題號： 205　　　國立臺灣大學 114 學年度碩士班招生考試試題
科目： 遺傳學(D)
節次： 4

1.Please choose the best matching phrase in the lower section (1 to 10) to match each of the terms in the upper section (a to j). (20 points)　※ 本大題請於試卷內之「選擇題作答區」依序作答。

a. Locus　　b. Law of independent assortment
c. Law of segregation　　d. Transcription
e. Penetrance　　f. Expressivity
g. Alleles　　h. Chiasma
i. Karyotype　　j. Heterozygosity

(1) Alternate forms of a gene
(2) The condition of having two different alleles at the same position on chromosome
(3) Alleles of one gene separate into gametes randomly with respect to alleles of other genes
(4) Degree or intensity with which a particular genotype is expressed in a phenotype
(5) An individual's complete set of chromosomes
(6) The process by which the information in a strand of DNA is copied into a RNA
(7) Structure formed at the spot where crossing-over occurs between homologs
(8) Percentage of individuals with a particular genotype that express the expected phenotype
(9) The separation of the two alleles of a gene into different gametes
(10) The relative chromosomal location of a gene

以下注意：請於試卷內之「非選擇題作答區」作答，並應註明作答之題號。

2.Professor is studying genes controlling petal (花瓣) number in the plant *Arabidopsis thaliana*, the wild-type has 4 petals. Professor gives you a bag of Arabidopsis pure seeds from one accession “C24” and ask you to create mutants.

2.1. How do you confirm this bag of Arabidopsis seeds are pure-bred? Please describe the method and expected outcome (4 points)
2.2. To create the mutants, name one chemical mutagen that you can use to create mutants having different petal numbers (2 points)

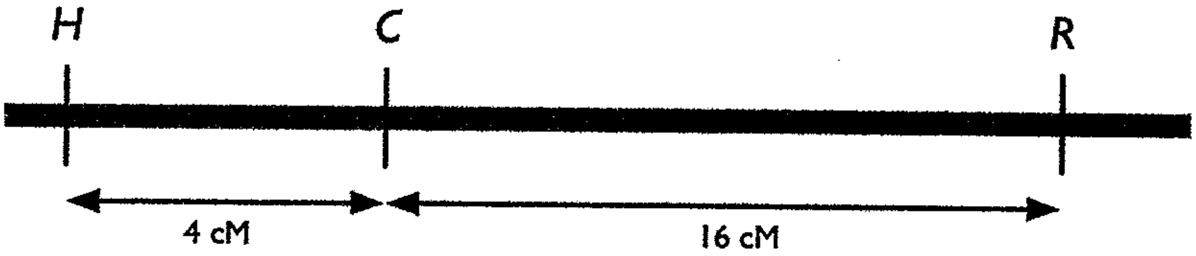
You identified five independent recessive mutations that resulted in plants that had abnormal petal number (A to E). You started to perform complementation tests with these mutants, the finished tests results are shown in the table below:

	A	B	C	D	E
A	–	?	+	–	+
B		–	–	?	+
C			–	+	?
D				–	+
E					–

2.3 Please describe the experiment performed to conclude these five mutants are “recessive” mutations? (2 points)
2.4 What does plus (+) and minus (-) indicate in the complementation results? (2 points)
2.5 After you solved the “?” with the expected results, how many genes were mutated to affect petal number in this experiment? (2 points)

見背面

3.A true-breeding of Taiwan maize inbred line has dominant alleles determining plant height (H), leaf color (C), and kernel wrinkle (R). The USA maize inbred line is homozygous for the recessive alleles of these three genes. These genes are found on the chromosome as follows:



An F1 hybrid between Taiwan and USA inbred lines is now backcrossed to the USA inbred. Assuming no interference:

3.1 Calculate the frequency of gametes with no crossovers in either interval will be produced by the heterozygote (3 points)

3.2 What proportion of the backcross progeny will resemble the Taiwan inbred lines for all three traits? (3 points)

4.Please select the type of gene interaction from (1) ~ (6) to match (A) ~ (F) in the figure (12 points)

(1) **Reciprocal recessive epistasis**: When homozygous, recessive allele of each gene masks the dominant allele of the other gene

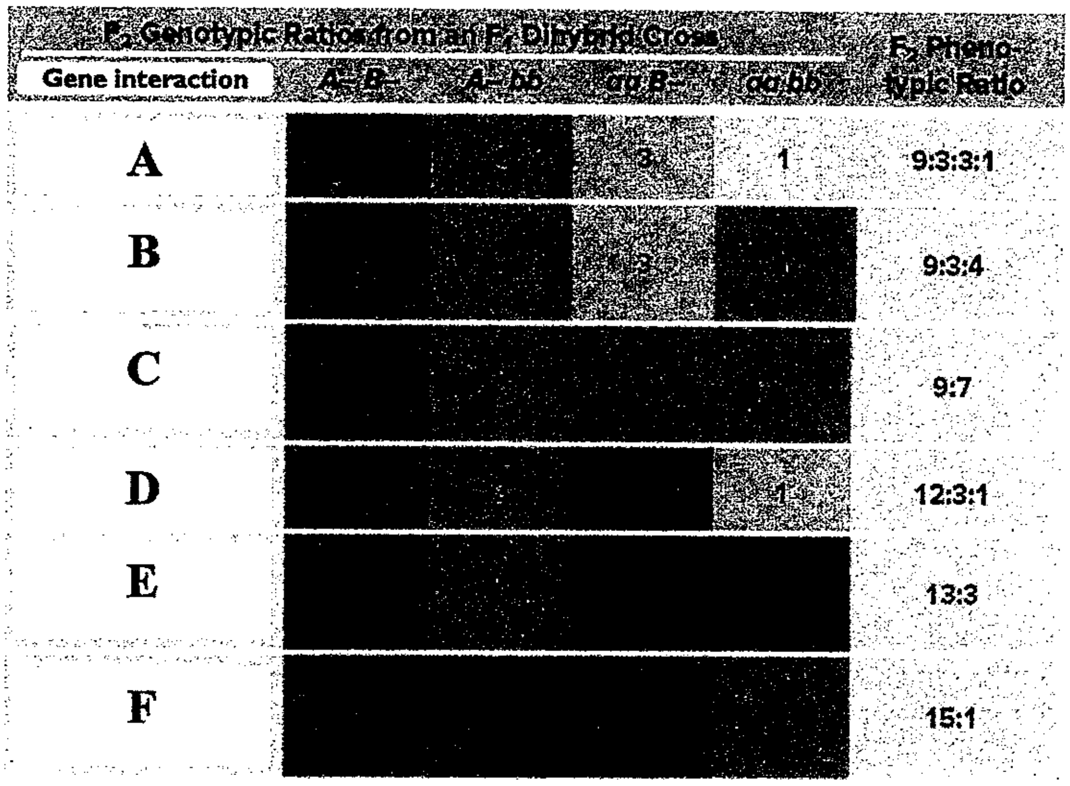
(2) **Redundancy**: Only one dominant allele of either of two genes is necessary to produce phenotype

(3) **Dominant epistasis I**: Dominant allele of one gene hides effect of both alleles of the other gene

(4) **Recessive epistasis**: When homozygous, recessive allele of one gene masks both alleles of another gene

(5) **Additive**: Four distinct F2 phenotypes

(6) **Dominant epistasis II**: Dominant allele of one gene hides effect of dominant allele of other gene



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5.Use **the appendix table** to complete the following table. Please copy the following table in your answer sheet, and complete your answer there. Assume that reading is from left to right and that the columns represent transcriptional alignments. (16 points)

C												DNA double helix
						T	A	A				
	A	C				U						mRNA transcribed
									G	C	A	Appropriate tRNA anticodon
			Trp									Amino acids incorporated into protein

The appendix table

Second base

First base	U		C		A		G		Third base
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys	U
	UUC		UCC		UAC		UGC		C
	UUA	Leu	UCA		UAA	Stop	UGA	Stop	A
	UUG		UCG		UAG	Stop	UGG	Trp	G
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg	U
	CUC		CCC		CAC		CGC		C
	CUA		CCA		CAA	Gln	CGA		A
	CUG		CCG		CAG		CGG		G
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser	U
	AUC		ACC		AAC		AGC		C
	AUA		ACA		AAA	Lys	AGA	Arg	A
	AUG	Met	ACG		AAG		AGG		G
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly	U
	GUC		GCC		GAC		GGC		C
	GUA		GCA		GAA	Glu	GGA		A
	GUG		GCG		GAG		GGG		G

6.The sequence of a segment of mRNA, beginning with the initiation codon, is given here, along with the corresponding sequences from several mutant strains. Please indicate the type of mutations presenting in the Mutant_1 ~ 5 is one of which: (a) silent mutation; (b) missense mutation; (c) nonsense mutation; or (d) frameshift mutation. (10 points)

Normal	AUGACACAUCGAGGGGUGGUAAACCCUAAG...
Mutant_1	AUGACACAUCGAGGGGUGGUAAACCCUUAG...
Mutant_2	AUGACCAUCGAGGGGUGGUAAACCCUAAG...
Mutant_3	AUGACACAUCGAGGGGUGGUAAAUCCUAAG...
Mutant_4	AUGACACAACGAGGGGUGGUAAACCCUAAG...
Mutant_5	AUGACACAUAGAGGGGUGGUAAACCCUAAG...

見背面

7.A corn breeder is interested in selecting large ears in a corn breeding program. Individual corn plants with large ears were chosen as new parents to generate a full-sib crossed population in the next generation. The mean weight of a corn ear of the entire parental generation is 185.5. The mean weight of a corn ear of the selected individuals in the parental generation is 320.7. The mean weight of a corn ear in the progeny generation is 255.3. Please calculate the selection differential, the response to selection, and the realized heritability in this experiment. (9 points)

8.A mating of one lentil (扁豆) strain of pure-breeding white-color seed with pure-breeding brown-color seed results in tan-color hybrids. A cross between the tan F1 hybrids produces 28 tan, 12 brown, and 13 white offspring. You formulated two hypotheses for the inheritance of seed color in this particular cross. The first hypothesis is two genes that predict phenotypic ratio as tan: brown: white equivalent to 9:3:4. The second hypothesis is one gene with incomplete dominance. Please design an experiment that distinguish these two hypotheses and involves genetic crosses based on the genetic analysis of Mendelian laws. Please explain your answer. (15 points)

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