

UNIT VII
GENETICS AND EVOLUTION

1 Mark questions

1. If a double stranded DNA has 40% guanine calculate the % of adenine in the DNA.

2. What is the latest interest in human genomics?

Ans. Deteremination of complete nucleotide sequence of human genome

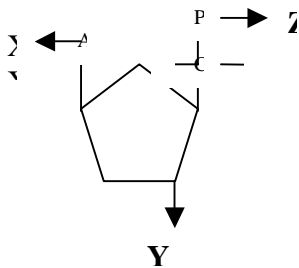
3. Which property of base pair sequences is exploited and applied in genetic engineering and biotechnology?

Ans. The property of complimentarity of base pair sequence.

4. Why do RNA viruses have high evolution rate?

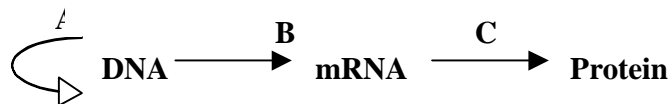
Ans. RNA genome has short life span, unstable & mutable so it evolves at high rate.

5. Complete the labels X, Y and Z:



Ans. X= Nucleotide ,Y= Pentose sugar ,Z= Phosphate

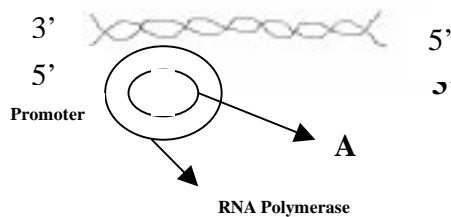
6. Complete the following, label A,B and C and name the process(Dogma).



Ans. A=replication B=transcription C=Translation

The process is “Central Dogma”.

7. The diagram depicts a stage in transcription. Mention the stage and indicate A .

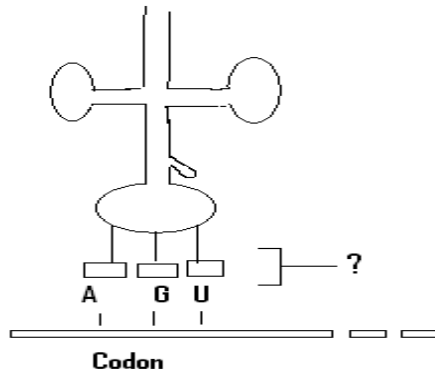


Ans. σ =Sigma factor and the process is “Initiation”

8. Amino acid Arginine if coded by CGU; how many codons can code for this amino acid?

Ans. 6 codons

9. Write the anticodon of the given t-RNA



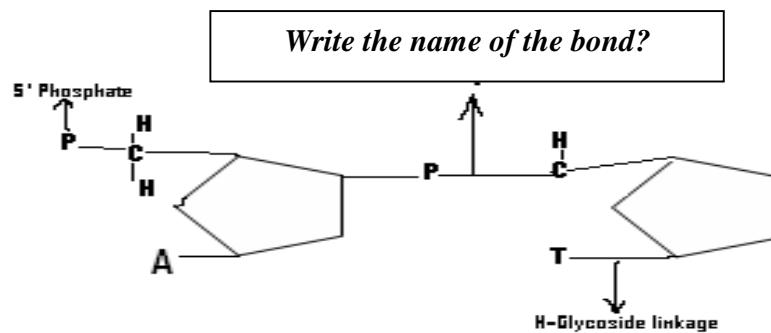
Ans. Anticodon U C A

10. Write the full form of the terms: 'ESTs' and 'SA' concerning to human genome project.

ESTs = Expressed sequence tags

SA = Sequence Annotation

11.



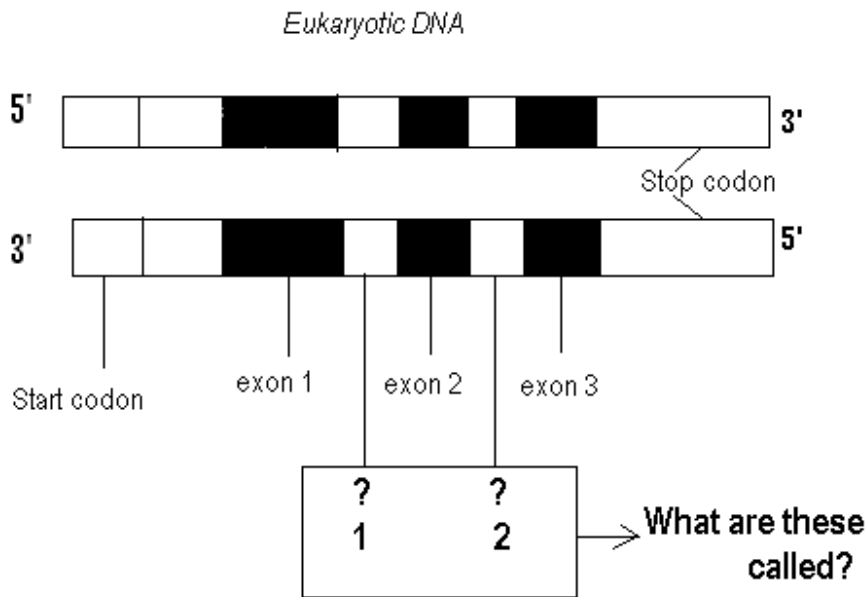
Ans. Phosphodiester bond

12. What is the difference between RNAs and RNase ?

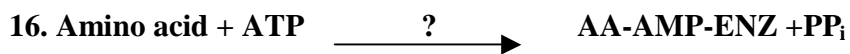
Ans: RNAs--- Nucleotide polymer

RNase--- Enzyme

15.

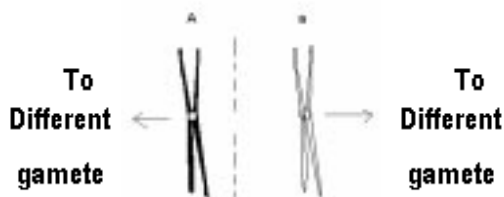


Ans. 1 and 2 = INTRONS (non coding sequence)



Ans:- Amino acyl t RNA Synthetase.

17. State which law of Mendelian inheritance is expressed in the following diagram?



Ans:- Law of Segregation

18. Write the scientific name of the free living non pathogenic nematode used in Genomic Project study.

Ans: *Caenorhabditis elegans*.

19. What are the hotspots of DNA?

Ans:- Sites where frequency of mutation & crossing over is high.

20. List 2 significant contribution of Kornberg in the field of Genetics.

Ans: Synthesis of DNA and discovery of DNA polymerase

**21. There is a large increase in absorption of Ultraviolet radiation of 260nm by melted DNA as compared to intact DNA. What is this differential effect called?
Ans: Heterochromatic effect.**

**22. What kind of inheritance is seen in haemophilia?
Ans: Sex linked inheritance**

EVOLUTION

23. Why do the animals have certain functionless organs in their body?

Ans. In the course of evolution due to change in mode of life few organs remained functionless and gradually reduced in to remnants of past as an evidence to evolution.

**24. Which of the following are homologous organs?
a) Trunk of an Elephant and forelimbs of a Monkey
b) Wings of a bird and wings of butterfly
Ans: None**

**29. Which of the following are analogous organs?
a) Legs of Cockroach and legs of Cat.
b) Pectoral fin of fish and forelimb of a frog.
Ans: (a)**

**30. Wing of bat is homologous to
a) Arm of a human
b) Tail of a kangaroo
c) Wing of a butterfly
Ans: (a)**

**31. Can we call human evolution as an 'Adaptive radiation'?
Ans Yes**

**32. What is 'saltation'?
Ans: Single step large Mutation**

**33. What is meant by genetic equilibrium?
Ans: When allele frequencies in a population is stable and gene pool remains constant it is called genetic equilibrium.**

34. What is 'Founder effect'?

Ans: Change in allele frequency of an original drifted population which becomes a different species and the founder.

35. What is 'genetic drift'?

Ans Change in the gene or allele frequencies of a population that occurs by chance.

36. Name the common ancestors of Apes and Man.

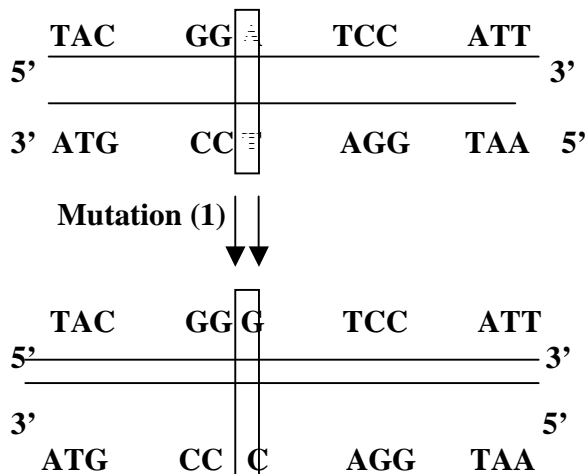
Ans: Ramapithecus

37. Give the Scientific name of first human like ancestors.

Ans: Homo habilis

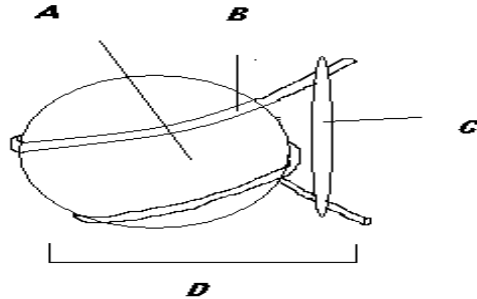
2 MARKS QUESTIONS

38. From the following diagram of molecular mechanism of mutations identify the type of mutations.



Ans:- (1)transition (Purine base Substitution by another purine base and pyrimidine base by another pyrimidine)

39. Label A, B, C and D in the given diagram



Ans:- A-Histone octomer
 B- DNA
 C- H 1 Histone
 D- Nucleosome

40. Match the following experiments & conclusions with respective worker.

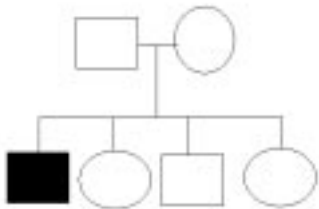
<p>a. Transforming Principle b. DNA is genetic material c. Semi conservative mode of DNA replication d. Proof of semi conservative replication</p>	<p>i) Messelson & Stahl ii) Watson & Crick iii) Fredrick Griffth iv) Hershey & Chase</p>
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Ans:- a-(iii) ; b-(iv) ; c-(ii) d- (i)

41. Assume that no new mutations have arisen in the family.

Answer each question with either 'Yes' or 'No'

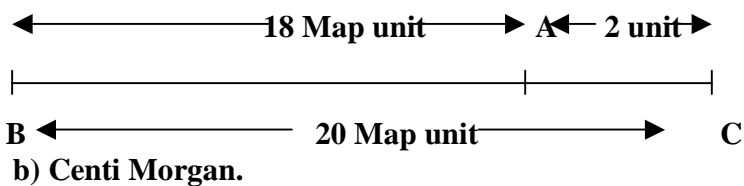
- i) Could this be inherited as recessive trait?
- ii) Could this be inherited as dominant trait?



Ans: (i) Yes (ii) No.

42. The map distance between A & B genes is 18 unit; between B & C is 20 unit and C & A is 2 unit.(a)What is the order of genes on a linkage group?(b) Write the unit of map distance.

Ans:-



43. Colour blindness is a recessive trait. A couple with normal vision has two sons, one colour blind and one with normal vision. If the couple also has daughters what proportion of them will have normal vision?

Ans:- All daughters will have normal vision.

44. In a cross between a black and a white guinea pig, all F₁ members are black but F₂ generation raised by crossing two such F₁ consists of approximately ¾ black & ¼ white guinea pigs.

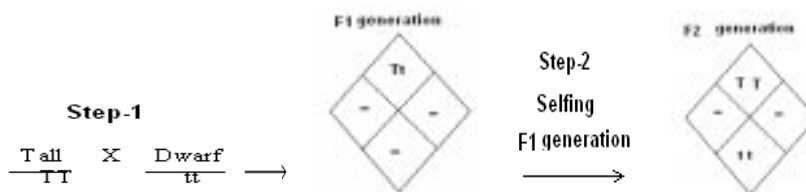
a) What are possible genotypes of the F₂ generation?

b) What will be the type of offsprings produced when two F₂ white are z mated?

Ans: a) BB-Black; Bb- Black; bb- White.

b) All White.

45. .Complete the following steps



Ans:- all blanks –Tt.

46. Write the full form of RFLP, SNP

Ans:- Restriction Fragment Length polymorphism
Single Nucleotide Polymorphism

47. Which is the longest known human gene and the number of bases present in it.

Ans:- Dystrophin gene in human with 2.4 million bases.

48. What do you mean by SNPs and its significance with respect to human genome?

Ans: ‘Single Nucleotide Polymorphism’ Used for finding chromosomal locations for disease associated sequences and for tracing human history

49. Recombination frequency between two genes white(W) and miniature wing(m) is 37.2% .what is the distance between genes ‘W’ and ‘m’.

Ans: Recombination frequency between two genes = distance between two genes = 37.2 map units(centiMorgan).

50. Drosophila has four pairs of chromosomes and Human has 23 pairs of chromosomes. How many linkage groups will each have?

Ans :Drosophila - 4 linkage groups
Human Being - 23 linkage groups

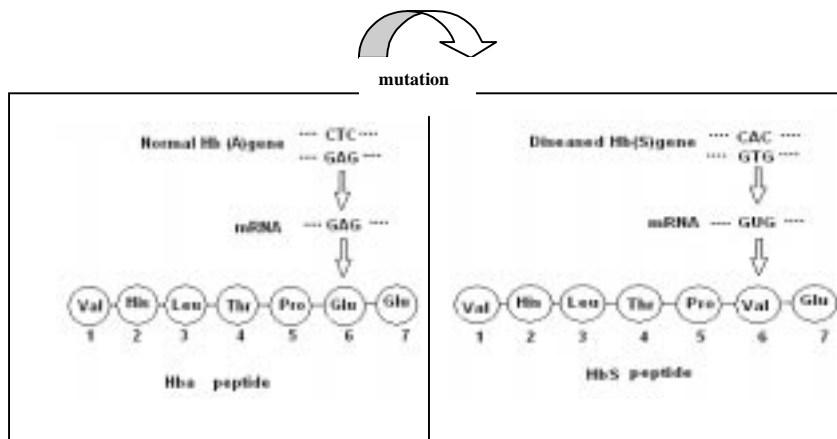
51. ZO-ZZ type mechanism occurs in honey bee for Sex-determination and the female Bee has 32 chromosomes.

i) What is the number of chromosomes in male Bee?

ii) Which cell division will the male perform for gametogenesis?

Ans: i) 16 (Haploid) ii) Mitosis

52. Identify the type of 'Mutation' occurring in the following diagram and name the 'Disease'.



Ans: Point mutation. The disease is Sickle cell anaemia

EVOLUTION

54. How can you explain the existence of analogous organs?

Ans: Some organs developed in the course of evolution as adaptation of different organisms to a similar mode of life.

55. i) What is differential reproduction?

ii) How does it help in evolution?

Ans: i) Varying degrees of success with which individuals of a population reproduce.

ii) Reproductively fit individuals leave more progeny than others and are selected by nature to survive and evolve into new species.

56. Give two reasons why life cannot originate today.

Ans: 1) Atmosphere is oxidizing so any molecule synthesised will be oxidized.

2) Other organisms devour any molecule formed.

57. Differentiate 'Gene flow' and 'Genetic drift'.

Ans:

Gene flow	Genetic drift
Change in allele frequency of a population Due to migration	Change in allele frequency of a population Occurring by chance

58. When and where did Neanderthal man live? What was his brain capacity?

Ans: between 1,00,000-40,000 years back. Lived near East and Central Asia. Brain capacity 1,400cc.

3 mark questions

59. Mention the steps involved in the following Pea plant cross

Removal of anthers----- A



Transfer of Pollen----- B



Raising the next generation-----C

Ans:- A- Emasculation, B- Pollination C- Hybridisation (Crossing)

60. What is 'UTR'? Where is it located? Write its significance.

Ans:- Untranslated regions in mRNA.

Present at both 5' end (before start codon) and at 3' end (after stop codon).
They are required for efficient translation process.

61. The area with long sequence of short repetitive DNA is called Satellite DNA. These are of two types like microsatellite & minisatellite. On what basis they are called so? Where do they occur generally?

Ans:- Microsatellites have 1-6 bp repeat units.

Minisatellites have 11-60 bp repeat units. So they are called accordingly.

They occur specifically near ends of chromosomes (telomere), centromeres, pericentric and other heterochromatic areas.

62. Give two examples each for linear and circular DNA. Why are they called so?

Ans: Linear DNA- (i) All Eukaryotes (Human DNA,)

(ii) DNA Virus (Rubella virus)

Circular DNA (i) Bacterial DNA

(ii) Mitochondrial DNA

They are called so since in linear DNA ends are free and in circular they are covalently linked.

63. E.coli was cultured in a medium containing $^{15}\text{NH}_4\text{Cl}$ (^{15}N is the Heavy isotope of nitrogen). After first generation E.coli was extracted and transferred to culture medium having $^{14}\text{NH}_4\text{Cl}$ (Normal nitrogen medium).

- What is the time duration by which E.coli completes its first generation
- At 40th minute what would be the nature of DNA
- At 80th minute what would be the nature of DNA and its proportion.

Ans. a) E.coli completes its first generation by 20 minutes

b) At 40th minute the nature of DNA would be intermediate density with both ^{14}N & ^{15}N .

c) At 80th minute composition of DNA is light chain : hybrid chain = 3:1

64. Genomic mutation is the term used for change in chromosomal number, Write its two types and mention where they are seen?

Ans: a) Euploidy - Increase in the whole set of chromosome. Generally seen in plants (Triticale)

b) Aneuploidy - One chromosome less (Turner's Syndrome) OR one chromosome more (Klinefelter's Syndrome)

65. From the given monohybrid ratio identify the type of inheritance and give one example each.

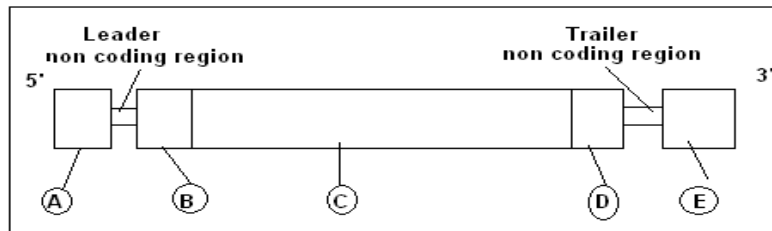
i) Both phenotypic and genotypic ratio is 1:2:1

ii) Phenotypic ratio is 3:1 and genotypic ratio is 1:2:1

Ans: i) Incomplete Dominance eg: Snap Dragon

ii) Complete Dominance eg: Pea plant

66.



(i) What do you infer from this schematic representation

(ii) Label A, B, C, D & E

Ans:

(i) It shows heterogenous nuclear RNA 'Capping' & 'Tailing'

(ii) A - Methylated G Cap

B - Initiation Codon (AUG/GUG)

C - Coding region

D - Termination codon

E - Poly 'A' Tail

EVOLUTION

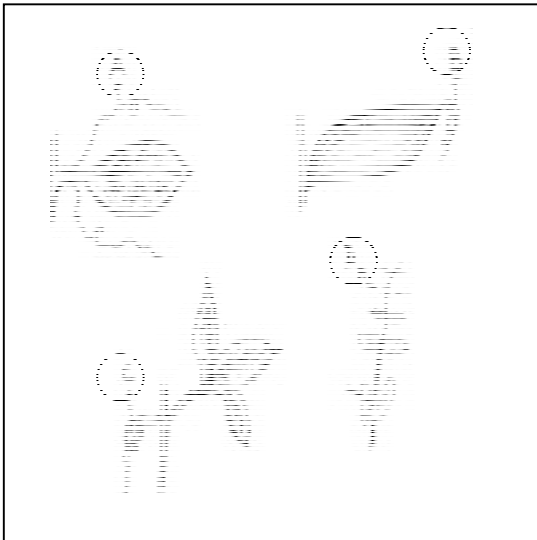
67 .When and where did Neanderthal man live?What was his brain capacity?

Ans: Between 100000-40000 years back.Lived near East and Central Asia.Brain capacity 1400cc.

68.Give three examples for 'Homology' which occur in the stem of some plants.

Ans: a) Passiflora(Stem tendril-clinging stem)
b) Bougainvillea(Stem thorn-Defence)
c) Cucurbita (Stem tendril - climbing)

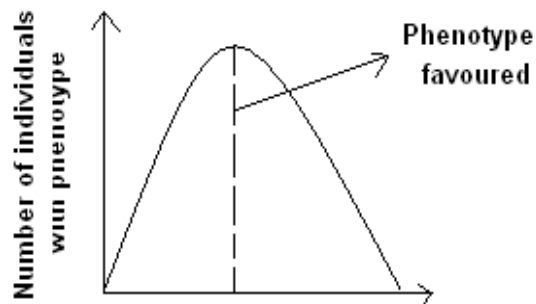
69.What is the evolutionary significance of the following figure & label A,B,C &D?



Ans: Analogy in tendrils of different plants show functional similarity though the structure and origin are different that proves **convergent evolution**.

A –Stipular tendril
B – Leaf tip tendril
C – Stem tendril
D – Leaflet tendril

70. What do the following changes represent in the given graph?



- (i) If operation of natural selection makes peak higher and narrower
- (ii) if peak shifts to right direction
- (iii) If two peaks are formed instead.

Ans: (i) Stabilising (ii)Directional (iii)Disruptive

71. Classify the following as examples of homology and analogy.

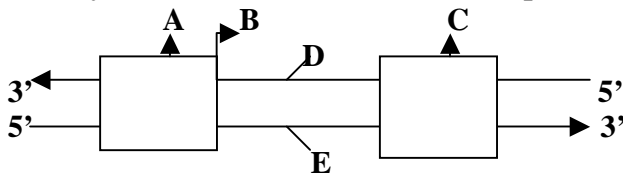
- (i) Hearts of fish and crocodiles
- (ii) Eyes of octopus and mammals
- (iii) Wings of butterfly and birds
- (iv) Tubers of sweet potato and potato
- (v) Thorn of bougainvillea and tendril of cucurbita
- (vi) Forelimb of whale and forelimb of a Bat

Ans Homologous - (i)(v)(vi)

Analogous - (ii)(iii)(iv)

5 MARKS QUESTION

72. Identify the structural units of transcription unit



Ans:- A- Promoter
 B- Transcription start site
 C- Terminator
 D- Template strand
 E- Coding strand

73. Cystic fibrosis is recessive condition that affects about 1 in 2,500 babies. Calculate the following.

- a) Name the principle involved
- b) the equation used
- c) the frequency of the recessive allele in the population
- d) the frequency of the dominant allele in the population
- e) the percentage of heterozygous individuals (carriers) in the population

Ans:- a) Principle:- Hardy Weinberg's Equilibrium

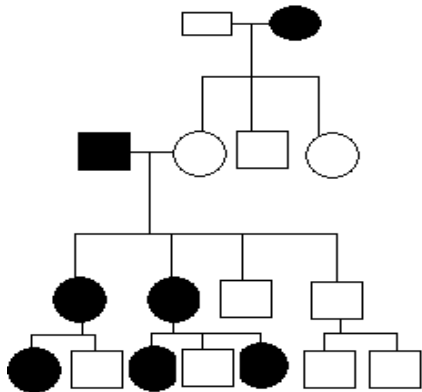
b) $(p+q)^2 = p^2 + q^2 + 2pq$

c) Recessive allele $q^2 = 1/2500$ so $q = \sqrt{1/2500} = 0.02$

d) Dominant allele $P = 1 - 0.02 = 0.98$ (98%)

e) Heterozygous $2pq = 2(0.98 \times 0.02) = 0.04$ or 1 in 25

74. Pedigree analysis:



Ans a)

- Normal male
- Normal female
- Affected male
- Affected female

b) Dominant X linked inheritance.

c) i. More frequently found in female than male
 ii. Affected male pass condition to all daughters but not to sons
 iii) Affected female passes it to 50% of her offsprings.

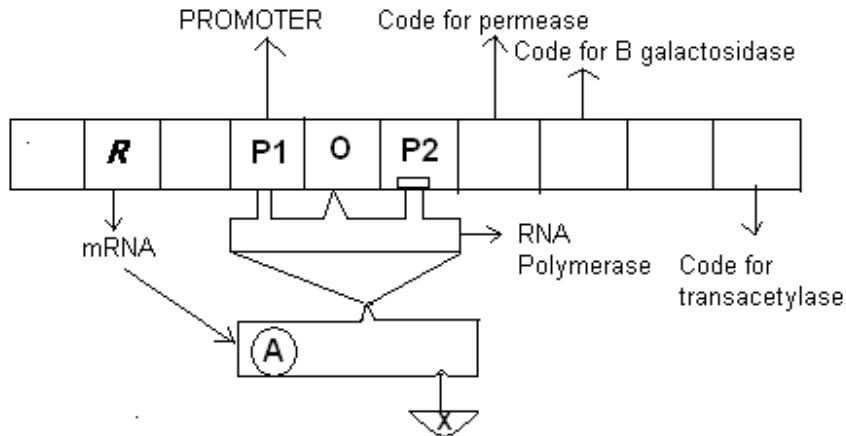
a) What do the symbols used in the pedigree mean



b) What is the inheritance pattern of the above pedigree analysis.

c) Mention 3 clues by which you can detect this type of inheritance.

75.



- (i) Label R, A, X & O
- (ii) Which operon the above figure represents?

Ans:- (i) R- Regulator gene
 A- Repressor gene
 O- Operator gene
 X- AlloLactose
 (ii) Lac- operon

76. Mention whether the male individuals of the following organisms are homozygous/ heterozygous.

- i) Human = XY-XX
- ii) Hen = ZW-ZZ
- iii) Drosophila = XY-XX
- iv) Grasshopper = XO-XX
- v) Birds = ZZ-ZW

Ans : MALE

- i) Human = Heterozygous(XY)
- ii) Hen = Homozygous (ZZ)
- iii) Drosophila = Heterozygous (XY)
- iv) Grasshopper = Heterozygous (XO)
- v) Birds = Homozygous (ZZ)

77. Mention the type of error in the following diseases:

1. Sickle cell anaemia
2. Haemophilia
3. Phenylketonuria
4. Down's syndrome
5. Klinefelter's syndrome

Ans :1.Autosomal recessive

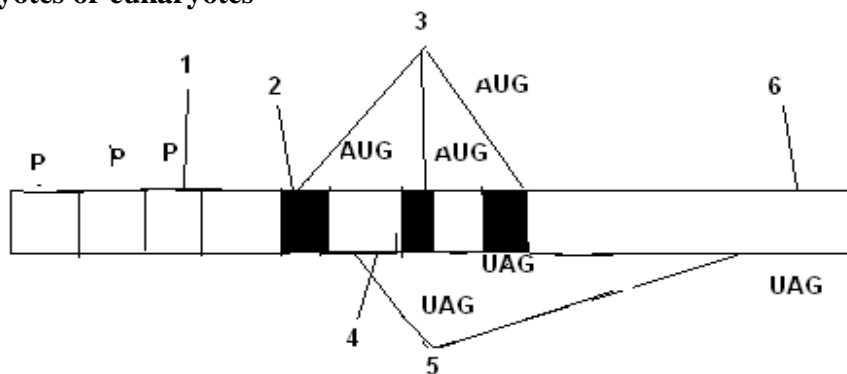
2.Sex linked recessive

3.Autosomal recessive Metabolic error

4.Autosome 21 Trisomy

5.Sex chromosome Trisomy XXY

78. (i) Label the diagram1,2,3,4,5and 6 (ii) State whether the diagram is of Prokaryotes or eukaryotes



Ans: (i) 1) 5' end

2) Ribosome binding site

3) Start codon

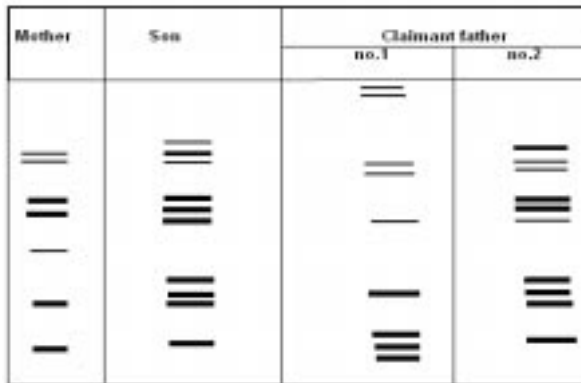
4) Stop signal

5) Open reading frames (ORFs)

6) 3' end

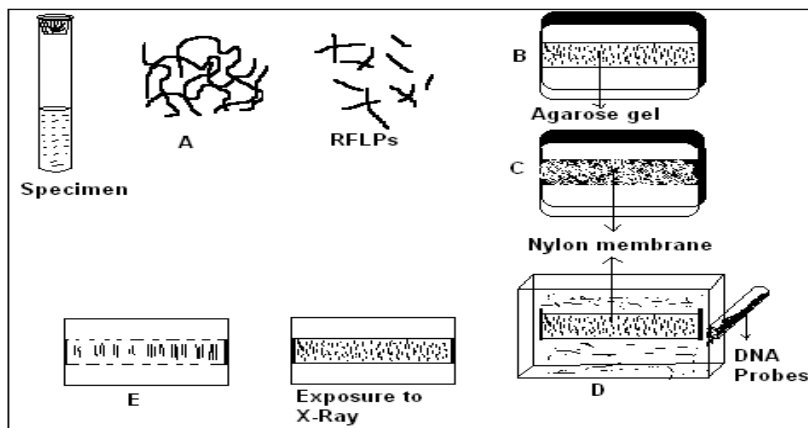
(ii) Prokaryotes due to presence of more than one open reading frames with separate initiation and stop codons.

79. (i) Identify the biological father of the son from the two claimants.-----
 (2marks)
 (ii) Write the name of the procedure adopted.-----
 (1mark)
 (iii) List Four sources of DNA used in this technique.-----
 (2marks)



- Ans . (i) Claimant number 2 (due to more VNTR similarity).
 (ii) DNA Finger Printing
 (iii) Sources
 Hair root
 Saliva
 Semen
 Blood

80.



‘A’ is the Raw material and ‘E’ is the Result in the above procedure. Answer the following

- (i) Name the technique shown here. -----1mark
 (ii) What is ‘A’ –the raw material and ‘E’ the Result -----1/2+1/2=1mark
 Give the names of the processes labeled as B, C & D-----1+1+1=3 marks

Ans (i) DNA fingerprinting

(ii) A – DNA

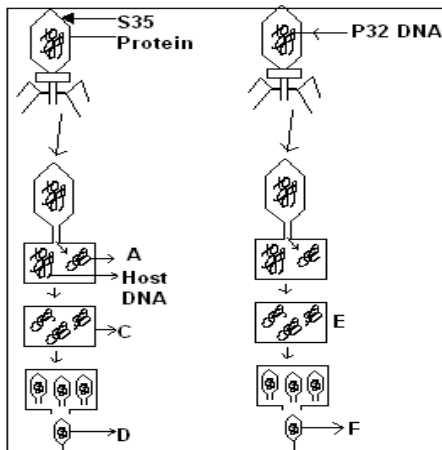
B – Electrophoresis

C - Southern Blotting

D – Hybridisation

E - X-ray film with DNA profile

81.



i) Name the scientists who performed this experiment?

ii) What was the inference of the experiment?

iii) Label A, B, C, D, E & F

Ans . i) A.D.Hershey and Martha Chase ----- (1 mark)

ii) It is proved that DNA is the genetic material & not protein----- (1 mark)

iii) A – Viral DNA

B – Host DNA

C- Bacteria with Radioactive sulphur

D- Unlabelled Bacteriophage

E - Bacteria with Radioactive Phosphorus

F - Labeled Bacteriophage

(3 mark)

82. Duchene's muscular dystrophy is sexlinked and usually affects only males.

Victims of the disease become progressively weaker early in life.

a) What is the probability that a woman whose brother has Duchene's muscular dystrophy will have an affected child

b) If your mother's brother had Duchene's disease what is the probability that you will receive the gene

C) If your father's brother had the disease what is the probability that you will receive the gene.

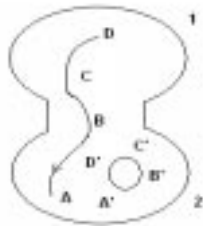
Ans.

(a) $\frac{1}{2}$ of her children will be sons, & $\frac{1}{2}$ of them will have muscular dystrophy.

Overall probability = $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{8}$

(b) $\frac{1}{2}$ chance that your mother has and a $\frac{1}{2}$ chance that you have it, if you are a male or female. Overall probability = $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

83. . Given below is schematic representation of two interacting bacterial cells :

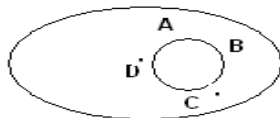


- (i) Name the bacterium and describe the process illustrated?
- (ii) What is the use of such a process in genetics?
- (iii) Which of the two cells act as a male?
- (iv) Draw a labeled diagram of the stage immediately next to the one shown here?

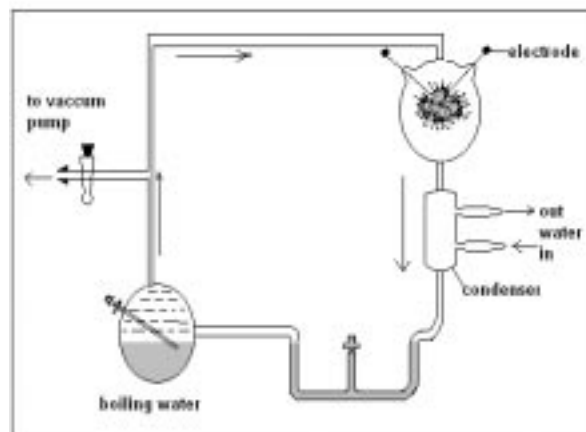
Ans: (i) Bacterium E.coli

- (ii) It represents Conjugation between donor and recipient
 - Portion of DNA comes into recipient
 - Incorporation in recipient DNA by replacing equivalent segment
- (iii) Cell number 1 is the donor 'Male'

(iv)



84. (a) Name the scientist who conducted simulation experiment as shown in the figure



- (b) Name the mixture of inorganic substances used in spark discharge.
- (c) What was the purpose of the experiment?
- (d) How was lightening simulated in this experiment?
- (e) Name the compounds synthesized in this experiment?

Ans:(a) Stanely L Miller & C., Urey 1953

(b) H₂ Gas, NH₃, CH₄ & Water vapour.

(c) To synthesis simple organic compounds from inorganic substances

(d) Electric spark of 75,000 volts from electrodes simulated lightening.

(e) Amino acid,(glycine, alanine, aspartic acid adenine, simple ribose sugar).

85. Give scientific reasons for the following statements.

(i) Process of growth & divisions were not précise & regulated in coacervates.

(ii) Oparin & Haldane theory of origin of life is the most accepted one at present.

(iii) First evolved organisms were heterotrophs & anaerobes

(iv) Abiogenesis is not possible at present.

(v) Ozone sheath was formed in the stratosphere after the origin of life on earth.

Ans:(i) It is so because coacervates lacked nucleic acids.

(ii) Because it has experimental evidence in favour .

(iii) Prefomed organic matter were available as food & there was no O₂ in the Atmosphere.

(iv) On the primitive earth atmosphere was reducing, so it permitted only Abiogenesis At present oxidizing atmosphere does not allow

(v) Because photoautotrophs sometime after their origin became capable of getting H₂ from water & releasing O₂ as by product. As O₂ accumulated in the atmosphere ,the UV radiations changed some of it into O₃

86. Justify the following:-

(i) Modern concept of evolution is considered a synthesis of ‘Darwin-Wallace’s & De Vries’ theories.

(ii) The addition of antibiotics to cattle feed has been banned

(iii) The interspecific hybrids are usually sterile.

(iv) Reproductive isolation ultimately leads to speciation

(v) Prolonged use of pesticides leads to pesticide resistance.

Ans:

(i) Genetic variation (mutations) are only inherited not all variations as held by Darwin. So modern theory is the modification of Darwin-Wallace & Devries theories together.

(ii) Because it makes the cattle fatten & they become breeding ground for antibiotics resistance bacteria.

(iii) Interspecific hybrid receives chromosomes from 2 species & being dissimilar fail to pair in meiosis, so gametes do not receive full chromosome complement i.e. one of each kind.

(iv) Reproductive isolation causes accumulation of genetic variation in different populations, ultimately turn into new species. Without this, variation may disappear.

(v) Pesticide resistant individuals always occur in all population –multiply, but pesticide sensitive ones die. So existing population comes to consist of pesticide resistance.

87. Make an evolutionary tree for human evolution according to chronological age.

Ans:-

