

# **MARKING KEY**



## Part 1: Multiple Choice Section [40 marks]

Question	Answer
1	D
2	D
3	D
4	C
5	B
6	A
7	A
8	D
9	C
10	B
11	B
12	C
13	F
14	A
15	D
16	C
17	B
18	A
19	B
20	A



Question	Answers	Marks
	<ul style="list-style-type: none"> <li>handle all tubes the same</li> </ul>	
	Total	4

(d) Explain why measurements were taken for two weeks before treatments were given.

Question	Answers	Marks
(d)	<ul style="list-style-type: none"> <li>make sure cell cultures are stable and growing</li> <li>baseline data to compare treatments not only with others but also with self</li> <li>trial measurement techniques</li> <li>select cultures with cells of the same growth rate to increase reliability</li> </ul>	Any 2 for 1 mark each
	Total	2

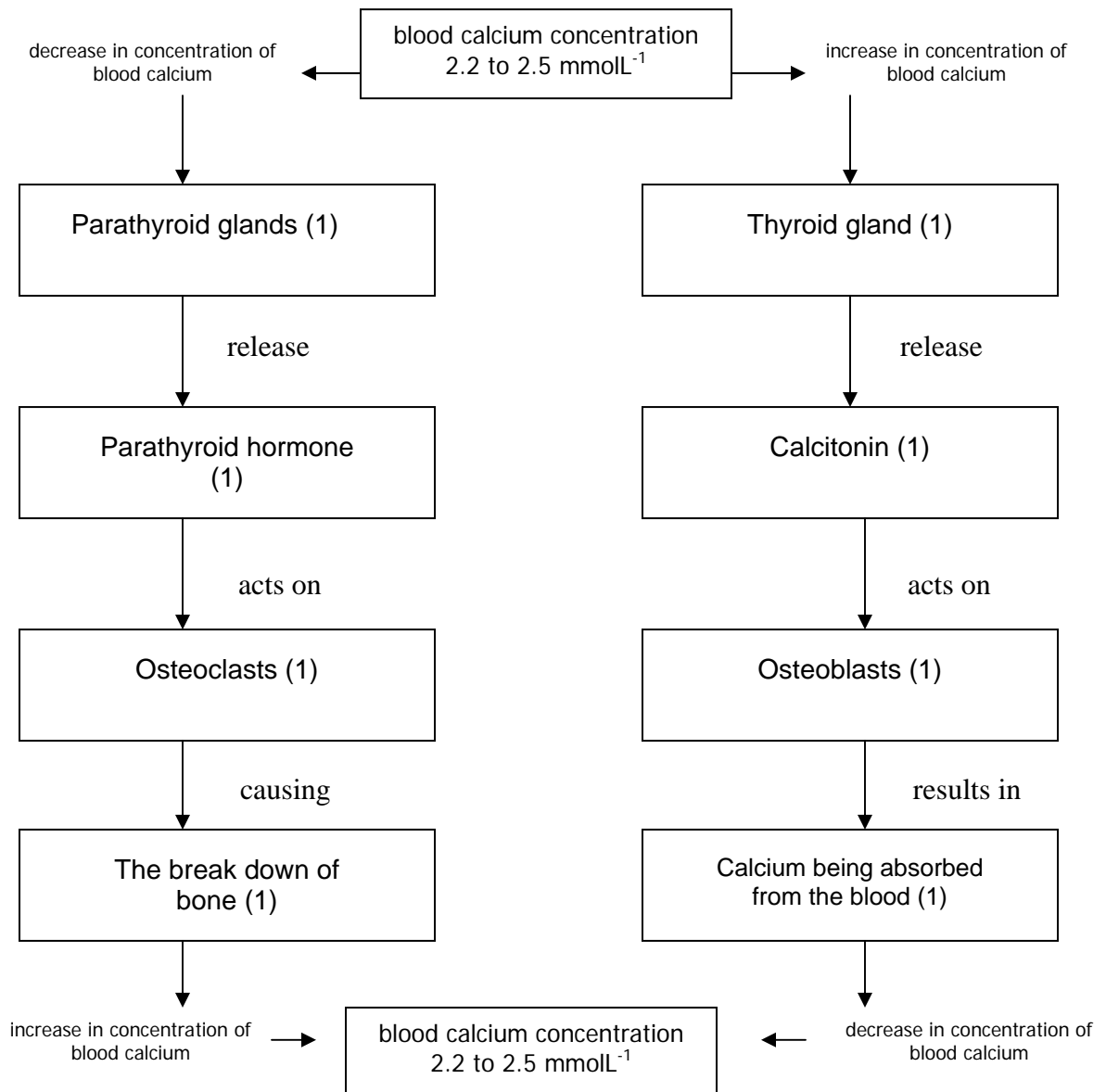
(e) The last dose for treatment C was given at the beginning of week 8. What would be expected to happen to axon growth over the next few weeks? Explain the reasons for your answer. [4 marks]

Question	Answers	Marks
(e)	<ul style="list-style-type: none"> <li>growth rate would decline to resemble the growth shown by B in weeks 6-9</li> <li>and A in weeks 3-9.</li> </ul> <p>Reason</p> <ul style="list-style-type: none"> <li>the nerve axons would continue to grow if nutrients were still available and the conditions were suitable, but they would not grow as fast. because the chemical stimulus is removed.</li> <li>the Neurogen is either broken down or no longer available to promote rapid growth.</li> </ul>	1 1  1 1
	Total	4

**22. Flow chart for calcium Total = 8 marks**

Figure 22: Control of blood calcium

(a)



## Question 22

Explain how low oestrogen levels would affect the secretion of calcitonin and parathyroid hormone.

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>low oestrogen causes an increase in parathyroid hormone activity resulting in break down and release of calcium and bone tissue</li> <li>Calcitonin activity - this hormone normally reduces calcium mobilisation</li> </ul>	1 1
	Total	2

Describe how calcium supplements, such as taking a calcium tablet daily, could help older women reduce the risk of osteoporosis in terms of the flow chart.

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>Calcium supplements will keep blood calcium levels high which prevents any stimulation of the parathyroid glands to release parathyroid hormone.</li> <li>This hormone acts upon osteoclasts to stimulate break down of calcium and bone tissue. The natural process of bone destruction is inhibited which is the cause of osteoporosis.</li> </ul>	1 1
	Total	2

Vitamin A is used to treat some skin conditions and many women use Vitamin A preparations to promote "younger looking skin". One of the hazards of using Vitamin A is that it stimulates the actions of osteoclasts.

Refer to the flow chart and explain how this would affect the blood calcium level.

Question	Answers	Marks
(d)	<ul style="list-style-type: none"> <li>If Vit A is taken, it is stimulating osteoclasts to calcium breakdown in the bones ( that contributes to osteoporosis) which is shown in flow chart on LH side</li> <li>so the thyroid is stimulated to produce calcitonin to promote the reabsorption of calcium.</li> </ul>	1 1
	Total	2



**23. Water balance -**

At what plasma solute concentration is the release of antidiuretic hormone Triggered ?

Question	Answers	Marks
(a)	85 (mOsm/kg)	1

Antidiuretic hormone is released from a gland. Name the gland and its specific release site.

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>Posterior Lobe</li> <li>Pituitary gland</li> </ul>	1
		1
	Total	2

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>ADH is released from the pituitary</li> </ul>	1
	<ul style="list-style-type: none"> <li>when decrease in body fluids is detected in the hypothalamus</li> </ul>	1
	<ul style="list-style-type: none"> <li>ADH travels through the blood to the nephron walls in the kidney</li> </ul>	1
	<ul style="list-style-type: none"> <li>to increase reabsorption of water from filtrate.</li> </ul>	1
	Total	4

**24. Protein Synthesis**

(a) Which process does this diagram represent ? (Process 1 or 2) ?  
Name the process .

Question	Answers	Marks
(a)	<ul style="list-style-type: none"> <li>Process 2</li> <li>Translation</li> </ul>	1
		1
	Total	2



- (b) Structures P and N in the above diagram are different forms of the same molecule. Identify and name these two structures.

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>• TRNA Transfer RNA - P</li> </ul>	1
	<ul style="list-style-type: none"> <li>• MRNA Messenger RNA -N</li> </ul>	1
	Total	2

- (c) Describe the functions of P and N in the process named in (a)

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>• "P" - TRNA is responsible for carrying amino acids to the ribosome where they are assembled into a protein.</li> </ul>	2
	<ul style="list-style-type: none"> <li>• "N" - MRNA carries the template of the DNA to the cytoplasm of the cell where new proteins are made.</li> </ul>	2
		4

## 25. Muscle contraction

- (a) In old age, the myofibrils lose some of the cross connections between the thick and thin filaments. How would this affect the functioning of the whole muscle?

Question	Answers	Marks
(a)	<ul style="list-style-type: none"> <li>• reduce strength of whole muscle and speed of full contraction</li> </ul>	2

- (b) Describe the changes that occur in the myofibrils when muscle contraction takes place. Refer to the structures labeled above in your answer.

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>• the thick filaments ( myosin) attach to the thin filaments ( actin)</li> </ul>	1
	<ul style="list-style-type: none"> <li>• , pulling them closer and shortening the length of the myofibril as shown in "B"</li> </ul>	1
	<ul style="list-style-type: none"> <li>• the A band ( as shown in Diagram A) increases in length and darkens during contraction</li> </ul>	1
	<ul style="list-style-type: none"> <li>• the I band is shortened also</li> </ul>	1
	Total	4

## 26. Temperature Regulation

(a) Where are the body's thermoreceptors located?

Question	Answers	Marks
(a)	<ul style="list-style-type: none"><li>• In the hypothalamus</li></ul>	1

(b) What two responses to the high temperatures would occur in the skin of the men in the oven?

Question	Answers	Marks
(b)	<ul style="list-style-type: none"><li>• vasodilation</li><li>• sweating</li></ul>	1 1
	Total	2

(c) The men's breathing rates increased during the time in the oven. Give one reason why this would happen.

Question	Answers	Marks
(c)	<ul style="list-style-type: none"><li>• body tries to release heat through breathing process</li><li>• increase in body temp leads to increase in metabolic rate</li></ul>	1 1
	Total	2

(d) How would dry air have helped the men's survival?

Question	Answers	Marks
(d)	<ul style="list-style-type: none"><li>• no moisture in the air surrounding their bodies allows for maximum evaporation from the skin could occur to control over- heating</li></ul>	1 1
	Total	2

## 27. ABO inheritance

Use the inheritance of ABO blood group to explain each of the following:

Question	Answers	Marks
(a)	<ul style="list-style-type: none"><li>• CO-DOMINANCE - When the A allele and B allele are passed onto an individual they are expressed co-dominantly in the phenotype and produce A antigens and B antigens on the surface of the red blood cells i.e. Type AB blood</li></ul>	2
	<ul style="list-style-type: none"><li>• RECESSIVENESS - The A and B alleles are equally dominant over the O allele. The O allele is recessive</li></ul>	2

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>When the A allele and B allele are passed onto an individual they are expressed co-dominantly in the phenotype and produce A antigens and B antigens on the surface of the red blood cells i.e. Type AB blood</li> </ul>	2

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>The A and B alleles are equally dominant over the O allele. The O allele is recessive (1) and Type O blood will result only when 2 O alleles are Inherited (1)</li> </ul>	2

Question	Answers	Marks
(d)	<ul style="list-style-type: none"> <li>Inheritance of the AB and O alleles occurs equally in males and females. (1) There is no evidence of either gender showing increased frequency of a particular blood type. (1)</li> </ul>	2

## 28. Population genetics

Question	Answers	Marks
(a)	<ul style="list-style-type: none"> <li>Natural selection</li> <li>as high melanin content (darker hair/skin) provides greater protection against high UV radiation, those individuals living in geographic regions that experienced a hotter/ high UV conditions tended to be more successful and survived better in this type of environment. In the cooler, Scandinavian regions the intensity of UV was less and so lighter hair/skin was a combination that provided the survival advantage.</li> </ul>	1
	• Total	2

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>Random genetic drift</li> <li>– due to chance in a small isolated pop'n like this island, certain genes become high in frequency leading to uncharacteristic features being expressed in the population</li> </ul>	1
		1
	• Total	2

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>• Founder Effect</li> <li>• – when explorers or founders of the isolated population of melanesians settled and contributed genes to the population, which are ordinarily in very low frequency, did over time, produce an effect of uncharacteristic features i.e. blonde hair</li> </ul>	1  1
	• Total	6

## 29. Biotechnology

Question	Answers	Marks
(a)	<ul style="list-style-type: none"> <li>• <i>A Plasmid</i></li> <li>• Small circles to DNA taken from bacterial cells that are used to insert the insulin gene used in the production of human insulin in the laboratory</li> <li>• <i>Insulin gene</i></li> <li>• Genetic information ( segment of DNA) that codes for insulin protein</li> <li>• <i>Restriction Enzyme</i></li> <li>• Enzyme used to cut a plasmid at particular sites to allow insertion of gene.</li> <li>• <i>Recombinant Bacteria</i></li> <li>• used to produce large quantities of insulin in laboratory.</li> </ul>	1  1 1  1 1  1 1  1
	Total	8

Question	Answers	Marks
(b)	<p>Risks (any of the following for 2 marks max)</p> <ul style="list-style-type: none"> <li>possible production of antibodies as the insulin is not produced from patient</li> <li>unknown efficacy due to short history of use</li> </ul> <p>Benefits (any of the following for 2 marks max)</p> <ul style="list-style-type: none"> <li>patient not having to take animal derived product which less suitable than human.</li> <li>animals not being used as insulin factories</li> <li>high yield of product through this process – less costly, supply more patients without delay.</li> </ul>	<p>2</p> <p>2</p>
	Total	4

### 30. Reflex Arc

Question	Answers	Marks
(a)	<ul style="list-style-type: none"> <li>The time it takes the nerve impulse to reach the association neurone in the spinal cord is almost identical to the impulse that is simultaneously travelling to the cerebrum.</li> <li>There is no time for the brain to intervene with the response</li> </ul>	<p>1</p> <p>1</p>
	Total	2

Question	Answers	Marks
(b)	<ul style="list-style-type: none"> <li>A nerve impulse can only travel one way across a synapse</li> <li>when it reaches the axon on the other side, the impulse will continue in the same direction</li> </ul>	<p>1</p> <p>1</p>
	Total	2

Question	Answers	Marks
(c)	<ul style="list-style-type: none"> <li>Myelin sheath function acts as insulator around the axon</li> <li>allows the impulse to travel faster</li> </ul>	<p>1</p> <p>1</p>
	Total	2

Question	Answers	Marks
(d)	<ul style="list-style-type: none"> <li>• Ageing affects myelin sheath possible autoimmune response causing disintegration and a slowing of nerve impulses</li> <li>• Schwann cell regeneration / repair slower – less myelin to cover axon leading to slowing of nerve impulses ( reactions )</li> </ul>	1  1
	Total	2

### 31. Knee joint

(a) (3 marks )

The shape of the long bones in the joint are complementary (1)  
Location(1) and arrangement (1) of ligaments in the joint prevents Lateral movement or rotation.

(b) Tibia– bone tissue (1) + any one of the following

- Solid matrix containing calcium and collagen for strength
- Compact bone collar around it to provide strength
- Cross structures in the cancellous bone – light and strong

Cruciate Ligament - dense regular connective tissue (1) and one of the following

- Large amount of thick collagen fibres arranged parallel to give great strength
- Ligaments withstand pulling forces in one direction

(c) Osteoarthritis treatments ( any 2 - 2 marks each)

- Chemical – dietary intake of materials that promote growth of cartilage
- Mechanical – joint replacement removes damaged material replaces with metal/composite structure to allow movement without pain
- Biotechnological – remove cartilage cells, clone them and replace into joint ( Cartilage replacement)

## Part 3: Extended Answer Section (60 marks)

### 1. COMPULSORY QUESTION : DESIGN OF INVESTIGATION 30marks

#### (a) Design of investigation Max total = 22 marks

##### 1. VARIABLES ( MAX 6 marks)

- Independent - new drug being tested "Drug x" (1)
- Dependent - relief from pain and swelling in joints(1)\_
- Controlled variables - 1 / correct variable - max (4)
- - including  
same number of people with arthritis used,  
same dose of drug,  
environmental conditions  
same time period

##### 2. HYPOTHESIS (MAX 2 marks )

- Drug X provides faster relief from pain and swelling i  
in arthritic patients compared to *Arthramat* (2)  
( statement along these lines - must include reference to drugs being  
compared)

##### 3. PRE-TESTING (Any 2 the following MAX 2 marks )

- Determine threshold of pain/discomfort with patients
- Observe other effects of drugs may be taking on pain
- Management
- Determine parameters for measuring /describing pain
- Diagnostic imaging of joints to establish inflammation/Progression of  
joint damage.

##### 4. METHODOLOGY / RELIABILITY (Total 10 marks)

***Methodology any two of the following:  
MAX 2 marks***

- establish large sample size of arthritis sufferers ( same type of  
arthritis, similar stage of disease, equal numbers males and females,  
medical profiles/ age/ lifestyle as similar as possible)
- divide group into experimental and control group ( equal numbers)
- determine (without subjects knowing) who is receiving Drug X and  
who is receiving *Arthramat*
- decide on length of investigation ( possibly 3-6 months) time of day for  
administering of drug, dosage of drug
- patients to record daily level of pain discomfort, also level of activity  
for the day,
- method of collecting data from patients should be weekly monitoring  
to ensure any side effects or other unforeseen medical issues are  
recorded

### **Reliability ( MAX 2 marks)**

- mention importance of the large sample size, controlling all variables as much as possible i.e. profile of patients
- repetition of investigation required to increase reliability, reduce chance of experimental error.

### **(b) Risks,/ethical concerns**

**( any 5 issues discussed - 2 marks each- Total 10marks)**

- using an animal ( flat worm) that needs to be harvested from the coral reef area poses a threat to ecological balance. (coral reefs are particularly sensitive ecosystems)
- using a compound developed recently runs the risk of not having any supportive evidence of its long term efficacy.
- possibility of allergic or antibody reaction to new compound developed in bacterial cultures

### **Benefits**

- It appears to be of greater pain relief benefit - more people will have a better quality of life
- cost of the production could be less - produced in the lab
- quantities of the drug will be greater if it can be produced in the lab
- Drug therapy could mean slowing of the progression of the disease and less need for costly surgery to replace joints.

## **2. Hominin Question**

**(a) Any 5 of the following with valid reason relating to environmental change Total 10 marks**

- Reduced prominence of zygomatic arches
- Reduced prominence of midsagittal crest
- Reduction in proportion of facial skeleton to cranium
- Reduction in size of canines
- Emergence of forehead

Explanations must link to environmental changes ( e.g. vegetative changes and diet and reduced need for large attachment areas for the muscles of mastication; better quality of diet, increased the need for a larger cranium for the brain), evolution and natural selection

**(b) 4 cultural changes 2 marks each Total 8 marks**

- Tool making - larger brain meant increased intelligence allowing development of simple activities and linking of ideas
- Use of fire - greater intelligence and climate change led to hominids harnessing fire and learning to use it for cooking, deterring predators keeping warm, driving animals during a hunt.



- Shelter and Clothing - climate change meant those who were able to take shelter from harsh conditions survived, whilst using natural shelters initially and learnt to build simple constructions eventually. Clothing was also created from animal skins
- Cooperative hunting - those hominids with ability to work cooperatively were able to benefit from more successful hunting and food gathering.

**(c) Techniques 6 marks per technique Total 12 marks**

Choice of:

- **Absolute Dating - Carbon 14**  
used to determine amount of C14: C12 ratio present in a specimen (carbon based) with known decay rate of C14 allows for accurate dating of fossil skulls., can only be used for carbon based specimens, can date up to 70,000 – 100,000 years old.
- **Relative Dating - Stratigraphy / Fluorine dating**  
Could use knowledge of location of skulls to compare the depth / geological layer to determine which are older or younger, to then be able to classify them.  
Absorption of fluoride ions into bone will determine a relative age (older fossil more fluoride present)

**3 Ageing Question**

**(a) Musculoskeletal:**

**Discussion of each condition and examples of technologies used to treat them. MAX 15 marks each**

*Osteoporosis:*

- **MECHANICAL** (5 marks max) : braces/walking frames, casts, exercise programs including weight bearing exercises
- **CHEMICAL** (5 Marks max) mineral supplements - calcium, HRT for post menopausal women, Antiresorptive drugs which reduce progression of bone thinning and remodelling and maintains and increases bone strength.  
Parathyroid Hormone - can contribute to increasing bone strength.
- **BIOTECHNOLOGICAL** (5 marks max) DNA recombinant technology produces a bone-forming agent, taken from parathyroid hormone and it works by increasing bone mass and improving bone density with structurally normal new bone.

*Osteoarthritis:*

- **MECHANICAL** ( 5 Marks max) Joint replacement with metal/composite material structures- removes damaged tissue and allows movement without pain, braces, modified household items to provide assistance in the home with daily tasks
- **CHEMICAL** ( 5 marks) dietary intake of materials that promote growth of cartilage and encourage the replacement of bone tissue e.g. glucosamine and calcium; increase calcium rich food in diet. Anti-inflammatories and immune system suppressors.

BIOTECHNOLOGICAL (5 marks) use of stem cells for ( cartilage) to produce more cartilage cells in vitro, then use them to replace and regrow new joint cartilage. At the least, can promote thickening of remaining cartilage and reduces likelihood of more damage

OR

**Nervous – Discussion of each condition and examples of technologies used to treat them. MAX 15 marks each**

*Alzheimers Disease*

- MECHANICAL(5 marks max) Exercise and mental stimulation to maintain good circulation to the brain
- CHEMICAL ( 5 marks max) Depending on the stage of the disease, medications can slow the progression including cholinesterase inhibitors, glutamate blockers, antipsychotics and antidepressants. Antioxidants (Vit E) are being investigated as helpful in some patients but the evidence is inconclusive at present.
- BIOTECHNOLOGICAL (5 marks max) Proteins identified to prevent cellular activity that causes the “cellular mistake” that causes the disease.
- Stem cell production may offer possible replacement of neural connections

*Parkinsons Disease*

- MECHANICAL (5 marks max) Exercise specialised programs to target isolated areas of the body. Overall fitness is promoted as a key to assist management of the disease. Physiotherapy and Occupational therapy is highly recommended in early stages of disease to ensure long term management of symptoms.  
Surgery to sever specific neural connections ( deep brain stimulation also) to reduce undesirable symptoms i.e. tremors and wriggling/writhing.
- CHEMICAL ( 5 marks max) Medication is the major treatment for this disease. The major groups of medications include dopamine replacement therapy, acetylcholine blockers, dopamine transmission enhancers, dopamine metabolism inhibitors. Depending on the stage of the disease different medications will be appropriate.
- BIOTECHNOLOGICAL (5 Marks max) There are no fully tested effective treatments available yet, but research is continuing into the use of compounds to stimulate neuronal growth and implanting of stem cells in the brain to replace dopamine.

**(b) Risks, ethical issues and benefits to patient : (10 marks max)**

- Biotechnological treatment of Parkinsons (e.g.)
- **Risks** - new treatments have not been used for many patients and for long time periods so not all possible effects are known i.e. allergic reactions, long term damage to other parts of body or even death in certain circumstances.
- **Ethical issues** - potential use of embryonic stem cells for possible treatment/prevention. The source of these cells raises controversy as they are harvested from embryos. Also the testing of this technology requires animal./mammal testing for the most valid results - some disagreement to this in the community.

- **Benefits** - possible prevention or "cure" of this disease. As currently this disease shortens the length and quality of life for a patient - this would be the strongest benefit. As this disease is debilitating and robs the patient of ability to function in everyday life, relief of even some of the symptoms would be a benefit. The cost in time and money in the management of this disease is very high so this would be a burden also removed from the patient.

#### Question 4 Immunity

(a) 5 marks / description of passive and active immunity

**Total = 10 marks**

##### PASSIVE IMMUNITY (5 marks max)

- involves administering of antibodies via injection
- short term response in the body
- no memory cells are produced
- can be given to prevent infection ( short term)
- can be given to treat poisoning ( immediate effect)
- can result in hypersensitivity reactions due to molecular nature of antibodies.

##### ACTIVE IMMUNITY (5 marks max )

- involves administering antigens via injection
- long term response in the body
- the antigen stimulates a specific immune response
- memory cells are produced
- used as a preventative measure to reduce the risk of disease - not a treatment
- different types of antigens are used e.g. inactivated, attenuated, toxoids

##### (b) Process producing monoclonal antibodies (10 marks max)

- mouse injected with a chosen antigen (1) which stimulates antibody production(1)
- spleen from the mouse is removed(1) and B cells that produce the antibodies are isolated(1)
- a culture of tumour cells is grown (1)
- the mouse B cells and tumour cells are combined in a suspension(1)
- these are known now as hybridomas(1)
- due the combined features of both cells the result is the rapid production of cells(1) that secrete the desired antibody(1), which will produce very high amounts and are highly specific.(1)

(c) Risks / Benefits **(Any of the following for a total of 10 marks)**

- Risks include mouse cell use can cause reactions in humans. The immune system of some people react against the foreign mouse proteins and provoke deleterious side effects. (2)
- Ethical issues arise when dealing with the above issue - the ultimate solution to reactions from mouse cells is to have humans used to produce antibodies for harvesting . This would benefit individuals but the use of humans for "harvesting "of cells in this manner is not acceptable to society.(2)
- Benefits of this process is to provide a range of diagnostic tools, to treatments of infections and cancer and prevention of tissue rejection in transplant patients.(2)
- This process makes the diagnosing of STD's and parasitic infections much quicker and easier. (2)
- This process makes the interpretation of diagnostic tests much easier and require fewer highly trained personnel. ( lower costs) (2)

**Human Biological Science  
Sample Examination Stage 3  
Mapping questions to content**

	Human Form and Function		Human Diversity and Change		The Practice of Human Biology	
Quest. No.	Cells, metabolism and regulation	Body Systems	Inheritance	Variation and Evolution	Approaches to investigating	The relevance of human biology to everyday life
<b>Section A - Multiple Choice</b>						
1		✓B				
2		✓A				
3	✓A					
4	✓A					
5		✓B				
6		✓B				
7				✓A		
8				✓A		
9		✓A				
10		✓A				
11	✓B					
12			✓A			
13	✓A					
14					✓AB	
15	✓A					
16		✓B				
17		✓B				
18				✓A		
19			✓A			
20	✓B					

	Human Form and Function		Human Diversity and Change		The Practice of Human Biology	
Quest. No.	Cells, metabolism and regulation	Body Systems	Inheritance	Variation and Evolution	Approaches to investigating and communicating human biology	The relevance of human biology to everyday life
<b>Section B - Short Answer</b>						
21					✓AB	
22	✓A					
23		✓B			✓AB	
24	✓B					
25		✓B				
26	✓A					
27			✓A			
28				✓A		
29			✓B			✓B
30		✓B				
31		✓B				

	Human Form and Function		Human Diversity and Change		The Practice of Human Biology	
Quest. No.	Cells, metabolism & regulation	Body Systems	Inheritance	Variation and Evolution	Approaches to investigating and communicating human biology	The relevance of human biology to everyday life
<b>Section C Extended Answer</b>						
32					✓AB	✓B
33				✓AB		
34		✓B				✓B
35	✓B		✓B			✓B