**Chapter 1: Overview of Genetics**

**Chhaya Rani1 and Shubham Bhere2**

*1Ph.D. Scholar, Animal Genetics Division, ICAR-IVRI, Bareilly*

*2M.V. Sc Scholar, Division of Biotechnology, ICAR-IVRI, Bareilly*

**Refresher points-**

* **Genetics** is defined as the science dealing with heredity and variation. It is derived from a Greek word meaning ‘*to generate*’.
* **Major areas of Genetics**

|  |  |  |
| --- | --- | --- |
| **Classical or Transmission genetics (including cytogenetics)** | **Biochemical. or molecular genetics** | **Population & Quantitative genetics** |
| **Topics covered:*** Mendelian principles
* Meiosis & mitosis
* Sex determination
* Sex-related inheritance
* Linkage & chromosome mapping
* Karyotyping & chromosomal abnormalities
 | * Chemistry & structure of gene
* Transcription & translation
* Gene regulation expression &
* DNA mutation
* DNA cloning
* Extra-chromosomal inheritance
 | * Gene & frequencies. genotypic
* Hardy-Weinberg equilibrium
* Factors changing gene & genotypic frequencies
* Inheritance of quantitative traits
* Study of evolutionary forces
 |
| **Pioneer scientists:*** Batson; Punnett; Morgan; Bridges; Muller, Sturtevant; McClintock
 | * Griffith; Avery, Hershey & Chase; Beadle & Tatum; Benzer, Watson & Crick; Khorana, Nierenberg & Jefferys
 | * Wright, Fisher, Haldane, Hardy & Weinberg; Malecot, Crow & Kimura
 |
| **Techniques used:*** Experimental crosses and their segregation ratios.
* Pedigree analysis.
* Study of chromosomes using banding techniques
 | * Biochemical and molecular techniques like electro-phoresis, polymerase chain reaction (PCR) etc.
 | * Mathematical models and statistical method
 |

* **Father of Genetics**: Gregor Johann Mendel
* **Father of experimental Genetics**: Thomas Hunt Morgan
* **Father of modern Genetics**: Bateson
* **Father of biochemical Genetics**: Garrod
* **Heredity** is defined as the transmission of characters from one generation to next generation.
* Mendel was the first to explain that heredity involves transition of units from reproductive cells of the parents.
* **Rediscovery of Mendel’s law** was done by Hugo de Vries, Correns and Tschermak.
* **'Cinderella of Genetics'/ 'Queen of Genetics'**: Fruit flies (Drosophila melanogaster).
* **Chromosomal theory of inheritance** was given by Sutton and Boveri (1902).
* **The Genic balance theory of sex determination** was given by C.B. Bridge.
* Strausburger discovered chromosomes.
* W. Waldeyer coined the term chromosome.
* Mc Clung discovered sex chromosomes.
* Sex chromosome: The X or Y chromosome.
* Autosomes: A chromosome other than sex chromosomes.
* **Chromosomal no. in different species.**

|  |  |
| --- | --- |
| Species | (2N) |
| Cattle, Goat, Yak, Bison | 60 |
| Mithun  | 58 |
| Buffalo (Riverine) | 50 |
| Buffalo (Swamp), Hare | 48 |
| Sheep | 54 |
| Camel | 74 |
| Horse | 64 |
| Mule, Hinny  | 63 |
| Donkey | 62 |
| Rabbit | 44 |
| Dog, Poultry | 78 |
| Cat | 38 |
| Duck | 80 |
| Turkey | 82 |

* **Linkage**: Exchange of the chromatid segments between homologous chromosomes.
* **Crossing over**: Exchange of the chromatid segments between non- sister chromatids of homologous chromosomes in Pachytene stage of Meiosis -I. Morgan and Cattell gave concept of crossing over.
* **Multiple allelism**: More than two alternative forms of a gene located on the same chromosomes.
* **Modifier Genes**: Modifier genes are defined as genes that affect the phenotypic and/or molecular expression of other genes. Genetic modifiers can affect penetrance, dominance, expressivity, and pleiotropy.
* **Penetrance**: Percentage of the individual with a given genotype that expresses a particular phenotype.
* **Expressivity**: Extent or degree to which a given genotype expressed phenotypically.
* **Mosaicism**: It results from a mitotic error in a single zygote.
* **Chimerism**: It is defined as the fusion of two different zygotes in a single embryo.
1. The phenomenon of ‘like begets like’ is due to…………………-**Heredity**
2. Mendel published his work/paper, "Experiments on Plant Hybridization," in………

-**1866**

1. The book ‘Origins of Mendelism’ was written by…………………-**R.C. Olby**
2. The term ‘genetics’ was coined by …………… - **Bateson**
3. Theory of linkage and concept of sex linked inheritance was proposed by………….-**Thomas Hunt Morgan**
4. Mendel presented his experimental findings in the meeting of…………………………in 1865- **Brunn Society for Natural History**
5. Universally accepted Mendel’s law is………………….- **Law of segregation.**
6. The short arm of the chromosome is labeled as……………..-**p arm**
7. Expression of ancestral traits is termed as………………..- **Atavism.**
8. Number of linkage groups in an organism is equal to no. of …………………….-**Chromosome pairs**
9. Rediscoverers of Mendelian genetics were……………..- **Tschermack, Correns and De vries**
10. Complete linkage is seen in……………..-**Male Drosophila, Silk moth female.**
11. Sex linked genes for hemophilia and colorblindness in man are examples of …………………-**Incomplete linkage**
12. Crossing over occurs between non – sister chromatids of …………-**Homologous pairs of chromosomes**
13. ‘Cat cry syndrome’ is caused by deletion in the short arm **…………..- 5th chromosome**
14. Interchange of chromosome segments in non-homologous chromosomes is called………………….- **Translocation**
15. Interphase chromosomes which are large and visible with naked eye are called as………- **Polytene chromosomes**
16. Crossing over takes place at the……………… -**Tetrad** **stage of meiosis**
17. During meiosis, pairing of chromosomes occurs at……………….- **Zygotene stage**
18. Condition of karyotype 2n+2 are called…………………….-**Tetrasomic**
19. Sister chromatids of homologous chromosomes…….........to form a tetrad. **-Synapse**
20. To eliminate chance factor, Mendel performed…………- **Reciprocal cross**
21. Law of independent assortment is applicable for the traits which are……………….- **Located on the different chromosomes**
22. Chromosomes with equal arms are known as…………….-**Metacentric**
23. Lampbrush chromosomes are found in the……………-**Ovarian cells of amphibians**
24. XX-XO sex determination occurs in……………………-**Round worms**
25. Expression oof the sex linked genes in the population is are carried by the …………..-**Heterogametic sex**
26. The sex determination system in poultry is …………………-**ZW method**
27. Genes for the sex influenced traits are present on the ………….**-Autosomes**
28. Having identical genotypes is known as…………… -**Isogenic**
29. A linkage group is defined as ………………..-**Different group of genes located on the same chromosomes**
30. Crossing over occurs at………………… -**Two- stranded stage**
31. Extra nuclear genes usually present in mitochondria and**…………-Plastids**
32. Special type of chromosome seen in drosophila is
33. **Polytene chromosome**
34. Lampbrush chromosomes
35. B chromosomes
36. All of these
37. Study of genetics involving application of principles of heredity for improvement of mankind is
38. Genomics
39. **Eugenics**
40. Proteomics
41. None of these
42. Factor that suppresses crossing over is
43. **Inversion**
44. Deletion
45. Translocation
46. All of these
47. Lyon’s hypothesis involved with
48. Sex chromosome
49. Autosome
50. **Sex chromatin**
51. Centromere
52. Genic balance theory of sex determination determines the ratio of
53. **Sex chromosome: autosome**
54. Autosome: sex chromosome
55. X chromosome: autosome
56. None of these
57. The Greek philosopher, who proposed that semen of the male is highly purified form of blood having life giving property, is
58. **Aristotle**
59. Hypocrites
60. Empedocles
61. Pythagoras
62. What is mosaicism?
	1. **A genetic condition where an individual has two or more populations of cells with different genetic makeup**
	2. A condition where an individual has only one type of cell throughout the body
	3. The presence of a single gene mutation in all cells of the body
	4. A disorder characterized by the absence of certain chromosomes
63. Crossing over during meiosis results in:
	1. **Increased genetic diversity**
	2. Decreased genetic diversity
	3. No change in genetic diversity
	4. A complete loss of genetic information
64. What is a deviation from Mendelian inheritance known as incomplete dominance?
	1. One allele completely masks the expression of the other allele
	2. **Heterozygotes show an intermediate phenotype between the two homozygotes**
	3. Both alleles are expressed independently in the heterozygote
	4. There is no dominance relationship between alleles
65. Mendel's Law of Independent Assortment states that:
	1. **Alleles of different genes segregate independently during gamete formation**
	2. Alleles of the same gene segregate independently during gamete formation
	3. Alleles of different genes do not segregate independently during gamete formation
	4. Alleles of the same gene always segregate together during gamete formation
66. The pangenesis theory was proposed by
67. **Charles Darwin**
68. Charles Bonnet
69. Mendel
70. None of these
71. Human syndrome associated with deletion of a piece of a chromosome is
72. **Cry du chat syndrome**
73. Klinefelter syndrome
74. Turner syndrome
75. None
76. Which one of these is the most important mechanism for the generation of new combination of genes?
77. **Crossing over**
78. Linkage
79. Translocation
80. mutation
81. Chromosomal status of down syndrome individual is
82. 45+1(21st)
83. 46+1(18th)
84. 47+1(18th)
85. **46+1(21st)**
86. The book ‘Theory of genes’ was authored by
87. Mendel
88. **Morgan**
89. Boveri
90. Bateson
91. X- Linkage was discovered for the first time in
92. **Fruit flies**
93. Mice
94. Chickens
95. Ants
96. Mendel published his work in
97. 1864
98. **1866**
99. 1857
100. 1909
101. Crossing over takes place in paired bivalents consisting of………chromatids, and involves…… of the chromatids
102. 4,4
103. **4,2**
104. 2,2
105. 2,4
106. Total no. of chromosomes in dogs
107. **78**
108. 74
109. 38
110. 48
111. Extrachromosomal autonomously replicating circles of DNA are called
112. Plasmosome
113. Pseudogenes
114. **Plasmids**
115. Cosmid
116. Phenylketonuria is a example of
117. Expressivity
118. Penetrance
119. Phenocopy
120. **Pleiotropism**
121. A chromosomal aberration that affects the fertility of daughters is
122. **Robertsonian translocation**
123. Random union of chromosomes
124. Addition
125. Deletion
126. A fly in which the males have half the chromosome number as that of the females
127. **Honey bee**
128. Butter fly
129. Drosophila
130. None
131. The two chromosomes that are member of the same pair are known as
132. **Homologous**
133. Heterologous
134. Diploid
135. Tetrad
136. In grasshopper male, the sex chromosome complement is:
137. **XO**
138. XX
139. XY
140. None
141. Reappearance of recessive traits in F2 generation is due to
142. Law of independent assortment
143. **Law of purity of gametes**
144. Law of dominance
145. Law of co-dominance
146. Science dealing with heredity and variation
147. Cytology
148. Embryology
149. **Genetics**
150. Cytogenetics
151. The resemblance of individuals to their progenitors is called
152. **Heredity**
153. Evolution
154. Genetics
155. None
156. Which is true about Eukaryotic chromosomes
157. Are larger
158. Have interrupted genes
159. Display lower gene density
160. **All of the above**
161. Cri du chat is caused due to
162. Deletion
163. Duplication
164. **Translocation**
165. Transversion
166. Edwards syndrome, characterized by developmental delays and organ malformations, is caused by:
	1. Trisomy 21
	2. Monosomy X
	3. **Trisomy 18**
	4. Trisomy XXY
167. Which of the following chromosomal aberrations is associated with a rearrangement of genetic material within the same chromosome?
	1. Deletion
	2. Duplication
	3. **Inversion**
	4. Translocation
168. Sickle cell anemia occurs due to
169. Deletion
170. **Point mutation**
171. Duplication
172. Translocation
173. Notch wing mutation in drosophila occurs due to
174. **Deletion**
175. Duplication
176. Translocation
177. Transversion
178. Chromosome no. in drosophila is
179. 10
180. **8**
181. 14
182. 12
183. Mendel formulated some laws which are known as
184. Laws of germplasm
185. **Laws of inheritance**
186. Laws of recapitulation
187. None
188. Polytene chromosomes found in
189. **Salivary glands of drosophila**
190. Fish
191. Birds
192. Mammals
193. Who coined the term “gene” for “factor”?
194. **Johannsen**
195. Morgan
196. Punnett
197. Mendel
198. Father of experimental genetics
199. Mendel
200. **Morgan**
201. Johannsen
202. Bateson
203. Father of biochemical Genetics
204. **Garrod**
205. Morgan
206. Punnett
207. Mendel
208. The phenomenon of ‘like begets like’ is due to
209. Genetics
210. **Heredity**
211. Variation
212. Germplasm
213. Which refers to turning a chromosome segment around 180 degree and rejoining it to the original chromosomes.
214. Deletion
215. Duplication
216. **Inversion**
217. Transversion
218. The total aggregates of alleles in a population is termed as
219. **Gene pool**
220. Genotypic frequency
221. Gene frequency
222. Genetic structure
223. The types of chromosomal abnormalities are
224. Structural
225. Numerical
226. **Both (a) and (b)**
227. None
228. When different cells in the body express different genotypes and the cells are derived from different zygotes is termed as
229. **Chimera**
230. Mosaic
231. Gynandromorph
232. Diandry
233. Illegitimate crossing over is another term for
234. **Reciprocal translocation**
235. Transition
236. Transversion
237. None
238. Fruit fly has
239. 2 linkage groups
240. **4 linkage groups**
241. 6 linkage groups
242. 1 linkage groups
243. Chromosome no. in indigenous pig is
244. 32
245. **38**
246. 34
247. None
248. In prokaryotes, the chromosomes is held in a region called
249. **Nucleoid**
250. Centriole
251. Kinetochore
252. Centromere
253. In genetics, the use of checkerboard was done by
254. Bateson
255. **Punnet**
256. Mendel
257. Morgan
258. The exotic cattle has……
259. **30 pairs of chromosomes**
260. 30 chromosomes
261. 25 pairs of chromosomes
262. 50 chromosomes
263. The concept of linkage was given by
264. **Morgan**
265. Bateson
266. Mendel
267. Hugo de vries
268. A trait caused by genes at several loci called as
269. Monogenic trait
270. **Polygenic trait**
271. Pleiotropic trait
272. None of these
273. What is true to homologous individuals
274. Breed true to the trait
275. Does not bred true to the trait
276. Produce only one type of gamete
277. **Both (a) and (b)**
278. What is true for homologous chromosomes?
279. They are similar in shape and location of the centromere
280. They carry genetic code for the same traits
281. They have contrasting genes called alleles
282. **All of these**
283. In Japanese quail, chromosome number is
284. 38 pairs
285. **39 pairs**
286. 40 pairs
287. None of these
288. A zygote has
289. 1 set of chromosomes
290. No chromosomes
291. 23 chromosomes
292. **2 sets of chromosomes**
293. The technique of hybridisation used by Mendel was
294. Back cross
295. Single cross
296. Double cross
297. **Emasculation**
298. A non- reciprocal crossover causes which of the following products?
299. Deletion
300. Duplication
301. **Both (a) and (b)**
302. Non disjunction
303. Ocassionally, a single gene may express more than one effect. This phenonmenon is known as
304. Multiple allelism
305. **Pleiotropy**
306. Mosacism
307. Chimerism
308. An inherited character and its detectable variant is called as
309. Allele
310. Gene
311. **Trait**
312. None
313. Filial means………..
314. **Offspring produced in sexual reproduction**
315. Offspring produced in asexual reproduction
316. Offspring produced in vegetative reproduction
317. Both (a) and (c)
318. No. of chromosomes in swamp buffalo is
319. 50
320. **48**
321. 60
322. 52
323. Lampbrush chromosomes are founds in
324. **Ovarian cells of amphibians**
325. Brain cells of cat
326. Salivary glands of diptera
327. None
328. Balbiani rings are founds in
329. Polysomes
330. Heterosomes
331. **Polytenic chromosomes**
332. Lampbrush chromosomes
333. Genetically active part of chromatin is
334. Heterochromatin
335. **Euchromatin**
336. Both (a) and (b)
337. None
338. Which scientist is known for his experiments with fruit flies that provided evidence for the chromosomal theory of inheritance?
	1. Gregor Mendel
	2. **Thomas Hunt Morgan**
	3. Rosalind Franklin
	4. Barbara McClintock
339. XX-XO sex determination occurs in
340. Moth
341. Butterflies
342. Birds
343. **Round worms**
344. Cytoplasmic inheritance is
345. **Mother to son and daughter**
346. Father to son
347. Father to son and daughter
348. None of these
349. The genes which interact to allow each other to express in a new characteristic are said to be
350. **Complementary genes**
351. Supplementary genes
352. Epistatic genes
353. Dominant genes
354. 5-Bromouracil is a base analogue to
355. Cytosine
356. **Thymine**
357. Uracil
358. Adenine
359. A genotype refers to:
	1. The physical appearance of an organism
	2. **The genetic makeup of an organism**
	3. The combination of dominant and recessive traits
	4. The expression of genes in an environment
360. What is the term for the exchange of genetic material between homologous chromosomes?
	1. Replication
	2. Translation
	3. Transcription
	4. **Crossing over**
361. Where are genes located in eukaryotic cells?
	1. Nucleolus
	2. Ribosomes
	3. Mitochondria
	4. **Chromosomes**
362. Which of the following genetic disorders is caused by the absence of an entire sex chromosome (X or Y)?
	1. **Turner syndrome**
	2. Down syndrome
	3. Klinefelter syndrome
	4. Huntington's disease
363. Who proposed the theory of inheritance of acquired characteristics, which was later disproven?
	1. Gregor Mendel
	2. **Jean-Baptiste Lamarck**
	3. Alfred Russel Wallace
	4. Thomas Hunt Morgan
364. Diseases associated with non-chromosomal inheritance often exhibit:
	1. Mendelian inheritance patterns
	2. Continuous variation in phenotypes
	3. **Incomplete penetrance**
	4. Multifactorial inheritance
365. In humans, traits influenced by mitochondrial DNA are usually passed from:
	1. Father to son
	2. Father to daughter
	3. **Mother to son**
	4. Mother to daughter
366. How many copies of mitochondrial DNA does an individual inherit from their mother?
	1. **One**
	2. Two
	3. Three
	4. None
367. In some cases of nonchromosomal inheritance, genetic information is transmitted through:
	1. Ribosomal RNA
	2. **Transfer RNA**
	3. Messenger RNA
	4. MicroRNA
368. The phenomenon where individuals with the same mitochondrial DNA exhibit variability in phenotype is termed:
	1. **Genetic heterogeneity**
	2. Genetic linkage
	3. Gene duplication
	4. Pleiotropy
369. What is the primary role of extrachromosomal genes in bacteria?
	1. **Regulation of cellular metabolism**
	2. Synthesis of ribosomal RNA
	3. Formation of the cell wall
	4. Resistance to antibiotics
370. Diseases associated with nonchromosomal inheritance are often maternally inherited due to:
	1. **The absence of paternal genetic material**
	2. Faster replication of maternal DNA
	3. Specific cellular mechanisms
	4. Random chance
371. Diseases associated with defects in nonchromosomal genes are often challenging to treat because:
	1. They are not inherited
	2. **They involve mutations in essential cellular functions**
	3. They exhibit complete penetrance
	4. They follow simple Mendelian inheritance patterns
372. What is the process of introducing foreign genes into an organism's genome called?
	1. Gene cloning
	2. Gene therapy
	3. **Genetic engineering**
	4. Genetic modification
373. Which of the following techniques is commonly used for the artificial transmutation of genes?
	1. Polymerase chain reaction (PCR)
	2. Gel electrophoresis
	3. CRISPR-Cas9
	4. **Recombinant DNA technology**
374. In gene therapy, the primary aim is to:
	1. Introduce foreign genes into an organism
	2. **Correct or replace defective genes in an individual**
	3. Clone organisms for medical purposes
	4. Induce artificial mutations in genes
375. Which term refers to genes that are not located on a chromosome?
	1. Autosomal genes
	2. Non-mendelian genes
	3. **Nonchromosomal genes**
	4. Extrachromosomal genes
376. The inheritance pattern of mitochondrial DNA is predominantly:
	1. Autosomal recessive
	2. Autosomal dominant
	3. **Maternally inherited**
	4. Paternally inherited
377. The term "modifier gene" is often used to describe genes that:
	1. Cause diseases directly
	2. **Influence the expression of other genes**
	3. Encode structural proteins
	4. Are involved in DNA replication
378. How can a gene modifier affect the phenotype of an individual?
	1. By causing a mutation in the target gene
	2. **By suppressing the effects of other genes**
	3. By directly controlling the production of proteins
	4. By altering the chromosomal structure
379. Which term is used to describe the phenomenon where one gene masks the effect of another gene?
	1. Codominance
	2. **Epistasis**
	3. Pleiotropy
	4. Penetrance
380. A gene modifier that enhances the effect of another gene is known as a:
	1. Enhancer
	2. Suppressor
	3. **Potentiator**
	4. Silencer
381. In what way do gene modifiers contribute to genetic variation?
	1. They lead to a decrease in genetic diversity
	2. They increase the likelihood of genetic mutations
	3. They introduce novel genes into the genome
	4. **They influence the expression of existing genes**
382. Which of the following statements is true about modifier genes?
	1. They always cause diseases directly.
	2. They are only found in plants.
	3. They are not involved in genetic variation.
	4. **They can affect the expression of multiple genes.**
383. In gene modification, what is the term for a gene that masks or diminishes the effect of another gene?
	1. Enhancer
	2. **Suppressor**
	3. Modifier
	4. Allele
384. Which of the following genetic conditions is an example of gene modification where the severity of symptoms can be influenced by modifier genes?
	1. Huntington's disease
	2. Cystic fibrosis
	3. **Marfan syndrome**
	4. Hemophilia
385. What term is used to describe any change in the number, structure, or arrangement of chromosomes?
	1. Mendelian mutation
	2. **Chromosomal aberration**
	3. Somatic mutation
	4. Point mutation
386. Down syndrome is an example of a chromosomal aberration caused by:
	1. Deletion
	2. Duplication
	3. **Aneuploidy**
	4. Inversion
387. Klinefelter syndrome results from a chromosomal aberration involving:
	1. Monosomy X
	2. **Trisomy 21**
	3. Trisomy 18
	4. Trisomy XXY
388. In which phase of the cell cycle does chromosomal aberrations, such as translocations, most likely occur?
	1. G1 phase
	2. **S phase**
	3. G2 phase
	4. M phase
389. The Philadelphia chromosome, associated with chronic myeloid leukemia, is an example of:
	1. Deletion
	2. Duplication
	3. Inversion
	4. **Translocation**

 **Match the column: -**

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Sex linked traits
 | 1. Milk production
 | b |
| 1. Sex influenced traits
 | 1. Broodiness in poultry
 | c |
| 1. Sex limited traits
 | 1. Horn condition in sheep
 | a |
| 1. Multiple allelism
 | 1. Double muscling gene in cattle
 | e |
| 1. Pleiotropy
 | 1. ABO blood group in human
 | d |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Crossing over
 | 1. Exchange of the chromatid segments between homologous chromosomes
 | b |
| 1. Linkage
 | 1. Exchange of the chromatid segments between non sister chromatids of homologous chromosomes
 | a |
| 1. Transition
 | 1. Replacement of Purine by Pyrimidine or Pyrimidine by Purine
 | d |
| 1. Transversion
 | 1. Replacement of Purine by purine of Pyrimidine by Pyrimidine
 | c |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Strausburger
 | 1. Chromosomes term
 | b |
| 1. W. Waldeyer
 | 1. Discovery of chromosomes.
 | a |
| 1. Sex Chromosomes
 | 1. Other than sex chromosomes
 | e |
| 1. Autosomes
 | 1. Discovery of sex chromosomes
 | c |
| 1. Mc Clung
 | 1. X or Y chromosome
 | d |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Patau syndrome
 | 1. 45 (44+XO)
 | d |
| 1. Edward syndrome
 | 1. Trisomy of 21st chromosome
 | c |
| 1. Down syndrome
 | 1. Trisomy of 18th chromosome
 | b |
| 1. Cat cry syndrome
 | 1. Trisomy of 13th chromosome
 | e |
| 1. Turner syndrome
 | 1. Terminal deletion of short arm of 5th chromosome
 | a |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Genic balance theory of sex determination
 | 1. Gregor Johann Mendel
 | d |
| 1. Father of Genetics
 | 1. Morgan
 | a |
| 1. Father of experimental Genetics
 | 1. Bateson
 | b |
| 1. Father of modern Genetics
 | 1. C.B. Bridge.
 | c |
| 1. Father of Biochemical Genetics
 | 1. Garrod
 | e |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Human male
 | 1. 44+XX
 | b |
| 1. Humane female
 | 1. 44+XY
 | a |
| 1. Poultry female
 | 1. 76+ZZ
 | d |
| 1. Poultry male
 | 1. 76+ZW
 | c |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Monoploidy
 | * 1. 2N-1
 | b |
| 1. Monosomy
 | * 1. 2N-N
 | a |
| 1. Triploidy
 | * 1. 2N+1
 | d |
| 1. Trisomy
 | * 1. 2N+N
 | c |
| 1. Tetrasomy
 | * 1. 2N+2
 | e |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| * 1. Klinefelter’s syndrome
 | * 1. 45 (44+XO)
 | d |
| * 1. Turner syndrome
 | * 1. 47 (44+XYY)
 | a |
| * 1. Super male/ Jacob’s syndrome
 | * 1. 47 (44+XXY)
 | b |
| * 1. Super female
 | * 1. 47 (44+XXY)
 | c |

|  |  |  |
| --- | --- | --- |
| **Column -I** | **Column-II** | **Answer** |
| 1. Sex linked inheritance
 | * 1. Sutton and Boveri
 | b |
| 1. Genic balance theory of sex determination
 | * 1. Morgan
 | d |
| 1. Chromosomal theory of heredity
 | * 1. Hugo de Vries
 | a |
| 1. Mutation theory of evolution
 | * 1. C. B. Bridge
 | c |
|  |  |  |