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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** | **A** |
| **14** | **D** |
| **15** | **B** |
| **16** | **A** |
| **17** | **D** |
| **18** | **D** |
| **19** | **C** |
| **20** | **A** |
| **21** | **D** |
| **22** | **D** |
| **23** | **B** |
| **24** | **C** |
| **25** | **B** |
| **26** | **A** |
| **27** | **C** |
| **28** | **B** |
| **29** | **D** |
| **30** | **B** |

**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 **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Question31 (18 marks)**

1. **Virus – not a living organism** (1 mark)
2. (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**

1. (3 marks)

**Any 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**

1. (1 mark)

**Foreign protein or substance capable of causing a specific immune response**

1. (1 mark)

* **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 the antigen is unknown cannot create a vaccine.**
* **OR – once identified vaccine can be made and given to many members – to reduce spread (Herd Immunity)**

e) (i) (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**
    - **Bind to virus surface preventing entry into cells**

(ii) (2 marks)

**artificial (1)**

**passive (1)**

f) Must mention memory cells and 3 other points from the following: (4 marks)

* **First exposure causes humoral response/antibody mediated response**
* **Production of memory cells**
* **if virus enters again memory cells recognise the virus/antigen quickly**
* **so 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 (13 marks)**

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

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

***e.g. Levothyroxine reduces average blood cholesterol/LDL levels.***

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

**Any two**

* **Age of subjects same**
* **Gender of subjects same**
* **Amount/dose of drug/placebo needs to be the same**
* **Diet would need to be the same**
* **Exercise levels would need to be the same**

1. What is a placebo? (1 mark)

**A substance that has no active chemicals used for comparison**

1. 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.

Levothyroxine

Placebo

195

190

185

180

175

170

165

160

155

150

145

140

Average blood cholesterol levels (mg/dL)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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0 1 2 3 4 5 6 7 8

Number of weeks (weeks)

**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/key**

1. What conclusion can be drawn from the results? (2 marks)

**E.g.**

**levothyroxine lowers cholesterol/LDL levels (in people who suffer hypothyroidism) (1) whereas the placebo appeared to have little effect on the level of LDLs/cholesterol (1)**

1. (2 marks)

**Increase the sample size/more subjects (1)**

**Repeat the trials (1)**

**Question 33 (11 marks)**

1. Describe the role of the structure labelled “A”. (1 mark)

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

1. (1 mark)

**To produce the myelin sheath**

Use the graph below to answer the following questions.

1. Explain what is occurring at the phase indicated by the letter ”C” (3 marks)

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

1. (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 unmyelinated (1)**

e) (2 marks)

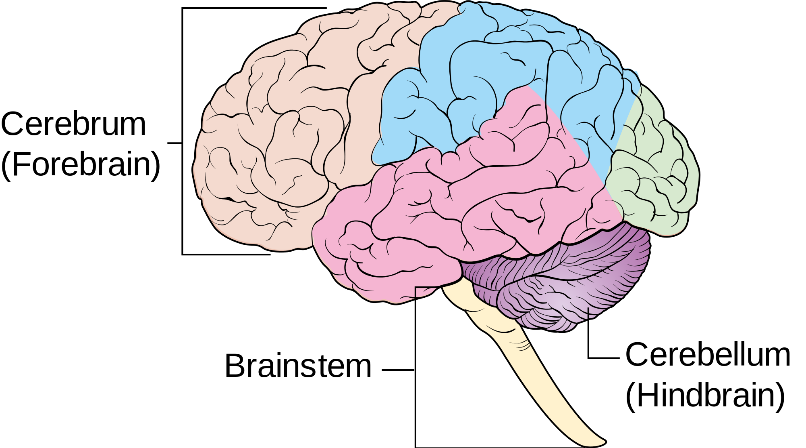
**more receptors are stimulated (1) depolarisation of more nerve fibres the more stimulus/with heavy metal (1)**

**Question 34 (13 marks)**

(3 marks)

|  |  |
| --- | --- |
| **Two systems to compare** | **Main difference** |
| Afferent division vs Efferent division of the peripheral nervous system | **Afferent carry impulse toward CNS and efferent carrying impulse away from CNS** |
| Central nervous system compared to the peripheral nervous system | **CNS – brain and spinal cord coordinate movement/body functions**  **Peripheral – (central nerves and spinal nerves) connect the muscles and glands with CNS** |
| Somatic sensory nervous system compared to the visceral sensory nervous system | **Somatic is sensory neurons from skin and muscle to CNS, visceral from internal organs to CNS** |

The diagram below is of the human brain.



**Medulla oblongata**

**Occipital lobe**

1. On the diagram, label or shade the following three areas: (2 marks)
2. the occipital lobe.
3. Medulla oblongata
4. Describe the structure of the meninges. (1 mark)

**Three layers of connective tissue/dense tissue forming membranes between bone and spinal cord/ brain**

1. Explain the role of the cerebrospinal fluid. (2 marks)

**Any 2 of**

**Acts as shock absorber, cushioning blows/shock (1)**

**Suspends the brain/brain floats/supports the brain (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 / thermoregulation/osmoregulation/controls pituitary secretions** |
| Medulla | **Controls breathing/heart rate/blood pressure/vomiting** |

1. During a mining accident, a gentleman received substantial damage to his cerebellum when a metal pipe hit him from behind.

Describe two symptoms the man might experience as a result of this damage (2 marks)

**Any two of:**

* **uncoordinated movements**
* **difficulty with balance**
* **difficulty with fine motor movements such as writing**

**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.

1. 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/sweating has little effect so difficulty cooling the body (1)**

1. 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 physiologically increased from the body to prevent overheating. Do not include the behavioural response. (5 marks)

**Response**

***Vasodilation of skin blood vessels***

***Increased sweating (1)***

**Modulator**

***Hypothalamus (1)***

**Stimulus**

Body temperature too high.

***Negative Feedback?***

***Reduce body temp (1)***

**Receptor (1)**

***Central Thermoreceptor in hypopthalamus***

**Effector (1)**

***sweat glands***

***skin blood vessels/arterioles***

1. (1 mark)

**Humidity does not allow for evaporation of sweat from skin**

1. 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.
2. (1 mark)

**Loss of water through sweating**

1. 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 posterior pituitary (1)**

**--- collecting tubule more permeable to water (1)**

**--- more water reabsorbed into the blood/plasm (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)**

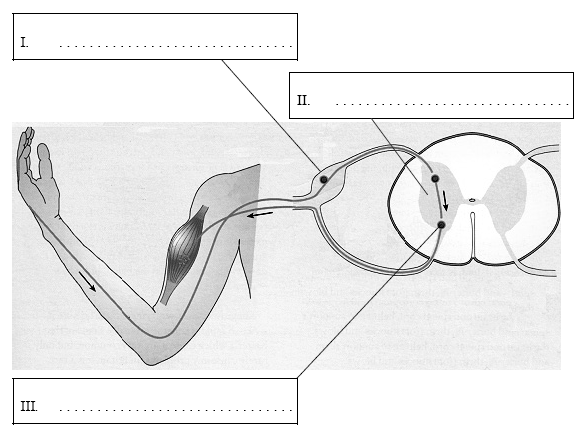
**Question 36 (7 marks)**

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.

Dorsal root ganglion

Grey matter



Receptor or stimulus

Sensory neuron from receptor to spinal cord

Motor neuron

Interneuron/

connector neuron/

association neuron

1. Identify the main parts involved in the reflex arc indicated by the lines on the diagram above. (5 marks)

1. 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) OR**

**Can be by forcing a foreign antigen out from the body so it cannot cause harm eg vomiting, sneezing(1)**

**To maintain homeostasis (1)**

**Question 37 (11 marks)**

1. (2 marks)

**Posterior pituitary is made up of neural tissue/neurons/axons and terminals (1)**

**Anterior pituitary is glandular/groups of cells producing and secreting hormones (1)**

1. (2 marks)

**Antidiuretic hormone (1) can accept ADH**

**Oxytocin (1)**

1. (4 marks)

**Hypothalamus produces/synthesises the 2 hormones (1)**

**Hormones are moved down nerve extensions (in infundibulum) (1)**

**Stored in the axon terminals in posterior pituitary (1)**

**Nerve impulses from hypothalamus trigger hormone release (1)**

1. **Steroid hormones enter the target cells (1)**

**Combine with receptor protein inside the cell/forms a receptor-hormone complex (1)**

**Activates genes/changes DNA expression controlling formation of particular proteins (1)**

**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.

1. Insulin is protein based hormone. Explain how they work. (3 marks)

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

**causes secondary messenger substance to diffuse through cell (1)**

**and activate a particular enzyme/ Brings about a change inside the cell cytoplasm/. (1)**

1. Describe how insulin controls glucose levels in the body. (3 marks)

**When levels too high, Insulin causes liver to remove glucose from blood and convert to glycogen(1),**

**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 three***

1. (2 marks)

* **Less chance of infections from animals**
* **Less risk of allergic reactions**
* **All religions/cultures that believe that cows/pigs are sacred can use it**
* **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 2**

1. One of the major concerns for a person suffering from Type I diabetes is becoming hyperglycaemic if they consume too much sugar.
2. 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***

1. (3 marks)

**Glucose levels low detected by alpha cells in pancreas (1)**

**Glucagon is secreted (1)**

**Glycogenolysis (1) to increase blood glucose levels**

**Extended Answers**

**Question 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.

1. 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 cleft/synapse |
| 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 cleft/synapse |
| Neurotransmitter builds up in the cleft/gap |
| 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 vital part of the peripheral nervous system. Compare and contrast 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 1-6 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 |
| 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** |

**Question 40.**

Graves’ disease is an autoimmune disease that attacks the cells in 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.

1. The common symptoms of hyperthyroidism are weight loss, increased appetite, fatigue, sweating and restlessness. Using your understanding of the functioning of the thyroid gland, explain why these symptoms occur. (10 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Mark** |
|  | Thyroxine increases metabolic rate/body metabolism (can have a mark for stating this) |  |
|  |
| 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) |
| 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) |
| restlessness – body full of energy all the time (1), causes heightened brain activity leading to increased movement/twitchy (1) |
| **Total** | **10** |

b) Some teenage boys were at a pool party and were trying to see who could swim the furthest underwater. Some of them were using hyperventilation to get rid of carbon dioxide from their lungs to allow them to hold their breath for longer. There can be serious consequences of this particular technique, including drowning.

Using a feedback loop, explain how this practise allows the boys to stay underwater for longer and how it can lead to drowning. (10 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Marks** |
| (b) | Stimulus – decreased CO2/increased pH | **Must have feedback loop 5 marks**  **Explanation**  **Of drowning 5 marks** |
| Receptors – chemoreceptors in aortic arch/carotid/medulla |
| Modulator – respiratory centre in the medulla oblongata |
| Effectors- diaphragm and intercostal muscles |
| Response – decreased rate and depth of breathing |
| Levels can be so low that breathing stops/ceases |
| Boy may faint due to lack of oxygen to brain |
| CO2 levels increase/pH decreases |
| Message sent to respiratory centre in medulla oblongata |
| Causing muscles to contract and start breathing again |
| Breathes in water not air |
| **Total** | **10** |

**Question 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 one traditional and one modern type of vaccine and discuss the risks and ethical concerns that are associated with these vaccines. (6 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Marks** |
| (a) | 1. Attenuated micro-organism   * 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   * 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   * Inactivate toxins so cannot cause symptoms of disease * Toxoids initiate an immune response * Develop antigens against toxoid   4. Sub-unit vaccine   * Use a fragment of dead or attenuated micro-organism * Not enough of micro-organism to cause disease but enough to cause immune response | **1 method**  **only**  **1 mark = name**  **1 mark per description**  **Total = 2**  **1 method only**  **1 mark = name**  **1 mark**  **per description**  **Total = 2**  **1 risk = 1 mark** |
| 1. Modify the DNA in the micro-organisms cell   * 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   * 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   * 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 |
| Risks   * allergic reaction * cross-species disease introduction * preservatives in vaccines can cause health issues |
| Ethical concerns   * how vaccine manufactured * how vaccine tested * use of human tissue * religious stance | **Any one point = 1 mark** |
| **Total** | **6** |

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.(8 marks)

|  |  |  |
| --- | --- | --- |
|  | **Description** | **Marks** |
|  | * Macrophages bring the foreign antigen to the lymph glands | **Any point = 1 mark** |
| * When specific T-cell for that antigen found, it becomes sensitised/activated |
| * Sensitised T-cell enlarges |
| * and divides creating clones |
| * Clones then specialise into four different types of T-cells |
| * Memory T-cells remain in lymphoid tissue in case antigen returns at later date |
| * Killer T-cells migrate to site of infection * Attach to invading cells secreting substance that destroys them |
| * Helper-cells secrete substances that intensify the response of lymphocytes at infection site * Attract macrophages to site so they can destroy antigen * Intensify macrophage activity |
|  | **Total** | **8** |

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 warm, 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. (6 marks)

Name = **inflammatory response.** (1)

**Mast cells release histamine and heparin (1)**

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

**Redness due to increased blood flow to area (1)**

**Warmth due to increased blood flow (1) So warm blood confined to inflamed area (1)**

***Five main points from above***