



Semester One Examination 2015

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

Multiple Choice Answer Sheet

Two Extended Answer Booklets: Part A and Part B

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 qu 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

1. 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.
2. 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 short answers in this question booklet. Write extended answers in Part A and Part B booklets.

3. 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.
4. 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.

Part I**(60 marks)**

Mark your answers to Questions 1-30 on the separate **Multiple Choice Answer Sheet** using a 2B, B or HB pencil. If you want to change an answer, rub out your first answer and mark the new choice. The answer sheet for Part I should be inserted into your booklet at the end of the examination.

SELECT THE SINGLE CORRECT ALTERNATIVE IN EACH OF THE FOLLOWING QUESTIONS.

1. Which of the following is not a symptom for hypothyroidism?
 - a) Weight loss.
 - b) Fatigue
 - c) Goitre
 - d) Cold intolerance

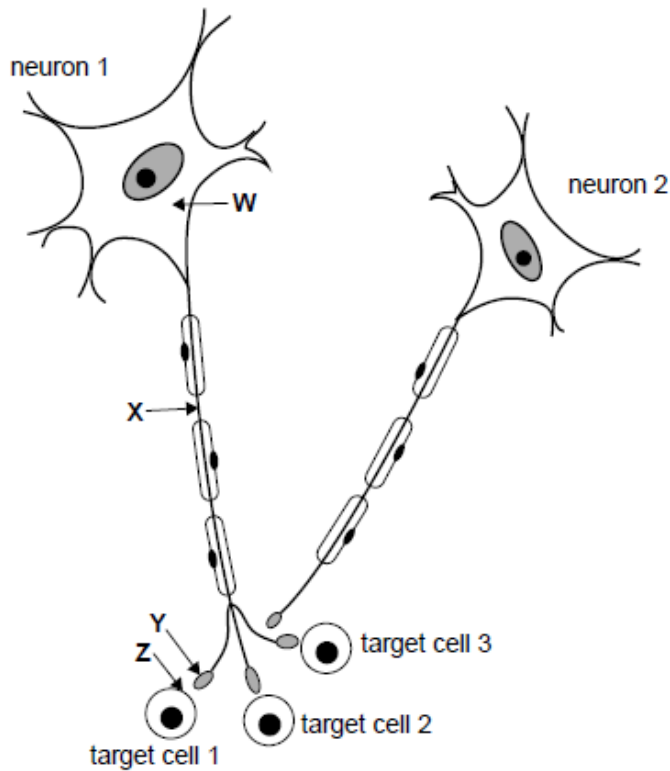
2. The control centre for regulating blood pressure is located in the:
 - a) Hypothalamus
 - b) Thyroid gland
 - c) Medulla oblongata
 - d) Islets of Langerhans

3. After the intake of a sugary food which of the following processes would take place?
 - a) Glycogenolysis
 - b) Gluconeogenesis
 - c) Glycogenesis
 - d) Lipolysis

4. Which of the following hormones is not directly involved in blood glucose regulation?
 - a) Cortisol
 - b) Insulin
 - c) Adrenocorticotrophic hormone
 - d) Glucagon

5. A control group is:
 - a) used to improve the accuracy of an investigation.
 - b) a set of variables which do not change to produce a fair investigation.
 - c) a particular variable that you change in order to observe its effect.
 - d) used as a comparison for the experimental group.

Question 6 and 7 refers to the diagram below.



6. Structure X and Y of a neuron are called:

	Structure X	Structure Y
A	axon	axon terminal
B	axon	motor end plate
C	dendrite	receptor
D	Node of Ranvier	axon terminal

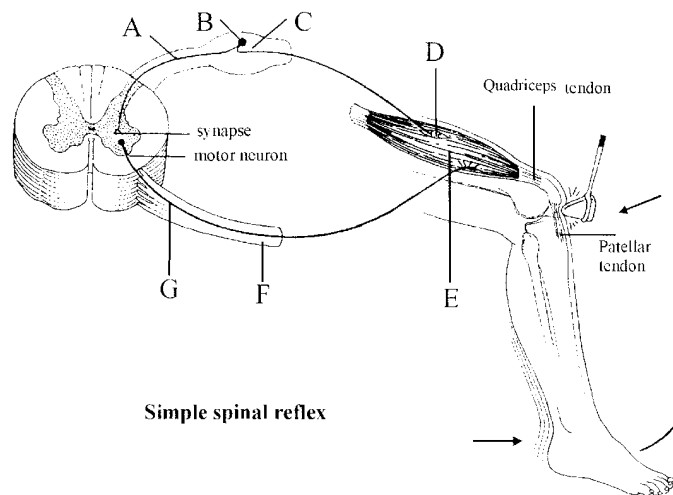
7. Neuron 1 and 2 are both second neurons in a neuron pathway. Neuron 1 is an excitation neuron. Neuron 2 is an inhibition neuron. The diagram represents a component of the

- a) Somatic nervous system
- b) Autonomic nervous system
- c) Afferent nervous system
- d) Central nervous system

8. A “ foreign" molecule which can result in the immune response is called a(n)

- a) immunoglobulin
- b) antigen
- c) Hapten
- d) antibody

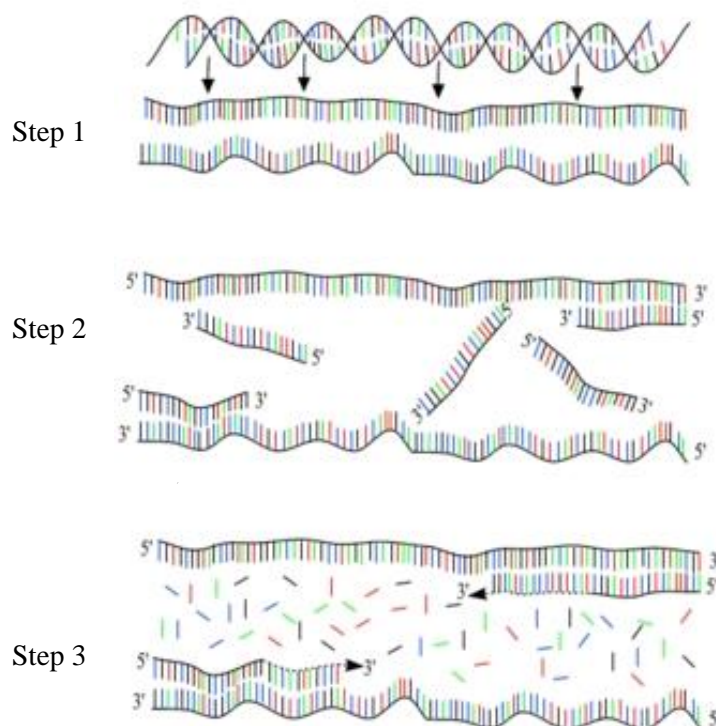
Question 9 refers to the following diagram of a simple spinal reflex.



9. The efferent axon is located at point:

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

The diagram below shows the different steps involved in Polymerase Chain Reaction.



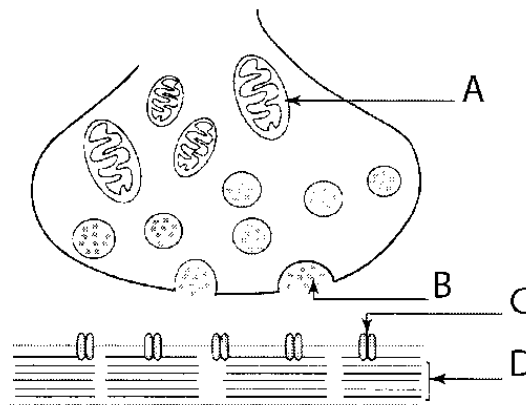
10. What is the name of the process occurring at step 3?

- a) Annealing
- b) Extension
- c) Denaturing
- d) Amplification

The table below shows the amount of urine produced compared to the volume of water consumed.

Volume of water (mL)	Volume of urine (mL)
2000	1360
1500	1150
600	520

11. Which of the following statements is correct?
- As the volume of water consumed increases, the urine becomes more concentrated.
 - The volume of urine is directly proportional to the amount of water consumed.
 - Urine becomes less dilute as the volume of water consumed increases.
 - An increase in water consumption stimulates the hypothalamus to produce anti-diuretic releasing factor.
12. Which of the following best describes the difference in the way B cells and T cells respond to invaders?
- B cells result in active immunity; T cells result in passive immunity.
 - B cells kill viruses directly; Killer T cells kill cells that are infected by viruses.
 - B cells become plasma cells that produce antibodies; Killer T cells directly kill cells that are infected by viruses
 - T cells remember pathogens and produce antibodies; Killer B cells directly kill cells that are infected with pathogens
13. 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
 - B
 - C
 - D
14. A factor that would cause the heart rate to slow down is:
- Increased sympathetic stimulation.
 - Increased parasympathetic stimulation.
 - Decreased parasympathetic stimulation.
 - Decreased stimulation from the cerebellum.

15. When a nerve cell is at rest, there is a potential difference between the inside of the cell and the outside of the cell of about - 70mV. This difference in charge exists because:

- a) the outside of the membrane has more positive potassium ions
- b) the extracellular fluid has more negatively charged ions than the intracellular fluid
- c) sodium ions which are positively charged are more concentrated in the extracellular fluid
- d) the membrane continuously pumps positively charged potassium ions from the intracellular fluid to the extracellular fluid

A common neurotransmitter is acetylcholine (Ach), which excites the post-synaptic neuron. Lack of Ach in brain synapses has been linked to Alzheimer's disease. A number of other chemicals also act at synapses. The table below outlines some of these chemicals and their actions.

Chemical	Source in nature	Effect at synapse
Botulinium	<i>Clostridium</i> bacteria	Prevents release of Ach from the pre-synaptic membrane
Eserine	African calabar bean	Inhibits the enzyme which breaks down Ach after post-synaptic stimulation
Curare	South American plant <i>Chondrodendron</i> sp.	Blocks post-synaptic receptors
Nicotine	Tobacco plant	Stimulates in the same way as ACh

16. Based on the information in the table, a possible treatment for Alzheimer's disease is:

- a) administer Eserine as a drug.
- b) inject Curare into the patient's CNS.
- c) recommend that the patient stops smoking.
- d) purposely infect the patient with *Clostridium*.

17. The link between the endocrine and nervous systems is the:

- a) thalamus
- b) hypothalamus
- c) pons
- d) cerebral cortex

18. A nerve fibre is a:

- a) bundle of axons.
- b) bundle of dendrites.
- c) motor nerve.
- d) cytoplasmic extension of a nerve cell body.

19. A type of bacteria causes sore throats. This bacteria was found to be susceptible to a type of antibiotic. A person with a sore throat recovered after taking this antibiotic. Several months later when the same person developed another sore throat caused by the same type of bacteria, a repeat dose of the same antibiotics was ineffective. Which of the following statements explains this situation?
- All the original bacteria population was resistant to the antibiotic.
 - The antibiotic caused genes for resistance to the antibiotic to appear in the bacterial population.
 - The person developed genes for resistance to the antibiotic.
 - The antibiotic acted as a selecting agent for resistance in the bacterial population.

As part of a research project into treating patients with liver damage, a scientist was asked to grow and monitor liver cells in a petri-dish. This required the measurement of fluid concentrations in and around the cells. The results from one such measurement are shown below.

Concentration (micrograms/Litre)

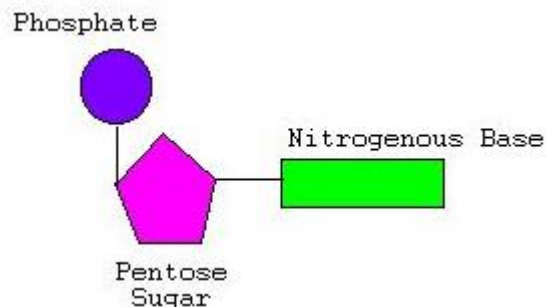
Solute	Intracellular Fluid	Extracellular Fluid
Glucose	30	50
Sodium	25	35
Chloride	15	20
Potassium	5	25
Bicarbonate	20	20

20. Based on this table of results, which of the following statements is true?

- These cells must use energy to obtain glucose and are in danger of dehydration.
- These cells will lose sodium, chloride and bicarbonate by diffusion.
- These cells will lose water
- The scientist must add more bicarbonate to the surrounding fluid.

21. The structure shown on the right is:

- a nucleotide
- an amino acid
- a protein
- DNA



The table below summarises the functions of the three functional areas of the cerebral cortex.

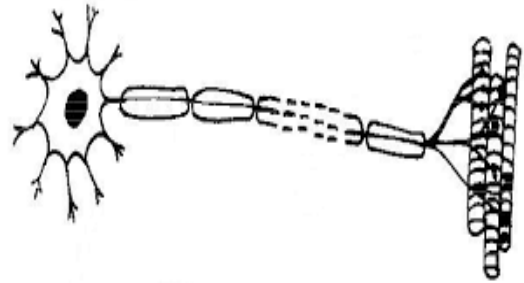
X	Y	Z
Receive and process nerve impulses from the senses	Send impulses to muscles, especially for voluntary movement	Interpret information from the senses and make it useful

22. The headings indicated by the letters X, Y & Z respectively should be;

- a) Motor areas, Association areas, Sensory Areas
- b) Sensory areas, Motor areas, Association areas
- c) Sensory areas, Motor areas, Cerebellum area
- d) Motor areas, cerebellum area, Sensory areas

23. The type of nerve cell illustrated in the diagram below is found in

- a) the grey matter of the brain
- b) the white matter of the spinal cord
- c) nerves supplying skeletal muscle
- d) touch receptors in the skin



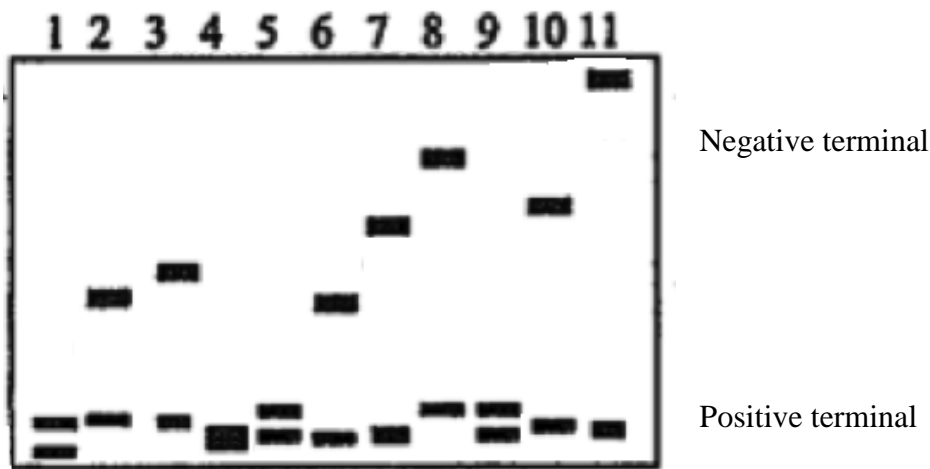
24. Osteoclasts are a special type of bone cell that are responsible for breaking down bone, resulting in the release of calcium into the blood stream. Which of the following statements is true:

- a) Parathyroid hormone is secreted from the parathyroid gland when calcium levels are high to reduce the action of osteoclasts, thus reducing calcium levels in the blood.
- b) The hormone calcitonin is released from the parathyroid gland when calcium levels are low to stimulate osteoclast activity.
- c) The hormone calcitonin is released from the thyroid gland when calcium levels are high to inhibit the action of osteoclasts.
- d) Parathyroid hormone is released from the thyroid gland when calcium levels are low to increase calcium levels via osteoclast activity.

25. Sally, a long distance runner, took part in a laboratory test using a treadmill. She was asked to run at 8 km/hour for thirty minutes. Sally was allowed to rest for five minutes and then repeated the exercise three times. Her performance was similar on all four occasions even though her breathing rate increased greatly. The change in her breathing occurred due to:

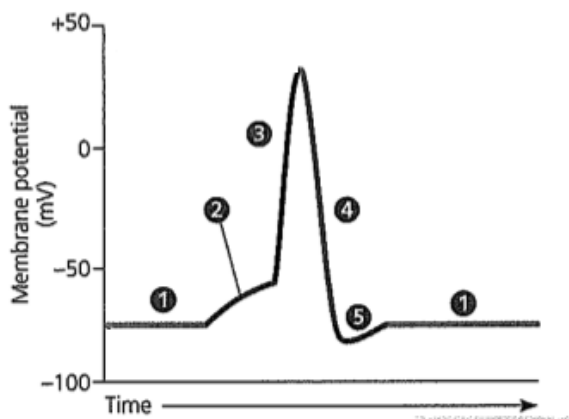
- a) a decrease in the blood pH and this change was detected by the chemo-receptors located in the hypothalamus.
- b) an increase in the blood pH and this change was detected by chemo-receptors located in the medulla oblongata.
- c) a decrease in her cardiac output and this change was regulated by the medulla oblongata.
- d) a decrease in the blood pH and this change was detected by the chemo-receptors in the aorta and carotid arteries.

A genetic defect on one gene on chromosome 4 results in a sequence of nucleotide bases, CAG, being repeated over 50 times for each affected allele. The greater the number of repetitions of the CAG codon in the gene, the longer the strand of DNA, and the more severe the outcome. Eleven people had their two alleles for this gene tested for the condition using DNA electrophoresis. Their results are shown below:



26. Which of the following is correct?
- a) Individuals 1 and 5 are both badly affected as they have the most repetitions.
 - b) Individual 11 would be the worst affected in this group.
 - c) Individuals 2 and 8 would be similarly affected by the condition.
 - d) There are three affected people in this group.

The diagram below shows the changes in the membrane potential of a neuron.



27. What is happening during point 3 on the graph?
- a) The sodium channels have closed and the cell is becoming re-polarised.
 - b) The sodium potassium pump is maintaining the resting membrane potential.
 - c) The potassium gates have opened and potassium is flooding out of the cell.
 - d) The sodium channels have opened and the cell is becoming de-polarised.

28. In order to reduce the heart rate the cardiac centre would:

- a) activate parasympathetic nerve fibres which would trigger the release of dopamine.
- b) activate sympathetic nerve fibres which would trigger the release of noradrenaline.
- c) activate sympathetic nerve fibres which would trigger the release of acetylcholine.
- d) activate parasympathetic nerve fibres which would trigger the release of acetylcholine.

29. The function of the structural gene in gene expression is to:

- a) activate the production of mRNA.
- b) code for the amino acid sequence.
- c) facilitate transcription.
- d) activate the production of tRNA

30. Which one of the following statements best illustrates artificial active immunity?

- a) Antibodies in breast milk enter the babies bloodstream.
- b) Antigens are made when a person suffers an attack of a disease.
- c) Antibodies are injected into the bloodstream.
- d) Antigens are injected into the bloodstream.

Part II (100 marks)

Write answers to ALL questions on the ruled lines after each question or in the spaces provided within each table. Write your answers in blue or black ballpoint or ink pen.

Question 31 (13 marks)

A pharmaceutical company was investigating the possibility of a new drug for the treatment of patients with heat stroke or hyperthermia. The designed effect of the drug was to increase the skin blood flow of the patients within minutes of administering the drug intra-venously.

In order to test the efficacy of the drug a trial was conducted in which patients admitted to the emergency rooms of hospitals with heat stroke were asked if they wished to participate. A total of 180 patients agreed to take part over the duration of the trial.

Participants were put in to one of two groups. One group of patients would receive an intra-venous injection of the new trial drug and the other group would receive an intra-venous injection of saline (sterile salty water). The normal protocols for treating patients with heat stroke were also carried out for both experimental groups. Each group had 90 individuals.

The skin temperature of participants was recorded on their administration to the ER and every ten minutes after their intra-venous injection. A summary of this data is included in the table below.

Examine the data presented and answer the questions that follow.

The effects of new drug on lowering body temperature of patients suffering heat stroke

Treatment group	Number of patients	Average Temperature (°C) on admission	Average Temperature (°C) following administration of drug or saline					
			10 min	20 min	30 min	40 min	50 min	60 min
New drug	90	40.8	39.9	38.6	37.5	37.3	37.2	37.2
Saline	90	40.6	39.9	39.3	38.7	38.2	37.8	37.4

a) State the hypothesis for this investigation.

(1 mark)

b) State the following variables:

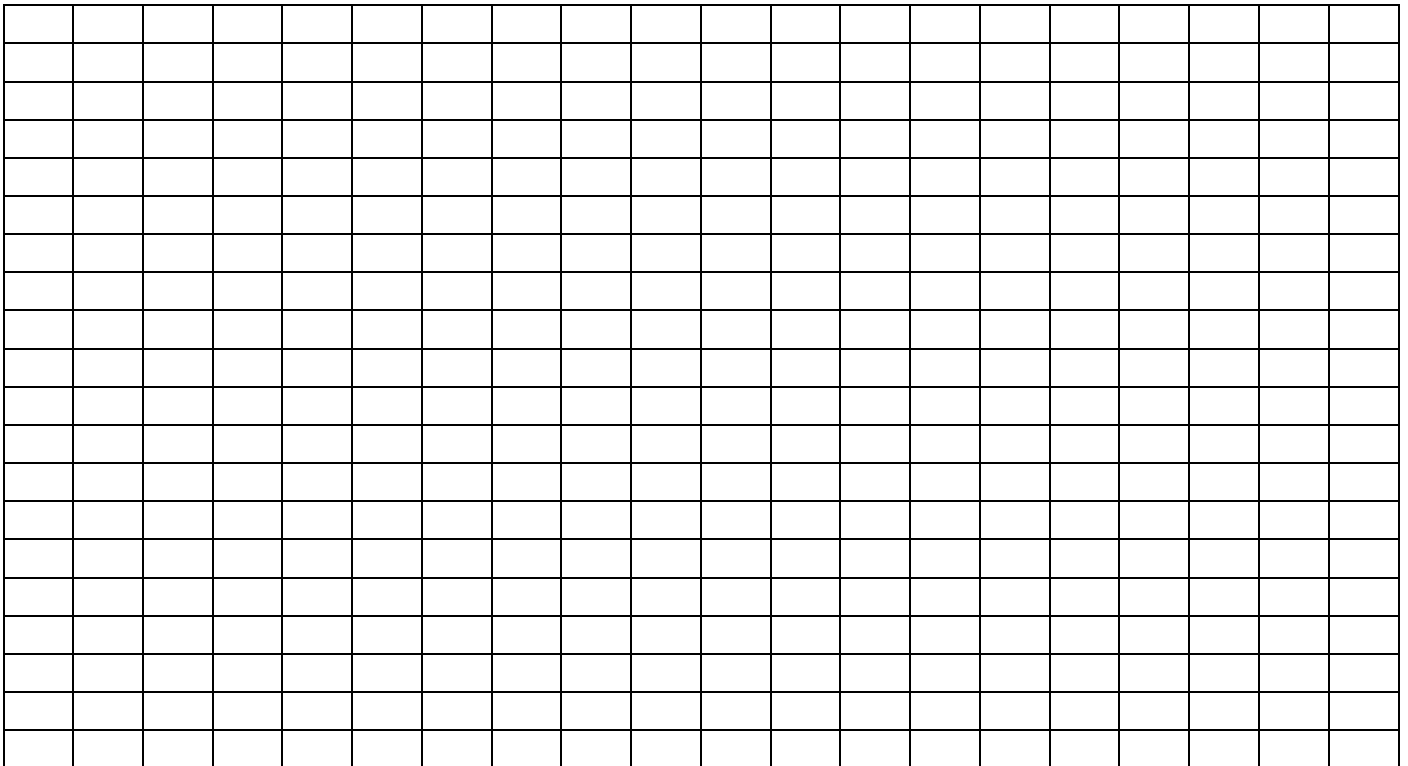
Independent variable: _____

Dependent variable: _____

(2 marks)

c) On the grid provided, construct a graph that can be used to represent this data (A spare grid is provided at the back of this booklet).

(4 marks)



d) Write a valid conclusion for this investigation.

(1 mark)

e) Why was one group given the saline injection?

(2 marks)

f) Use the data above to explain the effect of this drug on blood flow to the skin.

(3 marks)

Question 32 (5 marks)

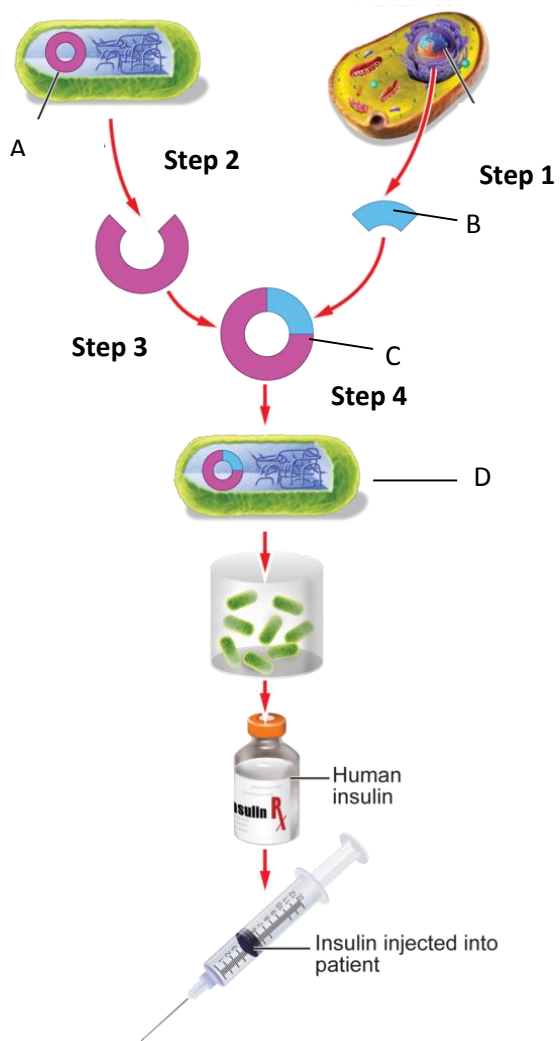
A lady has been diagnosed with ‘hyperthyroidism’. Complete the table summarising the cause, symptoms and treatment for this disease.

Cause	
Symptoms (x2)	
Treatment(s)	

(5 marks)

Question 33 (11 marks)

With reference to the diagram below:



a) Label the following:

A	
B	
C	
D	

(2 marks)

b) In the table below, describe the sequence of events that results in the formation of recombinant DNA in a transgenic organism.

Step	Description of events
1	
2	
3	
4	

(4 marks)

c) Insulin is an important hormone for regulating blood glucose levels.

i) Which cells are responsible for secreting insulin in the human body?

(1 mark)

ii) What is the advantage of using recombinant technology instead of more traditional techniques to harvest insulin?

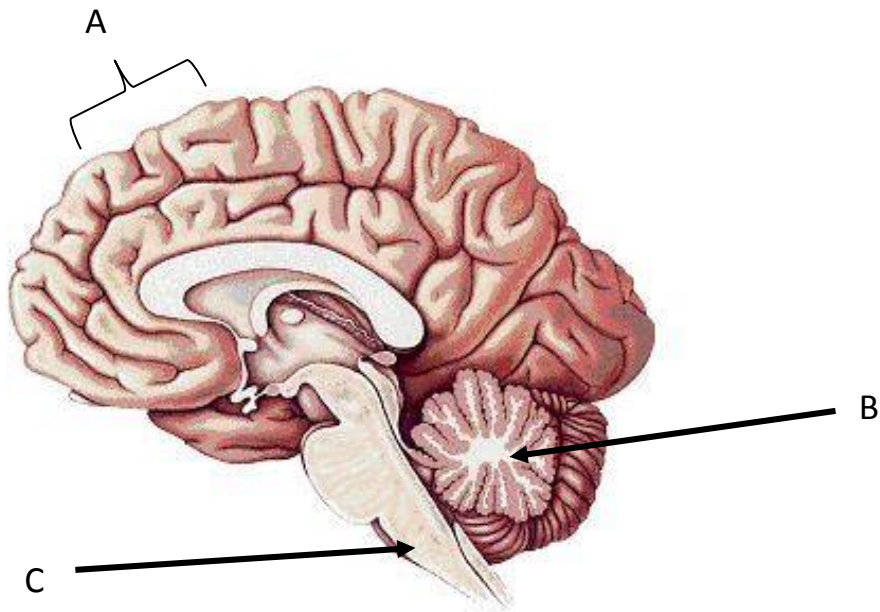
(1 mark)

iii) Explain why individuals suffering from Type 1 Diabetes require insulin injections.

(3 marks)

Question 34 (17 marks)

This diagram is an illustration of a cross-section through the brain. Use this diagram to answer part (a) below.

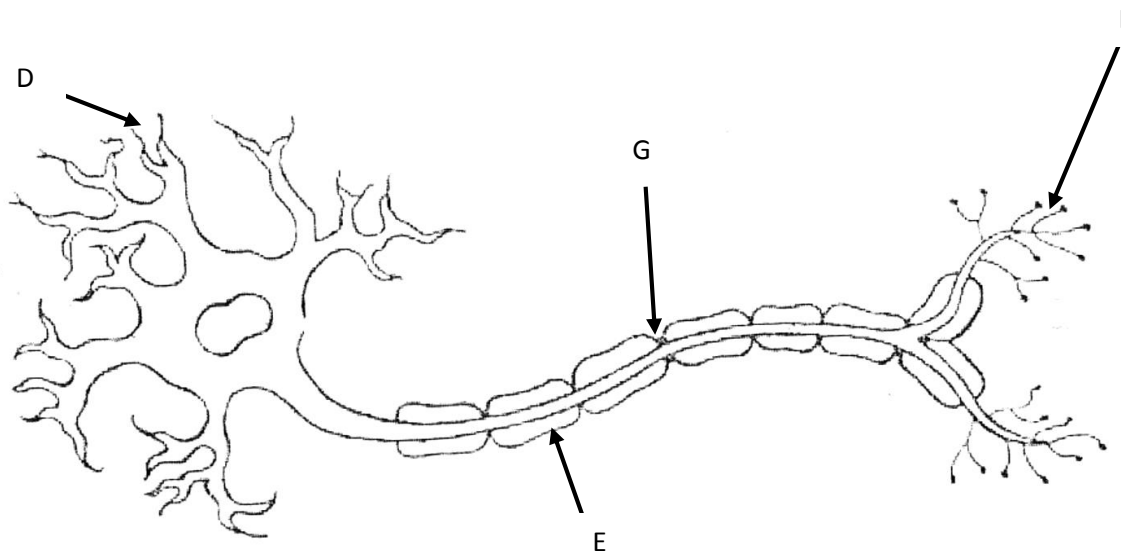


a) In terms of body movement, what is the role of the structures labelled A, B and C.

STRUCTURE	ROLE IN MOVEMENT
A	
B	
C	

(3 marks)

This diagram is an illustration of a motor neuron. Use this diagram to answer parts (b) and (c) below.



b) In terms of normal function, what is the role of the structures labelled D, E and F?

STRUCTURE	FUNCTION
D	
E	
F	

(3 marks)

c) A student researching the term “*saltatory conduction*” stated that the region in the motor neuron labelled G experiences *depolarisation*.

i) What is meant by the term: *saltatory conduction*?

(1 mark)

ii) Describe the events that occur during depolarisation of a neuron.

(4 marks)

Question 35 (3 marks)

Our body's internal environment can be disrupted by the things we do in our everyday lives and also by disease. Explain how caffeine, alcohol and emphysema disrupts homeostasis within the human body.

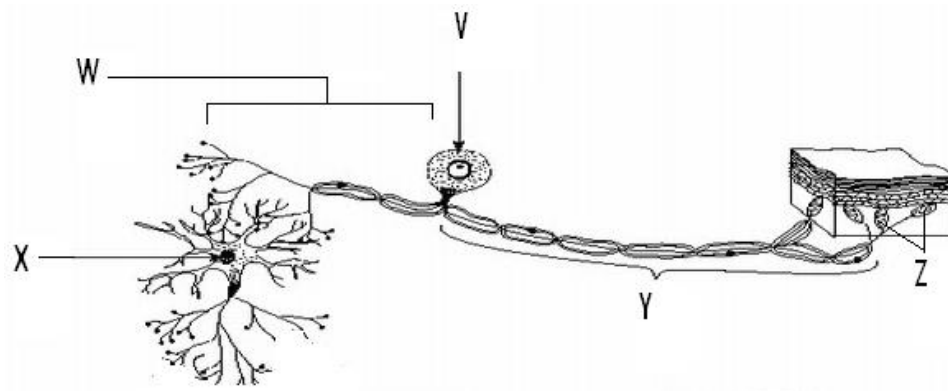
Disruption to Homeostasis	Describe <u>ONE</u> way homeostasis is disrupted?
Caffeine	
Alcohol	
Emphysema	

(3 marks)

Question 36

(8 marks)

Examine the following diagram of two neurons. One found in the peripheral nervous system and the other in the central nervous system.



a) Is this diagram illustrating the efferent or afferent division of the peripheral nervous system? Explain your answer.

(2 marks)

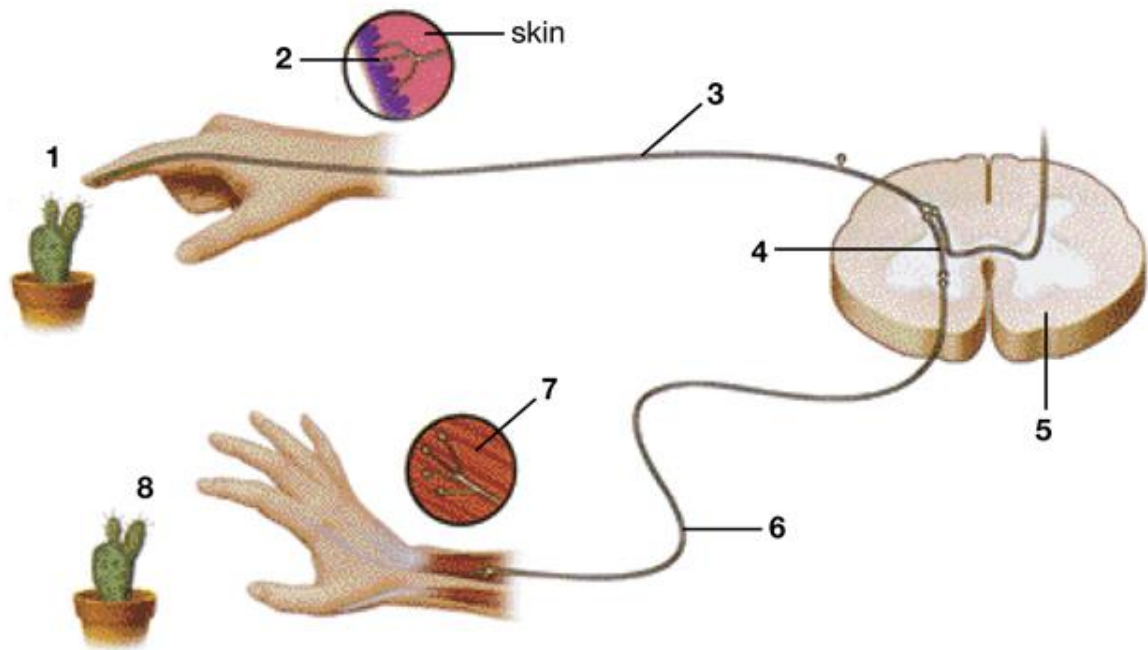
b) Based on its structure, classify the neuron in the central nervous system.

(1 mark)

c) Where would part “V” in the above diagram be located?

(1 mark)

The diagram below is of the reflex arc. The Red-back spider is one of Western Australia's most deadly spiders. The spider's venom acts specifically at nerve endings to reduce the release of contents from synaptic vesicles at motor nerve endings.



d) On the diagram, indicate where this venom would act.

(1 mark)

e) Explain the effect of the venom.

(3 marks)

Question 37 (10 marks)

There are several different ways hormones are recognised by cells.

- a) Identify the location of each receptor associated with each type of hormone and then describe the effect on the cell.

Hormone	Location of receptor protein	Effect on the cell
Protein/ amine hormone		
Steroid hormone		

(4 marks)

- b) Complete the following table.

	Prolactin	Oxytocin	Adrenocorticotrophic hormone
Where produced			
Where released			
Target organ(s)			
Effect			

(6 marks)

Question 38**(8 marks)**

A man is swimming in the ocean and gets a huge fright when seeing a large, dark shape below him. As a result, a number of physiological changes occur to his body to assist his survival in this situation. Discuss one action of each of the following organs and how that action may assist survival.

ORGAN	ACTION	ASSISTANCE WITH SURVIVAL
Liver		
Iris		
Bronchioles		
Blood vessels of the intestine		

(8 marks)

Question 39 (6 marks)

Complete the table below indicating

- i. Which modes of transport are passive and which are active.
- ii. Identify one molecule which uses each process to cross the cell membrane.

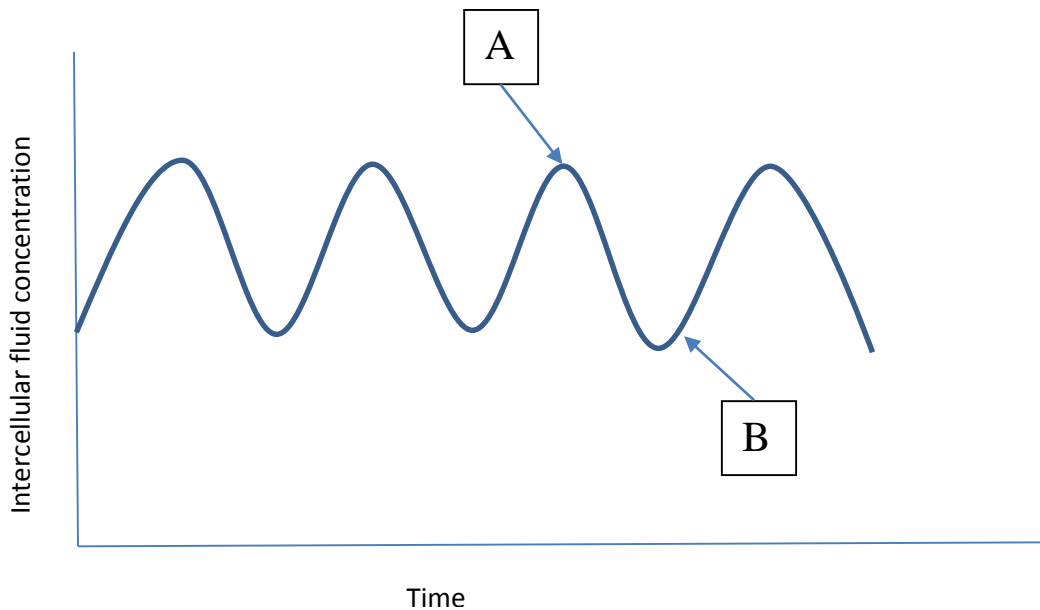
Water, oxygen, alcohol, amino acids, salivary amylase, glucose, sodium ions, cholesterol

Type of transport	Passive or Active	One Substance transported by this method
DIFFUSION		
OSMOSIS		
FACILITATED DIFFUSION		
ACTIVE TRANSPORT		
ENDOCYTOSIS		
EXOCYTOSIS		

(6 marks)

Question 40 (9 marks)

The graph below shows the fluctuations in body fluid over time.



a) Draw in the optimal intercellular fluid concentration onto the graph.

(1 mark)

b) Name the receptors that detect changes in body fluid and their location in the body.

Name: _____

Location: _____

(2 marks)

c) Describe the physiological changes the body undergoes at point B and the effect of this change on the concentration and volume of urine.

(3 marks)

d) The thirst reflex assists in the regulation of body fluids.

i) Name the stimulus that initiates the thirst reflex.

ii) Identify the effector that carries out the response.

iii) Is this an example of positive or negative feed back. Explain your answer.

(3 marks)

Question 41 (10 marks)

a) Complete the table below by writing transcription or translation next to the statement in reference to protein synthesis

Statement	Stage of Protein Synthesis
Ribosomes are involved	
tRNA is involved	
mRNA is made	
DNA acts as a template	

(4 marks)

The table shows some amino acids and their corresponding tRNA anti-codon. The tRNA anti-codon for a stop signal is also shown. Below the table, a section of DNA is also shown. Use this information to answer questions (b) to (f).

Amino acid/stop signal	tRNA anti- codon
Alanine	CGG, CGA, CGU, CGC
Arginine	GCA, GCG, GCU, GCC
Cysteine	ACA, ACG
Glutamine	CUU, CUC
Glycine	CCU, CCG, CCA, CCC
Leucine	GAA, GAG, GAU, GAC
Proline	GGU, GGG, GGA
Serine	AGG, AGA, AGU, AGC
Stop signal	AUU, AUC, ACU
Threonine	UGC, UGA, UGU, UGG

DNA Template Strand:

A C A C T T A C A G C C G G T G G G
 Triplet 84 Triplet 85 Triplet 86 Triplet 87 Triplet 88 Triplet 89

b) What amino acid is coded for by triplet 85?

(1 mark)

c) List the sequence of amino acids found in the polypeptide chain that is coded for by the DNA strand above.

(1 mark)

d) List the sequence of bases on a molecule of messenger RNA (mRNA) synthesised from the DNA strand above.

(1 mark)

e) Triplet 89 coded for the last amino acid in the polypeptide chain. What is the next triplet?

(1 mark)

f) Describe the polypeptide chain if triplet 90 was ACT and the next triplet was CTT on the DNA molecule.

(2 marks)

Part III**(40 marks)**

Answer **TWO QUESTIONS** from the following three options. Illustrate your answers with diagrams where appropriate. **DO NOT WRITE ANSWERS IN PENCIL.** Write your answers in blue or black ballpoint or ink pen on the lined pages in this booklet following the end of the questions.

Answer one question in Answer Booklet **Part A** and one question in Answer Booklet **Part B**.

ANSWER TWO OF THE FOLLOWING THREE QUESTIONS**Question 42****(20 marks)**

- a) Regulation of body temperature can become a matter of life and death, especially for the aged and very young. Using a feedback loop, explain how human bodies act to maintain core body temperature under cold conditions, both physiologically and behaviourally.

(14 marks)

- b) Young children commonly play a game to see who can hold their breath for the longest. After a short period of time, the child is always forced to breath. Explain this phenomenon.

(6 marks)

Question 43**(20 marks)**

The endocrine system and the nervous system play a very important role in communication within the body.

- a) Compare and contrast the actions of the endocrine system and the nervous system.

(10 marks)

- b) The efferent division of the peripheral nervous system can be divided into two major categories. Compare the structure and function of these two sub divisions of the nervous system.

(10 marks)

Question 44 (20 marks)

Mary is feeling unwell and has decided to visit her local G.P. She has recently been overseas and the doctor believes she has contracted a bacteria which is releasing a toxin into her bloodstream and this is leading to her symptoms.

- a) Using the information above, identify the form of defence her body undertakes against the bacteria and discuss how her immune system is prepared to deal with this invasion now and in the future.

(10 marks)

- b) Describe how antibodies work to defend against invading antigens.

(4 marks)

- c) Vaccinations are said to have had a great impact on people's health. Explain three types of vaccines that can be given to a person to help protect them from disease.

(6 marks)

