HUMAN BIOLOGY
UNIT 3
2017

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

Name: _____

Teacher: _____

TIME ALLOWED FOR THIS PAPER

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

MATERIALS REQUIRED/RECOMMENDED FOR THIS PAPER

To be provided by the supervisor:

- This Question/Answer Booklet
- Multiple Choice Answer Sheet

To be provided by the candidate:

- Standard items: Pens, pencils, eraser or correction fluid, ruler, highlighter, ruler.

- Special items: Calculators satisfying the conditions set by School Curriculum and Standards Authority for this subject.

IMPORTANT NOTE TO CANDIDATES

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

Structure of this paper

Section	Suggested working time	Number of questions available	Number of questions to be attempted	Marks	Percentage
SECTION ONE: Multiple-choice	50 minutes	30	All	60	30
SECTION TWO: Short answers	90 minutes	7	All	100	50
SECTION THREE: Extended answers	40 minutes	3	2	40	20
			Total marks	200	100

Instructions to candidates

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

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 your answers in this Question/Answer Booklet.

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.

SEE NEXT PAGE

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

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

Suggested working time for this section is 50 minutes.

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

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

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

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

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

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

1. The range and median for the patient's TSH level was

   a) 2.0 to 2.9 with a median of 2.4
   b) 2.1 to 2.9 with a median of 2.3
   c) 2.0 to 2.1 with a median of 2.9
   d) 2.0 to 2.9 with a median of 2.3

2. TSH is a hormone secreted by

   a) the hypothalamus and released from the anterior lobe of pituitary gland.
   b) the posterior lobe of the pituitary gland and its release is controlled by the hypothalamus.
   c) the anterior lobe of the pituitary gland and its release is controlled by the thyroid gland.
   d) the anterior lobe of the pituitary gland and its release is controlled by the hypothalamus.

3. Based on the information the patient provided, the disease the doctor was most likely checking for was

   a) type 1 diabetes.
   b) type 2 diabetes.
   c) hypothyroidism.
   d) hyperthyroidism.

SEE NEXT PAGE

4. Choose the two correct words to complete the following sentence.
Given the results showed a normal level of TSH present in the blood, the doctor would now need to detect for the presence of _____ to determine if the _____ gland was dysfunctional.

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

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

a) The loss of excess glucose in urine.
b) The secretion of oily substances from the sebaceous glands to reduce water lost from the skin surface.
c) The vasoconstriction of the capillaries in the skin to reduce heat loss.
d) The mother feeds the baby with breast milk so that the useful nutrients go back to the human body again.

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

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

7. One hormone molecule causes the manufacture or activation of thousands of enzyme molecules through the process of

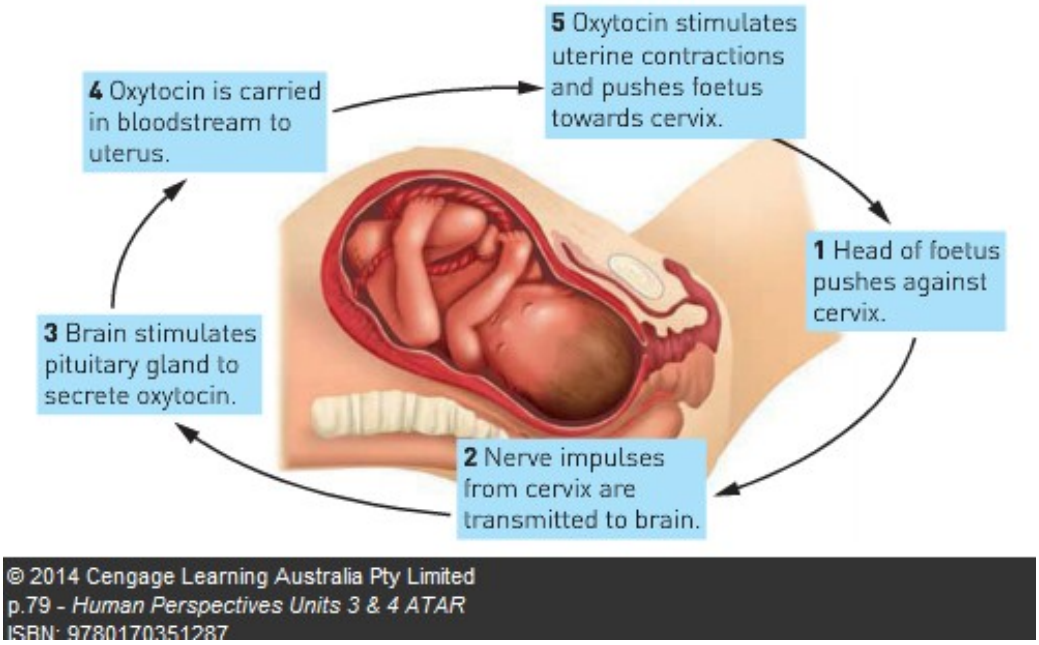
a) negative feedback.
b) enzyme amplification.
c) hormone amplification.
d) hormone clearance.

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

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

SEE NEXT PAGE

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



9. In this stimulus-response and feedback process, the effector would be the

   a) cervix.
   b) uterus.
   c) pituitary gland.
   d) oxytocin.

10. The type of feedback involved in this process would be

   a) negative feedback, as the response negates the stimulus.
   b) positive feedback, as the response negates the stimulus.
   c) negative feedback, as the response intensifies the stimulus.
   d) positive feedback, as the response intensifies the stimulus.

11. The hormone responsible for stimulating the contractions of the uterus is

   a) produced in and released from the anterior lobe of the pituitary.
   b) produced in the hypothalamus and sent to the anterior lobe of the pituitary via nerve fibres.
   c) produced in the hypothalamus and sent to the posterior lobe of the pituitary via nerve fibres.
   d) secreted from the hypothalamus and sent to the posterior lobe of the pituitary via blood vessels in the infundibulum.

SEE NEXT PAGE

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

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

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

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

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

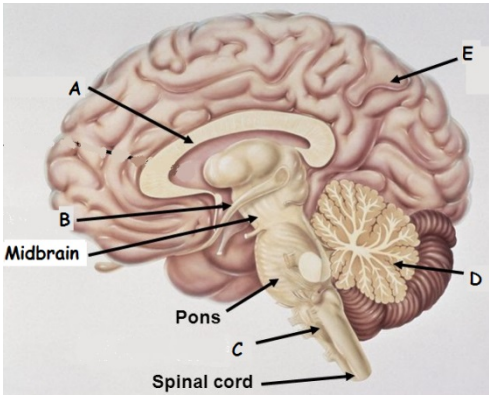
    a) A, B, C and E
    b) A, C, D and F
    c) A, B, C, and D
    d) B, C, E, and F

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

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

SEE NEXT PAGE

Refer to the diagram below to answer the next question.



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

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

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

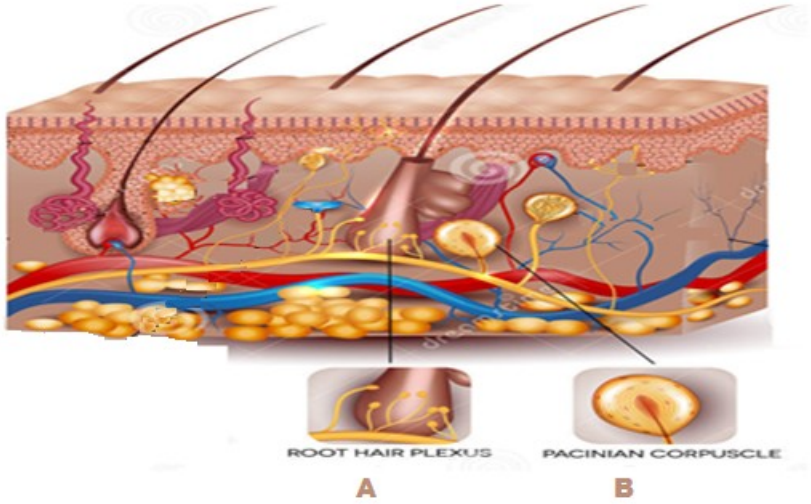
a) Medulla oblongata.
b) Cerebellum.
c) Cerebral cortex.
d) Hypothalamus.

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

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

SEE NEXT PAGE

Look at the diagram below and answer the following question.



18. Choose the correct statement that describes the similarity and difference between the receptors labelled in the above diagram.

	Similarity	Difference
a)	Detect heat	A detects cold, B detects heat.
b)	Detect pH of body fluids	A detects low pH body fluid and B detects high pH body fluid.
c)	Detect touch	A detects strong pressure, B detects light pressure.
d)	Detect touch	A detects light pressure, B detects strong pressure.

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

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

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

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

SEE NEXT PAGE

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

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

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

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

23. Which of the following is true about active immunity?

a) The antibody formed will attack any pathogen.
b) Both B and T lymphocytes can play a role.
c) It is short-lived because no memory cells are involved.
d) Prepared immunoglobulins activate this type of immunity.

24. An individual contracted Lyme disease after a tick took a blood meal from them.
Which of the following methods would describe how this disease was transmitted?

a) By contact
b) By body fluids
c) By a vector
d) By ingestion

25. The enzyme that is found in human tears that helps to kill bacteria is called

a) cerumen.
b) lysozyme.
c) vaccine.
d) leukocyte.

SEE NEXT PAGE

26. Which of the following organs in LIST 1 correctly matches the mode of defence against a possible pathogen in LIST 2?

	LIST 1	LIST 2
a)	Trachea	Hairs and mucus
b)	Stomach	Impervious barrier
c)	Skin	Sebum and sweat
d)	Urethra	Digestive enzymes

27. When B lymphocytes bind to an antigen they undergo cell division to produce a

a) macrophage and a memory cell.
b) memory cell and a killer T cell.
c) plasma cell and a macrophage.
d) plasma cell and a memory cell.

28. Which of the following is NOT an example of a pathogen?

a) Mosquito.
b) Bacteria.
c) Protozoan.
d) Fungi.

29. When an individual experiences a rapid onset of a fever they may feel

a) cold and, as a consequence, vasodilation in the skin and shivering occurs.
b) hot and, as a consequence, vasoconstriction in the skin and sweating occurs.
c) cold and, as a consequence, vasoconstriction in the skin and shivering occurs.
d) hot and, as a consequence, vasodilation in the skin and shivering occurs.

30. Vaccination programs that reduce the chance of disease in individuals and increase the immunity of a population is best described as

a) natural passive immunity.
b) artificial passive immunity.
c) natural active immunity.
d) herd immunity.

SEE NEXT PAGE

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

This section has **seven (7)** questions. Answer **all** questions.
Write your answers in the spaces provided.

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

Suggested working time for this section is 90 minutes.

31. **(25 marks)**

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

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

		Number of pellets eaten within 15 minutes after release.			
		Trials			
Time of restraint (Hours)	Average amount of ACTH in blood (pg/mL)	1	2	3	Average
0	30	14	14.25	13.75	14
2	60	10	10.25	9.75	10
4	90	8.25	9	8.25	8.5
6	120	17	19	18	18
8	150	21	24	22.5	

SEE NEXT PAGE

(a) Name the independent variable. _____. (1 mark)

(b) List three controlled variables that would ensure the test was fair.

_____

_____

_____

(3 marks)

(c) Complete the table on the previous page by calculating the average number of pellets eaten for the last test. (1 mark)

(d) Plot the results on the graph paper supplied on the next page. (Spare graph grid on page 34) (4 marks)

(e) State where in the body, glucocorticoids are released from. _____ (1 mark)

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

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

_____

_____

_____

(2 marks)

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

_____

_____

_____

(2 marks)

SEE NEXT PAGE

(g) Using the results of the experiment, explain what effect the amount of ACTH appeared to have on the rats' appetite for the first three tests and provide an explanation as to why this occurred.

(6 marks)

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

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

Explain what the independent scientist meant by this statement.

(2 marks)

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

(3 marks)

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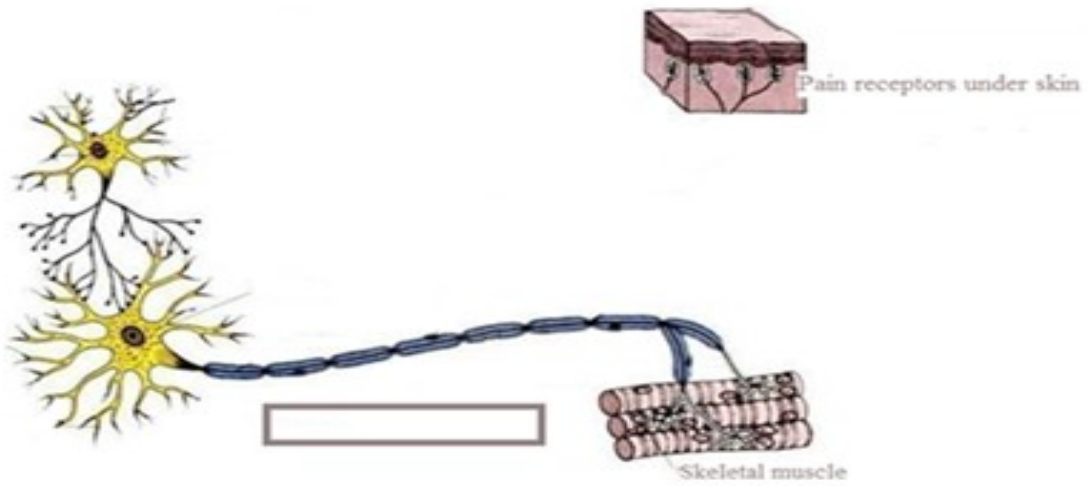
32. **(15 marks)**

(a) Complete the diagram below of a reflex arc, by drawing a myelinated unipolar neuron in the appropriate space below. (1 mark)



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

(c) Complete the following table.

Part	Function
Cell Body	
Dendrites	
Myelin sheath	
Axon	

(4 marks)

(d) Label the parts listed in the above table onto the multipolar neuron in the diagram above. (4 marks)

(e) Label each neuron in the diagram above according to their functional type. (3 marks)

(f) State which of the neurons above cannot regenerate its axon and state why.

_____

(2 marks)

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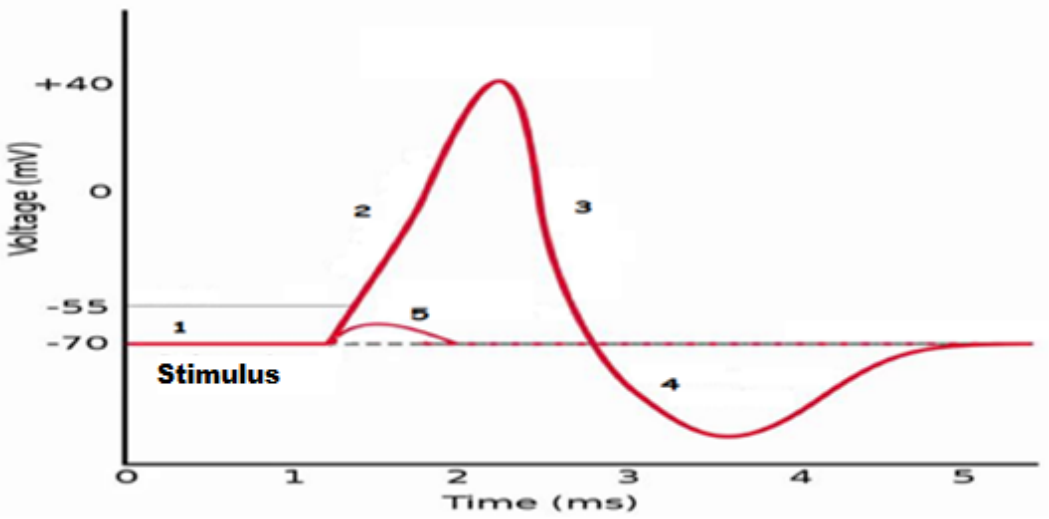
33. **(13 marks)**

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



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

_____

_____

_____

(2 marks)

(b) The second stimulus resulted in the line labelled with the numbers 2, 3 and 4.

State TWO events that could not possibly occur during the phases shown by the sections labelled 2, 3 and 4.

_____

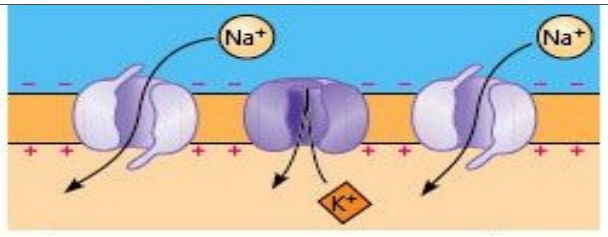
_____

_____

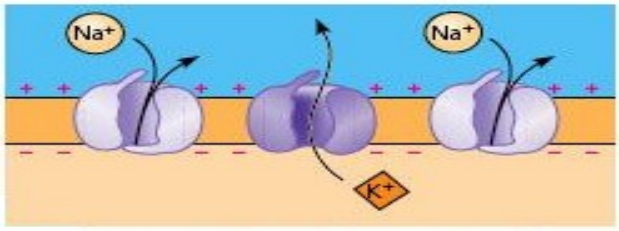
_____

(2 marks)

(c) Label the following diagrams with the numbers from the above graph, to show what would be occurring with the ions and their respective channels during an action potential.



Number: _____



Number: _____

(1 mark)

SEE NEXT PAGE

(d) Looking at the action potential graph on the previous page, locate the section labelled with a 1.

In the box below draw a labelled diagram (similar to those shown in © above) of this section to show:

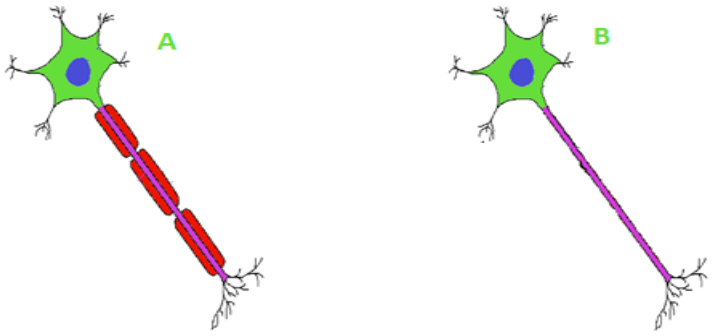
(i) The location of the sodium and potassium ions and, if they are moving, the direction the ions would be travelling.

(ii) The gated channels and whether they are open or closed.

(iii) The charge either side of the neuron membrane.

(3 marks)

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



(i) State which nerve fibres shown above would be myelinated or unmylinated and whether they would be found in grey or white matter.

A _____

B _____

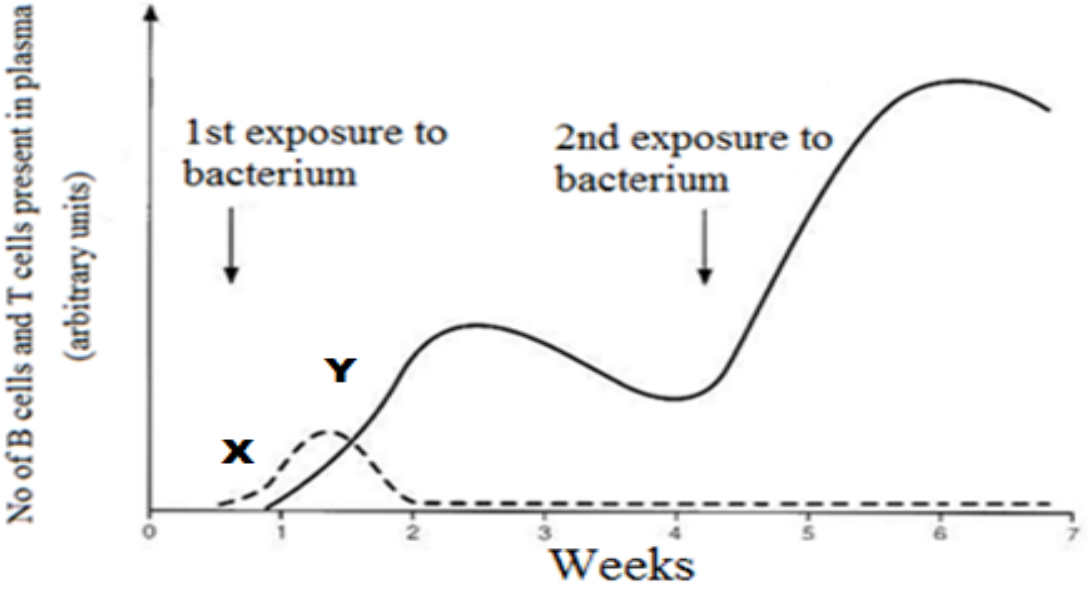
(2 marks)

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

34. **(15 marks)**

The graph below shows the immune response of a person to a bacterial infection. Refer to the graph to answer the following questions.

Immune response to bacterial infection.



(a) State which of the lines (X or Y) on the graph represent the cloning of the B cells. Explain why you made your choice.

SEE NEXT PAGE

(2 marks)

(b) The number of cells represented by the Y line after the second exposure was greater and their production was much faster, despite the person never receiving a vaccination. Explain what allowed this to happen.

(2 marks)

(c) After the first exposure to the bacterium, the person experienced an elevation of their body temperature.

(i) State the name of this non-specific response. _____ (1 mark)

(ii) State the name of two effectors and describe how their response contributed to this non-specific defense.

(2 marks)

(iii) Describe two benefits an elevated body temperature is believed to provide as the body fights against a disease.

(2 marks)

(d) There are two types of antibiotics. Name each type and describe how they kill bacteria.

(4 marks)

(e) The number of doctors that are becoming reluctant to prescribe antibiotics for every patient that presents with an infection is increasing. Describe one reason why doctors would feel this way.

(2 marks)

SEE NEXT PAGE

35. **(15 marks)**

Free divers are athletes who descend underwater as far as possible without breathing apparatus. Before diving into the water, the free diver deliberately hyperventilates.

(a) State what hyperventilation is and what effect it has on the gas concentration in the blood.

_____

_____

_____

_____

_____

(3 marks)

(b) Hyperventilation can occur voluntarily or involuntarily. It can occur involuntarily in response to severe pain or extreme fear.

Complete the following table to distinguish between the two different efferent nervous divisions that can regulate hyperventilation.

	Names of two different nervous efferent divisions	
	1._____	2. _____
Neurotransmitters		
Effector(s) / target organ(s)		
Effect of neurotransmitter on effector(s) / target organ(s)		
The number of neurons between the CNS and effector		

(5 marks)

(c) Explain how voluntary hyperventilation allows the free diver to stay underwater for longer.

(3 marks)

SEE NEXT PAGE

(d) Whether an individual hyperventilates or not, drowning can still occur if the individual is under the water and does not get to the surface in time to inhale.

Explain why a person could drown if they:

(i) did hyperventilate.

_____

_____

_____

(ii) did not hyperventilate.

_____

_____

_____

(4 marks)

36. **(12 marks)**

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

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

Symptoms	**Stimulus**	**Receptor**	**Modulator**	**Effector**	**Response**
Red and hot skin	Increased body temperature	Thermoreceptor	Hypothalamus		
Sweating	Increased body	Thermoreceptor		Sweat glands	Sweat released onto the surface of

	temperature				this skin
Thirsty	Increased osmotic pressure		Hypothalamus		Conscious decision to have a drink

(5 marks)

(b) After the race, despite the large volumes of plain water consumed by the athlete, he feels light headed, has a headache and feels nauseous.

As a result of the light headedness, the athlete stumbled forwards and grazed his hands. The palms of his hands are now bleeding, red, swollen, hot and painful.

(i) Based on the symptoms listed, name the internal non-specific defensive response that has been stimulated as a result of the injury.

_____ (1 mark)

(ii) Describe the sequence of events that would keep the wound free of infection and allow the wound to heal.

_____
_____
_____
_____
_____
_____
_____
_____

(6 marks)

37. **(5 marks)**

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

(5 marks)

_____
_____
_____
_____
_____
_____
_____
_____

SEE NEXT PAGE

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

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

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

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

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

Suggested working time: 40 minutes.

38. **(20 marks)**

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

(i) Using a labelled diagram, describe how dopamine would move from the presynaptic neuron, across the synapse, to enter and activate a specific target neuron.

(5 marks)

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

(5 marks)

(b) Cocaine prevents the reabsorption of dopamine and noradrenaline (norepinephrine) into the axon of the presynaptic neuron. This action has its greatest effect on those neurones with D1 receptors.

(i) State whether the constant supply of dopamine would stimulate the presynaptic neuron to be depolarised or remain polarised and describe why this would occur.

(4 marks)

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

(6 marks)

SEE NEXT PAGE

SEE NEXT PAGE

39. **(20 marks)**

Bacillus cereus is a bacterium that can cause food poisoning, usually contracted from rice meals which have been allowed to rest at room temperature for hours, particularly at a buffet. If the bacterium is exposed to high temperatures or acidic conditions, they will enter a dormant state and develop a heat and chemical resistant cell wall, until their surrounding environment is favourable again. This dormant and protective state is referred to as being an endospore.

An infection is initially indicated by vomiting and/or diarrhoea and then 30 minutes to 6 hours later the lymph glands/nodes can become swollen. Most patients recover within 6 to 24 hours.

(a) Describe how the non-specific defences initially triggered in response to the infection destroy or remove some of the *Bacillus cereus* and explain why they are incapable of completely eradicating the bacteria.

(10 marks)

(b) The swollen lymph nodes are an indication of the specific defences the body employed to destroy the bacterium. State what an antibody is and describe the steps that would occur during a humoral response.

(10 marks)

40. **(20 marks)**

Under normal circumstances, homeostatic control mechanisms ensure blood glucose levels (BGLs) are maintained at a constant level. People with diabetes mellitus are incapable of maintaining their BGLs and they can experience increased urination (polyuria) if they consume a meal high in glucose.

(a) Explain how the pancreas and liver would reduce the BGLs in someone who was not a diabetic. (5 marks)

(b) Explain the cause and treatments of type 1 and type 2 diabetes.

(6 marks)

(c) The high amounts of glucose in a diabetic's blood plasma can lead to a high osmotic pressure within the blood plasma.

Describe what effect this stimulus would have on the action of antidiuretic hormone (ADH) in controlling water balance and explain why a diabetic would urinate excessively and feel thirsty.

(9 marks)

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Question number: _____

SEE NEXT PAGE

Additional Working.

SEE NEXT PAGE

Spare grid for question 31 (d)

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