

八十五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 3905 共 五 頁第 1 頁 *請在試卷【答案卷】內作答

2. Filling blank

(請按括弧標示號碼答題，1至29題，每題二分；30至39題，每題一分)

- A. In four-o'clock plants, two unlinked genes *Y* and *R*, affect flower color. Neither is completely dominant, and the two interact on each other to produce seven different flower colors:

$Y/Y R/R = \text{crimson}$	$Y/y R/R = \text{magenta}$
$Y/Y R/r = \text{orange-red}$	$Y/y R/r = \text{magenta-rose}$
$Y/Y r/r = \text{yellow}$	$Y/y r/r = \text{pale yellow}$
$y/y R/R, y/y R/r, y/y r/r = \text{white}$	

Please answer the following questions.

In a cross of a crimson-flowered plant with a white one ($y/y r/r$), what will be the appearances of the F1? (1)

what will be the appearances of the F2? (2)

What will be the appearances of the F1 backcrossed to the crimson parent? (3)

Two plants were crossed and gave the following offspring: 1/8 crimson, 1/8 orange-red, 1/4 magenta, 1/4 magenta-rose, and 1/4 white. What are the genotype of the parents? (4)

- B. A normal chromosome has the following gene sequence:

ABCD ○ EFGH

Determine the chromosomal mutation illustrated by each of the following chromosomes:

ABC FE ○ DGH (5)

AD ○ EFBCGH (6)

ABCD ○ EF EFGH (7)

ABD ○ EFGH (8)

ABCD ○ EGFH (9)

八十五學年度轉動生物研究所系(所) _____ 組碩士班研究生入學考試

科目 遺傳學 科號 3905 共 五 頁第 2 頁 *請在試卷【答案卷】內作答

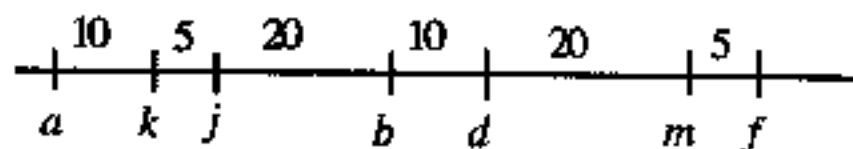
C. For each of the following diploid genotypes, indicate the synthesis of β -galactosidase is inducible (+), constitutive (C), or no expression of β -galactosidase (-). I, P, O, Z are used for *Lac*, *LacO*, *LacP*, *LacO*, *LacZ*.

$$I^+ Z^+ / I^+ O^c Z^- \quad (10)$$

$$I^+ P^- Z^+ / I^- Z^- \quad (11)$$

$$I^+ P^- O^c Z^+ / I^- Z^+ \quad (12)$$

D. The questions below make use of this genetic map:



Calculate:

The frequency of *jb* gametes from a *JB/jb* genotype. (13)

The frequency of *AM* gametes from an *aM/Am* genotype. (14)

The frequency of *JBD* gametes from a *jBd/JbD* genotype. (15)

The frequency of *jbD/jbD* genotypes in a *jBd/JbD* X *jBd/JbD* mating. (16)

E. In a diploid organism with a haploid chromosome number of 7, how many sister chromatids are present in its mitotic metaphase nucleus? (17)

In its meiotic metaphase I nucleus? (18)

In its meiotic metaphase II nucleus? (19)

F. From the list below

(a) centromeres (b) hexose sugars (c) supercoiling (d) telomeres (e)

nonhistone protein scaffolds (f) DNA (g) nucleosomes

(h) circular chromosome (i) looping

Identify

(20) Three features that both eukaryotic and bacterial chromosomes have in common.

(21) Four features that eukaryotic chromosomes have but which are not found in bacterial chromosomes.

(22) One feature that bacterial chromosomes have but which is not found in eukaryotic chromosome.

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- G. A chemically induced mutation, a , can only be reverted by proflavin when subjected to treatment by the following mutagens: 2-aminopurine, 5-bromouraci, proflavin, hydroxylamine, and methylemthane sulfonate. What is the mutagen used to generate the original mutation (e.g. a^+ to a^-)? (23)
 What is this type of mutation called? (24)
- H. The following are melting temperatures for different double-stranded DNA molecules. Arrange these molecules from lower to higher content of GC pairs. (a) 73°C , (b) 69°C , (c) 84°C , (d) 78°C , (e) 82°C . (25)
- I. The normal sequence of a particular protein is given below, along with several mutant versions of it. The DNA sequence of the gene encoding the protein is known and shown below. For each mutant, explain what mutation occurred in the coding sequence of the gene.
- Normal Met-Gly-Glu-Thr-Lys-Val-Val-Pro-His-Val-Arg-Leu-..
 AUG GGU GAG ACC AAA GUC GUG CCU CAU GUU AGA CUC..
- Mutant 1 Met-Gly (26)
- Mutant 2 Met-Arg-Glu-Thr-Lys-Val-Val-Pro-His-Val-Arg-Leu-..(27)
- Mutant 3 Met-Val-Arg-Pro-Lys-Ser-Cys-Leu (28)
- J. In *Drosophila* mutants A, B, C, D, E, F, and G all have the same phenotype: the absence of red pigment in the eyes. In pairwise combinations in complementation tests the following results were produced, where += complementation and -= no complementation.

	A	B	C	D	E	F	G
G	+	-	+	+	+	+	-
F	-	+	+	-	+	-	
E	+	+	-	+	-		
D	-	+	+	-			
C	+	+	-				
B	+	-					
A	-						

How many genes are present? (29)

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- K. (a) DNA Polymerase I (b) DNA Polymerase III (c) Uvr ABC endonuclease (d) RecA protein (e) Ligase (f) SSB protein (g) Gyrase (h) Helicase (i) Primase

From the list above, choose the enzyme(s) involved in the following events occurred in *E. coli*

- (30) unwinds the double helix during DNA replication
- (31) prevents association of complementary bases during DNA replication
- (32) the RNA polymerase used during DNA replication
- (33) the major elongation enzyme used during DNA replication
- (34) the DNA polymerase used for DNA repair
- (35) posses 3'-to-5' exonuclease activity
- (36) separates daughter molecules and causes supercoiling
- (37) binds free 3'-OH end of a polynucleotide to a free 5' monophosphate end of polynucleotide
- (38) binds free 3'-OH end of a polynucleotide to a free 5' nucleotide triphosphate
- (39) enzymes involved in the excision repair

II. Short essay

L. The mammalian genome contains about 10^5 genes. Mammals can produce about 10^6 to 10^8 different antibodies. Explain how it is possible for both of the above sentences to be true. (八分)

M. The *phe*, *his*, *thr*, and *leu* operons are regulated, in part, by an attenuator mechanism similar in many respects to that described for *trp*. The most important difference lies in the tandem codons present in the leader sequence. What do you think these codons would be in each case (operon)? (八分)

N. Explain the following phenomenon. Restriction enzyme 1 acts at all sites acted on by restriction enzyme 2, yet enzyme 2 cannot act at most of the sites for enzyme 1. (四分)

O. What would happen to a recipient cell (with no λ DNA) if λ prophage DNA was transferred in through conjugation? (四分)

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- P. 5000 bp piece DNA is digested with restriction enzymes A and B, singly and together. The results of these digestion are as following:
- digestion with A: 2100, 1400, 1000, 500 bp
 - digestion with B: 2500, 1300, 1200 bp
 - digestion with A+B: 1900, 1000, 800, 600, 500, 200 bp
- Each A fragments and B fragments were extracted from the gel and digested with the B and A enzymes, respectively. The sizes of the resulting DNA fragments are as following:
- A fragment
 - 2100 bp: 1900 + 200 bp
 - 2400 bp: 800 + 600 bp
 - 1000 bp: 1000 bp
 - 500 bp: 500 bp
 - B fragment
 - 2500 bp: 1900 + 600 bp
 - 1300 bp: 800 + 500 bp
 - 1200 bp: 1000 + 200 bp
- Construct a restriction endonuclease map. (八分)