

Exam Choice

2010 Biology Trial HSC examination. Marking Guidelines and model Answers.

Section I A Multiple Choice

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

Section I B

21

Marking Guidelines	Marks
• Explanation given of how each measure reduces spread of virus	3
• Explanation given of how 1-2 measures reduce spread of virus	1-2

Quarantine – By identifying people infected with the disease at the point of entry to the country, they can be directed to hospital and isolated from the general population. Their isolation will limit their ability to pass the pathogen on to other people.

Closing Sports Grounds – The H1N1 pathogen is easily spread from person to person. Large gatherings of people would allow one infected person to infect a large number of people. Banning such gatherings will reduce the spread of the pathogen.

Mass vaccination. – This would reduce the reservoir of the pathogen. The more people vaccinated, the smaller the potential number of sources of infection.

22.a

Marking Guidelines	Marks
• Stimulus correctly identified	1

Drop in blood glucose below 90mg/100mL.

22.b

Marking Guidelines	Marks
• Characteristics of a negative feedback outlined.	3
• Stimulus, response and effect, altering stimulus identified from control of blood glucose	
• Characteristics of a negative feedback outlined.	2
• Some aspects of blood glucose control outlined	
• One of the above	1

A negative feedback mechanism is one where the stimulus provokes a response which has the effect of changing the stimulus so that it no longer provokes the response. Blood glucose control is an example of this. A rise in blood glucose level is the stimulus, it provokes the response of releasing insulin. Insulin reduces the blood glucose level, removing the original stimulus.

22.c

Marking Guidelines	Marks
• Sequence of events in normal immune response outlined	4
• T cells identified as main agent against foreign cells	
• Explanation of response as a malfunction in terms of recognition of self and non self.	
• Two of the above or all three done less well	3
• One of the above or 2 done less well	2
• One done less well	1

In the normal immune response to foreign cells, foreign proteins are transported by macrophages to lymph nodes where they encounter T cells which, due to the action of helper T cells become sensitised against these foreign proteins as cytotoxic T cells. The cytotoxic T cells then travel to the foreign cells and destroy them. In Type 1 diabetes the cytotoxic T cells attack the b cells of the pancreas. This is a malfunction, The immune system should distinguish between self and non-self. In this example it is failing to do that.

23.

Marking Guidelines	Marks
• Relevant parts of Pasteur's work outlined (germ theory)	5-6
• Purpose of Koch's postulates outlined and at least 2 given or implied in answer	
• At least 2 important steps in development of knowledge of causes of malaria outlined	
• Links made between work of Pasteur and Koch, and that on Malaria.	
• Three of the above	3-4
• Correct information about work on malaria, or work of Pasteur and Koch, without any links	2
• One correct fact about work of Pasteur, Koch, or workers on malaria.	1

Pasteur put forward the germ theory of disease. Essentially he showed that infectious disease was caused by pathogens. Thanks to Pasteur, the workers on Malaria were looking for a pathogen, rather than some other factor. Koch developed a protocol, or a series of conditions

which had to be met to prove that a particular disease was caused by a particular pathogen. The workers on Malaria sought to satisfy this protocol.

Laveran examined the blood of sufferers and non-sufferers, he discovered a microorganism in the blood of virtually all sufferers, but not in the blood of non-sufferers, thereby satisfying Koch's first postulate. (a pathogen must be present in individuals with the disease, but not in individuals without it)

Ross suspected that mosquitoes were the vector and compared the micro-organisms from mosquitoes which had bitten malaria sufferers with those from mosquitoes which had bitten non sufferers. He found a micro-organism that was only present in those that had bitten sufferers. In this he had partially satisfied Koch's second postulate. (the suspected pathogen must be isolated from the host and grown in pure culture).

Grassi showed that mosquitoes which had bitten sufferers could pass the pathogen on to non-sufferers, effectively satisfying Koch's third postulate. (The isolated suspected pathogen must cause the disease in a susceptible host when given to it).

24.a.

Marking Guidelines	Marks
• One symptom described	1

CF sufferers would cough a lot because of mucus build up in their lungs.

24.b.

Marking Guidelines	Marks
• Defensive role outlined	1

Mucus traps pathogens.

24.c.

Marking Guidelines	Marks
• Pattern of inheritance of each disorder described or illustrated using pedigrees or punnet squares	4
• Pattern related to dominance/recessiveness	
• Point made that only homozygous individuals will show CF, but that heterozygotes will show HC	
• 2 of the above OR all 3 done less well	3
• 1 of the above OR 2 done less well.	2
• 1 done poorly	1

CF is caused by a recessive allele, therefore sufferers must be double recessive. Their parents must either have the disease or be heterozygous. Therefore it is likely that the parents and grandparents of a sufferer do not have it. Huntington's (HC) is caused by a dominant allele. Anyone homozygous or heterozygous will have it. For someone to inherit HC, at least one of their parents must also have it.

In a cross between 2 parents heterozygous for CF, 25% of their offspring might be expected to show the condition.(see below left) In a cross between a HC sufferer and a non sufferer, 100% of the offspring will have the condition if the parent was homozygous, and 50% if they were heterozygous.(see below right)

	N	n
N	NN	Nn
n	Nn	nn

	H	h
h	Hh	hh
h	Hh	hh

25

Marking Guidelines	Marks
• Each factor's effect on enzyme function described	3
• 2 factors' effects described	2
• 1 factor's effect described	1

Temperature. As temp increases enzyme activity increases, until it reaches an optimum level. As temp increases beyond this point, enzyme activity decreases. At high temps the enzyme denatures.

pH The enzyme functions optimally at a particular pH. As pH is raised or lowered from this point the enzyme functions progressively less well.

Substrate conc. As the substrate concentration is increased, the rate of enzyme activity increases, until it is no longer a limiting factor.

26.

Marking Guidelines	Marks
• Could be case control or cohort study, provided it has:	5
• Large numbers	
• Control group	
• Attempt to control other variables	
• Survey of environmental factors	
• Statistical analysis of results	
• 1-4 of the above	1-4

Survey a large number of people living in the area (several thousand) Record incidence of cancer, exposure to coal dust, type of house, diet etc. Set up a control group from another area not exposed to coal dust. This group must be as similar to original as possible in gender division, age structure and life style factors. The 2 groups should then be compared statistically in terms of cancer incidence and any patterns of exposure to particular environmental factors.

27.a

Marking Guidelines	Marks
• Both processes named and described	3

• Both processes named, One described.	2
• Both processes named OR one named and described.	1

Process 1 Filtration. - Most water and solutes filtered out of blood into Bowman's Capsule. Blood cells and large proteins remain in blood.
Process 2 Selective Reabsorption – Materials required by body such as glucose reabsorbed into blood. Water and salts also selectively reabsorbed to restore water balance.

27.b.

Marking Guidelines	Marks
• One difference identified	1

Blood entering kidney has higher urea concentration than blood leaving it.

28.a.

Marking Guidelines	Marks
• Both structures correctly labelled	1

28.b.

Marking Guidelines	Marks
• Three steps outlined	3
• 1 – 2 steps outlined	1-2

Pressure – flow theory. Sugars are moved by active transport from photosynthetic cells (source) into phloem. Water follows from xylem to phloem by osmosis. The pressure created moves the sucrose solution along the phloem from cell to cell. When it reaches cells which need it (sink), sucrose is moved out of the phloem into these cells by active transport. Water then leaves the phloem by osmosis, maintaining the pressure gradient.

29.a.

Marking Guidelines	Marks
• Type of compound identified	1

Protein

29.b.

Marking Guidelines	Marks
• Explanation in terms of differential survival and subsequent passing on of resistance to offspring.	2
• One of the above	1

Some individual insects may possess a genetic variation which makes them less susceptible to the toxin. They will survive and reproduce more successfully than the others. This resistance will be passed to their offspring and will become much more widespread in the population.

29.c.

Marking Guidelines	Marks
• One implication for society outlined and assessed – points for and/or against given.	4
• One implication for the environment outlined and assessed – points for and/or against given.	
• One of the above assessed, the other just outlined.	3
• One implication assessed OR both just outlined.	2
• One implication outlined.	1

Bt crops are more successful than conventional ones – on a large scale they are more economical. One positive implication for society is that this will allow more efficient large scale food production – resulting in more, cheaper food available for people. One negative implication is the fact that these crops are owned by large agribusinesses. Poor, small scale farmers will not be able to afford to grow them, they will be less competitive against the larger farmers and third world subsistence communities will be disadvantaged. One environmental implication will be the reduction in use of pesticides, this will be good for nearby natural ecosystems as these chemicals will be removed from their food chains. It will also have positive health implications for agricultural workers working with the crops.

29.d.

Marking Guidelines	Marks
• One ethical argument outlined.	2
• Explanation of why some people might hold to that view	
• One of the above.	1

Some religious people hold to the view that people do not have the right to interfere with species created by God. This view derives from their religious convictions. Creating Bt crops involves mixing genetic material from two species that would never normally come together.

30

Marking Guidelines	Marks
• The effect of each factor on diversity assessed	7
• The effect of 1-3 factors assessed. The others outlined	4-6

• Aspects of the four factors outlined, but not linked adequately to diversity	3
• Aspects of 2-3 of the factors outlined.	1-2

Mutation is a change in the DNA of a cell. Mutation is the only source of new alleles. It would have been a critical contributory factor to this diversity as it is the source of all new genetic material since that time. Genetic diversity is reflected in phenotypic diversity. Meiosis is the type of nuclear division that gives rise to gametes. Thanks to random segregation and crossing over, every gamete is genetically different from every other gamete and has new combinations of maternal and paternal chromosomes and new combinations of alleles. Meiosis doesn't produce new genetic material, it just allows new combinations of existing alleles. These new combinations give rise to a range of new phenotypes.

Sexual reproduction involves the combination of haploid gametes to produce a diploid individual. The combination of 2 unique gametes to produce a genetically unique individual further increases the phenotypic diversity.

Sexual reproduction and meiosis between them are essential contributors as they mix up the existing genetic material to give a range of phenotypes.

Natural Selection is the process by which individuals with favourable characteristics survive and reproduce more successfully than others, passing these characteristics on to their offspring and, over generations bringing about change to the population. Isolated populations would have been subjected to different selection pressures. Features such as light skin would have become common in Northern populations. Tall, angular body shape would have become more common in hot tropical areas. In this way natural selection would have been essential in producing the regional and racial phenotypic diversity that we see today.

Section 2 Options

Question 31. Communication.

a.i.

Marking Guidelines	Marks
• Correct cell named	1

Neurone

a.ii.

Marking Guidelines	Marks
• Description of how a stimulus generates an impulse	3
• Role of threshold potential outlined	
• One of the above OR both done less well.	2
• One done poorly	1

A stimulus generates a nervous impulse by causing the movement of ions across the axon membrane leading to a reversal of its normal polarity. This reversal then travels along the axon. This is an all or nothing response. Once enough ions have moved to reach a 'threshold' of polarity change, then the complete reversal proceeds automatically and the impulse is transmitted. If the stimulus is not sufficient to reach this threshold then the polarity reversal doesn't happen and the impulse isn't transmitted.

b.i.

Marking Guidelines	Marks
• Range of each animal related to an aspect of its lifestyle.	2
• Range of 1 animal related to lifestyle.	1

Human – up to about 23000 Hz. Human language relies upon clear hearing of sounds in the lower end of this range – the frequencies generated in speech. It is much more important for humans to hear well in this range than to hear higher frequencies.

Plus one of:-

Dogs – up to about 45,000 Hz. Dogs are nocturnal hunters, the ability to hear the high frequency sounds of small prey animals is very important for their survival.

Whales – up to about 120,000 Hz. Water is a very good conductor of sound. Whales use sonar for navigation under water. High frequency sounds are useful for this.

Mice – up to about 90,000 Hz. Mice are nocturnal, they communicate with high pitched sounds that cannot be heard by all their predators. This also allows them to hear predators which use high pitched sounds.

b.ii.

Marking Guidelines	Marks
• One similarity described.	3
• One important difference described.	
• One of the above	2
• Facts given about either with no comparison.	1

Humans produce sound by passing air from the lungs over the vocal cords which vibrate to cause sound.

One similarity with grasshoppers is the fact that they also produce sound through vibration. However they produce these vibrations by rubbing their legs or wings against special structures on their abdomens. They don't do it through passing air.

b.iii.

Marking Guidelines	Marks
• One aspect of structure given and linked to its function	2
• Aspect of structure or function given without linking.	1

The eardrum is a thin, taught membrane. This allows it to vibrate in response to sound waves and transfer these vibrations to the ossicles of the middle ear.

c.

Marking Guidelines	Marks
- Methods of action, effectiveness as substitutes and implications for society of each described. - Similarities and differences between devices outlined for each of the above.	6-7
Two of the above, or all three done less well.	3-5
Facts about each device given	1-2

The bionic eye and the cochlear implant both have sensors which capture light and sound respectively outside the body. They both process that input and feed it into nerve tissue. Both devices bypass the parts which process the input and convert it into nervous impulses. The bionic eye bypasses the refractive media of the eye and the rods and cones of the retina, the cochlear implant bypasses the eardrum and ossicles, as well as the hair cells of the organ of Corti. In these ways they are very similar. One obvious difference is the fact that the bionic eye detects light and the cochlear implant, sound. Both devices provide less effective hearing or sight than functional ears or eyes because of the limited number of electrodes able to synapse with nerve cells. The bionic eye, with only 98 points of light will probably be a less effective substitute than current model cochlear implants. Both devices have major implications for society. They both allow people who were functionally blind or deaf to function much more effectively within society – with major benefits for them personally and for society as a whole.

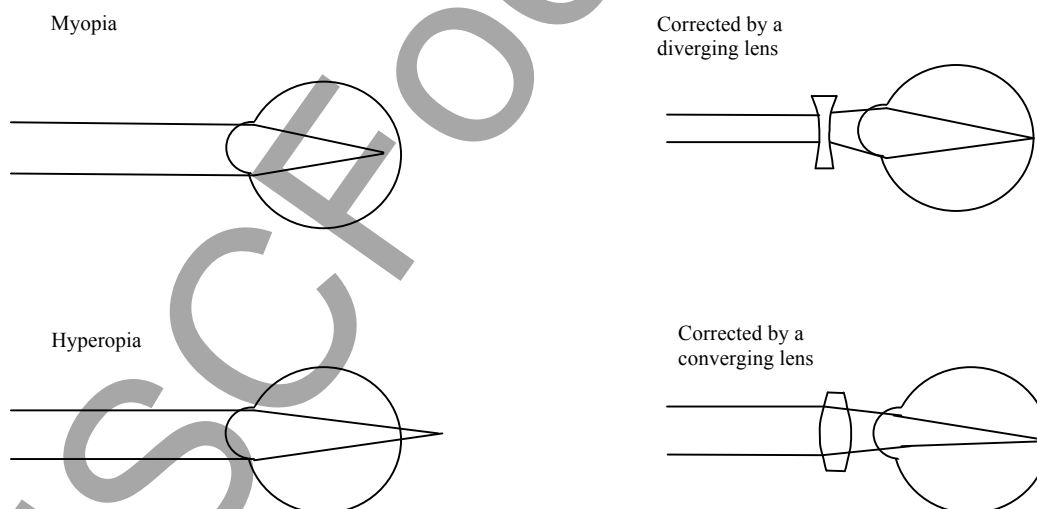
d.i.

Marking Guidelines	Marks
Causes of myopia and hyperopia described and related to defects of the eye.	3
One of the above described OR both done less well.	2
One done poorly	1

Sufferers from myopia produce an image in front of the retina. This can be due to refractive media in the eye which bend the light too much ie. a lens which is too thick, or an eyeball which is too long.
Sufferers from hyperopia produce an image behind the retina. This can be due to refractive media which don't bend the light enough, ie a lens which is too inflexible, or an eyeball which is too short.

d.ii.

Marking Guidelines	Marks
- Diagram drawn showing use of converging lens to correct hyperopia - Diagram drawn showing use of diverging lens to correct myopia.	4
One of the above and the other done less well	3
One of the above OR both done less well.	2
No diagrams. Converging and diverging lenses correctly suggested.	1



Question 32. Biotechnology

a.i.

Marking Guidelines	Marks
- Definition of biotechnology given - Explanation of why selective breeding fits this definition.	2
One of the above	1

Biotechnology is the use of plants and animals and biological processes for human benefit. Selective breeding makes use of reproductive processes to produce plants and animals with characteristics useful to humans – therefore it can be thought of as a biotechnology.

a.ii.

Marking Guidelines	Marks
Two key events outlined	2

• One key event outlined	1
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Yeasts are naturally occurring fungi and their first uses in fermentation occurred in prehistory. Most likely the events that led to their use in making alcohol would have been the discovery that stored grain fermented and also the discovery that fruit fermented if left uneaten.

a.iii.

Marking Guidelines	Marks
• Ethical arguments made in favour and against a named biotechnology	3
• One of the above, or both done less well.	2
• One done poorly	1

The production of transgenic organisms is a new area of biotechnology which has generated ethical debate. It involves introducing genetic material from one species into another. One example is the introduction of genes for cancer into mice to produce strains of mice which develop tumours which can be used in cancer research. One ethical justification for this is that it will help produce treatments and cures for cancer which will be of great benefit to humans. One ethical argument against it is that it causes great suffering to the mice – trespassing on their rights as living animals.

b.i.

Marking Guidelines	Marks
• Correct sequence given	1

AGACT

b.ii

Marking Guidelines	Marks
• Role of each outlined	4
• Significance of base sequence of each outlined.	
• 1-3 of the above	1-3

mRNA carries the code (base sequence) which has been transcribed from the template strand of the DNA molecule. Its role is to take that code from the DNA to the site of polypeptide synthesis and then be used as a template for the production of a polypeptide. tRNA is a molecule which binds to free amino acids in the cytoplasm. Each tRNA has a triplet of exposed bases (anticodon) which is specific to the amino acid it is bound to. Its role is to transport the amino acid to the ribosome and align itself on its complementary codon on the mRNA molecule. In this way the base sequence on the mRNA molecule determines precisely which tRNA molecules will be attracted to it, and hence what the sequence of amino acids will be in the polypeptide produced.

c.

Marking Guidelines	Marks
• At least three advances in industrial fermentation outlined.	6-7
• Each one linked to advances in scientific knowledge or technology.	
• Two of the above OR all three done less well	3-5
• One of the above, or two done less well	1-2

Large scale production of alcohol was made possible in the early eighteenth century by the discovery of techniques to avoid contamination of material and distillation techniques to allow production of pure alcohol.

Louis Pasteur discovered the role of bacteria in the spoiling of wine. He showed that heating killed these bacteria and prevented the spoiling. This heating, or pasteurisation is an important technique nowadays in industrial fermentation.

Strain isolation techniques developed in the 1940s allowed useful strains of microorganisms such as *Penicilium* fungi to be extracted from mould cultures and then cultured itself to produce useful compounds such as penicillin.

d.i.

Marking Guidelines	Marks
• At least three steps outlined	3
• 1-2 steps outlined	1-2

Firstly restriction enzymes are used to cut out the desired gene from DNA. These enzymes cut at a specific base sequence and leave characteristic 'sticky ends'. The same restriction enzymes are then used to cut into a bacterial plasmid – leaving the same sticky ends. The gene is then allowed to join with the plasmid – binding to the complementary sticky ends, and ligase enzymes cause the sugar and phosphate groups to join up and complete the altered plasmid.

d.ii

Marking Guidelines	Marks
• Points given for and/or against the use of vectors in the production of multicellular transgenic organisms.	3
• One point given, or two points discussed less well.	2
• One point discussed poorly	1

Vectors are useful in producing transgenic multicellular organisms because they are able to deliver DNA directly to the nucleus which is difficult to reach by other techniques. They also have the potential to reach a lot of cells in the organism. Viruses are a good vector – they are able to insert DNA into chromosomes. One disadvantage of this technique is the fact that the body's immune system will quickly develop antibodies against viral vectors, making follow up procedures difficult.

Question 33. Genetics. The Code Broken?

a.i.

Marking Guidelines	Marks
• Correct answer given	1

Gene linkage occurs when genes are on the same chromosome.

a.ii.

Marking Guidelines	Marks
• Frame shift and base substitution mutations described	4
• Potential effects of both on polypeptide explained.	
• 1-3 of the above	1-3

A frame shift mutation occurs when a new base is inserted into a DNA sequence. A base substitution occurs when an existing base is replaced by another one. Each group of three bases in the DNA molecule codes for a specific amino acid in the polypeptide coded for by the gene. A base substitution changes one of these groups of three and therefore can lead to a change of one amino acid in the resultant polypeptide. A frame shift mutation however, shifts all the bases along, changing every group of three 'downstream' of the mutation. This can change every amino acid from this point, or include 'nonsense sequences which will not code for amino acids and thereby disrupt polypeptide synthesis.

b.i.

Marking Guidelines	Marks
• Correct answer given	1

AGACT

b.ii.

Marking Guidelines	Marks
• Role of mRNA in transcription and translation described	2
• One of the above or both done less well	1

mRNA is the molecule which carries the transcribed code (base sequence) from the template strand of the DNA molecule to the ribosome. At the ribosome it acts as the template for the translation of that code into a polypeptide molecule. Each triplet of bases acts as a codon which attracts a tRNA molecule bound to a specific amino acid. In this way a polypeptide with a sequence of amino acids precisely determined by the sequence of bases is produced.

b.iii.

Marking Guidelines	Marks
• 3 steps outlined in process	3
• At least one enzyme named in process	
• 2 steps outlined	2
• Some details of the process given	1

In the event of a mutation the DNA can sometimes repair itself. This involves 3 steps.

- Removal of damaged section of DNA. Endonuclease enzyme opens DNA chain, exonuclease enzyme removes one nucleotide at a time from the end of the strand.
- Filling in the gap. New nucleotides fill the gap, lining up on the complementary strand.
- Joining sections. Ligase enzyme joins the new nucleotides into the sugar-phosphate chain to complete the repair.

c.

Marking Guidelines	Marks
• Two modern advances described	6-7
• Earlier discoveries or developments described and their links to the modern advances shown.	
• One modern advance linked to previous work	3-5
• Information given about another advance	
• Information given about modern advances	1-2

Gene therapy is a modern and developing genetic technology. It involves inserting genetic material into patients to help treat them for disease. For example Cystic fibrosis sufferers, who lack a gene for the production of an important enzyme, can be given that gene in a way that allows it to be taken up by cells in the lungs. This technology would never have been possible without previous research on restriction enzymes, allowing the gene to be precisely extracted from DNA before being cloned and used.

Whole animal cloning is another modern genetic technique. It involves taking a nucleus from an animal's body cell, placing it into an enucleated egg cell and implanting it into a surrogate mother, where it develops into a new animal. This technology could never have been developed without the earlier development of microinjection and in vitro fertilisation techniques.

d.i.

Marking Guidelines	Marks
• Genotypes of parents given	3
• Co-dominance outlined	
• Cross performed to show how group O can result	
• Less thorough explanation	1-2

The allele for group O is recessive (i). The alleles for groups A and B are co-dominant (I^A and I^B). In a cross between a heterozygous blood group A person ($I^A i$), and a heterozygous group B person ($I^B i$) there is a 25% chance of a double recessive child – group O.

d.ii

Marking Guidelines	Marks
- Example given - Gradation of phenotypes explained in terms of polygenic control	3-4
Poorer explanation	1-2

Human skin colour is a trait under polygenic control. This means that it is controlled by more than one gene. In skin colour there are at least three genes, each with two alleles, controlling for melanin production, which gives dark skin. This means that a person can have any number from 0 – 6 melanin producing alleles, giving 7 different shades. With environmental effects such as the sun also affecting skin colour, in practice this means that there is a gradation from very light to very dark in the population, rather than 7 distinct forms.

Question 34. The Human Story

a.i.

Marking Guidelines	Marks
Species named	

Homo habilis

a.ii.

Marking Guidelines	Marks
- Scientist named - One aspect of work described and explanation of how it has increased our knowledge given	3-4
Scientist named and an aspect of work described.	1-2

Johansen discovered the fossil remains of 'Lucy'. She had many human like characteristics, such as upright posture, but ape like characteristics such as small brain and ape like jaw shape. Lucy is an Australopithecus afarensis thought by many, including Johansen to be a direct human ancestor. Johansen's work helped to show the probable path of human evolution.

b.i.

Marking Guidelines	Marks
Two features named	2
One feature named	1

Forward facing eyes, giving it stereoscopic vision. Opposable thumb and forefinger.

b.ii

Marking Guidelines	Marks
- Table with headed columns. - Correct information about each characteristic for each species. (9 pieces of info)	4
Table with 7 correct pieces of info	3
Table with 5 pieces of correct info	2
3 pieces of correct info.	1

	prosimian	Spider monkey	human
Hand/foot structure	Thumb opposable to forefinger	Thumb opposable to forefinger	Thumb opposable to all fingers
Head shape	Prominent snout, forward facing eyes	Much less prominent snout than prosimian.	Very reduced snout, much larger cranium than prosimian or spider monkey.
stance	Four legged stance	Four legged stance	Upright, 2 legged stance.

c.

Marking Guidelines	Marks
- Two points given for and /or against the proposition - At least one past and one future effect discussed.	6-7
As above, but with three links poorly shown	3-5
Some facts given about human evolution and cultural development.	1-2

Human evolution and cultural development are closely linked. For example, the large human brain requires babies to be born at a relatively undeveloped stage compared to other primates. This means that they are helpless and require a great deal of parental care – leading to the cultural development of large family groups and the potential for parents to teach their offspring. This in turn has placed a strong selective advantage on any genes that enhance the ability to communicate – they place their owner at an advantage. These conditions have led to development of language and complex social structures. For cultural development to have an impact on human evolution in the future it has to affect the differential survival of genes from generation to generation. One major recent development has been in the field of infertility treatment. This allows people who would otherwise not have children to have them. This removes a selective pressure, causing an evolutionary change.

d.i.

Marking Guidelines	Marks
Difference in inheritance of mtDNA and chromosomal DNA outlined.	2

• Explanation of how this makes mDNA a useful tool.	
• One of the above	1

Mitochondrial DNA is found in the mitochondria. It has a purely maternal pattern of inheritance as mitochondria are self replicating and everyone receives their first mitochondria in the cytoplasm of their egg – from their mother. Chromosomal DNA, on the other hand is inherited from both parents and meiosis ensures that it is mixed up when reproduction occurs. This means that mDNA remains unchanged from generation to generation, except by mutation. Therefore the degree of relatedness of two groups can be inferred from the similarity of their mDNA. The longer ago they diverged, the more dissimilar their mDNA will be.

d.ii.

Marking Guidelines	Marks
• Genetic diversity defined or definition inferred.	3
• Two reasons suggested	
• Two of the above	2
• One of the above	1

Genetic diversity is a measure of the variety of genes present in a population, the number of different alleles. One reason why humans show greater genetic diversity than any of the apes is the comparative sizes of our populations. There are six billion humans, and no great ape species even reaches one million in population. A population that is that much larger is going to experience a greater total of mutations and hence will have a greater genetic diversity.

A second reason is the fact that humans can live in such a wide range of environments. Natural selection will favour some alleles in one environment, but other alleles in another – maintaining a wide range of alleles in the population. Each species of ape, however, lives in quite specialised environments. Its populations are subject to similar selective pressures and therefore it will have smaller genetic diversity.

d.iii.

Marking Guidelines	Marks
• One example of each described	2
• Only one example described	1

Stratigraphic correlation is an example of a relative dating method. Fossils can be dated relative to fossils in deeper rocks, which are older and shallower rocks which are younger. Radioactive dating is an absolute dating method. By measuring the ratio of a radioactive isotope to its breakdown product in a fossil the age of the fossil can be calculated if the half life of the isotope is known.

Question 35. Biochemistry

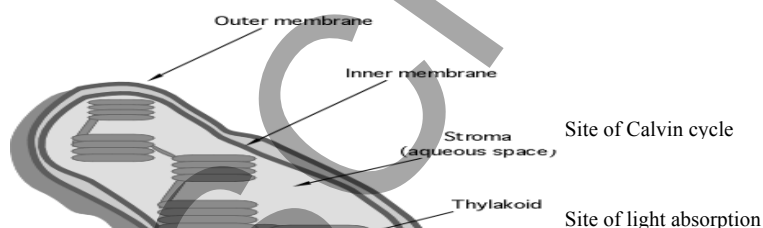
a.i.

Marking Guidelines	Marks
• Average size given	1

About 3μ by 6μ .

a.ii

Marking Guidelines	Marks
• Good drawing	3-4
• Sites of light absorption and Calvin cycle correctly labelled	
• Poor drawing	1-2
• Only one site correctly labelled	



b.i.

Marking Guidelines	Marks
• Both techniques described	4
• Importance of each technique discussed.	
• 1-3 of the above	1-3

Homogenisation is the process by which plant cells are ground in a blender. This breaks down membranes, but doesn't damage the internal parts. This is a very important research tool as it allows components of cells to be isolated so that their reactions can be studied. Centrifugation involves spinning the homogenised plant material, so that denser components settle to the bottom and progressively less dense further up. This is also a very important tool as it allows different cell fractions to be separated so that they can be further studied.

b.ii.

Marking Guidelines	Marks
• Ruben's experiment described	3
• Some aspects of Ruben's experiment described	1-2

Ruben procured water which had been labelled with oxygen-18, a heavy isotope of oxygen. He provided photosynthesising plants with this water and used a mass spectrometer to trace the oxygen-18. He found no O-18 incorporated into the tissues of the plant – rather it was in the oxygen released by the plant as O₂ during photosynthesis. From this he concluded that the oxygen released by a plant during photosynthesis comes from the breakdown of the water molecule.

c.

Marking Guidelines	Marks
• Work of three scientists outlined.	6-7
• Importance of previous work to each of these explained.	
• Links between scientists poorly made	3-5
• Some information about the work of some scientists given.	1-2

Hill and Scarisbrook were investigating the fate of water in photosynthesis. They deprived plant cells of CO₂ and provided the with a different hydrogen acceptor. They showed that the water molecules were broken down and that oxygen was released.

Ruben investigated this further by using oxygen-18 and showing that all the oxygen in water is released into the atmosphere

Hill and Scarisbrook had not been able to show that the CO₂ accepted the hydrogen.

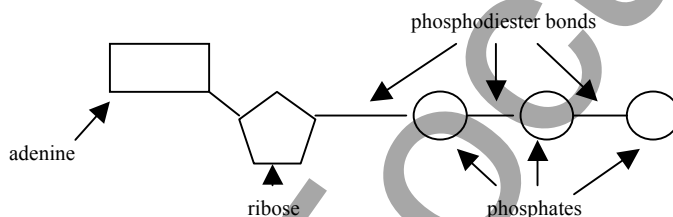
Ruben and Kamen were investigating the fate of carbon during the early stages of carbon fixation in the early 1940's. They used a short lived isotope of carbon, carbon-12, but its half life was too short to give useful results. They then discovered carbon-14 and determined its half life.

Ruben died and Kamen was unable to proceed. Calvin and his team built on the work of Rubin and Kamen by using carbon-14. They identified the intermediate compounds of the Calvin cycle by exposing an alga to C-14 and then every few seconds placing samples in alcohol. This killed the samples and allowed the radioactive compounds in each to be determined and hence the sequence of compounds to be worked out.

d.i.

Marking Guidelines	Marks
• Outline of structure of ATP	3
• Explanation of role in biochemical reactions linked to ATP structure.	
•	1-2

ATP consists of an adenine subunit, a ribose sugar and three inorganic phosphate subunits. The phosphates are held together by high energy phosphodiester bonds.



The ATP molecule releases energy to biochemical reactions by releasing one of its phosphates to give ADP and an unbonded phosphate. The breaking of the phosphodiester bond releases the energy.

Marking Guidelines	Marks
• Role of ATP in light reactions outlined.	3
• Role poorly outlined	1-2

ADP in the light reaction acts as an energy vehicle. Its role is to take up the energy from light. It picks up energy in the form of a high energy bond when it combines with an inorganic phosphate group to make ATP.

ATP then provides the energy which drives the Calvin cycle.