NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2013

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.

QUESTION 1

1.1 F G I H L B A E C J (10)

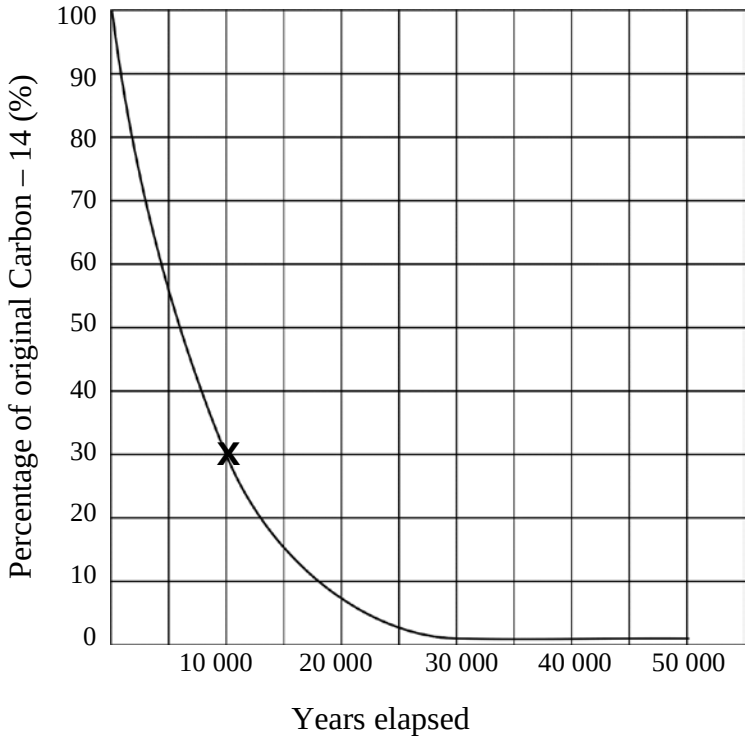
1.2
1.2.1 B (1)
1.2.2 B/C (1)
1.2.3 A (2)
1.2.4 A (1)
1.2.5 D (2)
1.2.6 B (2)

1.3
1.3.1 Chromatids 1 and 4 remain unchanged; Genes A, B and C are swapped only this change/the rest remain unchanged (3)

1.3.2 increased variation in gametes/offspring / increased variation increases chance of survival/position of alleles has changed. (2)
(other suitable phrasing)

1.3.3 Alleles (1)

1.4



1.4.1 (a) Use an **X** to indicate the point on the graph where a fossil fish contains 30% of the original Carbon-14. (1)

(b) According to the graph above, how old is the fossil fish referred to in Question 1.4.1 (a)?

10 000 years (1)

1.4.2 at 30 000 yrs the graph flattens out as all original C_{14} has decayed/broken down/changed. reading for C_{14} remains same after/from 30 000 – 50 000 yrs/too low after 30 000 yrs to pick up differences in C_{14} (2)

1.4.3 share similar distant/tetrapod ancestor/different origin ancestors to limb and fin/ different bone plan to achieve same function/meet same environmental needs/whale has pentadactyl limb fish is not a mammal/ so has different limb structure (alsoaccept description ofdifferentbonesin fin and limb) *two good reasons* (2)

1.5 1.5.1 Black rhino/White rhino/Indian rhino/Javan rhino/Sumatran rhino (1)

1.5.2 58 million years ago (1)

1.5.3 Ceratotherium (1)

1.5.4 (a) Darwin – rhinos with larger horns more likely to survive/fend off competitors passed on characteristic/genes/genotype of long horns to offspring (or other suitable reason) (2)

(b) Lamarck – rhino horns grew to aid survival, acquired adaptation passed on to offspring (or other suitable reason) (2)

1.5.5 (a) Sumatran rhino (1)

(b) most recently branched from phylogenetic/family tree/most features in common/most recent common ancestor/branch from same evolutionary line
(or any other suitable answer) (1)
[40]

QUESTION 2

2.1 2.1.1 chimpanzee (1)

2.1.2 narrow thin elongated pelvic girdle – does not support upright weight of body above pelvis/narrow pelvis – weight also supported on forehands/ quadrapedal divergent big toe – indicates tree climbing/arboreal ability/opposable big toe – used for grasping branches/climbing trees
Foot bones/ sacrum smaller cannot support body weight
(include other suitable answers). (4)

2.1.3 **hands freed;** greater dexterity carry food make and use tools make and control fire therefore greater brain development
Habitat changing to savannah: move across grasslands more efficiently find/see new sources of food therefore greater brain development
Upright posture: could see over grass more easily observe predators/prey more intimidating to predators stay cooler in sun as less of body exposed to direct heat (greater brain development – concept = 1 mark only)
Accept *any 5 good facts and different wording meaning same as above* (5)

2.2 2.2.1 Grey (1)

2.2.2 Caused by expression of the genotype/gene variation within all populations natural selection of more suited genotype to environment/different alleles for different colours of wings/genotype selected for because of camouflage from predators mutations causing different alleles / dominant and recessive genes (2)

2.2.3 (a) II (1)

(b) Countryside; there are more light moths; as the trees are not covered in soot/trees covered in lichen/fewer dark moths; as predators have eaten the dark ones/more exposed./ Light moths camouflaged escape predation (accept wording that explains why it COULD NOT be industrial area) (3)

2.3 2.3.1 Different species of (Darwin's) finches have arisen on the Galapagos (specific place names not required)Islands due to population becoming isolated by the sea between islands that each have different environments/feeding niches Or other example; tortoises; iguanas; cichlids, Grand canyon squirrels, etc.
(Name clearly place/location description) (3)

2.3.2 Due to isolation, gene flow is restricted gene frequencies change there are different selection pressure in each population ✓ different phenotypes develop/differences become so great that populations become reproductively isolated/new subspecies develop. *Three acceptable points* where wording is different, but concept same as above underlined (3)

2.3.3 it flew to the island; westerly wind assisted flight/westerly wind blew these butterflies to the island
OR
sea levels rose/flooding; mainland species evolved into subspecies owing to isolation. eggs/larvae on food in boats
(or other reasonable explanation.) (2)

2.4 mutations produce variations antibiotic resistance mutation/gene selected for gives survival advantage to these bacteria pass on resistance gene to offspring persist and reproduce many resistant bacteria therefore antibiotics not effective for humans
(N.B. Relate resistance to 'bad for humans', e.g. antibiotics can no longer cure bacterial infections in humans/humans die include: economic implications of discovering antibiotics and revenue lost to sick days)
Must cover natural selection and antibiotic resistance= 3 to 4 marks
Problem for humans = 2 or 1 mark
4 *good facts* + 1 (5)
[30]

QUESTION 3

3.1 3.1.1 (a) Mm (1)

(b) 67(%) $\left(\frac{8}{12} \times \frac{100}{1}\right)$ (1)

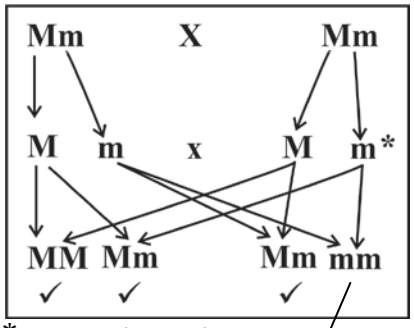
(c) isolate manx cats during breeding season to ensure that mating occurs only between selected manx cats
Provide good prenatal and birth care to ensure that fertilised ova develop into kittens/(survival of kittens only dependent on genotype/ not health issues)
count dead kittens also, include in stats to quantify lethal genotype
Any other reasonable answer (2 × 2 = 4)

3.1.2 (a)

	M	**m**
M	**MM**	**Mm**
m	**Mm**	**mm**

= correct gametes

(b) lethal genotype



* = correct gametes

(b) lethal genotype

(a): (3 + 1 = 4)

If incorrect genotype used in Punnett or Cross, then mark three genotypes as a result of incorrect cross = possible 3 marks; no mark given for incorrect gametes = 0

(b) mm = genotype that would die before birth (only marked on cross) (1)

3.1.3 Yes – suggests statistical data for inheritance of lethal mutations, etc.
OR
No – inheritance in cats not helpful/different species to humans, etc. (2)
(accept other suitable answers)

3.2 Project: Sequencing of human genome/identifying all genes/determining order of nucleotide bases in (coding) DNA of human chromosomes collaboration of scientists across the world
Implications: Understand exactly what each gene codes for/increased understanding of disorders/expression of genes finding cures/correcting defective genes. *(accept other suitable outcomes)*
Include : little impact = too costly little understanding as yet of all genes/DNA
Project + implications OR project + implications (5)

3.3 3.3.1 GMO an organism that has had a selected/desired foreign gene/altered genetic makeup inserted into its genome/chromosomes *(or other correct definition)* (2)

3.3.2 (a) Access to research facilities /funds to develop GMOs/large nation requiring large amounts/successful crop yield *any suitable answer* (1)

(b) 100% – (21% + 6% + 4% + 4% + 1% + 1%) = 63 % (2)
(99% - (21% + 6% + 4% + 4% + 1% + 1%) = 62 %

3.3.3 (a) **advantages:** pest/drought/herbicide resistance; increased nutritional value; increased yield; feed increased population numbers; lower production costs, etc. *Any two (or other reasonable advantage).* (2)
Disadvantages: may introduce allergenic properties; disrupt food chains; may introduce mutagens to food; etc.
Any two (or other reasonable disadvantage). (2)

(b) yes/no (*relate answer specifically to SA*)
e.g. Yes: rapidly growing pop numbers will provide sufficient food
e.g. No: need to test more thoroughly to see if produces diseases, etc. *other suitable answers explained, e.g. allergenic; destroying food chains, etc.* (3)
[30]

QUESTION 4

4.1 4.1.1 transcription (1)

4.1.2 proteins manufactured/protein synthesis/proteins/polypeptides (1)

4.1.3 **Table of differences between A (DNA) and B (mRNA)**

(Table drawn = 1 mark)

Difference	**A-(DNA)**	**B-(mRNA)**
Structural	Double helix/strand or: nucleotides G C A T or: T	Single strand or: Nucleotides G C A U or: U
Function	Stores genetic information	Transfers genetic code to cytoplasm

All correct and appropriate structural and functional differences accepted.

No matching points = 0 (5)

4.1.4 mRNA provides code for assembly of amino acids in correct order for protein synthesis/codons provide order for amino acid sequence. (3)
mRNA carries genetic code to ribosome/cytoplasm for assembly of amino acids

4.1.5 DNA fingerprinting bars in gel to analyse unique genetic code/determine gene markers; karyotyping determine number and type of chromosomes; PCR increase small amounts of DNA; DNA sequencing determining positions of genes on chromosomes; genome mapping/sequencing of genes
any one described (2)

4.2 4.2.1 Indicates similarity of DNA/similarity of complementary strands (1)

4.2.2 Human and chimp DNA very similar slight difference only between melting points OR
Melting points very close / human and chimp DNA not similar different melting points / sufficient complementary bases to form hybrid DNA (2)

4.2.3 DNA made from two different species one stand of human joined to one strand of chimp matching base pairs between single stands of chimp and human DNA join up Combination of human and chimp DNA which join through matching bases (three good points) (3)

4.2.4
- paleontological/fossil evidence / similarities in bone structure indicates common ancestor/ evolutionary relatedness / fossils can be studied and dated.
- modification by descent similar body plans or structures / similar limb structures in ancestors
- biogeography fossils of similar/same organisms on different continents

Include explanations of : embryology; - similar embryological structure; vestigial organs; - remnants of evolutionary structures
mtDNA; used to draw/work out evolutionary lineage*(two reasons)* (4)

4.3 4.3.1 prevent self-pollination to use pollen of a chosen characteristic/plant/ feature not pollen randomly brought by pollinating agent. (2)

4.3.2 3 (dominant) : 1 (recessive)
2,983 (2,9/ 2,97) : 1 (taken from averages on diagram)
75 (%):25(%) (1)

4.3.3 Mendel kept meticulous records of data, much statistical data provided evidence for his theories repeated over many generations
(Law of segregation) of two genes (characters) for a heritable feature, only one is passed on to offspring into gametes; (Law of independent assortment) there are two genes for each heritable feature/characteristic they are passed on to offspring independently
Only experimented with two variables at a time
Controlled other variables
Any five good facts (5)
[30]

QUESTION 5

Exploit animals	**Do not exploit animals**
YES – TRANSGENIC IS WORTH IT	**NO – TRANSGENIC ANIMALS HARMED**
• Proteins made to help humans with life threatening disorders, e.g. haemophilia, cancer, insulin. • Many useful products, e.g. immune boosting substances, proteins in human milk, medical products, etc. • Process is more effective – greater quantities can be produced more quickly. • The potential human health benefits justify tinkering with genes. • Human milk contains high quantities of key nutrients that can help to boost the immune system of babies and reduce the risk of infections. • Milk from herds of genetically modified cows could provide an alternative to human breast milk and formula milk for babies, which is often criticised as being an inferior substitute. • Increased global demand for human proteins and vaccines. • Profitable – one transgenic animal could make millions of dollars worth of products.	• There are concerns that viruses could be hidden in animal DNA and passed on to humans, or that drugs produced in milk might be contaminated with prions. (Prions can cause 'mad cow disease.) • The welfare of the animals themselves: The drugs they produce might be harmful to them. • Query safety of milk from genetically modified animals and its effect on the cattle's health. • Animals are more prone to infection, tend to die young and the females are infertile. • Procedures likely to cause pain and distress • Handling and restraint can be distressful to farm animals but are essential for almost all GE procedures • In sheep it caused arthritis, gastric ulcers, heart and kidney disease. • Question human centred approach to using animals. • Very costly to produce one transgenic animal. • Low success rate of producing transgenic embryos.

(an excellent essay would have 12 facts and 2 from beyond the sources)

Total: 150 marks

	1 mark	2 marks	3 marks	4 marks
Content: Thoroughness	• Up to 1/3 of potential detail in sources cited (1 to 2 source based facts)	• About half of potential detail in sources cited (3 – 5 source based facts)	• All main topics in sources covered • About ¾ of potential detail in sources cited (6 – 8 source based facts)	• All main topics covered • Source detail very close to full potential • At least (1 – 2) significant instances of information beyond the sources (9 source based facts; or 2 original and beyond the sources + 7 SB facts; or 1 original +8 SB facts)
Content: Relevance	• Mostly digression and/or repetition	• Around half is digression and/or repetition	• Repetition mostly avoided • Some minor digression • Argument relevant	• Isolated incidences of minor repetition • No digression. • Argument relevant
Supporting Argument, i.e. <u>for</u>	• Writing consists of facts with little linkage or reasoning • Reasoning incorrect	• **<u>Maximum if no clear decision to support</u>** • Reasoning correct, but hard to follow • Ordinary; some linkage is evident	• Supports the position • Reasoning is clear • Minor errors in flow • Solid but not compelling; linkage sometimes missed	• Strongly supports a clear position • Reasoning is very clear and succinct • Flow is logical, showing evidence of clear planning • Compelling with regular use of linking language
Fairness, i.e. Argument <u>against</u>	• One counter opinion given.	• Two counter opinions given	• Three or more counter opinions given	
Position	• **<u>Clear decision made</u>**			
Presentation	• Writing is almost unintelligible • Tone, language and terminology unscientific and exceptionally weak • Introduction **and/or** conclusion **not** present	• Tone, language and terminology is weak • Attempts at correct paragraphing • **Introduction** and **conclusion** present, no matter how weak	• Tone is consistent and suited to scientific argument • Good and appropriate language and terminology • Mostly appropriate paragraphing • **Introduction** and **conclusion** have merit	• Tone mature and suited to scientific argument • Excellent and appropriate use of language and terminology • Correct paragraphing with good transitions • Interesting **introduction**, satisfying **conclusion**