

E 289

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2003.

Third Semester

Industrial Biotechnology

IB 233 — GENETICS

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mendel crossed tall pea plants with dwarf ones. The F_1 plants were all tall. When these F_1 plants were selfed to produce the F_2 plants he got a ratio of 3 : 1 tall to dwarf ratio. Predict the genotypes and phenotypes of the F_3 (obtained by selfing the F_2).
2. Define epistasis. Give a suitable example.
3. What do you mean by multiple alleles? Mention the four blood-type alleles responsible for the production of A & B antigens.
4. State Lyon's hypothesis.
5. Differentiate between homozygous and hemizygous, codominance and incomplete dominance.
6. What is a sex-limited and a sex-influenced trait?
7. Define coefficient of coincidence and interference.
8. What is generalized transduction? What is a transducing particle?
9. Which experiment provided evidence that DNA is the genetic material? What bacterial process was involved in that experiment?
10. Give two techniques for mapping human genes.

PART B — (5 × 16 = 80 marks)

11. (i) What is a three-point cross? Why is it preferred over a 2-point cross in mapping? (4)
- (ii) How is linkage and crossing over important in mapping genes to chromosomes? (6)
- (iii) A homozygous groucho fly (gro, bristles clumped above the eyes) is crossed with a homozygous rough fly (ro, eye abnormality). The F₁ females are test-crossed, producing these offspring.

Groucho	518
Rouch	471
Groucho rough	6
Wild-type	5
	1000

What is the linkage arrangement of these loci? (4)

What offspring would result if the F₁ dihybrids were crossed among themselves instead of being test crossed? (2)

12. (a) (i) How can you generate human chromosomal maps. Lay special emphasis on somatic cell hybridization. (12)
- (ii) Three mouse-human cell lines were scored for the presence (+) or absence (-) of human chromosomes, with the results as follows.

Human Chromosomes

Clones	1	2	3	4	5	14	15	18
A	+	+	+	+	-	-	-	-
B	+	+	-	-	+	+	-	-
C	+	-	+	-	+	-	+	-

If a particular gene is located on chromosome 3, which clones should be positive for the enzyme from that gene? (4)

Or

(b) (i) What is transduction? Why is specialized transduction not useful in mapping experiments? (8)

(ii) A gal⁻ bio⁻ alt λ⁻ strain of E.coli is transduced by P₂₂ phages from a wild-type strain. Transductants are selected for by growing the cells with galactose as the sole energy source. Replica plating and testing for lysogenic ability gives the genotypes of 106 transformants.

Class 1	gal ⁺	bio ⁻	alt λ ⁻	71
Class 2	gal ⁺	bio ⁺	alt λ ⁻	0
Class 3	gal ⁺	bio ⁻	alt λ ⁺	9
Class 4	gal ⁺	bio ⁺	alt λ ⁺	26

What is the gene order and what are the relative cotransduction frequencies? (8)

13. (a) (i) What is a plasmid? (2)
- (ii) How does one integrate into a host's chromosome? (2)
- (iii) How does it leave? (2)
- (iv) Diagram step-by-step events required to integrate foreign DNA into a bacterial chromosome in each of the 3 processes. (10)

Or

- (b) (i) What is Hfr, fertility factor? F⁻-pilli & merozygote? (4)
- (ii) What is interrupted mating and how does it enable a geneticist in mapping genes? (4)
- (iii) What is F⁻-duction? (4)
- (iv) In conjugation experiments, one Hfr strain should carry a gene for some sort of sensitivity so that the Hf donors can be eliminated on selective media after conjugation has taken place. Should this loci be near or far from the origin of transfer? What are the consequences of each alternative? (4)

14. (a) Describe sex-determination mechanism in humans? What is dosage compensation? How can you determine whether a particular gene is X-linked or not? What are the four classes of inheritance? Draw a pedigree to illustrate each class. (16)

Or

- (b) (i) What is pedigree analysis? Give all the symbols used in a pedigree. (10)
- (ii) Differentiate between penetrance and expressivity. Discuss sex-linkage. (6)
15. (a) (i) Discuss what bacterial phenotypes are used in genetic experiments. (2)
- (ii) What is replica plating and screening technique, resistance and sensitivity? (4)
- (iii) What is the mechanism of transformation? (6)
- (iv) How is transformation mapping useful? (2)
- (v) What is cotransfer index? (2)

Or

- (b) Describe the structure of an eukaryotic chromosome. (16)
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