

SECTION ONE:

MULTIPLE CHOICE

Total

CROSS THE BEST ALTERNATIVE

- | | | | | | | | | | |
|----|--------------|--------------|--------------|--------------|----|--------------|--------------|--------------|--------------|
| 1 | A | B | C | D | 16 | A | B | C | D |
| 2 | A | B | C | D | 17 | A | B | C | D |
| 3 | A | B | C | D | 18 | A | B | C | D |
| 4 | A | B | C | D | 19 | A | B | C | D |
| 5 | A | B | C | D | 20 | A | B | C | D |
| 6 | A | B | C | D | 21 | A | B | C | D |
| 7 | A | B | C | D | 22 | A | B | C | D |
| 8 | A | B | C | D | 23 | A | B | C | D |
| 9 | A | B | C | D | 24 | A | B | C | D |
| 10 | A | B | C | D | 25 | A | B | C | D |
| 11 | A | B | C | D | 26 | A | B | C | D |
| 12 | A | B | C | D | 27 | A | B | C | D |
| 13 | A | B | C | D | 28 | A | B | C | D |
| 14 | A | B | C | D | 29 | A | B | C | D |
| 15 | A | B | C | D | 30 | A | B | C | D |

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

QUESTION 31 (16 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	360 384	21 39
60	450 834	27 66
90	255 1089	36 102
120	48 1137	29 131
150	30 1167	34 165
180	27 1194	24 189

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

Drinking solutions that are more saline will result in a decrease in urine production

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

Water consumption group.

- (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)

Either - control how much fluid/type of fluid drunk leading into activity
OR
Have all subjects empty bladder prior to drinking 1L of fluid

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

(2 marks)

1. Have more than 15 subjects in each group.

2. Repeat the experiment and average results.

Increase the number of experimental groups / have other groups of various salinity drink

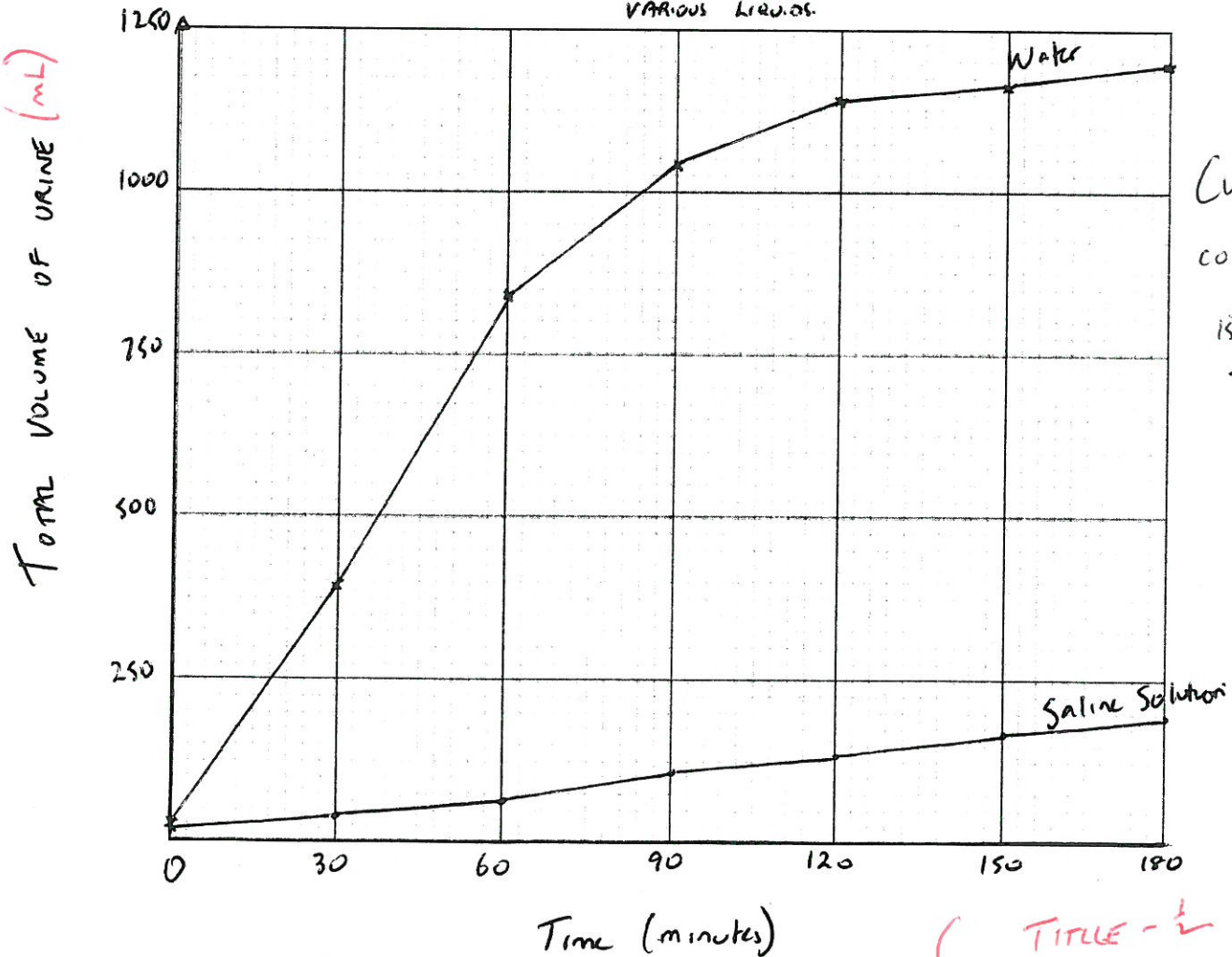
(c) At the homeostatic level, what changes in the internal environment as a result of drinking 1 litre of water? (1 mark)

Osmotic pressure.

(d) ^{use} ~~Graph~~ the data in the table on the grid below. ^{to graph} the ^{Average} TOTAL URINE VOLUME PRODUCED OVER 180 MINUTES (5 marks)

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

TOTAL VOLUME OF URINE PRODUCED AFTER DRINKING 1L OF VARIOUS LIQUIDS.



Cumulative column graph is OK!!

MARK DEDUCTION {
 TITLE - 1/2
 LABELS ON SCALERS (1)
 UNITS ON SCALERS (1/2 each)
 POSITIONING OF POINTS (-1/2 to -2 marks)
 LINEAR SCALERS (1)
 VERTICAL (1/2 + ->)

- (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)

antidiuretic hormone ADH

(1)

distal convoluted tubule and collecting duct

(1)

- (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)

SALINE

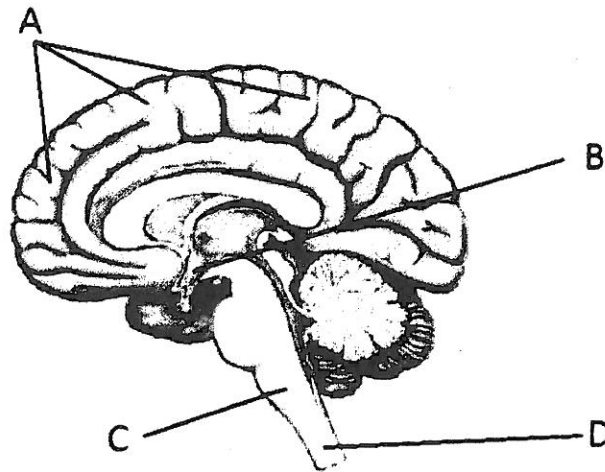
- (iii) Explain why people suffering dehydration are given either a saline solution to drink or a saline intravenous drip rather than only water. (2 marks)

Drinking saline reduces urine production.

Less water loss

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	Cerebrum or Cerebral cortex	Contains 3 functional areas - sensory - receives and processes nerve impulses from senses - motor areas - voluntary control of skeletal muscles - association areas - concerned with intellectual + emotion processes.
B	Hypothalamus	Regulates homeostatic control in the body such as water balance, body temperature, patterns of waking/sleeping, autonomic control of glands + muscles
C	Medulla oblongata.	Contains the <u>cardiac</u> , <u>respiratory</u> or <u>vasomotor</u> centre <u>twice</u> controlling heart rate, blood vessel diameter, breathing rate + force of contraction
D	Spinal cord.	Involved in reflex arcs and contains ascending tracts to the brain + descending tracts from the brain.

(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)

cerebellum

(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)

- difficulties with posture⁽¹⁾ and balance⁽¹⁾

(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)

- skeletal muscles are controlled by the cerebrum.

If the cerebrum is undamaged it can still send nerve impulses and move the skeletal muscles.

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

unmyelinated

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? After a meal with carbohydrate

(ii) A person's blood glucose level falling? Exercising or In between meals

(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)

beta cells in Islets of Langerhans

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

insulin

(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)

glycogenesis

SPELLING ESSENTIAL !!

(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 - glycogenolysis

Description conversion of glycogen to glucose. (in liver + skeletal muscles)

Name of Process 2 - gluconeogenesis

Description conversion of amino acids + fatty acids → glucose (in liver)

SPELLING NEEDS TO BE SPOT ON !!

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

(2 marks)

Which gland secretes cortisol? adrenal cortex

What is a major function of cortisol in blood sugar homeostasis? to promote glycogenolysis / or gluconeogenesis to maintain BSL at an optimal level / lipolysis - (breakdown of fats into fatty acids in adipose tissue)

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.

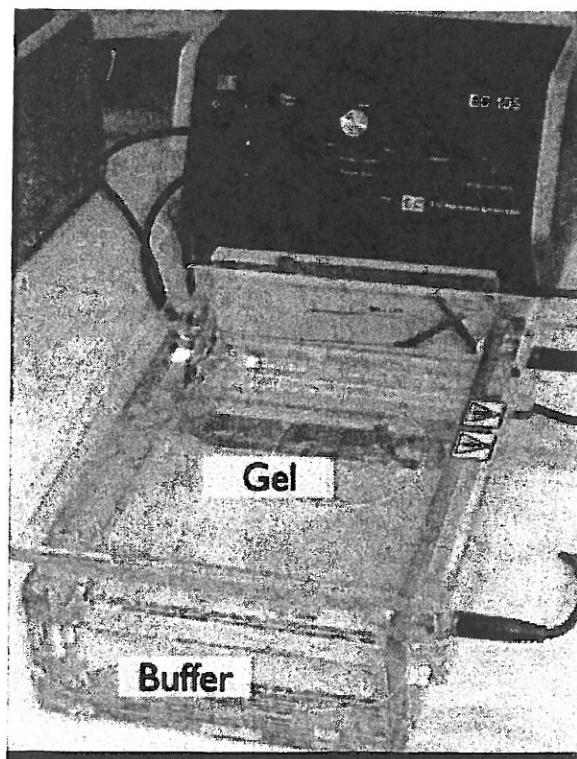
(2 marks)

It is differentially permeable, allows movement of DNA fragments through it, separating them according to size.

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

(1 mark)

Allows (electric) current to flow through.



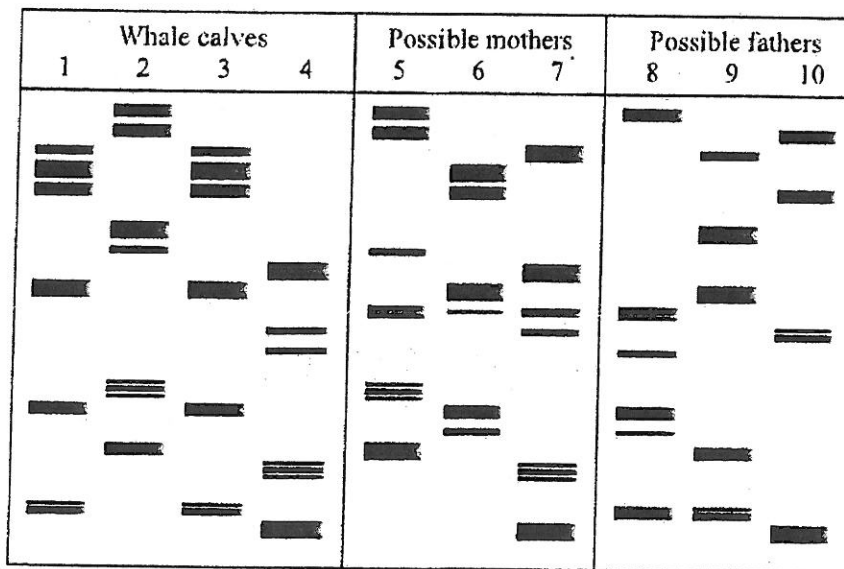
- (c) There appears to be two wires attached to the tray. What are they and how are they important in this process? (2 mark)

Electrodes - negative is at the end where DNA is originally placed
 -ve → +ve and positive at the other end of the tray. DNA will move toward the +ve end.

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

They are -ve and move toward the positive terminal. (1)
 Due to their difference in length (or shape) (1)
 Small fragments move faster than bigger ones. (1)

- (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)

if a band (seg. of DNA of partic length) is present, must have come from either the mother or father

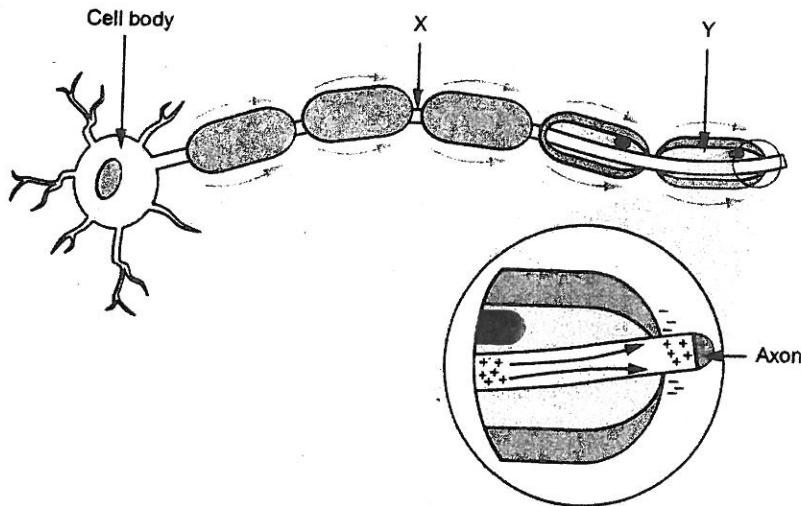
Offspring get 1/2 their DNA from each parent. ∴ you would expect 1/2 DNA lengths to match with each parent ∴ So you should be looking for banding that correlates with potential ♂ or ♀

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

9

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)

Node of Ranvier

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

Speed up nerve impulses /

Provides protection

insulates $\frac{1}{2}$ only. need why? i.e. Speed up.

- (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)

• Na channels open and

• Na^+ ions rush into axon

• Causing reversal of charge / depolarisation

↳ This stimulates adjacent sodium channel to open

• So the action potential moves along the axon

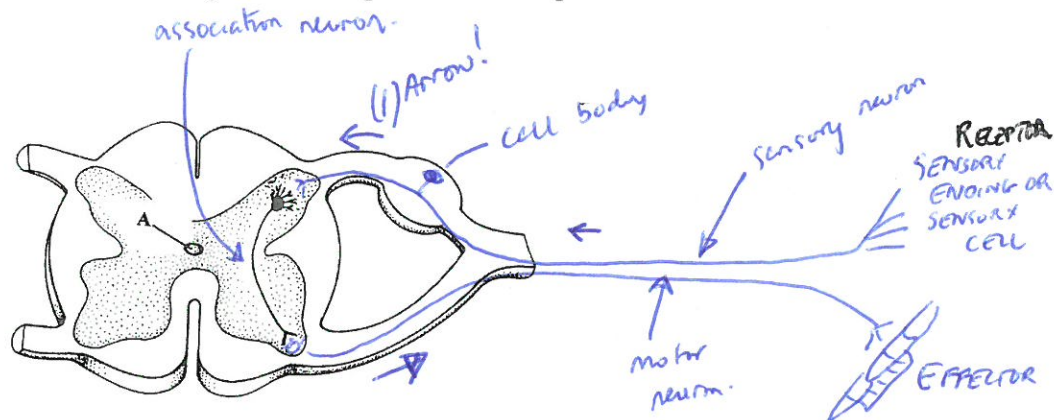
• Jumping from one Node of Ranvier to the next.

- (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	closed	open	closed
K^+ channels in axon membrane	closed.	closed	open.

(-1/2) each

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



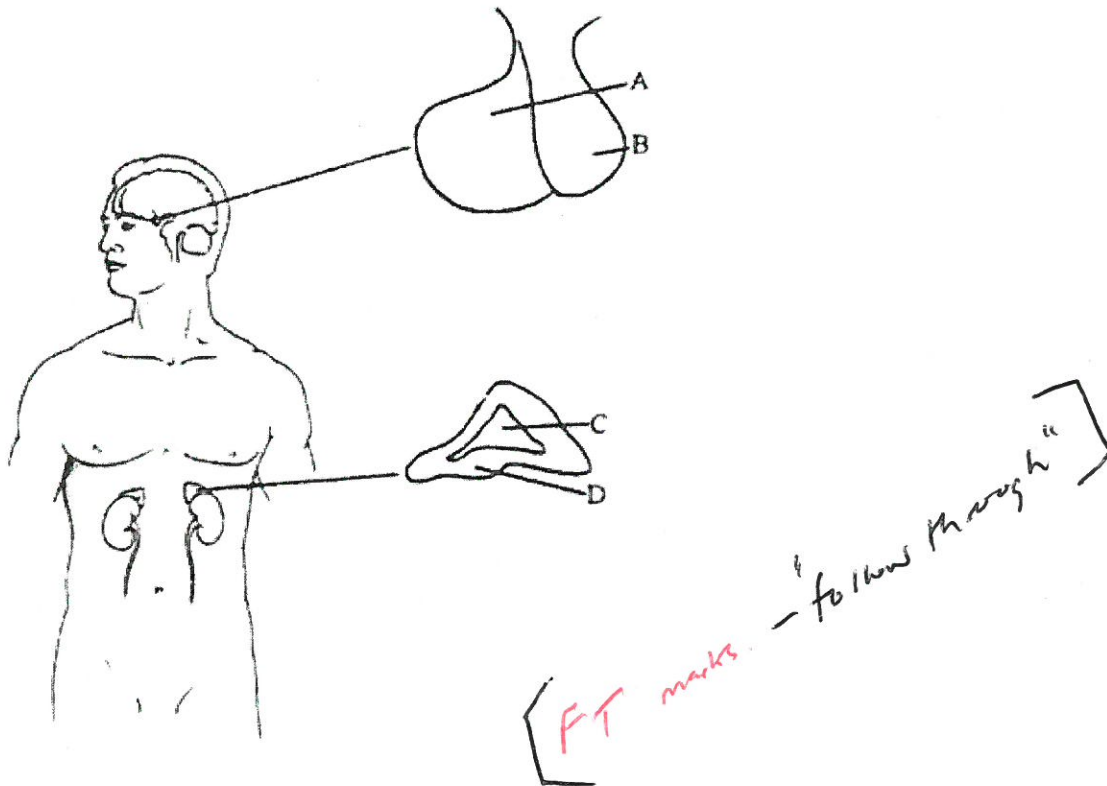
Complete the diagram by drawing the other components that form a reflex arc. Label all the structures of the reflex arc and use an arrow to show the direction of the nerve impulse. (5 marks)

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

Type of Communication	Specificity	Duration of Action
Nerves	- one nerve impulse stimulates only a few cells. (very localized)	- lasts milliseconds only
Hormones	- one hormone may stimulate tissues, or organs, organ systems or the whole body	- can last weeks, days...

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.

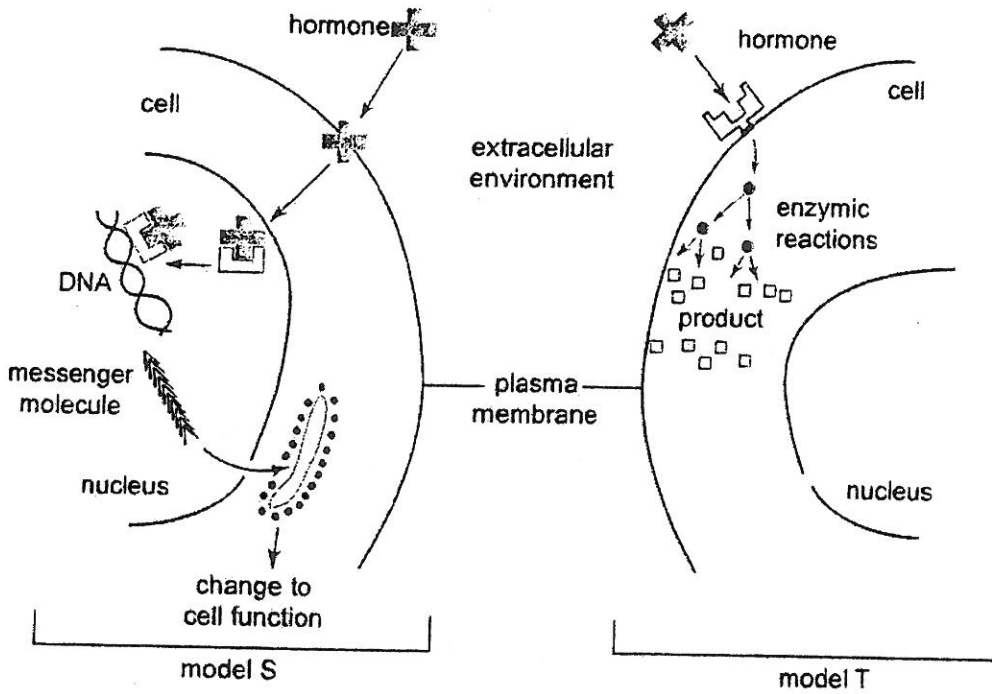


FT marks - follows through

PART	NAME OF STRUCTURE	ONE HORMONE THAT IS SECRETED	ONE PRINCIPAL ACTION OF THIS HORMONE
A	Anterior Pituitary gland	FSH, LH, GH TSH, ACTH PRL	
B	Posterior Pituitary gland.	Oxytocin ADH.	→ muscle contraction for milk let down or birth. → water reabsorption from nephrons
C	Adrenal medulla	- Adrenaline Noradrenaline	- as neurotransmitter during autonomic stimuli ↑ HR, gluconeogenesis ...
D	Adrenal cortex	Cortisol Aldosterone	→ can cause muscle wasting / protein breakdown → B.S. increases / stress regulation

(6 marks)
(6 - 1/2 each)

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



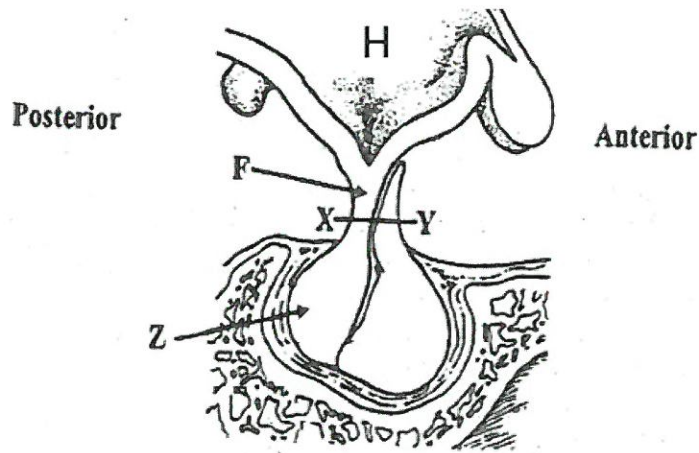
(i) Which model represents the mode of action for steroid hormones? (1 mark)

Model S

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

- *The hormone is diffusing through the plasma membrane*
- *It is attaching to the receptor inside the cell / not on the cell membrane.*
- *Appears to be changing protein synthesis*

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



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

Hypothalamus

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

- It produces hormones (ADH/Oxytocin) which travel down axons to the endings located in Z
- A nerve impulse results in their secretion.

(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)

- Probably none

- Since rf and if can still travel via blood capillaries to the lobe.

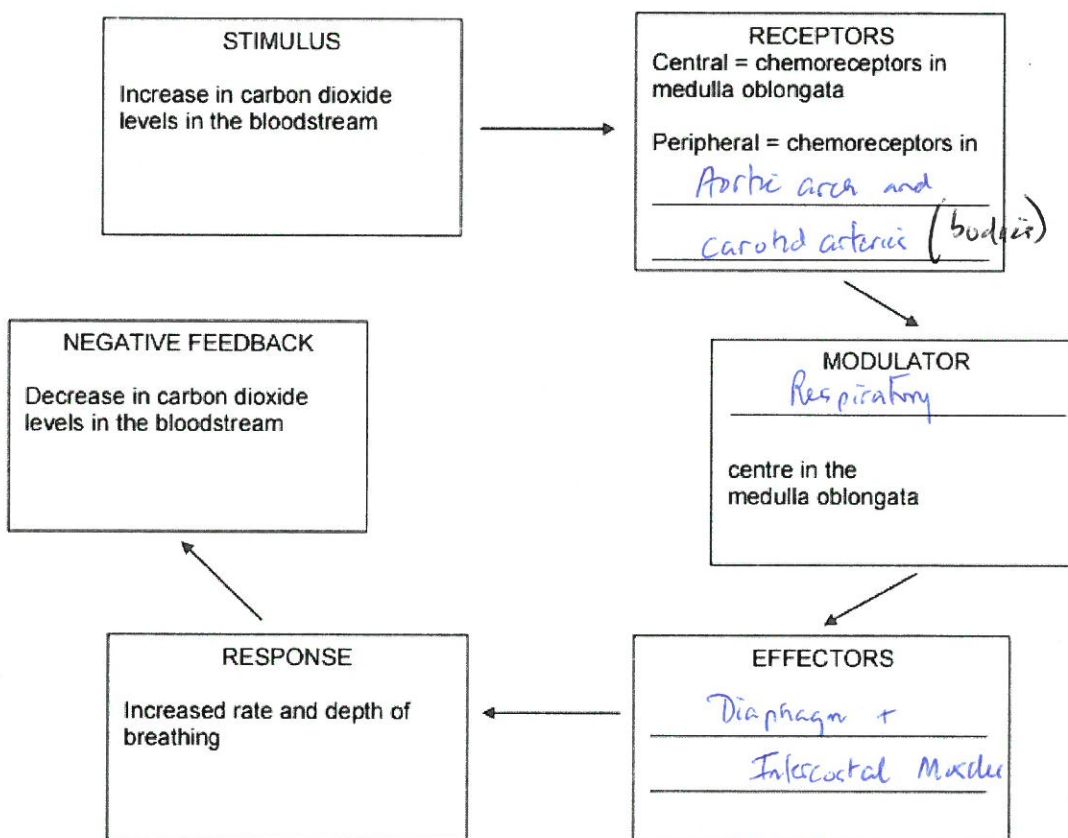
Reasoning is all important!!! If say portal vein cut - hormones of hypothalamus (rf and if) cannot travel to anterior pituitary gland } OK!

QUESTION 37 (6 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. (3 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)

Nervous

- (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)

(Carbon dioxide reacts with water producing H^+) OR pH decreases.

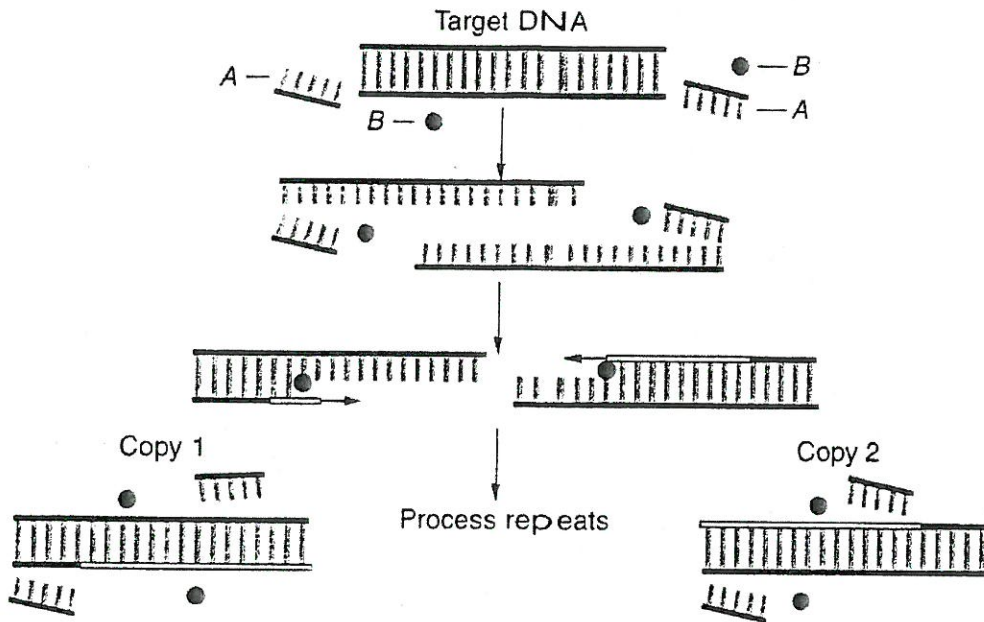
- (d) Name the chemical (which is not listed in question part (c) above), that plays a minor role in changing rate and depth of breathing.

Oxygen (gas)

(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 Primer
 B taq polymerase (DNA polymerase)

- (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: involved in cutting DNA at a specific sequence
Used in recombinant DNA to cut plasmids and gene of interest

DNA ligase An enzyme which joins pieces of DNA where each piece has
overhanging / sticky ends which are complementary to each other.

simple is OK

- (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. vasoconstriction of arterioles to skin - reduces blood flow to skin / heat loss
2. piloerection of hairs on skin - (although pretty ineffective) can trap a layer of air close to the skin to insulate + reduce heat loss by conduction
3. decreased sweating

- (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.

- High osmotic pressure is
 - detected by (receptors) located in the hypothalamus
 - results in ↑ secretion of ADH.
 - ADH results in walls of collecting duct and DCT becoming more permeable
 - ↑ reabsorption of water from nephron
- (3 marks)
- 1/2 mark each

next page