# LIFE SCIENCES: PAPER I

## MARKING GUIDELINES

Time: 3 hours                                                                 200 marks

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**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.**

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## QUESTION 1

1.1  **COLUMN A**                                                                **COLUMN B**

[ G ]  Crossing over occurs.                                           A    Diploid

[ E ]  Cytoplasm splits to form 2 cells.                      B    Chiasma

[ C ]  Double-threaded chromosomes move to poles.    C    Anaphase I

[ I ]  Bivalents line up at equator.                             D    Metaphase II

[ L ]  Ploidy of cells at end of meiosis I.                   E    Cytokinesis

[ J ]  Centromeres split.                                            F    Gamete

[ F ]  Human cell with 23 chromosomes.                 G    Prophase I

[ D ]  Chromosomes line up at equator in single file.   H    Centrosome

[ B ]  The point at which genetic material is exchanged    I    Metaphase I
          between homologous pairs.

[ H ]  Organelle which forms the spindle in animal cells.    J    Anaphase II

K    Interphase

L    Haploid

(10)

1.2

| Question | 1.2.1 | 1.2.2 | 1.2.3 | 1.2.4 | 1.2.5 | 1.2.6 | 1.2.7 |
|----------|-------|-------|-------|-------|-------|-------|-------|
| Answer   | A     | C     | A     | D     | C     | C     | D     |

(10)

1.3    1.3.1  Diagram showing protein synthesis/transcription and translation.    (1)

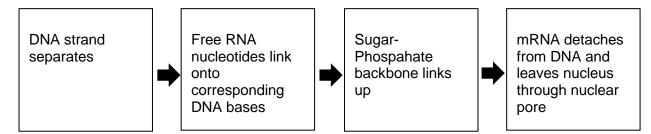1.3.2  A – DNA
B – mRNA
C – Anticodon
D – tRNA
E – Amino acid
F – Polypeptide
G – Ribosome
H – Nucleus/nuclear membrane    (8)

1.3.3

| DNA strand separates | → | Free RNA nucleotides link onto corresponding DNA bases | → | Sugar-Phospahate backbone links up | → | mRNA detaches from DNA and leaves nucleus through nuclear pore |

Summarised info in logical flow    (5)

1.4    1.4.1  (a)    Hours after sexual intercourse    (2)

(b)    Dependent variable – pregnancy rate    (2)

1.4.2  1.5/100 × 200 = 3    (3)

1.4.3

| | Statement | A, B or C |
|---|---|---|
| (a) | Taking MAP within 12 hours of unprotected sex guarantees no pregnancy. | B |
| (b) | The longer you wait to take the MAP after unprotected sex, the less effective it becomes. | A |
| (c) | MAP is not recommended as a method of contraception. | C |
| (d) | 95,9% of women who take the MAP 72 hours after unprotected sex will not fall pregnant. | A |
| (e) | MAP should only be dispensed if a doctor prescribes it. | C |

(5)

1.4.4  Yes – every woman has a right to make decisions about her body
- A young girl is not ready to become a parent regardless of what her parents think
- It will cut down on abortion rate as it won't allow implantation (less traumatic than abortion)
**OR**
No – girls are too young to make mature decisions about their futures; need parental guidance
- Encourages promiscuity as it is so easy to prevent the pregnancy
- Bad for health so parents must be involved with decision    (2 × 2)

1.5    1.5.1    Normal – Two normal parents can have an albino child so they must have both been carrying the albino gene masked by the dominant normal    (3)

1.5.2    Key: <u>N = allele for normal melanin; n = allele for albinism</u>

| Individual | Genotype |
|------------|----------|
| 1 | Nn |
| 6 | Nn |
| 12 | nn |

(4)

1.5.3    P1 genotypes: Nn x Nn

|   | N | n |
|---|----|----|
| N | NN | Nn |
| n | Nn | nn |

gametes

F1 genotype: 1NN : 2Nn : 1nn
F1 phenotype: 3 normal : 1 albino (25% chance of an albino child)    (6)

1.6    1.6.1

| Phase | Positive or negative growth? | Slow or fast growth rate? | Reason for speed of growth. |
|-------|------------------------------|---------------------------|-----------------------------|
| A | Positive | Slow | Establishing themselves/low numbers |
| C | Positive | Fast | Abundant resources/living below carrying capacity |
| D | Positive | Slow | Approaching carrying capacity/ environmental resistance/ competition |

(9)

1.6.2    Stable because it is levelling off at carrying capacity/E    (2)

1.6.3    (a)    $P = MC/R$

$$= \frac{530 \times 480}{80}$$

$= 3\ 180$    (3)

(b)    Make sure tags do not harm the animals
Make sure tags do not make the animals vulnerable to predation or recapture
Make sure tags cannot fall off
Don't allow too much time between captures
Allow sufficient time for animals to mix after a capture (or any other)    (3)

**[80]**

**QUESTION 2**

2.1    2.1.1    A chromosome is a structure in the nucleus, which is <u>made of DNA</u> <u>and histones</u>
DNA <u>contains genetic code</u> of chromosome
Genes are <u>areas of a chromosome</u> that code for a particular protein    (3)

2.1.2    A – phosphate
B – sugar (deoxyribose)
C – Nitrogenous base    (3)

2.1.3    Histones    (1)

2.2    2.2.1    Suspect 2 because his DNA banding pattern matched crime scene DNA and we were told that semen at the crime scene belonged to Michael    (3)

2.2.2    PCR amplifies specific section of DNA so that there is sufficient DNA to create a DNA profile.    (2)

2.2.3    Yes, so that if he commits a crime in the future they will be able to identify him
**OR**
No, because he never committed any crime so why should he be treated any differently to a normal person    (2)

2.3    2.3.1    (a)    Organisms whose DNA have been artificially manipulated for a specific purpose    (2)

(b)    The use of living organisms to create a product useful to man    (2)

2.3.2    Higher yields
Reduced need for pesticides/herbicides
Production of medicinal products, e.g. insulin
Drought resistance
Flood resistance or any other reasonable benefit (only mark first three)    (3)

2.3.3    Against natural laws as man is interfering with nature
Possible long term health issues linked to GMOs as they have not been tested for long enough
Possibility of cross pollination of the GM crop with natural flora leading to loss of biodiversity
High cost of GM seeds will not be accessible to all
or any other reasonable benefit (only mark first 2)    (4)

2.4    2.4.1    In females there are 2 X chromosomes so a single mutation will be masked by a healthy gene
In males there is only 1 X-chromosome so if there is a mutation on it, it will be expressed    (4)

        2.4.2    Let $X^H$ be allele for normal and $X^h$ be allele for haemophilia

|  | $X^H$ | Y |
|---|---|---|
| $X^H$ | $X^H X^H$ | $X^H Y$ |
| $X^h$ | $X^H X^h$ | $X^h Y$ |

gametes

methodology of cross

Therefore the son will have a 50% chance of suffering from haemophilia    (5)

        2.4.3    Isolate human Factor VIII gene using restriction enzyme → insert into hamster DNA using ligase enzyme → hamsters start to code for human Factor VIII → which is isolated from hamster blood    (6)

**[40]**

## QUESTION 3

3.1    3.1.1    Behaviours that increase the chance of successful fertilization/ reproduction.    (2)

        3.1.2    Seahorses don't look after young so they have smaller chance of survival therefore they produce many offspring so that at least some survive
Mouth brooders protect the young so many survive therefore don't need to produce many as energy is used in looking after young    (4)

        3.1.3    Courtship/External fertilization/Parental care    (2)

        3.1.4    Mouth brooders: male and female circle each other
Egg scatterers: Male butts and nips stomach and vent area
Live bearers: Link tails and spin in unison then male pumps water through his pouch    (3)

3.2    3.2.1    B – both have few offspring/long life/less energy used to produce offspring.    (2)

        3.2.2    They have short lifespan but they are able to spread species quickly by producing many small seeds so it is beneficial to be an r-strategist.    (2)

        3.2.3    Small seeds/quick growth/many seeds/parachutes for good dispersal.    (2)

3.3    3.3.1   Pituitary Gland/Hypophysis (1)

        3.3.2   P – Oestrogen          Q – Progesterone (2)

        3.3.3   (a)     Corpus Luteum (1)

                (b)     Placenta (1)

        3.3.4   No – her progesterone levels have decreased; at end of cycle (3)

3.4    3.4.1   Glucose absorbed into blood → raises blood sugar level → Islets of Langerhans in pancreas release insulin → causes glucose to be absorbed into cells → converted to glycogen → blood sugar level restored to normal/drops (7)

        3.4.2   (a)     Following Banting Diet can/cannot reduce/reverse Type 2 diabetes. (statement) (3)

                (b)     3 Fixed – age of patient/sex of patient/length of time diabetic/ method of testing insulin resistance/quantity of food in diet, etc. (any 3) (3)

                (c)     Test more candidates
                        All same age
                        Standardise diets completely in terms of quantity and type of food, etc. (2)

**[40]**

## QUESTION 4

4.1    4.1.1   Male reproductive – fertilise female eggs
                Female reproductive – produce eggs/new offspring
                Soldier – defend colony/queen
                Worker – feed babies/build nest/clean queen, etc.
                Winged reproductive – spread species/form new colonies (5)

        4.1.2   Can specialise on a particular job and thus become structurally suited to perform with excellence/colony can survive even when individuals die – survival of species (max 2) (2)

4.2    4.2.1   Can develop hunting strategies as a pack ensuring more successful hunts (or they can discuss a particular hunting strategy)
                Work as a pack so can bring down bigger prey
                More eyes and ears to look for prey
                Can communicate with each other to alert each other to proximity of prey/strategies thus more success
                Some females stay behind to look after pups so that all hunters can be focused on the hunt (6)

4.2.2 (a)   When genes from different gene pools mix, genetic weaknesses are masked by healthy genes and the pack stays strong and fit (or similar answer). (3)

(b)   As they inbreed the weak genes pair up and start showing in the phenotype. This causes illness and weakness which leads to more death. Wild dogs are endangered so we cannot afford to let this happen (3)

(c)   Move dogs to new packs
Educate public about endangered status
Fence off larger areas for them to move freely/collapse fences of neighbouring parks
Vaccinate wild dogs against disease (or any reasonable idea) (4)

4.3   4.3.1 (a)   Better health care
New medicines
Better nutrition
Better education (2)

(b)   Availability of contraceptives
Better educations
Hormones in food/water
Women with careers
Pollution (2)

4.3.2 (a)   90–110 million (1)

(b)   310–330 million (1)

(c)   340–360 million (1)

4.3.3 (a)   Increased infant survival rates and decreased birth rate shifted the bulk from the base into the 30's and 40's giving the bell shape
Good health care causes people to live longer preventing the declining numbers at the top and bell becomes barrel (4)

(b)   Not enough working people to support elderly
Not enough facilities, e.g. hospitals for elderly
Not enough working population to drive economy (any 2) (2)

(c)   Build more health care facilities to cope with elderly people
Divert budget allocation from education to pensions as there are fewer children and more elderly (4)

**[40]**

**Total: 200 marks**