

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 <table border="1"><tr><td></td><td></td><td></td><td></td><td></td></tr></table>						Candidate Number <table border="1"><tr><td></td><td></td><td></td><td></td><td></td></tr></table>					
Thursday 11 June 2020													
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 ►

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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 Genome sequencing and genetic modification (GM) can be used to develop proteins as personalised medicines.

(a) (i) Which of the following correctly describes the genome of an adult male?

(1)

- ☐ A all of his alleles plus all of his genes
- ☐ B all of his exons minus all of his introns
- ☐ C all of his introns minus all of his exons
- ☒ D all of his introns plus all of his exons

(ii) Which row correctly identifies all the types of organism that can be both genetically modified and be a source of a gene to be used in GM?

(1)

	Animal	Bacterium	Plant
☐ A	no	no	yes
☐ B	no	yes	yes
☐ C	yes	yes	no
☒ D	yes	yes	yes

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- (b) Genetically modified organisms (GMOs) can synthesise personalised proteins for use as medicines.

Describe the role of enzymes involved in the synthesis of personalised proteins in GMOs.

(3)

DNA helicase unzips the DNA by breaking the hydrogen bonds between the bases, so the gene can be transcribed.

RNA polymerase is involved in transcription of the gene, making mRNA by joining RNA nucleotides together, forming phosphodiester bonds.

During translation, enzymes join the amino acids together by forming peptide bonds to make the polypeptide.

(Total for Question 1 = 5 marks)



- 2 A spirometer can be used to study the performance of an athlete.



snabbiology.wordpress.com

The trace produced by a spirometer can be used to determine the respiratory minute ventilation and the oxygen consumption of an individual.

- (a) Describe how a spirometer trace can be used to calculate the respiratory minute ventilation and the oxygen consumption per minute.

(4)

respiratory minute ventilation

Find the difference between the volume at a peak and the next trough to give the tidal volume.

Find the ventilation rate by counting the number of peaks in a stated time and converting to per minute.

Multiply the tidal volume by the ventilation rate.

oxygen consumption per minute

Find the difference in volume between one trough and a subsequent trough (the drop in the trace, as oxygen is used up).

Divide this volume by the time between the two troughs (in seconds) and multiply by 60 to give a value per minute.



- (b) A student compared the spirometer trace for a pair of healthy, genetically identical twins.

State two variables that would have to be controlled to make this a valid comparison.

(2)

Same level of fitness (physical activity), and the same level and duration of exercise.

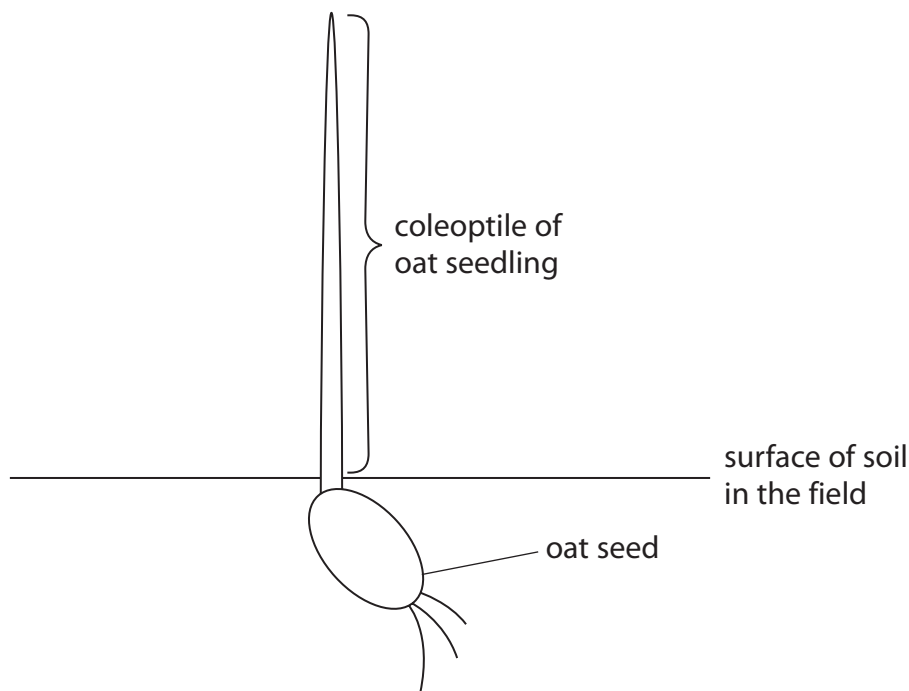
Same body mass, and exposure to the same environmental conditions (e.g. temperature).

(Total for Question 2 = 6 marks)



3 Phytochromes and IAA (indole acetic acid) are important substances that bring about growth responses in plants.

(a) The diagram shows an oat seedling in part of a field.



Cells in the tip of the oat coleoptile release IAA.

Explain how the IAA affects the growth of the coleoptile.

(4)

IAA diffuses from the tip of the coleoptile down to the zone of elongation.

IAA is taken up by cells in the zone of elongation, where it activates proton pumps so H^+ ions are pumped into the cellulose cell wall, lowering the pH.

The low pH loosens the bonds between cellulose microfibrils, so the cell wall becomes more flexible and the cells take up water and elongate.

Therefore the coleoptile increases in height. If light comes from one side, IAA moves to the shaded side, so the cells there elongate more and the coleoptile grows towards the light (positive phototropism).



(b) Phytochrome is found in two different forms known as P_R (or P_{660}) and P_{FR} (or P_{730}).

(i) Which row correctly describes the effects of sunlight on phytochrome?

(1)

	Change in form of phytochrome	Speed of change
☐ A	P_{FR} to P_R	slow
☐ B	P_{FR} to P_R	rapid
☐ C	P_R to P_{FR}	slow
☒ D	P_R to P_{FR}	rapid

(ii) Phytochrome can be described as

(1)

- ☐ A a form of opsin
- ☒ B a photosensitive pigment
- ☐ C an isomer of retinal
- ☐ D a type of cytochrome

(iii) Give one example of a growth response of a plant that is affected by phytochrome.

(1)

Seed germination (or flowering).

(Total for Question 3 = 7 marks)



4 A number of seed banks have been set up around the world.

(a) When a seed bank receives new seeds, it processes them in several ways.
The processes can include the following stages:

- washing the seeds with disinfectant
- allowing the seeds to dry.

Explain the advantages of these two stages.

(3)

Washing with disinfectant kills any microorganisms (bacteria and fungi) on the seed surface.

Drying the seeds reduces the chance of germination and decreases enzyme action, so the seeds stay dormant.

Therefore this prevents decay, infection or damage to the seeds, so they can be stored for the long term.

(b) The food store of many seeds is an organ called a cotyledon.

An organ can be defined as

(1)

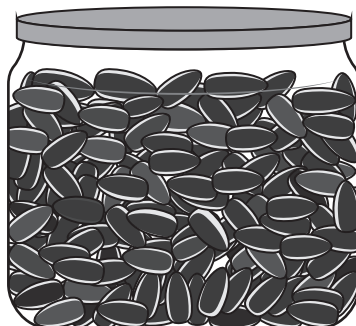
- ☐ A a group of cells of one type that has a function
- ☒ B a group of several different cell types, each type working together
- ☐ C a group of tissues that are located together that have unrelated functions
- ☐ D part of a system and therefore does not have a function of its own



- (c) The processed seeds are stored at minus 20 °C. At intervals, samples of seeds are removed from storage and tested for viability.

If at least 75% of the seeds in the sample germinate, the remaining seeds are described as viable.

The diagram shows a container with many seeds in it.



Sunflower Seeds
mass of 1000 seeds = 50 g

A sample of 3 g of seeds was removed from this container. These seeds were given optimum conditions for germination.

However, only 48 seeds germinated.

Determine whether the remaining seeds in the container are viable or not.

(3)

$$\text{number of seeds in 3 g} = (1000 \div 50) \times 3 = 60 \text{ seeds}$$

$$\text{percentage germinated} = (48 \div 60) \times 100 = 80\%$$

80% is greater than 75%, so the remaining seeds are viable.



(d) Glycolysis occurs during germination. One of the products is adenosine triphosphate (ATP).

Which of the following is another product of glycolysis?

(1)

- ☐ A carbon dioxide
- ☐ B glucose
- ☐ C oxygen
- ☒ D pyruvate

(Total for Question 4 = 8 marks)



5 An investigation was carried out to study the effect of alcohol concentration on heart rate in *Daphnia*.

- (a) Give one reason why some people believe that there are fewer ethical issues when using *Daphnia* for this investigation rather than using a species of mammal.

(1)

Daphnia has a simpler nervous system, so it is thought not to feel pain (or feels less pain) than a mammal.

- (b) In this investigation, *Daphnia* were placed into three groups of 10. Each group was placed in alcohol of a different concentration for five minutes.

After five minutes, each *Daphnia* was removed from the alcohol and its heart rate recorded every 15 seconds for one minute. A mean for each concentration was calculated.

The results are shown in the table.

Alcohol concentration / mol dm ⁻³	Mean <i>Daphnia</i> heart rate / beats per minute
0.00	221
0.17	176
0.34	97

- (i) Give one reason why 10 *Daphnia* were used for each alcohol concentration.

(1)

So that a mean can be calculated and any anomalies (outliers) can be identified and removed, giving more repeatable data.

- (ii) Explain why the *Daphnia* were left for five minutes in the alcohol before the heart rate was recorded.

(2)

*Time is required for the alcohol to be absorbed into the *Daphnia*'s body and reach the heart.*

*Time is also required for acclimatisation, so the *Daphnia* can get used to the new conditions and overcome the stress of being moved.*



- (c) Devise an investigation to find the lowest concentration of alcohol that has an effect on the heart rate of *Daphnia*.

(5)

Prepare a range of alcohol concentrations between 0.00 and 0.17 mol dm^{-3} , for example $0.00, 0.02, 0.04, 0.06 \dots 0.16 \text{ mol dm}^{-3}$.

Control a biotic variable: use *Daphnia* of the same species, age, size and sex.

Control an abiotic variable: keep the temperature constant (e.g. with a water bath) and use the same volume of alcohol solution and the same time (five minutes) in it.

Place each *Daphnia* on a cavity slide and use a microscope to count the heart beats for a set time, then calculate beats per minute. Use 10 *Daphnia* at each concentration and calculate a mean.

Determine the lowest concentration at which the *Daphnia* show a decrease in heart rate, i.e. where the mean heart rate drops below 221 beats per minute.

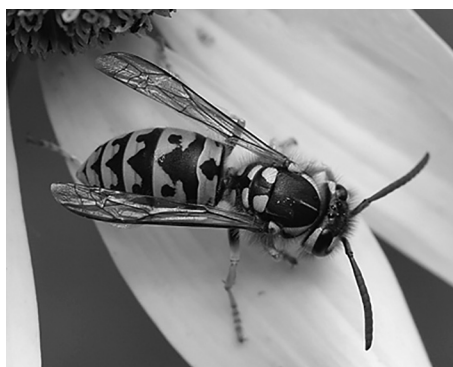
(Total for Question 5 = 9 marks)



6 Wasps are insects that live in groups.

One species of wasp (*Vespula germanica*) has been shown to knock its body repeatedly against a hard surface. This signals the presence and quality of food to other wasps.

When threatened by another animal, it may use its stinger to inject a venom to protect itself.



bugguide.net

(a) Complete the table by giving the name of the type of adaptation.

(2)

Description of adaptation	Type of adaptation shown by the wasp
knocking its body to signal food	<i>behavioural</i>
the stinger	<i>anatomical</i>

- (b) The stinger injects a venom that contains the enzyme phospholipase.
This enzyme hydrolyses phospholipids, releasing fatty acids.

Describe how the structure of phospholipase allows it to hydrolyse phospholipids.

(4)

Phospholipase is an enzyme whose structure is determined by its sequence of amino acids (primary structure).

The polypeptide folds into a specific tertiary structure (globular shape), held by hydrogen bonds, ionic bonds and disulfide bridges between R groups, which provides an active site.

The active site has a shape complementary to part of the phospholipid, so they form an enzyme-substrate complex. R groups in the active site (e.g. hydrophobic R groups) bind to the substrate.

This allows the enzyme to break (hydrolyse) the ester bonds between glycerol and the fatty acids.

- (c) Phospholipase in the venom of wasps can cause allergic reactions.
Phospholipase can affect the Golgi apparatus in cells.

Phospholipase inhibitors are being investigated as possible drugs to treat the allergic reactions.

- (i) Give two functions of the Golgi apparatus.

(2)

Modifies (processes) proteins, e.g. adds carbohydrate to protein to form glycoproteins.

Packages proteins into vesicles, e.g. secretory vesicles and lysosomes.



- (ii) A three-phase protocol will be used when developing the phospholipase inhibitor as a new drug.

Explain the purpose of each phase of this protocol for a phospholipase inhibitor.

(3)

Phase 1: given to a small number of healthy volunteers to make sure the phospholipase inhibitor is not harmful, to find a safe dosage, to test for side effects and to see how the drug is absorbed and metabolised.

Phase 2: given to a small number of patients to see if it is effective in treating the condition, i.e. preventing allergic reactions to wasp venom, and to test for side effects.

Phase 3: given to a large number of patients in double blind trials, comparing effectiveness with a placebo or the existing drug, to gather much data for statistical tests and to look for rare side effects.

(Total for Question 6 = 11 marks)



- 7 When scientists visit Antarctica, they need appropriate clothing to help with thermoregulation.

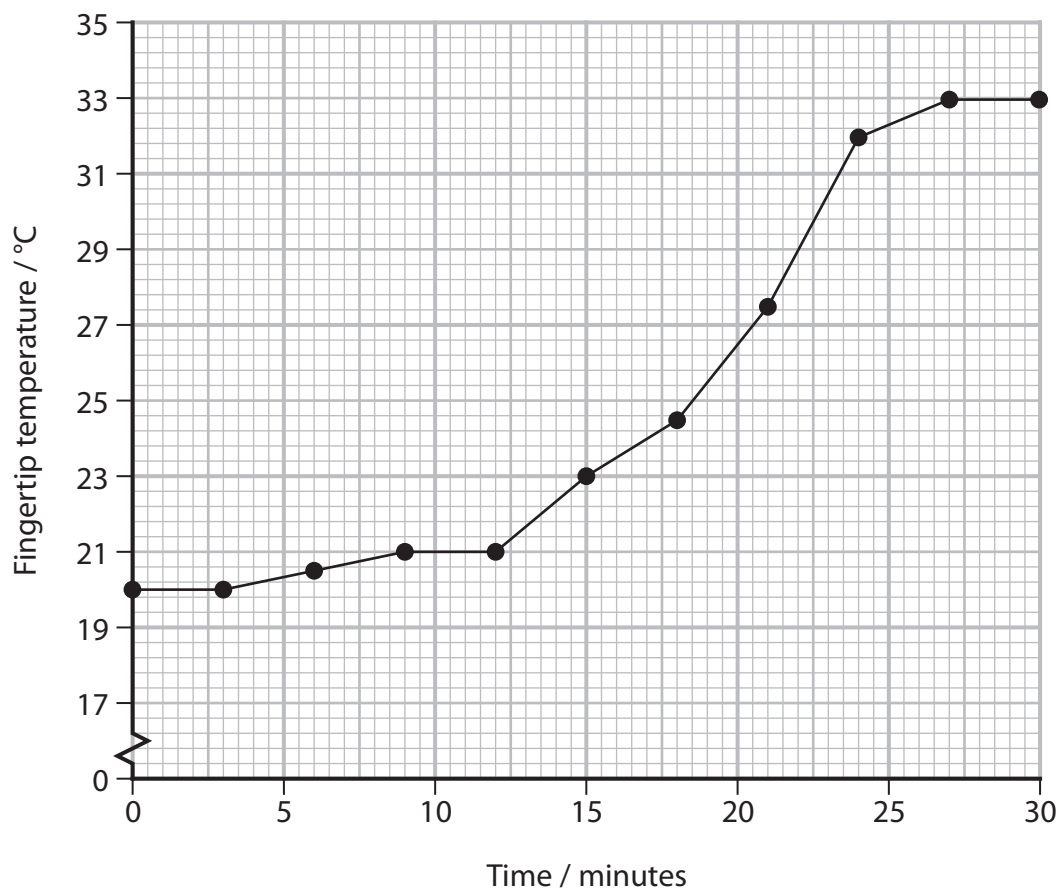


www.aa.com

- (a) An investigation was carried out to study thermoregulation in humans.

A woman was wrapped in blankets and her feet were put in hot water for 30 minutes. During this time, the temperature of the skin at the end of one of her fingertips was recorded.

The graph shows the results of this investigation.



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- (i) Explain why there was no change in fingertip temperature between 0 and 3 minutes.

(2)

Time is required for heat from the hot water to warm the blood, and for the warm blood to circulate and reach the fingertip.

There is also a layer of insulation in the skin, so heat takes time to reach the surface.

- (ii) Calculate the greatest rate of increase in fingertip temperature.

(2)

greatest rate between 21 and 24 minutes:

$$(32.0 - 27.5) \div 3 = 1.5$$

Answer *1.5 °C min⁻¹*



(iii) Explain the role of the nervous system in bringing about the increase in temperature of the fingertip as shown in this investigation.

(5)

Thermoreceptors detect the increase in temperature of the blood (warmed by the hot water).

Thermoreceptors in the hypothalamus detect the temperature increase, and the heat loss centre (thermoregulatory centre) in the hypothalamus coordinates heat loss mechanisms.

More impulses are sent along the sympathetic nerves to the blood vessels in the skin.

This leads to constriction of the shunt vessels, therefore causing vasodilation of the arterioles.

So more warm blood flows through the capillaries near the skin surface of the fingertip, increasing its temperature and allowing radiation of heat from the skin.

(b) Sweating is a thermoregulatory mechanism.

A student stated that loss of heat when sweating is related to the dipole nature of water molecules.

Justify this statement.

(3)

Water is a dipole, as it has an uneven distribution of charge: the oxygen is slightly negative and the hydrogens are slightly positive.

So water molecules form hydrogen bonds with other water molecules.

A lot of heat energy is required to break these bonds and allow water to evaporate (high latent heat of evaporation), so evaporation of sweat takes heat energy away from the skin.

(Total for Question 7 = 12 marks)

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- 8 There are many reasons why humans may lose muscle mass.

Two known causes are hip replacement surgery and some genetically inherited conditions.

- (a) A muscle fibre is a specialised body cell.

Explain how the structure of a muscle fibre is related to its specialised function.

(3)

The sarcolemma (cell surface membrane) contains voltage-gated channels to allow depolarisation, and T tubules carry depolarisation to the sarcoplasmic reticulum, which stores and releases calcium ions.

Many mitochondria carry out aerobic respiration to supply ATP.

Many myofibrils containing actin and myosin, which slide past each other to allow contraction.

- (b) Muscles can be scanned using magnetic resonance imaging (MRI) to investigate the loss of muscle mass.

It is safer to use MRI than computed tomography (CT) because

(1)

- ☒ A CT uses X-rays that can cause mutations in the DNA of muscle fibres
- ☐ B CT uses X-rays that can cause mutations in the protein in the muscle fibres
- ☐ C CT uses magnets that can cause mutations in the DNA of muscle fibres
- ☐ D CT uses magnets that can cause mutations in the protein in the muscle fibres



- (c) Muscular dystrophy (MD) is a range of genetically inherited conditions in which a loss of muscle mass can occur.

Limb-girdle muscular dystrophy (LGMD2A) is a rare type of MD. Only six people per million have this recessive condition.

In 2018 there were 66.5 million people in the UK.

- (i) Calculate the number of people in the UK who are carriers of LGMD2A using the Hardy-Weinberg equation.

(3)

$$p^2 + 2pq + q^2 = 1$$

$$q^2 = 6 \div 1\,000\,000 = 0.000006$$

$$q = \sqrt{0.000006} = 0.0024, \quad p = 1 - 0.0024 = 0.9976$$

$$2pq = 2 \times 0.9976 \times 0.0024 = 0.0049$$

$$\text{carriers} = 0.0049 \times 66\,500\,000 = 325\,850$$

Answer 325 850

- (ii) In the human population, the frequency of the allele for LGMD2A may change from one generation to the next.

Explain why the frequency of this allele may change from one generation to the next.

(3)

The allele for LGMD2A may undergo random mutation, creating new copies of the allele.

Gene flow due to immigration or emigration may cause alleles to be gained or lost from the population.

Natural selection: the allele confers a disadvantage, as people with the condition may not have children, so fewer copies are passed on.



(d) Duchenne muscular dystrophy (DMD) is the most common inherited type of MD. DMD is caused by a recessive allele.

The table shows some data on DMD from 1993 to 1999.

Year	Number of deaths due to DMD per year in England and Wales		Median age of death / years
	males	females	
1993	75	0	19
1994	37	2	19
1995	41	0	20
1996	53	0	19
1997	43	1	20
1998	51	0	21
1999	51	1	20

Analyse the data to explain why DMD causes more deaths in males than in females.

(4)

Far more males die of DMD than females in every year (e.g. 75 males and 0 females in 1993), so more males have the condition.

This suggests DMD is a sex-linked (X-linked) condition: the recessive allele is carried on the X chromosome.

Males have only one X chromosome, so they only need one copy of the recessive allele to show the condition. Females need two copies, so most are only carriers.

The condition may also be more severe in males than in females, so it causes more deaths.

(Total for Question 8 = 14 marks)



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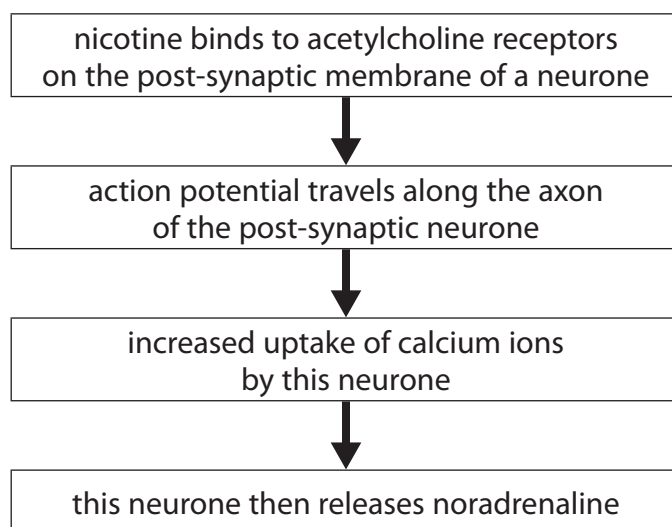
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9 Nicotine is a drug found in the smoke of cigarettes.

- (a) The flow diagram shows how the presence of nicotine can cause the release of noradrenaline.



- (i) Explain how nicotine causes an action potential in the post-synaptic neurone that releases noradrenaline.

(3)

Nicotine is similar in shape to acetylcholine, so it binds to the acetylcholine receptors.

This changes the shape of the receptor (channel protein) so sodium ion channels open, increasing permeability to Na^+ , which diffuse into the neurone.

This causes depolarisation of the post-synaptic membrane, which reaches the threshold level.

- (ii) State how an increase in calcium ion uptake by the neurone leads to the release of noradrenaline.

(1)

Calcium ions cause vesicles containing noradrenaline to fuse with the presynaptic membrane, releasing it by exocytosis.



(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

- (i) The concentration of nicotine in the blood plasma of the group A rats was recorded at different times and the means calculated.

The means are shown in the table along with the range of data for each mean.

Time of sampling / minutes	Mean concentration of nicotine in blood plasma / ng cm^{-3}
0 (immediately after inhalation)	35.0 ± 9.3
30 (after inhalation)	24.1 ± 5.6

Determine the maximum rate of decrease in the concentration of nicotine in the blood plasma per minute after being given the nicotine.

(2)

$$\text{largest value at 0 min} = 35.0 + 9.3 = 44.3$$

$$\text{smallest value at 30 min} = 24.1 - 5.6 = 18.5$$

$$(44.3 - 18.5) \div 30 = 25.8 \div 30 = 0.86$$

Answer 0.86 $\text{ng cm}^{-3} \text{ min}^{-1}$



- (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)

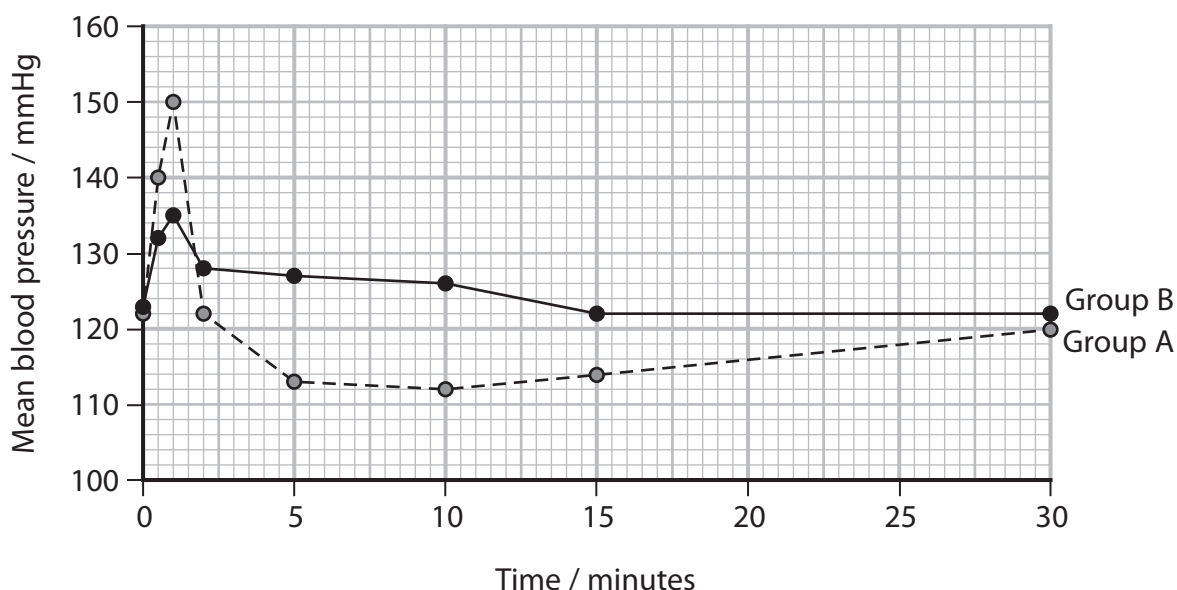
group A (1.0 mg): $(49 - 48) \div 48 \times 100 = +2.08\%$

group B (0.1 mg): $(45 - 48) \div 48 \times 100 = -6.25\%$

The higher nicotine concentration gives a positive change, whereas the lower concentration gives a negative change, and the percentage change is greater for 0.1 mg.



*(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)

The statement is partly supported. The rats inhaled nicotine, as humans do during smoking, and rats are mammals, so the results can to some extent be extrapolated to humans.

In the first 0.5 minutes the lumen diameter decreased from 48 to 44 μm in both groups, showing vasoconstriction, and blood pressure rose sharply: to about 150 mmHg in group A and 135 mmHg in group B. Nicotine causes release of noradrenaline, which causes vasoconstriction and increases heart rate, so blood pressure increases.

However, the decrease in lumen diameter was only temporary. After 1 minute there was vasodilation: in group A the lumen increased to 57 μm at 5 minutes and in group B to 52 μm , before returning to about the original diameter (49 and 48 μm) by 15 minutes. So nicotine does not cause a lasting decrease in the lumen.

Blood pressure in both groups increased and then decreased. In group A (1.0 mg) it

dropped below the original value, to about 112 mmHg at 10 minutes, as a result of the vasodilation, and was still below the start at 30 minutes. In group B it fell back to about 122 mmHg, near the resting value. So the higher dose did not cause a lasting increase in blood pressure.

The rats inhaled only nicotine, not cigarette smoke, which contains many other substances such as carbon monoxide. Rats are not the same as humans, so they may respond differently, and the effects were measured over only 30 minutes after a single dose, not over many years of smoking.

The sample size was very small (6 rats per group), the lumen of only one artery was measured, and the range of data for the plasma nicotine means was large, so the results may not be reliable or repeatable. No statistical test was carried out.

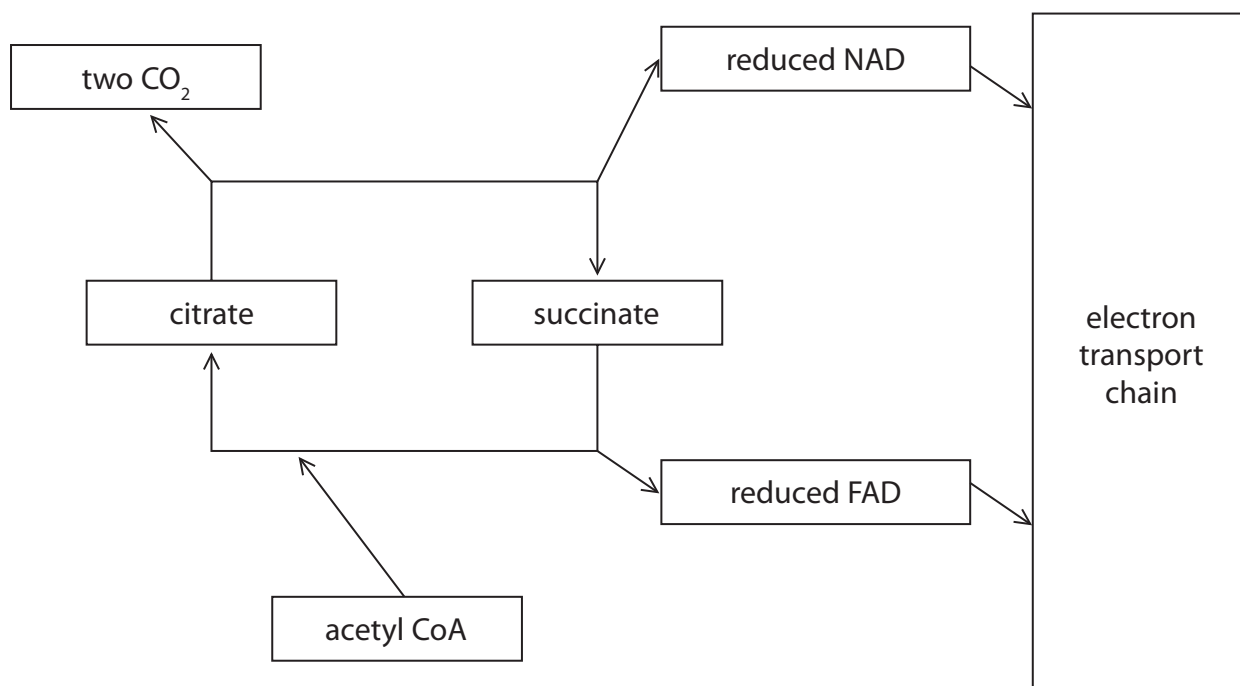
Overall, the data only support the statement for the first minute. The statement is not valid for humans on the basis of this investigation, as the effects were short-lived and further studies on humans who smoke would be needed.

(Total for Question 9 = 14 marks)



10 Respiration occurs in all healthy living cells.

(a) The diagram shows part of the Krebs cycle and the electron transport chain.



(i) Which row shows the number of carbon atoms in citrate and succinate?

(1)

Number of carbon atoms in		
	citrate	succinate
☐ A	2	4
☐ B	5	4
☒ C	6	4
☐ D	6	8

(ii) Which of the following is transferred to a molecule of FAD to form reduced FAD?

(1)

- ☐ A two oxygen atoms
- ☒ B two hydrogen atoms
- ☐ C one oxygen atom and one hydrogen atom
- ☐ D one water molecule

(iii) Explain the need for reduced NAD to be oxidised in a mitochondrion.

(2)

So that hydrogen (protons and electrons) can be delivered to the electron transport chain, allowing ATP synthesis by chemiosmosis.

To regenerate NAD so that the Krebs cycle (and the link reaction) can keep going.

(iv) A mutation in the gene that codes for the enzyme succinate dehydrogenase stops the conversion of succinate into citrate.

Which row states the change in concentration of citrate and reduced FAD as a result of this mutation?

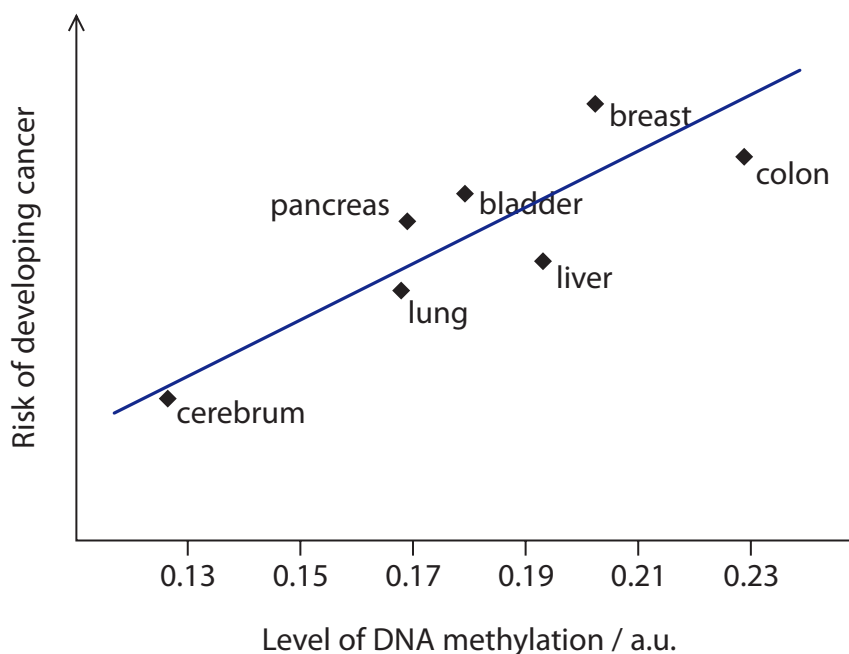
(1)

	Concentration of citrate	Concentration of reduced FAD
☒ A	decreases	decreases
☐ B	decreases	increases
☐ C	increases	decreases
☐ D	increases	increases



- (b) There is a link between the methylation of certain regions of DNA and the risk of developing cancer.

The graph shows the relationship between the level of methylation of these regions of DNA and the risk of developing cancer in different parts of the body by the age of 70.



- (i) Draw a line of best fit on the graph to identify any correlation between the independent variable and the dependent variable.

(1)

- (ii) An investigation studied the effect of age on the mean level of DNA methylation. In this investigation, the null hypothesis was rejected at the 5% significance level.

Explain what is meant by the phrase: the null hypothesis was rejected at the 5% significance level for this investigation.

(2)

There is a significant correlation between age and the level of DNA methylation.

There is less than a 5% probability that these results were produced by chance, i.e.

95% probability that DNA methylation changes with age.



- * (iii) Scientists have found that a high level of succinate leads to the inhibition of an enzyme called TET.

The function of TET is to remove methyl groups from DNA.

Explain how a mutation in the gene for succinate dehydrogenase can increase the risk of developing cancer.

(6)

A mutation is a change in the base sequence of the gene for succinate dehydrogenase.

This changes the amino acid sequence (primary structure) of the enzyme, so it folds into a different tertiary structure and its active site changes shape.

Succinate dehydrogenase is then non-functional (or less functional), so succinate cannot be converted and succinate accumulates in the mitochondria.

The high level of succinate inhibits the enzyme TET, so methyl groups are not removed from DNA, leading to increased methylation of DNA.

Methylation affects transcription of genes, e.g. a tumour suppressor gene may not be transcribed, which alters the amount of protein product formed, so cell division is not controlled.

The graph shows that greater methylation of DNA is associated with an increased risk of cancer, so the mutation increases the risk of developing cancer.

(Total for Question 10 = 14 marks)

TOTAL FOR PAPER = 100 MARKS



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