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HUMAN BIOLOGY

UNIT 3

Semester 1 Exam 2017

Section	Marks	Your mark
Multiple-Choice	60	
Short Answers	100	
Extended Answers	40	
Total	200	

Name: _____

Teacher: _____

TIME ALLOWED FOR THIS PAPER

Reading time before commencing work: Ten minutes
Working time for the paper: Three hours

MATERIALS REQUIRED/RECOMMENDED FOR THIS PAPER

To be provided by the supervisor:

- This Question/Answer Booklet
- Multiple Choice Answer Sheet

To be provided by the candidate:

- Standard items: Pens, pencils, eraser or correction fluid, ruler, highlighter, ruler.
- Special items: Calculators satisfying the conditions set by School Curriculum and Standards Authority for this subject.

IMPORTANT NOTE TO CANDIDATES

- No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

Structure of this paper

Section	Suggested working time	Number of questions available	Number of questions to be attempted	Marks	Percentage
SECTION ONE: Multiple-choice	50 minutes	30	All	60	30
SECTION TWO: Short answers	90 minutes	8	All	100	50
SECTION THREE: Extended answers	40 minutes	3	2	40	20
Total marks				200	100

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2017*. Sitting this examination implies that you agree to abide by these rules.
- Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

- You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
- Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
 - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
 - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

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Section One: Multiple-choice**30% (60 Marks)**

This section has **30** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a **blue or black pen** to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time for this section is 50 minutes.

The following information is needed to answer the next FOUR questions.

A patient has complained of the following symptoms to their doctor:

- Feeling a lack of energy
- Unexplained weight gain
- Feeling cold, even though the surrounding temperature is around 25°C.

In response, the doctor had the patient's Thyroid Stimulating Hormone (TSH) levels tested over five consecutive days. The patient's results, measured in milli-international units per litre (mIU/L), can be seen in the table below.

Day	1	2	3	4	5
TSH concentration (mIU/L)	2.0	2.3	2.9	2.7	2.1

A normal range is between 0.4 to 4.0 mIU/L.

1. The range and median for the patient's TSH level was
 - a) 2.0 to 2.9 with a median of 2.4
 - b) 2.1 to 2.9 with a median of 2.3
 - c) 2.0 to 2.1 with a median of 2.9
 - d) 2.0 to 2.9 with a median of 2.3
2. TSH is a hormone secreted by
 - a) the hypothalamus and released from the anterior lobe of pituitary gland.
 - b) the posterior lobe of the pituitary gland and its release is controlled by the hypothalamus.
 - c) the anterior lobe of the pituitary gland and its release is controlled by the thyroid gland.
 - d) the anterior lobe of the pituitary gland and its release is controlled by the hypothalamus.
3. Based on the information the patient provided, the disease the doctor was most likely checking for was
 - a) type 1 diabetes.
 - b) type 2 diabetes.
 - c) hypothyroidism.
 - d) hyperthyroidism.
4. Choose the two correct words to complete the following sentence.

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Given the results showed a normal level of TSH present in the blood, the doctor would now need to detect for the presence of _____ to determine if the _____ gland was dysfunctional.

- a) insulin, pancreas
- b) thyroxine, parathyroid
- c) glycogen, pancreas
- d) thyroxine, thyroid

5. Which of the following illustrates a negative feedback mechanism?

- a) The loss of excess glucose in urine.
- b) An increased level of oestrogen in the blood resulting in the release of luteinising hormone.
- c) The vasoconstriction of the capillaries in the skin to reduce heat loss
- d) The release of oxytocin during child birth.

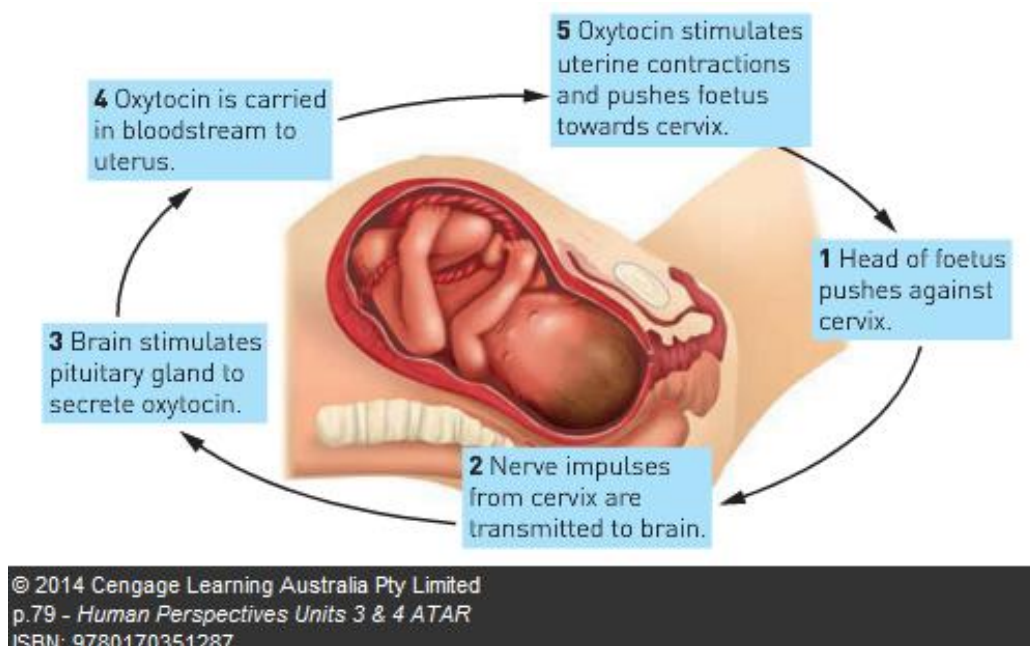
6. Many nerve fibres consist of an axon and its myelin sheath. This myelin sheath is

- a) responsible for the colour of the grey matter in the brain and spinal cord
- b) produced by Schwann cells located along the axon
- c) continuous all the way along the cell body
- d) responsible for the colour of the grey matter in the peripheral nervous system

7. Which of the following statements about ALL hormones is most correct? They

- a) change the functioning of cells by changing the type or quantities of proteins made.
- b) activate certain genes in the nucleus.
- c) change the shape or structure of an enzyme.
- d) change the rate of production of an enzyme.

Refer to the following diagram, showing the processes involved in labour, to answer the next THREE questions.



8. In this stimulus-response and feedback process, the effector would be the
- cervix.
 - uterus.
 - pituitary gland.
 - oxytocin.
9. The hormone responsible for stimulating the contractions of the uterus is
- produced in and released from the anterior lobe of the pituitary.
 - produced in the hypothalamus and sent to the anterior lobe of the pituitary via nerve fibres.
 - produced in the hypothalamus and sent to the posterior lobe of the pituitary via nerve fibres.
 - secreted from the hypothalamus and sent to the posterior lobe of the pituitary via blood vessels in the infundibulum.

10. Which of the following statements about the autonomic nervous system is INCORRECT?

- a) It regulates the activities of smooth muscle, cardiac muscle and glands
- b) It usually operates without conscious control
- c) It is regulated by centres in the cerebral cortex, hypothalamus and the medulla
- d) **It contains motor and sensory nerve fibres**

Refer to the list below to answer the next question. This information shows some normal physiological changes in the human body.

- A. Dilation of pupils
- B. Increase in heart rate
- C. Decreased secretion of saliva
- D. Increased secretion from sweat glands
- E. Dilation of blood vessels in the skin
- F. Decreased levels of adrenalin in blood

11. Which of the changes in the above list would result from stimulation by the sympathetic division of the autonomic nervous system?

- a) A, B, C and E
- b) A, C, D and F
- c) **A, B, C, and D**
- d) B, C, E, and F

12. Substantial injury to the right cerebral cortex results in loss of:

- a) **voluntary muscular movements of the left side of the body.**
- b) voluntary muscular movements of the right side of the body.
- c) involuntary muscular movements of the left side of the body.
- d) involuntary muscular movements of the right side of the body.

13. *Thermus aquaticus* is a bacteria that is used as a source of enzymes for PCR because it:

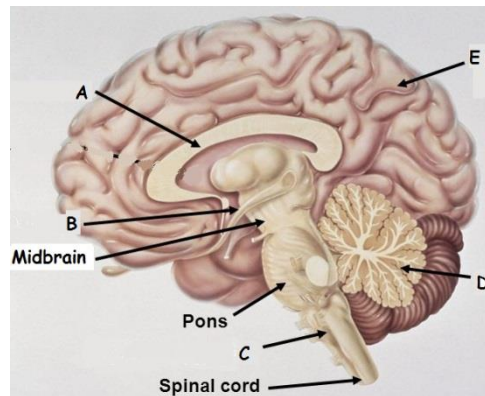
- a) speeds up the rate of the PCR process.
- b) **naturally lives in hot water.**
- c) raises the temperature of the solution.
- d) will survive in water.

14. Bacteria and yeasts are transgenic organisms which are used as “biofactories” to manufacture a variety of useful products. A number of products are listed below. Which ones are produced in “biofactories”?

- i) Antibodies
 - ii) Insulin
 - iii) Human growth hormone
 - iv) Milk proteins
- a) (i) only
 - b) (i) and (ii)
 - c) **(ii) and (iii)**
 - d) (i) and (iv)

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Refer to the diagram below to answer the next question.



15. Which of the following correctly identifies the structures of the central nervous system?

	A	B	C	D	E
a)	Cerebellum	Hypothalamus	Corpus Callosum	Cerebrum	Pituitary Gland
b)	Corpus Callosum	Hypothalamus	Medulla Oblongata	Cerebellum	Cerebrum
c)	Hypothalamus	Corpus Callosum	Medulla Oblongata	Cerebellum	Cerebrum
d)	Corpus Callosum	Hypothalamus	Cerebellum	Medulla Oblongata	Cerebrum

16. The sinoatrial (SA) node or pacemaker of the heart is under autonomic control from which part of the brain?

- a) medulla oblongata
- b) cerebellum
- c) cerebral cortex
- d) hypothalamus

17. Which of the following is NOT a property of a reflex?

- a) They occur without any conscious thought.
- b) They occur spontaneously, without a stimulus.
- c) They occur using only a small number of neurons.
- d) They occur in the same way each time they happen.

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18. The chemical that transmits a nerve stimulus via a somatic pathway to a muscle fibre is

- a) noradrenaline.
- b) cholesterol.
- c) acetylcholine.
- d) adenosine triphosphate.

19. Which of the following is NOT a similarity shared between the endocrine and nervous system?

- a) Some hormones are secreted by neurons into the extracellular fluid.
- b) Both systems are highly specific.
- c) Some hormones and neurotransmitters have the same effect on the same target cells.
- d) Some chemicals released from both systems function as both hormones and neurotransmitters.

20. The cerebrospinal fluid (CSF) is important in protecting the nervous system. Which of the following statements about this fluid is correct?

- a) The CSF occupies a space between the layers of the meninges, where the brain is suspended within this fluid.
- b) The CSF acts as a shock absorber, protecting the whole nervous system.
- c) The CSF is formed from blood and it circulates through the peripheral nervous system.
- d) During its circulation, the CSF takes nutrients to the cells of the brain and spinal cord, re-entering the lymphatic system.

21. A footballer, having received a blow to the head, has come off the field. She complains of having blurred vision. The most likely point of contact would have been the

- b) front of the head
- c) left hand-side of the head
- d) right hand-side of the head
- e) rear of the head

22. A symptom of a person with hyperthyroidism would include:

- a) slow heart rate.
- b) weight gain.
- c) intolerance to cold.
- d) increased appetite.

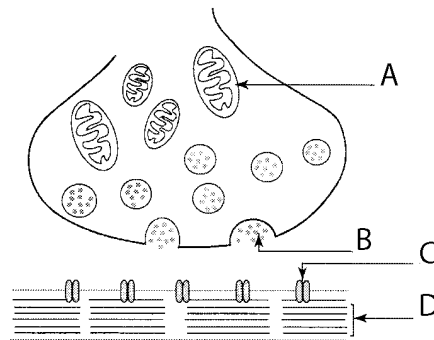
23. An individual suffering from excessive levels of calcium circulating in the blood would most likely have a dysfunctional:

- a) thyroid.
- b) pancreas.
- c) parathyroid gland.
- d) adrenal gland.

24. Using gene therapy to treat a disease would involve:

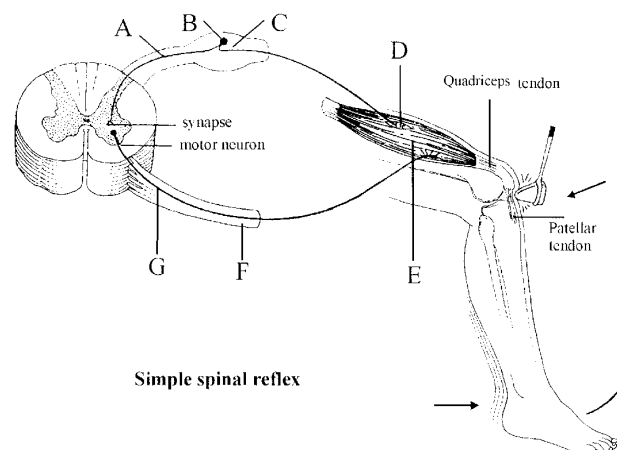
- a) transferring particular proteins into a person with the disease.
- b) injecting various types of blood into a person with the disease.
- c) injecting viruses that destroy certain cells of a person with the disease.
- d) transferring alleles into the cells of a person with the disease.

25. A bite from a cone shellfish (a type of marine animal) injects a toxin into the body of a victim. This toxin binds to neurotransmitter receptors in the synapse. Which of the following letters in the diagram below best represents these receptors?



- a) A
- b) B
- c) C
- d) D

The following question refers to the diagram below:

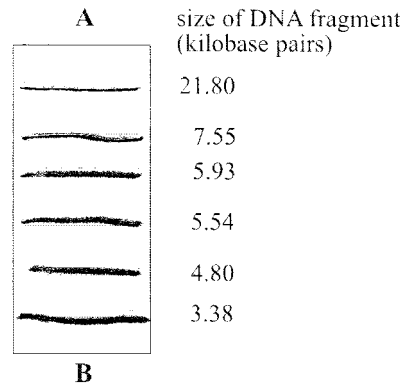


26. The efferent or motor neuron axon is located at

- a) A
- b) C
- c) F
- d) G

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The following DNA profile was obtained from skin cells found at a crime scene. One section of a chromosome from the skin sample was separated using gel electrophoresis.

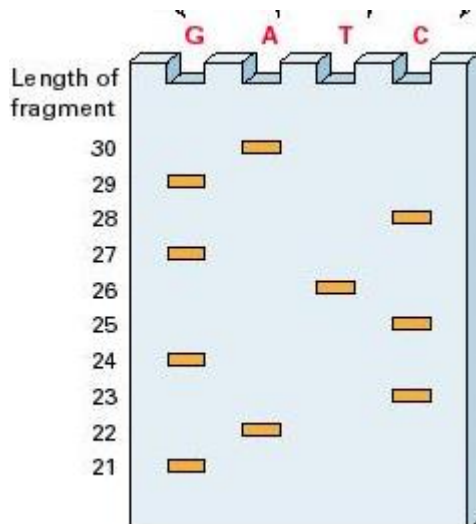


27. Which of the following statements is **CORRECT**?

- a) The direction of the movement of the DNA fragments is from B towards A.
- b) Three of the DNA fragments must have been inherited from the individual's mother.
- c) The polymerase chain reaction would have been used to multiply the section of the DNA molecule
- d) The restriction enzyme must have cut the section of the DNA molecule in six places.

28. Examine the gel below which was produced during the Sanger method of DNA sequencing.

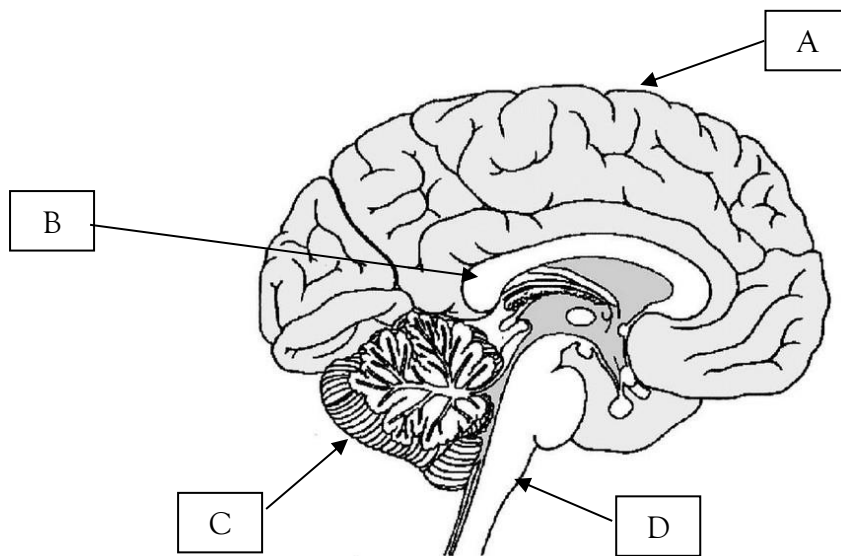
Identify the correct sequence of bases that would be found on the DNA of interest.



- a) AGCGTCGCAG
- b) GGGGAATCCC
- c) GACGCTGCGA
- d) CTGCGACGCT

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29. Which part of the brain is responsible for the maintenance of posture and balance?



- a) A
- b) B
- c) C**
- d) D

30. When the hormone cortisol reaches a target cell, it enters the cell and combines with a receptor protein inside the cell. The combined substance enters the nucleus, where it activates genes to produce a protein. Cortisol is an example of a:

- a) Water soluble amine.
- b) Water soluble steroid.
- c) Lipid soluble amine.
- d) Lipid soluble steroid.**

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Section Two: Short answer**50% (100 Marks)**

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.

Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question(s) that you are continuing to answer at the top of the page.

Suggested working time for this section is 90 minutes.

31.

(24 marks)

Scientists wanted to test the hypothesis that increased levels of adrenocorticotrophic hormone (ACTH) during stressful situations could lead to weight gain in humans. It has been acknowledged that glucocorticoids (namely cortisol), are released during times of stress and the presence of these hormones may cause weight gain.

To investigate this theory, scientists exposed the same number of rats (10), who were all one year of age, to increasingly more stressful situations and then allowed them access to an unlimited supply of food pellets for 15 minutes. To induce stress, the rats were kept in isolation and completely restrained by a belt lined with wool, which was appropriately sized, depending on the age and size of the rat. Once the time of restraint had elapsed, the amount of adrenocorticotrophic hormone (ACTH) present in their blood was measured and the average calculated. The average amount of ACTH was measured in picograms per mL of blood. The rats were then freed and allowed access to the food. The scientists recorded the number of pellets that were eaten. The results from the experiment can be seen below.

	Number of pellets eaten within 15 minutes after release.			
	Trials			
Average amount of ACTH in blood (pg/mL)	1	2	3	Average
30	14	14.25	13.75	14
60	10	10.25	9.75	10
90	8.25	9	8.25	8.5
120	17	19	18	18
150	21	24	22.5	22.5

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(a) Name the independent variable. *Amount of ACTH (1/2) in blood (1/2)* (1 mark)

(b) List three controlled variables that would ensure the test was fair. *Any 3 of the following for max 1 mark each.*

- *Unlimited food supply*
- *Same method used to induce stress*
- *Same age of rats*
- *Same eating habits*
- *Time spent eating the pellets (15 minutes)*
- *Same stress conditions eg belt*
- *Same temperature the experiment was conducted in*
- *Same weight of the rats*
- **Did not accept**
 - **the same amount of time they were stressed for. This was how they increased the amount of ACTH in their blood.**
 - **Number of rats in each sample size**
 - **Size of rat**

(3 marks)

(c) Complete the table on the previous page by calculating the average number of pellets eaten for the last test.

See table on previous page.

(1 mark)

(d) Plot the results on the graph paper supplied on the next page. (Spare graph grid on page 34)

Graph needs to have the following for one mark each:

Correctly plots points and joins points to form a line/curve (1)

Labelling of X and Y axes with correct name (1) and unit (1)

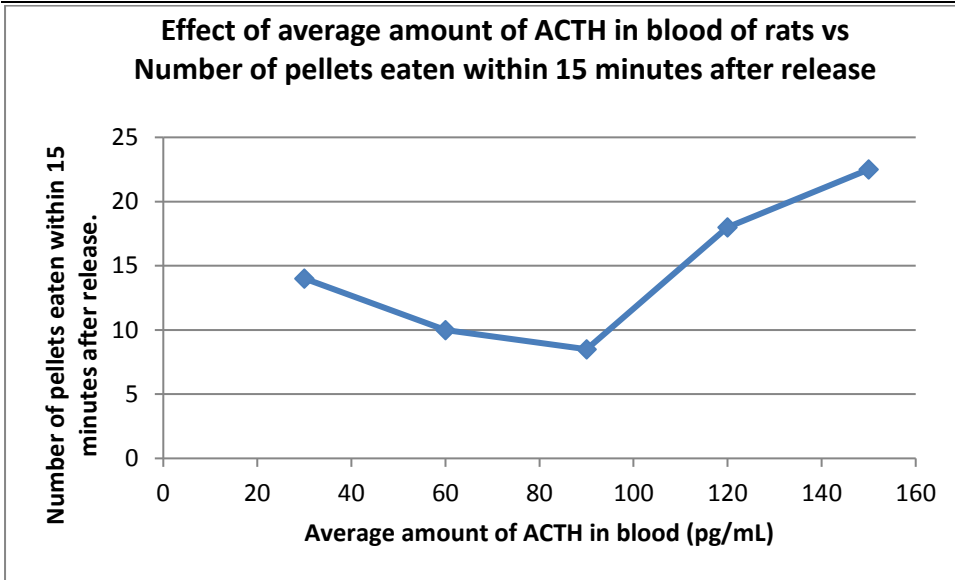
Uses a suitable scale (1)

Title appropriate with both variables included (1)

Bar graph -1 mark

No average graphed -1 mark

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(5 marks)

(e) State where in the body, glucocorticoids are released from. *Adrenal Cortex*
Many students just wrote adrenal glands"- no mark allocated for this

(1 mark)

(f) For each situation listed below, give one reason why the scientists:

(i) measured and calculated the average amount of ACTH.

1 mark each correct.

Provided a quantified level (1 mark) to indicate the level of stress the animal was experiencing. (1 mark)

(2 marks)

(ii) measured the amount of ACTH rather than the glucocorticoids.

ACTH is the hormone responsible for stimulating the release of glucocorticoids (1 mark)

It is easier to detect and measure one hormone rather than a number of them (1 mark)

(2 marks)

(g) Using the results of the experiment, describe the effect of increasing ACTH levels from 30 - 90pg/mL appeared to have on the rats' appetite.
 (2 marks)

MUST provide this or similar observation

- ACTH appeared to suppress the mices' appetite / the amount they ate decreased after each test (1 mark), from 14 to 10 to 8.5 pellets eaten(1 mark)*

(h) Provide one explanation as to why this effect occurred. (2 marks)

- *Increase in ACTH → increase in cortisol → increase in glycogenolysis and/or gluconeogenesis (1 mark) → increase in blood sugar levels → decrease in appetite (1 mark) or*
- *Appetite suppressed as sympathetic nervous system releases noradrenaline (1 mark) which decreases peristalsis/movement of the intestines/stomach. (1 mark)*

(h) Upon reviewing the procedure of this experiment, an independent scientist claimed,

“The procedure for this experiment was not conducted in an ethical way and the results were invalid given the hypothesis”.

Explain what the independent scientist meant by this statement.

- *Unethical because the treatment of the rats was inhumane (1 mark) / there was foreseeable risk of physiological and/or psychological harm. (1 mark)*
- *The results were invalid because the test determined the effects of stress on eating habits on rats and not on humans, as proposed by the hypothesis. (1 mark)*

(2 marks)

(i) Cortisol has the ability to pass directly through the membrane of liver cells. State what type of hormone cortisol is and explain how it stimulates the cell to form particular proteins.

- *Cortisol is a steroid hormone. (1 mark)*
- *Cortisol/steroid hormone enters the target cell and combines with receptor protein (1 mark)*
- *The hormone-receptor complex activates the genes / controlling the formation of proteins. (1 mark)*

(3 marks)

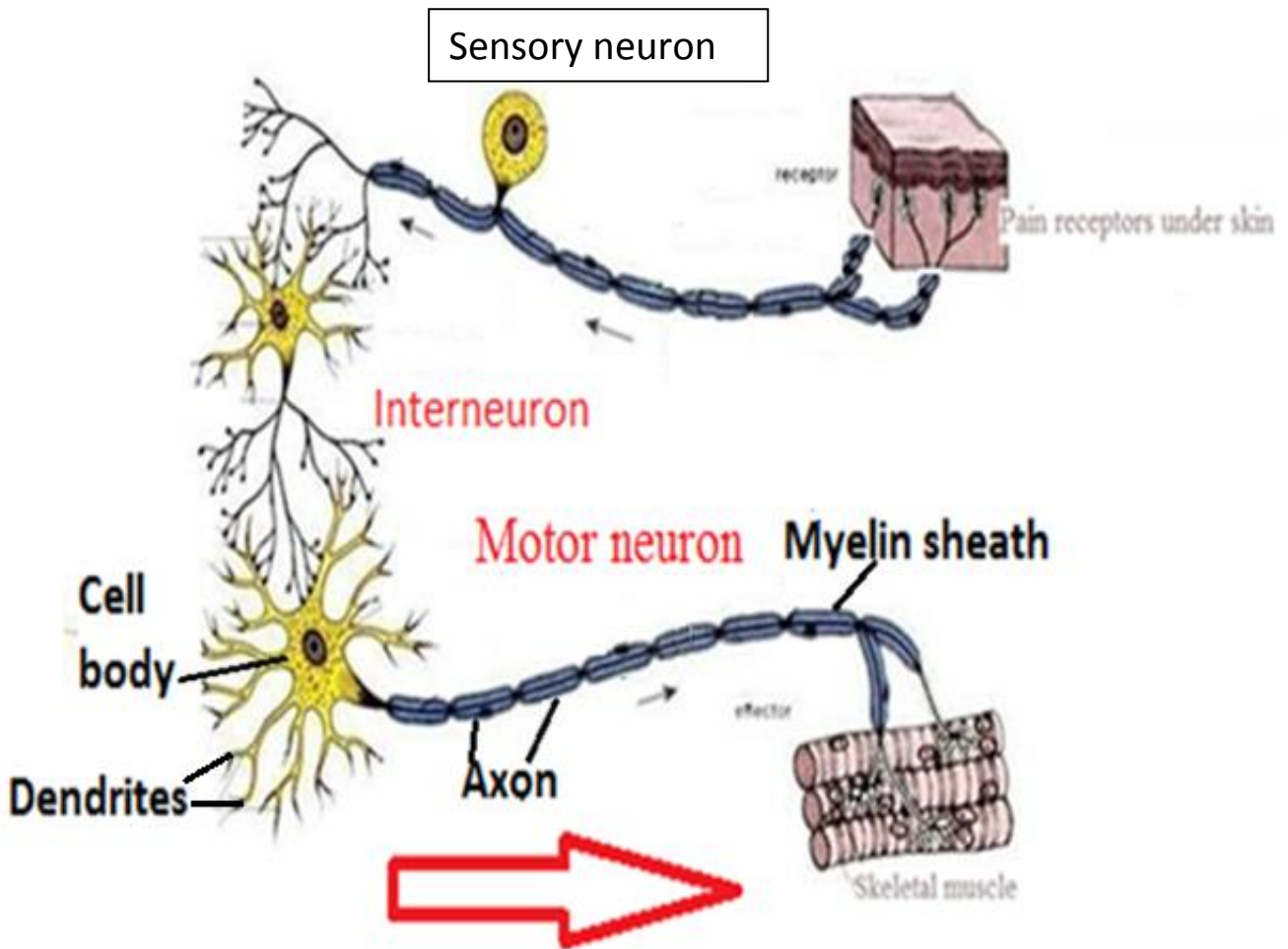
32.

(15 marks)

- Complete the diagram below of a reflex arc, by drawing a myelinated unipolar neuron in the appropriate space below.

Many students completed a poor diagram

(1 mark)



- Indicate with an arrow in the rectangular box above, the direction of the nerve impulse through the axon above the rectangular box. (1 mark)
- Complete the following table.

Part	One Function of the Part
Cell Body	<i>Controls all cell's functions. Accepted "contains cell organelles" but not "contains nucleus"</i>
Dendrites	<i>Receive messages/impulses from other neurons OR Carries impulses to the cell body</i>
Myelin sheath	<i>Any 1 of 3 (max 1 mark) Acts as an insulator Protects axon from damage Speeds up the movement of an impulse</i>
Axon	<i>Carries impulses away from the cell body</i>

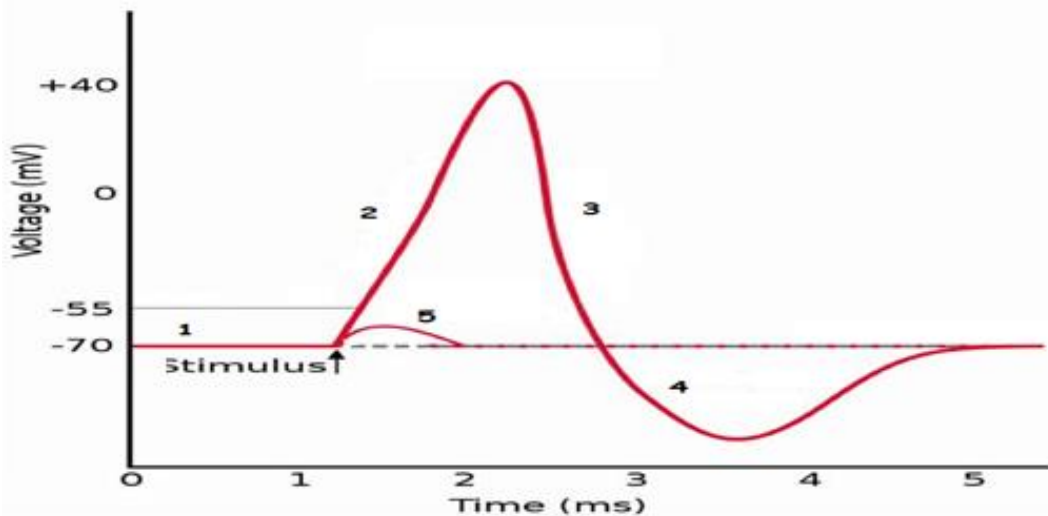
(4 marks)

- Label the parts listed in the table onto the multipolar neuron in the diagram above. (4 marks)
- Label each neuron in the diagram above according to their functional type.
Many students did not label the interneuron (3 marks)
- State which of the neurons above cannot regenerate its axon and state why.
The interneuron cannot regenerate its axon (1 mark) as it does not have a neurilemma layer, which is responsible for repairing damaged fibres (1 mark).
No mark for "no schwann cell or no myelin sheath". (2 marks)

33.

(14 marks)

Below is an action potential graph, showing the outcome from two different stimuli on the same neuron. Looking at the graph below, answer the questions that follow.



(a) Complete the following table which is referring to the section of the graph numbered 1.

Question	Answer
Is the inside of the cell depolarised or polarised?	Polarised
Are the sodium gates open or closed?	Closed
Are the potassium gates open or closed?	Closed
Is the outside of the neuron more positive or negative?	Positive
How many sodium ions are pumped out of the neuron relative to potassium ions?	3
How many potassium ions are pumped out of the neuron relative to sodium ions?	2

(3 marks)

(b) The first stimulus resulted in the line labelled with the number 5. Explain TWO reasons why the potential difference quickly returned to -70mV.

Student MUST have the following:

- The stimulus provided did not exceed the specific membrane potential threshold/ a change in 15mV did not occur. (1 mark)*

Student may have either of the following:

- Insufficient sodium ion gated channels were stimulated to open (1 mark) OR*
- Insufficient sodium ions moved across the membrane (1 mark)*

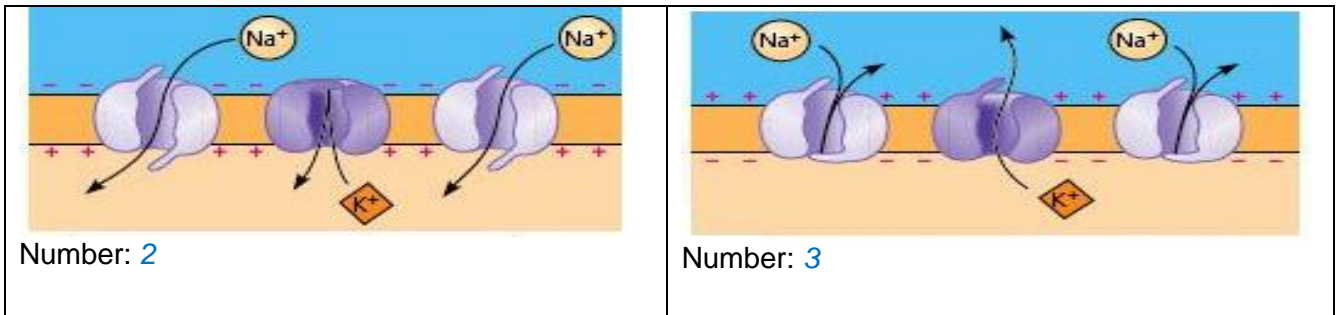
(2 marks)

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(c) The second stimulus resulted in the line labelled with the numbers 2, 3 and 4. State TWO events that could not possibly occur during the phases shown by the sections labelled 2, 3 and 4.

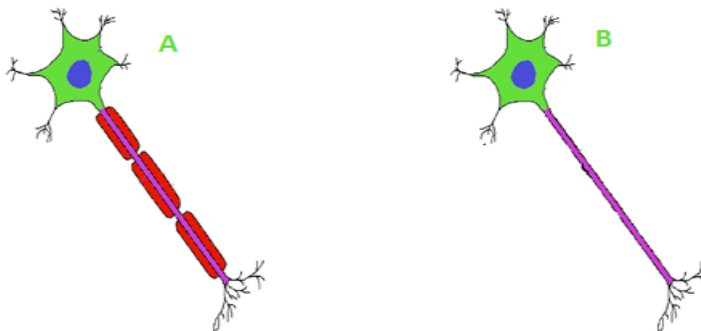
- *The impulse cannot flow backwards. (1 mark)*
- *A new action potential cannot be stimulated. (1 mark)* (2 marks)

(d) Use the graph above to identify the processes occurring in the following diagrams. Place the number 1, 2, 3 or 4 in the box highlighting the events that are taking place.



(2 marks)

(e) Look at the diagram below of the different nerve fibres and answer the questions that follow.



(i) Complete the following table:

Nerve fibre	Myelinated or unmyelinated?	Found in the grey matter or white matter?
A	myelinated	White matter
B	unmyelinated	Grey matter

(2 marks)

- (ii) State which of the nerve fibres above would conduct an impulse faster and briefly explain why. (3 marks)

A / Myelinated fibre = faster (1 mark).

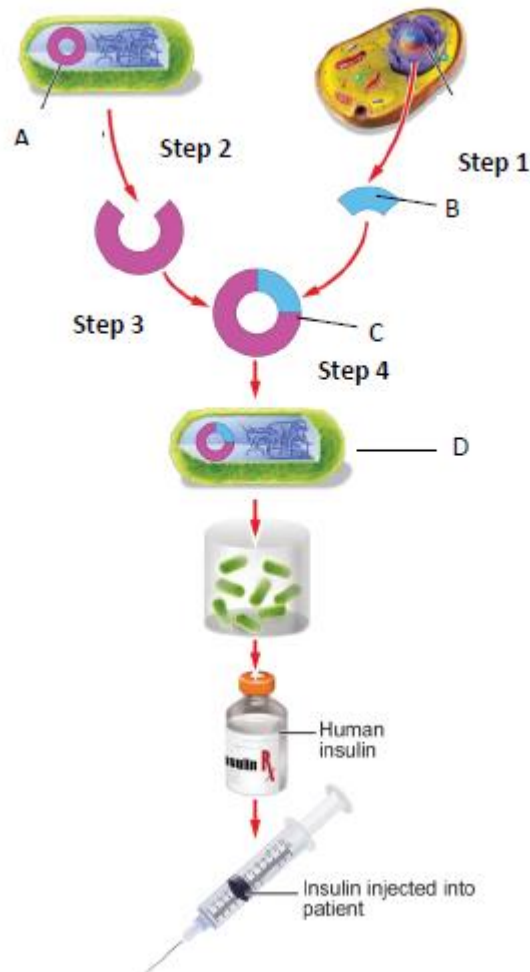
Myelin sheath insulates fibre and prevents the flow of ions through the membrane (1 mark), so the action potential jumps from node of Ranvier (where the myelin sheath is absent) to the next. (1 mark)

34.

(15 marks)

With reference to the diagram below

(4 marks)



a) Label the following:

A	Plasmid
B	Insulin gene
C	Recombinant DNA
D	Transgenic organism

b) In the table below, briefly outline the sequence of events in the production of insulin using biotechnology. (4 marks)

Step number	Description
Step 1	Removal of insulin gene using restriction enzymes
Step 2	Removal of bacterial plasmid using the same restriction enzyme
Step 3	Ligation using DNA ligase to connect the insulin gene to the plasmid
Step 4	Recombinant DNA/plasmid taken up by the bacterium

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c) The following questions refer to the regulation of blood glucose levels within the blood.

i) Name the main hormone that is responsible for increasing blood glucose levels in the blood. (1 mark)

• **Glucagon**

ii) Where is this hormone produced? Be as specific as possible. (1 mark)

• **Alpha cells**

iii) Give an everyday example of when this hormone may be produced. (1 mark)

• **During exercise**

• **Whilst fasting between meals**

iv) Explain the effects of this hormone in order to raise blood glucose levels. (4 marks)

• **Any two of the following:**

• Glycogenolysis (1 mark) is the production of glucose from glycogen (1 mark).

• Gluconeogenesis (1 mark) is the production of glucose from non carbohydrate sources such as amino acids (1 mark).

• Lipolysis (1 mark) is the production of glucose from the breakdown of lipids (1 mark).

35.

(15 marks)

Most people can only hold their breath for about one minute before they are forced to take a breath.

- e) Complete the following table summarising how the body regulates gas concentrations within the blood when a person holds their breath. (7 marks)

Stimulus	Increased carbon dioxide levels or Increased hydrogen ions (1 mark)
Receptor (name and location)	Chemoreceptors (1 mark) medulla oblongata / Aortic and carotid bodies (1 mark)
Modulator	Respiratory centre (1/2) of the medulla oblongata (1/2 mark) no marks for respiratory centre only
Effector	Diaphragm (1) Intercostal muscles (1)
Response	Increased breathing rate (1) No marks for providing the -ve feedback, the response is what the effector does

- f) Hyperventilation, the rapid and deep breathing in an out, can occur voluntarily or involuntarily. It can occur involuntarily in response to severe pain or extreme fear. Complete the following table to distinguish between the two different efferent nervous divisions that **can regulate hyperventilation**.

(5 marks)

	Names of two different nervous efferent divisions	
	<i>Autonomic</i>	<i>Somatic</i>
Neurotransmitters	<i>Acetylcholine or noradrenaline</i>	<i>Acetylcholine</i>
Effector(s) / target organ(s)	<i>Diaphragm and Intercostal muscles – answer must be in the context of hyperventilation</i>	<i>Diaphragm and Intercostal muscles</i>
Effect of neurotransmitter on effector(s) / target organ(s)	<i>Excitation or inhibition</i>	<i>Always excitation</i>
The number of neurons between the CNS and effector	<i>2</i>	<i>1</i>

1 mark awarded for each correct pair. No ½ marks can be given.

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g) Explain how voluntary hyperventilation allows a swimmer to hold their breath for longer. (3 marks)

- Rapid removal of carbon dioxide gas (1 mark)
- Chemoreceptors are not stimulated (1 mark)
- Delays the stimulation of the inspiratory centre which delays the swimmer from taking a breath (1 mark)

(5 marks)

36. A marathon runner is just about to complete a race in hot weather and he is sweating, feels thirsty and his skin is red and hot.

a) Complete the following table to summarise the body's symptoms to the exercise in the hot environment.

Symptoms	Stimulus	Receptor	Modulator	One Effector	Response
Red and hot skin	Increased body temperature	Thermoreceptor	<i>Hypothalamus</i>	Blood vessels	<i>Dilated blood vessels</i>
Sweating	Increased body temperature	Thermoreceptor	<i>Hypothalamus</i>	Sweat glands	Sweat released onto the surface of this skin
Thirsty	Increased osmotic pressure	<i>Osmoreceptor</i>	Hypothalamus	<i>Cerebral cortex</i>	Conscious decision to have a drink.

(5 marks)

37.

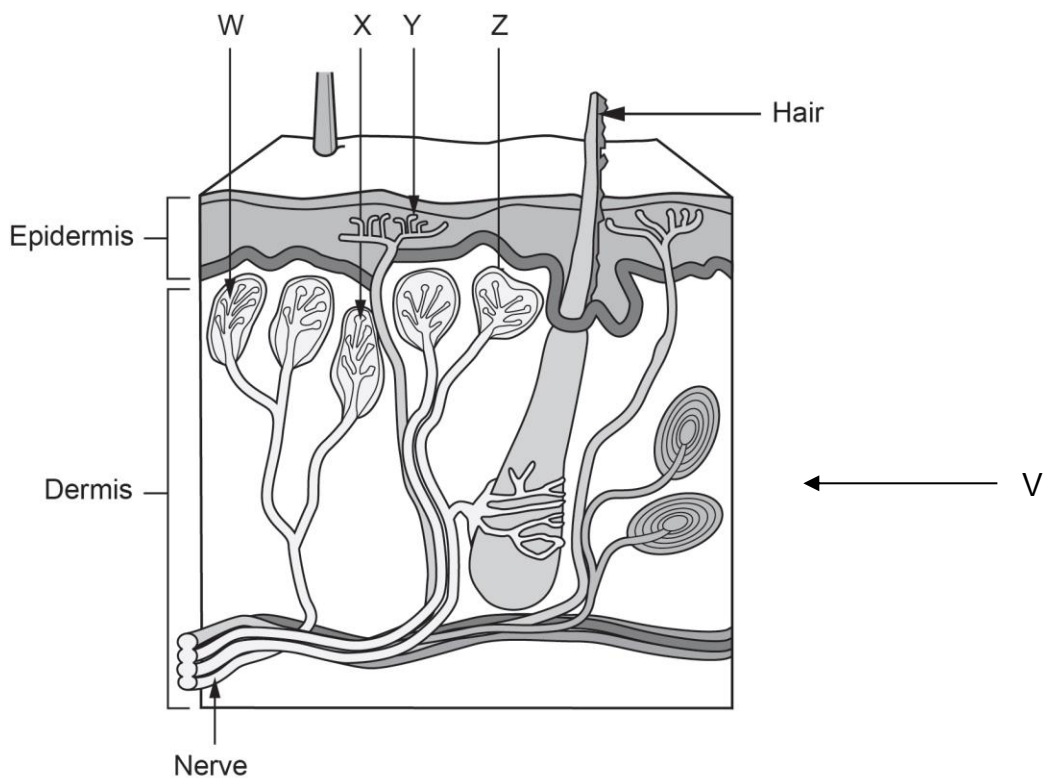
(5 marks)

(a) The pituitary gland is sometimes referred to as the “master gland” however; it could be argued the hypothalamus should have this title. Describe how the hypothalamus controls the secretion of hormones from the anterior and posterior lobe of the pituitary gland. (5 marks)

- *Anterior lobe controlled by releasing and inhibiting factors (1 mark)*
- *from the hypothalamus (1 mark)*
- *that reach the anterior lobe via network of blood vessels/infundibulum (1 mark).*
- *Hormones (oxytocin and ADH) are produced in the hypothalamus (1 mark)*
- *and passed along nerve fibres to the posterior lobe, to be secreted (1 mark)*

(7 marks)

38. The following question refers to the diagram of the skin below.

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d) Receptor W is close to the skin surface is said to be “adaptable”. What does this mean?

(1 mark)

- After a short time after being stimulated, you are no longer are aware of the touch.

e) Identify the difference between receptors labelled Y and X.

(4 marks)

Note well -this diagram is from the text book and appeared in last year's WACE exam. WACE marks payed touch receptor for Y as the text book is labelled incorrectly. Y is in fact a pain receptor- please change your text book

Receptor	Type of Receptor	One Function
Y	Pain receptor Paid touch receptor was paid as per the text book	Detect potentially damaging stimuli and send pain signals to the spinal cord and brain
X	Touch receptor	Detects any contact made with the skin and sends a message to the spinal cord and brain

f) How do you think the concentration of receptor X would be different when comparing your fingertips to the heel of your foot? Explain your answer.

(2 marks)

- There would be a greater number of receptor X in your finger-tips when compared to the heel of your foot (1 mark).
- A larger number of receptors allows greater sensitivity to touch (1 mark).

Section Three: Extended answer**20% (40 Marks)**

This section contains **three (3)** questions. You must answer **two (2)** questions. Make sure you clearly indicate which question you are answering and write your answers in the space provided.

Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.

- Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
- Continuing an answer: If you need to use more space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Write the number of the question(s) that you are continuing to answer at the top of the additional space page.

Responses could include clearly labelled diagrams with explanatory notes; lists of points with linking sentences; clearly labelled tables and graphs; and annotated flow diagrams with introductory notes.

Suggested working time: 40 minutes.

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© WATP

39.**(20 marks)**

The neurotransmitter, dopamine stimulates target neurones in the same manner as an amine hormone would affect a target cell. It can have an excitatory or inhibitory effect on the action potential of the target neuron. An excitatory or inhibitory effect on the target neuron is influenced by whether the post-synaptic neuron has D1 or D2 receptors. If the neuron has D1 receptors, sodium ion (Na⁺) channels are stimulated to be opened and if the neuron has D2 receptors, potassium ion (K⁺) channels are stimulated to open.

- (i) Describe how dopamine would move from the presynaptic neuron, across the synapse, to activate a post synaptic neuron.

(9 marks)

- *Action potential stimulates the calcium channels/ gates to open (1 mark)*
- *Calcium enters pre-synaptic neuron (1 mark)*
- *Vesicles bind to the neuron membrane (1 mark)*
- *Dopamine released from vesicles, (1 mark)*
- *and diffuses across synapse. (1 mark)*
- *Dopamine attaches to receptor protein/site in the membrane of the postsynaptic dendrite/ neuron (1 mark)*
- *Dopamine can only bind with a specific receptor. (1 mark)*
- *Sodium channels/ gates are stimulated to open (1 mark)*
- *Sodium ions enters the post synaptic neuron and an action potential is generated (1 mark)*

- (ii) State whether the D2 receptors would cause an excitatory or inhibitory effect on the action potential of the target neuron and describe why this response would occur.

- *D2 receptors = inhibitory effect because, (1 mark)*
- *The sodium ion gated channels are not stimulated and remain closed (1 mark)*

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- *If D2 receptors are stimulated, potassium ion gated channels are stimulated to open, which causes the inside of the cell to become electrically negative. (1 mark)*
- *If there is a negative charge inside the cell and a positive charge outside the cell, then the neuron remains polarised (1 mark)*
- *and an action potential cannot be stimulated (1 mark)*

(4 marks)

- (iii) The constant supply of adrenaline would stimulate the autonomic nervous system. State which division of the autonomic nervous system would be stimulated and describe how six different parts of the body would be affected by this neurotransmitter.

Autonomic nervous division = sympathetic division (1 mark)

Any one of the following parts and their matching responses awarded 1 mark each, to a maximum of 6 marks.

<i>Part</i>	<i>Effect of noradrenaline/sympathetic nervous division</i>
<i>Heart</i>	<i>Increases rate and strength of contraction</i>
<i>Lungs</i>	<i>Dilates bronchioles</i>
<i>Stomach, intestines</i>	<i>Decreases movement/ peristalsis</i>
<i>Liver</i>	<i>Increases breakdown of glycogen to glucose / glycogenolysis</i>
<i>Iris of the eye</i>	<i>Dilates pupil</i>
<i>Sweat glands</i>	<i>Increased sweat secretion</i>
<i>Salivary glands</i>	<i>Decreases saliva secretion</i>
<i>Blood vessels of Skin</i>	<i>Vasoconstriction / constricts vessels</i>
<i>Blood vessels of Skeletal muscles</i>	<i>Vasodilation / dilates vessels</i>
<i>Blood vessels of Internal organs</i>	<i>Vasoconstriction EXCEPT in heart and lungs</i>
<i>Urinary bladder</i>	<i>Relaxes wall muscles</i>
<i>Adrenal medulla</i>	<i>Stimulates hormone/adrenaline secretion</i>

(7 marks)

40.

(20 marks)

Under normal circumstances, homeostatic control mechanisms ensure blood glucose levels and body fluid composition are maintained at a constant level. The night before a triathlon, competitors may consume a large meal high in carbohydrates and they will be required to drink plenty of water during the event to remain hydrated.

(a) Explain how the human body reduces blood glucose levels after a meal high in carbohydrates.

- *Beta cells detect the rise in blood glucose levels (1 mark)*
- *Beta cells release the hormone insulin (1 mark)*
- *Glycogenesis (1 mark) is the conversion of glucose to glycogen (1 mark) in the liver (1 mark)*
- *Lipogenesis (1 mark) is the conversion of glucose to fat (1 mark) which is stored in adipose tissue (1 mark)*
- *Translocation (1 mark) is the accelerates transport of glucose from blood into cells (1 mark)*
- *Increase in rate of cellular respiration (1 mark)*
- *Increased rate of protein synthesis (1 mark)*

(7 marks)

(b) During the marathon, the competitor's body fluid levels will begin to drop. Explain the physiological and behavioural changes the body will undergo to maintain homeostasis.

(9 marks)

- *Increased osmotic pressure within blood (1 mark)*
- *Change in osmotic pressure is detected by the osmo-receptors (1 mark) in the hypothalamus (1 mark)*
- *The posterior lobe of the pituitary gland (1 mark) releases ADH (1 mark)*
- *ADH increases the permeability of the nephron tubules (1 mark)*
- *More water is reabsorbed into the blood (1 mark)*
- *Thirst reflex in the thirst centre of the hypothalamus is also stimulated (1 mark)*
- *The competitor will start experiencing a dry mouth and/or a feeling of thirst (1 mark)*
- *The competitor will drink water (1 mark)*

(c) If a person can not regulate their blood glucose levels, they may be suffering from Type 1 Diabetes. Explain the cause and treatments of Type 1 Diabetes.

(4 marks)

<i>Type of diabetes</i>	<i>Cause</i>	<i>Treatment</i>
<i>Type 1</i>	<i>A fault in the immune system/autoimmune disease that causes the destruction of beta cells (in the islets of Langerhans) of the pancreas (1 mark).</i> <i>Therefore do not produce insulin (1 mark)</i>	<i>Regular injections of insulin (1 mark) OR</i> <i>Use of a programmable pump that provides a continuous supply of insulin (under the skin) (1 mark)</i>

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41.

(20 Marks)

The understanding of the structure and function of DNA has allowed scientists to develop new technologies that can improve the quality of our life and the health of our planet. The Polymerase Chain Reaction and the Sanger method of DNA sequencing are two techniques used by scientists throughout the world today.

a) Name and describe the three main stages of the polymerase chain reaction technique.

(10 marks)

- Denaturing (1 mark) the DNA segment is heated to 96°C (1 mark) which causes the DNA to separate into two strands (1 mark).
- Annealing (1 mark) the DNA strands are cooled to around 50°C (1 mark) which allows DNA polymerase (1 mark) to attach a primer to the template strand (1 mark).
- Elongation/ Extension (1 mark) the DNA strands are heated to 72°C (1 mark) which allows DNA polymerase (1 mark) to add free nucleotides to the DNA template strand (1 mark)

b) Explain the steps involved in DNA sequencing. In your answer, name the synthetic nucleotide and its role in this process.

(10 marks)

- Synthetic terminator nucleotides are called dideoxy or terminator nucleotides (1 mark)
- The role of the dideoxy/ terminator nucleotide is to terminate the elongation/ extension of the DNA molecule (1 mark).

Any 8 of the following points

- DNA strand is denatured using heat (1 mark).
- DNA polymerase attaches a primer to the template strand (1 mark).
- DNA polymerase adds free nucleotides to the template strand (1 mark).
- Synthetic terminator nucleotides are randomly added onto the template strand which stops the elongation/ extension process (1 mark).
- Different sized strands of DNA are produced (1 mark).
- DNA strands are placed into a gel electrophoresis tank (1 mark).
- Negatively charged DNA strands move towards the positive electrode (1 mark).
- Smaller sized pieces of DNA move further through the gel (1 mark).

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