(15%) 1. What is the cell cycle? The proliferation of lung cancer cells is inhibited *in vitro* by a green tea catechin, (-)-epigallocatechin gallate (EGCG), which can also induces the apoptosis of these cells. Flow cytometric analysis indicated that EGCG-inhibited cancer cells have much higher proportion of G1 phase than the control. According to the signal transduction and the control of the cell cycle,
   (a) explain how EGCG arrests cancer cells in the G1 phase?
   (b) explain how EGCG induces the apoptosis of lung cancer cells?

(10%) 2. There are three types of muscle cells, including skeletal muscle cells, cardiac muscle cells and smooth muscle cells. Contractions of these muscle cells are innervated by the parasympathetic motor neurons which secrete acetylcholine (Ach), a neurotransmitter for chemical synapse.
   (a) Explain why the same Ach molecules secreted from the vagus nerve can cause skeletal muscle and smooth muscle of the stomach to contract but cardiac muscle to relax.
   (b) Compare the differences of contraction between skeletal muscle cells and smooth muscle cells.

(10%) 3. What are cotranslational import and posttranslational import? Which ways of translational import are for the following proteins, acid phosphatase (a lysosomal protein), cytochrome oxidase (a mitochondrial protein) and urate oxidase (a peroxisomal protein)?

(5%) 4. How to prove that DNA replication is semiconservative?

(10%) 5. Each of the following processes is associated with one or more specific eukaryotic organelles. In each case, identify the organelle or organelles, and suggest one advantage of confining the process to the organelle or organelles.
   (a) β oxidation of fatty acids
   (b) biosynthesis of cholesterol
   (c) biosynthesis of insulin
   (d) N-linked glycosylation of membrane proteins
   (e) hydroxylation of xenobiotics

(10%) 6. A cross is made between a plant that has blue flowers and purple seeds to a plant with white flowers and green seeds. The following results were obtained:
   F1 generation: all offspring have blue flowers with purple seeds
   F2 generation: 103 blue flowers, purple seeds
                  49 blue flowers, green seeds
                  44 yellow flowers, purple seeds
                  104 white flowers, green seeds
   _____
   Total: 300

注意:背面有試題

Start with the hypothesis that blue flowers and purple seeds are dominant traits and that the two genes are assorting independently. Calculate a chi square value. What does this value mean with regard to your hypothesis? If you decide to reject your hypothesis, which aspect of the hypothesis do you think is incorrect (i.e. blue flowers and purple seeds are dominant traits, or the idea that the two genes are assorting independently)?

Df	Probability (*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

Chi-square value (X)

Hint: chi-square

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

(30%) 7. A diploid cell contains three pairs of chromosomes designated A, B, and C. Each pair contains a maternal and a paternal member (e.g., A^m and A^p, etc.). Using these designations, demonstrate your understanding of mitosis and meiosis by drawing chromatid combinations in response to the following questions. Be sure to indicate when chromatids are paired as a result of replication and/or synapsis.
   (a) In mitosis, what chromatid combination(s) will be present during metaphase? What combinations(s) will be present at each pole at the completion of anaphase?
   (b) During meiosis I, assuming no crossing over, what chromatid combination(s) will be present at the completion of prophase? Draw all possible alignments of chromatids as migration begins during early anaphase.
   (c) Are there any possible combinations present during prophase of meiosis II other than those that you drew in (b)? If so, draw them. If not, then proceed to (d).

(d) Draw all possible combinations of chromatides during the early phases of anaphase in meiosis II.

(e) Assume that during meiosis I none of the C chromosomes disjoin at metaphase, but they separate into dyads (instead of monads) during meiosis II. How would this change the alignments that you constructed during the anaphase stages in meiosis I and II? Draw them.

(f) Assume that each gamete resulting from (e) participated in fertilization with a normal haploid gamete. What combinations will result ? What percentage of zygotes will be diploid, containing one parental and one maternal membrane of each chromosome pair?

(10%) 8. Duroc Jersey pigs are typically red, but a sandy variation is also seen. When two different varieties of true-breeding sandy pigs are crossed to each other, they produce F1 offspring that are red. When these F1 offspring are crossed to each other, they produce red, sandy, and white pigs in a 9:6:1 ratio. Explain this pattern of inheritance.