

國立清華大學 107 學年度碩士班考試入學試題

系所班組別：生命科學院甲組、丁組

考試科目（代碼）：分子生物學(0404、0704)

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*請在【答案卡】作答

I. Multiple Choice Questions (2 points / each question)

1. Which of the following statements is true concerning DNA replication in prokaryotes?
 - (A) DNA replication is conservative.
 - (B) DNA replication is discontinuous.
 - (C) DNA replication is RNA dependent.
 - (D) DNA replication requires only one enzyme.
 - (E) There are two origins of replication.
2. Which of the following mammalian cell DNA polymerases is NOT correctly matched with its function?
 - (A) DNA Pol α —priming DNA synthesis
 - (B) DNA Pol β —DNA repair
 - (C) DNA Pol γ —elongation of both strands
 - (D) DNA Pol δ —ligation of DNA strands
 - (E) DNA Pol ϵ —DNA repair
3. West and colleagues used gel mobility shift assays to demonstrate that _____ could bind to and resolve Holliday junctions.
 - (A) RecA
 - (B) RecB
 - (C) RuvA
 - (D) RuvB
 - (E) RuvC
4. The *Ds* transposable element of maize cannot transpose on its own because it lacks
 - (A) origin of replication.
 - (B) inverted repeats.
 - (C) transposase.
 - (D) antibiotic resistance.
 - (E) Tn10.

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5. Which of the following transposons does not contain inverted repeats or LTRs at its ends?
- (A) Tn3
 - (B) *Ds*
 - (C) *copia*
 - (D) Ty
 - (E) Alu elements
6. Sarah has performed a chromatin immunoprecipitation experiment using a specific antibody that recognizes a specific protein that can bind to TATA box in *E. coli*. This protein is likely
- (A) TFIID
 - (B) RNA polymerase-II
 - (C) Sigma factor
 - (D) TBP
 - (E) Helicase
7. Which of the following mechanism is most used to repair a single stranded DNA break?
- (A) Mismatch repair
 - (B) Homologous recombination
 - (C) Nucleotide excision repair
 - (D) Base excision repair
 - (E) Non-homologous end joining
8. Which modified nucleotide base is part of the 5' cap on eukaryotic mRNAs?
- (A) cytosine
 - (B) guanine
 - (C) adenine
 - (D) uracil
 - (E) thymidine

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9. Which of the following limits the use of PCR to detect and isolate genes?
- (A) The sequence at the beginning and end of the DNA to be amplified must be known.
 - (B) It also produces large numbers of copies of sequences beyond the 5' or 3' end of the desired sequence.
 - (C) It cannot be used to amplify cDNAs or mRNAs.
 - (D) It will amplify only sequences present in multiple copies in the DNA sample.
 - (E) Quantitation can be applied by adding modified fluorescent nucleotides.
10. Unlike DNA, which typically forms a helical structure, different molecules of RNA can fold into a variety of three-dimensional shapes. This is largely because _____.
- (A) RNA contains uracil and uses ribose as the sugar.
 - (B) RNA bases cannot form hydrogen bonds with each other.
 - (C) RNA nucleotides use a different chemical linkage between nucleotides compared to DNA.
 - (D) RNA is single-stranded.
11. Put the following steps of prokaryotic translation initiation in the correct order.
- (1) Binding of IF1, IF2, and GTP to the 30S subunit.
 - (2) Binding of IF3 to the 30S subunit.
 - (3) Binding of the 50S subunit and loss of IF1 and IF3.
 - (4) Dissociation of the 70S ribosome.
 - (5) Formation of the 70S initiation complex by dissociation of IF2 and GTP hydrolysis.
 - (6) Formation of the 30S initiation complex.
- (A) 1,2,3,4,5,6
 - (B) 2,1,6,3,5,4
 - (C) 2,4,1,6,3,5
 - (D) 4,2,1,6,3,5
 - (E) 5,6,3,2,1,4

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12. The Kozak sequence on an mRNA molecule is recognized by the ribosome as the _____ in eukaryotes.
- (A) ribosomal binding site
 - (B) interacting site with 5' cap
 - (C) translational start site
 - (D) internal ribosome entry site
 - (E) ribosome exit (E) site
13. Which of the following initiation factor is involved in aiding in ribosome scanning to locate the initiation codon?
- (A) eIF1
 - (B) eIF2
 - (C) eIF3
 - (D) eIF4F
 - (E) eIF6
14. Picornavirus mRNAs are not capped, yet they can still out compete host mRNAs for binding to the ribosome by
- (A) degrading host mRNA.
 - (B) inactivating host Cap binding protein, eIF4F.
 - (C) having a stronger affinity for the ribosome.
 - (D) inactivation of host RNases.
 - (E) inactivation of host eIF2B.
15. Place the steps of translation elongation in the correct order.
- (1) Peptidyl transferase forms a peptide bond between the peptide in the P site and the newly arrived aminoacyl-tRNA in the A site.
 - (2) EF-G, with GTP, translocates peptidyl-tRNA to the P site.
 - (3) EF-Tu, with GTP, binds an aminoacyl-tRNA to the ribosomal A site.
- (A) 1, 2, 3
 - (B) 2, 3, 1
 - (C) 1, 3, 2
 - (D) 3, 2, 1
 - (E) 3, 1, 2

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16. Which of the following description about piRNA is NOT correct?
- (A) piRNA is a small RNA is about 24-30 nt long
 - (B) piRNA associates with Argonaute proteins
 - (C) piRNA controls transposition in mammalian somatic cells
 - (D) The mature piRNAs are processed by ping-pong amplification
 - (E) piRNA is involved in transposon mRNA cleavage
17. Which of the following description about RNAi is NOT correct?
- (A) A post-transcriptional process that involves mRNA degradation
 - (B) Requires ATP
 - (C) Dicer dices double strand RNA and leaves 2-nt 5'-overhangs at the end of siRNA
 - (D) Dicer is a RNase III and has RNA helicase activity
 - (E) Dicer interacts with R2D2 to form a RISC loading complex (RLC)
18. Which of the following description about miRNA is NOT correct?
- (A) miRNA inhibits translation
 - (B) miRNA stimulates translation
 - (C) imperfect base-pairing binds to target mRNA 3'-UTR
 - (D) perfect base-pairing binds to target mRNA
 - (E) miRNAs are synthesized by RNA polymerase III as longer precursors as pri-miRNA

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19. Put the following steps of mRNA processing in correct order.

- (1) Capping
 - (2) Polyadenylation
 - (3) Pre-mRNA cleavage
 - (4) Elongation of poly(A)
 - (5) RNA Splicing
 - (6) Transcription termination
- (A) 1,2,3,4,5,6
 - (B) 1,5,3,2,4,6
 - (C) 6,1,2,4,3,5
 - (D) 6,3,1,2,4,5
 - (E) 3,6,1,2,4,5

20. Which of the following modification does not exist on histone tail?

- (A) Lys-Methylation
- (B) Lys-Acetylation
- (C) Lys-Ubiquitination
- (D) Lys-Phosphorylation
- (E) Lys-Sumoylation

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II. Essay Questions:

21. Please describe the following terms. (1 points/each)
 - (A) Semiconservative replication;
 - (B) Semidiscontinuous replication;
 - (C) Replicon (when DNA replication);
 - (D) Origin (when DNA replication);
 - (E) Terminus (when DNA replication)
22. Please describe the detailed steps of Homologous Recombination in *E. coli*; RecA, RecBCD, RuvA, RuvB and RuvC are involved in which steps. (10 points)
23. CRISPR/Cas9 technology has been applied for correcting hereditary defects in somatic cells. Please explain how does CRISPR/Cas9 technology work in gene editing. (10 points)
24. Please explain how does DNA polymerase control the fidelity of DNA replication. (5 points)
25. Please describe the mechanism behind how puromycin works as an antibiotic. (5 points)
26. Please explain the mechanisms behind the “degeneracy” of genetic codes. (10 points)
27. Please describe what is “alternative splicing” in RNA processing. (5 points)
28. Please explain how RAP1 and SIR proteins involved in yeast telomeric heterochromatin. (10 points)