Section 3: Extended Answer (20 marks)

- *Humans are warm-blooded – homeothermic.*
- *Normal body temperature is 37°C [1]*
- *Thermoreceptors in the hypothalamus detect body temperature. [1]*

Mechanisms of heat loss include: [2 marks per example]

- *Radiation – refers to heat transfer by infra-red rays from a hotter object to a colder one. There is no contact between the objects, e.g. standing in the Sun and absorbing heat from it.*
- *Convection – heat transfer due to the movement of air (or liquid) over the body, e.g. when you stand in a cold wind, the heat from your body is carried away by the air and you feel cold.*
- *Conduction – heat transfer due to physical contact between two objects. The hotter one loses heat to the cooler one, e.g. cold hands wrapped around a hot mug absorb heat from the mug.*

Physiological responses: [5 examples = 5 marks]

- *Sweating – increases the rate of evaporation from the skin. To change a liquid into a gas requires energy and the heat energy needed is taken from the skin so one feels cooler.*
- *Vasodilation – increase in diameter of arterioles causing a flushing of the skin which goes red.*
- *Vasoconstriction – reduction in diameter of the surface blood vessels (arterioles), resulting in a pale skin and this reduces heat loss by radiation and convection.*
- *Shivering – increased contraction and relaxation of voluntary muscles produces heat.*
- *Contraction of the erector pili muscles causes hairs to stand upright in an attempt to trap air next to the skin providing insulation. As we are not terribly hairy it is not very effective and results in 'goosebumps'.*
- *Increased metabolism due to increased levels of adrenalin and noradrenalin being released. The hypothalamus via sympathetic neurons stimulates the adrenal medulla to release these.*
- *Elevated thyroxine levels due to the hypothalamus causing the pituitary to release thyroid stimulating hormone also cause an increase in metabolism resulting in more heat production.*

Behavioural responses: [5 examples = 5 marks]

- *Level of activity. The more activity, the higher the rate of respiration in the muscles and more heat is released. If behaviour is reduced (sitting still) less heat is produced by the muscles.*
- *Amount of clothing/exposure of skin surface. Wear more layers of clothing in colder situations to trap layers of warm air and increase insulation. Reduce layers of clothing in hot weather to increase rate of radiation and evaporation.*
- *Ingesting hot food and drinks – increases oxidation of foods producing heat.*
- *Curling up small – to reduce surface area through which heat can be lost.*

Allocate 2 marks for presentation, spelling, grammar and clarity.

TT 5 – RESPONSE TO INFECTION

Section 1: Multiple Choice (30 marks)

1.	*d*	6.	*d*
2.	*d*	7.	*b*
3.	*a*	8.	*c*
4.	*c*	9.	*a*
5.	*d*	10.	*d*

Section 2: Short Answer (50 marks)

1. *Lymphoid tissue (bone marrow, tonsils, spleen, thymus gland, lymph nodes), lymphocytes (T and B cells), antibodies [any 2]*
2. *Any substance capable of producing a specific immune response [1], e.g. microorganisms, toxins, pollen grains, transplanted tissues, large molecules such as proteins. [1]*
3.
   (i) antibody
   (ii) red bone marrow
   (iii) T cells
   (iv) plasma cells
   (v) phagocytosis
   (vi) immunity
   (vii) vaccine
   (viii) lymph node
   (ix) thymus gland
   (x) bone marrow
   (xi) antiviral
   (xii) stem cells
   (xiii) pathogen
   (xiv) pandemic
   (xv) interferon

   [15]
4. *A primary response occurs after the first exposure to an infectious agent. It takes some time for the immune system to respond so the pathogen reproduces and you get sick. [2]*
   The secondary response happens when you are exposed to the same pathogen a second time. As a consequence of the first exposure, memory cells were produced that rapidly detect and respond to the pathogen, so the immune response is much faster, often not resulting in any symptoms. [2]
5. *Natural immunity occurs when you are exposed to a disease and develop antibodies*

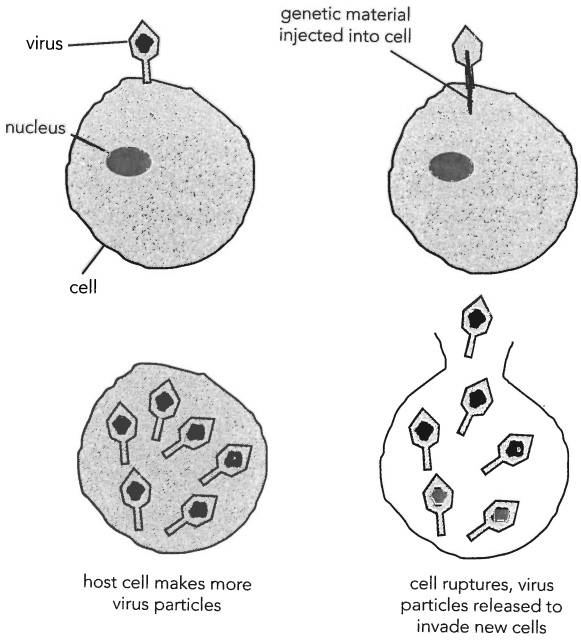
to it. [1] Passive natural immunity occurs if you receive the antibodies from your mother via the umbilical cord. [1]
Active natural immunity develops when you suffer from an infection and develop antibodies [1] e.g. chicken pox, seasonal flu, measles, etc. [1]
Passive acquired immunity refers to the situation when you are given antibodies directly. [1] Perhaps because you have been exposed to a disease and do not have time to develop your own antibodies e.g. tetanus, rabies. [1]
Active acquired immunity refers to the situation in which you are given attenuated or irradiated pathogens (which will not cause the disease) but allow antibodies to develop so that if you were exposed to that disease, you will be protected against it. [1] e.g. cholera, hepatitis B, etc. [1]

6.

(a) *Human Immunodeficiency Virus (HIV) [1]*
(b) *It infects lymphocytes (mainly helper T-cells) and macrophages and impairs their function. [1]*
(c) *People die from the effects of other pathogens that take advantage of a weakened immune system. They are described as opportunistic, e.g. pneumonia. [1]*

7.

(a) *Viruses do not carry out any processes that distinguish living things i.e. move, respire, sensitive, grow, reproduce, excrete, feed. [2]*
(b) *To 'reproduce' or replicate, viruses attach to the outside of another cell and inject their nucleic acid into it. [1] Their nucleic acid, DNA, joins to the cell's DNA and reprograms it [1], so that the cell now manufactures new virus particles [1]. The cell ruptures and the new virus particles escape to invade new cells [1].*



8.

(a) *Antibiotics are drugs that kill or destroy bacteria. [1] They are produced from other living organisms such as moulds (e.g. penicillin) and actinomycetes.*
(b) *It is important to take the full course of antibiotics because, if the full course of antibiotics is not taken, some of the pathogens unaffected by the drug may still be present. [1] The survivors can reproduce and resistance to the antibiotic can develop. [1] This resistance can then be passed on to subsequent generations of the pathogen. Then this pathogen may not respond to the antibiotic which could have serious consequences for people who are infected by the same pathogen. [1]*

9.

(a) *Self refers to all the cells and fluids that are part of your body. [1]*
Non-self refers to foreign materials – cells and tissues or particles from something or someone else that are not part of your body. [1]
(b) *It can be an issue for transplant recipients because their body recognises the transplant material as not belonging to 'self ' and the immune system is stimulated and responds to it. [1] This can result in the destruction (rejection) of the transplant. [1]*
(c) *Future strategies to overcome this situation include xenotransplantation, tissue regeneration from stem cells or tissue sourced from self (e.g. skin for grafts) or perhaps artificially produced organs. [2]*

Section 3: Extended Answer (20 marks)

(a)

- *The specific immune response is specific because each defence is tailored to deal with a particular antigen. [1]*
- *There are two forms of immune responses, humoral and cell mediated. [2]*

Antibody mediated (humoral) response: [Any five points]

- *Invading microorganisms (bacteria, bacterial toxins and viruses) activate B-lymphocytes.*
- *These enlarge and divide to form a clone.*
- *Some of the cells of the clone remain as memory cells.*
- *The rest become plasma cells.*
- *Plasma cells produce antibodies specific to the antigen.*
- *The antibody unites with the antigen to form an antibody - antigen complex.*
- *This results in the destruction of the antigen.*

Cell mediated response [5]:

- *Bacteria or viruses activate the T-lymphocytes.*
- *These enlarge, divide and form a clone.*
- *Some of the clone cells become memory cells.*
- *The rest become various T-cells.*

- *T-killer cells seek out the antigen and destroy it or enhance the activity of macrophages which will then destroy it.*

(b) Injections (vaccines) may result in either artificial passive immunity or artificial active immunity.

- *In artificial passive immunity, antibodies are injected into the blood stream. [1]*
- *This form of protection only lasts as long as the antibodies last. [1]*
- *In artificial active immunity, the weakened (attenuated); dead antigen or inactivated toxin (toxoid) is injected so a person manufactures their own antibodies without developing the disease. [1] They provide much longer protection against diseases. [1]*

(c) Quarantine – isolation of infected individuals; close country borders in a pandemic, wash hands with soap and water, dry properly; cover mouth when coughing or sneezing; put used tissues in a rubbish bin; do not share drink bottles or lip glosses; avoid sharing needles; use safe-sex practices. [3]

TT 6 – MUTATIONS

Section 1: Multiple Choice (30 marks)

1.	*d*	6.	*c*
2.	*d*	7.	*b*
3.	*c*	8.	*b*
4.	*b*	9.	*c*
5.	*b*	10.	*d*

Section 2: Short Answer (50 marks)

1.

(i) Mutant
(ii) Pedigree
(iii) Congenital
(iv) Allele
(v) Somatic cell
(vi) Deleterious
(vii) Phenotype
(viii) Autosome (autosomal chromosome)
(ix) Meiosis
(x) Cancer

[10]

2.

(a) Mutations are spontaneous random changes [1] in the nucleotide sequence of DNA. [1]

(b) Viruses such as rubella, HPV, chemicals such as benzene, formaldehyde, radiation such as X-rays, ultraviolet (UV), gamma rays. [3 groups and 3 examples = 6]

(c) These can produce mutations because they could interfere with the replication of DNA [1], alter the sequence of bases in a DNA strand [1], cause parts of chromosomes to move position or invert.[1]

3. *Somatic cell mutation. This is a change to a gene or a chromosome in a body cell. [1] The consequences of such a change may be insignificant OR serious depending how it affects the cell. [1] As these occur in a body cell, they are not passed on to offspring. [1] Somatic cell mutations are the cause of cancer.*

Germ-line (or gametic) mutation. This is a change to a gene or a chromosome in a gamete or zygote [1] and therefore can be passed on to the offspring and possibly to their offspring in turn. [1] e.g. phenyl ketonuria (PKU). Therefore, it can have serious consequences. [1]

4.

(a) Environmental influences can affect the rate of mutations in a population. [1] However, the environment cannot cause a particular mutation to occur. [1]

(b) A mutant gene may be transmitted through many generations unchanged. [1] It may mutate again producing another unusual feature or it may revert back to the original gene. Because it may persist for many generations it is possible for natural selection to act on it. [1]

(c) Useful mutations are very rare. [1] Random change to a gene which is functioning well is more likely to lead to its dysfunction rather than improvement. [1]

5.

(a) Advantageous mutations are most important. [1] They offer increased chances of survival and are selected by the environment. They are responsible for a wide variety of well adapted organisms which have appeared on Earth. [1]

(b) Unfavourable mutations are selected against. [1] They are not likely to persist in a population for long. Natural selection works against them and eventually removes them from the population. [1]

6.

(a) Klinfelter's Syndrome. [1]
(b) Male. [1]
(c) Forty-seven chromosomes. [1]

7.

(a) Female. [1]
(b) An extra twenty-first chromosome. [1]
(c) Down syndrome (trisomy 21). [1]
(d) Non-disjunction (when the chromosomes fail to separate) of homologous chromosomes during either anaphase I or anaphase II of meiosis. [2]

8. *Degeneracy refers to the fact that a number of codons determine the same amino acid. [2] E.g. AAG and AAA both code for the amino acid lysine [any example, 1]. Therefore the mutation of changing the G to an A does not change the amino acid [1] and therefore does not change the protein. [1]*