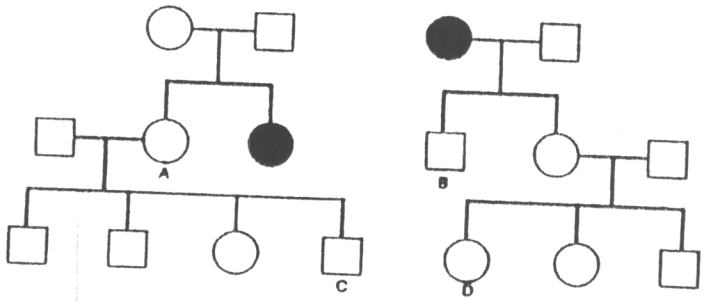
注意事項：本試題有 8 大題，答案一律寫在試卷上，請標明題號，依序作答。

1. Two genes control color in corn snakes as follows: O-B- snakes are brown, O-bb are orange, ooB- are black, and oobb are albino. An orange snake was mated to a black snake, and a large number of F_1 progeny were obtained, all of which were brown. When the F_1 snakes were mated to one another, they produced 100 brown offspring, 25 orange, 22 black and 13 albino.
   a) What are the genotypes of the F_1 snakes? (4%)
   b) What proportions of the different colors would have been expected among the F_2 snakes if the two loci assorted independently? (4%)

2. 下圖為某二家族的族譜之遺傳模式為體染色體隱性，實心符號為患有疾病者，○-代表正常女性，□-代表正常男性。所有與此二家族結婚者皆不含有此疾病之不正常對偶基因。



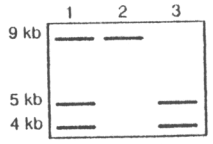
   a)若 A 與 B 結婚，則他們第一胎生出患有此疾病之小孩的機率為何？ (4%)
   b)若 C 與 D 結婚，則他們第一胎生出患有此疾病之小孩的機率為為何？(4%)

3. In one of Mendel's dihybrid crosses, one researcher observed 315 round yellow, 108 round green, 101 wrinkled yellow, and 32 wrinkled green F_2 plants. Analyze these data using χ^2 test to see if:
   a) They fit a 9:3:3:1 ratio. (show the χ^2, *df* and *p* value, respectively) (6%),
   b) The yellow:green data fit a 3:1 ratio. (show the χ^2, *df* and *p* value, respectively) (6%).

df	Probabilities (*p*)					
	0.90	0.50	0.20	0.05	0.01	0.001
1	0.02	0.46	1.64	3.84	6.64	10.83
2	0.21	1.39	3.22	5.99	9.21	13.82
3	0.58	2.37	4.64	7.82	11.35	16.27
4	1.06	3.36	5.99	9.49	13.28	18.47
5	1.61	4.35	7.29	11.07	15.09	20.52
6	2.20	5.35	8.56	12.59	16.81	22.46
7	2.83	6.35	9.80	14.07	18.48	24.32
8.	3.49	7.34	11.03	15.51	20.09	26.13
9	4.17	8.34	12.24	16.92	21.67	27.88
10	4.87	9.34	13.44	18.31	23.21	29.59
15	8.55	14.34	19.31	25.00	30.58	37.30
25	16.47	24.34	30.68	37.65	44.31	52.62

(背面仍有題目,請繼續作答)

4. When random samples of human DNAs were digested with *Eco*RI and examined for RFLPs using a cloned anonymous sequence called d17, three types of band patterns (shown below) were seen.
   a) Make a map of the region recognized by this probe showing the position of restriction sites. (6%)
   b) Which of the restriction sites on your map are varying in the population? (3%)
   c) Which patterns below represent homozygous and which represent heterozygous individuals? (6%)



5. a) Why is DNA synthesis expected to be more complex in eukaryots than in bacteria? How is DNA synthesis similar in two types of organisms? (6%)
   b) The DNA of the bacterial virus T4 produces a $Cot_{1/2}$ of about 0.5 and contains 10^5 nucleotide pairs in its genome. How many nucleotide pairs is present in the genome of the bacterium *E. coli*, whose DNA produce $Cot_{1/2}$ value of 10.0? (4%)

6. a) Clones of three adjacent genes involved in arginine biosynthesis have been isolated from a bacterium. If these three genes together make up an operon, what result do you expect when you use the DNA from each of these genes as probes in a Northern analysis? What result do you expect if the three genes do not make up an operon? (6%)
   b) Explain the difference between alternative splicing and RNA editing. (5%)

7. A recessive X-linked character appears in 40 percent of males and 16 percent of Females in a randomly interbreeding population. Assume only two alleles are present. What are the allele frequencies? How many females are heterozygotes? How many males are heterozygotes? (6%)

8. Select the best answer for the following questions. (30%)

8-1. In an organism with 52 chromosomes how many bivalents would be expected to form during meiosis?
   A. 52
   B. 26
   C. 13
   D. 104
   E. 208

8-2. One explanation for organelle inheritance is that
   A. Mitochondria and chloroplasts lack DNA and are therefore dependent on the maternal cytoplasmic contributions.
   B. Mitochondria and chloroplasts have DNA which is subject to mutation.
   C. Organelles such as mitochondria are always "wild type."
   D. Chloroplasts, for example, are completely dependent on the nuclear genome for components.
   E. None of the above.

8-3. A genomic condition which may be responsible for some forms of fragile X syndrome as well as Huntington disease involves
A. F plasmid inserted into the FMR-1 gene.
B. Various lengths of trinucleotide repeats.
C. Multiple breakpoints fairly evenly dispersed along the X chromosome.
D. Multiple inversions in the X chromosome.
E. Single translocation in the X chromosome.

8-4. The following segment of DNA occurs within the protein-coding region of a gene:
5′-GGAACTCTAGGGGCTG-3′
3′-CCTTGAGATCCCCGAC-5′

Which one of the following is true:
A. The upper strand must be the transcribed strand.
B. The lower strand must be the transcribed strand.
C. Either could be the transcribed strand.
D. Neither strand can be transcribed because both contain stop codons.

8-5. which of the following is not a component of the transcriptional system in cells?
A. RNA polymerase
B. DNA
C. Promoter
D. Shine-Dalgarno sequence
E. Hairpin loop

8-6. In E. coli a region of a gene with repeats of the sequence CTGG will be prone to
A. Reversion
B. Missense mutation
C. Nonsense mutation
D. Frameshift mutation
E. Amber mutation

8-7. Gene conversion
A. is caused by the repair of heteroduplex DNA
B. usually leads to a lethal mutation
C. is not associated with recombination
D. causes rolling-circle replication
E. is required for the cell to complete replication

8-8. In yeast four short viable deletions (1-4) encompassing the *ade-1* locus were intercrossed and the ascospores plated on minimal medium to determine if there were any wild-type prototrophic recombinants. The results were as follows, where + means that wild-type recombinants were produced:

	1	2	3	4
1			+	
2				+
3	+			+
4		+	+	

The order of the deletions must be

A. 3-2-1-4
B. 2-4-1-3
C. 1-3-4-2
D. 4-1-3-2
E. 3-1-2-4

8-9. Which of the following is not a general characteristic of an oncogene?

A. Ion channel
B. Growth factor
C. Transcription factor
D. Growth factor receptor
E. Signal transduction proteins

8-10. A quantitative trait is controlled by four genes, and each dominant allele of these genes contributes equally to the trait. If a tetrahybrid individual (heterozygous for all four genes) is self-fertilized, how many phenotypes can be distinguished among the progeny? (Assume no differences in environmental influences on the trait.)

A. 3
B. 4
C. 5
D. 9
E. 16