



CHURCHLANDS
SENIOR HIGH SCHOOL

Semester One Examination 2016

Question/Answer Booklet

HUMAN BIOLOGICAL SCIENCE

Stage 3

Name _____

Class _____

Teacher Name _____

Time allowed for this paper

Reading time before commencing work: Ten minutes

Working time for paper: Three hours

Materials required/recommended for this paper

To be provided by the supervisor:

This Question/ Answer Booklet

Two Extended Answer Booklets: Part A and Part B

(Note – your multiple choice answer sheet is in Booklet Part A along with SPARE grid for graphing)

To be provided by the candidate

Standard items: Pens, pencils, eraser, correction fluid, ruler, highlighters

Special items: Non-programmable calculators satisfying the conditions set by the Curriculum Council for this course

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	Number of questions available	Number of questions to be answered	Suggested working time (minutes)	Marks available	Percentage of exam	Student Score
Section One: Multiple-choice	30	30	40	60	30	
Section Two: Short answer	12	12	90	100	50	
Section Three: Extended answer	3	2	50	40	20	
					100	

Instructions to candidates

- The rules for the conduct of Western Australian external examinations are detailed in the *Year 12 Information Handbook 2011*. 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 **Multiple-Choice Answer Sheet provided in Booklet Part A.**

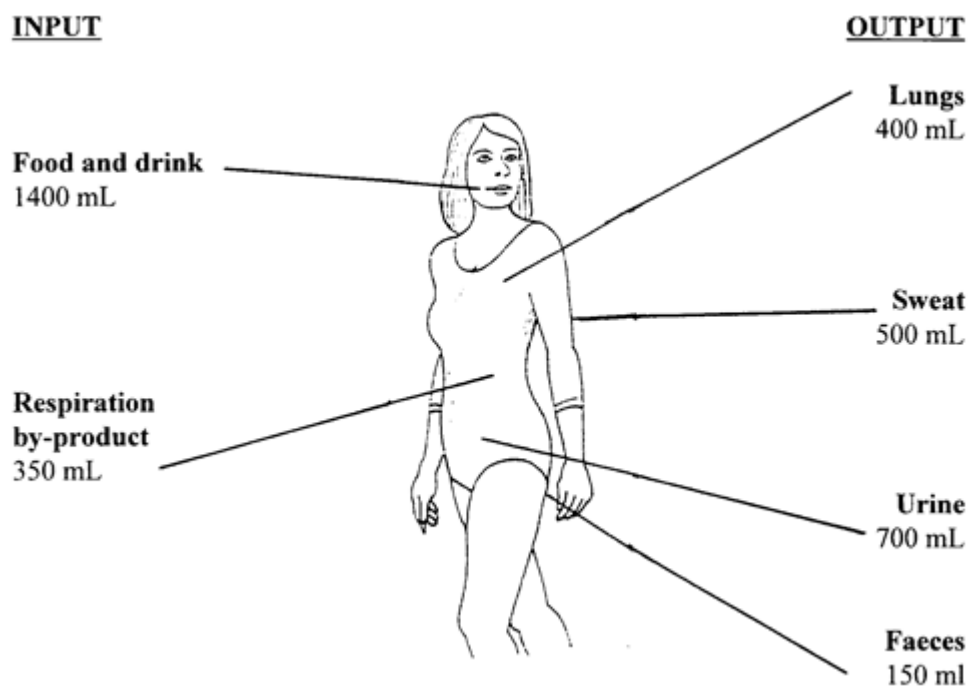
For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given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

Sections Two and Three: Write short answers in this question booklet. Write extended answers in Part A and Part B booklets.

- 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.

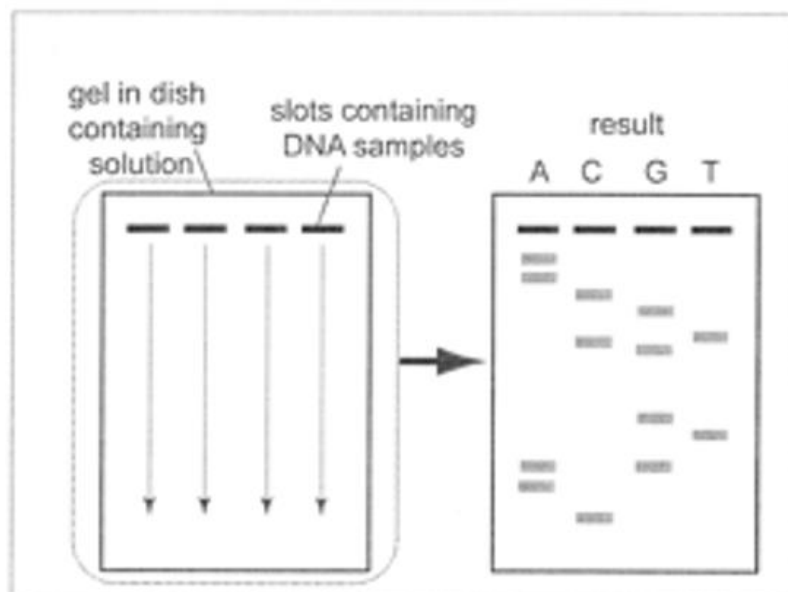
SECTION A:

Answer all questions by placing an **X** over the best answer on the multi-choice answer sheet on the answer booklet.



1. The figure above illustrates:
 - (a) Homeostasis.
 - (b) Dehydration.
 - (c) Hydration.
 - (d) Respiration.
2. The pituitary gland synthesizes and secretes all of the following hormones except:
 - (a) Thyroid stimulating hormone.
 - (b) Prolactin.
 - (c) Oxytocin.
 - (d) Growth hormone.

3. The figure below represents a method used to sequence DNA.

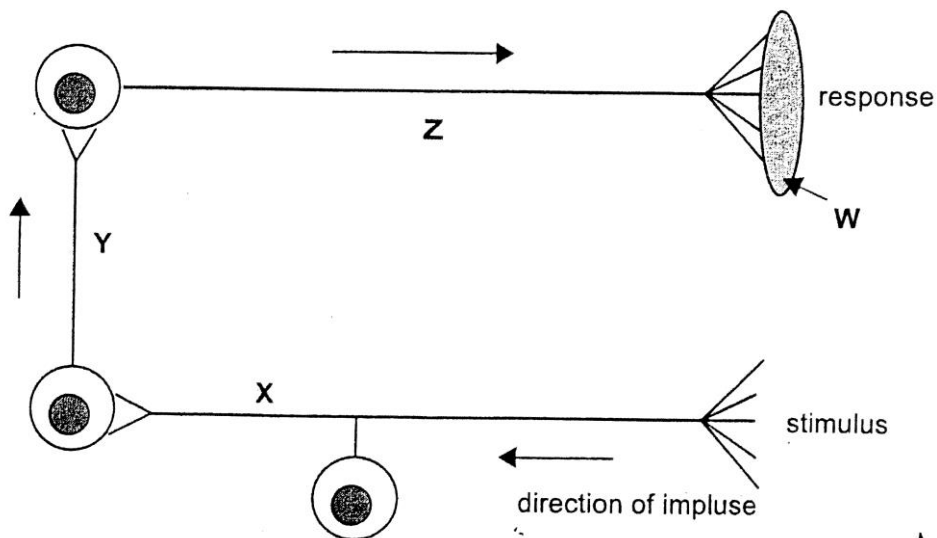


Which of the following statements concerning the diagram above is not correct?

- (a) The above equipment can be used to sequence DNA.
 - (b) The largest piece of DNA was placed in the slot labelled A.
 - (c) This method relies upon the attraction of opposite charges.
 - (d) The gel was extremely permeable to all of the DNA pieces tested.
4. In a reflex arc:
- (a) Sensory information travels along the ventral root to the grey matter of the CNS.
 - (b) The association neuron is found in the white matter of the spinal cord.
 - (c) The cell body of a motor neuron is found in the grey matter of the spinal cord.
 - (d) An effector is stimulated via nerve pathways in the dorsal root.

Use the following information to help you to answer Question 5 and 6.

An electrical impulse can be transmitted along three neurons as show in the following diagram:



5. The neuron which is part of the efferent division is:

- (a) W.
- (b) Z.
- (c) Y.
- (d) X.




6. The association neuron is represented by:

- (a) W.
- (b) Z.
- (c) Y.
- (d) X.


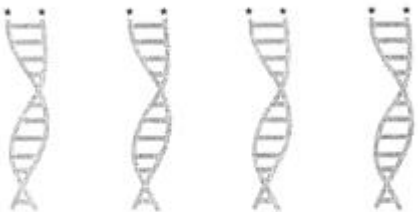
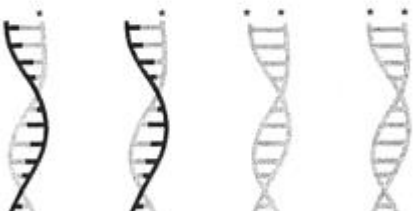

7. The parasympathetic nervous system is involved in:

- (a) Dilating the pupil of the eye; inhibiting secretion of the salivary glands.
- (b) Constricting the pupil of the eye; stimulating secretion of the salivary glands.
- (c) Stimulating motility of the gut; increasing heart rate.
- (d) Inhibiting motility of the gut; decreasing heart rate.

8. Radioactively labelled nucleotides were incubated with an unlabelled molecule of DNA. Appropriate enzymes were added and the DNA was allowed to replicate for two cycles. Examine the following key:

Unlabelled DNA	One strand labelled	Both strands labelled
		

Given that two cycles of DNA replication occurred, the end result would be:

- A. 
- B. 
- C. 
- D. 

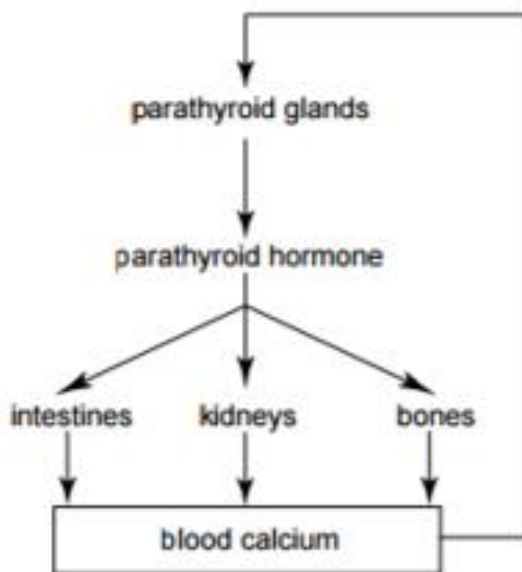
9. A point mutation occurs when there is a change in one nucleotide on a section of DNA. For example, a point mutation in a particular gene sequence of Chromosome 7 can result in an increased likelihood of a person developing skin cancer. To identify whether the Chromosome 7 gene is cancer causing, which of the following is the most correct sequence of processes that would occur in the laboratory?
- (a) Isolate the gene of interest, electrophoresis, DNA sequencing, PCR.
 - (b) PCR, isolate gene of interest, electrophoresis.
 - (c) Isolate gene of interest, PCR, DNA sequencing.
 - (d) PCR, use restriction enzymes to isolate gene of interest, DNA sequencing, DNA profile.

The next question refers to the diagram of the neuron below:



10. This neuron would be expected to be found associated with:
- (a) A skeletal muscle cell.
 - (b) An endocrine gland.
 - (c) A smooth muscle cell.
 - (d) A touch receptor.
11. A person suffering water intoxication has consumed too much water in a short period of time. What effect would this have on the blood plasma and the nephron tubules?
- (a) Increased osmotic pressure of the blood and increased water reabsorption from the nephron tubules into the blood plasma.
 - (b) Decreased osmotic pressure of the blood and decreased water reabsorption from the nephron tubules.
 - (c) Increased water concentration of the blood and increased water reabsorption from the nephron tubules into the blood plasma.
 - (d) Decreased water concentration of the blood and decreased water reabsorption from the nephron tubules into the blood plasma.

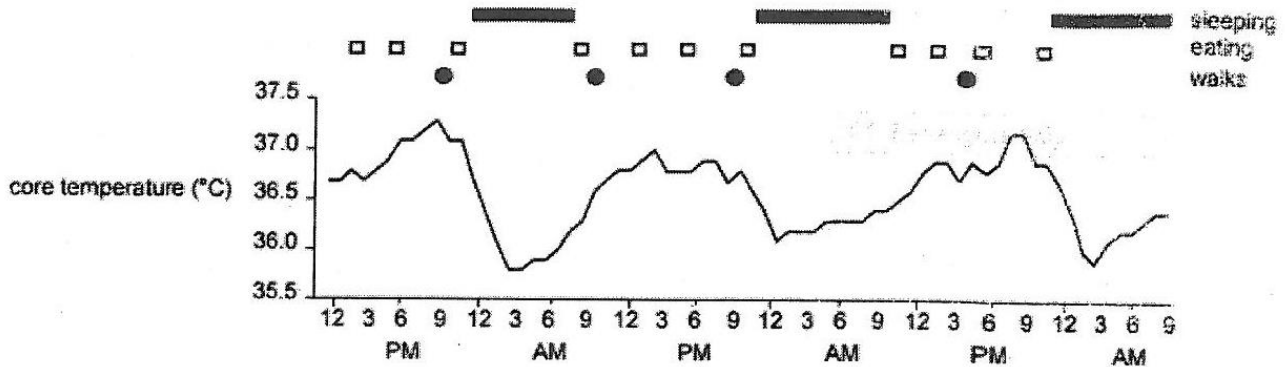
12. In a nerve impulse:
- (a) an all or nothing response occurs which means an impulse will occur regardless of the size of the stimulation.
 - (b) the refractory period is when further stimulation will not result in an impulse being generated.
 - (c) depolarisation occurs when potassium ions flood into the axon.
 - (d) repolarisation occurs when the inside of the cell becomes more electrically positive.
13. The following flow chart shows a feedback mechanism related to a parathyroid hormone. Parathyroid hormone acts on various parts of the body and stimulates an increase in the concentration of blood calcium. Use the flow chart to answer the following question.



A fall in the concentration of calcium in the blood would result in which of the following?

- (a) A rise in the level of calcium in urine.
- (b) An increase in absorption of calcium by bones.
- (c) A reduction in the activity of the parathyroid glands.
- (d) Increased absorption of calcium from the intestines.

Use of the following information to answer Questions 14 and 15. An experiment on the control of body temperature recorded the core temperature of one human subject, Jonah, living in one room for three days. The room temperature was kept constant at 20 °C. The results of the experiment are shown on the graph below:

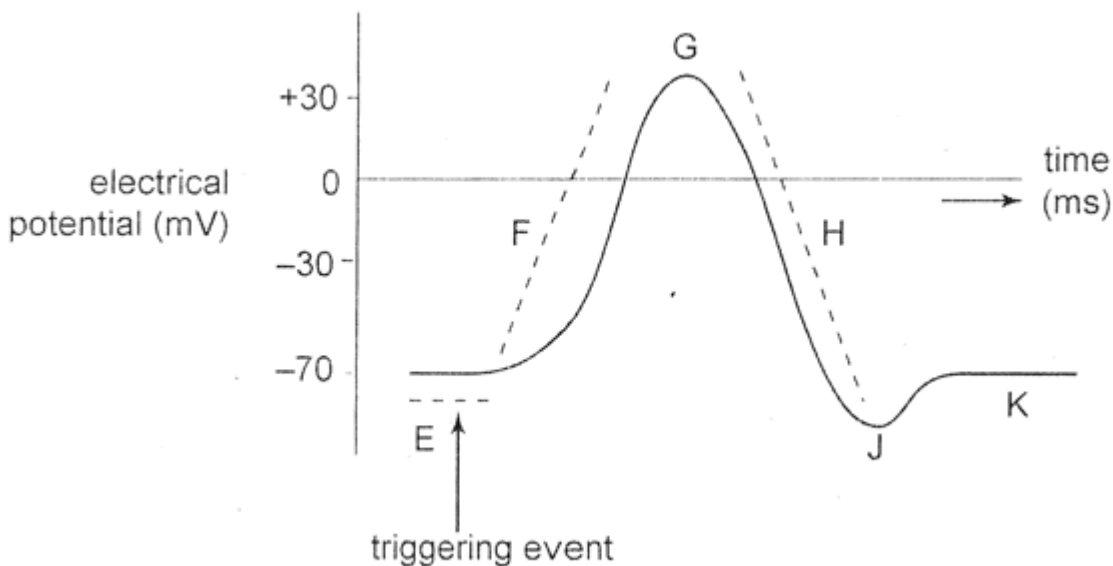


14. It is reasonable to state that Jonah's core body temperature is:
- Normally 36.5 °C.
 - Highest after eating.
 - Lowest when sleeping.
 - Similar to that of the environment.
15. The independent variable in this experiment was:
- Jonah.
 - The activity of Jonah.
 - The room temperature.
 - The core body temperature of Jonah.
16. If all of the beta cells in the pancreas of a person become non-functional, it would be reasonable to expect:
- Increased secretion of glucagon.
 - Decreased blood glucose levels.
 - Increased uptake of glucose by cells.
 - Decrease in glycogen in the liver.

When muscle fibres are stimulated, the muscle contracts. The gentle tapping of a tendon stimulates stretch receptors. The response to this stimulation is a 'knee jerk' reflex action. That is, the leg suddenly straightens. The pathway involved is shown in the diagram below:

17. Which of the following statements concerning somatic and autonomic nerve pathways is correct?
- They both are part of the afferent division of the nervous system.
 - Both the somatic and autonomic nervous system usually have one set of nerve fibres going to their respective effectors.
 - The autonomic nervous system can use two different neurotransmitters at a synapses.
 - The somatic pathway involves a ganglia where peripheral neurones synapse.
18. Which combination works together to reduce the flow of blood to the skin?
- Midbrain/decrease in heart rate.
 - Parasympathetic/vasoconstriction.
 - Cerebrum/lower cardiac output.
 - Sympathetic/vasoconstriction.

The graph below shows the pattern traced by placing electrodes at a point on the axon of a nerve cell as it is stimulated.

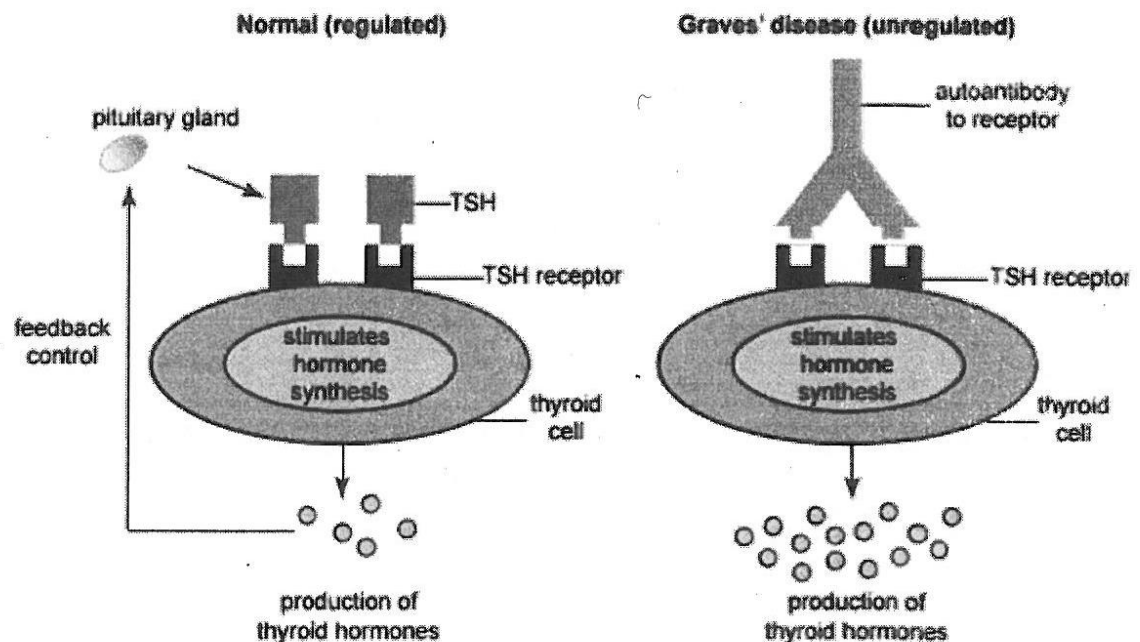


19. It is reasonable to claim that:
- The lowest potential **J**, represents the resting potential of the nerve.
 - During phase **F**, fewer sodium ions are leaving the cell than entering it.
 - During phase **K**, the membrane will fail to respond to further stimulation.
 - The stimulus applied only has an effect when the membrane potential is positive.

20. Using gene therapy to treat a disease involves introducing:

- Particular proteins into a person with the disease.
- Various types of blood into a person with the disease.
- Viruses that destroy certain cells of a person with the disease.
- Functional alleles into the cells of a person with the disease.

Graves' disease is an autoimmune disease in which the production of thyroid hormones by thyroid cells is unregulated. The following diagrams outline what occurs in regulated and unregulated thyroid cells. TSH stands for thyroid stimulating hormone.



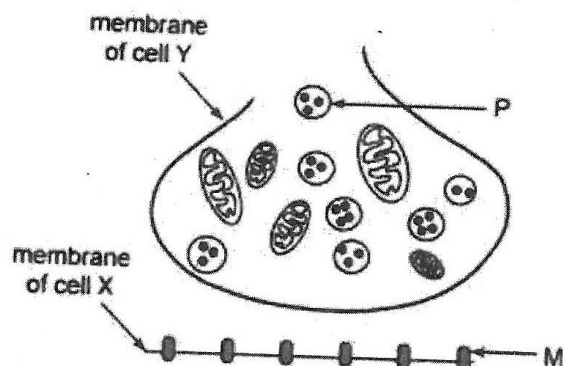
21. From the information given in the diagrams it is reasonable to claim that:

- Individuals with Grave's disease would be more likely to be overweight and sensitive to cold environmental conditions.
- Positive feedback control occurs with regulated cells.
- The presence of autoantibodies overstimulates the thyroid.
- Individuals with Graves' disease lack appropriate receptors on thyroid cells.

Question 22 refers to the table below:

HORMONE A	HORMONE B	HORMONE C
Reduces the amount of sodium in the urine	Reduces the amount of glucose in the blood	Increases heart rate

22. (a) Hormone A is aldosterone, B is insulin, C is adrenaline.
 (b) Hormone A is antidiuretic hormone, B is glucagon, C is noradrenaline
 (c) Hormone A is aldosterone, B is glucagon, C is noradrenaline
 (d) Hormone A is antidiuretic hormone, B is insulin, C is adrenaline.
23. Which of the following statements is true of a neuron undergoing repolarisation?
 (a) The membrane potential becomes more positive.
 (b) The sodium channels open and the potassium channels remain closed.
 (c) Potassium ions flow out through the potassium channels.
 (d) Both potassium and sodium are actively transported across the membrane.
24. The diagram below represents the membranes of two neurones across which a synapse occurs.



It is reasonable to suggest that:

- (a) Structure M secretes neurotransmitter molecules.
 (b) An electrical message travels from cell X to cell Y.
 (c) Structure P supplies energy to transmit a nerve impulse.
 (d) Neurotransmitter molecules diffuse from cell Y to cell X.

25. Which of the following statements is **incorrect**?

Many neurones are found in the thin outer layer of the brain because:

- (a) the outer surface of the brain is highly folded.
- (b) these neurones have very short projections from their cell bodies.
- (c) the fatty layer of these neurones helps to transmit impulses to other neurones very quickly.
- (d) the distance between these neurones is small.

26. Which ONE of the following is CORRECT:

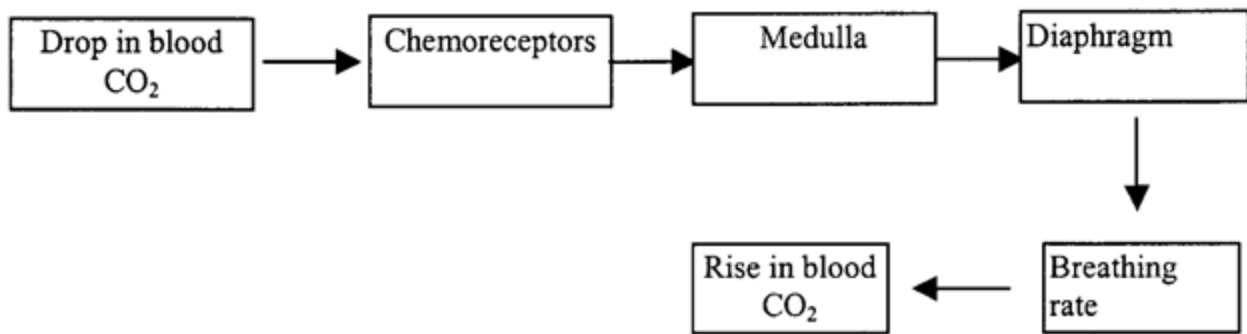
	Structure	Sympathetic Activity	Parasympathetic Activity
(a)	Urinary Bladder	Contraction	Relaxation
(b)	Salivary Glands	Increased Secretion	Reduced Secretion
(c)	Liver	Increased Glucose Uptake	Increased Release of Glucose
(d)	Bronchioles of the Lung	Relaxation	Constriction

27. Suffocation victims such as those found within damaged building are usually given a mixture of 95% oxygen and 5% carbon dioxide rather than pure oxygen because:

- (a) using pure oxygen will result in the patient getting a dry throat.
- (b) using these gases in this proportion will increase gas exchange at the lungs.
- (c) oxygen in this high proportion will stimulate the intercostal muscles and diaphragm.
- (d) having a small proportion of carbon dioxide will stimulate the respiratory centre.

28. Hormones produced in the hypothalamus:

- (a) are released from the anterior pituitary.
- (b) are released due to the presence of releasing factors.
- (c) may be secreted from the posterior pituitary gland..
- (d) may include thyroid stimulating hormone.



29. The sequence of events shown in the diagram above is best described as a:
- (a) Reflex action.
 - (b) Hormonal pathway designed to maintain CO₂ at a set level.
 - (c) Positive feedback because the CO₂ increases.
 - (d) Negative feedback because the rise in CO₂ is opposite to the initial stimulus.
30. A patient was admitted to hospital after complaining of blurred vision. An examination indicated damage to part of the patient's brain. This evidence is most likely to indicate that damage has occurred to the:
- (a) Cerebrum.
 - (b) Hypothalamus.
 - (c) Thalamus.
 - (d) Cerebellum.

Section Two: Short answer *Please answer in the spaces provided in this booklet.*

QUESTION 31 **(15 marks)**

An experiment was conducted on the effects of the consumption of different types of fluid and its effect on urine production. In the experiment one group drank water and another group consumed a saline solution. Saline solution is a sterile solution of water and salt (normally sodium chloride). The experiment involved 30 subjects, 15 who consumed *one litre of water* in a five minute period and 15 who consumed *one litre of the saline solution* in the same five minute period. All subjects were required to stay in a small room maintained at a temperature of 25 °C and were asked to keep to a minimum the amount of physical activity they performed. Urine production over the three hours following fluid consumption was recorded for all subjects. The results for each group were averaged and are presented below.

Time (minutes)	Volume of Urine Every 30 minutes After Initial Drink (mL)	
	Water consumption	Saline solution consumption
0	24	18
30	360	21
60	450	27
90	255	36
120	48	29
150	30	34
180	27	24

- (a) (i) Propose a hypothesis for the experiment. (1 mark)

- (ii) Name the control group for this experiment. (1 mark)

- (b) (i) There is a major flaw in how the experiment has been designed. How would you change the procedure to make this experiment a fairer test? (1 mark)

(ii) What are two ways you could improve the reliability of this experiment?

(2 marks)

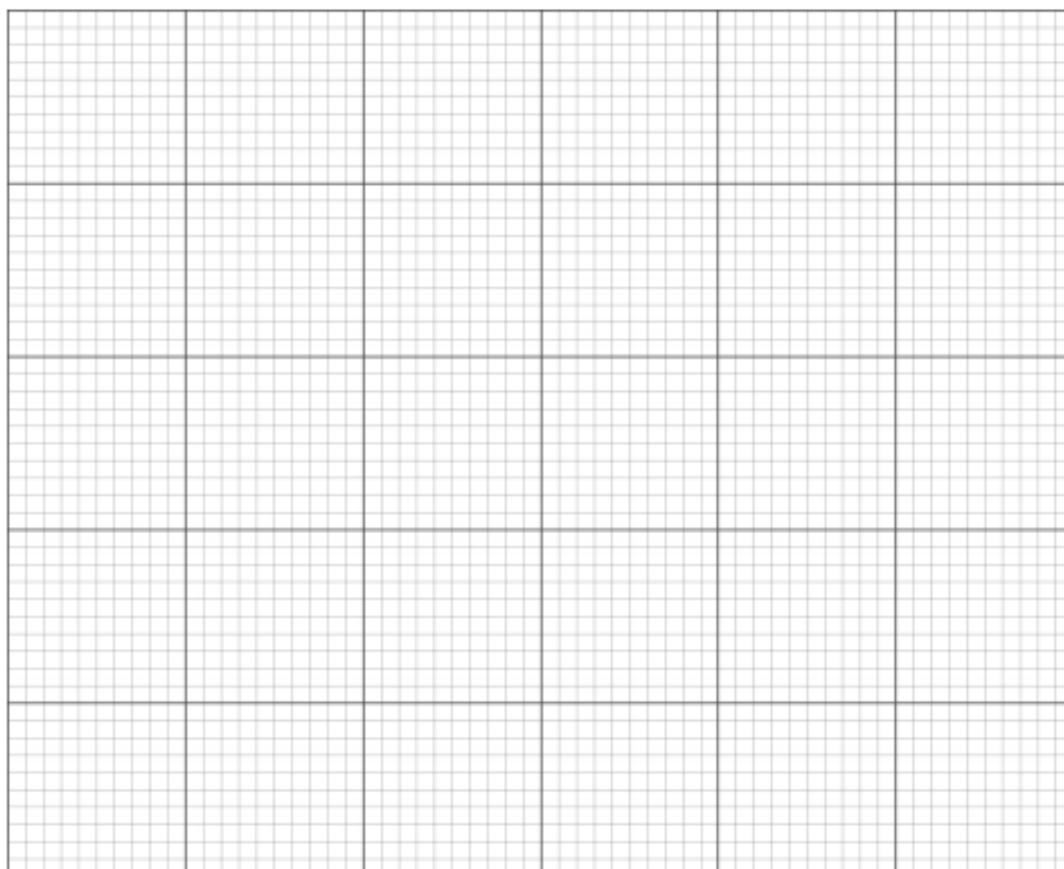
1. _____

2. _____

(c) At the homeostatic level, what changes in the internal environment as a result of drinking 1 litre of water? (1 mark)

(d) Use the data on the previous page to construct a graph on the grid below. Your graph should be of *The Total Volume of Urine Produced in 3 Hours Following Drinking Different Solutions*. (5 marks)

A spare grid is provided at the end of the Answer Booklet Part A. If you need to use it, cross out this attempt.



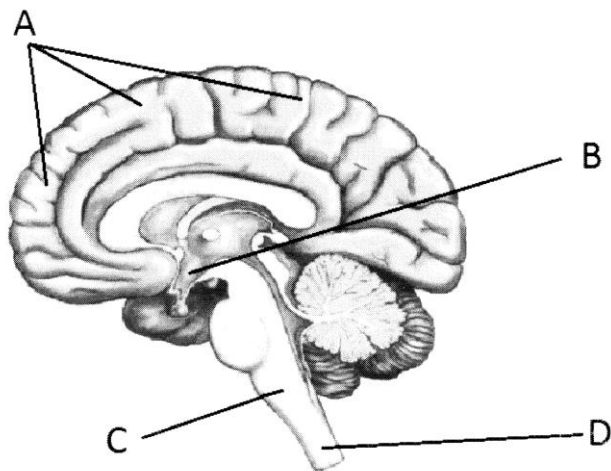
- (e) (i) Identify the hormone directly involved in the maintenance of water balance in the body and state the specific part of its target organ that it influences. (2 marks)

- (ii) On the basis of the results of the experiment, the consumption of which fluid, water or saline, would have triggered the release of the hormone identified in part (d) (i)? (1 mark)

- (iii) Explain why people suffering dehydration are given either a saline solution to drink or a saline intravenous drip rather than only water. (1 mark)

QUESTION 32 (14 marks)

a) The cross-sectional diagram below represents the parts of the brain. Use the table below to identify the parts labelled A-D and for each part thoroughly describe their functions.



(8 marks)

LABEL	NAME OF STRUCTURE	FUNCTIONS OF STRUCTURE
A		
B		
C		
D		

(b) Ataxia is a condition associated with disorders of the central nervous system in which there is a lack of muscle coordination. In one form of ataxia a person's muscles are able to move but their movements are not very smooth.

(i) In which part of the brain would damage have likely occurred to cause this form of ataxia? (1 mark)

(ii) Name **two** other symptoms, apart from being jerky and lacking smoothness of movement that a person would have if the area answered in part (b)(i) was damaged. (2 marks)

(iii) Explain why a person with the form of ataxia described above can still move their muscles even though their movements are not smoothly coordinated. (2 marks)

(c) The outer surface of the brain consists of grey matter. Give a common feature of neurons located in the grey matter. (1 mark)

QUESTION 33 (11 marks)

Glucose levels within the bloodstream of a subject tend to fluctuate (or change) during the course of the day although homeostatic feedback mechanisms try to keep the glucose levels within narrow limits.

(a) What are daily situations that may result in each of the following? (2 marks)

(i) A person's blood glucose level rising? _____

(ii) A person's blood glucose level falling? _____

(b) When blood glucose levels begin to rise above optimal, hormonal action occurs to help bring glucose levels down.

(i) Name the cells that are involved in detecting this rise in blood sugar levels:
(1 mark)

(ii) Name the hormone that is secreted into the blood stream to reduce glucose levels:
(1 mark)

(iii) Name the process that takes the glucose out of the blood stream and stores it in a non-soluble form in the liver and muscles:
(1 mark)

(c) During sympathetic stimulation secretion of adrenaline and noradrenaline can complement the action of the hormone glucagon to quickly raise blood glucose levels. Name and describe two processes that will raise blood glucose levels in this situation.

(4 marks)

Name of Process 1 - _____

Description _____

Name of Process 2 - _____

Description _____

- (d) Cortisol is a hormone that also plays a regulatory role in blood sugar homeostasis. (2 marks)

Which gland secretes cortisol? _____

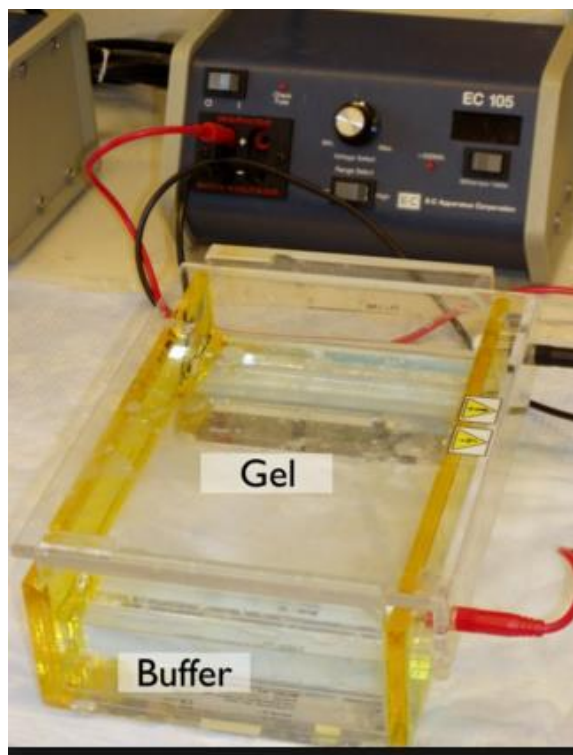
What is a major function of cortisol in blood sugar homeostasis? _____

QUESTION 34 (11 marks)

34. The diagram below is of equipment that is used in a technique called electrophoresis. This process can be used to as a means of identifying a person’s DNA.

- (a) Explain the role of the gel. (2 marks)

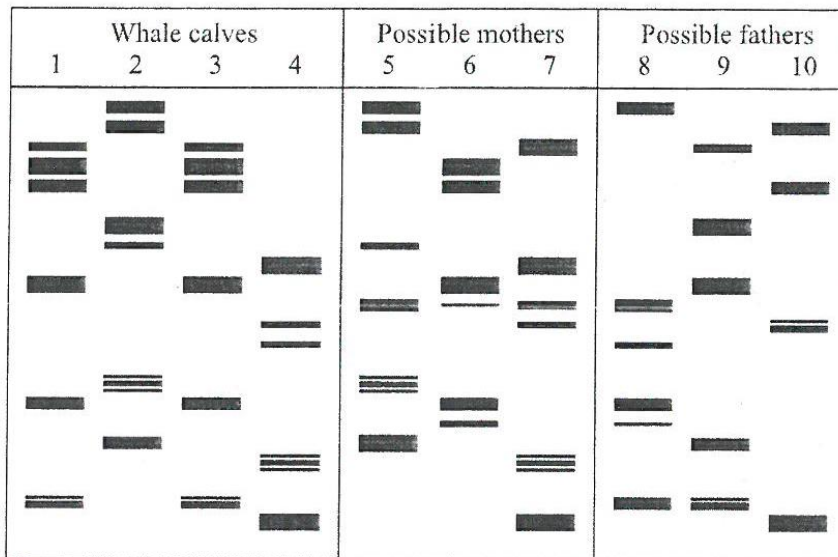
- (b) What is the purpose of the buffer? (1 mark)



- (c) There appears to be two wires attached to the tray. What are they and how are they important in this process? (2 marks)

- (d) Why do the different lengths of DNA move and why they get separated? (3 marks)

- (e) Refer to the following diagram, which shows the DNA profiles of four whale calves (1, 2, 3 and 4) and their possible mothers (5, 6 and 7) and possible fathers (8, 9 and 10):

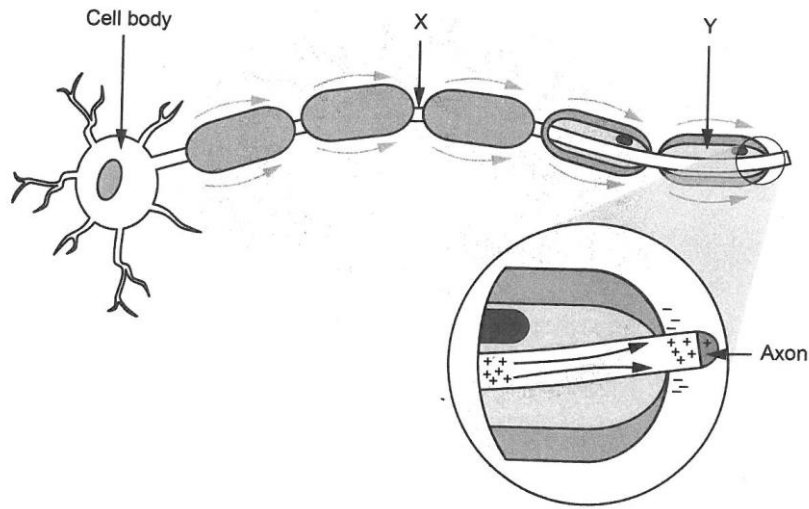


- (i) State how the information in the diagram above can be used to determine the parents of the whale calves. (2 marks)

- (ii) Use the diagram to identify the individual that is the father of most of the offspring. (1 mark)

QUESTION 35 (19 marks)

Parts (a), (b) and (c) of the question 35 refer to the diagram of a neuron below.



- (a) Identify the region of the axon labelled as structure X. (1 mark)

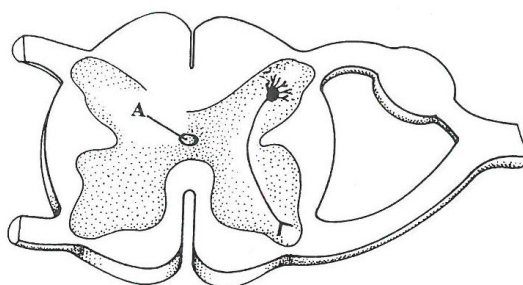
- (b) State **one** function of the structure labelled Y. (1 mark)

- (c) The arrows drawn along the axon show the direction of a nervous impulse. The impulse in this neuron would travel via saltatory conduction. Describe how a nervous impulse is propagated along this type of fibre. (5 marks)

- (d) The table shows the membrane potential of an axon at rest and during the different phases of an action potential. Complete the table by writing in each box whether the sodium ion (Na^+) channels and potassium ion (K^+) channels are open or closed. (3 marks)

	Resting	Starting to depolarise	Repolarising
Membrane potential/mV	-70	-50	-20
Na^+ channels in axon membrane			
K^+ channels in axon membrane			

- (e) The diagram below illustrates only **some** components of the path of a reflex arc:



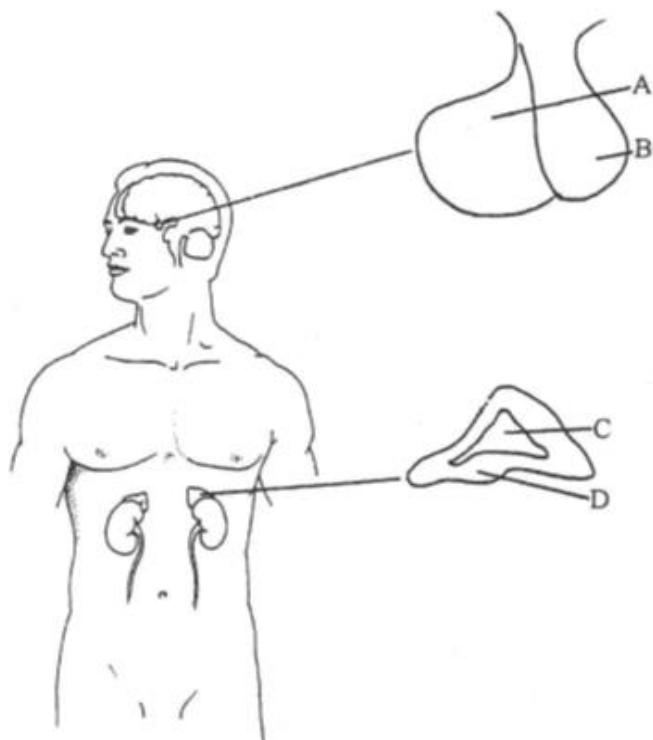
Complete the diagram above by drawing the other components that form a reflex arc. Label all the structures of the reflex arc and use an arrow to show the direction of the nerve impulse. (5 marks)

- (f) Use the table below to compare the actions of nerves and hormones. (4 marks)

Type of Communication	Specificity	Duration of Action
Nerves		
Hormones		

QUESTION 36 (14 marks)

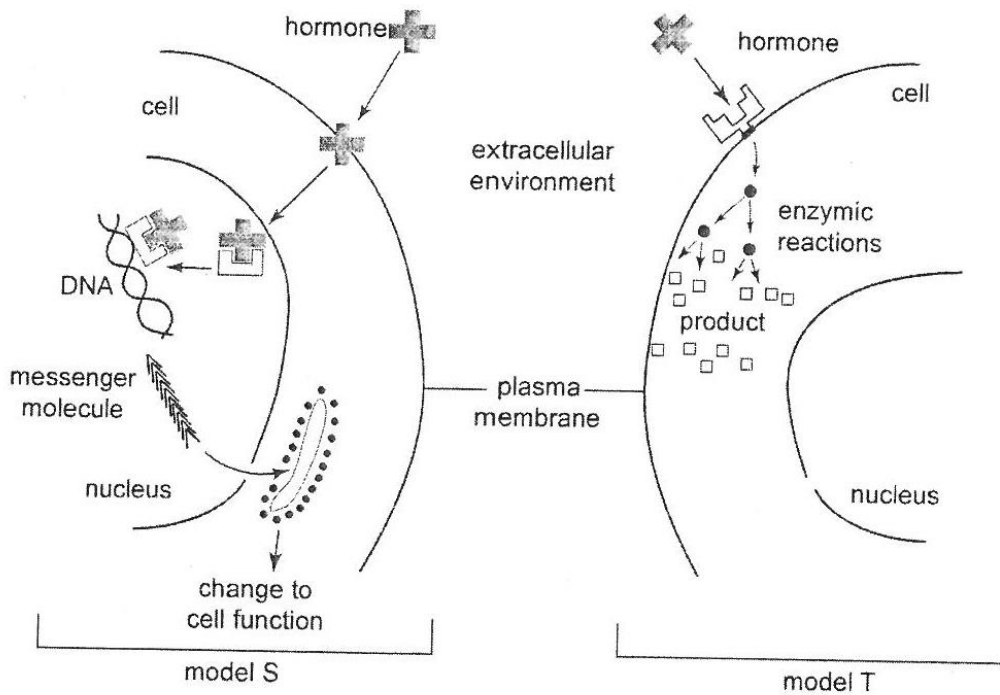
- (a) The diagram below identifies the location of four endocrine tissues labelled A, B, C and D. Complete the table below by identifying each endocrine gland, listing one hormone that is secreted from this gland and by giving one principal function of that hormone.



PART	NAME OF STRUCTURE	ONE HORMONE THAT IS SECRETED	ONE PRINCIPAL ACTION OF THIS HORMONE
A			
B			
C			
D			

(6 marks)

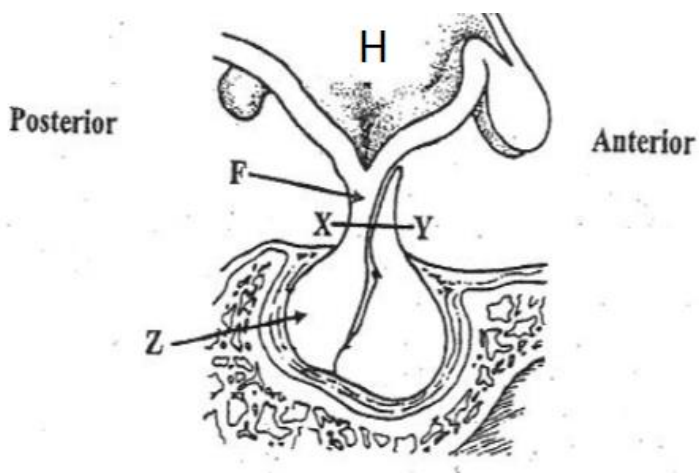
(b) The two diagrams shown below are general models for the hormonal modes of action.



(i) Which model represents the mode of action for steroid hormones? (1 mark)

(ii) Explain two reasons for your answer in part (i) above. (2 marks)

(c) The diagram below represents structures of the brain.



(i) Name the structure that is labelled H: (1 mark)

(ii) The structure labelled H controls how the lobe labelled Z functions. Explain how structure H does this? (2 marks)

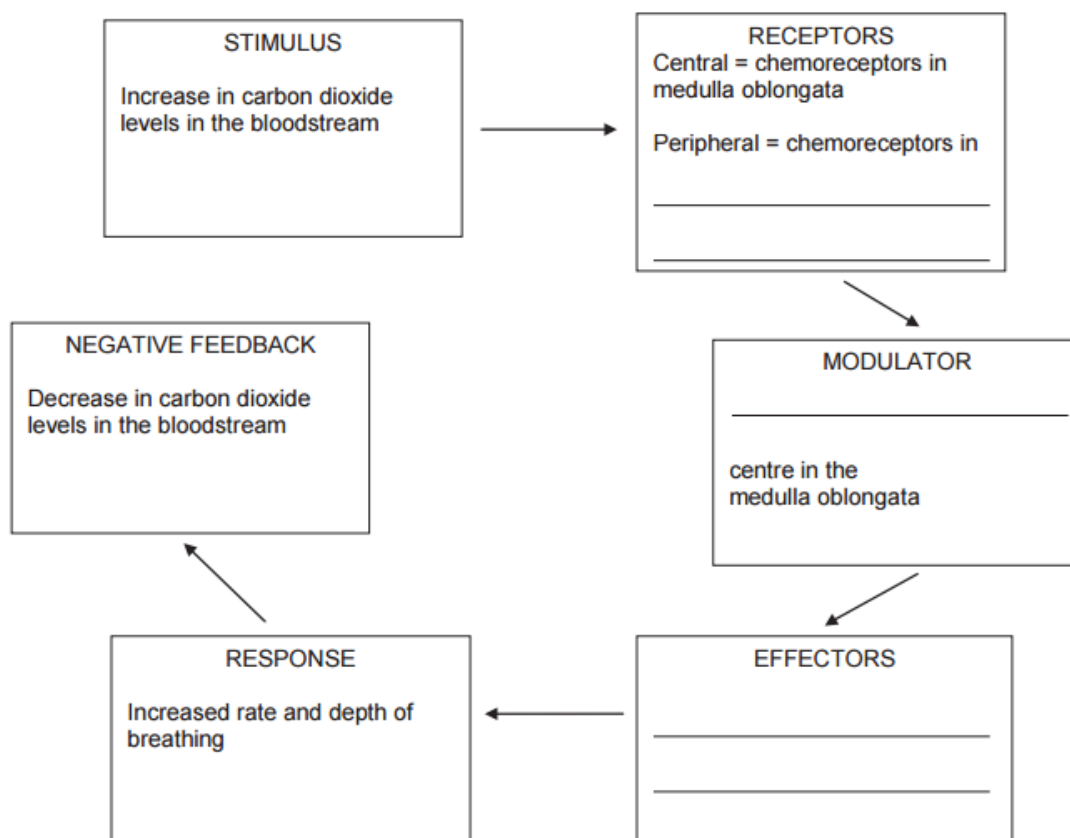
(iii) If a surgical cut is made along the line X-Y, then explain what affect will this have on the functioning of the anterior lobe? (2 marks)

QUESTION 37 (7 marks)

During cell respiration, carbon dioxide is produced as a waste product. If the rate of cell respiration is increased, carbon dioxide levels in the blood will also increase. The removal of excess carbon dioxide requires an increase in rate and depth of breathing.

Below is a negative feedback model showing that an increase in breathing rate is required to remove the excess carbon dioxide.

- (a) The feedback loop below is **incomplete, as information is missing** from the receptors, modulator and effectors boxes. Complete the feedback loop by writing the appropriate word/s in the spaces provided. (4 marks)



- (b) There are two main modes of transmission of messages in the body, nervous or hormonal. Which of these is stimulating the effectors in the diagram above? (1 mark)

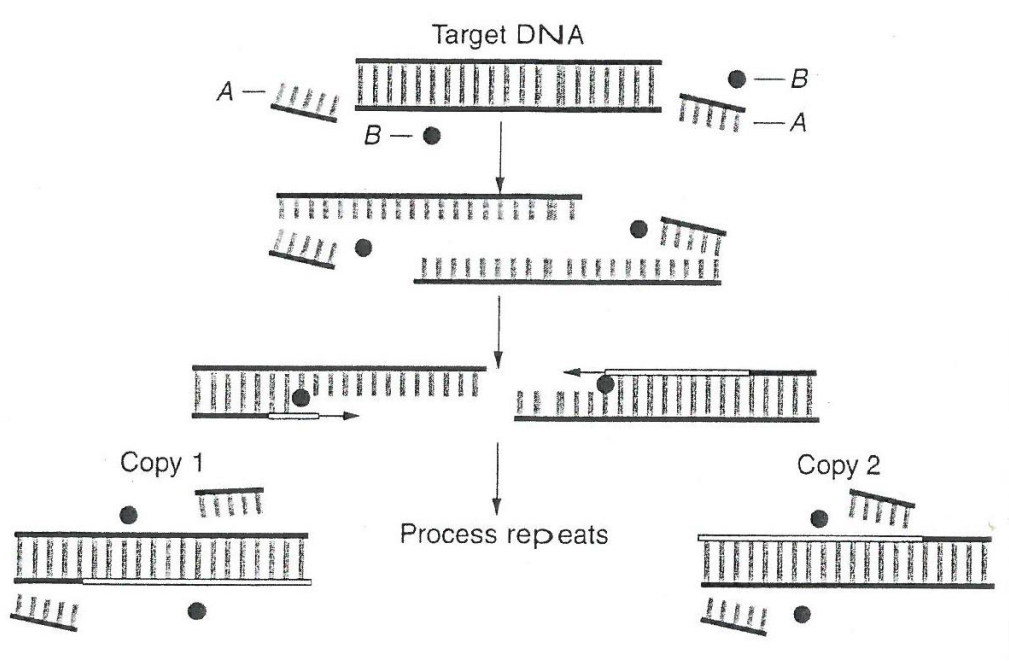
- (c) As the carbon dioxide in the blood increases, there is also a change in the pH of the blood. How does the pH change? (1 mark)

- (d) Name the chemical (which is not listed in question part (c) above), that plays a minor role in changing rate and depth of breathing.

_____ (1 mark)

QUESTION 38 (9 marks)

The diagram below shows a recombinant DNA technique.



- (a) What is represented by the components labelled A and B above? (2 marks)

A _____

B _____

- (b) Two enzymes that are used in biotechnology practice are ‘restriction enzymes’ and ‘DNA ligase’.

Describe the role of each of these enzymes in the laboratory. (2 marks)

Restriction enzyme: _____

DNA ligase _____

- (c) A hiker has become lost in a mountainous area and unfortunately the air temperature has dropped to around 0°C. The hiker is ill-prepared for this temperature change and is only wearing shorts and a T shirt.

Identify two physiological responses that would occur to conserve heat and reduce its loss from the hiker's body. (2 marks)

1. _____

2. _____

- (d) Explain in terms of homeostatic control how the kidneys are able to produce small volumes of urine on a hot day, especially when little water has been drunk.

(3 marks)

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

This section contains **three (3)** questions. **You must answer two (2) questions.** Write your answers in the extended answer booklets provided. Only **one question** must be answered **per booklet**.
Suggested working time: 60 minutes.

Question 39**(20 marks)**

- (a) In hot conditions, athletes must be able to control their body temperature to avoid major disruptions to cellular function. Explain the structures that are involved in detecting changes in body temperature when an athlete exercises on a hot day. Also, describe how the temperature modulator initiates the physiological changes that take place and explain those changes that enable the core body temperature of an athlete to be maintained at an optimal temperature during this physical activity. (11 marks)
- (b) If you were walking in the woods and suddenly a large and ferocious bear began running after you, a number of physiological changes would automatically occur to your body that may help to provide you with a survival advantage in this situation. List and clearly explain six of these physiological changes and how they may assist you to survive this dire situation.

(9 marks)

Question 40**(20 marks)**

- (a) Based upon their particular ability to differentiate, there are **three** types of different types of stem cells. **Use a table** to name each of these, identify where they can be found and discuss their respective differentiation abilities. (6 marks)
- (b) People with a deficiency of human Growth Hormone (hGH) may have growth retardation or dwarfism. Fortunately for these people biotechnology advances have resulted in transgenic organisms being developed that can manufacture hGH in quantities that can overcome the symptoms that are associated with this genetic disease. Discuss in detail the process that has enabled hGH producing genes to be inserted into suitable bacteria and how this has made hGH available in commercial quantities. (14 marks)

Question 41**(20 marks)**

A very small drop of blood was left behind at a crime scene. Discuss the laboratory processes that are used to enable the forensic scientist to be able to match up the DNA in that small drop of blood with the DNA of a suspect whose DNA profile is already on a data base.

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