Get Ready to crack CSIR-NET 2021 (Important Questions on Human genetics)

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Q1. Given below are some genetic disorders with their respective chromosomal aberrations. Choose the mismatch.

A. Cri-du-chat syndrome- $5p^-$

B. Patau syndrome- 47, +13

C. Retinoblastoma- 13q, 14

D. Edward's syndrome- 47, +21

Q2. Given below are some statements about genetic markers. Choose the incorrect statement(s).

P. Polygenic traits are controlled by QTLs

Q. In QTL mapping, RFLP is used as a marker

R. QTLs control quantitative trait

S. QTLs always present in single chromosome

A. P and Q

B. Q and R

C. P and S

D. only S

Q3. Ames test used to screen mutagenicity is based on
A. Reversion of arginine auxotrophic mutants to prototrophic
B. Reversion of histidine auxotrophic mutants to prototrophic

C. Reversion of tyrosine auxotrophic mutants to prototrophic
D. No reversion of auxotrophic mutants

Q4. Inversions are considered as cross-over suppressors because

A. Inversion heterozygotes, i.e., one copy having normal chromosome and its homologue having inversion, does not allow crossing over to occur as they cannot pair at all

B. **Homozygous inversions are lethal and thus they do not appear in next generation**

C. Due to inversion present, four chromosomes take part in the pairing and crossing over events which make the structure difficult to separate and form gamete

D. The pairing and crossing overs may occur in inversion heterozygotes but the gametes from cross over products are usually lethal

Q5. An experiment was carried out to know if a dominant DNA marker (7kb band) is linked to alleles which are controlling seed size. 100 offspring's were obtained from the cross between plant heterozygous for the marker and small seeded plant lacking the 7kb band. They were analysed for the presence and absence of the DNA marker.

The results are as given below:

Phenotype	Plant with large seed		Plant with small seed	
No. of offspring's showing presence or absence of DNA marker	Present	Absent	Present	Absent
	22	23	27	28

Based on the above observations which one of the following conclusions is correct?

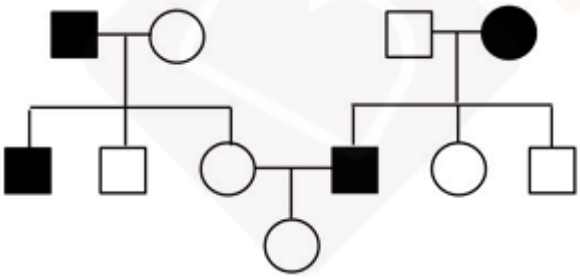
A. The DNA marker assorts independently of the phenotype

B. The 7kb band is linked to the allele 'B'

C. The DNA marker assorts independently with large seed but is linked to the small seed trait

D. The 7kb band is linked to the allele 'b'

Q6. The following pedigree shows the inheritance pattern of a trait.



From the following, what will be the possible mode of inheritance and the probability that the daughter in generation III will show the trait.

A. X-linked recessive, probability is 1/5

B. X-linked recessive, probability is 1/3

C. Autosomal recessive, probability is 1/2

D. Autosomal recessive, probability is 1/8

Q7. Person having sex chromosomes XXY suffers from which of the following:
A. Down's syndrome
B. Edward's syndrome
C. Klinefelter's syndrome
D. Patau's syndrome

Q8. A cross in which parents differ in a single pair of contrasting character is called-

A. tetrahybrid cross

B. dihybrid cross

C. monohybrid cross

D. trihybrid cross

Q9. A gene having reading frame ABCD-EFGH (with the hyphen as centromere) undergoes pericentric inversion, then which one of the following will be the resultant gene after inversion?
P. ACBD-EFGH
Q. ABCD-GEFH
R. ABED-CFGH
S. ABCD-EHGF

Q10. Match the following-

COLUMN A (genetic disorder)	COLUMN B (cause)
a. Down’s syndrome	i. additional sex chromosome
b. Cri-du-chat syndrome	ii. presence of an extra chromosome
c. Klinefelter’s syndrome	iii. absence of sex chromosome
d. Turner’s syndrome	iv. loss of part of chromosome

A. a-ii, b-iv, c-i, d-iii

B. a-i, b-iii, c- ii, d-iv

C. a-iii, b-ii, c-i, d-iv

D. a-ii, b-i, c- iii, d-iv

ANSWERS

1. **D**
2. **D**
3. **B**
4. **D**
5. **A**
6. **C**
7. **C**
8. **C**

9. R
10. A

SOLUTION

Solution- 1 A. Cri-du-chat syndrome- $5p^-$ caused by loss of short arm of chromosome 5

B. Patau syndrome- 47, +13, by addition of extra chromosome 13

C. Retinoblastoma- 13q, 14, by translocation of short arm of chr. 13 to chr. 14

D. Edward's syndrome- 47, +18, by addition of extra chromosome 18

Solution-2

QTLs i.e quantitative trait loci are controlled by many genes. QTL analysis is a statistical method for phenotypic and genotypic data. For this method, various types of markers are used which includes- RFLPs, SSRs and SNPs. QTLs control quantitative trait. All statements are correct except statement S as they are present in multiple chromosomes. Hence, D is correct option.

Solution-3

Prototrophs are the microbes which can grow on basic MEM (minimal essential media) while auxotrophs are microbes that require certain specific factors for their growth. Ames test assay inyolves testing of chemicals mutagenic potential. The Ames test is based on the mutant reversion of His auxotrophic strains of Salmonella typhimurium to prototrophic strain, when grown on minimal essential media (MEM) in the presence of mutagen. Hence, B is the right option.

Solution-4

Inversions is a type of mutations in which a DNA piece is flipped by 180 degrees in which the region between DNA breaks gets inverted and ends are rejoined to remaining chromosome. One of such inversion is para centric inversions in which the inverted region does not involve centromere, and these para centric inversions are called as Crossover suppressors. Crossover suspension happens when two chromosomes, mainly two homologous part of the same chromosome, break and reconnect with the different end of the chromosome. Such crossover suppression if occur within the gene causes the disruption of gene and if it is essential one then it could be lethal. Hence, except D, all are incorrect.

Solution-5

When genes are on separate chromosomes or are very far apart on the same chromosomes then they will assort independently. That is, when the genes go into gametes, the allele received for one gene doesn't affect the allele received for the other. It is clear from the above table or data that DNA marker (7 kb) is assorting independently of the phenotype as ratio comes out to be approximately 1:1:1:1. Hence, it is linked neither to allele B nor to allele b. Hence, only A is correct.

Solution-6

In autosomal recessive, trait often skip generations and can be transmitted by either sex. Affected person have homozygous recessive genotype (aa) and non-affected will have homozygous or heterozygous dominant genotype (AA/Aa). Unaffected outsiders will have homozygous genotype.

In generation I, parents will be Aa x aa

In generation II, probability of 1 (aa) -1/2, 2 (Aa)- 1/2, 3 (Aa)- 1/2, 4 (aa)- 1/2

In generation, probability of daughter being affected- 1/2

Solution-7

In males, presence of an extra X chromosome i.e. XXY leads to abnormality known as Klinefelter's syndrome. This affects physical and mental development of the individual. Affected persons are taller than normal, infertile, suffer from gynecomastia (enlargement of breasts) and reduced bone density. Klinefelter syndrome results due to non-disjunction of homologous XX chromosomes, resulting in abnormal number of chromosomes in gametes (22 + XX = 24) instead of 23 (22 + X). Hence, C is the right option.

Solution-8

Monohybrid cross involves cross between two parents differing with each other in only one trait, while in dihybrid cross two parents differ in two characters. Similarly, trihybrid cross involves parents with three different traits and tetrahybrid cross involve parents with four different traits. The alleles for different traits segregate independent of each other during gamete formation. Hence, C is the correct option.

Solution- 9

A inversion is a chromosomal defect in which a segment of the chromosome breaks off and reattaches in the reverse direction. Inversions are of two types: paracentric and pericentric. Paracentric inversions do not include the centromere and both breaks occur in one arm of the chromosome. Pericentric inversions include the centromere and there is a break point in each arm. Hence, R is the correct answer which involves centromere during inversion.

Solution- 10

COLUMN A (genetic disorder)	COLUMN B (cause)
a. Down’s syndrome	ii. presence of an extra chromosome
b. Cri-du-chat syndrome	iv. loss of part of chromosome
c. Klinefelter’s syndrome	i. additional sex chromosome
d. Turner’s syndrome	iii. absence of sex chromosome

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