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HUMAN BIOLOGY

Unit 3

2021

Marking Key

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 (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Special items: non-programmable calculators approved for use in this examination

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 material. 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 examination
Section One Multiple-choice		30	30	40	30	30
Section Two Short answers		8	8	90	100	50
Section Three: Extended answers	39-40	2	1	50	40	20
	41-42	2	1			
Total						100

Instructions to candidates

- The rules for the conduct of the Western Australian examinations are detailed in the *Year 12 Information Handbook 2021*. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
- 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. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

Section Three: Consists of four questions. You must answer two questions. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

- You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
- Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Section One: Multiple-choice**30% (30 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. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. 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: 40 minutes.

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

1. Which of the following lists contains only bacterial pathogens?
 - (a) tuberculosis, influenza, tapeworm
 - (b) syphilis, tuberculosis, tetanus
 - (c) tapeworm, tetanus, syphilis
 - (d) influenza, syphilis, tetanus

2. Homeostatic control of body temperature is coordinated by which part of the brain?
 - (a) medulla oblongata
 - (b) hypothalamus
 - (c) cerebellum
 - (d) cerebral cortex

3. The function of the interneurons is to
 - (a) carry sensory information to the brain.
 - (b) conduct nerve impulses down the spinal cord to lower motor neurons.
 - (c) transmit information between the afferent and efferent neurons.
 - (d) carry sensory information away from the brain.

4. Which of the following is a correct comparison of the nervous and endocrine systems?
 - (a) hormones have a rapid action, nerve impulses are slower
 - (b) hormones act on any cells that have receptors for that hormone, nerve impulses act on specific cells only
 - (c) hormones act on the body for a short period of time, nerve impulses act for much longer
 - (d) hormones are electro-chemical messages and nerve impulses are chemical messages

Questions 5 and 6 refer to the table below.

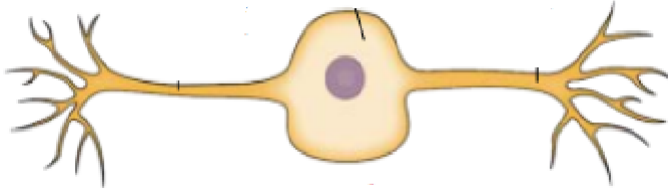
A year 12 Human Biology student measured the resting pulse rate of four of her classmates.

Student	Pulse rate (beats/min)
1	65
2	90
3	58
4	65

5. What would the mode be for this set of data?
- (a) 90
 - (b) 32
 - (c) 65
 - (d) 70
6. Which students' resting heart rate could be considered an outlier?
- (a) Student 1
 - (b) Student 2
 - (c) Student 3
 - (d) Student 4
7. The receptors that detect CO₂ levels in the blood are
- (a) chemoreceptors.
 - (b) thermoreceptors.
 - (c) baroreceptors.
 - (d) photoreceptors.
8. The target organ for the hormone Anti-Diuretic Hormone (ADH) is the
- (a) liver.
 - (b) bones.
 - (c) bladder.
 - (d) kidney.
9. A person who has blood sugar levels below 4.0mmol/L (90mg/100mL) is experiencing
- (a) type I diabetes.
 - (b) type II diabetes.
 - (c) hyperglycaemia.
 - (d) hypoglycaemia.

10. Which of the following would be a **correct** definition of positive feedback?

- (a) when the body returns to normal
- (b) when the original stimulus is intensified**
- (c) when the original stimulus is reversed
- (d) when the original stimulus cannot be reversed



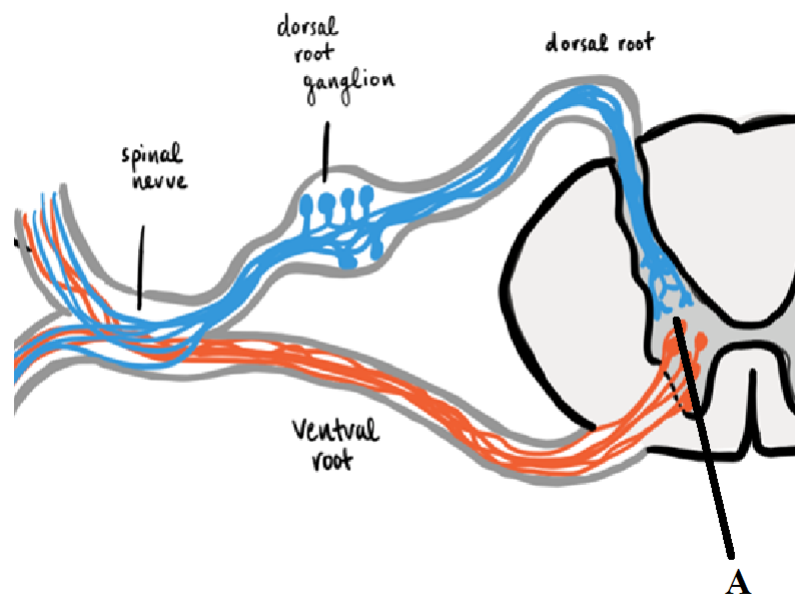
11. The neuron shown in the diagram above is

- (a) a receptor.
- (b) unipolar.
- (c) bipolar.**
- (d) multipolar.

12. Which of the following is **NOT** a response that occurs following parasympathetic stimulation?

- (a) decreased sweat production**
- (b) increased urine production
- (c) decreased heart rate
- (d) increase saliva production

Question 13-15 refers to the diagram below.



13. Which of the following would be found in the dorsal root ganglion?

- (a) sensory neuron cell bodies
- (b) motor neuron cell bodies
- (c) sensory nerves
- (d) mixed nerves

14. What type of neurons would be found at the point labelled A?

- (a) interneurons
- (b) unipolar neurons
- (c) multipolar neurons
- (d) pyramidal cells

15. What would be the effect on a person if the ventral root was severed completely?

- (a) no effect
- (b) they wouldn't be able to feel stimuli or move the part of the body corresponding to the nerve
- (c) they wouldn't be able to feel stimuli corresponding to the nerve
- (d) they wouldn't be able to move the part of the body corresponding to the nerve

16. Which of the following is **NOT** a function of the myelin sheath?

- (a) speeds up nervous transmission
- (b) insulates the axon
- (c) protects the axon
- (d) reduces threshold by 5mV

17. In which circumstance would memory cells be produced?

- (a) getting a deep cut
- (b) a baby receives immunoglobulins in breast milk from its mother
- (c) a person receives rabies antibodies after being bitten by a stray dog while on holiday
- (d) a person contracts measles and becomes ill

18. What type of vaccine is made up of the living pathogen that has been altered to render it non-virulent?

- (a) toxoid
- (b) attenuated
- (c) sub-unit
- (d) conjugate

19. Which of the following pairings is **correct**?

- (a) endocrine gland: ovary; hormone: oestrogen
- (b) endocrine gland: pancreas; hormone: cortisol
- (c) endocrine gland: parathyroid; hormone: calcitonin
- (d) endocrine gland: pineal gland; hormone: thyroid stimulating hormone

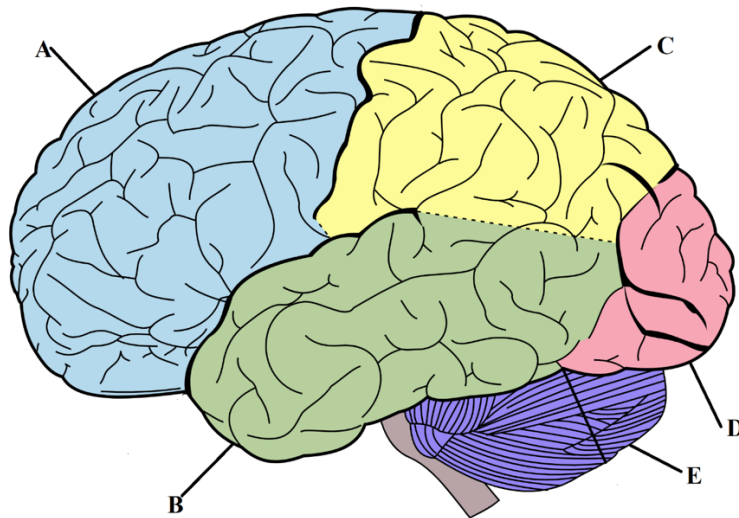
20. Which is the **best** definition of a suppressor T-cell?

- (a) a type of cell that secretes antibodies
- (b) a type of cells that kills foreign cells, cancer cells and cells infected with viruses
- (c) a type of cell that stimulates the action of some lymphocytes
- (d) a type of cell that blocks the action of some lymphocytes to prevent the immune system from becoming over-active

21. Which of the following is a correct comparison between B-cells and T-cells?

- (a) B-cells and T-cells both travel in the blood
- (b) B-cells and T-cells both stay in the lymph nodes
- (c) B-cells stay in the lymph nodes and T-cells travel in the blood
- (d) T-cells stay in the lymph nodes and B-cells travel in the blood

Use the diagram below to answer questions 22-24



22. Which label shows the parietal lobe?

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

23. What is the function of E?

- (a) to coordinate motor functions
- (b) transfers information between the left and right hemispheres
- (c) controls body temperature
- (d) regulate thirst and hunger impulses

24. What could result from damage to D?

- (a) disturbances of vision
- (b) inability to initiate voluntary movement
- (c) loss of hearing
- (d) sensitivity to temperature changes

25. The part of the brain most associated with the regulation of thirst?

- (a) medulla oblongata
- (b) cerebrum
- (c) cerebellum
- (d) hypothalamus

26. Which is the best definition of “accuracy” according to the scientific method?

- (a) baseline data to compare experiment results to
- (b) the extent to which an experiment produces consistent results
- (c) the extent to which a concept is correctly and precisely measured
- (d) the extent to which the hypothesis is tested by the method

27. How do bacteriostatic antibiotics act on bacteria?

- (a) they kill the bacteria
- (b) they slow bacterial growth or reproduction
- (c) they inhibit cell wall synthesis
- (d) they dehydrate the bacteria

28. What is the refractory period in an action potential?

- (a) the time it takes for threshold to be reached
- (b) the time following stimulation where the neuron cannot be stimulated again
- (c) the time it takes for the action potential to pass through the axon
- (d) the period where the membrane charges switch

29. Which of the following comparisons describing the differences between the anterior and posterior pituitary is **correct**?

	Anterior Pituitary	Posterior Pituitary
(a)	Produces oxytocin	Produces Follicle Stimulating Hormone (FSH)
(b)	Connects to the hypothalamus via capillaries	Connects to the hypothalamus via nerve cells
(c)	Releases hormones only	Produces and releases hormones
(d)	Released fewer hormones than posterior pituitary	Releases more hormones than anterior pituitary

30. A researcher was testing the hypothesis:

“A low-sodium diet reduces blood pressure in people over 50 years old”

The independent variable in this experiment was the:

- (a) age of the subjects.
- (b) total kilojoule consumed daily.
- (c) blood pressure.
- (d) low-sodium diet.

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

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

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

Question 31**(18 marks)**

Alzheimer's disease is a degenerative neurological disease that causes a loss of memory and thinking skills in sufferers. There is currently no effective treatment for this disorder though clinical trials are being conducted using cell-replacement therapy.

One such clinical trial is being conducted where Alzheimer's patients have stem-cells transplanted into parts of their brain that have been damaged by the disease. Before this surgery occurs a large amount of cognitive reasoning and memory tests are given to establish a baseline level of damage. These tests are then conducted on the patient post-surgery every month to monitor progress.

- (a) Propose an appropriate hypothesis for this investigation. (1 mark)

Description	Mark
A statement linking the independent variable to the dependent variable	1
E.g.: The cognitive reasoning/memory of the Alzheimer's sufferer will be improved after the cell replacement therapy.	
Cell replacement therapy/ stem cell transplantation will improve the cognitive reasoning/memory of an Alzheimer's sufferer compared to know therapy...	
Total	1

- (b) Name the independent and dependent variables in this experiment. (2 marks)

Description	Mark
Independent Variable: Cell-Replacement/ stem cell therapy	1
Dependent: Cognitive Reasoning and Memory	1
Total	2

- (c) Define the term 'control group' and suggest a reason why a control group was not used in this study.

(2 marks)

Description	Mark
Control Group: The standard to which comparisons are made in an experiment	1
Could compare the cognitive reasoning and memory after the operation to before the operation/ not ethical to put elderly people through the stress of a major operation for no reason	1
Total	2

- (d) State **four** variables that would need to be controlled to ensure a fair test. (4 marks)

Description	Mark
Any three of the following	
All patients have Alzheimer's- cant pay age/ degree of brain damage	1-4
Same method to transplant Stem-Cells	
Same method to measure cognitive reasoning and memory	
Same frequency to measure cognitive reasoning and cognitive capacity	
Also paid diet/ exercise during recovery	
Total	4

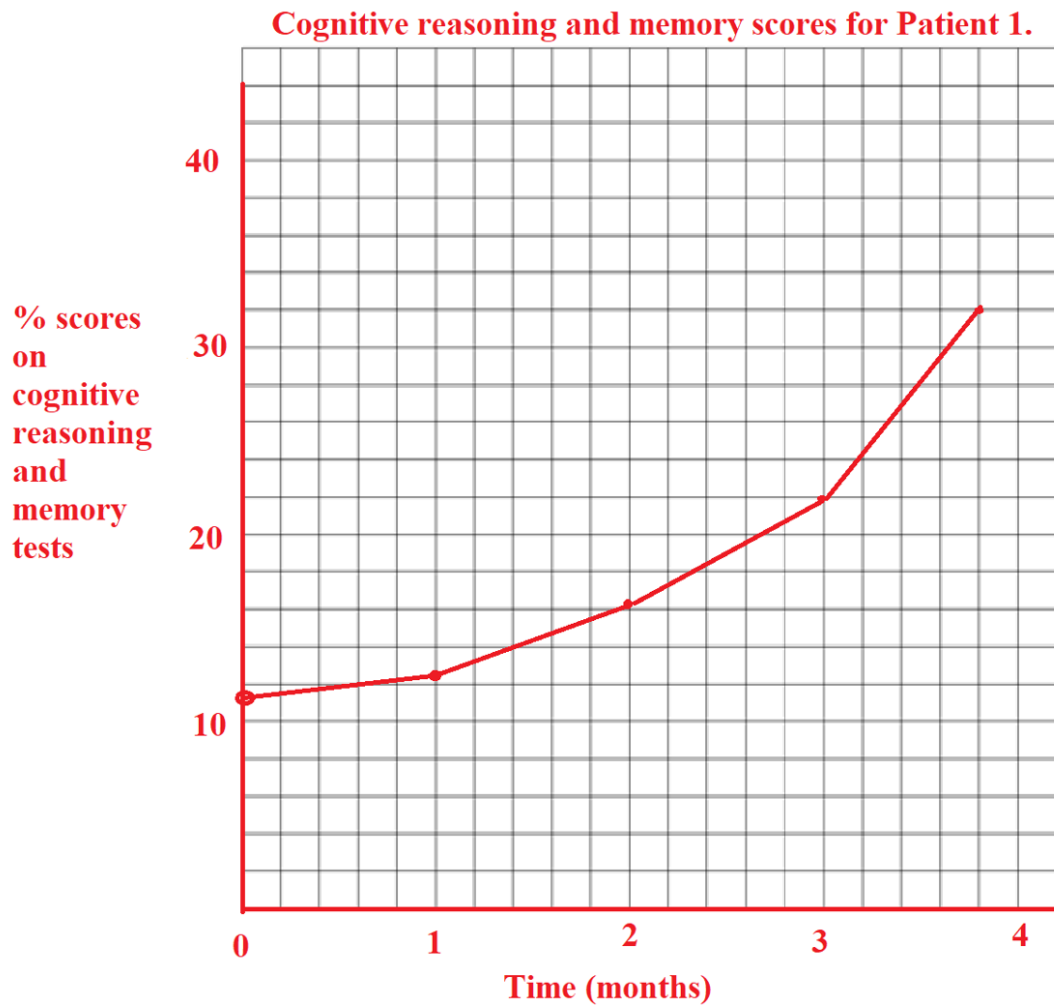
The score for the memory tests and cognitive reasoning tests were aggregated into a percentage.

	Patient 1 (%)	Patient 2 (%)	Patient 3 (%)
Before surgery	12	15	17
1-month post-surgery	13	14	17
2-month post-surgery	17	19	20
3-month post-surgery	22	25	25
4-month post-surgery	32	29	28

- (e) Calculate the mean test score for the three patients at 4-months post-surgery. (1 mark)

Description	Mark
29.7%	1
Total	1

(f) Use the grid below to construct a line graph for patient 1. (6 mark)



Description	Mark
Correctly constructs axes using appropriate scales.	1
Correct plots points using a line graph (1) and points joined (1)	4 2
Labelling of axes with correct name and unit	2
Key	4
Title appropriate with both independent and dependent variables included	1
Total	6

Notes: use the whole grid!
Title must include both variables

- (g) Using your knowledge of cell replacement therapy, suggest why improvement following this procedure has been so slow. (2 marks)

Description	Mark
Stem cells would take time to (differentiate) into nerve cells	1
Nerve cells would take time to begin to function properly	1
Total	2

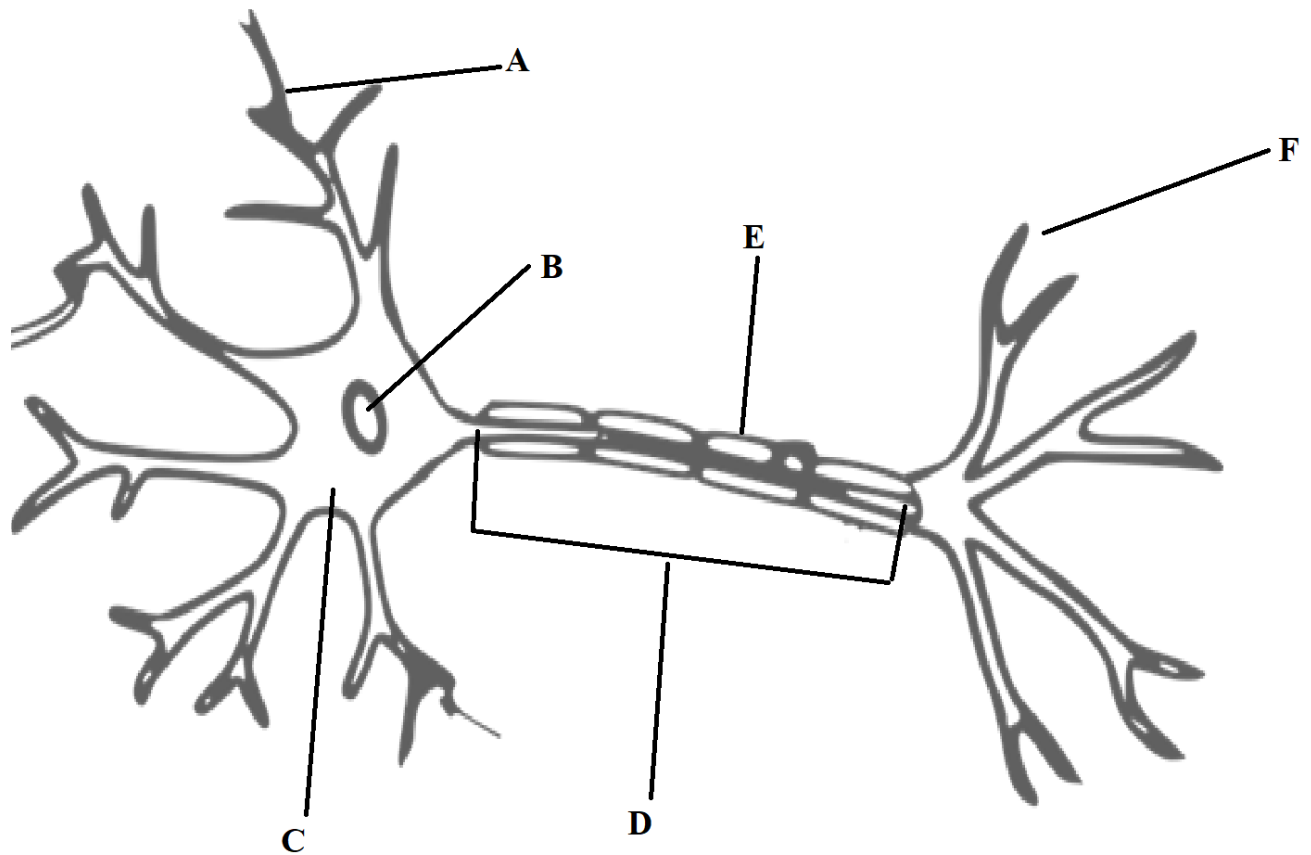
- (h) State a suitable conclusion that could be made based on the results of this study. (2 marks)

Description	Mark
Cell-replacement/ stem cell therapy causes an increase	1
In cognitive reasoning and memory in Alzheimer's sufferers	1
Total	2

Question 32

(9 marks)

Use the diagram below to answer the following questions.



(a) Name the following structures.

(2 marks)

Description	Mark
A: Dendrite	1
B: Nucleus	1
Total	2

(b) Describe the function of the following structures.

(4 marks)

Description	Mark
C: supports the internal structure/maintains shape/consistency	1
C: site of energy production/storage/ manufacture of cellular components	1
D: site of action potential/nerve transmission	1
D: carries the impulse away from the cell body	1
Total	4

(c) Describe the process that results in neurotransmitters being released from part F.

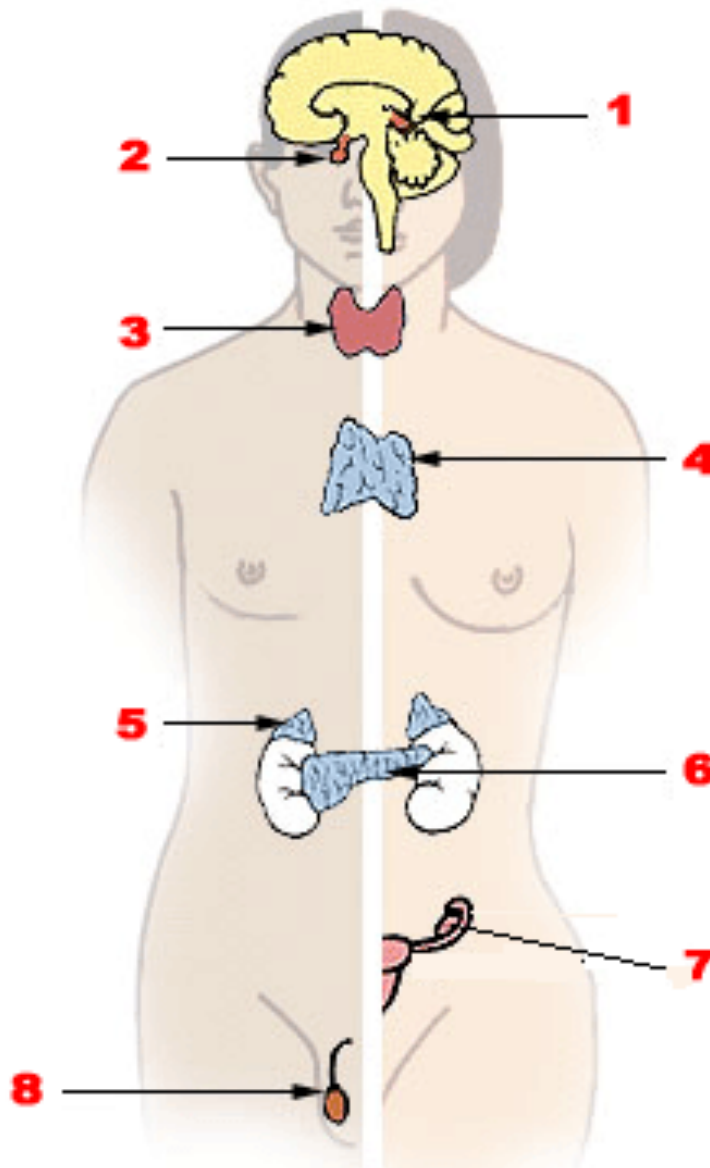
(3 marks)

Description	Mark
Depolarisation of the membrane of the axon terminal/ action potential occurs	1
Ca ²⁺ enters cell/ docking proteins drag vesicles containing neurotransmitters to membrane	1
Vesicles containing neurotransmitters bind to membrane releasing contents into synapse	1
Total	3

Question 33

(15 marks)

The diagram below shows the glands of the endocrine system.



(a) Name the endocrine organ and give an example of **one** hormone it releases.

(6 marks)

Description	Mark
2: Pituitary Gland	1
2: FSH/ Oxytocin/ Prolactin/ GH/ ACTH/ TSH/ LH/ ADH/ MSH	1
3: Thyroid	1
3: Thyroxine/ Calcitonin	1
4: Thymus	1
4: Thymosin	1
Total	6

(b) Complete the table below to identify the **target organ/s** and the **effect on the body** of the following hormones. (6 marks)

Hormone	Target organ/s	Effect on the Body
Testosterone	<ul style="list-style-type: none"> Many cells in the body Reproductive organs (not testes alone) see p40 	<ul style="list-style-type: none"> Develops secondary sexual characteristics Maintains sperm production Increases muscle growth <p>(any one)</p>
Oxytocin	<ul style="list-style-type: none"> Uterus Mammary glands (any one) 	<ul style="list-style-type: none"> Triggers uterine contractions during labour Stimulates milk letdown <p>(any one [effect must match target organ])</p>
Growth Hormone	<ul style="list-style-type: none"> All/most body cells 	<ul style="list-style-type: none"> Growth and development

- (c) Describe one effect on the body for the overproduction of each of the following hormones. (3 marks)

Description	Mark
Thyroxine: Hyperthyroidism/ Graves disease/ fast metabolism/ fast or irregular heartbeat/ weight loss/ increased appetite/ fatigue/ sweating/ anxiety/ protruding eyeballs (accept any correct symptom)	1
Oestrogen: Bloating/ swollen breast tissue/ fibrocystic lumps in breasts/ decreased sex drive/ irregular periods/ mood swings/ headaches/ weight gain (accept any correct symptom)	1
Aldosterone: High blood pressure/ muscle aches/ muscle spasms/ weakness/ paralysis (accept any correct symptom)	1
Total	3

Question 34**(5 marks)**

Addison's disease is an endocrine disorder where sufferers fail to produce enough of the hormone cortisol.

- (a) Name the organ of the endocrine system that would be affected by Addison's disease.

(1 mark)

Description	Mark
Adrenal cortex	1
Paired adrenal gland as specified organ	
Total	1

- (b) Describe the role of Adrenocorticotrophic Hormone (ACTH) on maintaining normal cortisol levels in the blood.

(4 marks)

Description	Mark
Anterior pituitary detects low levels of cortisol in the blood	1
ACTH is produced by the anterior pituitary	1
ACTH travels in the blood stream and attaches to the receptors on the adrenal cortex	1
Adrenal cortex produces cortisol	1
Total	4

Question 35

(12 marks)

Fugu is a Japanese dish that is made from the pufferfish. While this dish is very sought after it needs to be prepared carefully as large parts of the pufferfish contain a neurotoxin called Tetrodotoxin (TTX). If TTX is ingested, it binds to Sodium ion (Na^+) channels in the neuron where the cell fails to reach threshold and signal an action potential. People then experience paralysis and cardiac arrest.

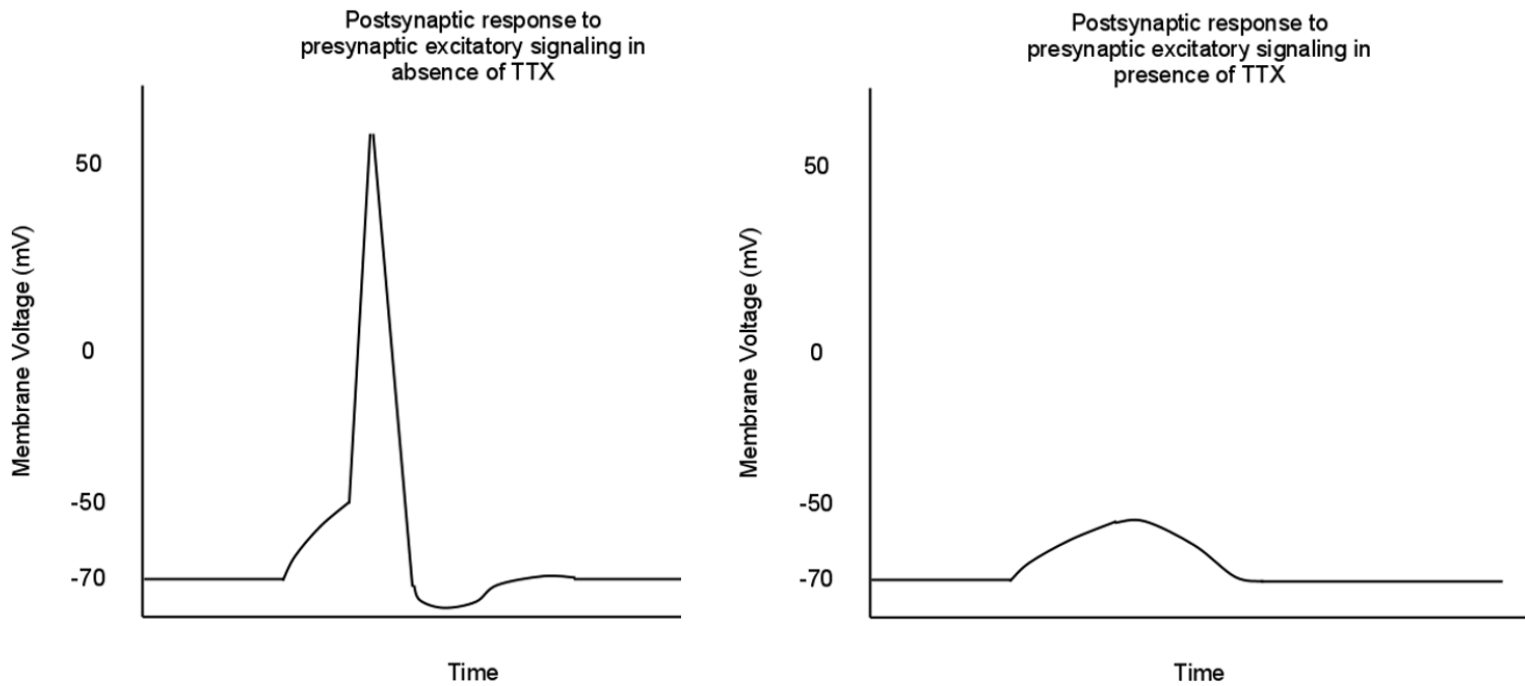
- (a) What does the term threshold mean in terms of an action potential? Explain how this threshold is reached. (4 marks)

Description	Mark
Threshold: The membrane voltage (also accepted potential) in a neuron that must be reached during depolarisation to trigger an action potential	1
Stimulation of the dendrites causes an intake of Na^+ ions	1
Na^+ ions cause the electrical potential of the cell membrane to be reduced	1
Until it reaches -55mV triggering an action potential	1
Total	4

- (b) Information is passed from the pre-synaptic neuron to the dendrites using neurotransmitters. Explain how neurotransmitters transmit the impulse across a synapse. (3 marks)

Description	Mark
Neurotransmitters are released into the synapse	1
Neurotransmitters migrate across the synapse via diffusion	1
Neurotransmitters bind to receptors on the post-synaptic cleft (to carry on the message)	1
Total	3

Use the diagram below to answer questions 35 c



(c) TTX affects the neurons by stopping Na^+ from entering the cell. Referring to the diagram above, explain why neurotransmission fails. (2 marks)

Description	Mark
Electrical potential across the membrane won't change	1
Threshold won't be reached/ Action potential won't be triggered	1
Total	2

(d) There is no antidote for TTX but people who have ingested it are sometimes given Atropine which is a drug that can stimulate the sympathetic nervous system to try and counter the effects of TTX. What are three changes that could occur in someone who has been treated with Atropine? (3 marks)

Description	Mark
Any three	
Increased heart rate	1-3
Increase blood pressure	
Decreased production of saliva	
Dilation of pupils	
Inhibition of digestive activity	
Increased adrenaline/noradrenaline production	
Increased sweat production	
Total	3

Question 36

(8 marks)

Herpes simplex labialis is a pathogen that causes recurrent outbreaks of cold-sores to those that are infected with this virus. It is estimated that between 50%-80% of humans have this virus.

- (a) Herpes simplex labialis is a virus. List three **structural characteristics** of a virus.

(3 marks)

Description	Mark
A genome made of single stranded DNA or RNA	1
A protein cap/capsid that covers the genome	1
A lipid envelope	1
Total	3

- (b) Herpes can be spread from those infected to those who are not infected by contact with the saliva or fluids from the blister when the sufferer is having an outbreak. Outline three steps that a person with an active cold-sore could take to avoid passing on the Herpes virus to the non-infected.

(3 marks)

Description	Mark
Any three	
Avoid close physical contact/ kissing	1-3
Avoid touching the cold sore	
Wash hands regularly	
Not sharing cutlery/crockery/cosmetics	
Total	3

- (c) Cold-sore outbreaks due to Herpes can be treated with topical antiviral medication. State how these antiviral medicines work to suppress the viral outbreak.

(2 marks)

Description	Mark
Stop the virus from reproducing	1
Stop the virus from entering uninfected cells	1
Total	2

Question 37

(10 marks)

Allie was daydreaming about what she would have for dinner and accidentally walked in front of a truck. She looked up just in time to jump out of the way of the truck before being hit.

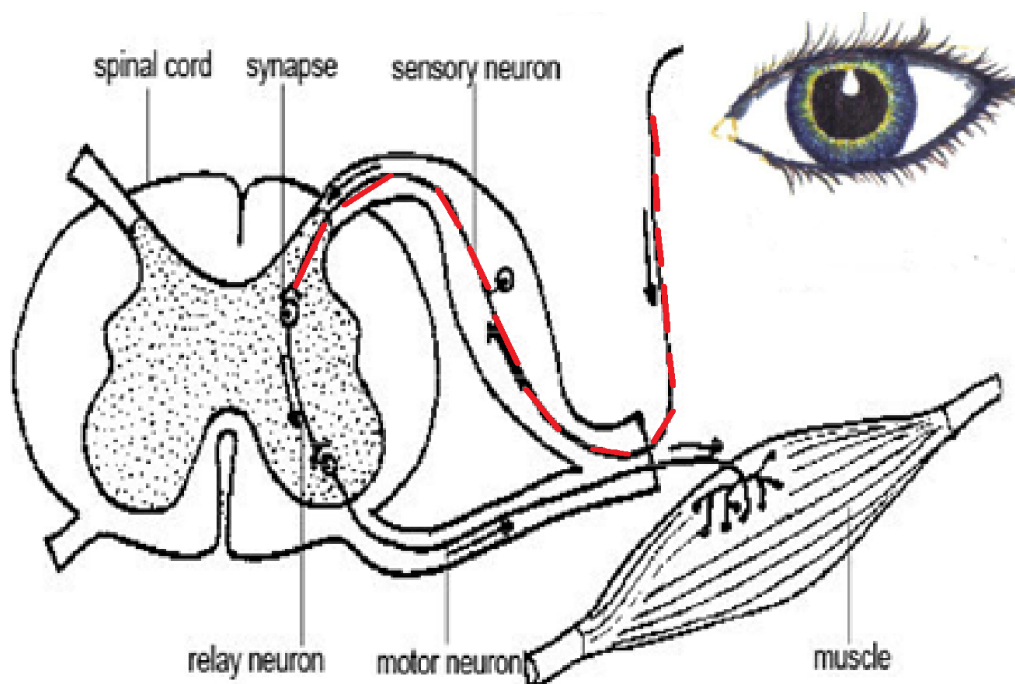
- (a) The photoreceptors allowed Allie to see the truck. Name the receptor that Allie used to feel the heat of the exhaust as the truck drove past. (1 mark)

Description	Mark
Thermoreceptor	1
Total	1

- (b) Explain how the heat of the truck was processed through this receptor to be recognised by Allie's Central Nervous System. (4 marks)

Description	Mark
Receptor in the skin detects heat	1
Heat is converted into electrical signals	1
Sensory neurons transmit signals to cerebrum/cerebral cortex/parietal lobe	1
Sensation is interpreted by the cerebrum/CNS/occipital lobe/parietal cortex	1
Total	4

Question 37 (c-d) refers to the diagram of the reflex arc below.



- (c) When Allie responded to the truck, she blinked without being consciously aware of it. Outline how this was possible. (2 marks)

Description	Mark
Reflex arc would send the stimuli to the spinal cord spinal reflex arc	1
Spinal cord would signal a response before the brain recognises the stimuli / faster than the brain can react	1
Total	2

- (d) On the diagram highlight the afferent pathway of the reflex arc. (1 mark)

- (e) Sufferers of Motor Neuron Disease have a breakdown of structure and function of the motor neuron. If Allie had been suffering from this condition, describe how the reflex arc would have been different when she saw the truck. (2 marks)

Description	Mark
The message would have been sent to the motor neurons to move out of the way	1
Because of the damage to the motor neurons no movement would have occurred	1
Total	2

Question 38

(9 marks)

Homeostasis is the maintenance of internal body conditions within tolerance limits. It involves behavioural and physiological activities.

- (a) Describe **two** physiological responses to increased levels of blood sugar in the body. (2 marks)

Description	Mark
Release of insulin from the pancreas to the blood stream from Beta cells	1-2
Conversion of glucose to glycogen/ glycogenesis	
Increased uptake of glucose by the cells	
Total	2

- (b) Describe **two** behavioural responses to a decrease in body temperature. (2 marks)

Description	Mark
Any two (accept other correct answers)	
Increase amount of clothing	1-2
Turn on a heater/sit near a fire	
Increase physical activity/ also accepted curl into ball	
Total	2

- (c) Temperature regulation and blood sugar regulation are controlled by negative feedback. What does this mean? (1 mark)

Description	Mark
That the response reverses/or reduces the initial stimulus	1
Total	1

- (d) Fever is an example of positive feedback. Describe the fever response and discuss why the body might initiate this response. (4 marks)

Description	Mark
Fever occurs when the thermoregulatory set point in the hypothalamus is reset to a higher level	1
Causing the body to create heat by shivering/ increased metabolic rate causing a rapid rise in body temperature	1
It occurs in response to infection with pathogens	1
To attempt to kill the pathogens by disrupting their metabolism	1
Total	4

Question 39**(14 marks)**

A runner ran in a 1500 meter race. After the race she noticed that her breathing rate was much faster than usual, but returned to a normal rate a few minutes after she finished.

- (a) Name and state the location in the body of the structures **receptors** involved in homeostatic control of breathing. (4 marks)

Description	Mark
Peripheral Chemoreceptors	1
In the Aorta/ Carotid arteries	1
Central Chemoreceptors	1
Medulla Obolongata	1
Total	4

- (b) What is the modulator for homeostatic control of breathing? (1 marks)

Description	Mark
Medulla Oblongata	1
Total	1

- (c) Exercise increases cellular respiration which decrease the pH of the blood. Explain how this happens? (3 mark)

Description	Mark
Cellular respiration produces H ₂ O and CO ₂	1
CO ₂ dissolves in water to form carbonic acid	1
Then broken down to form bicarbonate ions and Hydrogen ions	1
Total	4

- (d) Increased heat produced during exercise can be removed from the body several ways. Name and describe three methods of heat loss. (6 marks)

Description	Mark
Any three of the following	
Conduction Removal of heat by touching a solid object	1-2
Convection Heat being lost from the body through gases or liquids	1-2
Radiation Heat lost by electromagnetic radiation	1-2
Evaporation Heat lost through the evaporation of sweat on the skin	1-2
Total	6

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

This section contains **four** questions. You must answer **two** questions.
Answer **one** question from 40 and 41 and **one** question from 42 and 43.

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.

Supplementary pages for planning/continuing your answers to a question are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes.

Answer **one** question from Questions 40 to 41.

Indicate the questions you will answer by ticking the box next to the question. Write your answers on pages that follow.

Question 40**(20 marks)**

Production of testosterone is controlled by genes that are stimulated in males during puberty.

- (a) Testosterone is released by the gonads, but its production is controlled by the pituitary gland and the hypothalamus. Describe the pathway for the production of testosterone. (6 marks)

Description	Mark
The hypothalamus detects low levels of testosterone	1
The hypothalamus sends releasing factors to the anterior pituitary	1
To stimulate the anterior pituitary to release FSH and LH/FSH/LH	1
FSH and LH/FSH/LH travel through the blood stream	1
They attach to receptors in the testes	1
To stimulate the production of testosterone	1
Total	6

- (b) Testosterone is a lipid-soluble hormone. Explain how testosterone enters and affects the functioning of its target cell. (6 marks)

Description	Mark
Testosterone diffuses easily through the cell membrane	1
Once inside the cell, Testosterone binds to a receptor	1
Forming a hormone receptor complex/HRC	1
The hormone/HRC is transported to the nucleus	1
Where it binds directly to the DNA	1
Where it activates transcription of certain genes	1
Total	6

- (c) The other type of hormones the body releases are water soluble hormones. Describe how these hormones enter and effect the functioning of the target cell. (4 marks)

Description	Mark
Water soluble hormones do not enter the cell manual	1
They attach to receptors on the cell-membrane	1
Causes a secondary messenger to be produced	1
That diffuses through the cell to activate enzymes	1
Total	4

- (d) Compare and contrast water-soluble and lipid soluble hormones with respect to their action within the body. (4 marks)

Description	Mark
Both lipid and water-soluble hormones cause changes in the body to maintain homeostasis	1-4
Lipid hormones are slow to take an effect	
Lipid hormones have a long-lasting effect	
Water soluble hormones cause a rapid response	
Water soluble hormones have a short-lasting effect	
Total	4



Question 41

(20 marks)

In 2007 a woman entered a competition where participants had to drink 240mL of water every 15 minutes without urinating. She came second and later died due to water intoxication.

- (a) Describe the homeostatic mechanism that occurs when water levels in the blood increase.

(10 marks)

Description	Mark
Osmoreceptors in the blood vessels/ hypothalamus detect increased water levels in the blood/ decreased osmolarity	1-10
Osmoreceptors send a signal to the hypothalamus	
Hypothalamus sends signals to the posterior pituitary	
To decrease the release of Anti-diuretic hormone	
Low ADH decreases the permeability of the DCT	
Low ADH decreases the permeability of the DCT	
A lack of ADH will prevent reabsorption in the collecting duct	
Causing an decrease in urine concentration urine becomes more dilute	
Hypothalamus sends signal to the anterior pituitary	
To decrease production of Adrenocorticotrophic hormone (ACTH)	
Low ACTH decrease production of Aldosterone (from adrenal cortex)	
Low Aldosterone causes decreased reabsorption of the filtrate back to the blood	
Total	10

- (b) What would happen to the cells the in the blood stream if the fluid increased but was not allowed to be released.

(4 marks)

Description	Mark
Osmotic pressure in the blood would decrease	1
Red blood cells would absorb water	1
Causing them to swell and explode	1
Reducing the ability of the blood to transport O ₂ and CO ₂	1
Total	4

- (c) A person was in a hot dry environment with a limited water supply. Describe the hormonal response would occur to conserve fluid levels in their blood.

(6 marks)

Description	Mark
Osmotic pressure in the blood would increase	1
This would be detected by thermoreceptors (osmoreceptors) in the hypothalamus	1
This would cause a release of ADH from the posterior pituitary	1
ADH travels in the blood to the distal convoluted tubule/collecting duct of the nephron	1
Causes increased permeability of water at this membrane	1
Causing more water to be reabsorbed from the filtrate/urine	1
Total	6

Answer **one** question from Questions 42 to 43.

Indicate the questions you will answer by ticking the box next to the question. Write your answers on pages that follow.

Question 42
(20 marks)

Jessie was skateboarding when she fell and scraped her knee badly on some dirty gravel. To protect Jessie from pathogens, her body underwent a series of responses.

- (a) Outline the inflammatory response that Jessie's body would undergo as a result of her fall.

(6 marks)

Description	Mark
Damage to the tissue	1
Mast cells release histamine and heparin	1
Histamine increases blood flow to the area/capillaries become more permeable	1
Heparin prevents clotting in the immediate area	1
Mast cells attract macrophages to the site (also accepted neutrophils)	1
Macrophages consume debris and foreign materials	1
Total	6

- (b) After the initial injury her body started to undergo the antibody mediated response. Outline this response.

(8 marks)

Description	Mark
Pathogen enters the body	1-8
Macrophage engulfs pathogen	
Macrophages present the non-self antigen / fragment	
B-Cells are sensitised and enlarged	
B-cells divide producing clones	
Most B-cells will become plasma cells	
Plasma cells will produce antibodies	
Antibodies travel in the blood stream	
Antibodies inactivate or destroy antigens	
Some B-cells become memory cells	
Total	8

- (c) Compare and contrast the antibody mediated response with the cell-mediated response.

(6 marks)

Description	Mark
Both are specific responses to pathogens	1
Both use cells that originate in the bone marrow	1
Both create memory cells	1
Antibody mediated use B-Cells, Cell mediated use T-Cells	1
Antibody mediated occurs when body cells have not been infected with the pathogen, cell mediated when cells have been infected with the pathogen	1
Antibody mediated uses antibodies in the blood stream produced by B-Cells, cell mediated T-cells travel in the blood	1
Total	6



Question 43

(20 marks)

The nervous system is divided into several sections based on structure and function.

- (a)
 (i) Compare and contrast the CNS and the PNS. (6 marks)
 (ii) The PNS is divided into the somatic and autonomic divisions. What are the main features of the somatic division? (4 marks)

Description	Mark
(i)A maximum of 6 marks for the following	
Both are made up of nervous tissue	1-6
Both use electro-chemical signalling/action potentials/ nerve impulses	
Both CNS and PNS involve both automatic and voluntary processes	
CNS is made of the brain and spinal cord, the PNS is made of the nervous tissue in the rest of the body	
The nerves in the CNS are made of a huge variety of structural neurons, Nerves in the PNS are mostly sensory/unipolar and motor/multipolar	
The CNS only has one division (brain and spinal cord), the PNS has many divisions	
The CNS does not contain any sense receptors, the PNS does	
The nerves in the CNS are protected by multiple structures/skull/spinal column/CSF/meninges, the nerves in the PNS have less protection	

(ii)A maximum of 4 marks for the following

The somatic division is responsible for voluntary actions	1-4
The somatic division is also responsible for reflex arc	
The somatic division contains afferent and efferent neurons	
The somatic division can be divided into visceral muscles and skeletal muscles	
Total	10

- (b) On Christmas afternoon a person lays down on the couch following a large meal. Which division of the autonomic system would be engaged and what would the physiological effects on the person be?

(6 marks)

Description	Mark
The parasympathetic division of the NS	1-6
Constriction of blood vessels to skeletal muscles	
Dilation of blood vessels to digestive organs	
Stimulation of digestive secretions	
Increased peristalsis/ relaxation of sphincters in the digestive system	
Decrease heart rate	
Constriction of bronchioles	
Constriction of pupils	
Total	6

- (c) This person has a sleep on the couch but wakes up when they feel something strange on their right elbow. They slap the elbow and open their eyes to discover a squashed mosquito. Outline the pathway of nerve impulses from feeling the mosquito to slapping the mosquito.

(4 marks)

Description	Mark
Touch receptors in the skin are stimulated by the mosquito	1
Nerve impulses are sent to the CNS by sensory neurons	1
Impulse sent to the parietal lobe to interpret the stimuli	1
Impulse sent via a motor nerve to the arm to slap the mosquito	1
Total	4

END OF QUESTIONS

ACKNOWLEDGEMENTS

- Question 10** Adapted from Neuron [image] retrieved 9 December, 2020 from <https://search.creativecommons.org/photos/7a4312df-fc7b-43dd-928c-e4ff32519bde>
- Question 13** Adapted from image retrieved 24 February, 2020 from https://en.wikipedia.org/wiki/Pituitary_gland#/media/File:1806_The_Hypothalamus-Pituitary_Complex.jpg
- Question 17** Neuromuscular junction [image] retrieved 16 January, 2020 from https://en.wikipedia.org/wiki/Neuromuscular_junction
- Question 22** Adapted from brain image retrieved 16 December, 2020 from https://upload.wikimedia.org/wikipedia/commons/2/23/Brain_diagram_without_text.svg
- Question 32** Adapted from Neuron [image] retrieved 9 December, 2020 from https://upload.wikimedia.org/wikipedia/commons/0/00/Sketch_of_a_brain_neuron.png
- Question 33** Adapted from endocrine system [image] retrieved 15 December, 2020 from: https://upload.wikimedia.org/wikipedia/commons/d/da/Illu_endocrine_system_heb_%28cropped%29.PNG
- Question 35** TTX [graph] retrieved 5 December, 2020 from: https://en.wikipedia.org/wiki/Neurotoxin#/media/File:Tetrodotoxin_AP.png

