NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 3, 2004

Biology

Describe gene expression (90715)

Describe animal behaviour and plant responses (90716)

Describe patterns of evolution (90717)

Describe applications of biotechnological techniques (90718)

Describe trends in human biological and cultural evolution (90719)

National Statistics

Assessment Report

Assessment Schedule

Biology, Level 3, 2004

General Comments

Candidates gaining Achievement were familiar with the terms used in the standard and read questions carefully to identify key words that applied in the contexts used. They had knowledge of the concepts outlined in the achievement standards and were familiar with current advances in biology. Their answers were relevant to the context and did not simply repeat the question or resource material. They had taken note of the terms described in the last explanatory note of each standard. They approached all questions with knowledge that evidence for Achievement can be supplied in answers in all questions. Those who were assessed as Not Achieved lacked one or more of these.

The requirements for Achievement are similar for all standards in that candidates must give characteristics of, or an account of, the criteria that are outlined. The description provided by the candidate must be accurate and concise. Candidates do not necessarily need to use all of the space given to provide enough evidence for the assessor.

The marking panels for all achievement standards noted that some candidates regurgitated facts that were not pertinent to clear answers, and that the legibility of many scripts was poor. Candidates must realise that to have their script's evidence considered by an assessor, it needs to be able to be read.

Biology: Describe gene expression (90715)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
7,552	50.5%	33.9%	10.9%	4.7%

Assessment Report

To describe gene expression, candidates had to give the characteristics of, or an account of, the concepts and processes relating to gene expression. Candidates gaining Achievement were able to recognise and use appropriate concepts and processes specified in the achievement standard. These candidates could accurately give the characteristics of protein synthesis, nucleotides and mutations, and gave accounts for allele interactions, gene-gene interactions and factors that affect gene expression. Candidates need to have clear understanding of the concepts and process in the explanatory notes of the achievement standard.

Candidates gaining Achievement could competently use Punnett squares and draw simple metabolic pathways. They identified and described key concepts and processes accurately in context, and used resource material effectively to answer questions. These candidates realised that resource material given at the beginning of a question can be used in all parts of the question. They also picked key words from information given in the questions and incorporated relevant characteristics or accounts of these terms in their answers. They answered the questions asked and did not just repeat the question.

Candidates should attempt all questions as the 'explain' and 'discuss' questions incorporate evidence that can contribute to Achievement.

The candidates who gained Achievement with Merit or Achievement with Excellence showed they had formed meaningful links between ideas to explain the context given and could compare differences in concepts and processes, such as factors involved in gene function or integrating diagrams into explanations of phenotypic outcomes or metabolic pathways.

Assessment Schedule

Biology: Describe gene expression (90715)

Evidence Statement

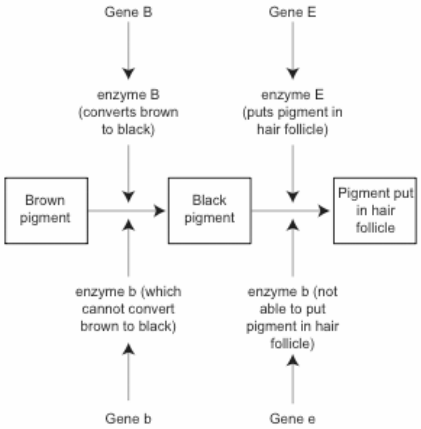
	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe biological ideas relating to gene expression.	Explain biological ideas relating to gene expression.	Apply biological ideas relating to gene expression.
Q	**Evidence contributing to Achievement**	**Evidence contributing to Achievement with Merit**	**Evidence contributing to Achievement with Excellence**
1(a)	Identifies the process as pleiotropy / **multiple phenotypic** effect of a gene.	Explains **pleiotropy** with links to metabolic pathway(s) / multiple phenotypic effects / physiological effects eg • The gene produces a product which is involved in a branched biochemical pathway, a mutation in the gene therefore affecting the different branches. • The gene produces an enzyme that is common to a number of metabolic pathways. Mutation of the gene will then cause a block in these otherwise unrelated pathways.	
1(b)	Identifies the exchange as translocation / parts of non-homologous chromosomes being swapped over / breaks in chromosomes are normally repaired correctly back together / allele on homologue functional when new allele is not / recessive / lethal / such mutations do not normally produce a functional protein / occurs in a somatic cell so not seen until many divisions have occurred. Not degeneracy.	Explanation of why such mutations rarely result in phenotype changes because of repair / not passed on / drastic changes / death, eg • If chromosomes break during meiosis they are normally repaired back correctly; only seldom are they repaired back onto the wrong chromosome. • Such mutations are usually not passed on to offspring as the chromosomes can't pair easily for further meiosis to occur. • The resulting change causes such drastic changes to the individual that it usually dies before the change can get passed on.	
1(c)	Description of transcription factors as any protein / enzyme (other than RNA polymerase) that is required for transcription.	Explanation of how transcription factors (are proteins other than mRNA polymerase that) enhance mRNA production, eg • Transcription factors are any protein other than RNA polymerase that is required for transcription. They appear to bind to RNA polymerase, or sequences on the DNA or other transcription factor proteins and enhance the production of mRNA by the target gene until a terminator nucleotide sequence is reached, which stops mRNA production.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(d)	Any description relating to genes forming functional proteins / polypeptides. Eg • A gene is a length of bases along the DNA / chromosome that codes for one protein. • A change in the sequence on the chromosome will : change the protein formed / stop that protein being formed.	Explanation shows why you would expect the new gene sequence to be ineffectual Eg A gene is the sequence of bases along DNA that codes for one protein. If the gene has a large part of itself replaced by another sequence, then it usually forms a completely different protein which probably does not function in the same way or is not functional at all.	Discussion justifies why it is remarkable that the new gene sequence forms a functional protein in terms of DNA codes / protein shapes. Eg A gene is the sequence of bases along DNA that codes for one protein. Proteins are made up of amino acids. There are 20 amino acids that make up proteins and the order, and how many of them are linked together, determines what the protein is and does. These amino acid sequences are coded for by sequenced triplets of bases on the DNA. If the DNA has a large part of the sequence replaced by another sequence, then it usually forms a completely different protein which probably does not function in the same way or is not functional at all. This is like the large change in sequence shown when parts of chromosomes 22 and 9 are exchanged. It is very unlikely that such a large change would make a functional cell protein so the fact that it does function is rare.
1(e)	Description of one difference in the nucleotide of DNA and RNA, either sugar or base Eg • DNA nucleotides contain the sugar deoxyribo(se) and RNA nucleotides the sugar ribose. • DNA nucleotides contain the base thymine and RNA nucleotides thymine is replaced by uracil.		
1(f)	Description relates to translation, eg: • stops translation • stops genetic information being transferred between mRNA and tRNA.		

<table>
<tr><th>Q</th><th>Evidence contributing to Achievement</th><th>Evidence contributing to Achievement with Merit</th><th>Evidence contributing to Achievement with Excellence</th></tr>
<tr><td>1(g)</td><td>Description identifies what may or may not be changed eg
• The bases must still be able to pair up.
• The drug must still be able to bind to the target sequence/nucleic acid.
• A change in the nucleotides will stop the drug/enzyme working properly.
• can change the backbone / sugar / phosphate</td><td>Explanation of what may or may not be changed in the nucleotides, eg
• Enzymes are specific and the enzymes that break down DNA or mRNA will only break down true DNA or mRNA. If the nucleotides are altered, these enzymes could not break them down because they could not recognise the structure.
• If the bases are altered the drug will not have the correct binding code to lock into the right place and do its job.
• The sugar / phosphate can be changed because this will not affect the drug locking into the right site to work effectively.</td><td>Discussion gives reasons for what is and is not changed eg
Enzymes are specific and the enzymes that break down DNA or mRNA will only break down true DNA or mRNA. However the base pairing rules of the nucleic acids are also specific so, if bases are changed, the drugs may not be effective. So to keep the drugs effective, the bases should stay the same but the backbone holding them together can be changed so that the nucleotides are altered and can no longer be recognised by the nuclease enzymes. So scientists are trying to change the sugars or phosphates.</td></tr>
<tr><td>2(a) (i)</td><td>Description of sex linked.
Eg: Sex linked refers to genes that are carried on a sex chromosome (other than those that affect the sexual characteristics).</td><td></td><td></td></tr>
<tr><td>2(a) (ii)</td><td>Description relating to identification of the parents or to lethal alleles or completes Punnett square correctly.
Eg:
• Yellow/F: dominant to grey/f
• Lethal alleles are involved
•
<table><tr><td>Eg:</td><td>F</td><td>f</td></tr><tr><td>F</td><td>FF</td><td>Ff</td></tr><tr><td>f</td><td>Ff</td><td>ff</td></tr></table></td><td>Explanation links cross/ Punnett square to lethal FF
<table><tr><td>Eg:</td><td>F</td><td>f</td></tr><tr><td>F</td><td>FF</td><td>Ff</td></tr><tr><td>f</td><td>Ff</td><td>ff</td></tr></table>FF: die
Ff: Yellow
Ff: Grey</td><td>Uses Punnett square to justify FF as a lethal combination with links to offspring numbers or ratio
<table><tr><td>Eg:</td><td>F</td><td>f</td></tr><tr><td>F</td><td>FF</td><td>Ff</td></tr><tr><td>f</td><td>Ff</td><td>ff</td></tr></table>FF: die
Ff: Yellow 208 2
Ff: Grey 96 1
ie: 1 FF (lethal) : 2 Ff Yellow : 1 ff grey</td></tr>
</table>

<table>
<tr><th>Q</th><th>Evidence contributing to Achievement</th><th>Evidence contributing to Achievement with Merit</th><th>Evidence contributing to Achievement with Excellence</th></tr>
<tr>
<td>2(b)</td>
<td>
Description relating to the genetics of coat colour in labs, eg:

Labrador coat colour is an example of epistasis / supplementary genes / nonallelic gene interaction.
The simple metabolic pathway has two steps where the genes act.
One of the genes masks the effect of the other

<table>
<tr><td></td><td>BE</td><td>Be</td><td>bE</td><td>be</td></tr>
<tr><td>be</td><td>BbEe</td><td>Bbee</td><td>bbEe</td><td>bbee</td></tr>
</table>
</td>
<td>
Explanation links a Punnett square to the phenotype ratio or correctly links the genes involved in labrador coat colour to a simple two-step metabolic pathway.
Eg Punnett square
<table>
<tr><td></td><td>BE</td><td>Be</td><td>bE</td><td>be</td></tr>
<tr><td>be</td><td>BbEe</td><td>Bbee</td><td>bbEe</td><td>bbee</td></tr>
<tr><td></td><td>1
Black</td><td>1
Golden</td><td>1
Brown</td><td>1
Golden</td></tr>
</table>
Metabolic pathway drawn or described eg:


or
Gene E → Gene B
golden → brown → black

Or vice versa depending on Punnett square.
</td>
<td>
Relation of cross to metabolic pathway, resulting in recessive epistasis in Labrador coat colours. Answer links steps in metabolic pathway, and links metabolic pathway to the outcome of the cross shown as a punnett square.
Eg Punnett square
<table>
<tr><td></td><td>BE</td><td>Be</td><td>bE</td><td>be</td></tr>
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</table>
which can be explained by the fact that B is a gene that processes a brown pigment to a black pigment, so that individuals with at least one B allele in their genotype make black pigment and individuals with the bb genotype make brown pigment only. The second gene, E, encodes a product that allows for the deposition of dark pigment into the hair follicle. Individuals that have at least one E allele deposit dark pigment into the hair, while individuals that are ee cannot deposit dark pigment into the hair. This accounts for the Metabolic pathway shown in adjacent Merit column.

So black labs have the allele to produce black colour and the allele to allow it to be deposited in the hair. Chocolate labs are homozygous for the non-functional b protein/enzyme (cannot produce black) and have the allele for colour deposition, so their coat hair is brown instead of black. The golden labs are homozygous for the non-functional e allele, so they cannot deposit dark colour into their coats.
</td>
</tr>
</table>

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(c)	Description correctly sequences the genes as BAC/CAB (lower case ok) or identifies / uses the recombinants or correctly works out one of the map intervals or identifies that double crossovers may lower the apparent distance between the genes.	Explanation gives a valid reason for the order by giving map distances or compares double crossovers to the parentals, eg: 1. Map distance method: a-b interval = 42+43+6+9 = 100/1000 = 0.10 = 10 mu b-c interval = 42+43+140+145 = 370/1000 = 0.37 = 37 mu a-c interval = 140+145+6+9 = 300/1000 = 0.30 = 30 mu The b-c interval is the largest interval so A must be in the middle. The map can be drawn as B----$_{10mu}$----A--------$_{30mu}$------C (or CAB since order left to right is unknown, also lower case ok) 2. Order first method: The double crossovers are the rarest class: aBc and AbC Compared to the parentals: ABc and abC The locus that is different is A, and so A is in the middle. Then the recombinants for the b-a and a-c intervals need to be shown.	Explanation justifies a reason for the order by determining map distances or the discrepancy in the b-c interval by comparing it with the smaller intervals (a-b and a-c), eg: Map distance and order determined : justifies the distance of 37 mu between b and c as opposed to the expected distance of 40 mu as due to double crossovers recombining the furthest apart genes back into their original order, so that there appears to be less crossing over between them.
3(a)	Identifies that more females will be produced.	Explains why more females will be produced, eg: Eggs in these positions will develop into more females, who are needed more than males in a conservation situation.	
3(b)	Describes an effect of the environment on the gene expression of another species other than humans, eg: • Colder temperature on dark fur development in cats, rabbits or fur seals. • Light and chlorophyll development in any plant. • Use of juvenile hormone by some plants/humans to control an insect pest. • *Daphnia* helmet development in the presence of predatory midge larvae (*Chaoborus*) or any other such response brought about by a chemical produced by a competitor or predator. • In some fish (eg wrasse), the presence of a male causes all other fish in the group to develop as females. When he dies the dominant female then develops into a male for the group.		

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Provides evidence of **description** level answers relating to gene expression. **5 questions answered to A level**	Provides evidence of **explanation** level answers relating to gene expression. **6 questions answered at least 3 of them at M level**	Provides evidence of **discussion** level answers relating to gene expression. **6 questions answered, at least one of them to M level and two to E level**

Biology: Describe animal behaviour and plant responses (90716)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
7,682	14.7%	46.0%	35.4%	3.9%

Assessment Report

The title and assessment criteria of this achievement standard specify the description of animal behaviour and plant responses in relation to environmental factors. Candidates need to understand that they need to cover both if they are to achieve. This means attempting all questions. Successful candidates identified key words and focused on words in bold in the questions. They knew the terminology required to describe animal behaviour and plant responses in relation to environmental factors.

Candidates who gained Achievement could read the actogram, and were able to select key information to give the characteristics of tropisms, the outcomes of competition, and the reproductive behaviour of the birds specified. They used relevant information from the resource material of the questions to account for animal behaviour and growth responses in plants.

These candidates were able to present evidence effectively, they wrote answers without restating questions and used biological terms appropriately. Their answers did not include unnecessary information that might relate to the concept being questioned.

Candidates who gained Achievement with Merit or Achievement with Excellence were able to link context to concepts appropriately. They read questions carefully and succinctly linked relevant behaviours to environmental factors. They applied information rather than just associating it to the behaviour or response.

Assessment Schedule

Biology: Describe animal behaviour and plant responses (90716)

Evidence Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe animal behaviour and plant responses.	Explain animal behaviour and plant responses.	Discuss animal behaviour and plant responses.
Judgement	Provides evidence of **description** level answers relating to animal behaviour and plant responses. **6 correct: at least one P & one A**	Provides evidence of **explanation** level answers relating to animal behaviour and plant responses. **8 correct: at least 4 × M**	Provides evidence of **discussion** level answers relating to animal behaviour and plant responses. **10 correct: at least 4xM and 2 × E**
Q	**Evidence contributing to Achievement**	**Evidence contributing to Achievement with Merit**	**Evidence contributing to Achievement with Excellence**
1(a)	Identifies a distinctive feature of the crabs' activity pattern over the first three days. Eg: • two activity periods a day • is circatidal • onset of activity slightly later each day. NOT same time • period of the activity is the same • activity starts before high tide • one activity period of the day is longer than the other.		
1(b)	Describes how the chart shows it is an endogenous rhythm. Eg • rhythm persists over time • rhythm follows the tide pattern • rhythm continues.	Explains how the rhythm persists without cues in constant environmental conditions. Eg When the crabs were put in constant environmental conditions, the rhythm still continued without the tidal/external stimulus.	
1(c)	Describes one survival advantage of this activity behaviour or that the activity periods coincide with high tide. Eg • active when food present • avoid predators • active at high tide.	Explains an advantage of synchronising the activity with high tides. Eg Synchronises their activity with high tide so that they do not dry out / get too hot / get too cold / avoid predators like birds / get food.	Links **2 or more** advantages to the synchronisation of the crabs' activity with high tides. Eg Allow crabs to 'anticipate' tide coming in for feeding and allow crabs to cease activity in order to seek cover, so reducing predation. Synchronises activity with tides so avoiding dehydration / solar radiation / fresh water (rain) / freezing / overheating / predation from birds.

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(a)	Describes a benefit of the allelopathy shown. Eg • grass inhibits the growth of apple seedlings • would not have so much other plant material to compete with • the apple tree receives less light/nutrients/water • grass gets more light/nutrients/water	Explains a benefit of the allelopathy shown between grass and the apple seedlings. Eg The grass produces a chemical that inhibits the growth of apple seedlings, so the grass receives more light/nutrients/water	
2(b)	Describes part of the process but no explanation. Eg • grass/allelopathy prevents the growth of shrub or tree seedlings • reduces the amount of shelter available for animals • animals limited to grazers • reduction of species diversity • allelopathic substances influence the species involved in the succession.	Explains how allelopathic substances influence interspecific relations/succession linked to decrease in biodiversity Eg Grass produces inhibiting chemical that prevents the growth of shrub or tree seedlings, reducing the biodiversity. Eg: The inhibition of the growth of shrubs by the grass reduces the amount of shelter available for animals so preventing them exploiting the area./ Animals limited to grazers: which is a reduction of species diversity.	Multiple links extending discussion to include the effect the allelopathy has on later stages of succession beyond the immediate effect of the allelopathy and the reduction in biodiversity. Eg Grass produces inhibiting chemical(s) that prevent the growth of shrub or tree seedlings. This reduces the amount of shelter available for animals so preventing them exploiting the area. The animals are limited to grazers. This means that the species that frequent bush are not present and there has been a reduction in biodiversity.
3(a)	Describes a benefit of the behaviour. Eg • allows species identification • shows fitness of male to mate • stimulates the urge to mate. • reduces aggression • attract a mate • can select the 'best' male to mate with.	Explains a benefit of the behaviour. Eg • allows species identification so that the birds do not mate unsuccessfully/waste energy with a species they are not genetically compatible with • female mates with fit male bird so her offspring have good genes • stimulates the maturation of the ovaries for mating to be successful.	
3(b)	Describes what the 'best' bower is like Eg • biggest • most decorated • strongest. • best location for food/predators.		

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(c)	Describes a survival advantage of the females all mating with the same male in an area. Eg • All the offspring get the best genes. • The male can pass on his good genes to more offspring.	Explains a survival advantage of the females all mating with the same male in an area by linking fitness to large numbers of offspring with desirable genes. Eg Male with best genes produces large numbers of offspring that inherit genes, so the species has 'fit' offspring that are competitive / strong / healthy / when the birds fully mature.	
3(d)	Description that makes a correct statement about the age of the bower or the age of the birds occupying the bower, or the role of the bower in the reproductive strategy of the birds, or that birds need to successfully challenge for/defend a bower. Eg • Young birds not mature enough to hold a bower. • Birds may move from bower to bower as they get older. • Bowers are to attract females • Bowers are older than the birds • Old birds cannot defend a bower. • Over years bower added to by subsequent 'owners' • The fittest birds get the best bowers.	Explanation that links the age of the bower to the length of ownership of the bower or the role of the bower in the reproductive strategy or that birds need to successfully challenge for/defend a bower. Eg • Males compete for best bower. Young birds not mature enough to compete successfully/old birds too weak to compete successfully. • Birds may move from bower to bower as they become able to defend 'better' site. • Over years bower added to by subsequent 'owners' so becoming larger / more elaborate / stronger / more established. • Bowers are much older than the birds as subsequent 'owners' add to the bower.	Discussion that links the role of the bower in the reproductive strategy of the birds with the need for the male bird to challenge for/defend a bower successfully and the lifespan of the bower compared with the lifespan of the birds Eg Males compete for the bowers and young birds not mature enough to compete successfully. Birds may move from bower to bower as they become able to defend 'better' sites. As birds age, no longer able to defend bower / replaced by younger bird. Over years bower added to by subsequent 'owners' so becoming larger / more elaborate / stronger / more established and remain longer than the birds.
3(e)	Description of a factor that could ensure the type of parenting found. Eg • The chicks can't be left alone in NZ because it is too cold. • There is more food in a tropical forest. • There are different predators. • The nests/chicks are more easily seen in the NZ forest.	Explains why the single parent rearing of chicks is not found in New Zealand birds like robins. Eg • The New Zealand habitat of these birds does not contain sufficient food for one parent to raise the chicks successfully on its own. Two birds are needed to get enough food for the fast growing chicks. • The predators of young birds are different in New Zealand so one adult must be there to defend the chicks at all times. • The tropical forest provides more cover for the chicks than the temperate forest of New Zealand, so tropical chicks don't need as much protecting. • The nests are colder in New Zealand so one bird needs to keep the chicks warm at all times.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
4(a)	Geotropism/Gravitropism		
4(b)	Describes a benefit of the plant response or the effect of auxin on the root or describes the result of one experiment. Eg • The roots grow down into the soil quickly. • The plant can access water • Auxin causes the downwards growth of the root/positive geotropism. • The tip of the root produces the substance that causes the downwards growth. • A dense liquid barrier is not strong enough to stop geotropism being effective.	Links the growth response to a benefit for the plant or to auxin. Eg • The roots grow down into the soil quickly so that they can get water / anchor the plant. • Auxin produced in the tip of the root inhibits root growth in high concentrations. It concentrates on the bottom of the root so the root growth is inhibited there and not on the upper side. The root grows more on the upper side causing it to grow downwards / enabling it to access water.	Discusses the mechanism of geotropism to the effects seen in the experiments and relates it to the benefits it gives to the plant. Eg Response controlled by auxin, produced in root cap / tip, which diffuses along the root and has its effect further back – evidence if root cap removed no curvature. Auxin in high concentrations hinders cell growth of roots but in low concentrations it stimulates cell growth. Auxin is affected by gravity so that it concentrates on the lower parts of the root. When the seeds are treated as in the diagrams it concentrates on the bottom of the root, so the root growth is inhibited there and not on the upper side. The root grows more on the upper side causing it to grow downwards. A barrier does not interfere with growth / growth has considerable force as root continues to grow through mercury. The overall effect is of benefit to the plant because the roots grow down into the soil quickly so that they can get water / anchor the plant.
4(c)	Describes an observation from the results of the experiment in the Spacelab. Eg • Without gravity, roots grow in a more random way. • With gravity acting the roots grow downwards.	Explains the difference / no differences in the growth of the two sets of roots in relation to the force of gravity. Eg The roots only show a directional growth / positive geotropism type response when there is a force like gravity to respond to. Without this directional force they show haphazard growth.	

Judgement Statement

Provides evidence of **description** level answers relating to animal behaviour and plant responses. **6 correct: at least one P & one A**	Provides evidence of **explanation** level answers relating to animal behaviour and plant responses. **8 correct: at least 4 × M**	Provides evidence of **discussion** level answers relating to animal behaviour and plant responses. **10 correct: at least 4 x M and 2 × E**

Biology: Describe patterns of evolution (90717)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
7,520	64.3%	17.4%	14.7%	3.6%

Assessment Report

Successful candidates could identify and give the characteristics of, or an account of, the biological concepts and processes relating to patterns of evolution. They could describe the concepts behind the adaptive radiation pattern for the legume group containing the genus *Carmichaelia* and the Tree Wetas of Banks Peninsular.

These candidates could clearly identify key parts of the diagrams and resource material and used it to formulate their answers. They wrote clear descriptions that showed that they understood the concepts and processes involved in the resource. They did not repeat given information without applying concepts or processes to describe it.

Candidates gaining Achievement could give the precise characteristics of adaptive radiation, divergent evolution, punctuated equilibrium and polyploidy, as well as accounting for speciation and reproductive isolating mechanisms. They saw where their knowledge of these concepts and processes could be used to describe the patterns shown. Those candidates who had obviously had practice in writing paragraph style answers, could develop their descriptions better than those who just listed facts without referring to the resource material.

Candidates gaining Achievement with Merit or Achievement with Excellence integrated information from the resource material into their answers. They could link the information to ‘how or why’ the pattern occurred or use it to analyse or justify the patterns.

Assessment Schedule

Biology: Describe Patterns of Evolution (90717)

Evidence Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe biological concepts and processes relating to patterns of evolution.	Explain biological concepts and processes relating to patterns of evolution.	Discuss biological concepts and processes relating to patterns of evolution.
Q	**Evidence contributing to Achievement**	**Evidence contributing to Achievement with Merit**	**Evidence contributing to Achievement with Excellence**
1(a)	Description = Name - of the evolutionary pattern shown by the group of legumes. Eg • adaptive radiation • divergent evolution from an ancestral species (Note: it must be a **pattern** hence Divergence is not acceptable) • speciation due to geographic isolation.		
1(b)	Describes punctuated equilibrium. Eg • Change occurs mainly in a **spurt of evolutionary activity within a relatively short geological period** **AND** • Followed by **longer periods in which little or no change occurs**. (Must have **BOTH** parts)	Explains **why** the diagram supports the idea of **punctuated equilibrium**. • Describes **punctuated equilibrium** (as Achievement) **AND** • **Explains**, by referring to the diagram the "forked" or **branched pattern over time** as it appears in the diagram. (ie how does the diagram show punctuated equilibrium?) Eg in *Carmichaelia* genus for most of the period **there was very little change** but **almost simultaneously** nine new species developed.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(c)	Describe **ONE CHANGE** in **ONE** of:- Climate Landform Isolation that **could result in divergence**. Eg **Geographic isolation** leads to divergence. • Break-up of Gondwana/split of NZ from Australia caused **isolation** of the original group. • (ie **separation** from each other **over time**) • Geographically isolated by the Southern Alps • There was **climate change** that caused the change in the genera / species. Note: must have a **historical context** – **tense is important**.	Explains **how ONE CHANGE** in **ONE** of: Climate Landform Isolation **could link** to the divergence shown. Eg • Separation of New Zealand from Australia leads to **geographic isolation** where there are **different selection pressures in each area**, which causes divergence of species. • Climate changes like cooling or warming cause **changes in the sea level**, which change the isolation of areas. eg **When sea levels fall in cold times**, (land is more continuous and) species can disperse into new area with **different selection pressures.** eg **When sea levels rise**, small isolated pockets arise with different selection pressures again and so change occurs. • Changes in the landform due to earthquakes and volcanoes cause **new habitats** to form that have **different selection pressures**, which cause the divergence of species. • Adapted to differences in their niches Must show the **LINKAGE.**	Discusses the **LINKAGE** between **geographic isolation, climate and land form** in **bringing about the divergence** shown in *Carmichaelia*. Eg • Separation of New Zealand from Australia by continental drift **geographically isolated the ancestral species** on the New Zealand land mass. There were **different selection pressures** here than in Australia. Eg This would account for the differences in the genera found here (*Carmichealia* and *Clianthus*) {diverged earlier} from those in Australia (*Swainsona*). {diverged later} • **Subsequent changes in landform** have occurred because of earthquakes, volcanoes, climate changes and so, **sea level changes**. This has further isolated small groups within New Zealand from each other. (Eg) **In each isolated area there are different selection pressures which means that divergence occurs**. Slightly different selection pressures have eventually caused a range of new species to develop, **each adapted to a slightly different new niche.** • **Changes in climate** have been paramount in these changes in selection, as they have **restricted populations to very limited areas** at times of moderation and allowed **species to disperse widely** in adverse times, as lowering sea levels have allowed more continuous land than presently occurs. Eg This happened in the last ice age about 20 000 years ago, which could account for the genetic similarity of most of the *Carmichaelia* species and their late divergence once the **sea level rose and climate warmed up again**.

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(d)	Describes **ONE** appropriate method of dispersal that could account for *C exsul* being on Lord Howe Island. Eg • Birds (**not** Animals) • Rafting • natural land-bridges.	Explains **HOW** *C exsul* could have got to Lord Howe Island. Eg • **Birds carry seeds caught on their body, or in their digestive system, to Lord Howe Island**. Once the seeds are deposited on the island, they can grow and evolve. • Seeds or parts of the plant were **carried to Lord Howe Island by humans in boats** and evolved there. • During the last glaciation **Lord Howe Island was continuous with New Zealand**, and a *Carmichaelia* species established there subsequently evolved to form *C. exsul* after sea levels rose and isolated it there.	
1(e)	Describes how polyploidy can result in new species. Eg • In polyploidy a new plant forms that has an **extra SET of chromosomes** (**Not** extra chromosomes) **AND** • **cannot interbreed** with its parents.	Explains **HOW** polyploidy can result in new species. Eg (requires all these ideas) A new plant gets an **extra set** of chromosomes **owing to non-disjunction** / **failure of the chromosomes to separate during meiosis.** The new plant can self-fertilise but is **reproductively isolated from the parent stock**. Eventually a population of these plants grows that **cannot breed back with the parent stock and so they are a new species**.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2	• Describes **ONE relevant** feature that **keeps the species separate**. Eg • There are **reproductive isolating mechanisms preventing the species interbreeding**. • The different groups **do not successfully interbreed.**	• Explains **ONE relevant isolating mechanism** that keeps the species separate. • Eg species are kept separate by **prezygotic reproductive isolating mechanisms** that act **before** the species can mate successfully. Eg differences in behaviour that the other species will not recognise. • Species are kept separate by **post-zygotic reproductive isolating mechanisms** that act **after fertilisation.** Eg Embryos not being viable.	• Discusses **relevant featureS of species AND isolating mechanismS** that keep species separate **using the information** given on **wetas**. ie Needs reproductive isolating mechanisms **AND** a discussion of <u>both</u> post zygotic and pre-zygotic Eg • Biologically, species are a group of similar individuals that can **interbreed freely** in nature to **produce fertile offspring**. **Reproductive isolating mechanisms** prevent populations of related species in the same area/**sympatric populations** from interbreeding. Some of these act before mating occurs – **pre-zygotic** – and others after mating – **post-zygotic**. **The wetas show examples of both.** Eg For example they show **post-zygotic reproductive isolation** because there may be **hybrids** formed between species, but they are usually not viable because they **cannot form gametes**. This is probably because the chromosomes are so different that **meiosis breaks down**. Once they are separate species, reproductive isolating mechanisms that have separated them become obvious. **A pre-zygotic isolating mechanism** can be seen in the weta populations from Banks Peninsula as the different species with different numbers of stridulatory ridges would make **different sounds** which would be recognised only by members of their own species, and **so the different species would not recognise the mating signals of the other species and so would not try to mate with each other.**

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Provides evidence of **description** level answers relating to biological concepts and processes relating to patterns of evolution. Needs to gain: **At least THREE Achieved questions correct**	Provides evidence of **explanation** level answers relating to biological concepts and processes relating to patterns of evolution. Needs to gain: **At least THREE Achieved questions correct** **AND** **At least TWO Merit questions correct**	Provides evidence of **discussion** level answers relating to biological concepts and processes relating to patterns of evolution. Needs to gain: **At least THREE Achieved questions correct** **AND** **At least TWO Merit questions correct** **AND** **At least ONE Excellence question correct**

Summary

Achieved: 3 out of 6

Merit: 2 out of 5

Excellence: 1 out of 2

Biology: Describe applications of biotechnological techniques (90718)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
7,199	57.6%	34.8%	6.1%	1.4%

Assessment Report

Candidates gaining Achievement were able to give characteristics or an account of biotechnological techniques in the **context of relevant** applications, and applications in the context of meeting human needs or demands.

They were able to recognise relevant basic techniques, their applied uses and how they meet human needs or demands. They used key words in the questions and resource material to target relevant techniques that fitted the application inferred or stated in the resource material. They were able to describe for example, that tissue culture produced identical plants and to give a full account of this technique rather than just mention the technique.

Successful candidates answered enough of the questions to gain Achievement.

Candidates gaining Achievement had thorough knowledge of the applications of biotechnological techniques, and could use them to describe different contexts, rather than regurgitating rote-learned notes that do not really account for the context of the question. They did not use knowledge that was not related to the question just because they had learned it. They knew more than just PCR and gel electrophoresis, and could be precise without grasping for terms eg ‘insert the protein into the plasmid’ instead of ‘gene into the plasmid’. Their applications of the techniques were not weak.

Candidates gaining Achievement with Merit or Achievement with Excellence planned their answers and were able to link the applications of biotechnological tools to meet human needs or demands. They were able to keep their answers within the context of the question, and applied knowledge to it to interpret outcomes of biotechnological applications that meet human needs and demands. They understood that they had to explain how or why the application occurred, and could justify and evaluate the outcomes.

Assessment Schedule

Biology: Describe applications of biotechnological techniques (90718)

Evidence Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe applications of biotechnological techniques to meet human needs and demands.	Explain applications of biotechnological techniques to meet human needs and demands.	Discuss applications of biotechnological techniques to meet human needs and demands.
Judgement	Provides evidence of **description** level answers relating applications of biotechnological techniques to meet human needs and demands. **5 Grades**	Provides evidence of **explanation** level answers relating applications of biotechnological techniques to meet human needs and demands. **A plus 3 M or higher**	Provides evidence of **discussion** level answers relating to applications of biotechnological techniques to meet human needs and demands. **M plus 1E**
Q	**Evidence contributing to Achievement**	**Evidence contributing to Achievement with Merit**	**Evidence contributing to Achievement with Excellence**
1(a)	Describes an application of a biological technique that can be used to determine the range of genetic variability of *Wollemi* pines. Eg DNA profiling/genome analysis/DNA sequencing : can be used to compare the DNA(genetic variability) from a range of the pines**.**		
1(b)	A technique used to develop a population of *Wollemi* pines for botanical gardens is described. Eg Tissue culture/microculture/plant culture : creates genetically identical *Wollemi* pines/cloned **OR** Full description of process, eg Explant/plant tissue : placed in growth medium : Callus / undifferentiated cells : form plants which are planted out giving rise to identical seedlings.	Explains how a technique such as tissue culture/microculture could be used to establish populations that show diversity Eg Obtain **a range/variety** of stock plants : use Tissue Culture / plant culture/microculture : to produce genetically identical copies : of the range/variety of stock plants. **OR** Obtain **a range/variety** of stock plants : use tissue culture / plant culture/microculture : to establish the populations in botanic gardens, without the need to wait for seed production by mature plants / faster / quicker.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
1(c)	Describes a biotechnological technique that would ensure the *Wollemi* pines could be made resistant to die-back fungus. Eg Transgenesis /description of gene transfer : is used to insert the **desired** / **resistant** gene into *Wollemi* pines.	Explains how the *Wollemi* pines could be made resistant to die-back fungus, using the process of transgenesis or links a relevant concern of transgenesis to the situation. Eg Take organism resistant to fungus : identify resistant gene : cut using restriction enzymes : insert into plasmid using ligation : use suitable vector to infect pine. **OR** Concerns. 'Gene product may interact with the products of another gene.' / transfer process may disrupt the ability for the gene to offer resistance / the gene may insert in the middle of a vital *Wollemi* pine gene and disrupt the ability of that gene to function / the gene may only function sporadically because it is not inserted into a chromosome therefore disrupting its ability to offer resistance.	Discussion includes the sequence of techniques that would be used to make the *Wollemi* pines resistant to die-back fungus and considers relevant concerns of transgenesis that might occur when genes are inserted into *Wollemi* pines. Eg Take organism resistant to fungus : identify resistant gene : cut using restriction enzymes : cut plasmid using the same restriction enzyme : insert into plasmid using ligase enzymes : infect pine using a suitable vector (eg Agrobacterium) Analyse effect to ensure correct protein is produced ensuring resistance as we do not know how the product of the inserted gene will interact with the other gene products of the *Wollemi* pine genes / it may disrupt the ability for the gene to offer resistance / the gene may insert in the middle of a vital *Wollemi* pine gene and disrupt the ability of that gene to function eg produce a non-functional protein/ the gene may only function sporadically because it is not inserted into a chromosome. (Concerns could include discussion of a cultural or bioethical nature.)
2(a)	Describes that PCR produces more copies of the DNA for research. Eg (There are only small amounts of DNA available in the moa bones for research so) PCR allows more copies / replicates (not amplified) to be made, to make the research easier.		

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2(b)	Describes a biotechnological technique that would be used to sequence mitochondrial DNA, or compares profiles of mDNA. Eg DNA sequencing : identifies each base within the DNA./ DNA profiling : separates out repeated sections of DNA/ Gel electrophoresis is used to separate fragments/ or show differences in DNA makeup.	Explains how biotechnological techniques are used to determine similarities and differences in DNA to show that the moa specimens belonged to the same species. Eg Gel electrophoresis: **separates fragments according to size** : to provide a genetic profile of the moa: which can be **compared to profiles of living birds to show similarities and differences** **OR** DNA sequencing allows the order of the bases of the Moa and related living birds to be identified: and **compared to show similarities and differences** **OR** DNA profiling : allows separation of repeated sections of DNA: of the Moa and related living birds: which can then be **compared to show similarities and differences**	Discusses how biotechnological techniques can be used on the mitochondrial DNA to show that the moa were all from the same species by explaining how DNA sequencing can be used, and how the DNA profile produced can be compared to show similarities or differences using genome analysis. Eg Restriction enzymes are used to cut up the mitochondrial DNA to produce small fragments : Gel electrophoresis is used to separate the fragments according to size : to obtain a genetic profile of the moa and related living birds : which are compared and **sufficient similarities determine that there are not enough** differences to distinguish the bones as being from different species.
2(c)	Describes that nuclear DNA is much rarer than mitochondrial DNA/the need to compare the moa DNA with the known DNA of closely related living species. Eg There are lots more mitochondria / mitochondrial DNA in cells compared to chromosomes/ nuclear DNA. **OR** The karyotype/chromosome structure of living species of related birds is known and can be used to identify the sex of the moa that the bones were from **OR** Sex chromosome/nuclear DNA is needed to identify the sex of the moa	Explains that nuclear DNA is much rarer than mitochondrial DNA OR why there is a need to compare the moa nuclear DNA with nuclear DNA of known closely related living species. Eg There are lots more mitochondria in cells containing mitochondrial DNA **so it is easier to get their DNA** for comparison than nuclear or **sex** chromosome DNA, where there is only **one** (2) in each cell**:** The karyotype/chromosome structure of living species of related birds is known and can be used to identify the sex of the moa that the bones were from.	Discusses that nuclear DNA is much rarer than mitochondrial DNA, and why it was harder to 'sex' the moa bones because the sex chromosomes are only two of the nuclear chromosomes of birds, and why the nuclear material of living birds was needed for comparison. Comparison is made between the techniques, to sex the Moa's and to identify the species. (Why karotypes are used instead of sequencing.) Eg To sex the bones of the moa was much harder than just identifying that they belonged to one species: because nuclear DNA is rarer than mitochondrial DNA: because there is only one copy of nuclear DNA in each cell: whereas there are multiple copies of mitochondrial DNA in each cell: Then they had to compare the karyotypes/chromosomes/nuclear DNA, found: with those known from closely related bird species to determine what sex the specimen was from : to help determine whether the birds were from different species or just from different sexes of the same species of birds**:** a comparison is made between profiling and a karyogram

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3(a)	Describes transgenesis or outlines the process of transgenesis. Eg A gene is inserted into a relevant microorganism: enabling it to produce the required protein.		
3(b)	Describes one of the techniques of transgenesis into a micro-organism. Eg Restriction enzymes: cut at the gene of interest. OR Ligase enzymes: stick the gene of interest into the target micro-organism.	Explains how one of the techniques of transgenesis contributes to the production of the human protein. Eg PCR makes many copies of the gene: which will produce the (human) **protein** so that there is enough of the gene of interest to work with./ Restriction **enzymes:** can be used to cut the DNA at specific places: so that the gene of interest for the (human) **protein** is isolated. (The same restriction enzymes are used to cut the target bacterial plasmid and gene of interest) / Ligase enymes: are used to stick the desired DNA into the selected micro-organism: so that the (human) **protein** can be made by the bacteria.	
3(c)	Describes / identifies gene therapy Eg A faulty gene: is isolated and replaced replaced by a healthy/active gene.	Explains the sequence of techniques that would be needed to get a working gene into a human being. Eg Isolation of the gene of interest: which is inserted into the DNA: of a suitable vector: using restriction enzymes: and ligation: cloned and correct gene is delivered back into the human: enabling coding of the required protein.	

3(d)	**Describe <u>a</u> difficulty that could** occur when delivering a gene into a patient with a genetic disease. Eg: Gene may disrupt an existing gene./Gene product may interact with the products of another gene./Not enough of the cells may take up the gene for it to show./Wrong target tissue receives the gene./Sporadic function of the gen./Side effects – patients have an immunological response to the viral vectors.	**Explains how <u>a</u> difficulty of transgenesis into a patient could be considered and checked for ie uses a link to show understanding.** Eg: Gene product may interact with the products of another gene: so look for new proteins in the cell other than the desired gene product and those normally produced./ Gene may disrupt an existing gene: so note any protein not produced that had been produced before./the gene has been inserted and is functioning in the correct tissue: a check is made to ensure that the target tissue is making the required protein.	**Discusses how difficulties of transgenesis into a patient could be considered, checked for and a cure obtained. Ie uses multiple links to show understanding.** Eg: To find out if the gene has been inserted into the correct tissue: a check must be made to ensure that the target tissue is making the required protein: the patient needs to be monitored over an extended time period to check that the gene is creating a functional protein without malfunctioning ie providing the patient with a cure./A check would need to be made to ensure no genes have been disrupted: by monitoring their protein production: If disrupted their gene delivery would need to be repeated or the procedure modified: If this is then successful the patient can be monitored over an extended time period to ensure that all proteins are being made thus providing the patient with a cure. (This is an example only)

Judgement Statement

Provides evidence of **description** level answers relating applications of biotechnological techniques to meet human needs and demands. **5 Grades**	Provides evidence of **explanation** level answers relating applications of biotechnological techniques to meet human needs and demands. **A plus 3 M or higher**	Provides evidence of **discussion** level answers relating to applications of biotechnological techniques to meet human needs and demands. **M plus 1E**

Biology: Describe trends in human biological and cultural evolution (90719)

National Statistics

Number of Results	Percentage			
	Not Achieved	Achieved	Merit	Excellence
7,545	42.6%	50.0%	5.9%	1.5%

Assessment Report

Candidates gaining Achievement understood the key words in both the standard and the questions themselves. They could give an account of, or the characteristics of, trends in human biological and cultural evolution. For example they could describe skeletal changes brought about by the advance of bipedalism, changes linked to cultural evolution such as tool technology changes, communication changes and the evidence used to explain possible dispersal of hominids (more recently referred to as hominins). These candidates were able to use all key words in the questions such as ‘skulls’, ‘stone tools’, ‘tool technology’, ‘brain development’ and ‘Brocas and Wernicke’s areas’ to describe the trends.

Candidates gaining Achievement used relevant information to write clear descriptions using correct terminology of the trends questioned. They could correctly interpret information from a graph or diagram and use this information in their response to the question. They recognised that when a comparison is required, they were to describe how a feature of both items, such as ape foot / human foot, *Homo* skull / *Paranthropus* skull, differed. For example, not just that the ape foot has an opposable big toe, but also that humans have their toes in line. They were aware of current information and were able to write a clear account of the two main theories of the dispersal of humans using this information.

Candidates gaining Achievement with Merit or Achievement with Excellence made links between differences by saying how or why the difference had occurred, eg they explained the differences in the feet of apes and humans in relation to their movement. These candidates could also link resource information, graphs and diagrams to trends in tool technology and dispersal theories. The Achievement with Excellence candidates could compare and contrast ideas and justify trends.

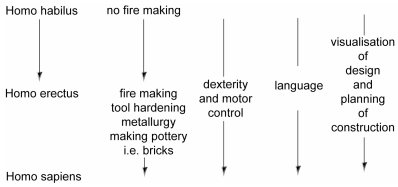
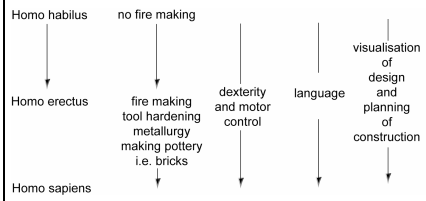
Assessment Schedule

Biology: Describe trends in human biological and cultural evolution (90719)

Evidence Statement

	Achievement	Achievement with Merit	Achievement with Excellence
Criteria	Describe trends in human biological and cultural evolution.	Explain trends in human biological and cultural evolution.	Discuss trends in human biological and cultural evolution.
Judgement	Provides evidence of **description** level answers relating to trends in human biological and cultural evolution. **4 × A**	Provides evidence of **explanation** level answers relating to trends in human biological and cultural evolution. **3 × M**	Provides evidence of **discussion** level answers relating to trends in human biological and cultural evolution. **1 × E**
Q	**Evidence contributing to Achievement**	**Evidence contributing to Achievement with Merit**	**Evidence contributing to Achievement with Excellence**
1(a)	Description outlines that the foramen magnum is more **centralised** under the skull. Eg Foramen magnum/hole where the spinal cord enters the skull is more centralized /not as far back as in the apes/quadrupeds/ further forward than in apes.		
1(b)	Describes a feature that differs between the two skulls. Must describe feature in **both** skulls Eg • Saggital crest on *Paranthropus* / no saggital crest on *Homo* • Large zygomatic arch on *Paranthropus* / small zygomatic arch on *Homo* • Large lower jaw on *Paranthropus* / smaller lower jaw on *Homo* • Large flattened molars on *Paranthropus* / smaller molars on *Homo.* • Sloping forehead on *Paranthropus* /more rounded forehead on *Homo.* • Teeth more pitted on *Paranthropus*/teeth less pitted on *Homo.* • Larger brain cavity/cranial vault on *Homo*/smaller brain cavity/cranial vault on *Paranthropus* **Accept for A only** • Brow ridge more pronounced on *Paranthropus*/brow ridge less pronounced on *Homo.*	Explains why the feature differs in at **least one of** the skulls Eg • Saggital crest on *Paranthropus* to accommodate the muscles needed to work the powerful jaw muscles./ With a smaller jaw saggital crest is not needed, as in *Homo*. • No need for the large zygomatic arch in *Homo* /compared with *Paranthropus* as the jaw muscles are smaller. • Large lower jaw on *Paranthropus* to accommodate powerful jaw muscles./ Smaller lower jaw on Homo because has less muscle to accommodate. • *Paranthropus* needs large molars to chew through tough plant material in its diet./ *Homo* did not have such a tough vegetarian diet therefore smaller molars • *Homo* had a more complex brain and more refined movements, which required a larger brain than *Paranthropus* to coordinate.	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
	Do not accept • Nuchal crest (not a distinguishing feature since both bipedal) • Prognathism (not a distinguishing feature) • Size (on its own is not sufficient) • Thick / thin skulls.	• More pitted teeth on Paranthropus due to food eaten being tougher / more gritty, food eaten by Homo less tough / gritty therefore fewer pits on teeth. • *Homo* had a more complex brain and more refined movements, which required a larger brain than *Paranthropus* to coordinate.	
1(c)	Identifies change in **stone** tool-shape : crude ⇒ refined. Accept unspecialized to specialised, more complex, more sophisticated, from multi-purpose to specialised etc. **Eg**:Oldowan tools only fashioned on one side, whereas Upper Paleolithic tools more than once tooled on each side to produce fine edges. **Do not accept better , smaller**		
2(a)	Describes a difference in the shape of a foot of a living ape and humans. Eg • Human foot has an arch/ ape foot has no arch. • Ape big toe is opposable / human big toe in line with other toes. • Ape toes are curved (prehensile)/ human toes not curved.	Explains how the shape of the ape foot differs from that of the human foot in relation to the movement of at least one of the groups. Eg • Human foot arched to support the weight of the body directly above it / acts as shock absorber allowing humans to walk longer distances, whereas the ape foot does not need to be arched as the body weight is not supported by just two legs. • Big toe in humans in line with other toes to allow easy movement / forward facing to provide thrust/balance in direction of movement. The ape's opposable big toe would get in the way of bipedal movement / used for grasping. • Apes toes are curved to allow grasping/human toes not curved as not required for grasping in locomotion.	
2(b)(i)	Describes Broca's area being used for speech production and Wernicke's area for speech recognition.	Explains that Broca's area needed to be developed first to make speech / sounds : then the development of Wernicke's area so that language recognition / comprehension/listening ability could be refined (or words to that effect).	

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
2 (b) (ii)	• Names some species in the Hominid trend (from graph) • Describes trend in brain size (from graph) • Describes another trend in biological or cultural evolution that could be related to tool technology **OR** describes trend in tool technology Eg  The first stone tool user was *Homo habilis*. From there, there was a tool culture that developed from *Homo habilis* through *Homo erectus* to *Homo sapiens.* The trend in tool technology was from crude tools to more refined and specialised tools.	As for achieved and: Explanation **links** at least **2** of the trends below: Tool Technologies Brain Development Other biological **OR** Cultural evolution Eg Trends in tool technology *H habilis* – crude tools fashioned on one side. ↓ *H erectus* – Pearl-drop shaped tools fashioned on two sides ↓ *H sapiens* – more refined refashioned on at least one side./ The first stone tool user was *Homo habilis*. From there, there was a tool culture that developed from *Homo habilis* through *Homo erectus* to *Homo sapiens.* The trend in tool technology was from crude tools to more refined and specialised tools. **Linked with one of the following:**  	Discussion makes **multiple links** between the tool technologies developed, brain development and other biological **and** cultural trend**s** in the hominid line. Eg *Australopithecus* did not use stone tools, but may have used tools made from perishable matter such as plant material and animal matter. The first stone tool user was *Homo habilis*. From there, there was a tool culture that developed from *Homo habilis* through *Homo erectus* to *Homo sapiens.* As tool technology became more refined and specialised, there was a need for more dextrous hands, specialisation of labour, language development, so the brain developed more and more to accommodate this. This occurred especially in the frontal and occipital regions which control vision, speech and advanced thinking. As well, this increase in brain power and coordination allowed them to take advantage of the cultural changes, that developed, such as refining tools, because of visualisation and planning design developments and fire, enabling them to develop technological advancements in tools, such as hardening, metallurgy, pottery and bricks.
2 (b) (iii)	Describes a **benefit** of fire to *Homo erectus* Eg • safety from large predators • hardening tools • group interaction • food easier to digest / chew • kills micro-organisms in food / food preservation • ashes preserve / tan hides • herding prey in hunting • warmth allowed expansion into areas of cooler climate • extended daylight hours for home-based activities eg toolmaking. Do not accept • Cooking (insufficient on its own) • Ward off enemies • More time to do things.		

Q	Evidence contributing to Achievement	Evidence contributing to Achievement with Merit	Evidence contributing to Achievement with Excellence
3	Describes the two hypotheses of human dispersal. (see information below) Must name the hypotheses correctly in the description. Multiregional / Parallel/regional continuity and Out of Africa/Eve / single lineage / Replacement.	Explains the link between the diagram and the Out of Africa Hypothesis **OR** explains a difference between the two hypotheses.	Compares and contrasts the two main theories of human dispersal and relates **at least one** of them to the information in the diagram saying how it supports the 'Out of Africa Hypothesis' / 'Eve Hypothesis' or not the Multi-regional Hypothesis.

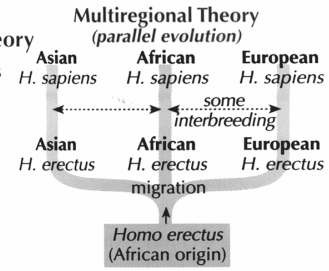
Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
Provides evidence of **description** level answers relating to trends in human biological and cultural evolution. 4As	Provides evidence of **explanation** level answers relating to trends in human biological and cultural evolution. 3Ms	Provides evidence of **discussion** level answers relating to trends in human biological and cultural evolution. 1E

Achieved

Multiregional Theory

This theory suggests that *H. erectus* migrated out of Africa about 1 mya and formed populations in Europe and Asia as well as in Africa. Partially geographically isolated, each population evolved in parallel (with some interbreeding) to form modern humans, which explains how we are one species with distinct regional features.



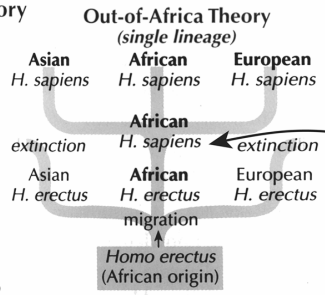
Merit

Excellence

There is fossil evidence of *H. erectus* populations in Europe and Asia, and some regional variation amongst fossils.

Out-of-Africa Theory

This theory proposes that *H. erectus* migrated out of Africa and established regional populations. Only the African population evolved into modern humans, *H. sapiens*, who eventually spread out into Europe and Asia, replacing *H. erectus* as they went.



Merit links information on map in Q & A booklet to here

Analysis of mtDNA suggests that we can all trace our ancestry back to Africa. A recent study that looked at all 16 000 bases in mtDNA from people from all over the world suggested that we can trace our ancestry back to a small group of women who lived in Africa about 170 000 years ago. A *Homo sapiens* skull of this age recently found in Africa gives strong support to this theory.

Modern humans are extremely similar genetically, much more so than chimpanzees. This does not support parallel evolution as the genetic variation should be much greater.

Excellence