



Province of the  
**EASTERN CAPE**  
EDUCATION

**NATIONAL  
SENIOR CERTIFICATE**

**KEREITI 12**

**LWETSE 2020**

**DISAENSE TSA BOPHELO P2**

**MATSHAWU: 150**

**NAKO: 2½ dihora**

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Pampiri ena ya dipotso ena le maqephe a-16.

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**TLHOKOMOMELISO LE TLHALOSO**

Bala ditaelo tse latelang ka hloko pele u araba dipotso.

1. Araba dipotso TSOHLE.
2. Ngola dikarabo TSOHLE BUKENG YA DIKARABO e fanweng.
3. Qala Karabo ya potso e ngwe qalong ya leqephe le lecha.
4. Nomora dikarabo ka nepo ho latela sistimi e sebelisetsweng pampiring ya dipotso.
5. Fana ka dikarabo ho latela ditaelo tsa potso ka ngwe.
6. Ditshwantsho TSOHLE DI LOKELA ho etswa ka pensile ebe di ngolwa ka enke e putswa kapa e ntsho.
7. Etsa ditshwantsho, ditebole kapa dichate ha o kopuwa ho etsa jwalo.
8. Ditshwantsho tse pampering ena ya dipotso HA WA HLOKAHALA ho redi hulelwe boholo.
9. SEO KE KENG WA SE sebelisa pampiri ya graph.
10. U tlameha ho sebelisa sebali sewu u keng sa programa, proractora le sesupa-tsela ha ho hlokahala.
11. Dipalo-palo tsohle di lokela ho potoloha ho isa dibakeng tse PEDI tsa palo.
12. Ngola ka makhetha le ka mokhwa o hlakileng.

**KAROLO A**

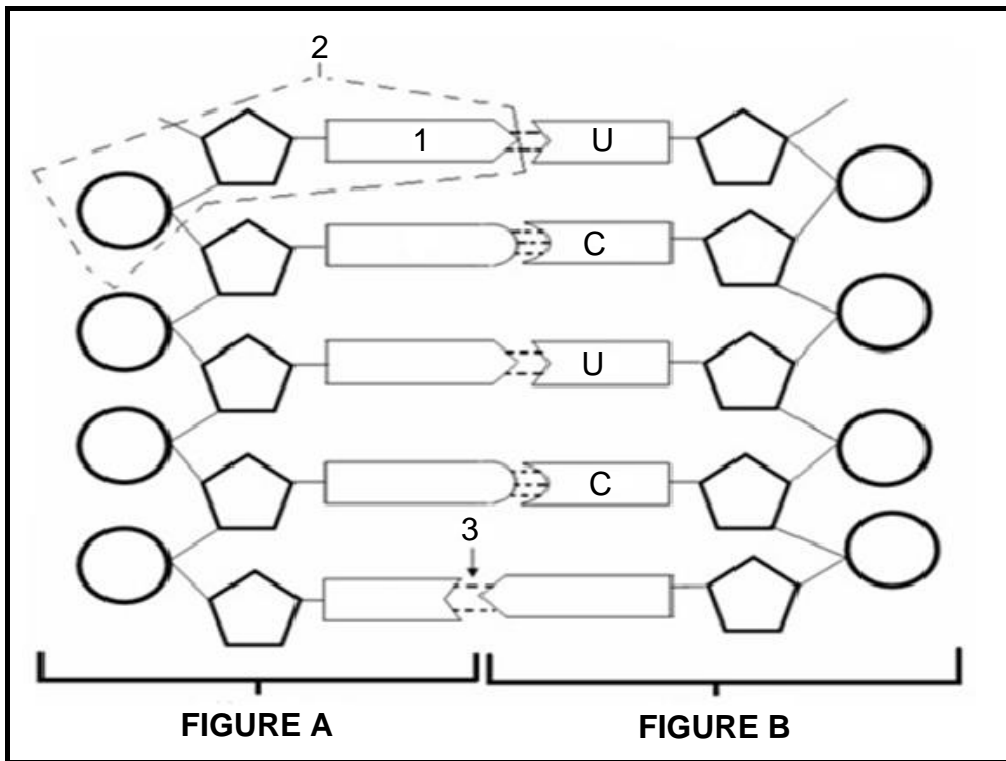
**POTSO 1**

1.1 Dikhetso tse fapaneng di fanwe e le dikarabo tse khonehang dipotsong tse latelang. Kgetha Karabo e nepahetseng mme o ngole feela tlhaku (A–D) haufi le nomoro ya potso (1.1.1–1.1.10) ho **BUKA YA DIKARABO**, mohlala 1.1.11 D Tshobotsi e nang le mefuta e fapaneng ya phenotypes ke mohlala wa.

1.1.1 Tshobotsi e nang le mefuta e fapaneng ya phenotypes ke mohlala wa ...

- A continuous variation.
- B codominance.
- C discontinuous variation.
- D complete dominance.

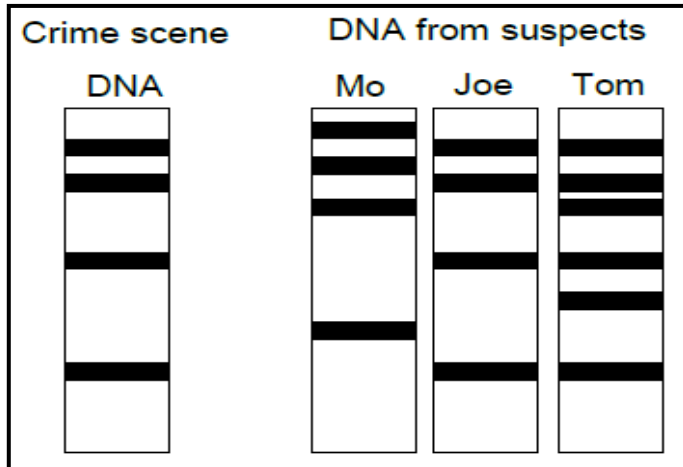
1.1.2 Ithute setshwantsho se latelang.



Ke efe ya dintho tsee e amanang le ena e bontshang ka nepo dikarolo tsa molekhule (molecule) e kaholimo?

	<b>FIGURE B</b>	<b>Molekhule 1</b>	<b>Molekhule 2</b>	<b>Tlamo 3</b>
A	DNA	Cytosine	nitrogenous base	Weak Hydrogen
B	DNA	Adenine	nucleotide	Sugar Phosphate
C	RNA	Adenine	nucleotide	Weak Hydrogen
D	RNA	Thymine	nitrogenous base	Weak Hydrogen

DIPOTSO tsa 1.1.3 le 1.1.4 di itshehlele ho setshwantsho se latelang:



1.1.3 Sephetho sa tsamaiso e bontshitsweng ka holimo e bitswa ...

- A cloning.
- B DNA replication.
- C fingerprinting.
- D DNA profiling.

1.1.4 Ithute lethathamo le ka tlase:

- (i) Ho etsa hlahlobo ya bo ntate. (Paternity testing)
- (ii) Ho bapiswa ha lisele hore ho hlongwe setho sa mmele
- (iii) Boitsebahatso ho tswa ho fingerprint.
- (iv) Ho phekola ho tswa taolong ha diphatsa tsa lefutso (genetic disorders)

Ke motswako ofe o bontshang ditshebediso tse nepahetseng tsa tsamaiso (procedure) tse setshwantshong se ka hodimo?

- A (i), (ii), (iii) and (iv)
- B Only (i), (ii) and (iv)
- C Only (i), (ii) and (iii)
- D Only (i) and (ii)

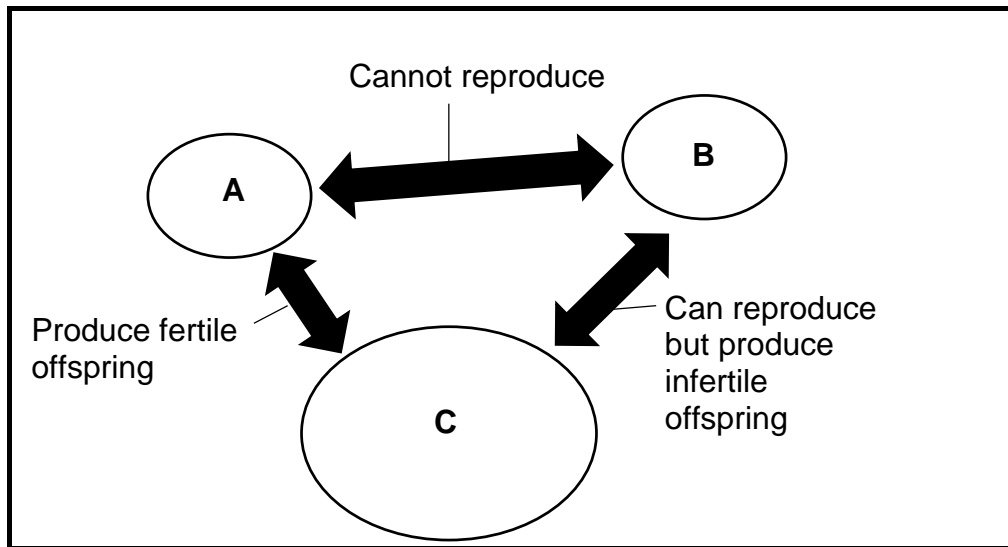
1.1.5 Ha phallo ya jene (gene flow) pakeng sa ditjhaba tse pedi e fe emisitse, ho bolela ho re ho etsahetse:

- A Speciation
- B Adaptation
- C Resistance
- D Variation

1.1.6 Ke efe ya tse latelang eleng mohlala wa khetho ya maiketsetso (artificial selection)?

- A DDT resistance in mosquitoes
- B Thuo ya dikhomo tse tshedi ho atisa tlhahiso ya lebeso
- C Antibiotic resistance in bacteria
- D Hlahiso ya mofuta (species) o sele wa Galapagos finch

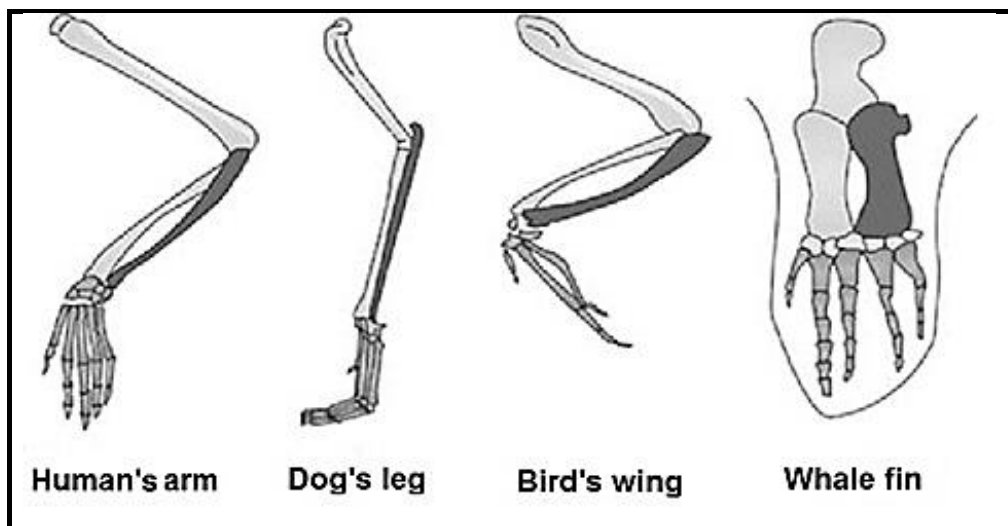
1.1.7 Setshwantsho se ka tlase se emela mefuta emeraro ya ( **A**, **B** le **C** ) e phelang dihlekehlekeng tse fapaneng.



Ke efe ya dipolelo tse latelang e nepahetseng?

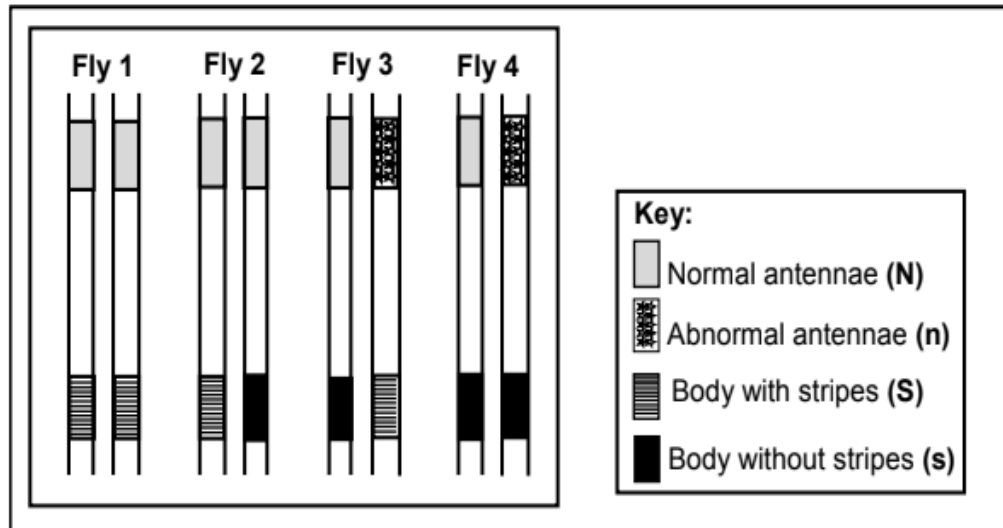
- A Kaofela ha dihlopha tsa baahi tse tharo ke mefuta e fapaneng.
- B Dihlopha tsa baahi B le C ke mefuta e fapaneng, ha A le B LE mefuta e tshwanang.
- C Dihlopha tsa baahi A le C ke mefuta e tshwanang, ha B le C e le mefuta e fapaneng
- D Kaofela ha dihlopha tsa baahi tse tharo ke mefuta e tshwanang

1.1.8 Diforelimbs tsa divertebrate, tse bontshitsweng ka tlase ke mohlala wa:



- A vestigial structures.
- B homologous structures.
- C analogous structures.
- D convergent evolution.

- 1.1.9 Setshwantsho se bontsha para ya homologous chromosome ya nomoro 3 e tswang ho engwe le engwe ya dintsinsi tsa tholwana tse nne. Sebopoho sa diallele (tse tlwaelehileng le tse sa tlwaelehang) le matshwao a mmele(e nang le metsero le e sang metsero) li bontshitswe hodima dikoromosome (chromosomes).



Ke ntsinsi efe e homozygous ho sebopoho sa dinaka hape e le heterozygous ho sebopoho sa mmele?

- A Ntsinsi 1  
 B Ntsinsi 2  
 C Ntsinsi 3  
 D Ntsinsi 4
- 1.1.10 Nonyana e kgabolang (hummingbird) e sebedisa molomo wa noyona o molelele ho ja lero le kahare ho dipalesa. Ho ya ka Gould le Eldridge ya punctuated equilibrium, molomo o molelele wa nonyana a kgabolang (hummingbird) o ile wa ntshethwa pele.

- A ka potlako ka nako e khutswane  
 B hobane ha nonyana e khabolang e ntse e sebedisa molomo wa yona khafetsa o wa hola o be molelele  
 C hobane melomo ya tsona e fetoha kamehla ka nako tsohle.  
 D butle-butle ka nako e telele

(10 x 2) (20)

1.2 Fana ka lentswe le nepahetseng la **tlhaho (biological term)** ho engwe le e ngwe ya ditlhaloso tse latelang, Ngola feela le ntse haufi le nomoro ya dipotso (1.2.1–1.2.8) BUKENG YA DIKARABO.

1.2.1 Mefuta e meng ya diforomo tsa gene e tshwanang

1.2.2 Sebopeliso sa tlhaho sa molekhule ya DNA

1.2.3 Mohato wa potoho ya sele (cell cycle) ha DNA e ikatisa (DNA replication)

1.2.4 Dintho tse phelang tse nang le ditshobotsi tse tshwanang tse lulang tikolohong (habitat) tse tshwanang di nyallana (reproduce) ka bolokolohi ho tswala ban aba ka ikatisang (fertile)

1.2.5 Mohato (phase) wa meiosis ha ho tshela (crossing over) e etswaha

1.2.6 Boemeli ba setshwantsho se bontshang ho iphetola hwa dintho le dikamano (evolutionary relationship) dipakeng tsa mefuta e fapaneng

1.2.7 Boithuto ba karolelano ya mefuta yak hale le ya mehleng ena mefuta lefatse ka ngwe ho phatlalla

1.2.8 Tshebetso yeo ditho tsohle tsa mofuta o itseng di timelang ka yona ke ha eba se seng se phonyohang

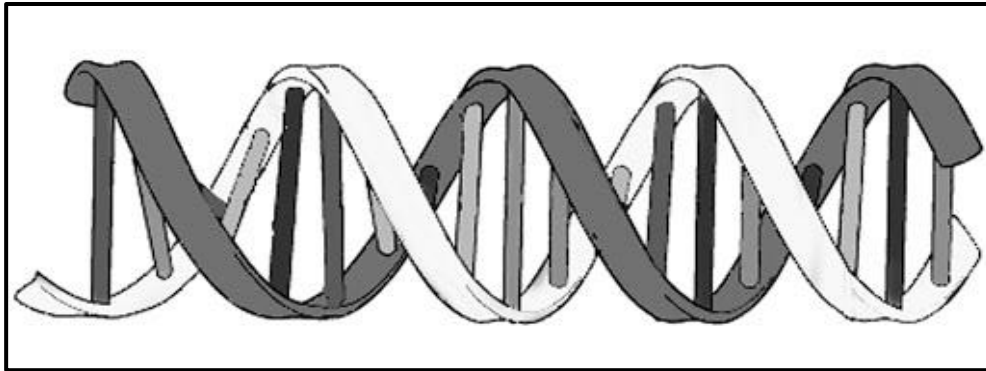
(8 x 1) (8)

1.3 Bontsha hore na dipolelo tse COLUMN I di tsamaelana le tse ho **A FEELA, B FEELA, bobedi A le B** kapa **ha ho le e ngwe** ho tse COLUMN II. Ngola **A feela, B feela, bobedi A le B, ha ho le e ngwe**, haufi le nomoro ya potso (1.1.3–1.3.3) BUKENG YA DIKARABO.

COLUMN I	COLUMN II
1.3.1 Rasaense ya ithutang feela mesaletsa ya dintho tsa khale (fossils)	A: Palaeontologist B: Archaeologist
1.3.2 E hloka hlahla bakeng sa khetho ya tlhaho hore e etsahale r	A: Variation B: Tlhadisano(Competition)
1.3.3 Karohano e thibelang ho ikatisa	A: Ho tswala ka dinako tse arohaneng tsa selemo B: Bana bas a tswaleng

(3 x 2) (6)

- 1.4 Setshwantsho se ka tlase se bontsha mohlala wa DNA e boletsweng ke bo ra-saense (ramahlale) ka 1953.



- 1.4.1 Bolela bo ra-saense ba pele ba ileng ba phatlalatsa sebopeliso sa DNA. (2)
- 1.4.2 Sebopeliso sa tlhaho sa DNA ke eng? (1)
- 1.4.3 Fana ka mesebetsi e medi ya DNA. (2)
- 1.4.4 DNA e fumanwa kaye ka hare sele ya motho? (2)
- 1.4.5 Bolela rasaense e mong ya fumaneng Moputso wa Nobel bakeng sa ho sibollwa ha sebopeliso sa DNA. (1)
- 1.5 Ho mofuta wa semela ho khethilwe tshobotsi tse pedi, mmala wa dipalesa le bophahamo semela. E ngwe le engwe ya ditshobotsi tsena e na le mofuta e meli e fapaneng: dipalesa di ka ba khubelu kapa tse tshweu ka mala dimela di ka ba telele kapa tsa ba bokhutswane.

Ha dimela tse pedi tse nang le heterozygous ho mala wa dipalesa le bolelele di ne di tswadiswa (crossed), bana ba 9 ba ba ne ba bokhubelu ebile ba balelele, ba 3 ba le basthweu ebile ba le telele, ba 3 ba le bokhubelu bape ba le bokhutshwanyane me 1 ene e tshweu ebile e le khutswane.

Ditlhaku tsa semelo (allele) se seng le se seng di bontshitswe tebuleng e ka tlase.

CHARACTERISTIC	DOMINANT ALLELE	RECESSIVE ALLELE
Mmala wa dipalesa	F	f
Bophahamo ba semela	H	h

- 1.5.1 Polelo ya (genetic cross) e kenyeletsang ditshobotsi tse pedi ke efe? (1)
- 1.5.2 Fana ka:
- (a) Tshobotsi e hlahelang (dominant phenotype) yam mmala wa palesa (1)
- (b) Genotype ya semela se palesa e tshweu, se sekhutswane (2)
- (c) Ho mmala wa palesa le homozygous e hlahelang (dominant) ho bophahamo ba semela (2)
- (d) Di gametes tse ka bang teng tsa semela se sefubelu, se heterozygous ka bophahamo (2)

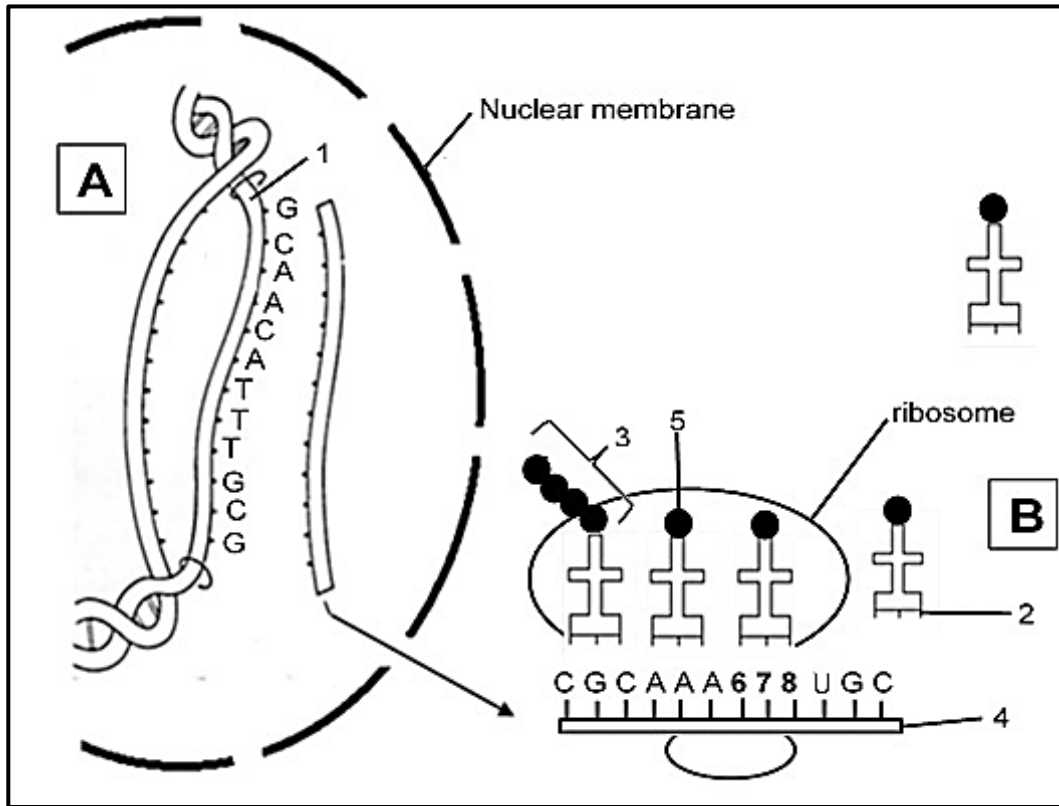
**MATSHWAO OHLE A KAROLO YA A: 50**



KAROLO B

POTSO YA 2

2.1 Ithute setshwantso se latelang.



2.1.1 Bolela tshebetso (process) e emelwang ke **A** le **B** di kopane. (1)

2.1.2 Process ya **B** e etsahala kae ka seleng ? (1)

2.1.3 Qolla tse latelang:

(a) Molekule (Molecule) **1** (1)

(b) Polymer **3** (1)

2.1.4 Fana ka tatellano e nepahetseng ya mothewo hore enke sebaka sa dinomoro **6, 7, 8**. (2)

2.1.5 Ngola anticodon ho label **2**. (1)

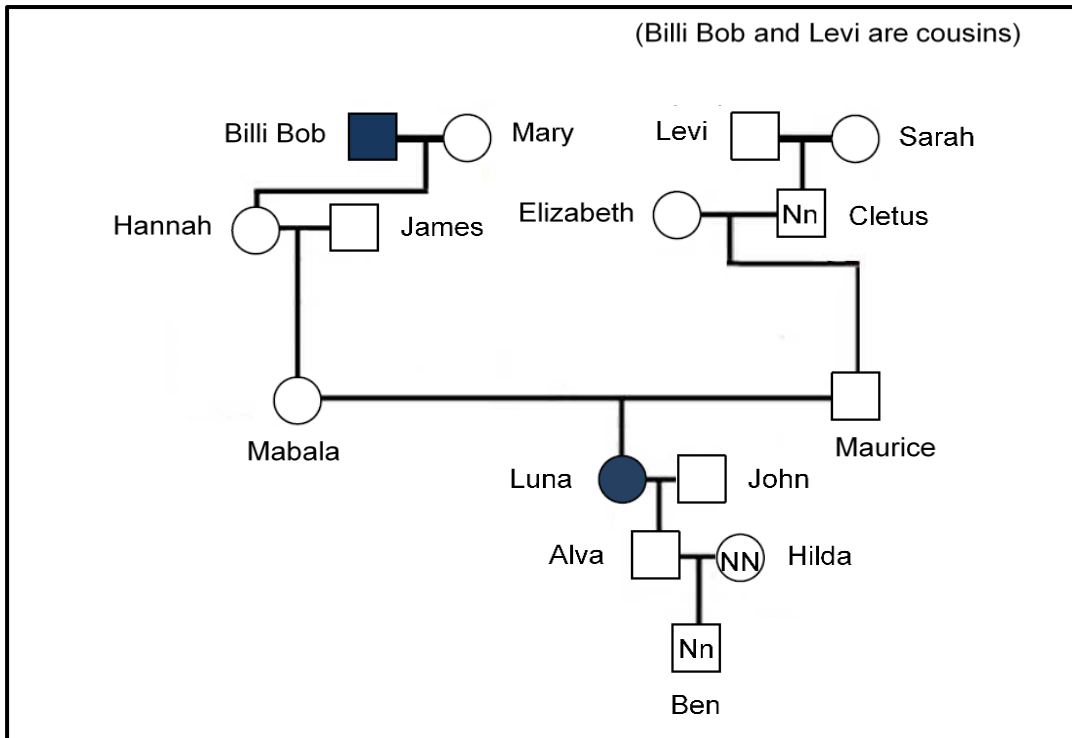
**SEBELISA TABOLE (TABLE) HA MMOHO LE DIAGRAM EKA HODIMO TSE LATELANG.**

ANTICODONS OF tRNA THEIR CORRESPONDING AMINO ACIDS THAT THEY CARRY	
tRNA ANTICODONS	AMINO ACIDS
UUU	Lysine
ACA	Cysteine
GCA	Arginine
GUU	Glutamine
CCA	Glycine
AAA	Phenylalanine

- 2.1.6 DNA base triplets ya Glycine ke efe? (2)
- 2.1.7 Bolela amino acid ho label 5. (1)
- 2.1.8 Hlalosa hore na moyetso wa molekhule (molecule) wa protheine o tla fetoha jwang haeba tatellano ya metheo ya codon bobeli ho molek'hule (molecule) ya 4 (ho tloha letsohong le letshihali) e ne e le **UUU** sebakeng sa **AAA**. (3)

2.2 'Batho ba Blue' (putswa) ke lefu la tlhaho (genetic disorder) le bakwang ke hobane motho ha a hlahise enzyme e fetolang methemoglobin (e putswa) hore e be haemoglobin (e khubelu). Sena se etsa ditekanyetso tse phahameng tsa methemoglobin madding. E etsa hore letlalo le fetohle le be leputswa 'dipounama tse pherese' (lips purple) le mmala o (chocolate brown) sekareleta wa mali.

Setshwantsho se ka tlase se bontsha ditho tsa lelapa tse nang le letlalo le leputswa. Mofuta wa ditho tse ding tsa lelapa wa tsebahala ebile o wa bontshwa setshwantshong.



[Ho tswa ho <http://ghr.nlm.nih.gov/indiana.edu/NCBI1000Genomes Browser>.]

- 2.2.1 Bolela mofuta wa setshwantsho se bolentshitsweng ka holimo. (1)
- 2.2.2 Fana ka:
  - (a) Phenotype ya Luna (1)
  - (b) Genotype ya Hannah (1)
- 2.2.3 Na lefu lee le bakwa ke (dominant) kapa ke (recessive) allele? (1)
- 2.2.4 Fana ka lebaka la Karabo ya hau ho POTSO ya 2.2.3. (2)
- 2.2.5 Mabala le Maurice bo bedi ba bona ba na le mmala wa letlalo le tlwaelehileng. Sebelisa (genetic cross) ho bontsha hore na ho ka etsahala jwang hore mora wa bona Luna abe le letlalo leliputswa. (7)

## 2.3 Bala qotso e latellang.

Ditlhapi tsa Antarctic di bile teng hore di phele metsing a leqhwa a Lewatle le ka Borwa. Diphela ka metsing a ka tlase ho 0 °C. Ka tlawelo disele di ne di tla hwama ebe di ya phatloha, motjheso ona o bolaya ditlhapi. Ditlhapi tsa Antarctic di hlahisitse diprotheine tse sebetsang joalo ka sethiba khwamo (anti-freeze). Diprotheine tsena tse thibelang khwamo di thusa tlhapi hore e se keya bata (hatsela) sebakeng se e lulang ho sona se batang ka ho emisa ho etswa ha dikristale tsa leqhwa ka hara disele.

Diprotheine tsena tsena thibelang khwamo di ka ba tsa bohlokwa hape khwebong. Bo rasaense ba ka sebediisa di (antifreeze) protheine gene tsena ho injinera di mila tse emalanang le serame kapa di ka sebedisa ha ho bolokwa dijo ka motjheso o tlase haholo. Di thibela dikristale tsa leqhwa hore di se ke tsa theha le ho senya dijo.

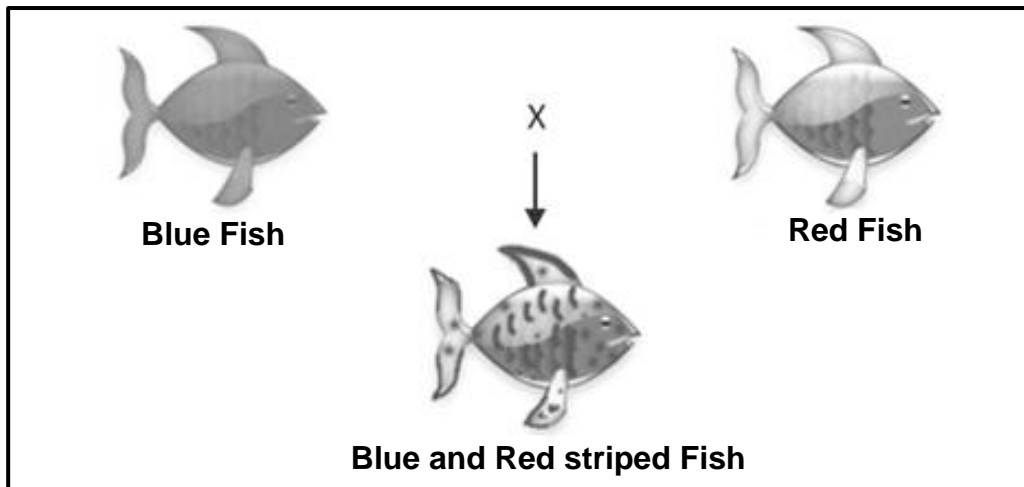
Bafuputsi ba se ba atlehile ho hlahisa di antifreeze protheine ya di tlhapi ho tomoso(yeast) le dibaktheria ka theknoloji e sebelisang dihlahiso tsa DNA (recombinant DNA). Ba ka sebeDlisa dibaktheria tsena le tomoso ho hlahisa di antifreeze protheine ka bongata.

- 2.3.1 Hlalosa hore na ditlhapi tsa Antarctic di ka be di hlahisitse antifreeze protheine jwang ho ya ka khetho ya tlhaho (natural selection). (5)
- 2.3.2 Bolela tshebetso eo sebophelo sa setho (genetic makeup) sa ntho ephilang seka fetolang ho hlahisa sebopeliso se sitjha (organism) ntho e phelang. (1)
- 2.3.3 Fana ka mekhwa e medi yeo di antifreeze protheine tsena di sebelisitsweng ka wona ho khwebo molemomg wa batho. (2)
- 2.3.4 Hlalosa hakhutswanyane hore na antifreeze protheine yena e hlahiswa jwang ka theknoloji e sebelisang ( recombinant) DNA le dibaktheria. (5)
- 2.3.5 Fana ka lebaka le le leng leo ho (fosahetsi) ke keng ahamohela ho sebelisa di antifreeze protheine ho dimela. (1)

**[40]**

### POTSO YA 3

- 3.1 Ditlhapi tsa Zebra di tla ka mebala e mengata e fapaneng. Emihle o ile a reka tlhapi e tona e putswa (**BB**) le tlhapi e khubelu ya zebra etshehadi (**RR**) bakeng sa tanka ya hae ya ditlhapi. Bana bahlapi ba tswetsweng ban a le metsero e meputswa le mefubedu.



Hamorao, Emihle o ile a etsa qeto ya ho ba le tanka ya bobedi a tswadisa ditlhapi tse peli tse putswa le e le ngwe emetsero e me khubelu. Ho ne ho e-na le bana ba 20 ka kakaretso bai le ba tswala bae ne le mebala e meraro e fapaneng: e putswa, e khubelu le e putswa le e metsero e putswa le mekhubelu.

- 3.1.1 Bolela mofuta wa puso e matla (dominance) e bontshitsweng mohlaleng o kahodimo. (1)
- 3.1.2 Hlalosa Karabo e fanweng HO POTSO 3.1.1. (2)
- 3.1.3 Rala (draw) tabule (table) e bontshang palo (lenani) labana ba genotypes tse fapaneng hotswa tswalisong ya bobeli ya Emihle. (5)
- 3.1.4 Ene e tla ba phenotype(s) le genotype di feng tsa tlhapi ya motswadi haeba Emihle o ne a batla feela bana tlhapi ba ba khubelu feela? (2)
- 3.2 Bala temana e latelang.

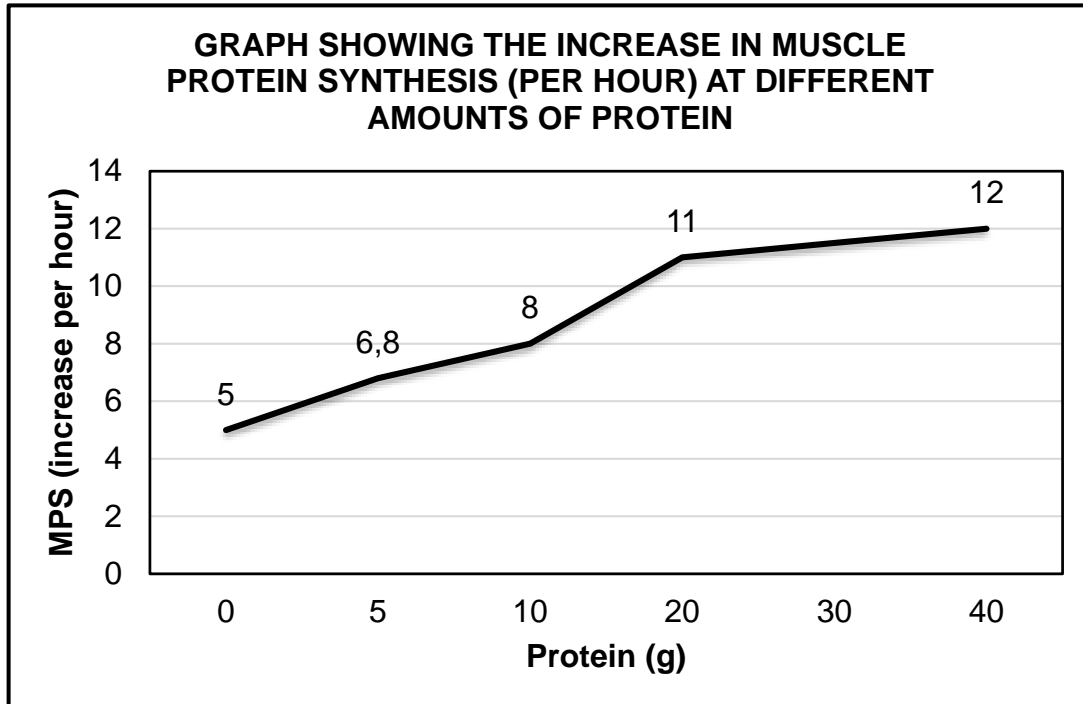
Baatlelete ba bangata ba tlameha ho ikwetlisa ka thata ho aha mesifa. Mesifa ke protheine mme ka hona e thehilwe ka motswako wa protheine. Baatlelete ba hloka ho ja le ho ikwetlisa ba le ba etsa bonnete ba hore ho na le Muscle Protein Synthesis (MPS) enepahetseng. Kamehla ba batla ho tseba hore na ba tlameha ho ja liprotheine tse kae ho theha mesifa e meholo.

Bo-rasayense ba e le ba etsa dipatlisiso ho fumana protheine e nepahetseng ya letsatsi le letsatsi (ka (digrama) e hloka halang bakeng sa keketseho e kholo ho Muscle Protein Synthesis.

Patlisiso e entswe tjena:

- Ba ithutile diahi tsa mmele (bodybuilder)s tse 100.
- Sehahi se seng le seng sa mele se ne se fuwa lenaniwo le tshwanang la ho ikwetlisa ka boyima ba letsatsi le letsatsi.
- Baatlelete bohle a ile ba feptjwa dijo tse lekantsweng tsa protheine hang ka mora ho ikwetlisa
- Di – MPS tsa bona di tlalehilwe dihora tse 4 kamora ho ikwetlisa.

Graph e ka tlase e bontsha sephetho sa dipatlisiso Diphetho tse na di tshwana le dipatlisiso tse ding tse pedi tse entsweng ke bo-rasayense ba bang.



Qeto e fihletsweng ke bo-ramahlale (bo-rasayense) e bile e latelang: Protheine e nepahetseng ya letsatsi le letsatsi e hlokahalang bakeng sa keketseho e kholo ho Muscle Protein Synthesis ke 20 g.

3.2.1 Bolela:

- (a) Phapang e etsitlehileng (Dependent variable) (1)
- (b) Phapang e ikemetseng (Independent variable) (1)

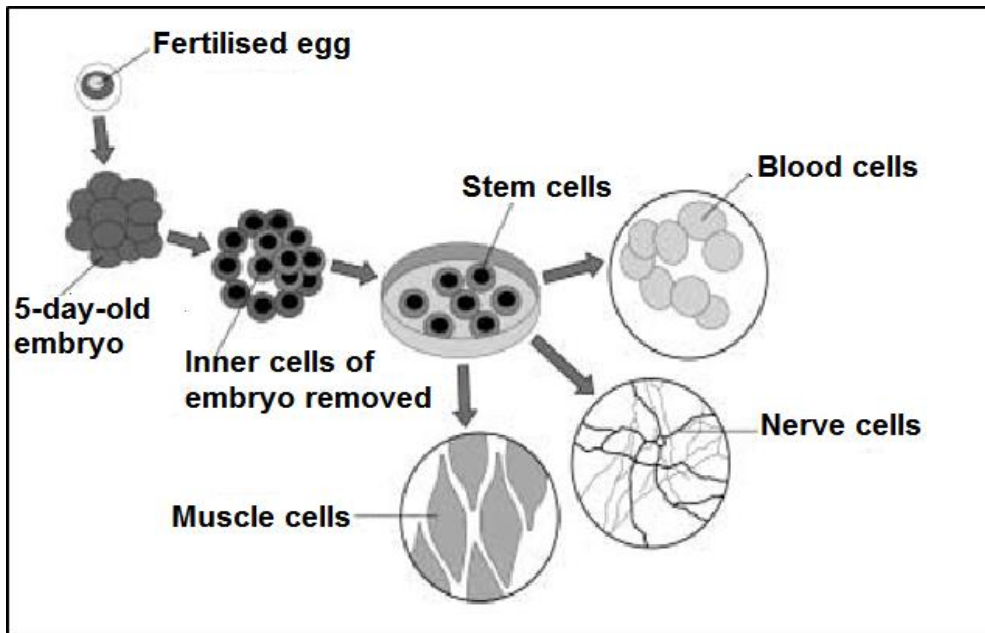
3.2.2 Fana ka mehato e mmedi ya ho rera yeo bafuputsi ba ka hlohang ho e latela. (2)

3.2.3 Fana ka mabaka a hore patlisiso ena e ka nkuwa e tshepahala (reliable). (2)

3.2.4 Bala keketseho ya diperesente ho MPS ho tloha ho 20 g ho ya ho 40 g. (2)

3.2.5 Ho sebedisa tlhaiso-leseding a fanweng fana ka maikutlo a hore na Hobaneng bo-ramahlale ba entse qeto ya ho re 20 g ya protheine e ne le Palo e lekaneng ya protheine e hlokahalang letsatsi le letsatsi bakeng Keketso ya Muscle Protein Synthesis. (2)

3.3 Setshwantsho se bontsha tsela e ngwe yeo disele tsa stem di hlahiswang ho tswa maheng a batho.



3.3.1 *Disele tsa stem* ke eng? (2)

3.3.2 Fana ka mehlodi e medi ya disele tsa stem ntle le mahe a batho. (2)

3.3.3 Fana ka boemo bo bong ba bongaka bo ka phekolwang ka ho sebedisa disele tsa methapo ho tswa diseleng tsa steme. (1)

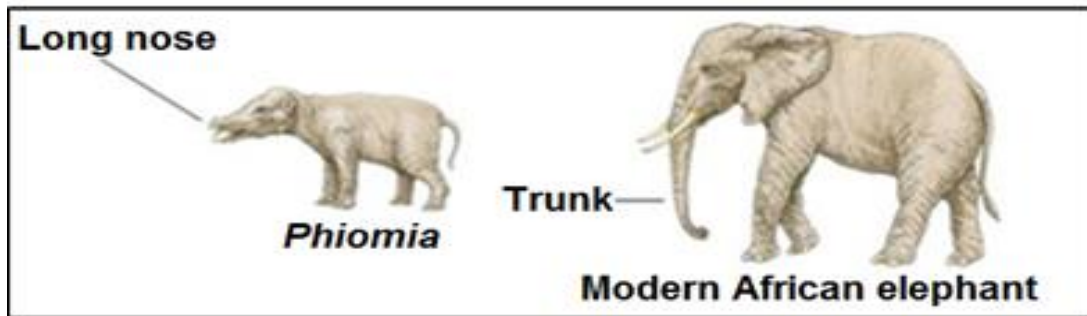
3.4 Mofuta wa mali a motho ke mohlala wa dikhakanyo tse ngata (multiple alleles).

3.4.1 Hobaneng ha mofuta ya mali e le mohlala wa dikhakanyo tse ngata? (2)

3.4.2 Fana ka mofuta wa genotypes ho monna ya nang le mofuta wa mali B. (2)

3.4.3 Haeba monna ana le sehlopha sa mali B mme mosadi ane le sehlopha sa madi A. Hlalosa hore na ho tla jwang hore ngwana a be le sehlopha sa madi O. (O SEKE WA TAKA Setshwantsho sa lefutso.) (3)

3.5 Ditshwantsho tse ka tlase di bontsha *Phiomia*, moholo wa ditlou le tlou ya sekwale-jwale ya Afrika. *Phiomia* e phetse dilemo tse dimilione tse 35 tse fetileng. Ka bobedi *Phiomia* le tlou ya sekwale-jwale ya Afrika di nyolohela difateng ho fumana makgasi awu di ka a jang.



- 3.5.1 Hlalosa hore na Jean-Baptise Lamarck o tla hlalosa jwang kajeno tlou ya Afrika e ile ya hlaha mokadi( nko ) e telele. (5)
- 3.5.2 Fana ka mabaka a MABELI a hore na hobaneng khopolo(theory) ya Lamarck e sa amohelwe kajeno . (2)
- 3.5.3 Fana ka ho tshwana pakeng tsa dikhopolo tsa Lamarck le khopolo ya Darwin ya khetho ya tlhaho (natural selection). (1)

**[40]**

**MATSHWAO OHLE AKAROLO YA B: 80**

**KAROLO C****POTSO 4**

Sekaseka sebopeho sa karyotype ya motho. Hape hlalosa o re na hobaneng meiosis e leng bohlokwa, le hore ho se arohane (non-disjunction) ka nako ya meiosis ho ka ama motho jwang.

Dikahare: (17)

Moaho: (3)

**HLOKOMELA:** Ha ho na matsowo a tla fanwa bakeng sa dikarabo ka mokhwa wa ditswantso tse tsamayang.

**MATSHWAO OHLE A KAROLO C: 20****MATSHWAO OHLE A PAMPIRI ENA: 150**