

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

I. Choose the best answer of the following questions: (3 points each, total 60 points)

1. In the DNA double helix, complementary base pairs are held together by _____ :
 - a. phosphodiester bonds
 - b. N-glycosidic bonds
 - c. hydrogen bonds
 - d. ionic bonds.

 2. The site on DNA to which RNA polymerases bind before initiating transcription is called the _____ :
 - a. promoter
 - b. enhancer
 - c. operator
 - d. initiator
 - e. terminator

 3. What is the theoretical progression limit of nucleic acid amplification by polymerase chain reaction (PCR)?
 - a. 1, 2, 3, 4, 5, 6, ...
 - b. 2, 4, 6, 8, 10, 12,
 - c. 1, 10, 100, 1000, 10000, 1000000, ...
 - d. 1, 2, 4, 8, 16, 32, ...
 - e. 2, 4, 24, 96, 384, 1024, ...

 4. Which of the following mRNA molecules would form the most stable stem-loop structure?
 - a. 5'...CCGAA.....AAGCC...3'
 - b. 5'...CCGAA.....AACGG...3'
 - c. 5'...CCGAA.....GGCUU...3'
 - d. 5'...CCGAA.....UUCGG...3'
 - e. 5'...CCGAA.....CCGAA...3'

 5. A mammalian cell typically has 1.2 meters of double stranded DNA. The total time to duplicate the DNA is 6 hours. How many origins of replication are there if the rate of duplication is 10 μ meters/min?
 - a. 200
 - b. 250
 - c. 400
 - d. 500
 - e. 2000
- (背面仍有題目，請繼續作答)

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6. MicroRNA processing from primary form to mature form is carried out by what specific proteins?
- Drosha and RISC
 - Drosha and Dicer
 - Dicer and RISC
 - Dicer, RISC, and Exportin 5
 - Drosha, Dicer, and Importin 5
7. A tRNA^{Cys} is charged with cysteine and then the attached amino acid is converted to alanine by removing its sulfhydryl group. The altered, charged tRNAs are used in a cell-free protein synthesis system. What is the result of this experiment?
- Cysteine was inserted in the proteins where alanine was supposed to be.
 - Alanine was inserted in the proteins where cysteine was supposed to be.
 - Nothing unusual happens.
 - Phenylalanine was inserted in the proteins where cysteine was supposed to be.
 - B and D
8. What fact does the experiment in question #7 above demonstrate?
- Protein synthesis requires cysteine.
 - tRNAs cannot be altered chemically and still work appropriately.
 - The anticodon plays no direct role in determining where an amino acid is incorporated in a polypeptide.
 - The amino acid plays no direct role in determining where it is incorporated in a polypeptide.
 - Protein synthesis requires ATP.
9. What is the purpose of the mammalian two hybrid assay?
- Measure protein-protein interactions in vivo
 - Perform Southern blots on chromosomal DNA
 - Identify promoter region
 - Measure protein-RNA interactions in vivo
 - Identify receptor signaling pathway.
10. miR-34 is an oncogenic microRNA. How would you determine whether miR-34 is expressed in tumor cells and healthy cells?
- Perform a Southern blot on chromosomal DNA from these cells.
 - Perform a qRT-PCR on miR-34 isolated from total RNA of the cells.
 - Perform a Western blotting on miR-34 isolated from total RNA of the cells.
 - Clone the miR-34 gene.
 - Perform a miR-34 reporter assay.

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11. RNA editing is:
- posttranscriptional alteration of sequences in mRNAs
 - pretranscriptional alteration of sequences in RNAs
 - posttranscriptional joining of two RNA molecules
 - all of the above.
 - none of the above
12. DNA that is transcriptionally active
- contains unacetylated histones
 - is tightly packed into a solenoid arrangement
 - is more susceptible to DNase I digestion
 - is more condensed than nontranscribed DNA.
 - none of the above
13. The polymerase chain reaction (PCR) technique can be used for
- direct isolation of a specific segment of genomic DNA
 - preparation of probes
 - synthesis of RNA from genomic DNA
 - all of the above
 - a and b
14. A mutation that changes the recognition sequence for the restriction enzyme BamHI from GGATCC to GATTCC is an example of a
- restriction fragment length polymorphism (RFLP)
 - single nucleotide polymorphism (SNP)
 - simple sequence repeat (SSR)
 - all of the above
 - a and b
15. Which of the following may have therapeutic potential if overexpression of the gene X is the cause of the disease?
- Recombinant protein X
 - A microRNA targeting mRNA of gene X
 - antibody against protein X
 - shRNA of gene X
 - a and b

(背面仍有題目，請繼續作答)

系所組別：口腔醫學研究所甲組

考試科目：分子生物學

考試日期：0223，節次：3

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16. All of the following are properties of heterochromatin except:
- is a dark-staining area of a chromosome
 - is usually transcriptionally inactive
 - is often simple sequence DNA
 - is a region of condensed chromatin
 - none of the above
17. In RNA interference studies, the short hairpin RNA (shRNA)
- disrupts the target DNA sequence
 - destroys the target mRNA
 - destroys the target protein
 - inhibits the translation
 - none of the above
18. You try to express a cDNA with 600bp in CHO cells. After the recombinant protein was expressed and purified, you found there were four different proteins with 44kDa, 34kDa, 22kDa and 18 kDa on an SDS gel. Which of the following possibilities may be true?
- Dimerization of the protein
 - Degradation of the protein
 - Overglycosylation of the protein
 - all of the above
 - a and b
19. How many amino acids are encoded by the following mRNA sequence: UAUCAUCCACUUUAAUUAU
- 6
 - 5
 - 4
 - 3
 - none of the above
20. Transcriptionally inactive genes
- are always located within heterochromatin
 - often are methylated
 - are not located within nucleosomes
 - all of the above
 - a and b

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II. Answer the following questions: (10 points each, total 40 points)

1. 比較 small interfering RNA (siRNA) 及 microRNA (miRNA) 之異同？並舉例說明此二類分子於生物醫學之應用及重要性。
2. 敘述基因表現之表觀調控 (epigenetic regulation of gene expression) 之分子基礎及機制。
3. 何謂癌症之標靶治療？舉一例子說明並敘述此標靶治療之分子基礎及機制。
4. 如何利用基因剔除鼠(knockout mouse)來證明特定基因是胚胎發育必要之基因(an essential gene required for embryonic development)?