國立高雄大學 101 學年度研究所碩士班招生考試試題

科目：分子生物學　　系所：生物科技研究所　　是否使用計算機：是
考試時間：100 分鐘　　本科原始成績：100 分

I. 單選題 (共 50 分；每題 2 分)【**務必將答案依序填寫於答案卷上印製的選擇題答案欄內！**】

1. Adenosine is a :
   (A) component of RNA
   (B) nucleotide
   (C) pyrimidine
   (D) a and b
2. Starting with 1 mCi (milliCurie) of a phosphorus-32-labeled compound, how long would it take until only 0.125 mCi remained?
   (A) 57.2 days
   (B) 42.9 days
   (C) 28.6 days
   (D) 14.3 days
3. Which of the following is not used to describe a parameter of DNA topology?
   (A) twist
   (B) writhe
   (C) wobble
   (D) linking number
4. Operator constitutive mutants of the lac operon would
   (A) express the lac repressor constitutively
   (B) block the binding of RNA polymerase to the promoter
   (C) prevent the inducer from binding to the repressor
   (D) express β-galactosidase constitutively
5. The 5′-terminal cap structure of eukaryotic mRNAs is a(n):
   (A) 7-methylguanosine joined to the mRNA via a $5' \rightarrow 5'$ triphosphate linkage
   (B) 7-methylcytosine joined to the mRNA via a 2′,3′-cyclic linkage
   (C) 7-methylguanosine joined to the mRNA via a $5' \rightarrow 3'$ diphosphate linkage
   (D) O^6-methylguanosine joined to the mRNA via a $5' \rightarrow 5'$ triphosphate linkage
6. A mutation that changes a cysteine codon to a tryptophan codon is called
   (A) a missense mutation
   (B) a nonsense mutation
   (C) a frameshift mutation
   (D) a silent mutation
7. Open reading frame (ORF) analysis is not effective in identifying genes in higher eukaryotes due to the presence of
   (A) promoters

(B) introns
(C) enhancers
(D) repetitious DNA

8. A step in the generation of knockout mutations in mice includes selection of embryonic stem (ES) cells that are
(A) sensitive to G418 and resistant to ganciclovir
(B) resistant to G418 and sensitive to ganciclovir
(C) resistant to G418 and resistant to ganciclovir
(D) sensitive to G418 and sensitive to ganciclovir

9. In a mammalian cell, DNA repair systems:
(A) are extraordinarily efficient energetically
(B) can repair deletions, but not mismatches
(C) can repair most types of lesions except those caused by UV light
(D) normally repair more than 99% of the DNA lesions that occur

10. All of the following steps are performed by the enzyme transposase during nonreplicative transposition of bacterial insertion sequences **except**:
(A) excision of the IS element from the donor DNA molecule
(B) synthesis of DNA to fill in the single-stranded gaps
(C) introduction of staggered cuts into the target DNA molecule
(D) ligation of the IS element to the target DNA

11. All of the following statements are true about a nucleosome **except**
(A) is the “string” of the “beads-on-a-string” appearance
(B) contains an octamer core of histones
(C) is about 10 nm in diameter
(D) contains approximately 150 base pairs of DNA

12. DNA that is transcriptionally active
(A) is tightly packed into a solenoid arrangement
(B) is more susceptible to DNase I digestion
(C) contains unacetylated histones
(D) is more condensed than nontranscribed DNA

13. All of the following are properties of heterochromatin **except**:
(A) is a dark-staining area of a chromosome
(B) is often simple sequence DNA
(C) is usually transcriptionally active
(D) is a region of condensed chromatin

14. A mutation that changes the recognition sequence for the restriction enzyme *Eco*RI from GAATTC to GATTTC is an example of a
   (A) restriction fragment length polymorphism (RFLP)
   (B) single nucleotide polymorphism (SNP)
   (C) simple sequence repeat (SSR)
   (D) a and b
15. All of the following statements about mitochondrial DNA are true **except**:
   (A) in mice, 99.99% of mitochondrial DNA is maternally inherited
   (B) mitochondrial DNA encodes rRNAs and tRNAs
   (C) mammalian mitochondrial DNA contains introns
   (D) the human mitochondrial genome is smaller than the yeast mitochondrial genome
16. Which of the following **is not** a step in the run on transcription assay?
   (A) exposure of cells to a labeled RNA precursor
   (B) isolation of nuclei
   (C) incubation with ^{32}P-labeled ribonucleoside triphosphate
   (D) hybridization of labeled RNA to cloned cDNAs
17. A leucine zipper motif contains
   (A) a stretch of five leucine residues in a row
   (B) a leucine residue at every seventh position
   (C) a leucine residue complexed with a zinc ion
   (D) an alternating leucine-alanine-proline structure
18. An alternative repair system by error-prone translesion DNA synthesis can result in a high mutation rate, because:
   (A) alternative modified nucleotides can be incorporated more readily
   (B) interference from the RecA and SSB proteins hinders the normal replication accuracy
   (C) the DNA polymerases involved lack exonuclease proofreading activities
   (D) replication proceeds much faster than normal, resulting in many more mistakes
19. Lipid soluble hormones activate transcription by
   (A) binding to specific cell-surface receptors
   (B) phosphorylating a protein kinase
   (C) inhibiting a histone deacetylase
   (D) binding to a nuclear receptor
20. Which process involves two transesterification reactions?
   (A) RNA editing
   (B) capping

(C) nuclear transport
(D) splicing

21. Which of the following **does not require** protein enzymes?
(A) excision of group II introns
(B) RNA editing
(C) transsplicing
(D) excision of group III introns

22. The DNA in a eukaryotic chromosome is best described as:
(A) a single circular double-helical molecule
(B) a single linear double-helical molecule
(C) multiple linear double-helical molecules
(D) multiple linear single-stranded molecules

23. Which one of the following statements about enzymes that interact with DNA is **true**?
(A) *E. coli* DNA polymerase I is unusual in that it possesses only a 5′→3′ exonucleolytic activity
(B) Endonucleases degrade circular but not linear DNA molecules
(C) Exonucleases degrade DNA at a free end
(D) Primases synthesize a short stretch of DNA to prime further synthesis

24. Which one of the following statements about eukaryotic RNA polymerases is **correct**?
(A) Only eukaryotic RNA polymerase I recognizes prokaryotic promoters
(B) Only eukaryotic RNA polymerase II recognizes prokaryotic promoters
(C) Only eukaryotic RNA polymerase III recognizes prokaryotic promoters
(D) None of the eukaryotic RNA polymerases recognizes prokaryotic promoters

25. A certain bacterial mRNA is known to represent only one gene and to contain about 800 nucleotides. If you assume that the average amino acid residue contributes 110 to the peptide molecular weight, the largest polypeptide that this mRNA could code for would have a molecular weight of about:
(A) 30,000
(B) 5,000
(C) 80,000
(D) An upper limit cannot be determined from the data given

II. 寫出題意描述的分子生物學**專有名詞中、英文全名**(每題 2 分；中、英文各 1 分；共 20 分)

1. A technique that uses X-ray film to visualize radioactively labeled molecules or fragments of molecules; used in analyzing length and number of DNA fragments after they are separated by gel electrophoresis.

2. The merger of biotechnology and information technology with the goal of revealing new insights and principles in biology. The science of managing and analyzing biological data using advanced computing techniques. Especially important in analyzing genomic research data.
3. A method of separating large molecules (such as DNA fragments or proteins) from a mixture of similar molecules. An electric current is passed through a medium containing the mixture, and each kind of molecule travels through the medium at a different rate, depending on its electrical charge and size. Agarose and acrylamide gels are the media commonly used for electrophoresis of proteins and nucleic acids.
4. A physical mapping approach that uses fluorescein tags to detect hybridization of probes with metaphase chromosomes and with the less-condensed somatic interphase chromatin.
5. The first few hundred nucleotides of DNA "upstream" (on the 5' side) of a gene, which control the transcription of that gene.
6. A class of enzymes generally isolated from bacteria, which are able to recognize and cut specific sequences in DNA.
7. An enzyme that catalyzes the esterification of a specific amino acid or its precursor to one of all its compatible cognate tRNAs to form an charged tRNA.
8. Protein that helps other proteins avoid misfolding pathways that produce inactive or aggregated polypeptides.
9. X-shaped structure observed in DNA undergoing recombination, in which the two DNA molecules are held together at the site of crossing-over, also called a cross-strand exchange.
10. Short lengths of DNA produced on the lagging strand during DNA replication. They are rapidly joined by DNA ligase to form a continuous DNA strand.

III. 問答題 (共 30 分；每題 10 分)

1. Which **five parts** of the newly synthesized mRNA molecule **do not** transmit information for the synthesis of protein?
2. Following the synthesis of their polypeptide chain, many proteins require further posttranslational modifications before they attain their full biological activity or function. List and describe briefly at least **five possible types** of modification that can occur.

3. Match the damage type or repair step at the left with a related enzyme at right. **Only one answer** will be the most direct for each.

___ (1) cytosine deamination
___ (2) base loss
___ (3) adenine deamination
___ (4) binds to GATC sequences
___ (5) binds to mismatch in DNA
___ (6) DNA synthesis in gaps
___ (7) seals nicks
___ (8) O^6-methylguanine
___ (9) direct chemical reversal of pyrimidine dimer formation
___ (10) double-strand break

(a) hypoxanthine-*N*-glycosylase
(b) AP endonuclease
(c) mutH protein
(d) DNA polymerase I
(e) uracil *N*-glycosylase
(f) mutS-mutL complex
(g) ABC excinuclease
(h) DNA photolyase
(i) O^6-methylguanine methyltransferase
(j) DNA ligase
(k) λ integrase
(l) RecA protein
(m) restriction endonuclease

（試題結束，祝您金榜題名！）