

**I. Multiple Choice Questions I (74 points; 2 points/each)** ※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. Which of the following RNA polymerases are responsible for the production of 5S rRNA?
  - A) RNA polymerase I
  - B) RNA polymerase II
  - C) RNA polymerase III
  - D) RNA polymerase IV
  
2. Which of the following is true about tryptophan operon?
  - A) Tetramer of identical subunits
  - B) The RNA product is very stable
  - C) The Trp repressor binds to the tryptophan
  - D) The Trp repressor is the product of the Trp operon
  
3. The catalytic activity of the ribosome is located in the \_\_\_\_\_.
  - A) Proteins
  - B) 50S ribosomal rRNA
  - C) 30S ribosomal rRNA
  - D) Undiscovered
  
4. You wanted to study the assembly of preinitiation complex in eukaryotes. This is by the means of protein-protein interaction. Which of these methods you can't absolutely put in use there?
  - A) Footprinting
  - B) Crystal structure
  - C) EMSA
  - D) Primer extension
  
5. For performing EMSA what type of gel should be used?
  - A) Native
  - B) Denaturing SDS-PAGE
  - C) Non-denaturing SDS PAGE
  - D) Zymography
  
6. Which of the following is untrue?
  - A) RNA polymerases I is responsible for the transcription of ribosomal RNA
  - B) RNA polymerases III is responsible for the transcription of tRNA
  - C) RNA polymerase II is exclusively responsible for transcribing protein-encoding genes
  - D) Synthesis of mRNAs is carried out by RNA polymerase I
  
7. The most commonly observed modification in the histone includes \_\_\_\_\_.
  - A) Acetylation of lysine and phosphorylation of serine
  - B) Acetylation of lysine and phosphorylation of threonine
  - C) Acetylation of arginine and phosphorylation of threonine
  - D) Acetylation of arginine and phosphorylation of serine

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8. Which of the following about the differences between the prokaryotic and eukaryotic genes are true?
- A) Prokaryotic genes are large, polycistronic and contain enhancers
  - B) Eukaryotic genes are large, polycistronic and contain enhancers
  - C) Prokaryotic genes are large, monocistronic and contain introns
  - D) Eukaryotic genes are large, monocistronic and contain introns
9. Which of the following is not a stop codon?
- A) UAA
  - B) GUG
  - C) UAG
  - D) UGA
10. If give a segment – 5'CTGACCAUGGCCTAGAUCCCTCT, which AUG will the eukaryotic ribosome choose as initiation site?
- A) Any at random
  - B) First
  - C) Second
  - D) None
11. Expression of T7 promoter- lac operator hybrid requires \_\_\_\_\_
- A) T7 RNA polymerase
  - B) An inducer such as IPTG
  - C) Both T7 RNA polymerase and inducer such as IPTG
  - D) T7 DNA polymerase
12. The E site of the ribosome has a high affinity for \_\_\_\_\_
- A) Peptide bound tRNA
  - B) Ester linked tRNA
  - C) Acylated tRNA
  - D) Deacylated tRNA
13. Histones are \_\_\_\_\_
- A) Neutral
  - B) Positively charged
  - C) Negatively charged
  - D) Neutral with positive and negative domains
14. Which of the following is not a common mode of histone modification in eukaryotes?
- A) Methylation
  - B) Phosphorylation
  - C) Sulphonation
  - D) Ubiquitylation

15. The lactose repressor is encoded by \_\_\_\_\_
- A) Lac-I
  - B) Lac-A
  - C) Lac-Y
  - D) Lac-Z
16. Which of the following can be extended by DNA polymerase?
- A) a single strand DNA end in a deoxyribonucleotide with free 5'-P
  - B) a RNA single strand with a ribonucleotide with a free 3'-OH
  - C) a single strand of DNA ending in a nucleotide with a free 3'-OH
  - D) a RNA single strand
  - E) all of the above
17. DNA Pol I is proteolytically cleaved to yield the \_\_\_\_\_, which lacks 5'→3' exonuclease activity.
- A) Okazaki fragment
  - B) Klenow polymerase
  - C) Klenow fragment
  - D) DNA ligase
  - E) primase
18. What is the causative agent in the formation of a cyclobutane thymine dimer?
- A) benzo[*a*]pyrene
  - B) *N*-methyl-*N'*-nitro-*N*-nitrosoguanidine
  - C) ultraviolet radiation
  - D) ethylmethanesulfonate
  - E) methylnitrosourea
19. Which of the following is formed by oxidation of a DNA base?
- A) uracil
  - B) 7-methylguanine
  - C) 8-oxoguanine
  - D) thymine dimer
  - E) all of the above
20. What is an Okazaki fragment?
- A) a small section of DNA bound to the leading strand
  - B) a small section of DNA bound to the lagging strand
  - C) a small section of RNA and DNA bound to the leading strand
  - D) a small section of RNA and DNA bound to the lagging strand
  - E) none of the above

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21. In DNA synthesis, the \_\_\_\_\_ strand is synthesized in a \_\_\_\_\_ fashion.
- A) template; discontinuous
  - B) template; continuous
  - C) leading; discontinuous
  - D) lagging; discontinuous
  - E) none of the above
22. Replication of DNA in *E. coli* occurs in what type of fashion?
- A) directionality can change depending upon specific conditions in the cell
  - B) unidirectional
  - C) bidirectional
  - D) multidirectional
  - E) none of the above
23. Which histone protein is associated with the linker DNA and therefore not actually part of the nucleosome?
- A) H1
  - B) H2A
  - C) H2B
  - D) H3
  - E) H4
24. Which of the following statements about DNA methylation is NOT TRUE?
- A) methylation plays a role in genomic imprinting
  - B) methylation can influence gene regulation
  - C) methylation occurs in prokaryotic cells, but not eukaryotic cells
  - D) methylation plays a role in restriction modification systems
  - E) none of the above
25. What technique is used to amplify portions of DNA, usually about 800 base pairs in size?
- A) DNA sequencing
  - B) cloning
  - C) polymerase chain reaction
  - D) restriction digestion
  - E) electrophoresis
26. The repair of a double-strand break can be accomplished by \_\_\_\_\_, which requires the Ku70/80 protein to \_\_\_\_\_.
- A) nonhomologous end joining; catalyze blunt end ligation
  - B) nonhomologous end joining; bind to both ends of the break
  - C) homologous recombination; catalyze blunt end ligation
  - D) homologous recombination; bind to both ends of the break
  - E) none of the above

27. DNA Pol I synthesizes new DNA with very high fidelity, due to its
- A) high processivity.
  - B) 3' → 5' exonuclease activity.
  - C) helicase association with the primase.
  - D) 5' → 3' exonuclease activity.
  - E) all of the above.
28. Synthesis of telomeres requires the enzyme \_\_\_\_\_, which is a type of \_\_\_\_\_.
- A) telomerase, helicase
  - B) telomerase, ribonucleoprotein
  - C) ribonuclease, riboprotein
  - D) ribotetase, ligase
  - E) none of the above
29. Deamination of cytosine leads to the formation of \_\_\_\_\_.
- A) thymine
  - B) uracil
  - C) 5-bromouracil
  - D) 5-methyluracil
  - E) 5-methylcytosine
30. Which of the following describes the Holliday junction?
- A) point where DNA base excision repair initiates
  - B) crossover point involving 4-stranded DNA structure in homologous recombination
  - C) insertion point of a gene flanked in transposons
  - D) point where MutS binds to initiate SOS response
  - E) none of the above
31. Huntington disease is caused by\_\_\_\_\_.
- A) pyrimidine dimers
  - B) trinucleotide expansion
  - C) suppressor mutants
  - D) ionic radiation
  - E) none of the above
32. How does RecA bring about strand exchange?
- A) RecA acts as a helicase, unwinding DNA in localized regions
  - B) RecA monomers bind to ssDNA to form a nucleoprotein filament
  - C) RecA monomers interact only with ssDNA and immediately dissociate when binding to dsDNA
  - D) RecA forms a tetramer that wraps around DNA at specific sites that must be cleaved by a nuclease
  - E) none of the above

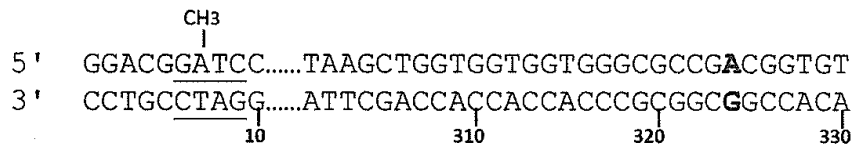
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33. What enzyme is responsible for unwinding of the DNA ahead of the replication fork?
- A) topoisomerase
  - B) primase
  - C) clamp loading complex
  - D) helicase
  - E) single-stranded binding protein
34. Which of the following is the best description for primase?
- A) an RNA-dependent DNA polymerase
  - B) a DNA-dependent DNA polymerase
  - C) an RNA-dependent RNA polymerase
  - D) a DNA-dependent RNA polymerase
  - E) none of the above
35. For a restriction enzyme with a 6-base recognition site, what is the average number of base pairs between occurrences of the site?
- A) 1024 base pairs
  - B) 4096 base pairs
  - C) 46656 base pairs
  - D) 186624 base pairs
  - E) none of the above
36. *EcoRI* has a restriction site of G↓AATTC while *EcoRV* has a restriction site of GAT↓ATC. Based upon this, *EcoRI* produces \_\_\_\_\_ and *EcoRV* produces \_\_\_\_\_.
- A) a 5' overhang; a 3' overhang
  - B) a 5' overhang; a 5' overhang
  - C) a 5' overhang; blunt ends
  - D) a 3' overhang; a 5' overhang
  - E) a 3' overhang; blunt ends
37. Which of the following describes the correct sequence of enzyme activity upon the lagging strand?
- A) primase, DNA ligase, DNA polymerase I, DNA polymerase III
  - B) primase, DNA polymerase I, DNA polymerase III, DNA ligase
  - C) primase, DNA polymerase III, DNA polymerase I, DNA ligase
  - D) primase, DNA ligase, DNA polymerase III, DNA polymerase I
  - E) DNA polymerase III, primase, DNA polymerase I, DNA ligase

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**II. Short Answer Questions (6 points)**

Suppose that an error in replication occurred at position 324 in the *E. coli* sequence below, and that a GATC motif is located about 300 bp upstream of that. Note that the A on the top strand is methylated.



1. What DNA repair system would be used to repair this error? (2 points)
2. If the DNA repair system does not repair the error, what kind of mutation will be occurred? (2 points)
3. After the DNA repair system repairs the error, what is the result of the sequence at position 324? (2 points)

**III. Please Answer The Following Questions (20 points):**

1. Describe the mechanisms of the 5' capping and 3' poly-A in detail and why are 5'-capping and 3'-poly-A important? (10 points)
2. Please briefly describe two real cases as to why RNA splicing is important? (10 points)

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