

八十六學年度 生命科學 系(所) 分生組甲 生醫組甲 組碩士班研究生入學考試

科目 分子生物學 科號 0906 1206 共 4 頁第 / 頁 *請在試卷【答案卷】內作答

Select the letters corresponding to the most appropriate term/phrases that complete or answer items 1-10; more than one of the choices provided may be correct. (30 points)

1. Yeast

- a. contain circular chromosomes.
- b. have chromosomes.
- c. have less DNA than other eukaryotes.
- d. have organelles.
- e. have plasma membranes.

2. Transformed eukaryotic cells

- a. can be induced to differentiate.
- b. may exhibit altered growth patterns.
- c. can be isolated from naturally occurring cancers.
- d. can form tumors when they are injected into nude mice.
- e. cease to grow after 100 generations in culture.

3. Which of the following radiolabeled compounds is (are) most commonly used for studying DNA synthesis in cell-free extracts?

- a. [^3H]thymidine
- b. [^{14}C]uridine
- c. [$\gamma\text{-}^{32}\text{P}$]dATP
- d. [$\alpha\text{-}^{32}\text{P}$]dATP
- e. [^{32}P]orthophosphate.

4. Telomeres

- a. contain regions with a high T content.
- b. are required for replication of YACs.
- c. contain short repetitive sequences, which vary in different organisms.
- d. contain non-Watson-Crick base pairing.
- e. are synthesized by a DNA-enzyme complex.

5. Topoisomerase II activity

- a. cuts one strand of DNA double helix.
- b. cuts both strands of a DNA double helix.
- c. changes the linking number by 1.
- d. changes the linking number by 2.
- e. requires energy supplied by ATP.

八十六學年度 生命科學 系(所) 分生組甲 生醫組甲 組碩士班研究生入學考試

科目 分子生物學 科號 0906 1206 共 4 頁第 2 頁 請在試卷【答案卷】內作答

6. Catabolite repression, a mechanism of gene control in prokaryotes,
 - a. is mediated through cAMP.
 - b. is mediated through CAP.
 - c. results in de novo synthesis of a positive activator protein.
 - d. affects enzymes involved in catabolic reactions.
 - e. is caused by several sugars.

7. Entry of G₀-arrest mammalian cells into the S phase of the cell cycle
 - a. can be inhibited by the tumor-suppressor protein p53.
 - b. requires transcription of early-response genes such as *c-jun* and *c-fos*.
 - c. requires transcription of delayed-response genes encoding E2F, cyclins, and certain Cdk.
 - d. can occur in the absence of growth factors once the cells have passed the restriction point.
 - e. is dependent on cyclin A.

8. Which of the following statements concerning protein phosphorylation, a key mechanism of cell-cycle control, are true?
 - a. Phosphorylation of a tyrosine residue produces active MPF.
 - b. Phosphorylated Rb protein inhibits synthesis of enzymes required for DNA replication.
 - c. The catalytic subunit of MPF is a substrate for phosphorylation only when it is associated with a cyclin as a heterodimer.
 - d. Phosphorylation of histone H1 may regulate condensation of chromosomes during mitosis.
 - e. MPF-catalyzed phosphorylation of myosin prevents cytokinesis.

9. Human immunodeficiency virus (HIV)
 - a. causes an infection that makes the patient prone to other infections and cancers.
 - b. primarily attacks cells of the nervous system.
 - c. contains fewer genes than most retroviruses.
 - d. mutates more rapidly than most other retroviruses.
 - e. has an RNA genome.

八十六學年度 生命科學 系(所) 分生組甲 組碩士班研究生入學考試
 生醫組甲

科目 分子生物學 科號 0906 共 4 頁第 3 頁 *請在試卷【答案卷】內作答
 1206

10. The product of a *ras* gene
- is located in the nucleus.
 - binds guanine nucleotides.
 - can transform 3T3 cells.
 - has tyrosine kinase activity.
 - can act synergistically with the product of a *myc* gene to produce transformation.

Define the following terms 11-15. (15 points)

- Allelic exclusion.
- Constitutive heterochromatin.
- Imprinting.
- SOS box.
- Single-stranded conformation polymorphism.
- Indicate the temporal order (from earliest to latest) in which the following *Drosophila* developmental genes act. (6 points)
 - gap genes.
 - bicoid*.
 - segment-polarity genes.
 - hunchback*.
 - pair-rule genes.
- A powerful technique for making transgenic mice takes advantage of embryonic stem (ES) cells. Describe how to produce chimeric mice from ES cells that contain a knockout gene X. (10 points)
- Describe molecular components involved in olfactory and visual signal transduction pathways. (10 points)
- Saccharomyces cerevisiae* can exist either as diploid cells or as haploid cells of two distinct mating types, α and α' . What gene locus determines whether a haploid yeast is α or α' ? Explain why does the mating type switch very frequently in homothallic strains of yeast. (10 points)

八十六學年度 生命科學 系(所) 分生組甲 組碩士班研究生入學考試
 科目 分子生物學 科號 0906 1206 共 4 頁第 4 頁 *請在試卷【答案卷】內作答

20. The transcription-initiation complexes involving eukaryotic RNA polymerase I and II exhibit some similarities to and differences from complexes involving polymerase II.
- Describe assembly of Pol I initiation complexes.
 - Describe assembly of Pol III initiation complexes.
 - What component is present in all eukaryotic initiation complexes.
 - Discuss three features that distinguish transcription initiation at Pol I and Pol III promoters from that at Pol II promoters. (12 points)
21. The 3' region of one of the two introns in human β -globin pre-mRNA has the following sequence (the * indicates the normal intron boundary):

5'-CCUAUUGGGUCUAUUCUUCCACCCUAG*GCUGCUG-3'
 ↑
 A

Within the human population, a point mutation sometimes results in the substitution of an A for the underlined guanosine residue (G). This substitution results in a clinical condition known as β^+ -thalassemia. In individuals homozygous for this substitution, the production of β -globin chains is depressed to 5-30 percent of normal, but the β -globin chains that are produced are normal. Why does this G \rightarrow A substitution result in decreased production of normal β -globin? (7 points)