八十六學年度輻射生物研究所系（所）＿＿＿＿組碩士班研究生入學考試

科目 遺傳學 科號 405 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

I. filling blank (2 points each)

(1-5) For each of the following partial diploids indicate whether β- galactosidase formation is inducible or constitutive.

(1) $i^+ o^+ z^+ y^+$
$i^+ o^c z^+ y^+$

(2) $i^+ o^+ z^+ y^+$
$i^+ o^+ z^+ y^-$

(3) $i^+ o^+ z^+ y^+$
$i^- o^+ z^+ y^+$

(4) $i^- o^+ z^+ y^+$
$i^- o^+ z^+ y^+$

(5) $i^+ o^c z^- y^+$
$i^+ o^+ z^+ y^+$

(6) DNA extracted from a fungus is found to be a standard Watson-Crick helix. It contains 35% adenine. What is its cytosine content (in %)

(7) Using somatic cell hybridization, a number of cells having a particular human enzyme were generated. Five of these cell lines had human chromosomes: (A) 4,9, 11; (B)2, 7, 11, 21; (C) 4, 9, 11, 17, 21; (D) 1, 2, 11, 18; (E) 4, 11, 15. On which chromosome is the gene for this enzyme located?

(8) Let us assume that we are trying to identify the genes involved in a deletion. Crosses to lines homozygous for recessive mutants at genes *e* and *f* gave offspring that were mutant, while crosses to lines homozygous for recessive mutants at genes *g* and *h* yielded wild-type progeny. Which genes are missing in the deletion?

(9) In a series of 94075 babies born in a particular hospital, 10 were achondroplastic dwarfs (an autosomal dominant condition). Two of these ten had an achondroplastic parent. The other 8 babies each had two normal parents. What is the apparent mutation rate at the achondroplasia locus?

(10) A woman who is blood type A and a man who is blood type B have a child that is blood type O. What is the genotype of the woman?

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科目 遺傳學 科號 4105 共 五 頁第 2 頁 *請在試卷【答案卷】內作答

II. Multiple choice (2 points each) 注意：單選答錯倒扣 0.5 分

(1) Interphase is a period corresponding to the cell cycle phases of (a) mitosis, (b) S, (c) G1+S+G2, (d) G1+S+G2+M, (e) none of above.

(2) Chromatids joined together by a centromere are called (a) sister chromatids, (b) homologs, (c) alleles, (d) bivalents, (e) tetrads.

(3) Mitosis and meiosis always differ in regard to the presence of (a) chromatids, (b) pairing of homologs, (c) bivalents, (d) centromeres, (e) spindles.

(4) The standard Watson-Crick model of DNA favored at high humidity and in solution. (a) A-form, (b) B-form, (c) D-form, (d) Z-form, (e) none of the above.

(5) The horse, Equus caballus, has 64 chromosomes; the donkey, Equus arinus, has 31 pairs of chromosomes. How many chromosomes does the hybrid mule have? (a) 31 (b) 32 (c) 63 (d) 64 (e) 126.

(6) If a rare genetic disease is inherited on the basis of an X-linked recessive gene, one would expected to find the following: (a) affected fathers have 100 percent affected sons, (b) affected mothers have 100 percent affected daughters, (c) affected fathers have 100 percent affected daughters, (d) affected mothers have 100 percent affected sons, (e) none of above.

(7) The somatic tissue of a species of mammal has 20 chromosomes. What is the least linkage groups expected to be? (a) 5, (b) 10, (c) 15, (d) 20, (e) 40.

(8) If a genetic disease is inherited on the basis of an autosomal dominant gene, one would expect to find the following: (a) affected fathers have only affected children, (b) affected mothers never have affected sons, (c) If both parents are affected, all of their offspring have the disease, (d) If a child has the disease, one of his or her grandparents also had the disease, (e) none of above.

(9) If a genetic disease is inherited as an autosomal recessive, one would expect to find the following: (a) Two affected individuals never have an unaffected child, (b) Two affected individuals have affected male offspring but no affected female children, (c) If a child has the disease, one of his or her grandparents will have had it, (d) in a marriage between an affected individual and an unaffected one, all the children are unaffected, (e) none of above.

(10) Which of the following statements is not true for a disease that is inherited as rare X-linked dominant? (a) all daughters of an affected male will inherit the disease, (b) sons will inherit the disease only if their mothers have the disease, (c) both affected males and affected females will pass the trait to half the children, (d) daughters will inherit the disease only if their father has the disease.

(11) Purebred does not imply (a) absence of mutations (b) homozygosity (c) a recognized breed free of genetic contributions from outside stock for many generations (d) a lineage established by registration records (e) producing the same phenotype and only that phenotype generation after generation.

(12) Mutations are (a) caused by genetic recombination, (b) heritable changes in genetic information, (c) caused by faulty transcription of the genetic code, (d) usually but not always beneficial to the development of the individuals in which they occur, (e) can be induced by individual needs

(13) The first stage of genetic recombination according to the Holliday model is (a) the G1 stage, (b) chromosome attachment, (c) branch migration, (d) recognition and alignment, (e) strand invasion.

(14) The total amount of DNA in the haploid genome of any organism is (a) its karyotype, (b) its C-value, (c) its Cot1/2 value, (d) an indication of its structural complexity, (e) all of above

Ⅲ. Short essay

1. In a garden variety of squash, disk-shape fruit, D is dominant over its allele sphere-shape fruit (d). Also, white fruit color, W, is dominant over its allele yellow fruit (w). Assume that these genes are on separate chromosomes. What kinds of fruit (phenotypes) will be produced when a plant with the genotype DdWw is crossed with a Ddww plant? What is the expected frequency of each phenotype? (6 points)

2. Retinoblastoma is caused by inactivation of a regulatory gene that normally holds cell division in check, what would be the likely phenotype (normal or malignant) of a hybrid between a retinoblastoma cell and a normal cell? Why? (6 points)

八十六學年度 [illegible] 系(所) _____ 組碩士班研究生入學考試

科目 遺傳學 科號 4105 共 2 頁第 4 頁 *請在試卷【答案卷】內作答

3. The complementation data shown in the following table are observed. The numbers refer to particular mutations. The symbols + and - indicate that the two mutations do and do not complement, respectively. How many genes are represented? Assign the mutations to the genes. (6 points)

	Mutants						
	1	2	3	4	5	6	7
1	-	+	+	+	+	+	-
2		-	+	-	+	+	+
3			-	+	+	-	+
4				-	+	+	+
5					-	+	+
6						-	+
7							-

4. The synthesis of β-galactosidase can be inhibited by growing *E. coli* in glucose-containing media. cAMP is involved in this process. (a) Do you think the concentration of cAMP will **increase or decrease** when bacteria are grown in the presence of glucose? (b) Explain how does cAMP influence the synthesis of β-galactosidase, with one or two sentences. (8 points)

5. A mutant *E. coli* cell has an aminoacyl-tRNA synthetase that should attach the amino acid phenylalanine to its tRNA ($tRNA^{phe}$). At the elevated temperature of 42°C, that tRNA instead attaches the amino acid arginine. What consequence would this have for the proteins that cell makes at the elevated temperature? Would this affect the function of these proteins? Why, or why not? (6 points)

6. In peanuts, the plant may be either "bunch" or "runner." Two different strains of peanut, V4 and G2, in which "bunch" occurred were crossed with the following results:

V4 bunch X V4 bunch —> all bunch

G2 bunch X G2 bunch ----> all bunch

The two true-breeding strains of bunch were crossed in the following way:

V4 bunch X G2 bunch ----> F1 runner

F1 X F1 —> F2 9 runner : 7 bunch

What is the genetic basis of the inheritance pattern of runner and bunch in the F2? (6 points)

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科目 遺傳學 科號 405 共 五 頁第 5 頁 *請在試卷【答案卷】內作答

7. A mutation prevents the synthesis of substance Z and results in the accumulation of large amounts of substance R, which is normally present in only very small amounts. What can probably be said about the relation between R and Z and about the gene product inactivated by the mutation? (6 points)

8. Within a certain group of house cats, the males are either black or yellow; females are black, tortoise-shell pattern, or yellow. Assuming coat color in cats is X-linked, explain the following:
one-half of the females produced by a certain kind of mating are tortoise-shell and one-half are black; one-half of the males are yellow and one-half are black. What colors are the parental males and females in this kind of mating?
another kind of mating produces progeny in the following proportions: 1/4 yellow male, 1/4 black male, 1/4 tortoise-shell female. What are the genotypes of the parental males/females in this kind of mating? (8 points)