

People were asked to estimate their risk of developing cardiovascular disease (CVD) during their lifetime.

This gave their perceived risk.

The scientists used information gathered from questionnaires and various tests to calculate a predicted actual risk of developing CVD, for each person.

The table shows how the perceived risk given by each person was compared with the predicted actual risk calculated by the scientists.

Underestimation of lifetime risk for CVD	Correct estimation of lifetime risk for CVD	Overestimation of lifetime risk for CVD
Perceived risk < predicted actual risk	Perceived risk = predicted actual risk	Perceived risk > predicted actual risk

Explain how blood tests and obesity indicators can be used to collect data to predict the risk of developing CVD.

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(Total for question = 4 marks)

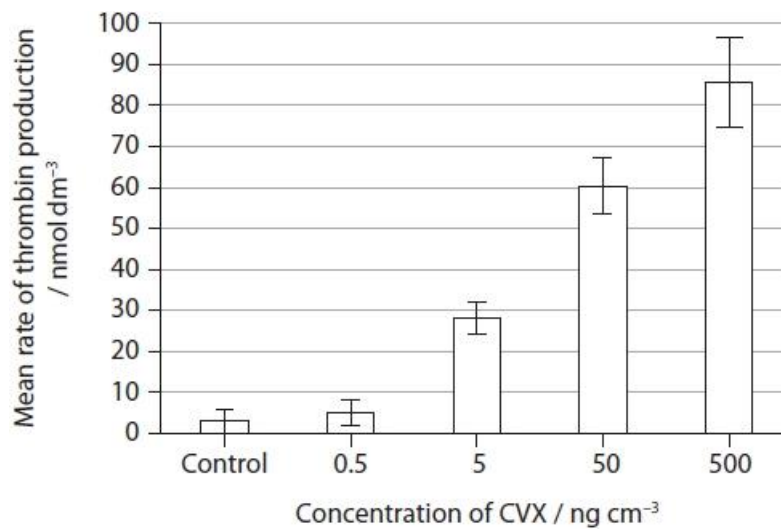# Edexcel Biology A-level - Data Collection and Analysis

Q9.

The graph shows the effect of additional risk factors on deaths due to CVD for people with and without diabetes.
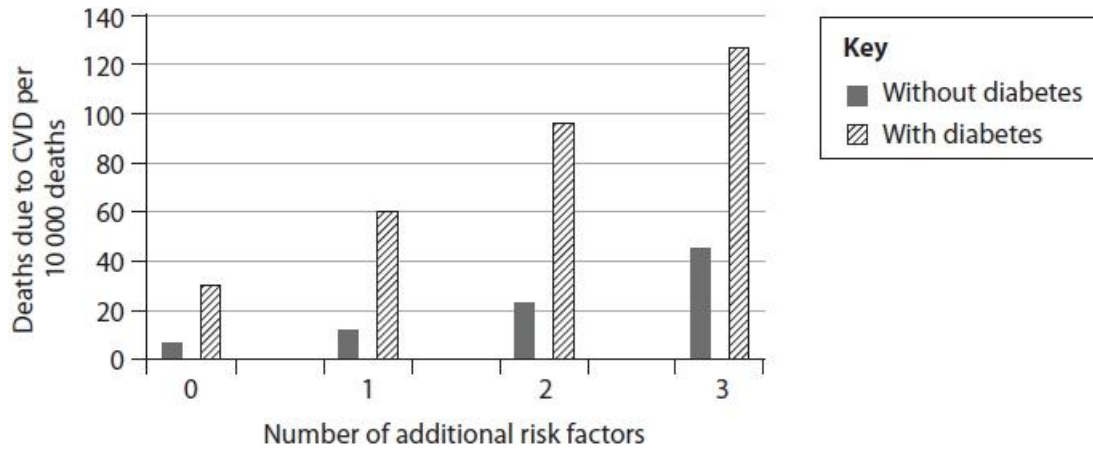
Identify the effect of the number of additional risk factors on deaths due to CVD for people with and without diabetes.

(2)

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(Total for question = 2 marks)

Edexcel Biology A-level - Data Collection and Analysis

Q10.

Cardiovascular disease (CVD) is a major cause of death.

Obesity and high blood pressure are two risk factors for CVD.

One way of determining if a person is obese is to calculate their body mass index (BMI).

BMI is calculated using the following formula.

$$\text{Body mass index (BMI)} = \frac{\text{mass (kg)}}{\text{height (m)}^2}$$

The graph shows the relationship between BMI and the relative risk of developing CVD.
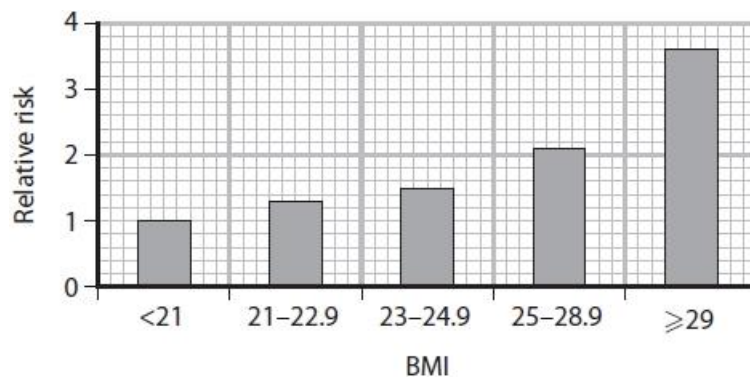
(i) Determine the relative risk of developing CVD for a person with a height of 1.54 m and a mass of 61 kg.

(2)

Answer ....

(ii) State another method that could be used to determine if a person is obese.

(1)

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(iii) Describe how high blood pressure could be reduced by medication and lifestyle changes.

(3)

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(Total for question = 6 marks)

Edexcel Biology A-level - Data Collection and Analysis

Q11.

The effect of salt in the diet on blood pressure was investigated.

This investigation involved 15 males and 5 females, all between 20 and 30 years old. They were split into two groups, A and B, each of 10 people.

Group A had a diet containing 3 g of salt per day. Group B had a diet containing 9 g of salt per day.

The systolic blood pressures, measured in mmHg, were recorded during one year.

The results are shown in the graph.

(i) Determine the effects of salt in the diet on systolic blood pressure in this investigation.

(3)

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(ii) Explain the effect that a diet high in salt could have on a person's risk of developing cardiovascular disease.

(5)

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(Total for question = 8 marks)

Q12.

Caffeine is a stimulant found in coffee.

The effect of different types of coffee on blood pressure was investigated.
Decaffeinated coffee has most of the caffeine removed.

Four groups of volunteers had their blood pressure measured before having a drink and again 30 minutes later.

The results of this investigation are shown in the table.

Drink provided to volunteers	Mean systolic blood pressure / mm Hg	
	Before the drink	30 minutes later
Water	115	119
Decaffeinated coffee	120	118
Regular coffee	106	118

(i) Calculate the percentage increase in the mean systolic blood pressure after drinking regular coffee.

(1)

.... %

(ii) *Daphnia* can be used to investigate the effects of caffeine on heart rate.

Devise a procedure to compare the effects of decaffeinated coffee and regular coffee on the heart rate of *Daphnia*.

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(Total for question = 5 marks)

Q13.
The photograph shows the tropical rattlesnake, *Crotalus durissus terrificus.*

This snake produces a toxin called convulxin (CVX), which activates platelets leading to blood clotting.

The effect of four different concentrations of CVX on thrombin production was investigated.

The graph shows the results of this investigation, with bars showing the standard deviation.

Analyse the data to assess the effect of CVX on the rate of blood clotting.

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(Total for question = 5 marks)

Q14.

Fibrin is involved in the formation of blood clots.

Thrombin is an enzyme that converts fibrinogen to fibrin.

The graph shows the effect of one concentration of thrombin on the conversion of fibrinogen to fibrin.
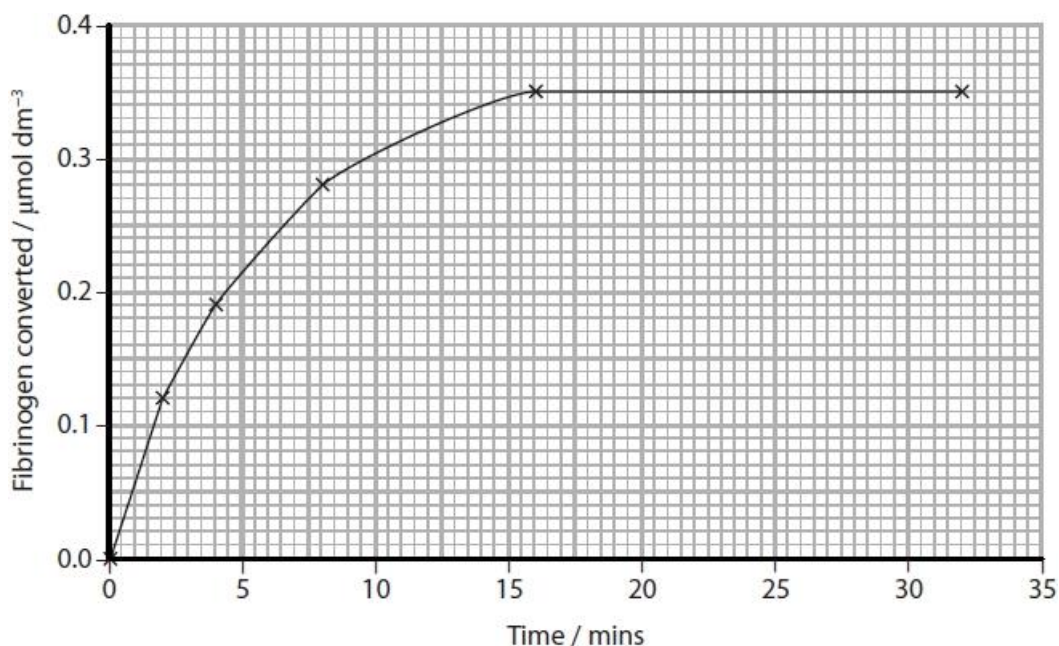
(i) Calculate the initial rate of reaction.

(2)

Answer ....

(ii) On the graph, draw a line to show the effect of halving the concentration of thrombin.

(1)

(iii) Explain the effect of changes in the initial rate of reaction on the time taken for a blood clot to form.

(2)

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(Total for question = 5 marks)

Q15.

Fibrin is involved in the formation of blood clots.

Thrombin is an enzyme that converts fibrinogen to fibrin.

The table shows the results of an investigation into the fibrinogen concentrations in the blood of males and females with and without cardiovascular disease (CVD).

	Mean fibrinogen concentration / mg 100 cm^{-3}	
	With CVD	**Without CVD**
Males	333 ± 5.16	322 ± 2.00
Females	336 ± 7.25	319 ± 1.89

(i) Explain how the results of this investigation could be used to identify individuals at risk of CVD.

(3)

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(ii) Explain how changes in fibrinogen concentration might be a risk factor for CVD.

(3)

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(Total for question = 6 marks)

Q16.

*Blood plasma contains many different proteins. Prothrombin is a plasma protein that is involved in the blood clotting process.

Mutations in the gene coding for the prothrombin protein have been identified.

These mutations have resulted in different forms of prothrombin being produced.

The diagram shows the same part of the genetic sequence for prothrombin A and prothrombin B.

Prothrombin A:

TCC CAA TAA AAG TGA CTC TCA GCG AGC

Prothrombin B:

TCC CAA TAA AAG TGA CTC TCA GAG AGC

Prothrombin A and prothrombin B were used in an investigation into blood clotting.

A sample of blood had all of the prothrombin removed.

Equal volumes of this blood were poured into test tubes.

Each test tube of blood received a different concentration of prothrombin A.

The volume of prothrombin A was the same in each tube.

The time taken for the blood to clot in each tube was measured.

The investigation was repeated with different concentrations of prothrombin B.

The results are shown in the graph.
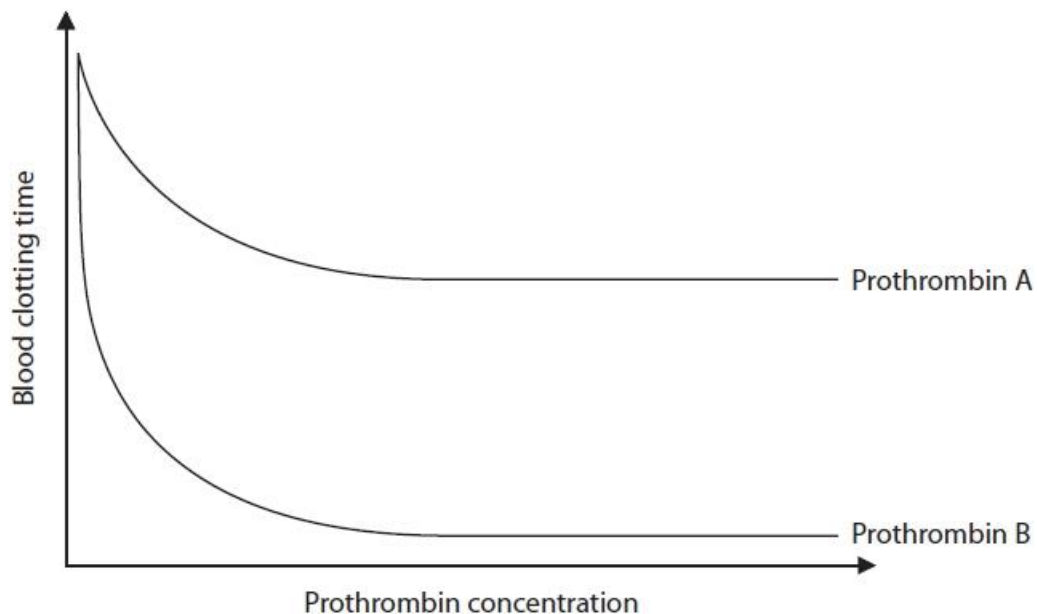
Explain the results of this investigation.

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(Total for question = 6 marks)

Edexcel Biology A-level - Data Collection and Analysis

Mark Scheme

Q1.

Question Number	Answer
	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)

Edexcel Biology A-level - Data Collection and Analysis

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

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct numbers from table used to calculate increase (1) • correct answer (1)	Example of calculation 12886-10090 or 2796 (Answer / 10090)*100 = 27.71(%) / 27.7(%) / 28(%) Correct answer without working gains full marks	(2)

Question Number	Answer	Mark
(ii)	**The only correct answer is C - 2223 kcal** *A is not correct because the decimal place is in the wrong place as they have not taken into account converting kJ to joules or calories to kcal.* *B is not correct because the decimal place is in the wrong place as they have not taken into account converting kJ to joules or calories to kcal.* *D is not correct because they have not taken into account converting kJ to joules or calories to kcal.*	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to the following: • stored as {glycogen / fat / lipids} (in body cells) (1)	Answer must be in context of energy	(1)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	A description that makes reference to two of the following: • increasing the number of months of breast feeding decreases the percentage of children with obesity (1) • large drop in obesity when children are breastfed for {3-5 months / more than 2 months} (1)	ALLOW the number of children with obesity decreases as the time they were breastfed increases	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	• values correctly substituted into rearranged equation (1) • correct answer with unit (1)	20×1.15^2 26.5 kg ALLOW 26.45 kg for one mark Correct answer with no working gains full marks	(2)

Edexcel Biology A-level - Data Collection and Analysis

Q4.

Question Number	Answer	Additional Guidance	Mark
	An explanation which includes reference to the following: • equal numbers of males and females (1) • larger sample size (1) • named suitable controlled variable (1)	e.g. same starting blood pressure / body mass / diet / exercise level	(3)

Q5.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to three of the following: • energy intake higher than energy output (1) • (excess) {energy / sugars} can be {stored as / converted to} fat (1) • leading to weight gain (greater than overweight) (1) • obesity as indicated by a {BMI above 30 / waist-hip ratio greater than 0.85 in women or 1.0 for men} (1)	ALLOW correct description of energy imbalance ALLOW increase in body mass	(3)

Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • as heart rate increases, so does incidence of {both conditions / CHD and cancer } **(1)** • relationship between heart rate and CHD quantified **(1)** • relationship between heart rate and cancer quantified **(1)** • greater increase in incidence of cancer with increased heart rate **(1)** • at a heart rate >99bpm there is a reduction in incidence of both conditions / plateaus / little difference **(1)**	ALLOW converse e.g. 1.95x increase up to 99 bpm / 1.88x increase at >99 e.g. 4.0x increase up to 99 bpm / 3.8x increase at >99 ALLOW converse	**(5)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer that makes reference to the following: • mid heart beat rate is more common in the (general) population / heart rate is normally distributed in the population **(1)** • fewer people available at low and high heart rate because of other health risks **(1)**	ALLOW high and low heart rates are less common	**(2)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An answer that makes reference to two of the following: • still (statistically) a large sample size **(1)** • wide range of heart rates considered **(1)** • percentage incidence used (rather than number) **(1)**		**(2)**

Q7.

Question Number	Answer	Mark
(i)	D – is correlated with a reduction in CVD *The only correct answer is* **D** **A** *is not correct because the incidence of CVD decreases with increasing magnesium ion intake and it is not possible to infer causation from the data* **B** *is not correct because it is not possible to infer causation from the data in graph* **C** *is not correct because the incidence of CVD decreases with increasing magnesium ion intake*	**(1)**

Question Number	Answer	Mark
(ii)	B – 78 mg day^{-1} *The only correct answer is* **B** **A** *is not correct because 43 is the increase required to achieve a 0.05 reduction in relative risk* **C** *is not correct because 118 is the Mg^{2+} intake that is associated with a 0.25 reduction in relative risk* **D** *is not correct because 347 is the correct column chosen with no subtraction*	**(1)**

Q8.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • blood test to measure {HDL and LDL / cholesterol} levels (1) • higher HDL:LDL decreases risk / high cholesterol increases risk (1) • measurement of {height and mass / waist and hip size} / calculation of {BMI / waist:hip} (1) • {BMI above 30 / waist:hip above 1} increases risk (1)	ALLOW correct BMI formula	**(4)**

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer which makes reference to the following: • correlation between the number of risk factors and deaths due to CVD (1) • (deaths due to CVD) is higher for diabetics than non-diabetics (1)	 Allow converse	 **(2)**

Q10.

Question Number	Answer	Additional guidance	Mark
(i)	 • correct BMI calculated (1) • correct risk determined from graph (1)	Example of calculation $(61 \div 1.54^2) = 25.72$ Relative risk = 2.1 Correct risk with no working scores full marks	 (2)

Question Number	Answer	Additional guidance	Mark
(ii)	• waist to hip ratio / waist:hip		(1)

Question Number	Answer	Additional guidance	Mark
(iii)	A description which makes reference to the following: • treatment with antihypertensive medication (1) plus any two relevant lifestyle changes: • reduce salt intake (1) • stop smoking (1) • increase exercise (1) • reduce weight (1)	ALLOW named example e.g. ACE inhibitor/ calcium channel blocker / diuretic / beta blocker	 (3)

Q11.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer which makes reference to the following: • {no increase / little change } in blood pressure for {low salt diet / 3g salt / group A} (1) • {high salt diet / 9g salt / group B }increased blood pressure (1) • data manipulation to show how much blood pressure increased by (1)	e.g. an overall increase for B of 32 mmHg / 20 mmHg higher than A / 29% increase for B / at 4 months group A is 2.5% higher	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation which makes reference to five of the following: • (diet high in salt) increases risk of CVD (1) • (high salt intake causes) higher blood pressure (1) • (which increases risk of) { damage to endothelium of artery / atherosclerosis } (1) • (therefore increases risk of) inflammatory response (1) • (leading to increased risk of) { atheroma / plaque formation } (1) • narrowing of arteries { increases risk of blood clots / increases blood pressure / reduces blood flow to cardiac muscle } (1)	ALLOW increases risk of heart attack / stroke	(5)

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct value for percentage increase	11.3 / 11.32 (%)	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	An answer that makes reference to four of the following		
	• details of the procedure (1)	e.g. use of a microscope / method ofcounting / allowing acclimatisation	
	• record heartbeat before and after placing in regular ordecaffeinated coffee (1)	ALLOW ref to heartbeat for *Daphnia* inwater and coffee	
	• controlled variable for the coffee (1)	e.g. concentration or volume	
	• reference to controlled variables (1)	e.g. temperature / length of time tocount heartbeat / same species	(4)
	• use of a suitable statistical test to compare the results (1)		

Edexcel Biology A-level - Data Collection and Analysis

Q13.

Question Number	Answer	Additional Guidance	Mark
	An answer which makes reference to five of the following: • increased thrombin production as CVX concentration increases (1) • the relationship between CVX concentration and rate of thrombin production is not { directly proportional / linear } (1) • little difference between control and 0.5 ng cm^{-3} (CVX) / greatest increase from 5ng cm^{-3} to 50 ng cm^{-3} (1) • { no significant difference / standard deviations overlap } between the control and 0.5 (1) • greater thrombin production leads to { faster / increased } conversion of fibrinogen to fibrin (1) • greater thrombin production leads to { faster / increased } clotting of blood (1)	Allow control and 0.5 ng cm^{-3} are similar **ACCEPT** reference to bars instead of standard deviation	(5)

Q14.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct values taken from the graph (1) • correct answer with correct units (1)	Example of calculation 0.12 ÷ 2 = = 0.06 µmol dm^{-3} min^{-1} = 0.06 µmol per dm^3 per minute or = 0.001 µmol dm^{-3} s^{-1} = 0.001 µmol per dm^3 per second Correct answer with no units gains one mark Correct answer with correct units but no working gains full marks	2

Question Number	Answer	Additional Guidance	Mark
(ii)	• curve that is less steep but reaches the same plateau (1)	e.g.	1

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • the slower the initial rate of reaction the longer it will take for a clot to form (1) • because fibrin will be produced more slowly (1)	Allow converse arguments	2

Q15.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • fibrinogen concentration is higher in individuals with CVD (1) • compare an individual's fibrinogen concentration with values in the table (1) • no overlap between fibrinogen concentrations for those with CVD compared with those without CVD (1)	 ALLOW females above 321and males above 324 or females above 328 and males above 329 are identified as being at risk ALLOW values above mean without CVD + SD or mean with CVD −SD identified as at risk	3

Edexcel Biology A-level - Data Collection and Analysis

Question Number	Acceptable answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to the following: • increased concentrations of fibrinogen leading to increased fibrin (1) • increase the risk of blood clotting / more frequent and extensive clotting (1) • blocking lumen of {arteries / capillaries} (1)		3

Q16.

Question Number	Answer
*	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 • as prothrombin concentration increases clotting time decreases • prothrombin B results in a faster clotting time / converse

Evidence for linkages made
- greater the concentration of prothrombin the greater the concentration of thrombin produced

- greater the conc of thrombin the faster the conversion of fibrinogen into fibrin

- fibrin traps {red blood cells / platelets} to form blood clot
- substitution mutation
- only one codon affected
- only one amino acid affected
- prothrombin will have a slightly different shape / charge

Evidence for sustained scientific reasoning
- prothrombin will have a slightly different shape / charge which means it will form an enzyme-substrate complex more easily

- change in one amino acid means more enzyme -{substrate/prothrombin B} complexes can be made per unit time

- (as prothrombin concentration increases clotting time decreases) up to a certain point where something else is a limiting factor

- reference to a suitable limiting factor e.g. enzyme which converts prothrombin to thrombin

(6)

Edexcel Biology A-level - Data Collection and Analysis

			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.	just describing what graph shows
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.	all level 1 plus some linkage ideas
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.	all level 2 plus some sustained ideas