FORM 4

BIOLOGY.

TOPIC 1: GENETICS

1. Write the types of gene mutation represented by the following analogues.

i.).Intended message BRING THERMOS ON OUTING

Actual message BRING MOTHERS ON OUTING

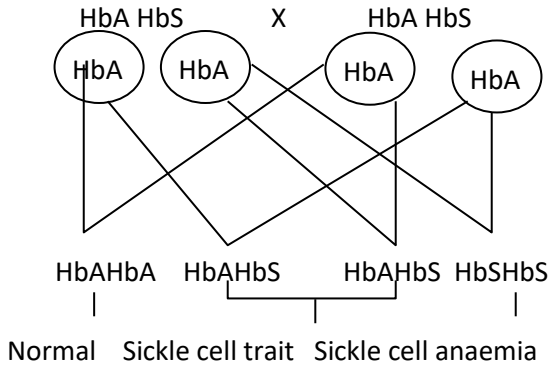
Inversion.

ii) Intended message PLEAS SAY WHERE YOU ARE Actual message PLEASE STAY WHERE YOU ARE

Insertion

2. Sickle cell anaemia is a hereditary disease due to a recessive gene which changes normal haemoglobin (Hb – A) to abnormal haemoglobin (Hb – S). The red blood cells of people with sickle cell anaemia are sickle shaped.

(a) What are the possible phenotypes of the offsprings of a man who is heterozygous and a woman who is also heterozygous? Show your working.



b).Sickle cell trait is more prevalent in tropical countries than in temperate countries. Give an explanation for this observation.

In tropical countries malaria incidence is high; those who are heterozygous have immunity to malaria; this is called heterozygous advantage. Or In tropical countries malaria incidences is high; those who are heterozygote have some red blood cells with crescent shape thus low oxygen carrying capacity plasmodium content therefore survive in such conditions making them to have an immunity.

3 The figure below illustrates a portion of a chromosome with genes named A, B, C, S, Q and R

A	B	C	S	Q	R

Use the diagrams similar to the one above to illustrate the changes if the above chromosome undergoes the following mutations affecting only gene C and S. i).Deletion

A	B	Q	R

ii).Inversion

A	B	S	C	Q	R

iii) Duplication.

A	B	C	S	C	S	Q	R

4. The genetic disorder hemophilia is due to a recessive sex linked gene .A man who is hemophilia marries a woman who is carrier for the condition.

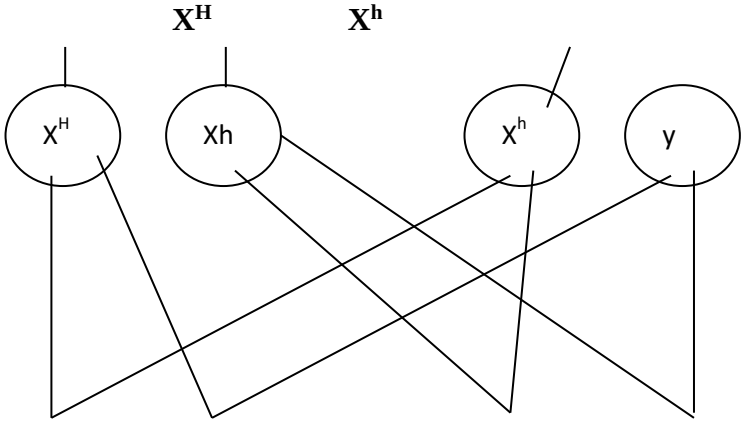
a) Using letter H to represent the normal condition and letter h for the hemophiliac condition.

i).What is the genotype for the man and the woman?

i) Work out a cross between the man and woman

Parental genotype

Gametes



X X^h y;

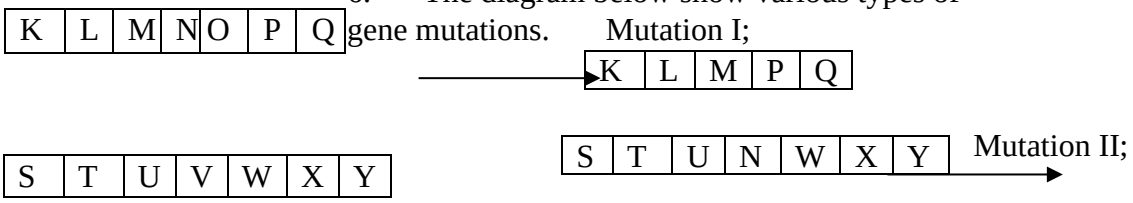
;

Fusion **Offspring** **X^HX^h** **X^Hy** **X^hX^h** **X^hy**
;

b) What is the chance that both the first and second sons will be hemophiliac?
¼ x ¼; = $^1/_{16}$

5 Hemophiliac is more common in males than in female human .Explain
Y chromosomes does not have the corresponding allele for the gene that determine or cause haemophilia/y chromosome is almost genetically empty;

6. The diagram below show various types of gene mutations.

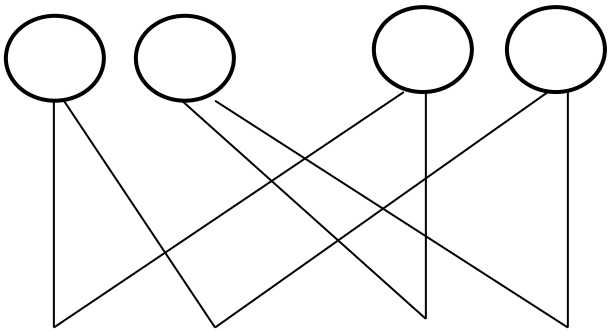


i).Identify the type of mutations shown above
I. Deletion II. Substitution.
ii).Name one disorder that results from gene mutation II. **Albinism/Sickle - cell anemia**

7. In a certain plant species which is normally green, a recessive gene for colour (n) causes the plant to be white when present in a homozygous state. Such plants die at early age. In heterozygous state, the plants are pale green in color but grow to maturity.
(a) Suggest a reason for the early death of plants with homozygous recessive gene.
Homozygous recessive plants do not have chlorophyll/cannot photosynthesize;
b).If a normal green plant was crossed with a pale green plant, what would be the genotype of the F1 generation? (Show your working)

Parental phenotype Normal green Pale green
Plants plants Parental genotypes NN x Nn ;

Gametes ;



F_1 offspring NN Nn NN Nn ;
Genotypes

Punnet's Square
Parental genotype NN x Nn;

♀ / ♂	**N**	**N;**
N	**NN**	**NN;**
n	**Nn**	**Nn**

c).Give an explanation for occurrence of the pale green color in heterozygous plants

Due to incomplete dominance of the gene for normal color;

8 .Define polyploidy.
Presence of more than two sets of chromosomes in a cell;

9. Name **three** disorders resulting from gene mutations.
-Albinism; -Haemophillia; -Colorblindness -Sickle cell anaemia

10. What is multiple allelism?

Multiple allelism is a condition in which a heritable characteristic is determined by more than two variant forms of the same single gene.

11. A pure breeding black male mouse was mated with a pure breeding brown female mouse. All the offspring had black coat color.

i. Explain the appearance of black coat color in the offspring.

Gene for black coat color (completely) dominant over gene for brown coat color / brown color gene recessive over gene for black color. ii).If the black parental mouse was mated with a mouse that is heterozygous for coat color, work out the genotypic ratio of offspring. Show your working.

Parental phenotype

Parental genotype **B B x B b**

Parental Gametes **B B B b**

Fusion / Fertilization

F2 generation **BB Bb BB Bb**

Genotype ratio => 1BB : 1Bb

12. State **<u>two</u>** disorders in human beings hat are as a result of chromosomal mutation.

-Down's syndrome -Klinefelter's syndrome -Turner's syndrome

13. What is meant by the term allele?

Alternative form of a gene;

14. Explain how the following occur during gene mutation. (i)
Deletion.

Some bases/nucleotides of a gene are removed

(ii) Inversion.

The order of some bases/nucleotides is reversed;

15. What is a test-cross?

A cross made between a homozygous recessive individual/parent and a parent/individual of unknown genotype (to determine whether the unknown genotype is homozygous or heterozygous for dominant gene);

16. Identify the nucleic acid whose base sequence is shown below.

G-A-C-U-A-G-A-C-G

i) Identify the type of nucleic shown above

RNA; ii)

Give reason for your answer in (i) above.

Has the base Uraci;

ii) Write the base sequence of a DNA strand for the nucleic acid shown above

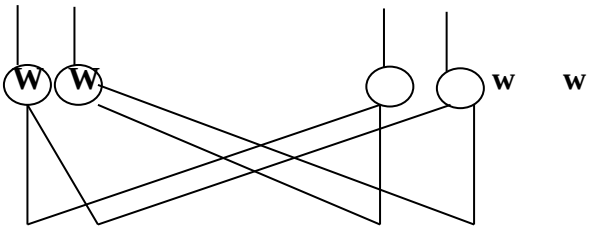
C-T-G-A-T-C-T-G-C ;

17. In human beings, a **downward pointed frontal hairline** ("windows peak") is a heritable trait. A person with windows peak always has at least one parent who has this trait; whereas persons with **frontal hairline** may occur in families in which one or even both parents have windows peak. Using **W** and **w** to symbolize genes for this trait. Determine the F1 generation if a homozygous windows peak male parent is married to a homozygous frontal hairline female parent.

Parents ♂ ♀

Phenotype **window peak** **frontal hairlined**

Genotype W W **x** **w w**



Ww W w **Ww** **Ww** **F1 generation**

All windows peak

18. State two causes of variations.

-Mutations - Gene formation/independent assortment of homologous chromosomes and crossing over; - Fertilization;

19. Name two sex linked genetic disorders affecting human females and males

Haemophilia Color blindness

20. What is genome?

It is the entire genotype of a cell individual;

21. Name an importance of non-disjuction in agriculture

Causes polyploidy

22. Give a reason why it is only mutation in genes of gametes that can influence mutation **Its only genetic acquired characteristics which can be inherited**

23. Define non disjunction?

Failure of homologous chromosome to separate, during meiosis leading to a loss or gain of a chromosome

24. Name two genetic disorders of the blood.

-Sickle cell anaemia -Haemophilia

25. In cattle the gene for red color is represented by letter R and that of white color as W. A Red bull and a white cow were crossed and all the offspring were Roan.

(a) Give a reason for the appearance of roan cattle in F1 generation.

Incomplete/co-dominance

b).Using a punnet square work out the F2 generation.

♀ \ ♂	R	W;
R	RR;	RW;
W	RW	WW;

(b) State the genotypic and phenotypic ratio of the F2 offspring above.
Phenotypic ratio ; 1 Red : 2 Roan : 1 white Genotypic ratio ; 1RR : 2RW: 1WW

26. Name the molecule that carries genetic information in eukaryotic cells. **Deoxyribon nucleic acid.**

27. What is meant by term sex-linkage?
Genes are located on the sex chromosomes / on X and Y chromosomes; They are transmitted together with those determining sex.

28. Name **two** sex-linked traits in humans.
-Baldness; colorblindness; haemophilia; -Hairly ears / pinna / nose; duchenne muscular dystrophy;

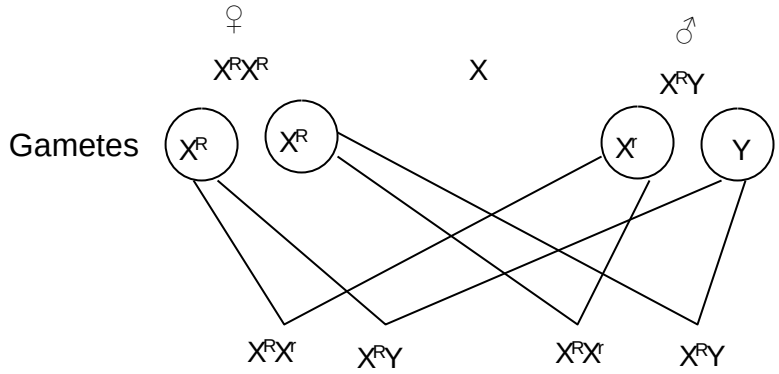
29. A pea plant with smooth seeds was crossed with one with wrinkled seeds. The gene for smooth seeds is dorminant over that for wrinkled seeds. Use letter R to represent the dorminant.

a).State the genotype of the parents if the plant with smooth seeds was heterozygous.
- Smooth seed plant - Rr; - Wrinkled seed plant - r r;

b).State the gametes produced by the smooth seeds and wrinkled seeds parents.
Smooth seed plant - R Wrinkled seed plant - r

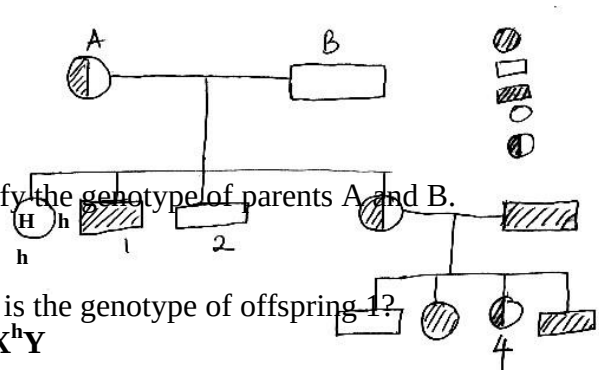
30. Distinguish between homozygote and heterozygote.
Homozygote is an organism containing a pair of identical alleles for a particular trait; while hererozygote is an organism having a pair of dissimilar alleles for a particular trait;

31. In fruit flies (Drosophila melanogaster) inheritance of eye color is sex linked. The gene for red eye is dominant. Across was made between homozygous red eyed female and white eyed male. Work out the phenotypic ratio of F_1 generation. (Use R to represent gene for red eyes



Phenotypic ratio => Red eyed males : Red eyed females;
1 : 1

32. The Haemophilia is an sex-linked recessive condition. The following pedigree shows a portion of a family in which members have haemophilia. Use H for non-haemophilia and h for hemophilia.



Key

Haemophilic female

Normal male

Hemophilic male

Normal female

Normal carrie

a).Identify the genotype of parents A and B.

b).What is the genotype of offspring 1?

X^hY

A. X X **B. X Y**

33. Name **one** defect of non-disfunction chromosomal mutation.

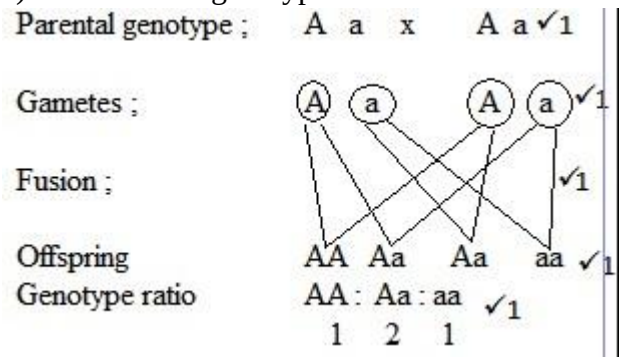
Down's syndrome/Tuner syndrome/Kline felter's syndrome.

34. In a family with four children three were found to have normal skin pigmentation while one was an albino. Using letter A to represent gene for normal skin pigmentation and a to represent the gene for albinism.

a) What are the possible genotypes of the parents?

Aa

b).Work out the genotypic ratio of their children.



35. Apart from albinism, name **two** disorders that are genetically inherited in human beings.

Sickle cell anaemia / hemophilia /color blindness; chondrodystrophic dwarfism / achondroplasia.

36. A horse has 64 chromosomes in its somatic cells while a donkey had 62. A mule is produced when a horse mates with a donkey. However a mule is sterile.

a).Work out the number of chromosomes in a mule. Show your working.

$\frac{64}{2}$ $\frac{62}{2}$ □□32□31□63chromosomes

b).Why is the mule sterile?

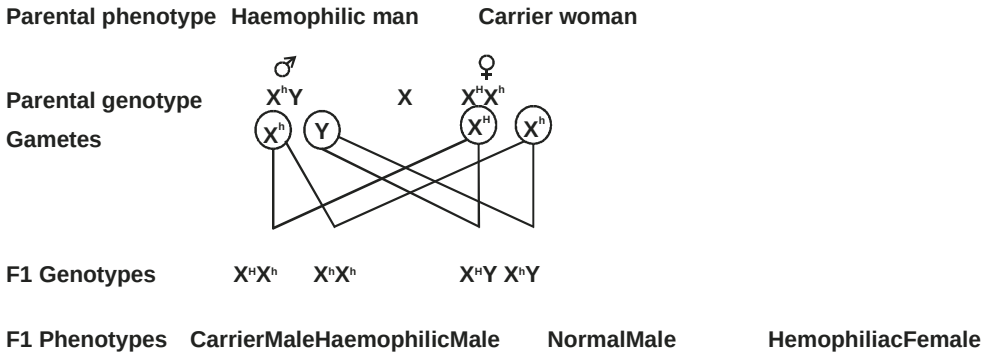
No pairing of homologous chromosomes will take race during meiosis due to the odd number of chromosomes

37. What is mutation?

Mutation is a sudden / spontaneous change in the genetic makeup of an organism;

38. Explain why certain bacteria and other pathogens become resistant to drugs after sometime.
Bacteria that survive the drug will undergo mutation to produce bacteria which are resistant to the prevailing condition / drug

39 a).Work out a cross between a haemophilic man married to a carrier woman for haemophilia.



b).State the phenotypic ratio of the children.

Phenotypic ratio
1 normal male: 1 haemophiliac male: 1 haemophilic female: 1 carrier female.

40. Give **two** advantages of polyploidy in plants.
Early maturity; Resistance to pests / diseases / drought; High yield;

41. Haemophilia is a sex linked disorder due to a recessive gene. A carrier woman married a normal man. Let H represent gene for normal condition and h to represent gene for haemophiliac condition.

(a) State the genotypes of ;

(i) Man.

- XHY;

(ii) Woman

Woman - XHXh ;

(b) (i) Using a punnet square, show the genotypes of the children resulting from this marriage.

(b)(i) Parental phenotypes Female carrier Normal male

Parental genotypes X^HX^h X X^HY ✓1

Gametes (X^H) (X^h) (X^H) (Y)

♀ gametes \ ♂ gametes →	X^H	Y ✓1/2
X^H ✓1/2	X^HX^H	X^HY
X^h	X^HX^h	X^hY ✓1

Children is genotypes X^HX^H, X^HX^h, X^HY, X^hY

Children's phenotypes Normal ♀ Normal ♀ carrier Normal ♂ Haemophiliac male

(ii) State the probability of getting a carrier daughter.

1/4 or 25%

42. Give an explanation why haemophilia is more common in males than in females.

Males have only one X chromosome which if it carries the single recessive allele, it will express itself fully; Females can only express the gene in the homozygous recessive state; thus reducing their

43. In a family with four children, the father had blood group A while the mother had blood group B. One of the children had blood group O.

a).What are the genotypes of the parents?

AO - mother B O - father

b).What was the genotype of the child with blood group O?

OO

44. A woman with normal skin pigmentation was married to a man with normal skin pigmentation. They had two children, one with normal skin colour, genotype AA, while the other one was an albino.

a) State the couple's genotypes.

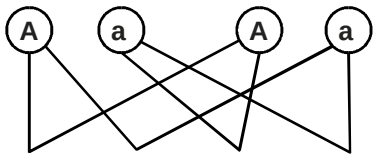
Both Aa / Aa or man Aa and woman Aa.

b).Using a genetic cross, show how they were able to produce an albino and a normal skinned child.

Parental phenotype

Parental genotype; **Aa** **X** **Aa**

Parental gamete;



Parental fusion

Parental Offspring **AA** **Aa** **Aa** **aa ;**

c).What is the percentage of their third child being an albino?

¼ × 100, = 25% *;*

45. State one way one could easily identify an albino.

Pink eyes/ white hair / light skin;

46. In humans, haemophilia is sex linked, caused by recessive gene, which exerts its effect when in homozygous state. A man whose mother was haemophilic marries a normal woman whose father was haemophilic. If H represents non-haemophilic, h represents haemophilic gene.

a) What are the possible genotypes of the man and the woman?

i) **Man X^hY *;***

ii) Woman X^HX^h *;*

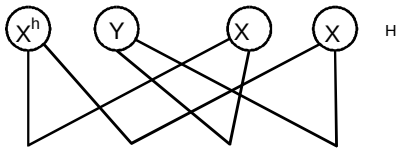
b).Showing your working, find out the possible genotypes of their F_1 generation.

Parents ♂ ♀

Parental phenotypes **Haemophilic** **Carrier**

Parental Genotypes X_h Y × X_H X_h

Gametes



H h ;

Fusion / fertilization;

F1 genotypes X_HX_h X_hX_h X_HY X_hY ;

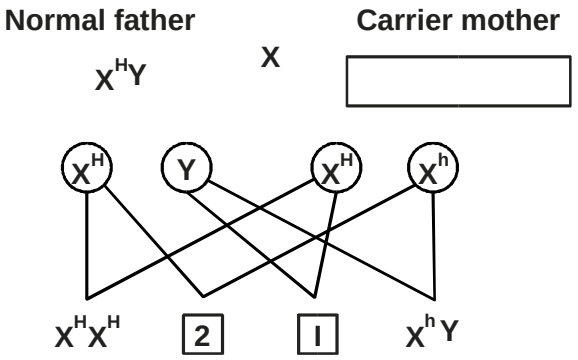
c) What is the probability of the first born son being haemophilic?
¼; / 0.25; / 25%

47. State one importance of DNA molecule.
Storage for the information of an organism.

48. Haemophilia is a sex - linked disorder caused by a recessive gene located on the x - Chromosomes. Give the genotype of a male haemophiliac individual. **X^hY ;**

49. State ONE cause of variations in organisms that take place during gametogenesis.
Crossing - Over / non - disjunction;

50. Haemophilia is a bleeder's disease. The disease is caused by a recessive gene which is carried in the X chromosome. X^H stands for normal gene whereas X^h stands for haemophilia gene. The figure below shows a family tree.



a) What is the genotype of;
i) Mother
X^HX^h; ii).Son marked 2

X^HY;
iii) Daughter marked 1
X^HX^h;