LIFE SCIENCES: PAPER I

MARKING GUIDELINES

Time: 2½ hours
150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates’ scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.
1.1 C H D A I K E J B (9)

1.2 1.2.1 A
    1.2.2 D
    1.2.3 B
    1.2.4 C
    1.2.5 D
    1.2.6 C
    1.2.7 A (9)

1.3 1.3.1 translation (1)

1.3.2 A T C A T G 3–5 (1 mark) (2)

1.3.3 A U C (1)

1.3.4 peptide (bond) covalent bond (1)

1.3.5 chromatin material/network

1.3.6 amino acid 1 = glutamic acid
    amino acid 2 = proline (1) (1)

1.4 1.4.1 they are different/not the same/different (male reproductive organ)
    structures/species 1 to 6 have) different shapes/morphological difference/
    won’t fit with female/male and female won’t fit/pre-zygotic isolation/
    morphological difference (1)

1.4.2 can only mate/produce offspring/reproduce penis/reproductive organs only
    fits/matches different genitalia, fit/matches different female structures
    different shaped reproductive organs with female of same species different
    shaped penis/prevents locking
    AND with female of same species not with female of other species within
    species/it is species specific/between 6 different types/groups (2)

1.4.3 damselflies not separated by geographical barriers physical barriers live in
    same area
    AND
    separated by their physical features/different genitalia/body structure
    different; cannot physically reproduce/interbreed (offspring with other
    species); (speciation owing to) reproductive isolation/prezygotic isolation/
    mechanical isolation (2)
1.5 1.5.1

![Graph showing population size over time](image)

1.5.2 (a) True
(b) False
(c) True
(d) True

1.5.3 breeding programs/interbreeding/outbreeding with cheetah from other areas/zoo select favourable genes/non-disease genes gene profiling explained to increase genetic variation stronger cubs produced
Establish corridors to allow interbreeding with isolated populations
Educate/create awareness farmers/public to not shoot, hunt, poach
Wildlife conservation areas/game reserves, provide correct heathy environment, no human development
Laws in place to stop hunting/poaching, secure area provided, penalties for poaching/hunting
Research/study, why bottlenecks occur/to prevent another bottleneck
Ensure food/prey available/reduce hunting of their prey
Fundraising/collect money/donate money, for wildlife conservation, explain specifically what
Vaccination against diseases, to prevent diseases, which the population is susceptible too (gene profiling)
Artificial selection (must be explained), selecting favourable genes
Genetic engineering (must be explained)
(a combination of several of the above).
2 strategies, one briefly explained/a well explained strategy/any other suitable strategy/facts

QUESTION 2

2.1 2.1.1 male/boy presence of Y chromosome/XY/doesn’t have two XX

2.1.2 one of the pair of chromosomes number 5 is shorter/shorter arm on one chromosome 5/one long one short chromosome 5/vary in length

2.1.3 cat like cry respiratory problems small head round face small chin widely set eyes folds of skin over eyes heart defects poor muscle tone difficulty walking difficulty talking severe mental retardation/hearing problems/sight problems/poorly developed larynx

any three

[40]
2.1.4 Yes: relief from uncertainty determine that it is an inherited disorder or not informed decisions about managing pregnancy/childcare/finances advice on possibly deciding to terminate a pregnancy explain how disorder originates provide valuable information on Cri-du-chat parents may be carriers so chances of child inheriting it are likely common disorder so could reappear in second child

No: religious objections deletion occurs in gonads during formation of gametes not all gametes/sperm/ova will have deletion cannot predict if a child will have disorder rather have IVF/amniocentesis/chorionic pre-implantation diagnosis when pregnant deal with disorder if present prepare for care of child ethically wrong to abort if child has disorder

2.1.5 genes/nitrogen bases/nucleotides/section of DNA are missing/lost/sequence of nitrogen bases is changed no DNA code/genotype for a protein trait/characteristic/phenotype would be different, incorrect protein /amino acid sequence

2.2 e.g. Sickle cell anaemia – mutation causes abnormal production of haemoglobin red blood cells loose shape/become spiky/sickle shaped malaria parasites cannot get inside sickle cells heterozygotes have advantage only some cells clump/distort some normal cells so not lethal
e.g. HIV – no marker lack of adhesion protein cannot gain entry to white blood cells resistant to HIV
e.g. Describe an example of benefits of evolutionary adaptation, e.g. finches, tortoises, olive baboon, giraffes, bipedalism, TB resistance, polyploidy in wheat/strawberries

Name and 2 good points which describes the benefit of the mutation

2.3 2.3.1 Snowball = number 2 same/ similar width/type/size bands/matching bands

2.3.2 to exclude cats that were in Beamish's neighbourhood as cat hairs easily stick to clothing could have come from another cat/make sure it was Snowball's fur to link Beamish to being with Duguay/more samples to make investigation valid
2.3.3 (a) chromosomes/DNA/non-coding (junk) DNA  
(b) semen; blood; skin, sperm, saliva, epithelium (any other suitable answer)  

2.4.1 **YES**: DNA profiles can be used to trace missing cats/hereditary disorders for pet owners/provide forensic evidence for crimes against pet owners/breeding programs for special types of cats/prevent inbreeding so cats don't have genetic disorders/a lot of people have cats so a worthwhile exercise/cats leave a lot of hair that sticks so easy to trace owner/way of linking human to crime without infringing on their human rights/SA has a high crime rate so worthwhile to collect evidence  

**OR**  
**NO**: SA does not even have a DNA database/establish DNA profiles first for humans/SA police not sophisticated enough to collect DNA evidence/use DNA database/ SA could use money required for DNA database on more pressing social/economic problems/a lot of stray cats so not reliable evidence/cats have a short life span so would need to update regularly  

*And any other suitable answers*  

2.4.2 (a) obtained from mitochondria of cells passed down from mother to her offspring small sections of DNA found inside mitochondria  
(b) high mutation rate more individuality/unique large amounts of genes does not undergo recombination maternal lineage  

**QUESTION 3**  

3.1 3.1.1 4 cells formed/at the end/one cell produced 4/two series of divisions/in photo G and H chromosomes are in 4 groups/4 groups of chromosomes in bottom row/Anaphase is taking place twice/equator is at 90°  
*(any other suitable answer)*  

3.1.2 (a) A = parent cell/diploid cell/somatic cell/body cell/mother cell/germinal cell  
(b) I = gametes/haploid cells/daughter cells/tetrad/egg/sperm cells/spore  

3.1.3 (a) A  
(b) C  

3.1.4 crossing over/chiasmata form swap genes/sections of DNA/chromatids/chromosomes/paternal and maternal chromatids/bivalents/homologous chromosomes gametes different to parent's genes/ genotype random assortment/independent assortment chromosomes line up independently/randomly on equator when separate and move to poles unequal amounts of original maternal and paternal chromatids/homologous chromosomes/genes/characteristics/different combination of maternal and paternal chromosomes/genes/characteristics mutations.  

**Importance**: changes in genotype offspring has greater opportunity to be adapted in changing environment evolution relies on small changes in characteristics/natural selection relies on variation  

*variation 4/5 + importance 2/1*
3.2 3.2.1 (a) Selective breeding/inbreeding/artificial selection/outbreeding

(b) characteristics/features/outward appearance/phenotype/expression of genes/physical appearance/physical attributes

3.2.2 resists mastitis placid avoids injury walks and stands comfortably few metabolic disorders shows when on heat conceives easily produces live calf without assistance maintains body condition on inexpensive feed first any two

3.2.3 Table of differences between selective breeding and natural selection

<table>
<thead>
<tr>
<th>SELECTIVE BREEDING/ARTIFICIAL SELECTION</th>
<th>NATURAL SELECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Characteristics selected by farmers</td>
<td>1. Environmental pressures(changes in environment favour certain characteristics)</td>
</tr>
<tr>
<td>2. Much quicker process – few years</td>
<td>2. Slower process – 100s to 1 000s of years</td>
</tr>
<tr>
<td>3. Farmers maintain desired genotype</td>
<td>3. Survival of fittest causes certain genotype to persist</td>
</tr>
<tr>
<td>4. Requires human intervention</td>
<td>4. Occurs naturally</td>
</tr>
<tr>
<td>5. Purposeful selection</td>
<td>5. Random selection</td>
</tr>
<tr>
<td>6. Predictable/known outcome (not for outbreeding)</td>
<td>6. Outcome unpredictable/unknown</td>
</tr>
<tr>
<td>7. Less variation (not for outbreeding)</td>
<td>7. More variation</td>
</tr>
<tr>
<td>8. Assistance needed</td>
<td>8. No assistance needed/environment dictates</td>
</tr>
<tr>
<td>9. Not necessarily for survival</td>
<td>9. For survival</td>
</tr>
<tr>
<td>10. Not necessarily fittest surviving/used for breeding</td>
<td>10. Only fittest survives/breeds</td>
</tr>
</tbody>
</table>

Column headings + 2 matching points Other suitable answers

3.2.4 (a) 74 – 42 = 32
Graph was altered in printing so these figures are incorrect

(74 – 78) – (36 – 38) = answer dependent on figures used in calculation
If figures are not in the above ranges but fall in the range of 70 – 80 and 30 – 40 and the calculation is correct the answer is credited with 1 mark

(b) 50 years
Graph was altered in printing so this figure is incorrect
47 – 50 years
3.2.5 demand for more dairy to feed increasing population/greater milk yield better quality milk higher profits for farmers/increased productivity fewer cows are needed

3.2.6 lower gene pool/reduced genotype increased incidence of malformations/mutations (not causes more mutations) increased susceptibility to disease sterility dysfunctionality increase in homozygosity decrease in hybrid vigour increase in vet bills expensive to breed reliant on human care increased infant mortality decreased life expectancy decreased size of offspring long process unpredictable results ethical issues eg killing unfavourable offspring (accept examples of specific features; or 2 well explained reasons)

QUESTION 4

4.1 4.1.1 1 = Male/father/male symbol Bb and 2 = female/mother/female symbol bb
If numbers are not indicated, but answers in correct order e.g. male female

4.1.2 (a) 5 brown : 2 white / 2.5 : 1 / 71,4% : 28,6 %

(b) 1 white : 3 brown offspring/white coated offspring produced; other parent has two white genes number 4 must have contributed a white recessive gene too. If 4 was homozygous then all offspring would be brown for offspring to be white, must have received a white fur gene from each parent. If use a punnet square, Bb bb (parents) and indicated which offspring was white or gave a verbal explanation

4.1.3 egg cells/ova all with b/(white fur colour)/recessive allele

4.1.4 (a) UV radiation/chemicals/herbicides/pesticides/viruses/pollution/Mutagens/gamma rays/X-rays/smoke pollution/formaldehyde/benzene/DDT/radiation/carcinogens

(b) more visible in wild not well camouflaged caught by predators more easily more susceptible to light damage/exposure to sun causing cancers

4.1.5 (a) More desirable/cuteness/novelty value/sought after/by pet owners/rare/greater profit/children like them/cleaner/represents purity

(b) recessive gene could become more prevalent/common/variety in gene pool reduced/increase homozygocity/increase in recessive disorders/closely related rabbits bred/inbreeding/reduced hybrid vigour

4.2 4.2.1 geographical isolation important in speciation/evolution islands have different vegetation animals adapt differently/show different adaptations eg. different finches/tortoises animals with mutation for favourable trait reproduce more natural selection these animals increase in numbers mention differences e.g. beaks adaptive radiation develop from a single ancestral group modification by descent can mention differences in habitat between islands. Must give an observation of Darwin. If only natural section etc. discussed, max of 3 marks.
4.2.2 (a) **Yes**: observe natural phenomena/plants and animals studied by Darwin greater development more sustainable local economy more jobs greater understanding of importance of islands development of wildlife services global awareness of environmental issues tourism major contribution to economy

**No**: pollution, e.g. rubbish threat from introduced pests, e.g. pigs/dogs killing indigenous species/disturbance of plants and animals too fragile habitat/ecologically sensitive area need to preserve environment for students of evolution restrictions on fishing for locals mass immigration of people looking for jobs. Any 4 facts. May be a combination of positive and negative aspects. If the facts are expanded on in greater detail, marks are awarded for these.

4.3

- 5 – 10 mya Galapagos Islands appeared
- Seeds attached to birds’ feathers, feet or in their guts light seeds
- ‘Weedy’ plants most successful can tolerate variety of environmental conditions
- Many wind pollinated plants on Galapagos few flowering plants/seeds too heavy to float/no pollinators

(accept variations that are logical and accurate) arrows + good points

Other facts that are accepted:
No plant or animal life, birds bring in seeds, wind brings in seeds, many grasses and ferns, organisms arrive through long distance dispersal
To get mark for arrow, facts must be in logical order as well
QUESTION 5

Is there benefit in scientists working together to find out more about the evolution of modern humans (Homo Sapiens)?

**EXPANDED MEMO Q5**

<table>
<thead>
<tr>
<th>source</th>
<th>BENEFITS through collaboration</th>
<th>NO BENEFIT in collaboration</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>• Berger collaboration –</td>
<td>• Have to share noble prize</td>
</tr>
<tr>
<td></td>
<td>• Open access to palaeontologists – improved quality of results</td>
<td>with others/loose recognition</td>
</tr>
<tr>
<td></td>
<td>• Good finds are rare – can collect more evidence</td>
<td>• Can be unreliable</td>
</tr>
<tr>
<td></td>
<td>• Berger sharing A. sediba findings – good example to scientific world</td>
<td>• Methods must be scientific – no cheating will get through.</td>
</tr>
<tr>
<td></td>
<td>• Require lots of evidence from different times and place</td>
<td>• No collaboration required as Science already has a good process to ensure accuracy, e.g. peer review etc.</td>
</tr>
<tr>
<td></td>
<td>• Berger’s approach inspired others to share</td>
<td>• Findings in Europe – scientists not obliged to inform each other</td>
</tr>
<tr>
<td>B</td>
<td>• Different disciplines can bring different ideas to the findings – more reliable results – can lead to greater discoveries, e.g. Nobel prizes/success</td>
<td>• Not required as most scientists are honest</td>
</tr>
<tr>
<td></td>
<td>• OR: Scientists with different skills and from totally different institutes can complement each other’s skills</td>
<td>• Scientists may not all get recognition</td>
</tr>
<tr>
<td></td>
<td>• Yamanaka and Gurdon – lead to important discoveries</td>
<td>• Much work still needs to be done – plenty of opportunities for all</td>
</tr>
<tr>
<td>C</td>
<td>• More testimonies gathered from different people – more accurate results</td>
<td>• Scientist divided on new findings – could hamper future progress on Hominids if they do not pursue own research</td>
</tr>
<tr>
<td>D</td>
<td>• Shows that it is better to get other people’s ideas that may refute the person who discovered the fossils – more accurate results</td>
<td>• What is intellectual property – great findings belong to scientists who discover them</td>
</tr>
<tr>
<td></td>
<td>• Much unknown about human family tree</td>
<td>• Allow prestige/money for country/could increase tourism and revenue for specific country</td>
</tr>
<tr>
<td>E</td>
<td>• Expose cheats/more difficult to cheat</td>
<td>• Fossils from the past/future research should focus on innovative scientific research – e.g. stem cells</td>
</tr>
<tr>
<td></td>
<td>• Peer review – validates results</td>
<td>• Human origins are not as important as, e.g. a cure for cancer – no rush to get accurate results</td>
</tr>
<tr>
<td></td>
<td>• Whistle blowing – reports foul play</td>
<td>• Political intervention prevents collaboration – must pursue scientific opportunities for a country</td>
</tr>
<tr>
<td></td>
<td>• Increased objectivity of method used to gain results</td>
<td>• Creates jobs for countries economy</td>
</tr>
<tr>
<td></td>
<td>• Replication by others validates findings</td>
<td>• Need to share success and financial gain</td>
</tr>
<tr>
<td></td>
<td>• Testability – can use other scientists to test theory – validity increases</td>
<td>• Concerns around authorship of results – financial implications</td>
</tr>
<tr>
<td></td>
<td>• Science has important rules/code of conduct that all must adhere to – ensure this happens</td>
<td>• Loose recognition of info</td>
</tr>
<tr>
<td></td>
<td>• Regulates findings</td>
<td>• Ownership of find/data/fame/ego</td>
</tr>
<tr>
<td></td>
<td>• Makes family tree info more certain as all data is scrutinised by all scientists working on hominids</td>
<td>• Concerns around intellectual property</td>
</tr>
<tr>
<td>F</td>
<td>• Compare alternate theories and new ideas are brought in from scientists around the world</td>
<td>• Hidden agenda – skews groups results/ignores valid data</td>
</tr>
<tr>
<td></td>
<td>• Fossil finds rare – need to share findings</td>
<td>• Political intervention prevents collaboration – must pursue scientific opportunities for a country</td>
</tr>
<tr>
<td></td>
<td>• Without collaboration – fossil finds can be contradictory</td>
<td>• Creates jobs for countries economy</td>
</tr>
<tr>
<td></td>
<td>• Ideas can be challenged/argued and ironed out</td>
<td>• Need to share success and financial gain</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th><strong>G</strong></th>
<th><strong>H</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Compare evidence from around the world to help validate ideas</td>
<td>• Watson, creek vs Franklin – work stolen</td>
</tr>
<tr>
<td>• All scientist have the same goal –</td>
<td>• Takes longer to publish results</td>
</tr>
<tr>
<td>• Decreases time of theories being put forward</td>
<td>• Leads to conflicts in a group</td>
</tr>
<tr>
<td>• No collaboration leads to inaccuracies</td>
<td>• Piltdown example – secrecy</td>
</tr>
<tr>
<td>• Collaboration results in relevant studies</td>
<td>• Mendel – did not share - was successful</td>
</tr>
</tbody>
</table>

**Own**

- Some scientist believe that *A. sediba* is more homo than Australopithecus
- Explanation of how different skills can help scientists.
- Relating relevance of Human genome project to discovery of evolution of modern human
- Watson and Creek – DNA model
- Climate change research has been collaborated
- Can lead to increased funding for research
- Can provide more jobs
- Religious viewpoint
- Science is fluid and changes
- (Need to be open to all ideas)

**COLLABORATION IS IMPORTANT**

- Much unknown about human family tree
- Should pool information for greater understanding
- Science has important rules/code of conduct that all must adhere to
- Will regulate findings:
  1. Peer review
  2. Regulation by authorities
  3. Objectivity
  4. Replication
  5. Testability
- This will make 'family tree' more certain as all data is scrutinised by all scientists working on hominids
- Prof Berger sharing *A. sediba* findings; good example to scientific world
- Yamanaka and Gurdon won Nobel prize for jointly discovering mature stem cells can be programmed – led to important research for therapeutic uses in humans – only owing to collaboration
- Fossils so rare, important to share any findings
- Without collaboration hominid findings are contradictory

**COLLABORATION NOT REQUIRED**

- Findings in Europe – scientists not obliged to inform each other
- Scientists might not get recognition
- Much work still to be done, plenty of opportunities for all
- Scientists divided on new findings – could hamper future progress on Hominids if they do not pursue own research
- What is intellectual property – great findings belong to scientists who discover them
- Allows prestige, money for country where scientist residing – could increase tourism – revenue
- Fossils are from the past – future research should focus on innovative scientific research, e.g. stem cells
- Human origins are not as important as, e.g. cure for cancer
- Political intervention would prevent collaboration – must pursue scientific opportunities for country
- Creates jobs for economy

Memo will be expanded with input from marking panel.

- many extra facts to use from own knowledge re: SAGS
e.g. Franklin; Watson and Crick – structure of DNA.
### Content: Thoroughness

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Up to 1/3 of potential detail in sources cited (e.g. 1 to 4 facts)</td>
<td>• About half of potential detail in sources cited (e.g. 4 to 8 facts from sources)</td>
<td>• All main topics in sources covered</td>
<td>• All main topics covered</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• About ⅔ of potential detail in sources cited (e.g. 9 to 12 facts = 11 + 1 original fact)</td>
<td>• Source detail very close to full potential</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• One instance of significant information beyond the sources</td>
<td>• At least (x) significant instances of information beyond the sources (e.g. 13 – 16 facts; 2 must be original &amp; beyond the sources) = 11/14 + 2</td>
</tr>
</tbody>
</table>

### Content: Relevance

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
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<tbody>
<tr>
<td>• Mostly digression and/or repetition</td>
<td>• Around half is digression and/or repetition</td>
<td>• Repetition mostly avoided</td>
<td>• Isolated incidences of minor repetition</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some minor digression</td>
<td>• No digression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Argument relevant</td>
<td>• Argument relevant</td>
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</tbody>
</table>

### Supporting Argument, i.e. for

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Writing consists of facts with little linkage or reasoning</td>
<td>• Maximum if no clear decision to support</td>
<td>• Supports the position</td>
<td>• Strongly supports a clear position</td>
</tr>
<tr>
<td>• Reasoning incorrect</td>
<td>• Reasoning correct, but hard to follow</td>
<td>• Reasoning is clear</td>
<td>• Reasoning is very clear and succinct</td>
</tr>
<tr>
<td></td>
<td>• Ordinary; some linkage is evident</td>
<td>• Minor errors in flow</td>
<td>• Flow is logical, showing evidence of clear planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Solid but not compelling; linkage sometimes missed</td>
<td>• Compelling with regular use of linking language</td>
</tr>
</tbody>
</table>

### Fairness i.e. Argument against

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• One counter opinion given</td>
<td>• Two counter opinions given</td>
<td>• Three or more counter opinions given</td>
<td></td>
</tr>
</tbody>
</table>

### Position

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clear decision made</td>
<td></td>
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</table>

### Presentation

<table>
<thead>
<tr>
<th>1 mark</th>
<th>2 marks</th>
<th>3 marks</th>
<th>4 marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Writing is almost unintelligible</td>
<td>• Tone, language and terminology is weak</td>
<td>• Tone is consistent and suited to scientific argument</td>
<td>• Tone mature and suited to scientific argument</td>
</tr>
<tr>
<td>• Tone, language and terminology unscientific and exceptionally weak</td>
<td>• Attempts at correct paragraphing</td>
<td>• Good and appropriate language and terminology</td>
<td>• Excellent and appropriate use of language and terminology</td>
</tr>
<tr>
<td>• Introduction and/or conclusion not present</td>
<td>• Introduction and conclusion present, no matter how weak</td>
<td>• Mostly appropriate paragraphing</td>
<td>• Correct paragraphing with good transitions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Introduction and conclusion have merit.</td>
<td>• Interesting introduction, satisfying conclusion</td>
</tr>
</tbody>
</table>

The above design grid will be used to assess the essay. The essay marking guidelines will be expanded in consultation with the marking panel at the standardisation meeting.

Total: 150 marks