

Please check the examination details below before entering your candidate information

Candidate surname <i>StemUp Model Solution</i>		Other names	
Pearson Edexcel Level 3 GCE		Centre Number 	Candidate Number
Thursday 13 June 2019			
Morning (Time: 2 hours)		Paper Reference 9BN0/02	
Biology A (Salters Nuffield) Advanced Paper 2: Energy, Exercise and Coordination			
You must have: Calculator, HB pencil, ruler			Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 100.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- You may use a scientific calculator.
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

P56697A

©2019 Pearson Education Ltd.

1/1/1/1/1/



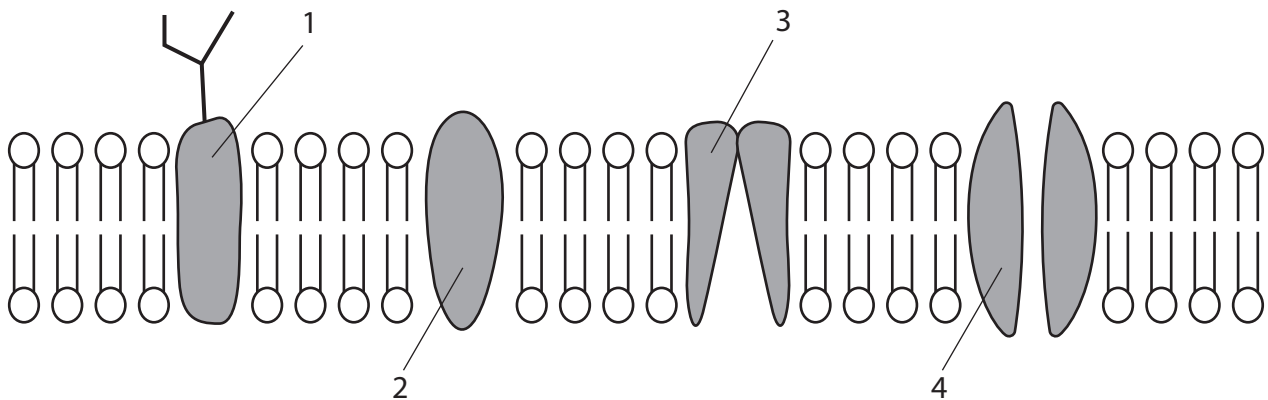
Answer ALL questions.

Write your answers in the spaces provided.

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

1 The structure of the cell surface membrane can be described by the fluid mosaic model.

(a) The diagram shows the fluid mosaic model of the cell surface membrane.



(i) Which of the shaded structures transport charged molecules or ions across the membrane?

(1)

- ☐ A 1 and 2 only
- ☒ B 3 and 4 only
- ☐ C 1, 2 and 3 only
- ☐ D 1, 2, 3 and 4

(ii) Which of the shaded structures contain both hydrophilic regions and hydrophobic regions?

(1)

- ☐ A 1 and 2 only
- ☐ B 3 and 4 only
- ☐ C 1, 2 and 3 only
- ☒ D 1, 2, 3 and 4

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



- (iii) A student measured the width of the phospholipid bilayer shown on the diagram as 2.5 cm. The actual size of this bilayer is 5 nm.

What is the approximate magnification of the diagram?

(1)

- ☐ A $\times 5000$
☐ B $\times 50\,000$
☐ C $\times 500\,000$
☒ D $\times 5\,000\,000$

- (b) Explain why the phospholipids are arranged in two layers in a cell surface membrane.

(3)

Each phospholipid has a hydrophilic phosphate head and two hydrophobic fatty acid tails.

The hydrophilic heads are orientated towards the water and the hydrophobic tails point away from the water, into the middle of the bilayer.

Two layers are needed because there is an aqueous (water-based) solution on both sides of the membrane, e.g. tissue fluid outside the cell and cytoplasm inside, so one layer of heads faces each solution.

(Total for Question 1 = 6 marks)



2 There are various ways to scan the brain.

- (a) (i) Brain tumours are dense masses of cells. The presence of brain tumours can be detected using several types of scanning method.

The table shows two types of scan. Place a tick [✓] in the box if the scan can identify the size and location of a large brain tumour or a cross [✗] in the box if the scan cannot identify the size and location of a large brain tumour.

(2)

Type of scan	Can be used to identify the tumour
CT	✓
MRI	✓

- (ii) Functional MRI (fMRI) measures brain activity by detecting changes in

(1)

- ☒ **A** blood flow
☐ **B** bone density
☐ **C** dopamine release
☐ **D** lactic acid production

- (iii) Which of the following types of scanner uses X-rays?

(1)

- ☒ **A** CT
☐ **B** fMRI
☐ **C** MRI
☐ **D** PET



(b) Describe how positron emission tomography (PET) scans can be used to investigate brain structure.

(2)

A radioactive tracer (e.g. radioactively labelled glucose) is injected and is taken up by the brain tissue.

The scanner detects the emission of positrons (gamma rays produced) and builds up a 3D image of the brain.

(Total for Question 2 = 6 marks)



3 Cystic fibrosis is a genetically inherited condition.

A couple who are both carriers for the condition have a 25% chance of having a baby with cystic fibrosis. In the UK, 1 in 2500 babies born have cystic fibrosis.

- (a) Use the Hardy-Weinberg equation to calculate the probability of babies born in the UK being carriers for cystic fibrosis.

(3)

$$p^2 + 2pq + q^2 = 1 \quad \text{and} \quad p + q = 1$$

$$q^2 = 1 \div 2500 = 0.0004$$

$$q = \sqrt{0.0004} = 0.020$$

$$p = 1 - 0.020 = 0.980$$

$$\text{carriers} = 2pq = 2 \times 0.980 \times 0.020 = 0.0392$$

Answer 0.0392 (3.92%)



(b) Cystic fibrosis can be caused by a number of different mutations in the CFTR gene.

- (i) A gene contains a number of base pairs. Of the base pairs in this gene, 50% are adenine and thymine.

Q = the number of base pairs in this gene.

Which of the following shows the total number of hydrogen bonds (H bonds) present in this gene?

(1)

- ☐ A $2.0 \times Q$
- ☒ B $2.5 \times Q$
- ☐ C $4.0 \times Q$
- ☐ D $5.0 \times Q$

- (ii) Explain why different mutations in the CFTR gene can lead to differences in the severity of the symptoms of cystic fibrosis.

(2)

Different mutations have different effects on the CFTR protein produced: some cause no protein at all, others a protein with a different folding (tertiary structure) or shape. So chloride ion transport is affected to a different extent, and the mucus varies in how sticky and thick it is, so symptoms differ in severity.

(Total for Question 3 = 6 marks)



4 A moderate amount of exercise is considered good for the human body.

- (a) A student carried out 20 minutes of physical exercise. During this time, her heart rate and level of sweating increased.

Shortly after completing the exercise, the student noted that her heart rate and level of sweating decreased.

- (i) Explain the role of the brain in reducing the student's heart rate after the exercise. (2)

Chemoreceptors detect the decrease in carbon dioxide concentration (rise in blood pH)

and send impulses to the cardiovascular control centre in the medulla.

The cardiovascular control centre sends impulses along the parasympathetic (vagus) nerve to the SAN, reducing heart rate.

- (ii) Describe how the brain reduces the activity of the sweat glands after the exercise. (2)

Thermoreceptors detect a decrease in (core blood) temperature.

The hypothalamus (thermoregulatory centre) then sends fewer impulses to the sweat glands, so less sweat is produced.



(b) Explain why too much exercise could be harmful to the human body.

(3)

Too much exercise causes wear and tear of joints, cartilage, tendons and ligaments, leading to joint damage, e.g. arthritis or a torn ligament.

It also suppresses the immune system, e.g. fewer T cells and reduced antibody production, so there is an increased risk of infection such as upper respiratory tract infections, colds or influenza.

(Total for Question 4 = 7 marks)



5 Muscle fibres contain a number of proteins, including actin, myosin and collagen.

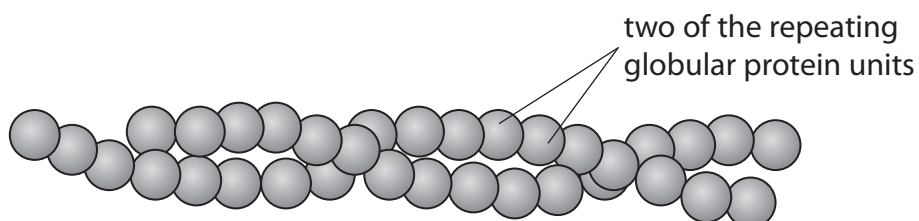
(a) The myosin binding site is found on

(1)

- ☒ A actin
- ☐ B sarcoplasmic reticulum
- ☐ C tropomyosin
- ☐ D troponin

(b) Actin and collagen are both proteins.

The diagram shows two filaments of actin from a muscle fibre. Each filament is a polymer of repeating globular protein units.



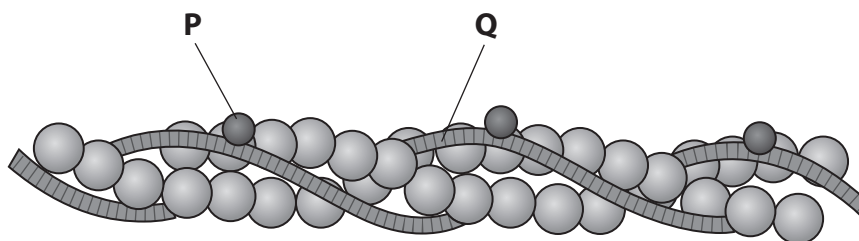
Compare and contrast the structures of an actin filament and collagen.

(3)

Similarities: both are made of a sequence of amino acids joined together by peptide bonds, and both have a secondary structure. Both also have more than one polypeptide chain (a quaternary structure).

Differences: only actin has a tertiary structure (globular units), whereas collagen is fibrous. Collagen has three chains wound together, whereas an actin filament has one chain of globular units.

(c) The diagram shows actin and other components (P and Q) of a thin filament in a myofibril.



(i) Describe the interaction between P and Q that allows muscle contraction.

(2)

Calcium ions bind to P (troponin), which changes shape.

This pulls Q (tropomyosin) away from the myosin binding sites on actin, so myosin heads can bind.

(ii) The thick filament in a myofibril contains myosin. The myosin head contains the enzyme ATPase.

Explain the importance of the primary structure for the functioning of this enzyme.

(3)

The primary structure (sequence of amino acids) determines the interactions between the R groups, e.g. hydrogen, ionic and disulfide bonds.

This determines how the chain folds into its tertiary structure (3D shape), and therefore the shape of the active site.

The active site must be complementary to ATP so that ATP fits and can be hydrolysed.

(Total for Question 5 = 9 marks)



DO NOT WRITE IN THIS AREA

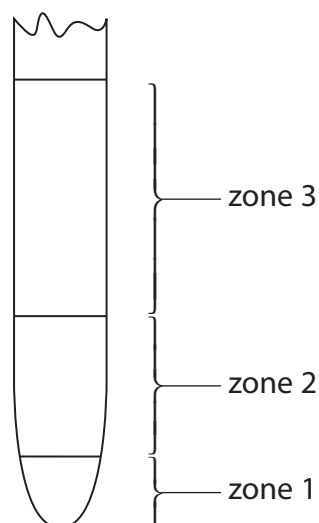
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



- 6 The diagram shows three different zones found in a plant root.



- (a) Cells in zone 1 carry out interphase, mitosis and cytokinesis.

A student stated the hypothesis that:

In zone 1, the percentage of cells carrying out mitosis decreases from the tip to the start of zone 2.

- (i) Which one of the following would be the correct null hypothesis?

(1)

- ☐ A the percentage of cells carrying out mitosis increases from the tip to the start of zone 2
- ☐ B the percentage of cells in interphase decreases from the tip to the start of zone 2
- ☒ C there is no change in the percentage of cells carrying out mitosis from the tip to the start of zone 2
- ☐ D there is no change in the percentage of cells in interphase from the tip to the start of zone 2



(ii) Devise an investigation to test this hypothesis.

(5)

Take samples from different regions of zone 1, e.g. at the tip, in the middle and at the start of zone 2.

Make a root tip squash: put the tip in hydrochloric acid to macerate it, rinse, then squash under a coverslip to produce a single layer of cells.

Stain with an appropriate stain, e.g. toluidine blue or acetic orcein, to make the chromosomes visible.

In each region count the number of cells with visible chromosomes (in mitosis) and the total number of cells in the field of view, and calculate the mitotic index = $\frac{\text{cells in mitosis}}{\text{total cells}} \times 100$. Repeat for several fields and roots.

Use a statistical test, e.g. Spearman's rank correlation (distance from tip against % mitosis) or a Student's *t* test between two regions.

Compare the calculated value to the critical value at $p = 0.05$ to accept or reject the null hypothesis.

(b) In zone 2, the plant cells elongate due to a change in their cellulose cell walls.

(i) Cellulose and amylopectin are polymers of hexose sugars.

State one difference between the hexose in cellulose and the hexose in amylopectin.

(1)

Amylopectin contains alpha glucose, cellulose contains beta glucose (H and OH reversed on carbon 1).

(ii) The cellulose molecules form microfibrils.

Name the bond between adjacent cellulose molecules in a cellulose microfibril.

(1)

Hydrogen bonds

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA



(c) In zone 3, some of the cells differentiate to give rise to phloem sieve tube elements and others differentiate into phloem companion cells.

- (i) Explain how genetically identical cells in zone 3 can differentiate to give rise to different tissues.

(3)

Different stimuli (e.g. chemical signals or transcription factors) act on different cells.

This results in different genes being activated (switched on) or deactivated, so different genes are transcribed and expressed.

So different proteins are made, and these proteins determine the structure and function of the cells, e.g. sieve tube element or companion cell.

- (ii) The student also hypothesised that the cells in zone 1 would be smaller in size than the cells that had differentiated into xylem vessels in zone 3.

The student prepared microscope slides of sections from zones 1 and 3.

Explain how the student could compare the sizes of cells in zone 1 with the sizes of xylem vessels in zone 3.

(3)

Identify the xylem vessels as hollow, thick-walled cells lacking cytoplasm, e.g. stained with phloroglucinol or toluidine blue to show the lignin.

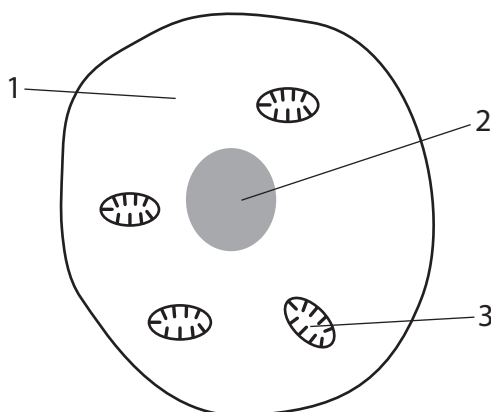
Calibrate an eyepiece graticule with a stage micrometer and use it to measure the length and width of several cells from each zone, then calculate and compare the means.

Actual size = image size $\div$ magnification.

(Total for Question 6 = 14 marks)



7 (a) The diagram shows some of the features of a human liver cell.



(i) Which of the labelled features in the liver cell contain RNA?

(1)

- ☐ A 1 only
- ☐ B 1 and 3 only
- ☐ C 2 and 3 only
- ☒ D 1, 2 and 3

(ii) Cells produce lactate during anaerobic respiration. Lactate travels in the blood to the liver.

Liver cells can absorb lactate from the blood.

Deduce what happens to the lactate in these cells.

(2)

The lactate is oxidised to form pyruvate, which is converted to glucose (and stored as glycogen).

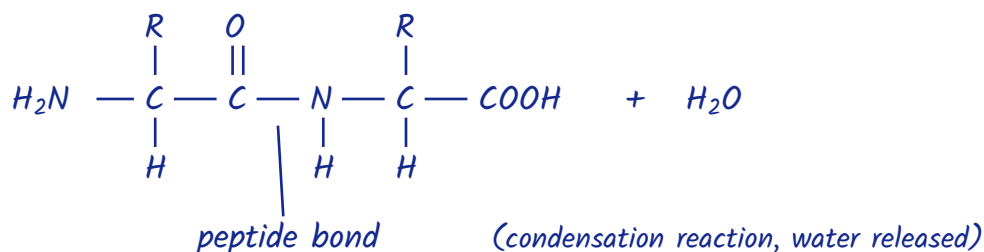
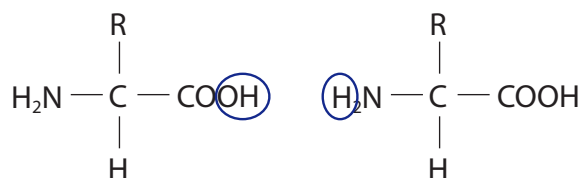
The pyruvate or glucose can then be used in respiration, e.g. pyruvate enters the link reaction.

(iii) During protein synthesis, two amino acids are joined together to form a dipeptide.

The diagram shows two identical amino acids.

Complete the diagram to show how the dipeptide is formed from these two amino acids.

(2)



(b) Explain why the liver is an organ and not a tissue.

(2)

The liver is made up of many different tissues, e.g. epithelial, connective and blood tissue, which work together to carry out several functions, e.g. detoxification, glycogen storage and making bile.



(c) Each liver cell carries out respiration.

During respiration, ATP is formed and broken down.

(i) During which of the following processes is ATP formed?

(1)

- ☐ A glycolysis and the electron transport chain only
- ☐ B glycolysis and the Krebs cycle only
- ☒ C glycolysis, the Krebs cycle and the electron transport chain only
- ☐ D glycolysis, the link reaction, the Krebs cycle and the electron transport chain

(ii) Explain why some ATP is broken down during glycolysis.

(2)

ATP is hydrolysed to donate phosphate to (phosphorylate) the glucose, forming hexose biphosphate.

This supplies energy to activate the glucose (make it more reactive) so it can split into two phosphorylated 3-carbon compounds (triose phosphate).

(iii) The electron transport chain occurs in the cristae of mitochondria. The electron transport chain involves a number of carrier molecules.

Explain the role of these carrier molecules in the electron transport chain.

(3)

The carriers receive hydrogen from reduced NAD and reduced FAD, so these are oxidised (and can be reused).

The hydrogen is split into protons (H^+) and electrons; the electrons are transferred along the carriers by a series of redox reactions.

The energy released is used to pump protons (H^+) into the intermembrane space, forming a gradient used to make ATP.

(Total for Question 7 = 13 marks)



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE



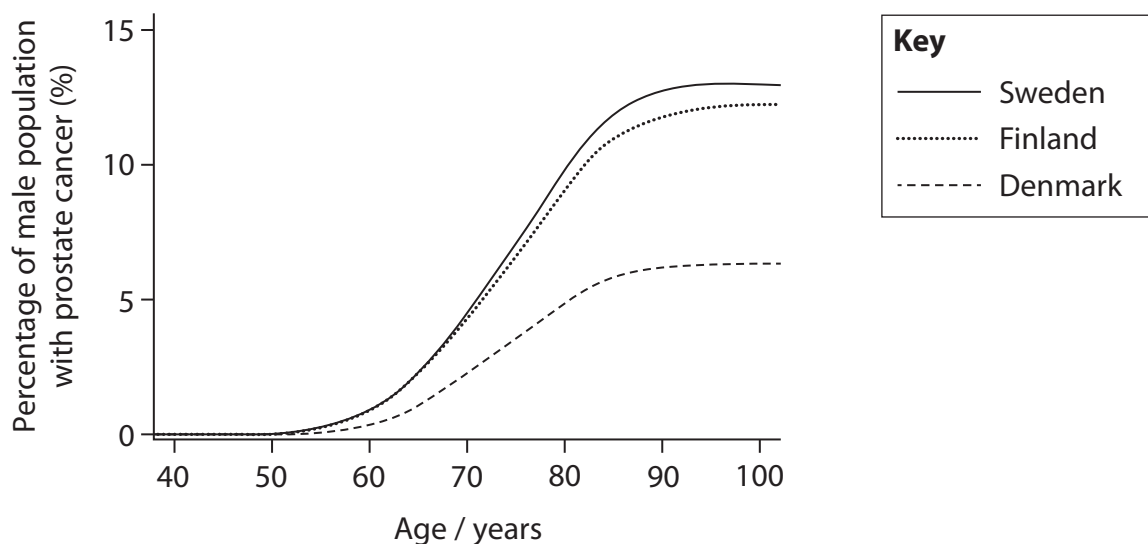
P 5 6 6 9 7 A 0 1 9 3 2

8 Prostate cancer is one of the most common forms of cancer in adult men.

A number of investigations have been carried out to study prostate cancer in a large number of men in Denmark, Finland and Sweden.

- (a) In one of these investigations, the effect of age on developing prostate cancer was studied.

The graph shows the results.



Comment on the effect of age on the development of prostate cancer.

(3)

Under the age of 50, increasing age has no effect: almost no men have prostate cancer in all three countries.

From 50 to about 90, the percentage with prostate cancer increases as age increases (positive correlation).

Over the age of 90 there is little or no change, the percentage plateaus.

Increasing age has less effect in Denmark (levels off at about 6%) than in Finland and Sweden (about 12 to 13%), lowest in Denmark, highest in Sweden.

- (b) In another investigation, the effect of diet on the development of prostate cancer was studied.

Data were collected on prostate cancer death rates and the intake of sugar. Some of the data are shown in the table.

Daily sugar intake per person / kJ	Prostate cancer death rate / 100 000 of the male population
420	5.0
840	8.5
1260	12.0
1680	16.0
2100	20.0

The male population size of Denmark is 2.86 million.

Calculate the number of men likely to die from prostate cancer if their daily sugar intake was 1260 kJ.

(2)

$$\text{death rate} = 12.0 \text{ per } 100\,000$$

$$12.0 \div 100\,000 = 0.00012$$

$$0.00012 \times 2\,860\,000 = 343.2$$

Answer 343 men



- (c) In a third investigation, prostate cancer in identical and non-identical male twins was studied.

Data were collected on the probability of one male twin developing prostate cancer if his twin brother had prostate cancer.

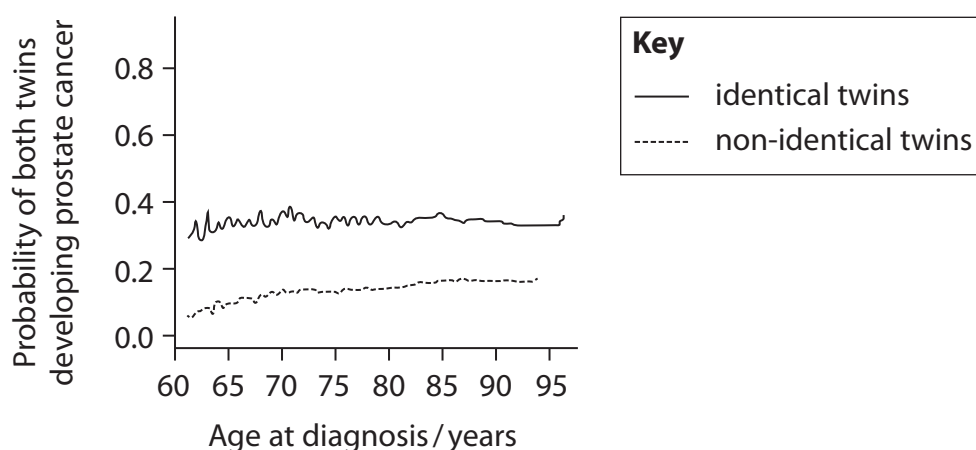
- (i) Explain why identical twins were included in this investigation.

(2)

Identical twins have the same genome (alleles / genotype), they are genetically identical.

So any (phenotypic) differences between them, i.e. one twin developing prostate cancer and not the other, must be due to environmental factors.

- *(ii) The graph shows the results of this investigation.



Analyse the data from these three investigations to evaluate the likely causes of prostate cancer.

(6)

Investigation 1: the risk of prostate cancer increases with age above 50, possibly because older men have had longer exposure to environmental factors (mutagens), so more mutations accumulate in prostate cells. The percentage differs between countries (about 6% in Denmark against 13% in Sweden), which could be due to differences in the gene pool or to environmental differences such as diet.

Investigation 2: the death rate rises as sugar intake rises (5.0 to 20.0 per 100 000), a lifestyle (dietary) factor. High sugar intake may lead to obesity, which is linked to a higher risk of cancer, but this is a correlation, not proof of cause.

Investigation 3: the probability of both twins developing prostate cancer is higher in identical twins (about 0.35) than in non-identical twins (about 0.15), which suggests genetic (inherited) factors, e.g. both have a mutation in the DNA. However the probability is only about 0.35, not 1.0, so genes alone are not the cause and environmental factors are involved too.

Overall, prostate cancer is multifactorial: it results from an interaction between genotype and environment (e.g. diet), with age increasing the time of exposure. The validity depends on the sample sizes and on controlling other variables between countries.

(Total for Question 8 = 13 marks)



9 Changes in diet are affecting the health of people in the UK.

(a) The table shows mean data for adult males in the UK in 1967 and 50 years later in 2017.

Year	Mean mass / kg	Mean height / cm	Mean BMI
1967	73	172	24.7
2017	84	178	26.5

The National Health Service (NHS) states that BMI can be used to assess the weight category of an adult male. The table shows these categories.

Category	BMI range
Underweight	≤ 18.4
Healthy weight	18.5 – 24.9
Overweight	25.0 – 29.9
Obese	≥ 30.0

The mean BMI for adult males in 1967 indicates that they were in the healthy weight category.

Use the BMI formula to determine the mean weight category for adult males in 2017.

$$\text{BMI} = \frac{\text{mass in kilograms}}{(\text{height in metres})^2}$$

(2)

$$\text{BMI} = 84 \div 1.78^2 = 84 \div 3.1684 = 26.5$$

26.5 is in the range 25.0 to 29.9, so the mean adult male in 2017 is (just) in the overweight category.



(b) The effect of being shown a cheeseburger on saliva production in a child was studied.

The mass of saliva produced by this child was measured.

The child was then shown a cheeseburger and the new mass of saliva produced was measured. The change in the mass of saliva produced was recorded.

This was repeated with the child being shown a cheeseburger on eight occasions, at five minute intervals.

The results in the table show the change in mass of saliva produced compared with the mass of saliva produced before the child being shown a cheeseburger.

Occasion	Change in mass of saliva produced / g
1	+ 0.30
2	+ 0.18
3	+ 0.05
4	+ 0.02
5	+ 0.02
6	– 0.08
7	– 0.18
8	– 0.19

(i) Describe the effect on saliva production shown by these results.

(2)

Being shown a cheeseburger at first increases saliva production (+0.30 g), but on repeated occasions less saliva is produced each time.

After six or more occasions less saliva is produced than before being shown the cheeseburger (–0.08 to –0.19 g).



- (ii) Name the type of learning behaviour shown by the child as they were repeatedly shown a cheeseburger.

(1)

Habituation

- (iii) Explain what happens at the synapse to cause a decrease in saliva production when the child was shown a cheeseburger on more than six occasions.

(4)

Repeated stimulation reduces the permeability of the presynaptic membrane to calcium ions (calcium ion channels become less responsive), so fewer calcium ions enter the presynaptic neurone.

So fewer vesicles move towards and fuse with the presynaptic membrane, and less neurotransmitter is released by exocytosis.

Less neurotransmitter binds to receptors on the postsynaptic membrane, so fewer sodium ion channels open; the membrane may not be depolarised and an action potential may not occur, so the salivary glands are not stimulated.

- (c) When the child was shown the cheeseburger, information would have been sent from the eye to the brain.

Describe the role of sodium ions in the functioning of a mammalian rod cell.

(3)

Sodium ions are pumped out of the rod cell (inner segment) by the sodium-potassium pump.

In the dark, sodium ions can move back into the rod cell (outer segment) through open sodium ion channels, so the rod cell is depolarised and releases neurotransmitter.

In the light, rhodopsin breaks down and the sodium ion channels close, so sodium ions do not move back in and the rod cell is hyperpolarised.

(Total for Question 9 = 12 marks)



10 Nandrolone is an anabolic steroid, it is a molecule with a similar shape to testosterone. Nandrolone has been used as a performance-enhancing substance by athletes in the past.

- (a) A number of investigations with mice have been carried out to study the effect of nandrolone on the structure and function of the aorta.

In these investigations, all the mice were of one type and were all supplied with the same amount of food and water. These mice were placed into four groups.

Each group was treated differently for eight weeks. The treatments are shown in the table.

Group	Treatment	
	Allowed to exercise	Given nandrolone
P	No	No
Q	No	Yes
R	Yes	No
S	Yes	Yes

After eight weeks, the aorta of each mouse was studied.

- (i) In investigation 1, samples of aorta were put under tension to test elastic recoil. The tension was removed and the mean maximum percentage recoil for each group was found.

The results are shown in the table.

Group	Mean maximum percentage recoil (%)
P	57
Q	38
R	80
S	53



The use of nandrolone has been linked to a variety of cardiovascular conditions.

Explain how the use of nandrolone could lead to atherosclerosis.

(3)

Nandrolone reduces the mean maximum percentage recoil of the aorta (57% to 38% without exercise, 80% to 53% with exercise), so the artery wall is less elastic.

Blood pressure in the artery is therefore higher, increasing the risk of damage to the endothelium.

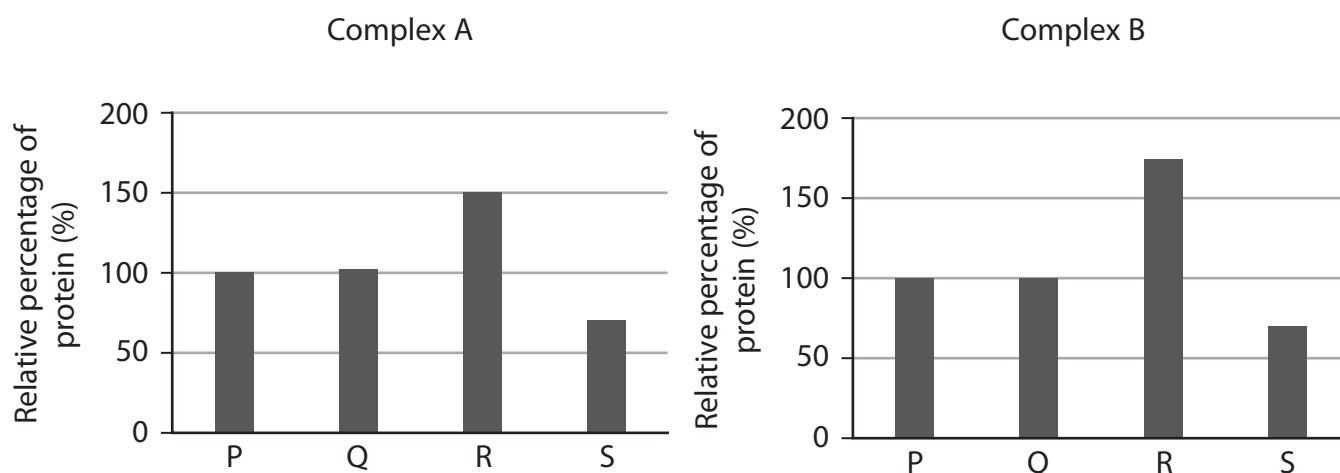
This triggers an inflammatory response: white blood cells accumulate, and a build-up of cholesterol, calcium salts and fibrous tissue leads to the formation of an atheroma (plaque).



- (ii) In investigation 2, some of the cells from the middle layer of the aortas of the mice were removed.

Two protein complexes, A and B, are found in the cells of the middle layer. These protein complexes are involved in the electron transport chain.

The graphs show the relative percentage of these two protein complexes in each group of mice.



Comment on the effects of nandrolone on the production of ATP.

(3)

Both protein complexes are involved in the electron transport chain, i.e. in ATP production by oxidative phosphorylation.

Without exercise, nandrolone has no effect on the production of the proteins (P and Q both about 100%), so it has no effect on ATP production.

When exercise is allowed, nandrolone reduces the production of both proteins (R about 150% and 170%, S about 70%), so it reduces ATP production.



(iii) The transcription factor Tfam is involved in the production of mitochondria.

In investigation 3, some of the cells from the middle layer of the aortas of the mice were removed. The quantity of mRNA per cell coding for Tfam was measured.

The results are shown in the table.

Group	Quantity of mRNA per cell coding for Tfam / a.u.
P	100 ± 20
Q	75 ± 10
R	170 ± 25
S	85 ± 15

A student concluded that nandrolone affects the quantity of mRNA per cell coding for Tfam.

Explain why this conclusion is not valid for all the mice.

(2)

Without exercise, the values for Tfam mRNA overlap for the groups with and without nandrolone (P 80 to 120, Q 65 to 85).

Also, S (exercise and nandrolone, 70 to 100) overlaps with P (no exercise, no nandrolone), so the difference may not be significant.



*(b) Analyse the data from these three investigations to discuss the advantages of an exercise programme without nandrolone.

(6)

Investigation 1: exercise without nandrolone (R) gives a higher maximum recoil of the aorta than no exercise (P), 80% compared with 57%, which is 23% greater. With more elastic recoil, oxygen-rich blood flows more rapidly and at the correct pressure from the heart to the muscles, and there is less damage to the endothelium, so the person is less likely to get atherosclerosis, CVD or strokes. Taking nandrolone (S) removes much of this benefit (53%).

Investigation 2: group R has more of both protein complexes than P (about 150% and 170% compared with 100%). These complexes are in the electron transport chain, so there is more oxidative phosphorylation (chemiosmosis) and more ATP synthesis. More ATP is available for muscle contraction, i.e. for breaking the bond between actin and myosin heads (in the muscle of the aorta wall and in skeletal muscle). Nandrolone with exercise (S) reduces this to about 70%.

Investigation 3: R has more mRNA coding for Tfam per cell than P (170 compared with 100 a.u., no overlap), so more Tfam is made and more mitochondria are produced. This means more aerobic respiration and more ATP formed per cell. With nandrolone (S) the value is only 85, lower than R.

So an exercise programme without nandrolone gives the greatest benefit: a more elastic aorta and more ATP from aerobic respiration for muscle contraction.

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS



DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE

