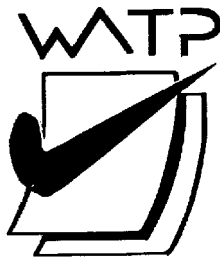


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SEMESTER ONE

Human Biology

UNIT 3

2016

SOLUTIONS

Section One: Multiple choice**30% (30 marks)**

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

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Section Two: Short Answer**50% (100 marks)**

This section has **eight (8)** questions. Answer all questions. Write your answers in the spaces provided.

Suggested working time: 90 mins

Question 31**(18 marks)**

Ebola Virus Disease, EVD, is a complex zoonosis that is highly virulent in humans. It was first detected in 1976, with the largest ongoing outbreak being in West Africa. Development of a marketable vaccine has yet to be achieved, with VSV-EDOV still in phase III of development.

- a) If Ebola is a zoonotic infection, how is it thought to be transmitted to humans? (1 mark)

Past from animals to humans

- b) State three non-specific external defences that a human has and describe how they could prevent entry of the Ebola virus. (3 marks)

Any three, must include reason

- **Skin – a barrier so cannot pass through unless cut**
- **Mucus membrane – stick to mucus so cannot pass or enter cells**
- **Hairs of nose/ears – mucus between hairs will trap virus**
- **Cilia – beat virus away from cells**
- **Ear wax/cerumen – virus will stick to so cannot pass**
- **Flushing action – bladder/sweat/tears/saliva, wash virus away**

- c) Virus act in different ways to bacteria when they enter the human body. Explain how a pathogenic virus such as Ebola acts after entering the body to cause a disease. (3 marks)

Three points from:

- **Bind to receptor site on a cell**
- **Uncoated RNA from virus will enter cell**
- **Virus makes a DNA copy of its RNA**
- **Virus DNA mixes with host DNA**
- **Host manufactures more viral RNA**
- **New viruses then released**

- d) To diagnose a person with Ebola, an antigen-capture detection test can be used.

- (i) What is an antigen? (1 mark)

Foreign protein or substance capable of causing a specific immune response

- (ii) Explain why identifying the Ebola antigen could help the World Health Organisation develop a vaccine for Ebola. (1 mark)

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- Once antigen identified, can modify it/attenuate it/create a sub-unit to create a vaccine
OR
- Vaccines work by introducing the body to a harmless version of the antigen, if you don't know the antigen you cannot create a vaccine.
- OR – once identified vaccine can be made and given to many members – to reduce spread (Herd Immunity)

e) In recent outbreaks of Ebola some people have survived an infection and made a full recovery. This has occurred because their body has learnt how to make the correct antibody against the virus.

- (i) Describe three ways an antibody can work to provide resistance to an antigen.
(3 marks)

Any three ways

- Combine so inhibit reaction with cells
- Bind to antigen so prevent entry into cells
- Agglutinate so can be digested/cannot enter a cell
- Dissolve antigen
- Turn a soluble antigen into an insoluble antigen

- (ii) Explain why a person who has recovered from Ebola can give blood to a person with Ebola and it may help them survive.
(2 marks)

Blood may still contain antibodies against the Ebola virus which will prevent the action of any Ebola viruses within the blood (1)

This will give the infected persons own immune system more time to develop its defences against the virus so they can recover. (1)

- f) The graph below shows how the body responds to two successive infections of a viral disease. Use this information to answer the next question.

Using the information in the graph, discuss why it is unlikely that a person that has had Ebola and has recovered is unlikely to get the disease again.
(4 marks)

- memory cells will be present in the blood stream for the virus
- if virus enters again the response is much quicker/plasma cells form very quickly
- antibody levels rise quickly in the plasma
- so destruction of the virus is quick preventing the person getting Ebola again/too quick for antigen to have any noticeable effect.

Question 32 (12 marks)

- a) Write a suitable hypothesis for this experiment.
(1 mark)

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Hypothesis must state how independent variable affects dependent variable (increase/decrease/no effect)

e.g. Levothyroxine reduces blood cholesterol levels.

- b) State two variables that would need to be controlled that are not mentioned (2 marks)

Any two

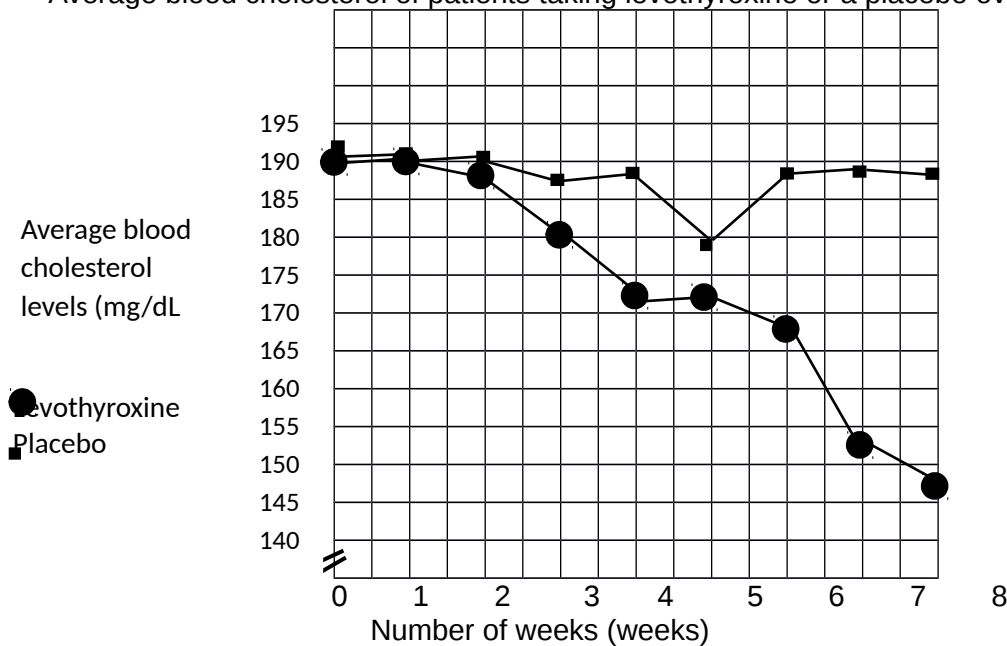
- Amount of drug/placebo needs to be the same
- Diet would need to be the same
- Exercise levels would need to be the same

- c) What is a placebo? (1 mark)

A substance that has no active chemicals

- d) Plot a graph of the information contained in the table. (5 marks)

Average blood cholesterol of patients taking levothyroxine or a placebo over 8 week period



Bar graph – maximum three points

- Points plotted correctly and joined to form a line
- Title must include independent and dependent
- X and Y axis labelled correctly, including units
- Axes constructed using appropriate scale (at least half the grid)
- Each line labelled/shown in a legend

- e) What conclusion can be drawn from the results? (2 marks)

E.g. hormone lowers cholesterol (1) – and as you can see there is a major difference to those who took placebo (1)

- f) Is this conclusion valid? Explain your answer. (2 marks)

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Yes because the experiment tested what it was supposed to test (1) and based on limited information the variables were controlled (1) OR due to a control group being used to test effectiveness

OR Yes to some extent because it tested what it was supposed to test (1) but there is not enough information to say if all variables were controlled therefore validity cannot be determined. (1)

Question 33

(11 marks)

a) Describe the role of the structure labelled "A".

(1 mark)

To receive impulses from neighbouring axon terminals/carry messages into the cell body

b) What are the three functions of the cells labelled "B"?

(1 mark)

speeds up transmission of nerve impulse

Use the graph below to answer the following questions.

c) Explain what is occurring at the phase indicated by the letter "C" on the graph in terms of ion movement and membrane potential. **(3 marks)**

- **Sodium channels open,**
- **sodium ions move in,**
- **cell membrane becomes depolarised**

d) Discuss the differences between how a nerve impulse is conducted along a myelinated and unmyelinated nerve fibre. **(4 marks)**

Unmyelinated – action potential moves along membrane continually (1)

Slower than myelinated (1)

Myelinated - action potential jumps from node of Ranvier to node of Ranvier or explanation of salutatory conduction (1)

Impulse travels quickly/quicker than unmyelinated3 (1)

e) A nerve impulse is described as an all or nothing action. If this is correct, explain why a person can tell the difference between a lump of heavy metal being dropped on their foot and a loaf of bread. **(2 marks)**

depolarisation of more nerve fibres the more stimulus (1)

strong stimulus produces more nerve impulses in a given time (1)

Question 34

(14 marks)

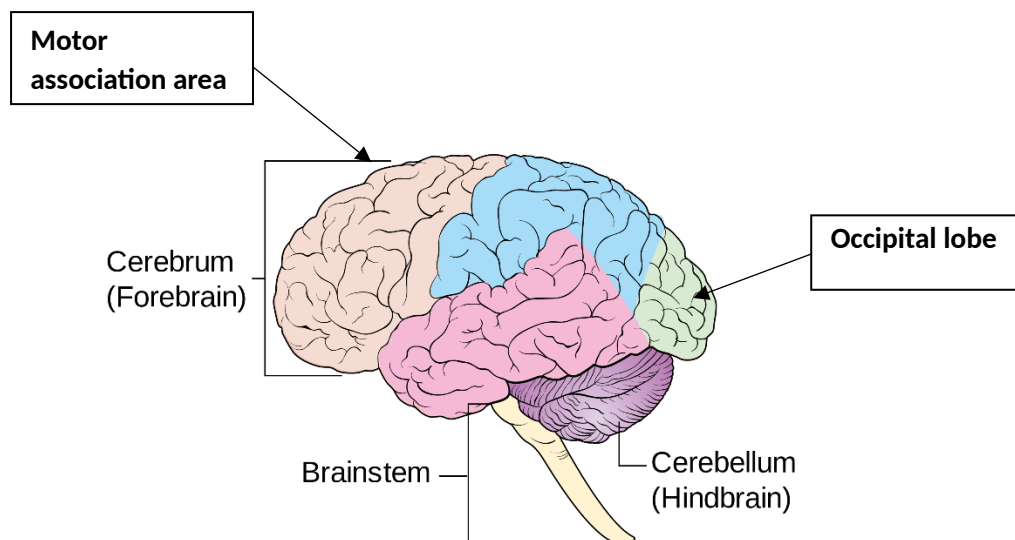
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- a) The nervous system has several different systems which all have quite specific functions. Using the table below, state one comparison between the following nervous systems.

(3 marks)

Two systems to compare	Main difference
Afferent division vs Efferent division of the peripheral nervous system	Afferent carry info into CNS and efferent carrying info away from CNS
Central nervous system compared to the peripheral nervous system	CNS – brain and spinal cord Peripheral – central nerves and spinal nerves
Somatic sensory nervous system compared to the visceral sensory nervous system	Somatic is sensory neurons from skin and muscle, visceral from internal organs

The diagram below is of the human brain.



- b) On the diagram, label or shade the following three areas: (2 marks)

- the occipital lobe.
- the motor association area

- c) The brain and the spinal cord are very delicate and as they are vital to human survival they must be protected. One structure that provides protection for these two parts is the meninges.

- Describe the structure of the meninges. (1 mark)

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Three layers of connective tissue forming membranes between bone and spinal cord/ brain, dura mater, arachnoid mater, and pia mater

- (ii) Explain the role of the cerebrospinal fluid within this structure. (2 marks)

Acts as shock absorber, (1)

Delivers nutrients and removes waste (1)

- d) The human brain is divided up into several sections, each with its own set of specific functions. Complete the table below by summarising the main functions of each area shown. (3 marks)

Structure	Function
Cerebral Cortex	Involved in mental activities, perception of the senses, control of voluntary muscle contraction, sensory areas interpret impulses from receptors, motor areas control muscular movements. (need 2)
Hypothalamus	Controls homeostasis
Cerebellum	Control over posture, balance, fine co-ordination of voluntary movements (need 2)

- e) During a mining accident, a gentleman received substantial damage to his medulla oblongata when a metal pipe hit him from behind.

Describe one difficulty the man might experience as a result of this damage to the medulla oblongata and explain why.

(2 marks)

1 mark – describe a difficulty (associated with either the cardiac centre, respiratory centre or the vasomotor centre)

1 mark – explain why the difficulty could occur, relate to role of medulla oblongata

Question 35**(14 marks)**

Many retired soldiers have made the trip to Papua New Guinea to walk the Kokoda Track in memory of the Kokoda Trail campaign fought during World War II. The track is made difficult because of the extreme humidity and heat, but if people look after themselves properly during the trek, the track is manageable.

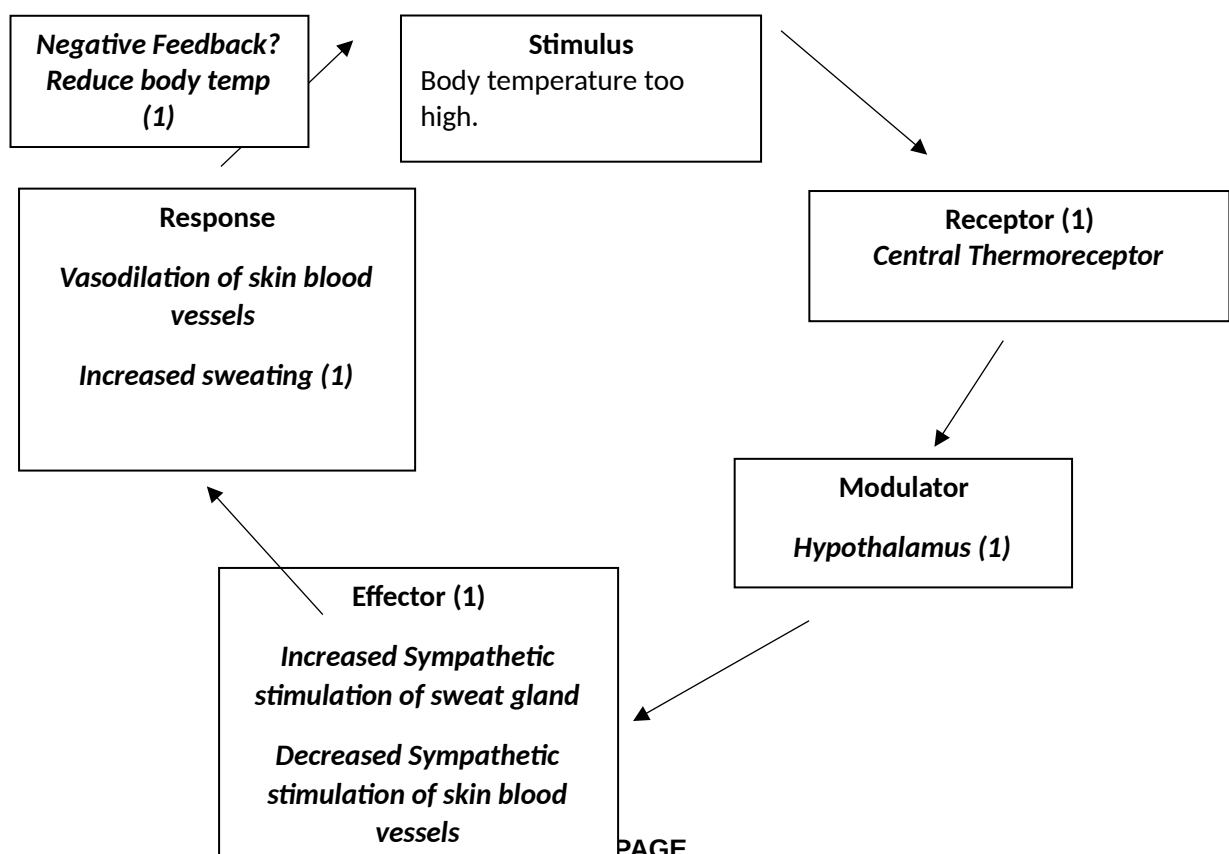
- a) Describe two problems that the extreme heat and humidity could cause for the retired soldiers walking the track. (2 marks)

Heat – too hot enzymes denature and effect all body functions/chemical reactions in body are heat sensitive/can cause nerve damage/change in structure of proteins/death. (1)

Humidity – heat exhaustion/low blood pressure/poor delivery of nutrient or removal of waste/inability to sweat so heat builds up (1)

- b) The control of the body's internal environment is essential is the person is going to be able to function properly and respond to the demands of such an arduous task of walking the track.

Complete the feedback loop shown below to show how heat loss can be increased from the body to prevent overheating. Do not include the behavioural response. (5 marks)



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- c) State a transmission method of heat loss that is being used by the body during the feedback loop described in part (b), include where it is occurring?

(1 mark)

Radiation / convection from skin

OR Conduction/evaporation of sweat from skin

- d) The feedback loop is an effective mechanism for maintaining the body's core temperature. However the process of sweating initiated by the effector can cause other problems for the body.

- (i) Name one problem the processes brought about by the effector could produce?

(1 mark)

Dehydration

- (ii) Explain how the body would respond to try and combat the problem stated in part (i).
(3 marks)

Low H₂O in blood --- osmoreceptors stimulated --- hypothalamus initiates release of ADH from pituitary (1)

--- distal convoluted tubule more permeable (1)

--- more water reabsorbed (1)

- e) Explain the difference between a positive feedback loop and a negative feedback.
(2 marks)

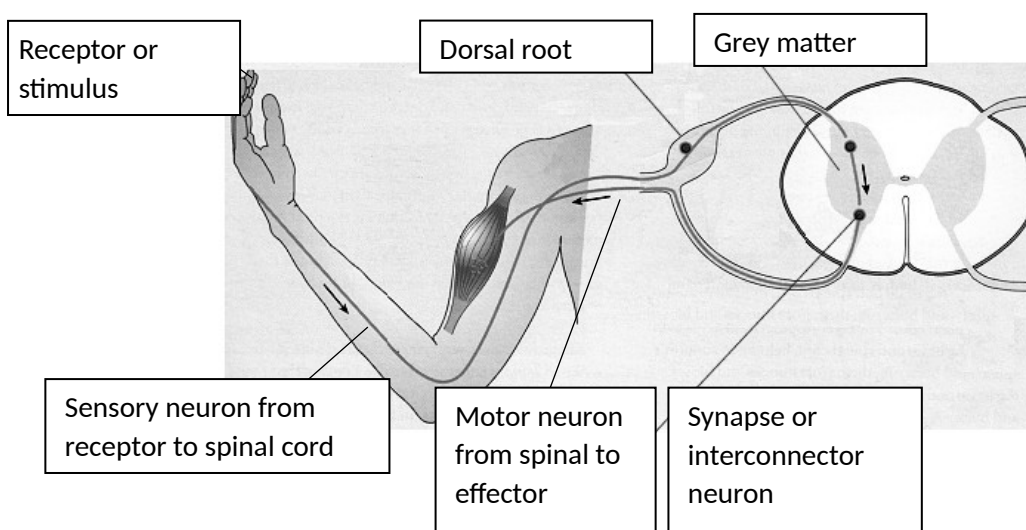
Positive feedback - Response to stimulus reinforces and intensifies stimulus (1)

Negative feedback – response to stimulus reduces/eliminates stimulus (1)

Question 36

(7 marks)

A reflex is a rapid response to a change in the internal and external environment. The diagram below shows the main component of a reflex arc.



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- a) Identify the main parts involved in the reflex arc indicated by the lines on the diagram above. (3 marks)

½ a mark each –

- b) Explain the difference between an innate reflex and an acquired reflex. (2 marks)

Motor patterns learned are acquired

Innate reflex you are born with/protective reflex

- c) A reflex is classed as part of a human's non-specific defence system. Explain the reasoning for this. (2 marks)

Protective reflex protects the body from injury or infection (1)

by forcing a foreign antigen out from the body so it cannot cause harm (1)

Question 37

(11 marks)

- a) Pathogens are disease causing organisms. The most common types of pathogens are bacteria and viruses.

If a person suffering from an illness enters a hospital and has a blood test taken, how would the doctors identify if the illness was caused by a virus or a bacteria? (2 marks)

Bacteria - Single cell, microscopic, no nuclear membrane, cell wall and cell membrane

Virus - Electron microscope, DNA or RNA surrounded by a protein coat

Any one identifying feature for a bacteria and a virus

- b) Explain the role of the enzyme Lysozyme in the body's defence against disease. (1 mark)

Kill bacteria

- c) During a game of soccer, one of the female players is pushed and falls to the ground, as she does, she cuts her knee open on a piece of old glass. By the time she reached home her knee had become all red and swollen. Her Mum told her not to worry about that because it was all part of her body's way of stopping the spread of pathogens that may have been on the glass. The girl's mother was talking about the inflammatory response.

Explain, in sequence, the steps the body goes through during the inflammatory response. (5 marks)

Mast cells release histamine and heparin (1)

Histamine increases blood flow to area/walls of capillaries become more permeable (1)

Heparin prevents clotting in immediate area/clot forms around damaged area to prevent spread (1)

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Chemicals released by mast cells attract phagocytes, consume debris (1)
Abnormal conditions stimulate pain receptors (1)
Phagocytes filled with bacteria die, form pus (1)
New cells produced by mitosis and repair damaged tissue (1)

Five main points from above

- d) During the night the girl developed a fever. The mother, thinking she was helping, gave the daughter some medication to bring her fever down.

Explain why this was not the right thing to do, as long as the fever is not extreme.

(3 marks)

- o **Any 2 – 2 marks**
- o **High body temp inhibits the growth of some bacteria and viruses.**
- o **Heat speeds up the rate of chemical reactions.**
- o **which help body cells repair themselves more quickly during disease.**
- **1 mark: If reduce the fever bacteria/virus breed at normal rate and could become very ill**

Question 38

(13 marks)

Type I diabetes affects around 120,000 Australians. It is caused when the body's own immune system attacks the body's own cells and prevents parts of the endocrine system from functioning normally.

- a) Insulin is an amine based hormone. Explain how an amine based hormone changes the functioning of a cell. (2 marks)

Amine locks on to a receptor protein on outside of cell membrane (1)

Brings about a change inside the cell cytoplasm/causes secondary messenger substance to diffuse through cell and activate a particular enzyme. (1)

- b) What type of cells produce insulin and where can they be found? (1 mark)

Beta cells, Islets of Langerhans (1)

- c) Describe how insulin controls glucose levels in the body. (2 marks)

When levels too high, Insulin causes liver to remove glucose from blood and convert to glycogen (1), too low insulin production stops to allow levels to rise again

Too high causes body cells to remove glucose from blood and store as glycogen (1)

Too high causes excess glucose to be removed and stored as fat in the fat cells (1)

Too high inhibits breakdown of lipids, protein and glycogen/gluconeogenesis (1)

Any suitable two

- d) The treatment for Type I diabetes is regular injections of insulin. Before the successful development of biotechnologies, this insulin was extracted from pigs and given to people suffering from Type I diabetes.

Discuss two ethical considerations that are associated with the extraction of insulin from pigs. (2 marks)

Insulin is not human – don't know if pigs have viruses that could potentially affect humans

Pigs are harmed when insulin is removed from them

Some cultures do not want to have anything to do with pigs

Any two ethical considerations

- e) Now with the advances in biotechnologies most insulin is produced by recombinant DNA technology.

Explain how this process is much more beneficial to people suffering from Type I diabetes.

(2 marks)

- **Creates a readily available supply of insulin as can be made any time or place**
- **Human gene used to produce insulin so is 100% human/not from another animal**
- **Only one bacteria needs to be altered, as reproduces rapidly to acquire as much insulin as needed.**
- **Cheaper**

Any two benefits.

- f) One of the major concerns for a person suffering from Type I diabetes is becoming hyperglycaemic if they consume too much sugar.

- (i) Describe two symptoms that a person would exhibit if they were hyperglycaemic?

(2 marks)

Blurry vision, difficulty concentrating, frequent urination, headaches, increased fatigue, thirsty. Any two

- (ii) Choose one of these symptoms and explain what has gone wrong in the body for this symptom to occur. (2 marks)

Thirsty – osmotic pressure high, fluid comes out of cells into blood to balance levels (1), cells trigger brain saying they are dehydrated, brain triggers thirst response. (1)

OR

Fluid going into blood continually increases blood pressure, kidney not reabsorb water to try and reduce pressure so urinate more (also Ketone disposal)

What has gone wrong (1) and how does it link to symptom. (1)

Long Answers

39. Nerve agents are often used as chemical weapons during times of war. Nerve agents work by preventing the production of acetylcholinesterase (AChE), a chemical that destroys acetylcholine after the nerve impulse has been transmitted. Nerve gas poisoning results in acetylcholine building up in the synaptic gap which drastically effects impulse transmission.

a) Explain how a nerve impulse is transmitted across a synaptic gap. (8 marks)

	Description	Marks
(a)	Action potential opens calcium channels in membrane	1-8
	Calcium ions flow into pre-synaptic knob	
	Vesicles stimulated to release transmitter	
	Vesicle releases neurotransmitter by exocytosis into the gap/synaptic clef	
	Neurotransmitter diffuses across the gap	
	Neurotransmitter attaches/binds to receptors/post synaptic receptors on dendrite	
	Nerve impulse can then travel down the neuron/receptor triggers a postsynaptic response specific for that receptor	
	Excitatory response produced causing the depolarisation of the postsynaptic membrane.	
	Neurotransmitter destroyed after impulse gone	
	Total	8

b) Discuss how a nerve gas would affect the transmission the nerve impulses and the side effects a person would experience from nerve gas poisoning. (4 marks)

	Description	Mark
(b)	Nerve gas prevents the neurotransmitter being broken down	1-4
	Neurotransmitter remains in the synaptic clef	
	Neurotransmitter builds up in the clef	
	Nerve impulses can flow/transmission of nerve impulse more likely	
	Can result in all muscles in the body trying to contract	
	Muscle control can be lost	
	Can prevent breathing/cause suffocation/respiratory failure	
	Muscles can go into spasm/tremors/convulsions/twitching/paralysis	
	Cramping and vomiting	
	Loss of consciousness/coma	
	Sweating/drooling/nausea/diarrhoea	
	Total	4

- c) The sympathetic and parasympathetic nervous systems are both part of the bodies peripheral nervous system. Discuss the differences and similarities between the structure and function of the two systems. (8 marks)

(c)				Marks
	Similarities	Both part of autonomic nervous system Both efferent branch of nervous system Both are under involuntary control Both have two sets of nerve fibres		2 marks
	Differences	Sympathetic	Parasympathetic	Between 1-4 marks
(c)	Neurotransmitter	Noradrenaline/adrenaline	Acetylcholine	
	Purpose	Fight or flight	Moderates all functions/homeostasis	
	Heart	Increase rate/strength of contractions	Decrease rate/strength of contractions	
	Lungs	Dilate bronchi	Constrict bronchi	
	Stomach/intestines	Decrease movement	Increase movement	
	Liver	Increase breakdown of glycogen to glucose	Increase uptake of glucose and synthesis of glycogen	
	Iris of eye	Dilates pupil	Constricts pupil	
	Salivary glands	Decrease production of saliva	Increase production of saliva	
	Urinary bladder	Relax muscle wall	Constrict muscle wall	
	Must have at least two of the following:			Min 2 marks
	Sweat glands	Increase sweat production	No effect	
	Blood vessels Skin Skeletal Internal organs	Constricts Vasodilates Constricts (except heart and lungs)	Little effect No effect Little effect	
	Adrenal medulla	Stimulates hormone secretion	No effect	
	Total			8

40. Graves' disease is the result of a person's autoimmune system attacking the thyroid gland. As a result a person can suffer from hyperthyroidism, a condition that can be treated by removal of some of the thyroid.

- a) The common symptoms of hyperthyroidism are weight loss, increased appetite, fatigue, sweating and anxiety. Using your understanding of the functioning of the thyroid gland, explain how these symptoms are brought about. (8 marks)

	Description	Mark
(a)	Thyroid gland is producing too much thyroxine	Max 2 marks
	Thyroxine is used to increase metabolic rate/body metabolism	
	Regulates reactions where molecules broken down to release energy	
	Regulates reactions where simple molecules joined to make complex molecules	
	Weight loss – increased metabolic rate means food is used up very quickly to produce energy(1), fat converted to energy as supply needed causing weight loss(1)	Each point worth 2 marks – max of 6
	Increased appetite – all food being converted into energy, little stored/or removed from cells (1) so trigger brain to produce behavioural response giving person sense of hunger(1)	
	Fatigue – all food being used to produce energy (1), cells no replenishing supplies so when energy needed no reserves to call upon so feels tired(1).	
	Sweating – increased metabolic rate increases heat production (1), raises body temp so homeostasis mechanism of sweating used to loss excess heat instigated to bring (1)	
	Anxiety – body full of energy all the time (1), causes heightened brain activity leading to anxiety (1)	
	Total	8

- b) A rapid heart rate is also a symptom of hyperthyroidism and this can subsequently lead to an increase in blood pressure. Normally these two factors are controlled by negative feedback systems. Describe how the body would normally bring the heart rate and blood pressure back to normal and explain how hyperthyroidism affects these systems. (12 marks)

	Description	Marks
(b)	Heart rate – controlled by sinoatrial node and atrioventricular node	Any points Max 10 marks
	Activity influenced by the autonomic nervous system	
	Information about cardiac output collected by receptors around the body eg chemoreceptors in the aortic and carotid bodies and in the medulla oblongata/decrease in pH of the blood or increase in CO ₂ concentration	
	Receptors send message to cardiovascular regulating centre in Medulla	
	Reduce sympathetic stimulation of sinoatrial node	
	Increase parasympathetic stimulation of sinoatrial node	
	Reduced heart rate/ also consequently blood pressure	
	Blood pressure stimulate presso/baroreceptors	
	Message sent to vasomotor centre in medulla oblongata	
	To reduce blood pressure increase parasympathetic stimulation of all blood vessels	
	Reduce sympathetic stimulation of blood vessels	Two linking points = 2 marks
	<ul style="list-style-type: none"> Because of increased metabolic activity from increased thyroxine levels More energy available for heart muscle contraction, increased contraction results in increased cardiac output Causing increased blood pressure 	
	Total	12

41. The World Health Organisation are currently working on trying to eliminate polio by using a range of vaccination programs. Vaccinations are used to develop immunity in a population. However traditional vaccines can come with associated risks and ethical concerns so more modern techniques are being tested to come up with vaccines that are more effective and have less associated risks

- a) Describe two traditional and one modern type of vaccine and discuss the risks and ethical concerns that are associated with these vaccines. (12 marks)

	Description	Marks
(a)	1. Attenuated micro-organism <ul style="list-style-type: none"> Reduce virulence of micro-organism When injected in micro-organism not capable of causing symptoms of disease/person does not get sick Person manufactures antibodies against antigen 2. Dead micro-organism <ul style="list-style-type: none"> Micro-organism dead so cannot cause disease as cannot enter cells/replicate/produce toxins Person manufactures antibodies against antigen 3. Filtrate containing toxins from bacterial cultures <ul style="list-style-type: none"> Inactivate toxins so cannot cause symptoms of disease Toxoids initiate an immune response Develop antigens against toxoid 4. Sub-unit vaccine <ul style="list-style-type: none"> Use a fragment of dead or attenuated micro-organism Not enough of micro-organism to cause disease but enough to cause immune response 	2 methods only 1 mark = name 2 marks per description Total = 6
	1. Modify the DNA in the micro-organisms cell <ul style="list-style-type: none"> Cell produce immune response No information/DNA to instruct the cell to cause the symptoms of the disease 2. Insert certain DNA sequences from a pathogen into harmless bacteria <ul style="list-style-type: none"> DNA sequence causes the production of antigens that are characteristic of the pathogen, vaccine with the harmless bacterium results in immunity against the pathogen as immune response created against harmless antigen 3. Recombinant DNA <ul style="list-style-type: none"> insert gene from harmful micro-organism into plasmid plasmid inserted in harmless bacteria bacteria produces antigen which is harmless by itself antigen inserted, causes immune response 	1 method only 1 mark = name 2 marks per description Total = 3
	Risks <ul style="list-style-type: none"> allergic reaction cross-species disease introduction preservatives in vaccines can cause health issues 	1 risk = 1 mark
	Ethical concerns <ul style="list-style-type: none"> how vaccine manufactured how vaccine tested use of human tissue religious stance 	Any two points = 2 marks
	Total	12

- b) Viruses such as polio when they enter the body can cause both a humoral and cell-mediated response. Describe the steps that occur during a cell-mediated immune response, including how the response was instigated and carried out. (8 marks)
- sensitised/activated