QATs
Quality Assessment Tasks

2009 Trial HSC Examination Mapping Grid
Biology

Exam Section	Question	Marks	Syllabus/Course Outcomes	Content	Targeted Performance Bands	Answer
Part A – Multiple Choice	1	1	H6	9.2.2.2.1	2-3	A
	2	1	H6	9.2.2.2.6	2-3	B
	3	1	H6	9.2.3.2.7	3-5	A
	4	1	H9	9.3.3.2.4	5-6	D
	5	1	H6,H12	9.2.1.3.1; 12.3c	4-6	C
	6	1	H6,H14	9.2.1.3.2; 14.1a,f	4-6	B
	7	1	H6	9.3.2.2.5	2-3	C
	8	1	H10	9.3.1.2.2	3-4	C
	9	1	H9	9.3.3.2.6	4-5	D
	10	1	H6	9.4.3.2.2	2-3	D
	11	1	H3	9.2.5.2.1	3-4	A
	12	1	H6	9.4.3.3.2	3-4	B
	13	1	H6	9.4.4.2.4	3-4	A
	14	1	H3	9.4.5.2.3	3-4	A
	15	1	H6,H12	9.4.6.3.1; 12.3c	3-4	C
Part B- Free response	16	4	H6	9.2.3.2.8 9.2.3.3.6	3-6	
	17	4	H6	9.2.3.2.5 & 2.6	3-6	
	18	3	H10	9.3.4.2.6 & 2.7	4-6	
	19	3	H10,H12	9.3.1.2.3 9.3.1.3.5; 12.3c	4-5	
	20	3	H9,H12	9.2.3.2.3; 12.3c	3-4	
	21	8	H6,H13,H14	9.2.1.2.8 9.2.1.3.3; 13.1f,g 14.1a,b	2-5	
	22	4	H6	9.4.4.2.1 9.4.5.2.1 & 2.2	2-5	
	23	4	H9,H12,H13	9.3.2.2.3 & 2.4 9.3.2.3.1 & 3.2 12.3c; 13.1d	2-6	
	24	3	H4,H6	9.4.5.2.2	2-4	
	25	5	H2,H3,H9,H10	9.4.6.2.2 9.3.4.2.6&7	3-6	
	26	4	H1,H4	9.4.7.3.3	3-6	
	27	3	H3,H4,H6	9.2.2.3.4	2-5	
	28	4	H4, H8	9.4.2.3.2	2-5	
	29	8	H1,H4,H9,H10	9.3.2.2.1 9.3.3.2.1 & 2.7 9.3.4.3.5	3-6	

Exam Section	Question	Marks	Syllabus/Course outcomes	Content	Targeted performance band
Part II Option 1 9.5	30a	3	H6, H13	9.5.1.2.1 & 2	2-4
	30b	5	H6,H12,H14	9.5.3.3.1 12.1a; 14.3c	2-5
	30c	4	H6	9.5.4.2.1-4	3-6
	30d	6	H6	9.5.7.2,2 & 5	3-6
	30e	7	H1,H3,H4	9.5.3.3.3 9.5.6.3.3	2-6
Part II Option 2 9.6	31a	3	H6	9.6.6.2.4 9.6.6.3.1	2-5
	31b	5	H6,H12,H14	9.6.4.3.1 12.1a; 14.3c	2-5
	31c	4	H6,H16	9.6.7.2.2 9.6.7.3.1	3-6
	31d	6	H6,H9	9.6.3.2.1,3,4 9.6.3.3.2	3-6
	31e	7	H1,H3,H4,H6	9.6.3.3.2	2-6
Part II Option 3 9.7	32a	3	H9	9.7.2.2.1	2-5
	32b	5	H6,H12,H14	9.7.3.3.2 12.1a; 14.3c	2-5
	32c	4	H9	9.7.4.2.1 9.7.4.3.2	3-6
	32d	6	H4,H9	9.7.6.2.1 9.7.6.3.1	3-6
	32e	7	H3,H4,H10	9.7.7.2.3-4	2-6
Part II Option 4 9.8	33a	3	H7,H10	9.8.1.2.1 & 2	2-5
	33b	5	H10,H12,H14	9.8.2.3.1 12.3a-d,14.3c	2-5
	33c	4	H9,H10	9.8.2.2.6	3-6
	33d	6	H1,H3,H9,H10	9.8.5.2.1-2 9.8.6.2.1	3-6
	33e	7	H1,H3,H4,H10	9.8.3.2.1 9.8.3.3.3	2-6
Part II Option 5 9.9	34a	3	H6	9.9.2.2.1-2	2-5
	34b	5	H6,H12,H14	9.9.3.3.1 12.1a; 14.3c	2-5
	34c	4	H6	9.9.4.2.6	3-6
	34d	6	H1,H6	9.9.6.2.2-3	3-6
	34e	7	H1,H3,H4,H6	9.9.1.2.1 9.9.1.3.2	2-6

QATs
Quality Assessment Tasks

2009 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	A	H6	2-3
2	B	H6	2-3
3	A	H6	3-4
4	D	H9	4-5
5	C	H6,H12	4-6
6	B	H6,H14	4-6
7	C	H6	2-3
8	C	H10	3-4
9	D	H9	3-4
10	D	H6	2-3
11	A	H3	3-4
12	B	H6	3-4
13	A	H6	3-4
14	A	H3	2-3
15	C	H6,H12	3-4

Section I
75 marks

Part B – 60 marks
Question 16 (4 marks)
16 (a) (2 marks)
Outcomes Assessed: H6
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly describes a process used by plants for salt regulation • Correctly uses a named example	2
• Correctly describes a process used by plants for salt regulation – no example/wrong example OR • Incorrect description but correct example	1

Sample answer
Saltbush has special salt secretion glands in its leaves that enable it to accumulate salt to very high concentrations.

16 (b) (2 marks)
Outcomes Assessed: H6
Targeted Performance Bands: 4-6

Criteria	Marks
• Understands the meaning of enantiostasis • Correctly explains why process in (a) is an example of enantiostasis	2
• Understands the process of enantiostasis • Example incorrectly explained	1

Sample answer
Enantiostasis is the maintenance of metabolic and physiological functions in response to variations in the environment. The saltbush is able to respond to variations in salt levels through physiological processes to remove excess salt to storage organs in the leaves.

Question 17 (4 marks)
Outcomes Assessed: H6
Targeted Performance Bands: 3-5

Criteria	Marks
• Shows an understanding of passive transport and shows an understanding of filtration and • Relates the above two correctly to the mammalian kidney nephron	4
• Any THREE of the above	3
• Any TWO of the above	2
• Any ONE of the above	1

Sample answer
Passive transport is a means by which substances move from a region of high to a region of low concentrate, without the expenditure of energy by the organism or cell. Blood reaches the glomerulus of the kidney nephron under pressure and the smaller water soluble components of the blood are forced into the Bowman's capsule passively.

Question 18 (3 marks)
Outcomes Assessed: H10
Targeted Performance Bands: 4-6

Criteria	Marks
• Shows an understanding of punctuated equilibrium • Shows how punctuated equilibrium differs from gradualism • Makes an evaluation	3
• Shows an understanding of punctuated equilibrium • Shows how punctuated equilibrium differs from gradualism • No evaluation made OR • Shows an understanding of punctuated equilibrium OR shows how punctuated equilibrium differs from gradualism • Attempts to make an evaluation	2
• Shows an understanding of punctuated equilibrium OR shows how punctuated equilibrium differs from gradualism • No evaluation made	1

Sample answer
Darwin put forward the idea of evolution through natural selection and suggested natural selection operated gradually over long periods of time (gradualism). However, the work of evolutionists later cast doubt on Darwin's idea of gradualism, and suggested that evolution was punctuated by short periods of intense change followed by long periods of little change (punctuated equilibrium). This, therefore, has given scientists two ways in which natural selection can work.

Question 19 (3 marks)
Outcomes Assessed: H10, H12
Targeted Performance Bands: 4-5

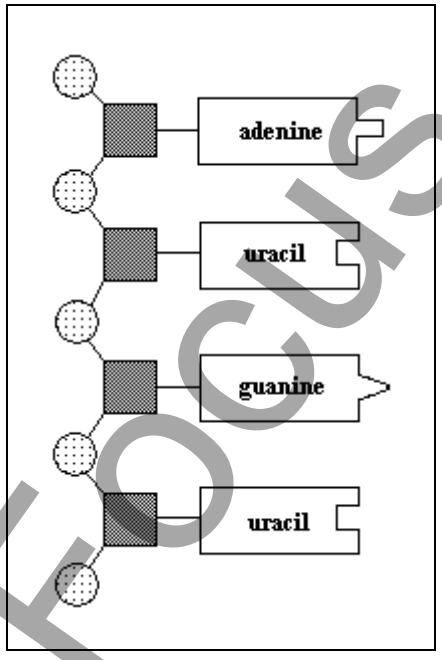
Criteria	Marks
• Shows an understanding of Darwin's theory of evolution by natural selection • Uses the theory to correctly explain the idea of convergent evolution • Refers to both animals in the explanation	3
• Shows an understanding of Darwin's theory of evolution by natural selection • Incorrectly attempts to explain the idea of convergent evolution • May or may not refer to both animals in the answer	2
• Attempts to show an understanding of Darwin's evolutionary theory, but it is incorrect or vague • Some attempt made to relate the stated theoretical ideas to convergent evolution • May or may not refer to both animals in the answer	1

Sample answer
Both animals, although belonging to different mammalian groups, evolved along similar lines in different habitats because they have been subjected to similar selection pressures; the Echidna in Australian and New Guinea and the hedgehog in Europe, Africa and Asia.

Question 20 (3 marks)
Outcomes Assessed: H9, H12
Targeted Performance Bands: 3-4

Criteria	Marks
• Correctly draws the section of m-RNA formed from the right-hand section • Shows bases correctly	3
• Correctly draws the section of m-RNA formed from the right-hand section • Bases shown incorrectly	2
• m-RNA section may be drawn incorrectly • Bases shown correctly	1

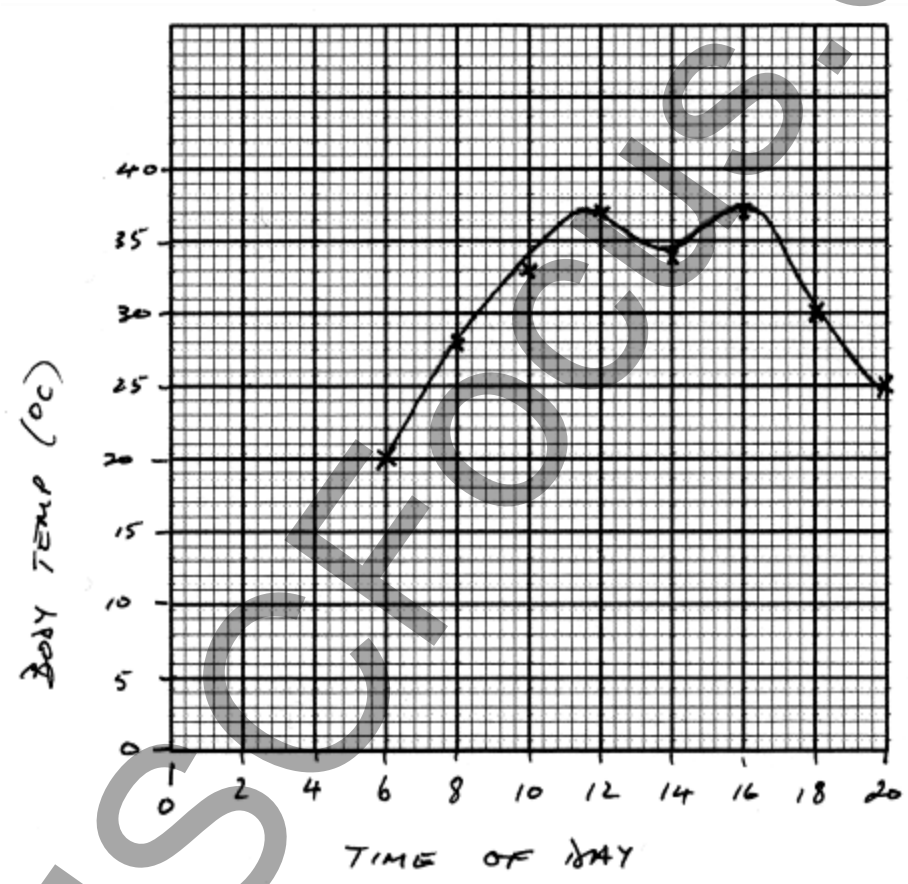
Sample answer



Question 21 (8 marks)
21 (a) 4 marks
Outcomes Assessed: H6, H13, H14
Targeted Performance Bands: 2-5

Criteria	Marks
• Axes correctly titled • Axes scales correct (appropriate use of scale,uniform scales/correct units) • Points plotted correctly • Line of best fit correctly drawn **to fit points plotted**	4
• THREE of the above correct	3
• TWO of the above correct	2
• ONE of the above correct	1

Sample answer



Question 21 (continued)

21 (b) (1 mark)

Outcomes Assessed: H6, H13, H14

Targeted Performance Bands: 2-3

Criteria	Mark
• Correctly names an Australian ectothermic organism	1

Sample answer

The central netted dragon.

21 (c) (1 mark)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 2-4

Criteria	Mark
• Correct suggestion made	1

Sample answer

The organism burrowed underground.

21 (d) (2 marks)

Outcomes Assessed: H6, H13, H14

Targeted Performance Bands: 2-4

Criteria	Marks
• Fully explains how the response named in (c) operates • Indicates effect on the temperature of the chosen organism	2
• One of the above	1

Sample answer

A burrow under the ground can be much cooler than the air above so the ectotherm in the burrow would also have a lower temperature than the air above.

Question 22 (4 marks)

22 (a) (1 mark)

Outcomes Assessed: H6

Targeted Performance Bands: 2-4

Criteria	Mark
• Correctly identifies a defence barrier to pathogens	1

Sample answer

The skin.

Question 22 (continued)
22 (b) (3 marks)
Outcomes Assessed: H6
Targeted Performance Bands: 4-5

Criteria	Marks
• Shows an understanding of the immune response mediated by B-lymphocytes and the defence barrier named in (a) • Correctly distinguishes between the two	3
• Shows an understanding of EITHER the immune response mediated by B-lymphocytes OR the defence barrier named in (a) • An attempt to distinguish between the two is made	2
• Shows an understanding of EITHER the immune response mediated by B-lymphocytes OR the defence barrier named in (a) • No attempt at distinction made	1

Sample answer
Unlike the skin which is continually acting as a non-specific barrier, specific B cells are activated when a specific antigen is present, clone themselves and either become antibody producing plasma cells or memory B cells.

Question 23 (4 marks)
23 (a) (1 mark)
Outcomes Assessed: H9, H13
Targeted Performance Bands: 4-6

Criteria	Mark
• Correctly identifies the pattern of inheritance	1

Sample answer
Attached ear lobes are recessive.

Question 23 (continued)
23 (b) (3 marks)
Outcomes Assessed: H9, H12, H13
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly draws a Punnett square • Chooses suitable genotype symbols for the Punnett square • Correctly completes the Punnett square	3
• Any TWO of the above	2
• Any ONE of the above	1

Sample answer

Father

Mother		F	f
	F	FF	Ff
	f	Ff	ff ← Individual X

This shows how the recessive phenotype (attached ear lobes – ff) could appear in the offspring from free ear lobed parents.

Question 24 (3 marks)
Outcomes Assessed: H4, H6
Targeted Performance Bands: 2-4

Criteria	Marks
• Correctly identifies the patients response to - own - and foreign cells • Correctly explains the advantage of this procedure	3
• TWO of the above	2
• ONE of the above	1

Sample answer
The use of cells from the patient's own body means that no immune response would occur and the use of immunosuppressant drugs would not be required. Using cells from a donor would initiate an immune response in the transplant patient and in order to prevent organ rejection immunosuppressant drugs would be required.

Question 25 (5 marks)

25 (a) (2 marks)

Outcomes Assessed: H9, H10

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly identifies a nutritional deficiency disease • Correctly outlines how the identified nutritional deficiency disease differs from Down Syndrome	2
• Correctly identifies a nutritional deficiency disease • Incorrectly outlines how the identified nutritional deficiency disease differs from Down Syndrome OR • Incorrectly identifies a nutritional deficiency disease • Correctly outlines how the identified disease differs from Down Syndrome	1

Sample answer

A nutritional disease such as scurvy occurs as a result of a lack of vitamin C in the diet and be cured simply by the intake of food high in vitamin C. Down Syndrome on the other hand results from the inheritance of incorrect information at the genetic level and cannot be simply cured.

25 (b) (3 marks)

Outcomes Assessed: H2, H3, H9, H10

Targeted Performance Bands: 5-6

Criteria	Marks
• Shows a good understanding of Darwin's theory of evolution by natural selection • Correctly explains how information in part (a) can lend support to the theory	3
• Shows a good understanding of Darwin's theory of evolution by natural selection • Incorrectly explains how information in part (a) can lend support to the theory	2
• Shows some understanding of Darwin's theory of evolution by natural selection • Fails to relate information in part(a) to the theory of natural selection	1

Sample answer

The appearance of Down syndrome in a population shows that inherited change can occur, and introduces a new variation into that population. The fact that it can be inherited, allows the selection process to take place allowing the possibility for change.

Question 26 (4 marks)
Outcomes Assessed: H1, H4
Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly identifies one infectious and one non-infectious disease • Correctly discuses changing methods of dealing with each of the named diseases.	4
• Correctly identifies one infectious and one non-infectious disease • Correctly discuses changing methods of dealing with ONE of the named diseases.	3
• Correctly identifies one infectious and one non-infectious disease • No discussion of changing methods attempted OR • Correctly identifies EITHER an infectious OR no-infectious disease • Correctly discuses changing methods of dealing with the disease identified	2
• Correctly identifies EITHER an infectious OR no-infectious disease • No discussion offered	1

Sample answer
Down Syndrome is a non-infectious disease. As there is no cure for Down syndrome, in the past children with the disease were often institutionalised and led lives isolated from mainstream society. Today special education programs have been developed so many can attend normal schools and eventually live independent lives.
Mosaic virus is an infectious disease of many plants including tomatoes. In the past the use of chemical sprays was the method used to control this disease, but today scientists have incorporated a virus-resistant gene into the tomatoes negating the need to spray and avoiding possible health risks.

Question 27 (3 marks)
27 (a) (1 mark)
Outcomes Assessed: H3, H4, H6
Targeted Performance Band: 2-3

Criteria	Mark
• Correctly identifies one product extracted from donated blood	1

Sample answer
Red blood cells etc.

Question 27 (continued)
27 (b) (2 marks)
Outcomes Assessed: H3, H4, H6
Targeted Performance Band: 3-5

Criteria	Marks
• Correctly describes the use of the product named in (a)	2

Sample answer
Given to people with anaemia and to those whose bone marrow cannot make enough red blood cells in order to increase the amount of oxygen that can be carried to the body's tissues.

Question 28 (4 marks)
28 (a) (1 mark)
Outcomes Assessed: H4, H8
Targeted Performance Bands: 2-4

Criteria	Mark
• Correctly identifies ONE method used to treat drinking water in order to minimise the risk of infection from pathogens	1

Sample answer
Chlorination.

28 (b) (3 marks)
Outcomes Assessed: H4, H8
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly explains how the method identified in (a) helps to reduce the risk of infection from pathogens • Uses relevant evidence to support the explanation	3
• Correctly explains how the method identified in (a) helps to reduce the risk of infection from pathogens • No evidence presented or evidence used is not relevant OR • Correctly explains a method other than that identified in (a) • Uses relevant evidence to support the explanation	2
• Correctly explains a method other than that identified in (a) • No evidence presented or evidence used is not relevant	1

Sample answer
Chlorine is added to the water to kill bacteria that may cause disease. Outbreaks of the disease cholera can be prevented by treating drinking water with chlorine as it kills the bacteria causing the disease.

Question 29 (8 marks)
Outcomes Assessed: H1, H4, H9, H10
Targeted Performance Band: 3-6

Criteria	Marks
• Correctly identifies the contribution of **each** individual or **group** of individuals to science – FOUR contributions identified (4 x 1 mark) • Correct evaluation done for each individual or group of individuals identified above – FOUR evaluations (4 x 1 mark)	8
• 4 correct contributions + 3 correct evaluations for identified individuals/groups	7
• 3 correct contributions + 3 correct evaluations for identified individuals/groups OR • 4 correct contributions + 2 correct evaluations for identified individuals/groups	5-6
• 4 correct contributions + 1 correct evaluation for identified individuals/groups OR • 3 correct contributions + 2 correct evaluations for identified individuals/groups	3-4
• 2 correct contributions + 2 correct evaluations for identified individuals/groups OR • 3 correct contributions + 1 correct evaluations for identified individuals/groups OR • 4 correct contributions	2
• 2 correct contributions + 1correct evaluation for identified individuals/groups OR • 3 correct contributions	1

Sample answer
Mendel's work with peas showed that these are units of inheritance that occur in pairs and segregate independently at gamete formation, with one unit being received from each parent. He called his units of inheritance 'factors'. Mendel showed that inheritance was NOT as a result of a blend of characteristics from each parent as had been thought by other scientists before him. Mendel also demonstrated the advantage of sound experimental technique when it came to experimentation.
Sutton and Boveri continued Mendel's work and showed that it was the paired chromosomes that carried the units ('factors') of inheritance. They also postulated that because there were many more 'factors' than chromosomes, each chromosome must carry many hundreds of inheritance 'factors'.

Question 29 (continued)

Morgan's work supported the ideas of Sutton and Boveri that Mendel's factors (now called genes) and proved that they were carried on the chromosomes. However, he showed that the inheritance of genes is not always as simple as Mendel thought when his work with Drosophila indicated some genes could be sex-linked.

The work of these scientists formed the basis of chromosomal theory of that eventually led to the ideas of linked genes, co-dominance, incomplete dominance and lethal gene expression.

Franklin, Wilkins, Crick and Watson took the work of the previous three scientists to the molecular level and worked on finding the chemical structure of the chromosomal material, DNA. Eventually they achieved their aim, and as a result, were able to provide a molecular basis for inheritance that has been the foundation for work being done today on genetic engineering in such areas as cloning, transgenics, DNA fingerprinting, recombinant DNA technology and DNA sequencing.

OPTION 1

Question 30 - COMMUNICATION (25 marks)

30 (a) (i) (1 mark)
Outcomes Assessed: H6
Targeted Performance Bands: 2-3

Criteria	Mark
• Correctly identifies the stimulus used in vision	1

Sample answer
The stimulus is light.

30 (a) (ii) (2 marks)
Outcomes Assessed: H6, H13
Targeted Performance Bands: 2-4

Criteria	Marks
• Correctly outlines all the steps (3)	2
• Correctly outlines only two of the steps	1

Sample answer
In the receptor the stimulus is converted into an impulse and from here impulses are transmitted by the nervous system and then sent to an effector so that a suitable response can be made.

30 (b) (i) (3 marks)
Outcomes Assessed: H6, H12
Targeted Performance Bands: 2-5

Criteria	Marks
• Selects a suitable investigation (1) • Correctly describes the investigation used (2)	3
• The investigation selected is unsuitable • Correctly describes the selected investigation (2) OR • Selects a suitable investigation (1) • Description of investigation is incomplete or only partially correct (1)	2
• Selects a suitable investigation (1) • No description	1

Sample answer
Pass rays of light through convex lenses of different focal length. As the curvature of the lens increases the focal length decreases changing the position of the image.

Question 30 (continued)

30 (b) (ii) (2 marks)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 3-4

Criteria	Marks
• Selects a suitable method for assessing validity • Correctly states how the chosen method could be used to assess validity	2
• Selects a suitable method for assessing validity	1

Sample answer

A valid investigation is one that fairly tests the hypotheses being tested. To assess the validity of information gathered one has to ensure that manipulations one has made to the independent variable are in fact responsible for the measured/observed variations in the dependent variable. If the investigation can clearly establish that the treatment was the cause of the measured/observed effect, then it is valid. If something other than the treatment caused the effect, then it is not valid. To ensure that a fair test has been designed, one has to treat experimental and control groups identically, except for the manipulation of the independent variable. To ensure that there is only one variable all other variables that might impact on the experiment must be held constant. These are the controlled variables.

30 (c) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-6

Criteria	Marks
• Shows a sound understanding of the structure and function of rods • Shows a sound understanding of the structure and function of cones • Correctly compares the two	4
• Shows a sound understanding of the structure and function of rods • Shows a sound understanding of the structure and function of cones • No attempt at comparison OR • Compares **either** the structure **or** function of the two structures	3
• Shows an understanding of the structure and function of **either** rods **or** cones • No attempt at comparison	2
• Shows an understanding of either the structure or function of one of the structures • No attempt at comparison	1

Sample answer

Both rods and cones are photoreceptor cells of similar structure containing photosensitive chemicals (opsins) that undergo reactions when they absorb light energy. Cones are responsible for the detection of colour through photopsin) and are of three types; red, green and blue, whereas rods are of one type (containing rhodopsin rather than photopsin)), more sensitive than cones, and responsible for our ability to see in dim light. Rods are better able to detect motion than cones.

Question 30 (continued)

30 (d) (i) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines the complete transmission process	2
• Correctly outlines part of the process	1

Sample answer

Stimuli received by the eye OR ear are converted to impulses that are carried to the brain by the optic nerve and auditory nerve respectively. The electrochemical impulses are transmitted along a series of interconnecting neurones, which then synapse with the next set of neurones via a chemical pathway. This pathway eventually reaches the brain.

30 (d) (ii) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly explains the importance of accurate interpretation • Includes two relevant examples	4
• Correctly explains the importance of accurate interpretation • Includes one relevant example OR • Explanation only partially correct or inaccurate • Includes two relevant examples	3
• Correctly explains the importance of accurate interpretation • No examples included OR • Explanation only partially correct or inaccurate • Includes one relevant example	2
• Explanation only partially correct or inaccurate • No examples included	1

Sample answer

The environment in which an organism lives is constantly changing. Sense organs such as the eye and ear detect these changes and send information to the brain. The cerebral cortex is the most important association centre of the brain. Based on the integration of the sensory information the cerebral cortex generates motor commands to ensure the appropriate response is made. For example, the eyes and ears, receptors in muscles and tendons, pressure sensors on the feet all provide signals about the position of the body in space. Correct interpretation of these signals by the brain ensures correct balance. Walking involves several receptors, including the eyes, gravity receptors in the ears, pressure sensors in the feet and position receptors in the joints. These receptors are connected to the brain that interprets the signals it receives. The brain sends messages to the muscles and other effectors to coordinate the process of walking.

Question 30 (continued)

30 (e) (7 marks)

Outcomes Assessed: H1, H3, H4

Targeted Performance Bands: 2-6

Criteria	Marks
• Technologies correctly identified that deal with vision and hearing impairment and extensive descriptions given • Analyses the limitations of the technologies and suggests advantages in the use of the technologies • Makes a judgement on the basis of the given criteria	7
• Technologies correctly identified that deal with vision and hearing impairment and extensive descriptions given. • Provides at least one limitation of the technologies and suggests at least one advantage in the use of the technology • Makes a judgement on the basis of given criteria	5-6
• Technologies correctly identified that deal with vision and hearing impairment and descriptions given. • Provides at least one limitation and suggests one advantage in the use of the technology OR • Makes a judgement on the basis of given criteria	3-4
• Technologies correctly identified that deal with vision and/or hearing impairment and descriptions given. OR • Technologies correctly identified that deal with either hearing or vision deterioration and states its limitation/advantage	2
• Technologies correctly identified that deal with either hearing or vision deterioration OR • Provides a limitation/advantage for either hearing or vision technologies	1

Sample answer

In the case of both visual and aural communication organs involved can sometimes malfunction or simply deteriorate with age.

In the case of visual communication, myopia and hyperopia reduce the ability of the patient to see, respectively, distant and close objects clearly. Simple treatment using spectacles and/or contact lenses can restore good and clear sight. These are relatively inexpensive and easy to update should the wearers sight deteriorate further. Even laser surgery that reshapes the curvature of the lens has become quite common and the cost is reasonable when one considers it provides a permanent correction. Another visual impairment found in an ageing population is caused by cataracts; a cloudiness of the lens of the eye, which if left untreated can result in blindness. The pioneering work done by Fred Hollows led to a simple but effective operation to cheaply replace the patient's lens with an artificial plastic one. This has meant many older people in poor countries have had sight restored and have been able to lead relatively normal lives.

Question 30 (continued)

In the case of aural communication, partial deafness due to outer and middle ear damage can be easily and cheaply remedied by the use of hearing aids. These are battery-operated devices consisting of microphone, amplifier and earphone that sit in the auditory canal. They have proved a valuable device in improving the hearing ability of people with partial deafness, but are of no use to people with damage to the inner ear that are profoundly or totally deaf. The damage to the inner ear – usually a destruction of the hairs of the organ of Corti – is much more serious. The use of a cochlear implant ('bionic ear') has addressed this problem for some, but it is an expensive operation and difficult for some recipients to get used to and program correctly. It requires an operation to place the receiver in the patient's skull and to connect a wire to the cochlea so that the auditory nerve can be stimulated. The result is not always as successful as the patient had hoped, but does usually result in improved speech recognition and understanding.

OPTION 2

Question 31 - BIOTECHNOLOGY (25 marks)

31 (a) (i) (1 mark)

Outcomes Assessed: H6

Targeted Performance Bands: 2-3

Criteria	Mark
• Correctly identifies one application of biotechnology in aquaculture	1

Sample answer

The production of pharmaceuticals by alga.

31 (a) (ii) (2 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines the process and names the alga and what it produces	2
• Correctly outlines the process OR names the alga and what it produces	1

Sample answer

The brown alga Laminaria saccharina is cultivated in an illuminated photoreactor to produce the hydroxy fatty acid oxylipin used in the production of pharmaceuticals.

30 (b) (i) (3 marks)

Outcomes Assessed: H6, H12

Targeted Performance Bands: 2-5

Criteria	Marks
• Selects a suitable investigation (1) • Correctly describes the investigation used (2)	3
• The investigation selected is unsuitable • Correctly describes the selected investigation (2) OR • Selects a suitable investigation (1) • Description of investigation is incomplete or only partially correct (1)	2
• Selects a suitable investigation (1) • No description	1

Sample answer

The effect of temperature on enzyme activity was investigated by measuring the rate at which the enzyme amylase broke down starch at temperatures of 10^oC, 20^oC, 30^oC, 40^oC and 50^oC. Starch solution was placed in a series of test tubes at the different temperatures, amylase added, and the time for glucose to appear noted (Benedict's solution used to test for glucose). A control of starch solution without the amylase was used at each temperature.

Question 31 (continued)

31 (b) (ii) (2 marks)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 3-4

Criteria	Marks
• Selects a suitable method for assessing validity • Correctly states how the chosen method could be used to assess validity	2
• Selects a suitable method for assessing validity	1

Sample answer

A valid investigation is one that fairly tests the hypotheses being tested. To assess the validity of information gathered one has to ensure that manipulations one has made to the independent variable are in fact responsible for the measured/observed variations in the dependent variable. If the investigation can clearly establish that the treatment was the cause of the measured/observed effect, then it is valid. If something other than the treatment caused the effect, then it is not valid. To ensure that a fair test has been designed, one has to treat experimental and control groups identically, except for the manipulation of the independent variable. To ensure that there is only one variable all other variables that might impact on the experiment must be held constant. These are the controlled variables.

31 (c) (4 marks)

Outcomes Assessed: H6, H16

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly names an example of the use of biotechnology • Correctly discusses at least TWO ethical issues related to the named example	4
• Correctly names an example of the use of biotechnology • Correctly discusses ONE ethical issue related to the named example OR • Correctly names an example of the use of biotechnology • Correctly discusses TWO ethical issue NOT related to the named example	3
• Incorrectly names an example of the use of biotechnology • Correctly discusses TWO ethical issue NOT related to the named example	2
• Correctly names an example of the use of biotechnology OR • Discusses ONE ethical issue	1

Question 31 (continued)

Sample answer

Genetically modified organisms (GMOs), in which genes from another organism are introduced, have raised many ethical issues with the general public. GM canola is a plant that is used as a source of oil for making margarine. Using the GM strain means less spraying with pesticides during growth therefore making it cheaper to produce. However, at this stage there is little known about possible long-term effects on human health, and there is concern about cross-pollination with other species to produce plants that might cause problems. In many countries there is no obligation to label products that contain ingredients made from GM canola, so people are robbed of choice between non-GM canola and GM canola products.

31 (d) (i) (2 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 3-4

Criteria	Marks
• Correctly outlines the function of both restriction enzymes and ligases	2
• Correctly outline the function of EITHER restriction enzymes OR ligases	1

Sample answer

In recombinant DNA technology, restriction enzymes cut the DNA into gene fragments at a specific sequence of bases leaving stick ends and ligases bond the sugar-phosphate backbone after polymerase has allowed for complementary base pairing.

31 (d) (ii) (4 marks)

Outcomes Assessed: H6, H9

Targeted Performance Bands: 3-6

Criteria	Marks
• Correct, detailed description of the use of both DNA vectors and microinjection	4
• Correct description of the use of DNA vectors and microinjection	3
• Correct, detailed description of the use of DNA vectors OR microinjection	2
• Correct description of the use of DNA vectors OR microinjection	1

Sample answer

Commonly used vectors (carriers) are viruses or plasmids. A viral vector is first modified so that it will not replicate or cause disease in the target cells of the host embryo. The gene of interest is incorporated into the viral genome and the virus is then used to infect an early stage embryo or a pronuclear embryo. The viral vector binds uniformly to the embryonic cells and acts as a vehicle to allow transfer and integration of the transgene into the host genome.

Microinjection is a physical method that enables genetic material to be introduced into the host cell. Once inside it is combined with existing genetic material.

Question 31 (continued)

31 (e) (7 marks)

Outcomes Assessed: H1, H3, H4, H6

Targeted Performance Bands: 2-6

Criteria	Marks
• Extensive description of identified technologies used in today's fermentation industry • Analyses the limitations of the technologies and suggests advantages in the use of the technologies • Makes a judgement on the basis of the given criteria	7
• Extensive description of identified technologies used in today's fermentation industry • Provides at least one limitation of the technologies and suggests at least one advantage in the use of the technology • Makes a judgement on the basis of the given criteria	5-6
• Technologies correctly identified that deal with today's fermentation industry and description given • Provides at least one limitation and suggests one advantage in the use of the technology OR • Makes a judgement on the basis of given criteria	3-4
• One technologies correctly identified that deals with today's fermentation industry and description given OR • States one limitation with relevant advantage/disadvantage	2
• One technology correctly identified that deals with today's fermentation industry	1

Sample answer

Traditional fermentation on a small scale was used in the production of bread, wine, cheese and in brewing, and was done without the knowledge that micro-organisms involved. It was only after the work of Pasteur that there was an understanding that micro-organisms were involved.

In yeast production the work of Pasteur and strain isolation technology has led to more advanced methods of culturing pure strains, making modern commercial yeast possible and turning yeast production into a major industrial endeavour.

Genetic engineering technologies have allowed production of new strains of microbes from which enzymes can be extracted that can be used in industrial fermentation. The production of the enzyme cellulase for cellulose fermentation to produce ethanol is an example.

Question 31 (continued)

Modern instrumentation such as the hydrometer and infrared sensor used in breweries and biofuel plants have enabled accurate measurement of ethanol content and therefore better quality control.

Improved engineering and building technologies have allowed the construction of fermentation tanks and distillation towers for the large-scale production of materials such as ethanol.

The use of these technologies has allowed production on an industrial scale of what, in the past, was only possible on a small scale. Also, products from today's fermentation processes are safer, of better quality, more consistent, more reliable and have a better yield.

OPTION 3

Question 32 - GENETICS - THE CODE BROKEN?

32 (a) (i) (1 mark)
Outcomes Assessed: H9
Targeted Performance Bands: 2-3

Criteria	Mark
• Correctly identifies one characteristic determined by multiple alleles in an organism other than humans	1

Sample answer
Coat colour in mice.

32 (a) (ii) (2 marks)
Outcomes Assessed: H9
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines the difference in the way characteristics are determined in the two types of inheritance	2
• Correctly outlines how characters are determined in ONE of the two types of inheritance	1

Sample answer
Characteristics attributable to multiple alleles show more than two different but distinct forms, e.g. the A, B and O blood groups of humans depending on the alleles present at a particular locus on a particular chromosome. In polygenic inheritance of a characteristic, many genes on many different chromosomes are involved, so the expression of the characteristic shows continuous variation, e.g. height in humans and leaf length in plants.

Question 32 (continued)

32 (b) (i) (3 marks)

Outcomes Assessed: H6, H12

Targeted Performance Bands: 3-5

Criteria	Marks
• Selects a suitable investigation (1) • Correctly describes the investigation used (2)	3
• The investigation selected is unsuitable • Correctly describes the selected investigation (2) OR • Selects a suitable investigation (1) • Description of investigation is incomplete or only partially correct (1)	2
• Selects a suitable investigation (1) • No description	1

Sample answer

Pipe cleaners were used to represent the chromosomes and along their lengths different coloured threads were tied to represent genes. The process of meiosis was then modelled to show that genes on the same chromosome (linked genes) are usually inherited together and do not sort independently during meiosis.

32 (b) (ii) (2 marks)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 3-4

Criteria	Marks
• Selects a suitable method for assessing validity • Correctly states how the chosen method could be used to assess validity	2
• Selects a suitable method for assessing validity	1

Sample answer

In terms of the model, validity is thought of as the degree to which it faithfully represents its real world counterpart. The model must replicate the data that is known about the observed system. Thus, the model has to explain the components/constructs that are used and how these map to the real phenomenon or the data that is known.

Question 32 (continued)

32 (c) (4 marks)

Outcomes Assessed: H9

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly discusses two benefits of the Human Genome Project • Correctly explains the limitations of the data obtained	4
• Correctly discusses two benefits of the Human Genome Project • Correctly explains one limitation of the data obtained OR any 3	3
• Correctly discusses one benefit of the Human Genome Project and correctly explains one limitation of the data obtained	2
• Correctly discusses one benefit of the Human Genome Project or correctly explains one limitation of the data obtained	1

Sample answer

The draft map of the human genome completed in 2000 was seen as a means of revolutionising health care by emphasising prevention of disease rather than treatment. Unfortunately this is a rather simplistic view as much work still has to be done. Although scientists may have sequenced a particular gene, knowing its function is a very different thing requiring greater research. The sequencing of one gene, and even knowing its function, may not be enough to identify the cause of a hereditary disease if another gene or genes are involved.

32 (d) (i) (2 marks)

Outcomes Assessed: H9

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines the difference between the two mutation types	2
• Correctly outlines one of the mutation types	1

Sample answer

A base substitution mutation occurs when one base is substituted for another (say cytosine for adenine) along the DNA, whereas a frame shift mutation occurs when a nucleotide is inserted into or deleted from the DNA sequence. Base substitution alters only one amino acid in a polypeptide. Insertion or deletion alters every codon from that point onwards and may change many amino acids in a polypeptide.

Question 32 (continued)

32 (d) (ii) (4 marks)

Outcomes Assessed: H4, H9

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly names and describes a mutation that occurs in humans • Correctly describes how it affects human health	4
• Correctly names and describes a mutation that occurs in humans • incorrectly describes how it affects human health OR • Correctly names a mutation that occurs in humans • Correctly describes how it affects human health	3
• Correctly names a mutation that occurs in humans • incorrectly describes how it affects human health	2
• Correctly names a mutation that occurs in humans	1

Sample answer

The human inherited disease sickle-cell anaemia is caused by a base substitution mutation. Red blood cells in sufferers of this disease are sickle or crescent shaped and their haemoglobin molecules differ from normal haemoglobin by one amino acid in a polypeptide chain. This mutation causes red blood cells to block capillaries and cells and tissues may suffer from lack of oxygen. This is a mutation that produces a recessive allele. The condition is often lethal in homozygous individuals.

Question 32 (continued)

32 (e) (7 marks)

Outcomes Assessed: H3, H4, H9

Targeted Performance Bands: 2-6

Criteria	Marks
• Shows an understanding of what is meant by gene cloning • Describes a current use of gene cloning in either plants or animals • Discusses advantages and disadvantages to humans of the application of cloned genes • Makes a judgement on the basis of the given criteria	7
• Shows an understanding of what is meant by gene cloning • Describes a current use of gene cloning in either plants or animals • Discuses advantages or disadvantages to humans of the application of cloned genes • Makes a judgement on the basis of the given criteria	5-6
• Discusses advantages and disadvantages to humans of the applications of cloned genes • Makes a judgement on the basis of the given criteria	3-4
• Discusses advantages and disadvantages to humans of the applications of cloned genes OR • Shows an understanding of what is meant by gene cloning	1-2

Sample answer

Gene cloning involves the production of many copies of identical single genes for specific purposes. This will transfer copies of single genes from one organism to another and result in many copies of the gene when those organisms reproduce. Human insulin, used by diabetics to control blood sugar levels, is now produced by the cloning of recombinant DNA. This process occurs by using special cutting enzymes, known as restriction enzymes, to cut out the gene for making insulin from a human chromosome. The enzymes are also used to cut open a plasmid in a bacterial cell (typically E. coli) leaving 'sticky ends'. The human DNA is then inserted into the plasmid. The plasmid (now genetically engineered) is placed back into a bacterium and is reproduced every time the bacterium reproduces asexually. In this way, the human gene has been cloned. When given all of the required nutrients, these bacteria will produce human insulin according to the human genes they contain. This is a much more efficient method than that previously used, which involved obtaining insulin from pigs or cattle or from trying to culture human cells. Attempts at trying to make insulin artificially proved too difficult and expensive. There is a risk of the bacteria escaping, mutating and becoming itself an environmental or health hazard, but today a special strain of E. coli is used that cannot survive outside the laboratory. The use of gene cloning has enabled man to bring relief to sufferers of the debilitating disease diabetes cheaply and efficiently, and scientists involved have done their best to ensure the production is done safely.

OPTION 4

Question 33 - HUMAN STORY (25 marks)

33 (a) (i) (1 mark)
Outcomes Assessed: H10
Targeted Performance Bands: 2-4

Criteria	Mark
• Correctly identifies one criterion	1

Sample answer
The two organisms can interbreed and produce fertile offspring.

33 (a) (ii) (2 marks)
Outcomes Assessed: H7
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines TWO characteristics	2
• Correctly outlines ONE characteristic OR • Correctly states ONE characteristic	1

Sample answer
Both the chimpanzee and human have:

- a large brain with a large cerebral cortex
- stereoscopic, three dimensional vision for good depth perception
- an opposable thumb and/or toe for grasping and locomotion
- flat nails rather than claws at the ends of the fingers and toes

Question 33 (continued)

33 (b) (i) (3 marks)

Outcomes Assessed: H10, H12

Targeted Performance Bands: 2-5

Criteria	Marks
• Selects a suitable investigation (1) • Correctly describes the investigation used (2)	3
• The investigation selected is unsuitable • Correctly describes the selected investigation (2) OR • Selects a suitable investigation (1) • Description of investigation is incomplete or only partially correct (1)	2
• Selects a suitable investigation (1) • No description	1

Sample answer

This was done from secondary sources such as texts or the internet. Pictures of normal male and female human karyotypes were compared with images of the karyotypes for Down Syndrome, Kleinfelter's Syndrome and Turner's Syndrome and comparisons made to determine the cause of these genetic abnormalities.

33 (b) (ii) (2 marks)

Outcomes Assessed: H10, H14

Targeted Performance Bands: 2-4

Criteria	Marks
• Selects a suitable method for assessing validity • Correctly states how the chosen method could be used to assess validity	2
• Selects a suitable method for assessing validity	1

Sample answer

In terms of the model, validity is thought of as the degree to which it faithfully represents its real world counterpart. The model must replicate the data that is known about the observed system. Thus, the model has to explain the components/constructs that are used and how these map to the real phenomenon or the data that is known.

Question 33 (continued)

33 (c) (4 marks)

Outcomes Assessed: H9, H10

Targeted Performance Bands: 3-6

Criteria	Marks
• Shows a deep understanding of mitochondrial DNA studies and DNA sequencing • Shows how these studies can be used to compare groups of living primates and hypothesise about their relationships	4
• Shows a basic understanding of mitochondrial DNA studies and DNA sequencing • Shows how these studies can be used to compare groups of living primates	3
• Shows an understanding of mitochondrial DNA studies and DNA sequencing OR • Compares groups of living primates and hypothesises about their relationships	2
• Shows an understanding of mitochondrial DNA studies or DNA sequencing	1

Sample answer

Most of the DNA in a cell is found in the nucleus but a small amount of DNA is found in the mitochondria. Mitochondrial DNA is much simpler than nuclear DNA and consists of a single circle of DNA. During fertilisation the egg cell provides the mitochondria for the new organism. This means that mitochondrial DNA is always through the female line. By comparing the mitochondrial DNA from living primates it is possible to calculate a molecular clock based on a constant rate of mutation. The number of differences in the mitochondrial DNA is an indication of how many years have passed since two organisms shared a common ancestor.

The order of bases along a DNA strand is called its sequence. In DNA sequencing genetic and biochemical tests are used to sequence the bases in a portion of DNA. These are then compared in different species. If the sequences are similar then the two organisms have shared a common ancestor in recent times.

Question 33 (continued)

33 (d) (i) (2 marks)

Outcomes Assessed: H1, H10

Targeted Performance Bands: 3-4

Criteria	Marks
• Correctly outlines TWO cultural impacts	2
• Correctly outlines ONE cultural impact	1

Sample answer

The use of tools and the development of communication enabled better hunting and gathering techniques to be developed. Hunting in small cooperative groups for food needed skills in stalking and killing prey. The ability to communicate effectively meant more effective kills and also time to share ideas about improvements in hunting tools such as stone tips for spears and bone hooks for fishing.

33 (d) (ii) (4 marks)

Outcomes Assessed: H3, H9, H10

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly names two examples of possible effects of genetic engineering on human evolution • Relates the implications of the stated examples to human evolution	4
• Correctly names two examples of possible effects of genetic engineering on human evolution • Relates the implications of one of the stated examples to human evolution	3
• Correctly names two examples of possible effects of genetic engineering on human evolution OR • Correctly names one example of genetic engineering that has a possible effect on human evolution • Relates the implications of the stated example to human evolution	2
• Correctly names one example of genetic engineering that has a possible effect on human evolution	1

Sample answer

Genetic engineering involves the manipulation of living organisms through the manipulation of genes.

It will be possible to treat many human genetic diseases such as haemophilia and so alter the frequency of these genes in the human population and by using modifications in gametic and embryonic cells to eliminate genetic defects altogether.

Agricultural genetic engineering has produced a number of GM crops such as GM canola that require reduced use of pesticides and produce higher yielding and better quality crops. This means better nutrition for more people and a generally more healthy human population with better survival rates.

Question 33 (continued)

33 (e) (7 marks)

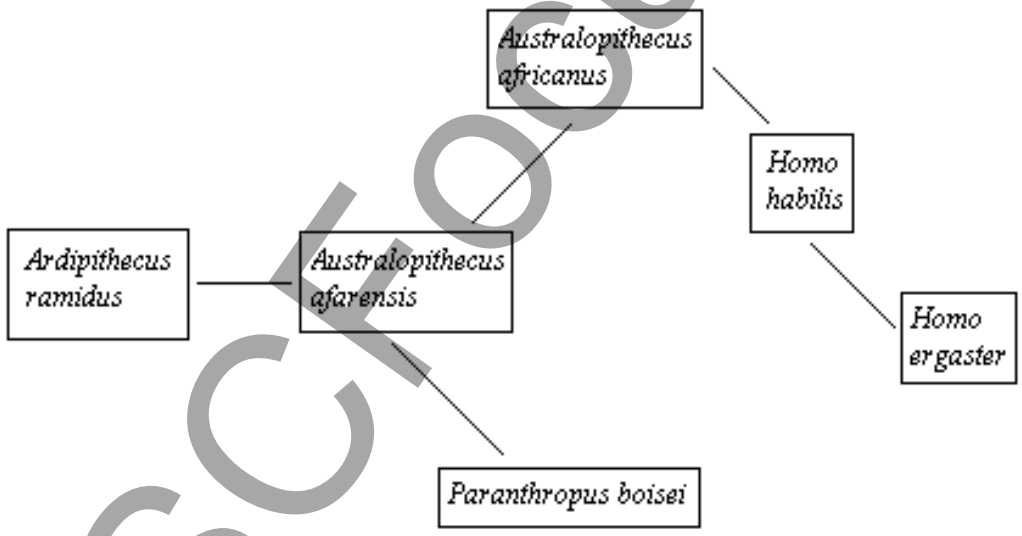
Outcomes Assessed: H1, H3, H4, H10

Targeted Performance Bands: 2-6

Criteria	Marks
• Describes one model in detail • Provides detailed, relevant evidence for model selected • Makes a judgement of validity of named model based on evidence provided	6-7
• Describes one model in some detail • Provides some relevant evidence for selected model • Attempts to make a judgement on the usefulness of the model	4-5
• Describes one model and provides limited detail • Provides relevant examples of evidence OR • Makes a judgement	2-3
• Describes one model OR • Provides a relevant example of evidence	1

Sample answer

Model:



Ardipithecus ramidus fossils have been dated at 4.2 mya. The fossil looked more like a chimpanzee but features such as the shape of its spine and canine teeth indicated it was a hominid. Australopithecus afarensis (3.7-2.8 mya) showed similarities to Ardipithecus such as a forward protruding face and U-shaped palate, but a bipedal gait made it a more advanced hominid than Ardipithecus.

Question 33 (continued)

Evidence supporting the evolution of two different lineages comes from fossils that show the existence of two very different hominid types; a heavy species called Paranthropus boisei and a much more gracile type Australopithecus africanus. Evidence from excavations found fossils of P.boisei and Homo ergaster in the same layer suggesting they lived alongside each other and therefore evolved along different lines. No fossils of P.boisei have been found younger than 1 million years old suggesting this line died out. Fossils of Homo habilis show an enlarged cranial capacity and more hominid features than A.africanus which could suggest it descended from this hominid. H. habilis also used stone tools. Fossils of Homo ergaster show reduced teeth size and advanced stone tools have been found with fossils of this hominid.

This is of course one of many models suggested to explain human evolutionary relationships based on the fossil evidence so far unearthed. Further fossil finds will make the relationships between hominids clearer.

OPTION 5

Question 34 - BIOCHEMISTRY (25 marks)

34 (a) (i) (1 mark)
Outcomes Assessed: H6
Targeted Performance Bands: 3-4

Criteria	Mark
• Correctly outlines one of the contributions made by Ingen-Housz	1

Sample answer
Jan Ingen-Housz demonstrated that in the presence of sunlight, green leaves give off oxygen from their green parts, but when placed in the shade oxygen production stops.

34 (a) (ii) (2 marks)
Outcomes Assessed: H6
Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly explains the conclusion reached by Mayer • Correctly explains how Ingen-Housz helped contribute to this conclusion	2
• One of the above	1

Sample answer
Mayer hypothesised that the sunlight provided the initial source of energy that was turned into chemical energy that was used to convert inorganic matter into organic matter and therefore plant growth. Mayer used this information to formulate a crude equation for photosynthesis:
$CO_2 + H_2O$ + sunlight → O_2 + organic matter
Ingen-Housz had previously shown that sunlight was needed for this process to work when he demonstrated the production of oxygen from the green parts of plants in the presence of sunlight.

Question 34 (continued)

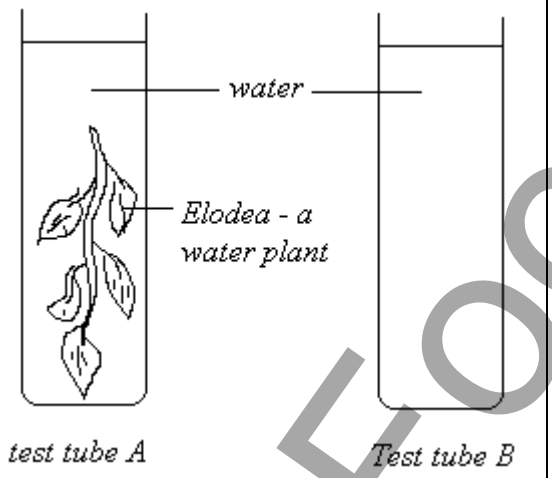
34 (b) (i) (3 marks)

Outcomes Assessed: H6, H12

Targeted Performance Bands: 3-5

Criteria	Marks
• Selects a suitable investigation (1) • Correctly describes the investigation used (2)	3
• The investigation selected is unsuitable • Correctly describes the selected investigation (2) OR • Selects a suitable investigation (1) • Description of investigation is incomplete or only partially correct (1)	2
• Selects a suitable investigation (1) • No description	1

Sample answer



4 test tubes similar to A were set up, each in a water bath of a different temperature.
A test tube similar to B with no plant was placed in each water bath to act as a control.
Each treatment had similar light conditions.
The number of gas bubbles produced by the leaves was counted per minute for each treatment to measure rate of gas production.
Any gas production in the control treatment was also noted.

Question 34 (continued)

34 (b) (ii) (2 marks)

Outcomes Assessed: H6, H14

Targeted Performance Bands: 2-4

Criteria	Marks
• Selects a suitable method for assessing validity • Correctly states how the chosen method could be used to assess validity	2
• Selects a suitable method for assessing validity	1

Sample answer

A valid investigation is one that fairly tests the hypotheses being tested. To assess the validity of information gathered one has to ensure that manipulations one has made to the independent variable are in fact responsible for the measured/observed variations in the dependent variable. If the investigation can clearly establish that the treatment was the cause of the measured/observed effect, then it is valid. If something other than the treatment caused the effect, then it is not valid. To ensure that a fair test has been designed, one has to treat experimental and control groups identically, except for the manipulation of the independent variable. To ensure that there is only one variable all other variables that might impact on the experiment must be held constant. These are the controlled variables.

34 (c) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly describes the role of NADP in the light-dependent reactions • Correctly describes the role of ADP in the light-dependent reactions • Compares the two roles	4
• Correctly describes the role of NADP OR the role of ADP in the light-dependent reactions • Compares the two roles	3
• Correctly describes the role of NADP in the light-dependent reactions • Correctly describes the role of ADP in the light-dependent reactions	2
• Correctly describes the role of NADP OR the role of ADP in the light-dependent reactions	1

Sample answer

Both act as coenzymes enabling specific enzymes to operate. NADP acts as an electron and hydrogen acceptor forming NADPH whereas ADP acts an energy acceptor and forms ATP. They both act as energy carriers for reactions in the light-independent reactions of photosynthesis.

Question 34 (continued)

34 (d) (i) (2 marks)

Outcomes Assessed: H1, H6

Targeted Performance Bands: 3-5

Criteria	Marks
• Correctly outlines how Calvin used chromatography to deduce the products of photosynthesis	2
• Outline attempted but lacks vital steps	1

Sample answer

- Radio active carbon dioxide fed to green algae
- Plant tissue killed at progressively shorter intervals and radioactive compounds separated using paper chromatography
- Paper x-rayed and radioactive compounds appeared as black spots
- Black spots analysed to determine composition of the products of photosynthesis

34 (d) (ii) (4 marks)

Outcomes Assessed: H6

Targeted Performance Bands: 3-6

Criteria	Marks
• Correctly outlines the main steps of the Calvin cycle	4
• 3 of the above in sequence	3
• 2 of the above in sequence	2
• 1 of the above	1

Sample answer

- Carbon dioxide attached to a 5-carbon acceptor and subsequent breakdown into 2 phosphoglycerate molecules (2 x 3C molecules)
- A phosphate group from ATP is added to each phosphoglycerate molecule NADPH reduces this molecule to glyceraldehyde phosphate
- Stepwise regeneration of the original 5-carbon acceptor

Question 34 (continued)

34 (e) (7 marks)

Outcomes Assessed: H1, H3, H4, H6

Targeted Performance Bands: 2-6

Criteria	Marks
• Correctly identifies two renewable resources that can be developed using photosynthesis • Correctly explains how photosynthesis can be used to produce these products • Makes a judgment regarding the use of the photosynthetic products with examples	7
• Correctly identifies two renewable resources that can be developed using photosynthesis • Correctly outlines how photosynthesis can be used to produce these products • Makes a judgment regarding the use of the photosynthetic products	5-6
• Correctly identifies at least one renewable resource that can developed using photosynthesis • Correct but limited understanding of the production of these products through photosynthesis • Attempts to make a judgment regarding the use of the photosynthetic products	3-4
• Correctly identifies at least one renewable resource that can developed using photosynthesis OR • Attempts to make a judgment regarding the use of the photosynthetic products	1-2

Sample answer

Materials that can be derived from renewable resources include fuels, gases and plastics.

The major fuel derived from renewable resources is ethanol. It can be used on its own as a fuel or combined with other fuels such as petrol and diesel. The industrial production of ethanol uses enzymes to break down the biomass such as sugar cane or corn to sugars then fermentation of the sugars to ethanol using micro-organisms such as yeast and finally distillation to purify the ethanol. At present, large amounts of land would be needed to grow enough biomass to meet world fuel demand so production is limited. Higher fuel prices could mean an increase in land under cultivation for biomass to produce ethanol with the subsequent reduction in food crop production.

A process called gasification has been developed to convert sewage sludge, animal waste and waste from the food and beverage industries into gases. This process uses water at high temperatures and pressures to rapidly convert the wastes to methane at lower temperatures and hydrogen at higher temperatures. At present this is only being done on a small scale as collection of the waste material is expensive, and production costs are quite high.

Question 34 (continued)

Both the processes described above produce only small amount of greenhouse gases, and as the need to reduce carbon emissions increases and non-renewable resources run out, the use of renewable resources for fuel and gas production will increase.