

2007 Trial Higher School Certificate Mapping Grid Biology

Exam Section	Question	Marks	Syllabus/Course outcomes	Content	Targeted performance band	Answer
Part A – Multiple Choice	1	1	H6, H7	9.2.1	4-5	C
	2	1	H6, H14	9.2.2	4-5	A
	3	1	H2, H6	9.2.2	4-5	D
	4	1	H6, H7	9.2.1	4-5	B
	5	1	H6, H7	9.2.2	3-4	C
	6	1	H2, H11	9.1.11.2	5-6	B
	7	1	H9, H14	9.3.3	3-4	C
	8	1	H9, H10	9.3.5	5-6	D
	9	1	H9, H14	9.3.3	3-4	C
	10	1	H1, H9	9.3.2	3-4	B
	11	1	H7, H11	9.4.3	2-3	C
	12	1	H6, H9	9.4.6	2-3	D
	13	1	H2, H8	9.3.2	3-4	A
	14	1	H6	9.3.4	2-3	B
	15	1	H4, H12	9.3.6	5-6	A
Part B- Free response	16	3	H6, H13, H14	9.2.1	3-6	
	17	4	H7, H13	9.2.3	3-5	
	18	4	H6, H7, H13	9.2.1	3-5	
	19	7	H2, H3, H11, H12, H13	9.2.2	3-6	
	20	2	H3, H13	9.2.2	4-5	
	21	6	H4, H7, H8, H10, H13	9.3.1; 9.4.3	2-5	
	22	2	H9, H13	9.3.4	2-3	
	23	4	H9, H13, H14	9.3.3	4-6	
	24	4	H1, H2, H6, H7, H10	9.3.1	4-6	
	25	2	H4, H9, H13	9.3.4	5-6	
	26	4	H9, H13	9.3.2; 9.3.3	3-4	
	27	2	H4, H13	9.4.2	2-3	
	28	4	H6, H8, H13	9.4.3	3-5	
	29	4	H3, H8, H14	9.4.7	4-6	
	30	8	H3, H4, H5, H6, H7, H13	9.4.5	3-6	

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Part II Option 1	31a	6	H6	9.5.2; 9.5.4	2-4	
	31b	7	H2,H11,H12,H14	9.5.3	4-6	
	31c	7	H3,H4,H6,H13, H14	9.5.6	2-6	
	31d	5	H6	9.5.2; 9.5.4	3-5	
Part II Option 2	32a	6	H2,H6,H8,H11	9.6.4; 9.6.3	2-5	
	32b	7	H3,H6, H13	9.6.5	3-6	
	32c	7	H3,H4,H8,H13	9.6.3; 9.6.6	2-6	
	32d	5	H6,H13	9.6.4	3-5	
Part II – Option 3	33a	6	H6,H9	9.7.2; 9.7.6	2-4	
	33b	7	H2,H6,H9,H11, H12,H13	9.7.1	4-6	
	33c	7	H3,H4,H6,H9,H13	9.7.4; 9.7.5	2-6	
	33d	5	H1,H2,H9,H14	9.7.3	3-5	
Part II Option 4	34a	6	H6	9.8.1; 9.8.4	2-4	
	34b	7	H2,H3,H9,H11, H12,H13	9.8.2	4-6	
	34c	7	H3,H4,H10,H13	9.8.6	2-6	
	34d	5	H2,H10	9.8.3	3-5	
Part II Option 5	35a	6	H2, H6	9.9.1; 9.9.4	2-5	
	35b	7	H1,H2, H6, H11,H12, H13	9.9.2	4-6	
	35c	7	H3,H4,H6,H9,H10, H13	9.9.3; 9.9.5	2-6	
	35d	5	H6,H13	9.9.6; 9.9.8	3-5	

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2007 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

BIOLOGY – MARKING GUIDELINES

The sample answers indicate features that should be found in a response that receives full marks. For the extended response questions, a set of guidelines is included rather than a sample answer.

Section I

Part A – 15 marks

Questions 1-15 (1 mark each)

Question	Correct Response	Outcomes Assessed	Targeted Performance Bands
1	C	H6, H7	4-5
2	A	H6, H14	4-5
3	D	H2, H6	4-5
4	B	H6, H7	4-5
5	C	H6, H7	3-4
6	B	H2, H11	5-6
7	C	H9, H14	3-4
8	D	H9, H10	5-6
9	C	H9, H14	3-4
10	B	H1, H9	3-4
11	C	H7, H11	2-3
12	D	H6, H9	2-3
13	A	H2, H8	3-4
14	B	H6	2-3
15	A	H4, H12	5-6

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Section I
75 marks

Part B – 60 marks

Question 16 (3 marks)

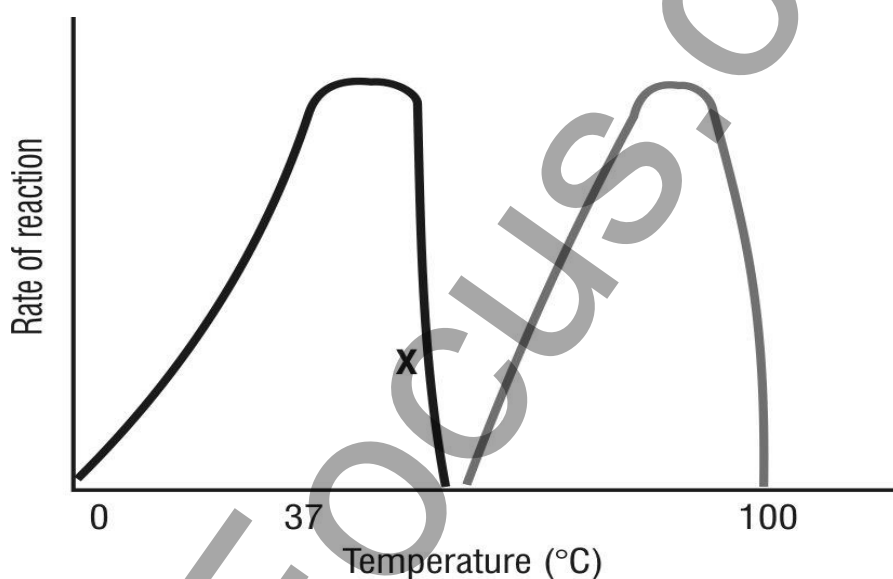
16 (a) (1 mark)

Outcomes Assessed: H6, H13

Targeted Performance Bands: 5-6

Criteria	Marks
Correct sketch of temperature optimum graph for thermophile	1

Sample answer



16 (b) (2 marks)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 3-4

Criteria	Marks
Explanation for drop in activity as temperature increases	2
Statement that activity drops as temperature increases	1

Sample answer:

Beyond the optimum temperature for that enzyme (37°C), the enzyme which is protein, is denatured. The shape of the active site changes and enzyme and the substrate no longer fit. Thus rate of reaction drops.

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Question 17 (4 marks)**Outcomes Assessed: H7, H13****Targeted Performance Bands: 3-5**

Criteria	Marks
Completes table with correct explanations for waste products and conservation of water for both insects and mammals	4
- Completes table for waste products only (for both) OR - Completes table for water conservation only (for both) OR - Completes table with a correct explanation for waste products and conservation of water for an insect OR a mammal	2-3
- Completes table for waste products only for insect or mammal OR - Completes table for water conservation only for insect or mammal	1

Sample answer

	Insect	Mammal
Concentrated nitrogenous waste	Uric acid in semi solid form	Urea in solution
Conservation of water	Insoluble in water, relatively non-toxic, excreted as a semi-solid paste. Can conserve much water.	Is soluble, low toxicity, therefore can reach high concentrations but requires some water for excretion.

Question 18 (4 marks)**Outcomes Assessed: H6, H7, H13****Targeted Performance Bands: 3-5**

Criteria	Marks
Discusses how stomatal grooves/pits and rolling assist in conservation of water	4
- Discusses how stomatal grooves or rolling assist in conservation of water OR - Statements that grooves and rolling cut transpiration OR - Discusses how leaf rolling assists in conservation of water	2 -3
Statement that grooves or rolling cut transpiration	1

Sample answer

Having stomatal grooves/pits means that stomates are sunk beneath the surface of the epidermis. Thus, when transpiration occurs, the water vapour molecules are not blown away by air. Movements and a vapour plug collects, reducing the gradient, so less water vapour is lost and greater conservation occurs. When the leaves roll, the stomates are enclosed within a vapour filled chamber, again reducing the humidity gradient and thus less transpiration will occur.

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Question 19 (7 marks)**Outcomes Assessed:** H2, H3, H11, H12, H13**Targeted Performance Bands:** 3-6

Criteria	Marks
- Describes fully the method used to estimate size of red blood cells AND - Discusses a safety precaution AND - Explains how reliability is achieved AND - Correctly draws scaled diagram, fully labelled	6-7
- Describes most steps in method used to estimate size of red blood cells AND - Discusses a safety precaution AND - Explains how reliability is achieved AND - Correctly draws diagram, partly labelled	4-5
- Any three out of four steps AND - Some steps in method used to estimate size of red blood cells AND - A safety precaution mentioned AND - States that repeat trials are performed AND - Draws diagram, partly labelled	2-3
- Any two steps OR - Some steps in method stated OR - A safety precaution mentioned OR - Explains how reliability achieved OR - Basic diagram correct (not labelled)	1-2

Sample answer**Method:**

Diameter of field of view on low power (x100) was measured using the millimeter grid/minigrid/graph paper/transparent ruler.

This was found to be 2mm and was converted to 2000 μ M.

Diameter of field of view on high power (x400) was calculated to be 500 μ M (2000/4).

Number of red blood cells that fitted across the radius was counted and doubled. This was estimated to be 67 cells.

Diameter of a red blood cell was calculated by dividing 500 μ M by number of cells.

Diameter of a red blood cell was estimated to be 7.5 μ M.

Safety precaution:

Prepared slide of blood used, as fresh blood could contain blood borne pathogens

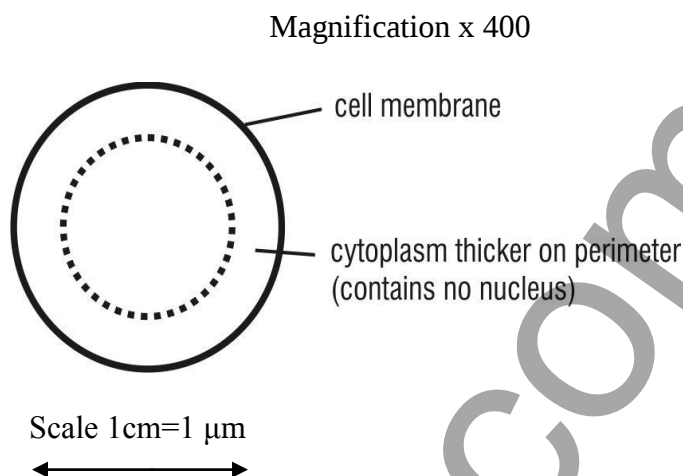
Reliability:

The estimation of the number of cells was repeated several times using different slides and the average was calculated to increase reliability.

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Diagram of a red blood cell



Question 20 (2 marks)

Outcomes Assessed: H3, H13

Targeted Performance Bands: 4-5

Criteria	Marks
• Condition described AND use of technology explained	2
• Condition described OR use of technology explained	1

Sample answer:

A pulse-oximeter may be used on a person who has a respiratory condition such as asthma, where the bronchioli are constricted and thus less air with oxygen gets through to the lungs. This technology allows the professionals to ensure that enough oxygen is getting through to maintain normal metabolism in the patient before they show signs of hypoxia.

Question 21 (6 marks)

21 (a) (1 mark)

Outcomes Assessed: H13

Targeted Performance Bands: 2-3

Criteria	Marks
• Correctly identifies role of antibiotics	1

Sample answer

Antibiotics are used to manage infectious diseases caused by bacteria.

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21 (b) (3 marks)

Outcomes Assessed: H4, H10, H13

Targeted Performance Bands: 4-5

Criteria	Marks
• Explains fully how resistant strains of <i>Staphylococcus</i> have evolved	3
• Partly explains evolution of resistant strains of <i>Staphylococcus</i>	2
• Mentions that some bacteria are favoured and survive	1

Sample answer :

There is variation in the population of *Staphylococcus* bacteria. When *Staphylococcus* are exposed to antibiotics those that are resistant, are selected for. These survive and reproduce and pass on their trait of resistance to their offspring. Those that are not resistant to the antibiotic are selected against and their numbers in the population decrease. Over time, as different antibiotics are used, strains of *Staphylococcus* bacteria become multi-drug resistant.

21 (c) (2 marks)

Outcomes Assessed: H4, H7, H8

Targeted Performance Bands: 4-5

Criteria	Marks
• Correctly discusses two problems related to antibiotic resistance	2
• Correctly discusses one problem related to antibiotic resistance OR	1
• Two problems identified or stated	

Sample answer :

People infected with antibiotic-resistant organisms like MRSA are more likely to have longer and more expensive hospital stays, and may be more likely to die as a result of the infection. When the drug of choice for treating their infection doesn't work, they require treatment with second-choice or third-choice medicines that may be less effective, more toxic and more expensive.

Question 22 (2 marks)

Outcomes Assessed: H9, H13

Targeted Performance Bands: 2-3

Criteria	Marks
• Correct description of DNA replication	2
• Partial description of DNA replication OR unlabelled diagram	1

Sample answer:

The two strands of the double DNA helix separate. Each parental strand serves as a template for the formation of a new complementary strand. One at a time nucleotides are added to each of the template strands until two double stranded DNA molecules, identical to one another and to the parent DNA, are formed.

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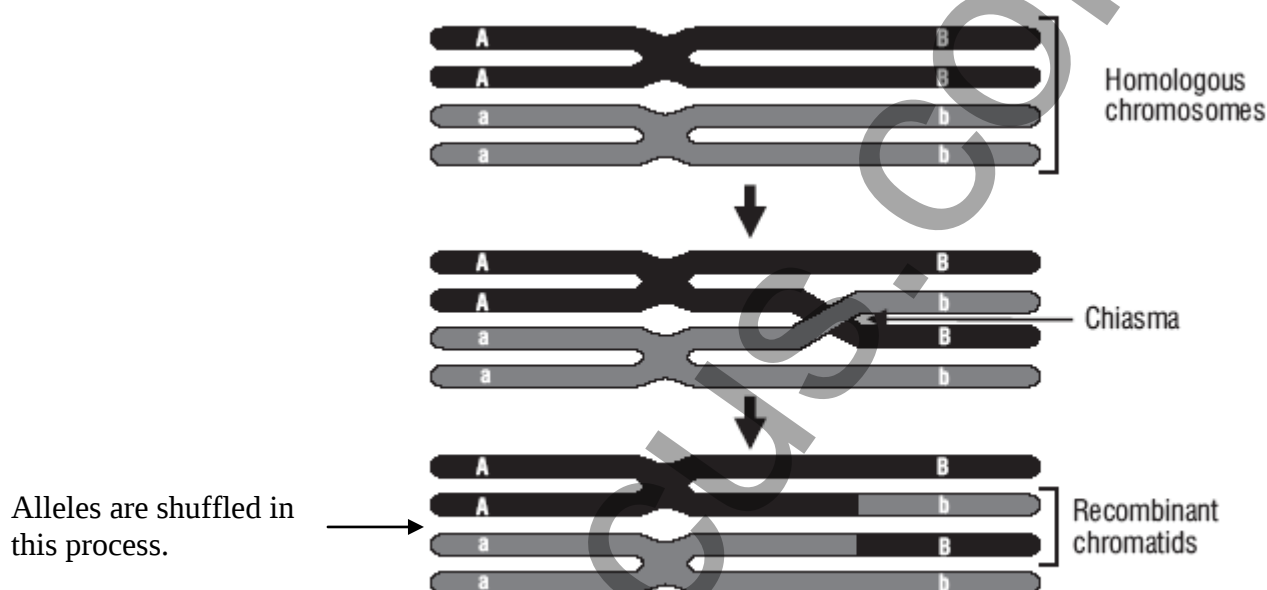
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Question 23 (4 marks)

23 (a) (2 marks)

Outcomes Assessed: H9, H13, H14**Targeted Performance Bands:** 5-6

Criteria	Marks
• Correct diagram showing crossing over between A and B	2
• Diagram shows crossing over of chromatids but not genes	1

Sample answer:

23 (b) (2 marks)

Outcomes Assessed: H9, H13, H14**Targeted Performance Bands:** 4-5

Criteria	Marks
• Correct explanation of how segregation increases variability	2
• Mention that separation is random OR diagram but no explanation	1

Sample answer:

Homologous pairs of chromosomes (one maternal and one paternal) line up across the equator of the spindle. The way they line up is random and this dictates the way they separate. There is a 50 per cent chance that a daughter cell of meiosis I will get a maternal chromosome of an homologous pair. In addition each homologous pair is positioned independently of all other pairs. This results in independent assortment of the chromosomes. (The number of combinations possible is 2^n where n is the haploid number).

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Question 24 (4 marks)

24 (a) (2 marks)

Outcomes Assessed: H2, H6, H10**Targeted Performance Bands:** 4-5

Criteria	Marks
Explains how biochemical evidence provides support for theory of evolution	2
Statement that biochemistry has provided support for the theory of evolution	1

Sample answer:

When the DNA of two species is heated it separates into single strands. When these are placed together, they hybridise, as complementary bases in the single strands pair. The greater the degree of pairing the more closely related the two species are to one another, the more recently they shared a common ancestor.

24 (b) (2 marks)

Outcomes Assessed: H1, H7**Targeted Performance Bands:** 5-6

Criteria	Marks
Explains how advances in technology have changed thinking about evolutionary relationships using named example	2
States the named example has been reclassified	1

Sample answer:

Cyanobacteria used to be called Blue Green algae and were classified as plants because they have a cell wall, are green and photosynthesize. After the introduction of the electron microscope it was revealed that these organisms were procaryotic having no membrane bound organelles or nucleus. They are now placed in the kingdom Monera along with bacteria and are no longer considered to be plants.

Question 25 (2 marks)**Outcomes Assessed:** H4, H9, H13**Targeted Performance Bands:** 5-6

Criteria	Marks
Explains why precautions are used when exposed to radiation	2
States that precautions are now used when exposed to radiation	1

Sample answer:

It is now recognised that exposure to high energy ionising radiation can result in mutation by causing changes to the DNA. Furthermore the harmful effects of radiation can accumulate and thus the people exposed on a regular basis, as well as the patient, are now protected so that their exposure is reduced.

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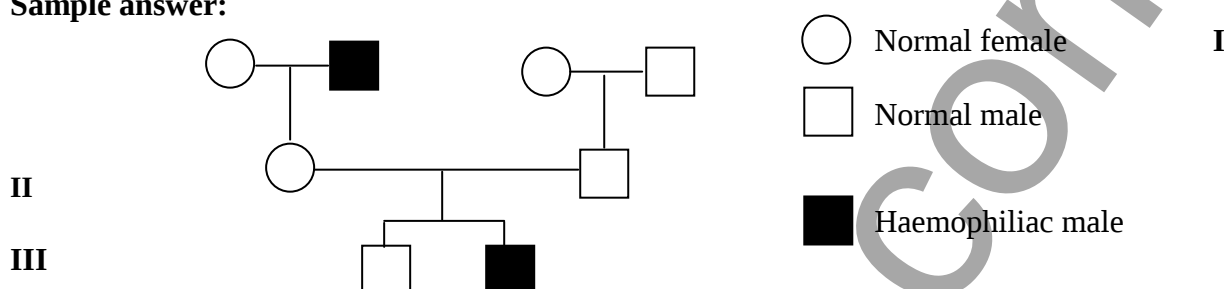
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Question 26 (4 marks)

26 (a) (3 marks)

Outcomes Assessed: H9, H13**Targeted Performance Bands:** 3-4

Criteria	Marks
• Correct pedigree constructed and drawn	3
• Partly correct pedigree drawn and without key	1-2

Sample answer:

26 (b) (1 mark)

Outcomes Assessed: H9, H13**Targeted Performance Bands:** 3-4

Criteria	Marks
• Discusses current use of pedigrees	1

Sample answer:

Pedigrees may be used to attempt trace the pattern of inheritance of a trait across several generations in a family and thus predict the probability of a future child inheriting a trait.

Question 27 (2 marks)**Outcomes Assessed:** H4, H13**Targeted Performance Bands:** 2-3

Criteria	Marks
• Identifies one safe food preparation practice AND explains how it can assist in the control of disease	2
• Identifies one safe food preparation practice	1

Sample answer

Cooking food controls the spread of infectious disease by killing bacteria that may contaminate the food before it is ingested.

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Question 28 (4 marks)**Outcomes Assessed: H6, H8, H13****Targeted Performance Bands: 3-5**

Criteria	Marks
Names an infectious disease AND identifies its cause AND describes how it is transmitted AND describes how it is treated AND tabulates the data	4
Any four of the five	3
Any three of the five	2
Any two of the five	1

Sample answer

Infectious Disease	Tetanus
Cause	Clostridium tetani bacteria
Transmission	Clostridium tetani spores are introduced directly into the body through contaminated puncture wounds, lacerations or burns
Treatment	Intravenous penicillin for 10 – 14 days

Question 29 (4 marks)**Outcomes Assessed: H3, H8, H14****Targeted Performance Bands: 4-6**

Criteria	Marks
Identifies and describes a relevant example AND describes the role of quarantine in Australia AND evaluates the effectiveness of quarantine in preventing the spread of disease in Australia	4
Correctly identifies and describes a relevant example AND describes the role of quarantine in Australia	2-3
Correctly identifies a relevant example OR describes the role of quarantine in Australia	1

Sample answer

The role of quarantine in Australia is to protect its animal, plant and human populations from disease by not allowing foreign pathogens to enter the country or travel across regions of Australia. Quarantine is a very effective method of protecting Australia's human, plant and animal populations and the fact that the Varroa mite has been kept out of Australia is a good example of this effectiveness. The Varroa mite has infected nearly all honey bee populations in the world including New Zealand because the quarantine procedures in those countries proved inadequate in preventing the entry of the Varroa mite. However, due to Australia's effective quarantine measures, the Varroa mite has been kept out of the country and Australia's honey bees have been protected from the pathogen. There could however be an accidental introduction of the Varroa mite in the future which quarantine is unable to detect.

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Question 30 (8 marks)**Outcomes Assessed:** H3, H4, H5, H6, H7, H13**Targeted Performance Bands:** 3-6

Criteria	Marks
- Analyses at least one implication for the malarial parasite AND analyses at least one implication for the immune response and assesses these implications AND analyses at least one implication for the production of an effective vaccine AND - Response is concise, logical, coherent and correct terminology used	7-8
- Describes one implication for the malarial parasite AND describes one implication for the immune response AND describes one implication for the production of an effective vaccine AND - Response is concise, logical, coherent and correct terminology used	5-6
- Identifies one implication for the malarial parasite AND identifies one implication for the immune response AND identifies one implication for the production of an effective vaccine AND - Response is poorly structured	3-4
- Identifies any one or two of the three above AND - Response not structured	1-2

Sample answer**Implications for the Parasite**

The implications of the varying proteins on the parasite's surface (antigens) are a positive adaptation for the parasite. It allows the parasite to evade the human's immune response and complete its life cycle hence perpetuating the species. This adaptation also helps the parasite to retain high numbers, increasing its chance of survival as a species and avoiding extinction.

Implications for the Immune Response

However, the adaptation of the parasite is not good for the immune system. When the parasite enters the body, its surface antigens trigger an immune response and B and T cells are specifically programmed to target cells with those specific antigens. However, if the parasite changes its antigens, then the programmed B and T cells will no longer recognise the parasite, therefore not destroying it and thus allowing it to continue infecting the host. The host will become more ill. There are also implications in case of reinfection as there is no guarantee that the memory B and T cells produced after a first infection will recognise the surface antigens on another parasite entering the body. The changing surface antigens may result in a weakened immune system because it constantly has to produce new strains of B and T cells to keep up with the changing surface antigens.

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Implications for the production of a vaccine

The implications for producing a malaria vaccine are also negative. It will be difficult to produce a vaccine that takes into account all of the different types of surface proteins. If such a vaccine was developed, there is no guarantee that the parasite will not develop a new surface protein that has yet to be discovered thus rendering the vaccine useless. Resources, including time and money, would then need to be again utilized to develop a new vaccine as the other one will eventually become useless.

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OPTION 1

Question 31 (25 marks)

31 (a) (i) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-4

Criteria	Marks
• Outlines function of iris AND outlines function of lens	2
• Outlines function of iris OR outlines function of lens	1

Sample answer

The iris controls the size of the pupil and therefore the amount of light that enters the eye.
The lens focuses light onto the retina.

31 (a) (ii) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-4

Criteria	Marks
• Identifies both types of photoreceptor cells AND distinguishes between the function of the two different types of	4
• Identifies both types of photoreceptor cells and describes the function of one type of photoreceptor cell OR identifies one type of photoreceptor cell and distinguishes between the function of the two different types	3
• Distinguishes between the function of the two different types of photoreceptor cell OR identifies and describes the function of one type of photoreceptor cell	2
• Identifies one type of photoreceptor cell OR describes the function of one type of photoreceptor cell	1

Sample answer

The two types of photoreceptors in the human eye are the rods and the cones. Cones provide sharper images, are less sensitive to light and are responsible for our colour vision in daylight. Rods are very sensitive to light and are responsible for black and white night vision.

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31 (b) (i) (3 marks)

Outcomes Assessed: H2, H11

Targeted Performance Bands: 4-6

Criteria	Marks
• Describes in detail how the process of accommodation was modelled including how the parts of the model represent the process of accommodation	3
• Describes how the process of accommodation was modelled	2
• Identifies relevant resources used to model accommodation	1

Sample answer

Accommodation is the way the lens in the eye changes shape to focus the image of an object on the retina.

A ray box, with four parallel beams and a convex lens were placed on a white piece of paper to model the process of accommodation.

1. A convex lens was placed at a distance in front of a ray box with four parallel beams on a white piece of paper.
2. The path of the four parallel beams was traced on the paper.
3. The distance from the lens to the point where all four beams crossed (the focal point) was measured and recorded.
4. The convex lens was then replaced with a thicker convex lens and the above procedure was repeated.

The different thicknesses of the convex lenses represented the changing shape of the eye lens. The ray box and four parallel beams represented light coming from an object. The point where the rays cross represents the focal point which falls on the retina.

31 (b) (ii) (2 marks)

Outcomes Assessed: H2, H11, H12

Targeted Performance Bands: 4-6

Criteria	Marks
• Identifies one strength of the model AND identifies one limitation of the model	2
• Identifies one strength of the model OR identifies one limitation of the model	1

Sample answer

The strength of the model was that it clearly showed that the thicker or rounder the lens, the more refraction of light occurs and the shorter the focal length. It also clearly demonstrated that the focal length required to focus an image with a thinner lens is a lot longer.

One limitation was that the lenses used had a fixed focal length whereas the lens in the eye is flexible and can accommodate different focal lengths.

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31 (b) (iii) (2 marks)

Outcomes Assessed: H2, H11, H12, H14

Targeted Performance Bands: 4-6

Criteria	Marks
• Explains in detail how the model helped in their understanding of the process of accommodation	2
• Describes one positive aspect of the model	1

Sample answer

It helped me to see that a rounder thicker lens has a shorter focal length than a thinner lens which has a longer focal length in comparison. The thicker lens is also better for focusing closer images and the thinner lens is better for focusing images at a greater distance.

31 (c) (7 marks)

Outcomes Assessed: H3, H4, H6, H13, H14

Targeted Performance Bands: 2-6

Criteria	Marks
• Identifies two technologies AND describes the conditions under which each technology assists hearing AND discusses the limitations of each technology AND assesses the implications of these technologies for society	7
• Identifies two technologies AND describes conditions under which technology assists hearing AND discusses the limitations of each technology OR • Identifies one technology AND describes conditions under which the technology assists hearing AND discusses the limitations of the technology AND assesses the implications of the technology on society	5-6
• Identifies one technology AND describes the condition under which it assists hearing AND discusses the limitations of the technology	3-4
• Identifies one technology OR describes the condition under which it assists hearing OR discusses the limitations of a technology	1-2

Sample answer

Hearing aids are battery operated electronic devices placed close to the external ear, either inside or outside the external ear. Hearing aids amplify sounds and are useful when there has been damage to the outer or middle ear but not to the inner ear or auditory nerve. They can also be useful when certain frequencies cannot be detected as some hearing aids are designed to amplify sound waves only in certain frequencies. Hearing aids have limitations. They will not restore normal hearing and the sound level may need to be constantly adjusted because hearing aids also amplify background noise. Hearing aids may also cause pain and discomfort to the wearer.

Cochlear implants are sophisticated electrical devices that are implanted in the skull. Cochlear implants are useful for profoundly deaf people with damage to the inner ear or auditory nerve. The

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cochlear implant allows for stimuli to bypass the damaged area of the ear and directly stimulate the auditory nerve. The limitations of this type of technology include the fact that it is expensive with potential post-operative risks of infection and/or facial nerve damage. The patient may also need to learn how to interpret the sounds they are hearing.

These types of technologies have very positive implications for those in society who have damaged their ears or who are profoundly deaf. Without hearing, there is limited speech and communication in general is difficult. These technologies give deaf or partially deaf people the opportunity to restore their hearing or make it more acute, allowing them to communicate more easily.

31 (d) (i) (1 mark)

Outcomes Assessed: H6

Targeted Performance Bands: 3-4

Criteria	Marks
Correctly identifies nerve cells	1

Sample answer

An action potential occurs in the nerve cells or neurons.

31 (d) (ii) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-5

Criteria	Marks
Explains why not all stimuli generate an action potential	2
Describes in part why not all stimuli generate an action potential	1

Sample answer

An action potential will only occur if a stimulus is of a particular magnitude that exceeds its threshold. If a stimulus is not of sufficient magnitude to exceed the threshold then an action potential will not be generated. Therefore, an action potential is not always generated because the stimulus does not always exceed the threshold.

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31 (d) (iii) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-5

Criteria	Marks
• Describes fully what happens during the generation of an action potential	2
• Describes partly what happens during the generation of an action potential	1

Sample answer

Neurons or nerve cells usually have opposite charges on either side of their cell membrane; negative inside and positive outside. A stimulus first causes sodium channels in the cell membrane to open and sodium ions, which are positive, rush in. As the sodium ions rush in, the inside of the neuron or nerve cell becomes more positive and it becomes depolarised. Eventually, potassium channels open, and when they do potassium rushes out of the cell. Potassium is also positively charged and this effectively reverses the depolarisation. Also at about this time, sodium channels start to close. This causes a repolarisation to occur and the neuron or nerve cell goes back to its initial state. The new membrane potential is called the action potential.

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OPTION 2

Question 32 (25 marks)

32 (a) (i) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-3

Criteria	Marks
• Describes one change in animal group AND in a plant group	2
• Describes one change in one group only.	1

Sample answer

Cabbages belong to the Brassica group. People began growing the first ancient "cabbage" plant as a leafy vegetable. Because leaves were the part of the plant which were consumed, those plants with the largest leaves were selectively propagated for next year's crop. This resulted in large and larger-leaved plants slowly being developed as the seed from the largest-leaved plants was favoured. This led to the development of the vegetable we now know as Kale. As time passed a preference for those plants with a tight cluster of tender young leaves in the centre of the plant at the top of the stem was expressed and this resulted in the gradual formation of a more dense cluster of leaves at the top of the plant. This produced the cabbage as we know it.

The asiatic wolf was a wild animal domesticated by humans. It is believed to be the ancestor of the great variety of domestic dogs. The domestication of the wolf over time lead to a reduction in skull size, shortening of the jaw bones, a reduction in tooth size, and a variation in coat color as seen in modern dogs.

32 (a) (ii) (1 mark)

Outcomes Assessed: H2, H8

Targeted Performance Bands: 3-4

Criteria	Marks
• Describes a strain isolation method used in 40's	1

Sample answer

The first virus isolation techniques involved straining infected material through successively smaller sieves and inoculating test animals or plants to show that the purified substance retained disease-causing activity. Cell culture techniques came about after this, where organisms were grown in pure culture after repeated streaking, which helped to isolate strains.

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32 (a) (iii) (3 marks)

Outcomes Assessed: H6, H8, H11

Targeted Performance Bands: 4-5

Criteria	Marks
• Uses examples to outline two benefits of strain isolation	3
• Uses example/s to outline one benefit of strain isolation OR	2
• Outlines two benefits without examples	
• Outlines one benefit	1

Sample answer

When the *Penicillium* mould was first isolated it gave very low yields of the antibiotic penicillin. However they were soon able to isolate a different strain that gave ten times the yield. Once a strain has been isolated it can be used for a specific purpose. Certain bacteria are able to accumulate certain minerals and can be used for remediation of degraded or polluted sites.

32 (b) (i) (3 marks)

Outcomes Assessed: H3, H6, H13

Targeted Performance Bands: 3-5

Criteria	Marks
• Describes processing of information to produce a flowchart related to recombinant DNA	3
• Describes processing of information and production of flowchart without linking them	1-2
• Describes processing of information or production of flowchart	1

Sample answer

Each of the main stages in the complex process of recombining DNA was analysed to see how they fit into the overall process. Irrelevant information was discarded. The trends or patterns in the information were noted and relationships were also identified, as were cause and effect relationships. After this the sequence of the major steps was determined and these were then used to construct the flowchart, modeling how the process works.

32 (b) (ii) (2 marks)

Outcomes Assessed: H13

Targeted Performance Bands: 4-5

Criteria	Marks
• Explains purpose of organising information into a flowchart	2
• Statement about series of steps	1

Sample answer:

Using a flowchart, complex processes are organised into the essential steps that are presented in a simple sequence. Lengthy verbal descriptions are excluded, as these often confuse the process.

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32 b) (iii) (2 marks)

Outcomes Assessed: H3, H6, H13

Targeted Performance Bands: 3-5

Criteria	Marks
Describes how processing of information to produce flowchart enhanced understanding of recombinant DNA formation	2
Describes processing of information and production of flowchart without linking them	1

Sample answer:

By constructing the flowchart, it was noted that recombinant DNA is formed when the DNA from two sources is combined. To do this, the desired gene has to be cut from its location (restriction enzymes used) and it has to be inserted into the DNA of another organism. The two DNA molecules have to be joined or welded together and ligase is used for that purpose. Now recombinant DNA has been formed. The flowchart emphasised the most important steps and their sequences.

32 (c) (7 marks)

Outcomes Assessed: H3, H4, H8, H13

Targeted Performance Bands: 2-6

Criteria	Marks
- Assesses the impacts of three applications of biotechnology on society and the environment AND - Response is concise, coherent and logical and demonstrates understanding of scientific principles and ideas	7
- Describes three applications of biotechnology on society and the environment AND - Attempts to assess the impacts of these	5-6
- Describes one or two applications of biotechnology on society and the environment AND - Describes the impact of one of these biotechnological applications	3-4
- Outlines an application of biotechnology OR - Outlines an impact of biotechnology	1-2

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Sample answer

- A high level response will describe three applications and **assess** the impact that these have had on society or the environment.
- In assessing the impact, the process itself or the product or both can be evaluated.
- The impact goes beyond the use of the product to broader outcomes for society or the environment.

The response should:

- be concise and avoid repetition
- be coherent and logical so that it is easy to read and makes sense
- use correct terminology
- use correct scientific principles

32 (d) (i) (2 marks)

Outcomes Assessed: H6, H13

Targeted Performance Bands: 3-5

Criteria	Marks
• Identifies X and Y and outlines their functions	2
• Identifies X or Y and outlines its function	1

Sample answer:

X represents a length of mRNA. This carries the code from DNA to the ribosome where the code will be translated into a sequence of amino acids in a polypeptide.

Y represents a tRNA molecule which delivers a particular amino acid to the ribosome when its anticodon and the codon in mRNA join.

32 (d) (ii) (3 marks)

Outcomes Assessed: H6, H13

Targeted Performance Bands: 3-5

Criteria	Marks
• Identifies Z AND fully describes its formation AND function in metabolism	3
• Identifies Z AND outlines its formation OR function in metabolism	2
• Identifies Z OR outlines its formation OR function in metabolism	1

Sample answer:

Z represents a growing polypeptide. This is formed as the sequence of bases in DNA, which was transcribed into the complementary sequence of bases in mRNA, is translated into a sequence of amino acids in a polypeptide. These join together by forming peptide bonds. The polypeptide then folds to form the secondary protein structure and intramolecular bonds form resulting in a specific three dimensional protein structure. This protein could be a functional protein such as an enzyme which has a particular active site. This could control metabolism.

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OPTION 3

Question 33 (25 marks)

33 (a) (i) (2 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 2-4

Criteria	Marks
• Defines polygenic inheritance AND identifies one appropriate example	2
• Defines polygenic inheritance OR identifies one appropriate example	1

Sample answer

Polygenic inheritance occurs when two or more genes at different loci control a particular characteristic of an organism. Height in humans is an example of polygenic inheritance.

33 (a) (ii) (4 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 2-4

Criteria	Marks
• Distinguishes between mutations of chromosomes and mutations of genes AND identifies one appropriate example of each type of mutation	4
• Distinguishes between mutations of chromosomes and mutations of genes AND identifies one appropriate example of each type OR • Defines mutations of genes or mutations of chromosomes AND provides an appropriate example of each type of mutation	3
• Defines mutations of genes or mutations of chromosomes AND gives an appropriate example of one type of mutation	2
• Defines either mutation of chromosomes or mutations of genes OR provides an appropriate example of one type of mutation	1

Sample answer

A chromosome mutation is a mutation that involves a change in the structure or number of chromosomes and can result in many genes being affected. An example of a type of chromosome mutation is trisomy 21 or Down Syndrome in humans where there are three of number 21 chromosome instead of two. Unlike a chromosome mutation, a gene mutation involves the change of a single gene only. An example of a gene mutation is sickle cell anaemia. Sickle cell anaemia is a gene mutation which has resulted from a base substitution.

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33 (b) (i) (3 marks)

Outcomes Assessed: H2, H6, H9, H11

Targeted Performance Bands: 4-6

Criteria	Marks
• Describes in detail how the model of DNA was constructed including how the parts of the model represented the parts of the DNA molecule	3
• Describes how the model of a DNA molecule was constructed	2
• Identifies relevant resources used to construct a model of a DNA molecule	1

Sample answer

Three different coloured cardboard pieces and sticky tape were used to produce a model of a DNA molecule.

1. One particular colour of cardboard was chosen to represent the bases in the model. What distinguished the bases were their shape. The shape of the complementary bases were such that they fit together like pieces of a jigsaw puzzle.
2. A different coloured cardboard to that of the bases was used to represent the sugar molecules. They were cut into a pentagon shape to represent the shape of a sugar molecule.
3. A third coloured cardboard was used to represent the phosphates. They were cut in the shape of small circles.
4. The bases, phosphates and sugars were stuck together to form nucleotides.
5. Nucleotides were then selected at random and stuck together to form a single strand of DNA.
6. A second complementary strand of DNA was constructed and stuck along side the first.
7. The entire shape was then stuck on cardboard.

The different coloured cardboards represented the different components within a DNA molecule. The specific matching shapes of the bases represented their complimentary nature.

33 (b) (ii) (2 marks)

Outcomes Assessed: H2, H11, H12

Targeted Performance Bands: 4-6

Criteria	Marks
• Identifies one strength of the model AND identifies one limitation of the model	2
• Identifies one strength of the model OR identifies one limitation of the model	1

Sample answer

The strength of the model was that it clearly showed the different components of the DNA molecule, its double stranded nature and the pairing of the complimentary bases.

One limitation of the model was that when displayed, it was difficult to see the different sequence of bases along the DNA strand because all the bases were the same colour. It was also difficult to twist the model into a double helix.

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33 (b) (iii) (2 marks)

Outcomes Assessed: H2, H6, H9, H11, H12, H13

Targeted Performance Bands: 4-6

Criteria	Marks
• Explains in detail how the model helped in their understanding of the nature of DNA	2
• Describes one positive aspect of the model	1

Sample answer

The model helped in the understanding of the nature of DNA by showing firstly that it is made of three components – bases, sugar and phosphates. By constructing the model the way we did, it reinforced the understanding that the DNA molecule is double stranded and that the two strands are complementary – this was shown by matching the shapes of the bases.

33 (c) (7 marks)

Outcomes Assessed: H3, H4, H6, H9, H13

Targeted Performance Bands: 2-6

Criteria	Marks
• Describes the technologies used in gene therapy including identification of the location of a gene, recombinant DNA technology and use of vectors or other technologies AND describes the term gene therapy AND clearly explains how a current use of gene therapy is used to manage an identified disease AND analyses and assesses the implications of these applications of technology for society	7
• Describes two of the three technologies used in gene therapy AND describes the term gene therapy AND clearly explains how a current use of gene therapy is used to manage an identified disease AND assesses the implications of these applications of technology for society	5-6
• Describes the term gene therapy AND explains how a current use of gene therapy is used to manage an identified disease	3-4
• Identifies an example of gene therapy OR describes the term gene therapy OR describes a current use of gene therapy	1-2

Sample answer

The Human Genome project was one which attempted to identify the position of all genes on the human genome. It was hoped that by mapping the genome, it could help scientists understand more about human development and find ways to treat diseases.

Recombinant DNA technology was used to achieve the purpose of the project. Recombinant DNA has many uses in genetic research and one of the most important is to produce probes for identifying the position of genes. A probe is a specific sequence of DNA which is complementary to a gene or part of a gene. It is prepared by working backward from a specific polypeptide. Once the polypeptide has been extracted, its amino acid sequence is determined and from there, the base

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sequence of the polypeptide is determined. A complimentary probe is then prepared and recombinant DNA technology is used to clone many copies of it before it is tagged with a fluorescent dye. When these probes are added to a preparation of chromosomes which have been treated to separate the strands, they bond with their complementary base pair sequence. If a fluorescent light is then turned on, the tag glows brightly so its position can be easily identified.

One of the greatest achievements of the Human Genome Project has been the location of genes responsible for genetic abnormalities. Gene therapy involves replacing faulty genes with healthy ones.

One application of gene therapy has been with the treatment of cystic fibrosis. People with cystic fibrosis have a gene that produces a faulty protein that results in an abnormal movement of salt in and out of the body's cells. This results in a sticky mucus forming around some body organs. This mucus causes some organs – particularly the lungs - to function abnormally. Gene therapy is being used in an attempt to insert the healthy gene into the lung cells. Recombinant DNA technology is used to clone large numbers of the healthy gene. The gene is then placed in an adenovirus which is used as a vector to carry the gene into the lung tissue. Adenoviruses naturally infect respiratory tissue. The viruses are dripped into the lungs down a flexible tube. The virus infects the lung tissue inserting the healthy gene into it. The new gene is then expressed in the form of the normal protein

Although this process has not been perfected, the implications of this technology for society are very positive. Although germ line therapy has not yet been approved, this technology has the potential to permanently remove faulty genes from the human genome allowing more people to live longer, healthier lives. Somatic line gene therapy, although not as permanent as germ line gene therapy, allows the symptoms of some serious conditions to be relieved and thus allowing patients to feel healthier for longer. The implications for society are longer and healthier lives.

33 (d) (i) (1 mark)

Outcomes Assessed: H1, H2, H9, H14

Targeted Performance Bands: 3-5

Criteria	Marks
Correctly identifies the genotype of the parent	1

Sample answer

The genotype of the parent is GgRr.

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33 (d) (ii) (3 marks)

Outcomes Assessed: H1, H2, H9, H14

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly identifies that the genes for stem colour and fruit colour are linked AND justifies response with clear explanation and working	3
• Correctly identifies that the genes for stem colour and fruit colour are linked AND explains answer	2
• Correctly identifies that the genes for stem colour and fruit colour are linked	1

Sample answer

The genes for stem colour and fruit colour are linked. According to Mendel's ratio for dihybrid crosses, if genes are linked, then, if two heterozygous parents for each trait are crossed, their offspring will show either dominant traits or recessive traits only in the ratio 3:1.

	GR	gr
GR	GGRR	GgRr
gr	GgRr	ggrr

The expected ratio of purple stemmed, red fruit plants to green stemmed, yellow fruit plants is 3 to 1. In the results table, the ratio of purple stemmed, red fruit plants: green stemmed, yellow fruit plants is approximately 3:1 thus it can be assumed that the genes are linked.

If the genes were not linked, there would be a significant number of plants produced that would show a mixture of one dominant and one recessive trait. In fact, the dihybrid ratio of dominant:mixed:mixed:recessive would be 9:3:3:1 in the F₂ generations. This did not appear to be the case so it can be assumed that the genes were linked.

33 (d) (iii) (1 mark)

Outcomes Assessed: H1, H2, H9, H14

Targeted Performance Bands: 3-5

Criteria	Marks
• Describes one reason for the appearance of the purple stemmed, yellow fruit plants and the green stemmed, red fruit plants in the offspring	1

Sample answer

The appearance of the purple stemmed, yellow fruit plants and the green stemmed, red fruit plants can be attributed to the crossing over of these linked genes during meiosis.

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OPTION 4

Question 34 (25 marks)

34 (a) (i) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-4

Criteria	Marks
• Outlines two features that classify humans as primates	2
• Outlines one feature that classifies humans as primates	1

Sample answer

Humans are classified as primates because they have pentadactyl limbs with an opposable thumb and they have forward-facing eyes which gives a field of view that overlaps allowing them to have stereoscopic or binocular vision.

34 (a) (ii) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-4

Criteria	Marks
• Distinguishes between polymorphism and clinal gradation AND identifies one appropriate example for each from human phenotypes	4
• Distinguishes between polymorphism and clinal gradation AND identifies only one appropriate example OR • Defines either polymorphism OR clinal gradation AND identifies an appropriate example for each from human phenotypes	3
• Distinguishes between polymorphism and clinal gradation OR identifies an appropriate example of each from human phenotypes	2
• Defines either polymorphism or clinal gradation OR identifies one appropriate example from human phenotypes	1

Sample answer

Polymorphism refers to two or more different forms of the same species. In humans, this gives rise to the different features associated with different races. An example of human polymorphism is skin colour.

Clinal gradation is a gradual change in gene frequency in a population and comes about when two previously isolated populations come into contact with one another and interbreed. A human example of clinal gradation is the gradual increase in the frequency of blonde haired blue-eyed people as you move from the south of Europe, where the population is predominantly dark haired and dark eyed, to the north of Europe, where there are more blonde haired, blue eyed people.

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34 (b) (i) (3 marks)

Outcomes Assessed: H2, H9, H11, H13

Targeted Performance Bands: 4-6

Criteria	Marks
• Describes in detail how DNA-DNA hybridisation was modelled including how the aspects of the model reflected the process	3
• Describes how DNA-DNA hybridisation was modelled	2
• Identifies relevant resources used model DNA-DNA hybridisation	1

Sample answer

1. Students were given four pieces of blue cardboard. Each piece of cardboard had a different DNA base sequence printed on it. The length of the DNA strand varied also. In total, on the four pieces of cardboard there were 100 base pairs. This represented human DNA. The different lengths represented the different fragments to be analysed.
2. The students then collected four pieces of the green cardboard. The green cardboard pieces also had DNA sequences printed on them and the lengths were the same as those on the blue cardboard. This represented chimpanzee DNA.
4. The complimentary DNA strands on the blue cardboard strands were separated by cutting them in half. The same was done with the chimpanzee DNA strands.
5. The human DNA strand and the chimpanzee DNA strands were then aligned and their base sequence compared. The number of base pairs that didn't match was recorded. Since there were 100 bases to begin with, each difference represented one percentage point.
6. The total number of differences was tabulated.
7. Steps 2 – 7 were repeated. This time however, an orange cardboard sheet with a DNA sequence printed on it was used to represent the DNA of a gibbon and purple cardboard with a DNA sequence printed on it was used to represent DNA of a Rhesus monkey.
8. The differences between all primates were then compared by graphing the results.

34 (b) (ii) (2 marks)

Outcomes Assessed: H2, H11, H12, H13

Targeted Performance Bands: 4-6

Criteria	Marks
• Identifies one strength of the model AND identifies one limitation of the model	2
• Identifies one strength of the model OR identifies one limitation of the model	1

Sample answer

The strength of the model was that it clearly showed how the DNA sequences of the primates can be compared and the percentage differences determined.

The limitation of the model was that the actual process of determining the similarities in the DNA sequence of the two strands relies on how well they hybridise and the strength of that bond. The strength is determined by measuring the temperature at which the new hybrid unzips into single

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strands again - the higher the degree of base pairing, the higher the temperature needed to unzip the strands. Instead, we had to model this process by counting the number of complementary base pairs in the sequences.

34 (b) (iii) (2 marks)

Outcomes Assessed: H2, H3, H9, H11, H12, H13

Targeted Performance Bands: 4-6

Criteria	Marks
Explains in detail how the model helped in their understanding the process of DNA-DNA hybridisation and its use in determining relationships between groups of primates	2
Describes one positive aspect of the model	1

Sample answer

The model helped in understanding of the process of DNA-DNA hybridization by allowing me to manipulate so called fragments of DNA, separating them into single strands then comparing the base sequence with other strands of primates of the same length. The process required great concentration and answers had to be checked. Once the values were determined, it was quite clear that certain primates have fewer variations to human DNA than to others and when they were compared with each other, it was clear that some primates are more related to each other than to others. The process helped to simplify the procedure and made it easier to understand.

34 (c) (7 marks)

Outcomes Assessed: H3, H4, H10, H13

Targeted Performance Bands: 2-6

Criteria	Marks
Identifies three modern technologies that could have effects on human evolution AND describe these effects AND assess the implications of these technologies on future human populations	7
Identifies two modern technologies that could have effects on human evolution AND describe these effects AND assess the implications of these technologies on future human populations	5-6
Identifies two or three modern technologies that could have effects on human evolution AND describe these effects	3-4
Identifies modern technologies OR describes some effects on human evolution	1-2

Sample answer

Modern technologies have allowed humans to travel quickly and easily all over the world. Populations and races are no longer isolated and therefore there are no physical barriers to prevent populations interbreeding. Future populations may show a reduction in racial differences, as there is increased interbreeding and no physical isolation between the different populations of humans. The human population therefore may become, over a very long period of time, more homogenous –

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overall reducing genetic diversity and perhaps making humans more susceptible to changes in the environment.

Modern technologies include medical applications such as vaccination, antiseptics, antibiotics, contraceptives and in vitro fertilization. These technologies have resulted in both a reduction in death rate and an increase in life span with people living longer thus increasing the human population dramatically. This increase in population can put great pressure on current resources and food shortages may follow. However, individuals who would have normally died through disease before reaching puberty now live full lives and reproduce, potentially passing on genes that would have been naturally selected against, rendering them deleterious and potentially harmful. In evolutionary terms, the 'fittest' are no longer the only individuals to pass on their genes. As these deleterious genes remain in the gene pool, this may have negative implications for the human species making them 'weaker' in evolutionary terms as a species and therefore more susceptible to changes in the environment, ultimately reducing the human population. Also, although we may be a healthier species that lives longer, the process of treating diseases this way is causing the rapid evolution of 'superbugs' which have the potential to destroy large numbers of the human population if they are not controlled.

A final technology is that of genetic engineering which changes the genetic makeup of individuals through selective breeding, cloning and creating transgenic species. Selective breeding, cloning and the creation of transgenic species help to increase the human population and make them healthier by providing greater access to food supplies and directly manipulating the human genome to control disease. It has the potential to quickly rid harmful genes from the human population quickly, speeding up the process of evolution. Although human populations will benefit from increased food sources, cloning and selective breeding reduces genetic diversity in the natural foods we eat increasing the chance of a reduction in world food supplies if disease should break out.

34 (d) (i) (1 mark)

Outcomes Assessed: H2, H10

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly identifies model B as representing the 'Out of Africa' model	1

Sample answer

Model B represents the 'Out of Africa' model.

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34 (d) (ii) (4 marks)

Outcomes Assessed: H2, H10

Targeted Performance Bands: 3-5

Criteria	Marks
• Describes AND evaluates at least one piece of evidence for each of the two different models of evolution	4
• Describes at least one piece of evidence for each of the two different models of evolution AND evaluates one piece of evidence only	3
• Identifies one piece of evidence for both models of evolution	2
• Identifies one piece of evidence for one model only	1

Sample answer

The 'Out of Africa' theory is supported by genetic evidence, supplied by the analysis of mitochondrial DNA (mtDNA). Examination of mtDNA was used to map the lineages of different groups of people across the world. Using the model of the molecular clock, which is measured in the rate of mutations, it was found that people with an African origin had the most genetic diversity and were therefore the oldest population. The mitochondrial evidence is a very strong piece of evidence that supports the 'Out of Africa' theory.

Analysis of the Y chromosome of men from various geographic regions, gives strong support to the theory of regional continuity. The Y chromosome maintains its genetic diversity as there is no crossing over during meiosis. Any recorded differences therefore must be due to mutations. Therefore, the Y chromosome can be used for tracing ancestry. If the theory of regional continuity is to be supported, then the divergence of different races would have taken place less than 100 000 years ago. When the Y chromosome of males from different geographic regions were analysed and compared, researchers found that the different races did in fact diverge less than 100 000 years ago, providing very strong support for the theory of regional continuity.

The evidence that supports the theory of regional continuity is stronger than the evidence that supports the 'Out of Africa' theory due to the huge amount of Y chromosomes available for analysis compared to the relatively small amount of mtDNA.

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OPTION 5

Question 35 (25 marks)

35 (a) (i) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 2-3

Criteria	Marks
• Identifies two products of photosynthesis	2
• Identifies one product of photosynthesis	1

Sample answer

Glucose and oxygen are two products of photosynthesis.

35 (a) (ii) (4 marks)

Outcomes Assessed: H2, H6

Targeted Performance Bands: 4-5

Criteria	Marks
• Distinguishes two differences between the functions of PS I and PS II	4
• Distinguishes one difference between the functions of PS I and PS II	2-3
• Outlines a function of PSI or PSII	1

Sample answer

When PS II absorbs light, non-cyclic photophosphorylation results in the production of ATP as electrons pass to PS I. NADPH is also formed as electrons do not pass back to PS II and water is split to provide the electrons to fill the electron gap. This provides the hydrogen ions for the reduction of NADP to NADPH.

When PS I only is involved, electrons flow in cyclic fashion back to the chlorophyll molecule which was oxidised. This process results in the production of ATP only.

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35 (b) (i) (3 marks)

Outcomes Assessed: H1, H2, H6, H11, H12, H13

Targeted Performance Bands: 4-6

Criteria	Marks
• Describes investigation performed and observations tested for named scientist	3
• Describes investigation performed for work of named scientist	2
• Describes observations tested for named scientist	1

Sample answer:

A seedling was planted in a pot containing dry soil. The mass of the seedling was recorded prior to planting as was the mass of the soil. The seedling was watered regularly and the mass of the soil and the plant were recorded after a month. This was repeated several times for reliability. This was to show that the plant mass increased from the water it had been given.

35 (b) (ii) (2 marks)

Outcomes Assessed: H2, H11

Targeted Performance Bands: 4-6

Criteria	Marks
• Identifies one strength and one limitation of investigation	2
• Identifies one strength or one limitation of investigation	1

One strength of my investigation was that it was repeated for reliability.

One limitation of my investigation was that there was limited time for growth to occur.

35 (b) (iii) (2 marks)

Outcomes Assessed: H2, H11

Targeted Performance Bands: 4-5

Criteria	Marks
• Explains importance of scientists findings to understanding plant growth	2
• Outlines investigation performed by named scientist	1

Sample answer:

Van Helmont wanted to investigate how plants grow since they do not eat. He planted a willow shoot that weighed 2 kg in a known mass of dry soil in a pot. He covered the soil so dust would not add to its mass. He watered the plant with rain water. At the end of five years the plant weighed 76 kilograms but the soil loss was less than 100 g. He concluded that the tree had gained 74 kg from the water alone.

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35 (c) (7 marks)

Outcomes Assessed: H3, H4, H6, H9, H10, H14

Targeted Performance Bands: 2-6

Criteria	Marks
• Describes two technologies that have assisted tracing pathways and assesses two implications of continued research	7-6
• Describes one technology that has assisted tracing pathways and assesses two implications of continued research (or two technologies and one implication)	4-5
• Describes one technology that has assisted tracing pathways and assesses one implication of continued research	2-3
• Outlines one technology that has assisted tracing pathways or outlines one implication of continued research	1

Sample answer:

- *Homogenisation* of tissue permitted the break up of tissue and cells. This was followed by *centrifugation* techniques resulting in cell *fractionation* which allowed for isolation of organelles such as chloroplasts, so that their functions could be studied.
- Chromatography allowed for separation of leaf pigments, in particular the chlorophyll molecules used in photosynthesis. This meant that the absorption spectrum for these pigments could be studied.
- The use of different radioisotopes meant that the pathway of oxygen or carbon could be studied. For example, to determine if the oxygen that is evolved in photosynthesis comes from the water or the carbon dioxide, the oxygen atoms in water or carbon dioxide were labeled and supplied to plants one at a time. The product was examined to see if it was radioactive. In this way it was found that the oxygen comes from water and not from carbon dioxide.

Photosynthesis is a very important series of reactions in ecosystems because not only do autotrophic plants produce food for all heterotrophic organisms, but it also removes carbon dioxide from the atmosphere by removing a green house gas. Photosynthesis helps to reduce global warming.

Furthermore photosynthesis replenishes oxygen in the atmosphere and hydrosphere so that all aerobic organisms can respire at maximum efficiency. All of this is possible because of the carbon and oxygen cycles.

As populations grow and more food is required it will be important to know how to maximize photosynthesis and by manipulating various requirements, the process can be made most efficient.

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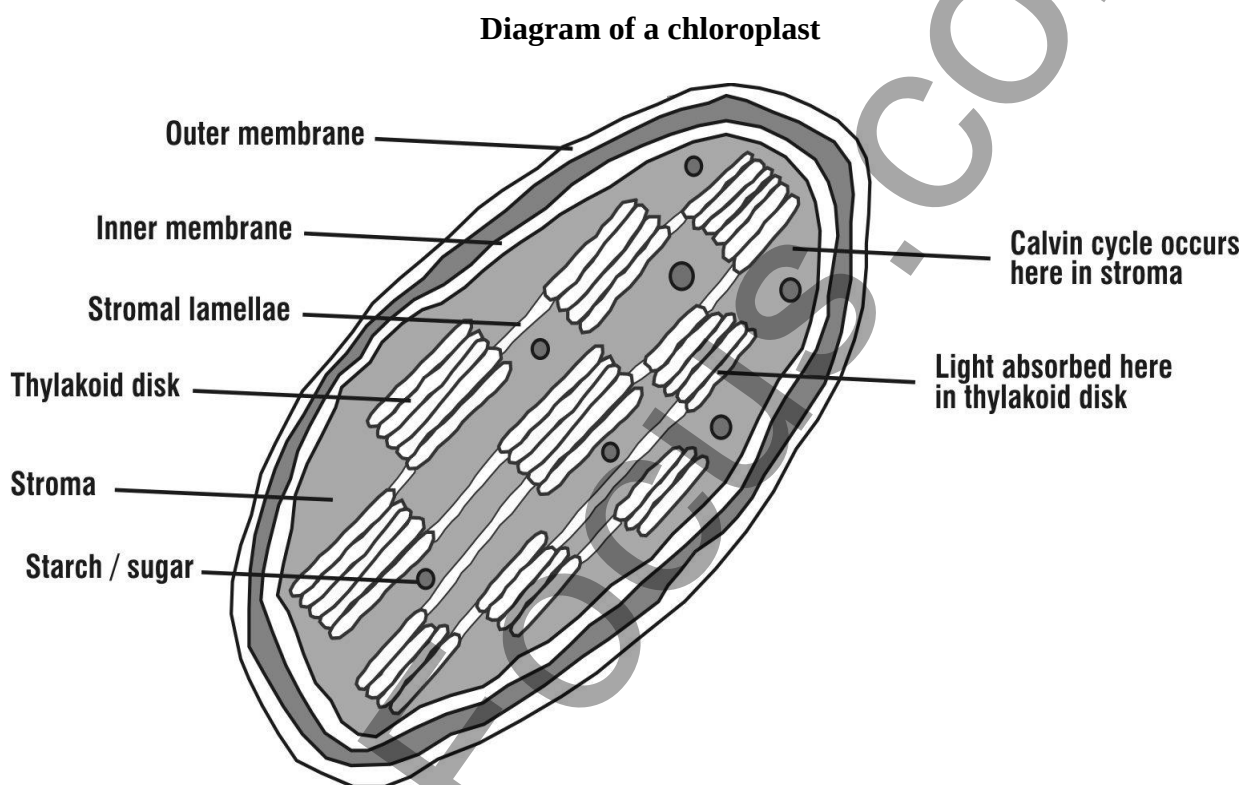
35 (d) (i) (3 marks)

Outcomes Assessed: H6, H13

Targeted Performance Bands: 3-4

Criteria	Marks
• Draws chloroplast and labels sites of light absorption AND Calvin cycle	3
• Draws chloroplast and labels sites of light absorption OR Calvin cycle	2
• Draws chloroplast and labels parts OR states where processes occur (no diagram)	1

Sample answer:



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35 (d) (ii) (2 marks)

Outcomes Assessed: H6, H13

Targeted Performance Bands: 4-5

Criteria	Marks
• Explains why light absorption and Calvin cycle occur in disks and stroma	2
• Explains why light absorption occurs in disks OR why Calvin cycle occurs in stroma OR	1
• Outlines why both processes occur where they do	

Sample answer:

The Calvin cycle, which involves carbon fixation and the conversion of carbon dioxide to carbohydrate, occurs in the stroma of the chloroplast because this is where the enzymes for this cycle are located, especially the enzyme that attaches carbon dioxide to RDP. This enzyme makes up 25% of the protein in the chloroplasts.

Light absorption occurs in the thylakoid membranes that are found in the grana within the chloroplast. This is where all the molecules required for the operation of PSI and PSII are located. The chlorophyll molecules are only soluble in the lipid component of the membranes and this is where they are located. The electron transport chain molecules are also located in the membranes. Hydrogen ions accumulate in the internal compartment of thylakoid membranes to form the H^+ reservoir.

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