LIFE SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours 200 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

	COLUMN A		**COLUMN B**
[F]	An organism that possesses two complete sets of chromosomes in their body cells.	A	Autosomes
[J]	A gene expressed only in a homozygous condition.	B	Haploid
[L]	A substance that can cause a mutation.	C	Genetics
[A]	Chromosome 1 to 22 in humans.	D	Translation
[D]	The process that involves the assembly of a polypeptide chain.	E	Gonosomes
[E]	X and Y chromosome in humans.	F	Diploid
[C]	The study of inheritance and variation in organisms.	G	Transcription
[B]	A gamete that possesses only one set of chromosomes.	H	Mendel
[H]	The scientist that conducted breeding experiments in pea plants.	I	Dominant
[I]	A gene that is expressed in the phenotype whether an individual is heterozygous or homozygous for the trait.	J	Recessive
		K	Darwin
		L	Mutagen

1.2

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5
Answer	C	B	B	D	A

1.3   1.3.1   Skull 2

1.3.2   Brow ridge is less prominent in skull 2/more prominent brow ridge in skull 1.
Larger/dome-shaped cranium in skull 2/flatter or less dome-shaped cranium in skull 1.
Flat facial angle in skull 2/angled face in skull 1.
Smaller teeth in skull 2/larger teeth in skull 1.
Chin present in skull 2/chin absent in skull 1.
Smaller mandible in skull 2/larger mandible in skull 1.
(*Any two*)

1.4   1.4.1

		Statement	True or false
	(a)	Females who are heterozygous will not have the genetic condition.	False/F
	(b)	All daughters of a male who has the trait will also have the trait.	True/T
	(c)	There is no father to son transmission; the trait follows the inheritance of the X-chromosome.	True/T
	(d)	Sons can have the trait only if their father also has the trait.	False/F
	(e)	Males can be carriers of the allele that causes the genetic condition.	False/F
	(f)	The chance of an unaffected father and unaffected mother producing a child with the genetic condition is 0%.	True/T

      1.4.2 X^HY

      1.4.3   Red green colour blindness haemophilia Duchenne muscular dystrophy ichthyosis ALD Alport syndrome Barth syndrome
(Accept other examples)

1.5   1.5.1   Anaphase I

      1.5.2   Evidence of crossing over seen as swopped sections of chromatids evident.
Chromosome number is halving from four chromosomes to two chromosomes at poles.
No division of centromere.
Whole chromosomes moving from equator/to opposite poles.
(*Any two*)

      1.5.3   2 chromosomes *(must have)*
single/without chromatids drawn.
2 chromosomes are different lengths/one long and one short chromosome.

      1.5.4   (a)   Trisomy 21/extra chromosome on chromosome 21/Down Syndrome

            (b)   Non-disjunction
failure of chromatids to separate
during meiosis/anaphase I/II
of one of chromosomes number 21

1.6   1.6.1   Bone tissue/skeletons

      1.6.2   Found DNA of individuals/identified sex chromosomes in DNA
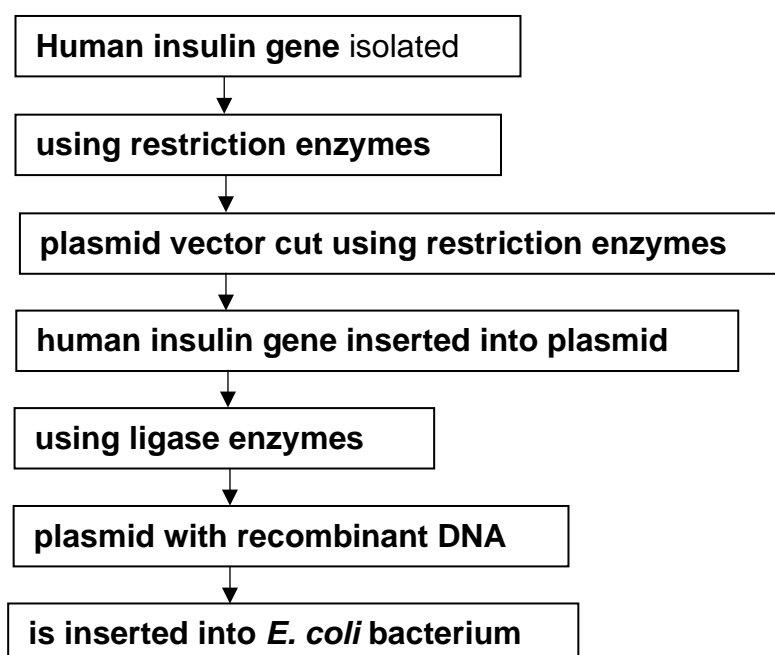presence of Y chromosomes in all individuals.

1.6.3 Artefacts weapons tools used by the individuals burial practices jewellery; these would indicate way of life/hunting practices, etc.
(*Any two*)

1.6.4 Mating/breeding between closely related individuals.

1.6.5 Reduces chances of homozygosity of accumulation of harmful recessive alleles less likely to suffer from genetic disorders fertility not reduced increased vigour.
(*Max three*)

1.7

Item	Term	Answer
1. Increase in complexity over time 2. Increase in diversity	Fossil record	C
1. Inheritance of acquired characteristics 2. Use and disuse of body parts	Alfred Wallace	D
1. Small changes over a long period of time 2. Changes occur in sudden bursts with long periods of no change	Gradualism	A
1. First tool maker of hominid species 2. Oldest extant people	*Homo erectus*	D
1. The study of where species occur and why 2. A divergence from a single lineage giving rise to many new species	Adaptive radiation	B

1.8 1.8.1 Body able to utilise it better/works more effectively as it is human insulin.
More ethical than collecting from animals.
Fewer adverse/allergic effects.

1.8.2 Heading: E.g. **Flow diagram showing steps to form recombinant E. coli bacterium**.
Short statements separated by arrows

Human insulin gene isolated
↓
using restriction enzymes
↓
plasmid vector cut using restriction enzymes
↓
human insulin gene inserted into plasmid
↓
using ligase enzymes
↓
plasmid with recombinant DNA
↓
**is inserted into *E. coli* bacterium**

(*Five correct consecutive steps*)

1.8.3   Must make clear decision with 4 supporting facts, or 2 well-explained facts

Yes	No
Could eliminate/decrease serious genetic diseases	Permanently alters genes
Reduce human suffering	Next generation individual did not give consent
Carriers of disease can have children without risk of passing disease onto next generation	Insertion of corrected gene could interrupt other gene functions/inaccuracies of technology present
Current therapies are not permanent	Long term effects not known
Vectors of current therapies can cause side effects	Technology still being developed/not ready for germ line use
Somatic cell line treatment not always effective	Open doors for nefarious uses other than treating diseases

1.9   1.9.1   Group of the same species living in an area where individuals are able to breed with one another.

        1.9.2   Zebra have larger population/lion smaller population prey (zebra) must be a sustainable food source for predator.

        1.9.3   Many eyes and ears for early detection of predators.
Dilution effect greater numbers of individuals increase chances of individual survival.
Confusion and distraction; prey scatters in all directions confusing predator.
(Identify one strategy + discussion)

1.10   1.10.1   Heading
                  x-axis label: Years
                  y-axis label: Number of zebra
                  Scale (sc)
                  Plotting (mark 158 and 150 correct)
                  Correct shape (s) – logistic
                  Line graph (l)

Graph showing the number of Zebra in a large game reserve from 2000 to 2012
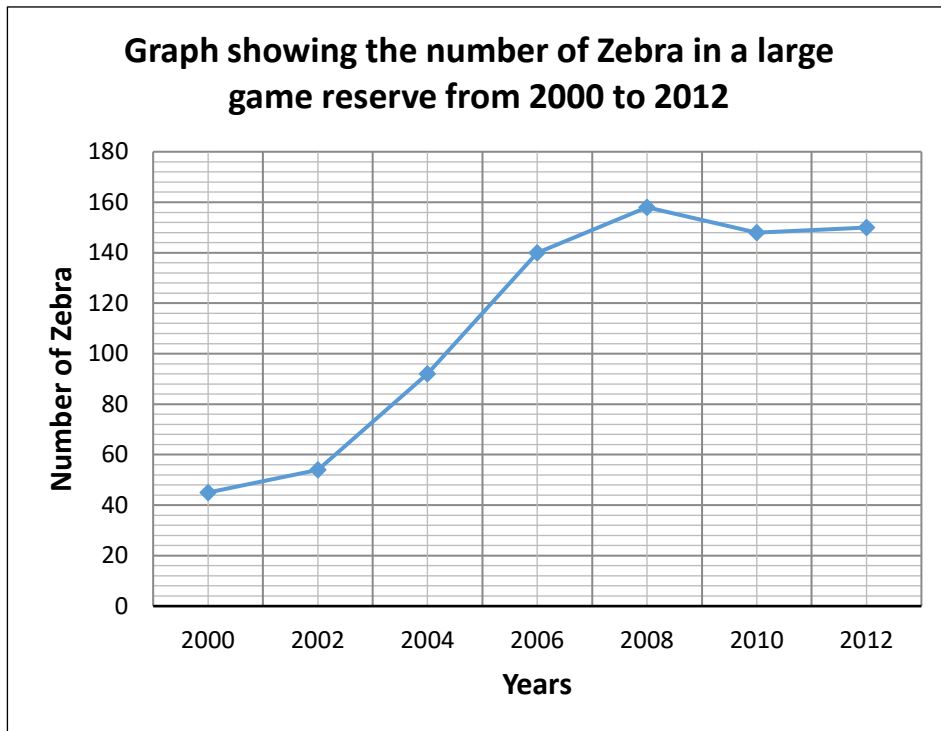
1.10.2   Horizontal Line to indicate carrying capacity between (140–155).
          Line labelled as "carrying capacity".

1.10.3   X placed on graph line between 2008 and 2010.

QUESTION 2

2.1   2.1.1   Southern Isolated new population:
Duration of call shorter higher/increased/faster note rate more notes
higher/increased pitch.
The northern frog population:
Call duration is longer longer note rate pitch is lower.
(Max two)

           2.1.2   Allopatric/geographic geographic isolation/reduction of rainforest
area which separated original populations.

           2.1.3   Reproductively isolated/unable to breed with original northern and
southern frogs mating call differences offspring between northern
and southern frogs not viable.
(Max two)

           2.1.4   Variation in male calls/males calls most closely resembling southern
calls/calls with faster note rate and longer duration selected by
southern females more often males with southern call more likely to
reproduce with southern females offspring with southern call more
chance of survival gene for call passed to offspring over time
southern mating call most numerous in species.
(*Five good facts sequentially)*

           2.1.5   New individual resulting from mating of two genetically dissimilar
frogs.

           2.1.6   Divergent groups of frogs had a common ancestor.

           2.1.7   Reliable:
research conducted by experts/scientists in field
from a university
many scientists agree
Not reliable:
no peer review
no publication of findings mentioned

2.2   2.2.1   (a)   True

                       (b)   False

                       (c)   False Check answer on final printed copy

                       (d)   True Check answer on final printed copy

                       (e)   False

                       (f)   False

2.2.2   Determine age of fossils using relative or radiometric dating/to determine comparative times organisms existed.
Compare similarities in DNA more shared sequences can indicate relatedness of organisms.
Physiological/structural features/similarities in structures/ homologous structures indicate common ancestors.
Vestigial structures functional homologous structure suggests common ancestry.
Biogeography closely related species would be located nearby from having descended from common ancestor.
Comparative biochemistry fewer sequences/proteins etc shared the more distantly related.
Modification by descent similar species descended from a common ancestor.
Embryological similarities supports common ancestry.
[2 × sources each discussed]

2.3   Bacterial evolution occurs due to natural selection natural variation exists amongst bacteria some antibiotic resistant bacteria survive antibiotic treatment especially if treatment is not completed therefore bacterial populations develop resistance to most commonly used antibiotics antibiotic use is the selection pressure so doctors can remove that pressure (how?) allows us to understand how to prevent antibiotic resistance develop alternative solutions to fight disease don't overprescribe antibiotics/determine what bacterial infection is present before prescribing antibiotics.
(Four facts explaining evolution in antibiotic resistance example one solution discussed)

2.4   2.4.1   Fruit fly
Has the highest % of heterozygous alleles.

2.4.2   Outbreeding mating of distantly related individuals.

2.4.3   Decreases chances of offspring being affected by harmful alleles/ healthier offspring
leads to increased variation
hybrid vigour
increases chance of evolution

2.4.4   Cheetah has 0% heterozygous genotypes
increased isolation/becoming isolated in separate areas results in little cross breeding with other populations

QUESTION 3

3.1   3.1.1   Migration/emigration/immigration

        3.1.2   Marking must not harm the animal
                must not interfere with animal behaviour/locomotion
                must remain on the animal for duration of investigation
                (Any one)

        3.1.3   Food supply /lack of space /shelter /disease or parasitism /
                predation / competition
                (Any two)

        3.1.4   N = $\frac{(37 \times 24)}{11}$ -

                N = 80 tortoise *(answer)*

        3.1.5   (a)   When animals are sessile slow moving area to survey is
                        large.

                (b)   Every member has equal chance of being selected
                        improves reliability eliminates bias.

3.2   3.2.1   They are different species of warbler finch occupying the same
                tree/competing for the same resource.

        3.2.2   Reducing competition *(must state this fact)*
                (Any two from following): each organism has a place to live within
                ecosystem consists of the conditions/resources/energy nutrients
                needed access to resources varies/shared between species can
                better avoid predation increases biodiversity in ecosystems.

        3.2.3   E.g. between Giraffe and kudu (accept other appropriate example)
                giraffes eat upper leaves of trees while kudu eat from lower
                branches.
                OR between browsers and grazers (e.g. kudu and zebra) kudu feed
                off the lower branches of trees while zebra eat the grass.
                (One named example + description of strategy)

3.3   Policy makers/politicians slow to act/ignore the crisis due to socio-political
        reasons governments satisfied to only pay lip service to issues *(must refer
        to this aspect of cartoon = 1 mark at least)*.
        Human overpopulation has reached crisis status fossil fuel resources
        depleting habitat loss for animals as human development demands land
        exploitation of wildlife food security/insufficient food supply to feed growing
        population access to fresh water supplies at risk shortly/water pollution.
        (Accept other reasonable answers)

3.4   3.4.1   *Australopithecus afarensis*

       3.4.2   Complete fossils rarely found need to be able to recognise that parts
                of a fossil are hominid need to be able to identify which part of the
                skeleton the fossil fragments are located need to recognise which
                features of a hominid fossil are more apelike or more human-like
                need to be able to compare small changes in bones not obvious to
                others
                (Accept other reasonable suggestions)
                (Max 3)

       3.4.3   Position of foramen central s-shaped spine broader pelvis femur
                angles inwards arched foot non-divergent big toe
                (Any 4)

       3.4.4   Access to information is not restricted/accessibility of information is
                free don't have to visit a museum appreciation for fossils fostered
                get better idea of size and form appreciate that fossils are human-
                like
                (Accept other reasonable suggestions)
                (Max 3)

3.5   3.5.1   Safety from predators foraging for food sleeping place

       3.5.2   CT scans indicated fractures in living bone tissue orthopaedic
                surgeons agreed fractures caused by falling fossils and geology
                indicate trees were found in area

       3.5.3   Evolution a science based on a body of evidence robust debate
                ensures data correctly interpreted eliminates errors reduces chance
                of scientists own attitudes influencing results peer review important.
                (Accept other reasonable suggestions)
                (Max 4)

QUESTION 4

4.1   4.1.1   Consists of two strands/double stranded
               Helix/spiral shape
               Circles show position of sugar molecules in backbone of strands
               (Any two)

       4.1.2   (a)   Sample 1
                       A and T bases (or C and G) are equal % so double
                       stranded/complementary base pairing shown thymine base
                       is present/no uracil.
                       (Sample identified correctly 2 facts in explanation)

                (b)   Cytosine

                (c)   All components correctly labelled (phosphate, sugar/
                       deoxyribose, base/adenine/guanine/cytosine/thymine).
                       Phosphate joined to sugar molecule.
                       Sugar molecule joined to base.

                       E.g.
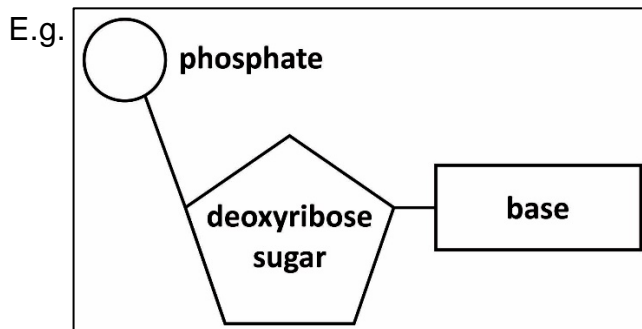
                (d)   RNA has uracil/DNA has thymine.
                       RNA does not contain thymine/DNA does not have uracil.
                       RNA is single stranded/ DNA is double stranded.
                       RNA is shorter molecule DNA is longer than RNA.
                       RNA has ribose sugar DNA has deoxyribose sugar.
                       (Accept any one)

4.2   4.2.1   Number of mosquitoes

       4.2.2   1968

       4.2.3   Spraying of DDT causes an increase in the number of resistant
               mosquitoes and a decrease in non-resistant mosquitoes.
               OR Spraying of DDT causes an increase in the number of resistant
               mosquitoes and when DDT is not sprayed the non-resistant
               mosquito number increases.
               *(Conclusion refers to: DDT spraying increase/decrease in number
               of mosquitoes and the phenotype of mosquitoes.)*

       4.2.4   (a)   DNA helix unwinds hydrogen bonds break.
                       RNA Polymerase links complementary bases of free
                       nucleotides in nucleoplasm but uracil replaces
                       Thymine/pairs with adenine mRNA leaves the nucleus.
                       (Any 4 logical correct facts)

       (b)   AUG
                  AGC
                  GUA

4.2.5   (a)   Substitution

        (b)   Change the type of amino acid change the function of protein.

4.3   4.3.1   Suspect 2

      4.3.2   (a)   Polymerase Chain Reaction/PCR

             (b)   White blood cells

      4.3.3   Not reliable: there must be other forensic evidence to corroborate/ support conviction, e.g. motive, fingerprints etc. DNA sample could have been planted at crime scene/framing of a person / human error in lab.
(Any 2)

      4.3.4   Familial relatedness identify remains fight illegal trade paternity testing medical research.
(Accept other reasonable suggestions)

4.4   4.4.1   A gene is a region of DNA that codes for a protein and an allele is a different form/version of a gene.

      4.4.2   Selective breeding

      4.4.3 P_1: Rr ✗ Rr parents

	R	r
R	RR	Rr
r	Rr	r

Gametes (method mark)

✓ All 4 correct
2 to 3 correct = *1 mark*
0 to 1 correct = 0 marks

F_1 genotypes – 1 RR : 2 Rr : 1 rr correct genotypic ratio:
F_1 phenotypes – 3 Curled ears: 1 straight ears correct phenotypic ratio.
(Accept ratio as fraction or percentage)

Total: 200 marks