

國立中央大學101學年度碩士班考試入學試題卷

所別：生命科學系碩士班 分子與細胞生物組(一般生) 科目：分子生物學 共 5 頁 第 1 頁
生命科學系碩士班 分子與細胞生物組(在職生)

本科考試禁用計算器

*請在試卷答案卷(卡)內作答

一、Multiple Choice 單選題 (70%; 2% each): Please choose the one alternative that best answers the question or complete the sentence (選擇題答案請填於答案卡).

- Many hotspots present in DNA result from modified bases. The most common modified base is
(a) 5-methyladenine. (b) 5-methylguanine. (c) 5-methylcytosine. (d) 5-methylthymine.
(e) 5-methyluracil.
- Which of the following statements about nucleosome is **incorrect**?
(a) A nucleosome contains a 200 bp of DNA and an octamer of small, basic proteins.
(b) The linker histones, such as histone H1, can stabilize the higher-order chromatin structures.
(c) Nucleosome is the subunit of all chromatin.
(d) The 10 nm chromatin fiber coiling into a 30 nm fiber requires covalent modifications of the histone fold domain.
(e) Histone H1 can be removed without affecting the structure of the nucleosome.
- Which of the following methods is **not** used to map and/or quantify transcripts?
(a) Run-off transcription (b) Restriction mapping (c) S1 nuclease mapping (d) Primer extension
(e) RNase mapping (RNase protection assay)
- Which of the following techniques is widely used to make inducible knockouts and knock-ins?
(a) the *Cre/lox* recombination system (b) gene targeting by homologous recombination (c) enucleation of embryonic stem cell (d) posttranscriptional gene silencing (e) *in vitro* fertilization.
- Developing B cells that fail to make productive D to J heavy-chain rearrangements on both homologous chromosomes
(a) will rearrange heavy-chain loci multiple times until a productive rearrangement is made.
(b) undergo clonal proliferation.
(c) upregulate expression of transcription factors E2A and EBF.
(d) fail to rearrange V to DJ.
(e) die by apoptosis in the bone marrow.
- IgM and IgD are co-expressed on naive B cells by a process called:
(a) alternative mRNA splicing. (b) somatic recombination. (c) somatic hypermutation.
(d) isotype switching. (e) affinity maturation.
- A DNA fragment whose sequence is
5' - CTAGAGTCTGGCTACA 3'
3' GATCTCAGACCGATGT 5'
Its mRNA sequence from transcription is 5' CUAGAGUCUGGCUACA 3'. Which of the following is **true**?
(a) The DNA sequence is mostly likely an intron sequence.
(b) The DNA sequence is mostly likely an enhancer sequence.
(c) The upper DNA strand is the coding strand.
(d) The lower DNA strand is the sense strand.
(e) Both strands can be the coding strand.
- Which of the following is **incorrect**?
(a) Genomic libraries can be constructed using phages or yeast artificial chromosome (YAC).
(b) Full sets of proteins encoded by genomes are studied in the field of proteomics.
(c) Most of the genomes that have been sequenced to date are eukaryotes.

注意：背面有試題

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- (d) Current estimates are that there are 25,000-30,000 genes in the human genome.
(e) Much of the DNA between genes consists of repetitive DNA.
9. Neither of your parents has cystic fibrosis, but your cousin, with whom you share a set of grandparents, does. How can you determine if you are a carrier for the disease?
(a) plasmid analysis (b) restriction fragment analysis (c) karyotyping (d) gene cloning (e) The only way to find out if you are a carrier is to reproduce and see if any of your children exhibit cystic fibrosis.
10. Which of the following is **not** true about cDNA library and cDNA cloning?
(a) A cDNA library is a set of clones representing as many as possible of the mRNAs in a given cell type.
(b) cDNA fragments cloned into the M13 phage vectors can be recovered in single-stranded form.
(c) Particular clones in a cDNA library can be detected by colony hybridization with radioactive DNA probes.
(d) Particular clones in a cDNA library can be detected by colony hybridization with antibodies if an expression vector is used.
(e) Cosmids behave both as plasmids and as phages, thus they have been popular as cDNA cloning vectors.
11. The one subunit in the *E. coli* DNA polymerase III that endows its DNA binding specificity is _____.
(a) α (b) β (c) γ (d) σ (e) τ
12. Double-strand break of DNA is normally repaired by _____.
(a) non-homologous end-joining at S phase (b) homologous recombination at S phase (c) non-homologous recombination at S phase (d) nucleotide excision repair (e) translesion repair.
13. The function of PCNA in a DNA replication fork is as a _____.
(a) DNA polymerase (b) helicase (c) clamp for DNA polymerase (d) topoisomerase (e) clamp loader
14. Replicative senescence of eukaryotic cells is caused by the lack of _____.
(a) DNA polymerase (b) helicase (c) telomerase (d) topoisomerase (e) DNA glycosylase
15. The one recombinase employed in the meiotic homologous recombination is _____.
(a) Rad51 (b) CRE recombinase (c) Flippase (d) Spo11 (e) Mre11
16. Long terminal repeats (LTR) can be found in the _____ elements.
(a) *Alu* (b) *L1* (c) *Ty1* (d) *Tn3* (e) *Tn5*
17. Gene conversion is possibly caused by _____.
(a) mismatch repair during mitosis (b) mismatch repair during meiosis (c) non-homologous end joining of double strand break DNA (d) poor resolution of holiday junction (e) integration of transposons
18. The catalytic center of an *E. coli* DNA polymerase III is formed by _____ subunits
(a) $\alpha\alpha$ (b) $\alpha\beta$ (c) $\alpha\gamma$ (d) $\sigma\beta$ (e) $\beta\beta'$
19. Branch migration of bacterial homologous recombination is catalyzed by _____.
(a) Rec A (b) Rec B, C, & D (c) SSB (d) Ruv A & B (e) Spo11
20. Okazaki fragments are found at the _____.
(a) lagging strand of a replication fork (b) leading strand of a replication fork (c) holiday junction (d) telomeres
(e) promoter of a gene

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21. Which of the following statements best characterizes a homeotic gene?
- (a). They define segmental regions in the embryo.
 - (b). They define the anterior and posterior compartments of individual segments.
 - (c). Mutations in these genes cause one body part to look like another.
 - (d). They are responsible for sex determination.
 - (e). They are involved in gene dosage compensation.
22. Prokaryotes use 70S ribosomes which consist of:
- (a). a (small) 30S and a (large) 50S subunit
 - (b). a (small) 40S and a (large) 60S subunit
 - (c). a (small) 40S and a (large) 30S subunit
 - (d). a (small) 10S and a (large) 60S subunit
 - (e). a (small) 20S and a (large) 50S subunit
23. Which of the following is NOT likely to result from the loss of functional p53?
- (a). the appearance of homogeneously staining regions on chromosomes
 - (b). increases propensity to arrest in G₁
 - (c). alterations in the G₁ to S checkpoint
 - (d). an increase in gene amplification in affected cells
 - (e). generation of fragments of chromosomal DNA lacking telomeres and centromeres
24. The _____ gene controls progression through "start" at the end of G₁ in the cell cycle.
- (a). *CDK* (b). *RAS* (c). *CDC28* (d). *RAD9* (e). *DCC*
25. Which of the following is not involved in RNA interference processes?
- (a). RISC (b). Drosha (c). RNA polymerase I (d). Dicer
 - (e). All of these play a role in RNA interference processes.
26. Transcription in prokaryotes and eukaryotes is similar in that
- (a). transcriptional machinery controls compaction and decompaction of chromatin.
 - (b). the mRNA produced can undergo alternative splicing.
 - (c). both prokaryotic and eukaryotic proteins have identical affinities for DNA.
 - (d). both are contained within the cell nucleus.
 - (e). both are regulated by attachment of proteins to DNA adjacent to the gene being transcribed.

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27. Which of the following is *not* true of enhancer DNA sequences?

- (a). They contain the TATA box regulatory element.
- (b). They retain function if their nucleotide sequence is inverted.
- (c). They can be more than 10 kilobases from the gene they regulate.
- (d). They may increase or decrease gene transcription levels.
- (e). They may contain multiple regulatory elements.

28. The gene products encoded by trans-acting elements perform their function by

- (a). associating with regulatory sequences distant from the gene from which they were transcribed.
- (b). regulating the expression of the gene from which they were transcribed.
- (c). the association of nucleotides with the elongating RNA transcript.
- (d). physically associating with DNA polymerase.
- (e). regulating the activity of telomerase.

29. Which partial diploid strain will produce β -galactosidase constitutively, and maintain normal induction of the permease and transacetylase?

- (a). $I^+o^+Z^+Y^+A^-/I^+o^+Z^+Y^+A^+$ (b). $I^+o^+Z^+Y^+A^+/I^+o^+Z^+Y^+A^+$ (c). $I^+o^+Z^+Y^+A^+/I^+o^+Z^+Y^+A^+$
- (d). $I^+o^+Z^+Y^+A^+/I^+o^+Z^+Y^+A^-$ (e). $I^+o^+Z^+Y^+A^+/I^+o^+Z^+Y^+A^+$

30. How do negative regulators such as the *lac* repressor prevent RNA polymerase from initiating transcription?

- (a). by blocking passage of the polymerase through the operator
- (b). by forming a loop in the operator that restricts the passage of the polymerase
- (c). by binding to the interacting domain of the polymerase to block its function
- (d). by physically blocking the DNA binding site of RNA polymerase
- (e). by binding to the polymerase, thus preventing its binding

31. In *E. coli*, the heat shock response, switching off the synthesis of some proteins and switching on of different proteins, is mediated by

- (a). inactivation of certain repressor proteins by elevated temperature.
- (b). denaturing of DNA in the promoters in the genes of heat sensitive proteins.
- (c). synthesis of alternative sigma factors at high temperatures, which then regulate transcription of heat shock genes.
- (d). increasing the promoter affinity of already existing polymerase sigma factors at high temperatures.
- (e). change conformation of existing protein to protect polymerase sigma factors at high temperatures.

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32. In the *trp* operon, attenuation occurs through the recognition of two Trp codons in the leader sequence. What would happen if these two codons were mutated to stop codons?

- (a). This operon will be insensitive to attenuation by tryptophan.
- (b). The structural genes will be transcribed in the presence or absence of tryptophan.
- (c). The tryptophan biosynthetic enzymes will be synthesized.
- (d). None of these results will take place.
- (e). All of these results will take place.

33. The appearance of a novel phenotype resulting from the substitution of a single base pair might be due to

- (a). change in the amino acid sequence only.
- (b). change in the amount of protein expressed.
- (c). alteration in a gene that codes for a nontranslated RNA.
- (d). change in the developmental time or location at which a gene is expressed.
- (e). all of the choices are possible consequences of a single base pair substitution.

34. Assume that a certain strain of bacteria carries a mutation that causes it to die at high temperature (37°C), but grow normally at cooler temperatures. This mutation is termed

- (a). recessive. (b). deletion. (c). biochemical pathway mutant.
- (d). conditional lethal that grows under restrictive conditions.
- (e). conditional lethal that dies under restrictive conditions.

35. A neomorphic mutation results in an allele that

- (a). produces no gene product.
- (b). produces a nonfunctional gene product.
- (c). produces novel proteins or cause inappropriate expression resulting in a new phenotype.
- (d). produces proteins that aggregate with wild-type subunits, inactivating them.
- (e). produces an altered protein that results in a wild-type phenotype.

二、Essay questions 問答題 (30%): Please answer the questions as sufficient as you can.

1. Please define and/or explain the following terms. (10%; 2.5% each)

- (a) polymorphism (b) DNA fingerprinting (c) transposon (d) telomere

2. Please compare the life cycles of retroviruses and retrotransposons. (10%)

3. Describe two functional differences between the Sigma70 and Sigma54 systems for bacterial transcription. (5%)

4. What is genomic imprinting and why it is considered as an epigenetic alteration? (5%)