

— 單選題 (2 points each, 30 points)

1. Choose the statement describes "antiparallel" for DNA correctly:
 - (A). each DNA molecule consists of one old and one new strand
 - (B). there is complementary base-pairing
 - (C). opposite strands are held together by base pairing
 - (D). the DNA helix twists to the right
 - (E). the two polynucleotide chains run in opposite directions

2. Which of the following about prokaryotes is correct?
 - (A). lack of nucleus
 - (B). lack of cell walls
 - (C). most of prokaryotic chromosome is linear
 - (D). they contain mitochondria
 - (E). all of these

3. Beadle and Tatum's key experiments involved exposing the bread mold *Neurospora crassa* to x-rays and causing mutations. In a series of experiments, they showed that these mutations caused changes in specific enzymes involved in metabolic pathways. These experiments led them to propose a direct link between genes and enzymatic reactions, known as the "one gene, one enzyme" hypothesis, but it can not apply to every gene. Why not?
 - (A). genes of *Neurospora crassa* do not encode polypeptide sequences
 - (B). some genes encode RNA sequences that do not lead to the formation of polypeptides
 - (C). some genes encode other DNA sequences that do not lead to the formation of polypeptides
 - (D). all of these are correct
 - (E). none of these is correct

4. Lightly stained regions and darkly stained regions of chromatin are receptively known as:
 - (A). Chromosome and nucleus
 - (B). Euchromatin and heterochromatin
 - (C). Heterochromatin and euchromatin
 - (D). Histones and histidine
 - (E). Haploid and diploid

5. When bacteriophage integrates into bacterial chromosome, it does so at:
 - (A). an attL site in the host chromosome using a RNA integrase
 - (B). an attR site in the phage chromosome using a RNA polymerase
 - (C). an attB site in the host chromosome using a DNA integrase
 - (D). an attP site in the host chromosome using a RNA ligase
 - (E). an attB site in both the host and phage chromosomes

見背面

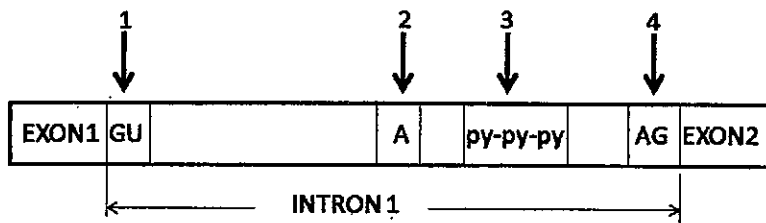
6. The Klenow fragment is a large protein fragment produced from *E. coli* that is enzymatically cleaved by protease, and it retains
- (A). Polymerase I by the 3' to 5' exonuclease activity
 - (B). Polymerase I by the 5' to 3' exonuclease activity
 - (C). Polymerase II by the 3' to 5' polymerase activity
 - (D). Polymerase II by the 5' to 3' polymerase activity
 - (E). Polymerase III by the 5' to 3' polymerase activity
7. Based on the sequencing data acquired from the Human Genome Project, how many genes are there in the human genome?
- (A). 20,000 ~ 35,000
 - (B). 50,000 ~ 100,000
 - (C). 100,000 ~ 120,000
 - (D). 150,000 ~ 200,000
 - (E). 220,000 ~ 250,000
8. EcoRI restriction enzyme was originally found in bacteria *E. coli*,
- [I] what is the natural biological function of this enzyme in *E. coli*?
 - [II] and how does bacteria protect its own DNA from being cleaved by this enzyme?
- (A). [I] to clone genes from eukaryotic DNA
[II] by methylation of endogenous restriction sites in *E. coli*
 - (B). [I] to protect viruses from bacterial invasion,
[II] by glycosylation of endogenous restriction sites in *E. coli*
 - (C). [I] to protect bacteria from viral invasion,
[II] by methylation of endogenous restriction sites in *E. coli*
 - (D). [I] to protect eukaryotes from bacterial invasion
[II] by glycosylation of endogenous restriction sites in *E. coli*
 - (E). [I] to clone genes in prokaryotic sequences
[II] by methylation and amylation of endogenous restriction sites in *E. coli*
9. Which of the following is essential component in a cloning vector?
- (A). origin of replication
 - (B). selection marker gene
 - (C). unique restriction enzyme sites
 - (D). origin of replication and unique restriction enzyme sites
 - (E). all of these
10. Homologous genes present within different species are known as
- (A). paralogues
 - (B). orthologues
 - (C). homologues
 - (D). similogues
 - (E). none of these

11. Which subunit of eukaryotic RNA polymerase II recognizes TATA box?
- (A). TFIIB
 - (B). TFIIH
 - (C). TFIIF
 - (D). TFIID
 - (E). none of these
12. Which of the following is not correct?
- (A). RNA Polymerase I synthesizes rRNA in the nucleolus
 - (B). RNA Polymerase III synthesizes tRNA, rRNA, and other small RNA found in the nucleus and cytosol
 - (C). RNA Polymerase II synthesizes precursor of mRNA in the nucleus
 - (D). RNA Polymerase III synthesizes microRNA in the cytosol
 - (E). RNA Polymerase IV synthesizes siRNA in plants
13. Which of the following describes the mechanism of antibiotics correctly:
- (A). Chloramphenicol binds 30S rRNA to block peptide formation
 - (B). Erythromycin binds 30S rRNA to block peptide formation
 - (C). Tetracycline binds 30S rRNA to block peptide formation
 - (D). Tetracycline interferes with tRNA anticodon-reading on mRNA
 - (E). Tetracycline interferes the synthesis of RNAs by RNA Polymerase II
14. Which kind of enzyme prevents DNA from tangling up by introducing negative supercoils as the replication fork migrates during replication?
- (A). helicase
 - (B). ligase
 - (C). DNA Polymerase I
 - (D). topoisomerase
 - (E). DNA Polymerase III
15. G protein-coupled receptors (GPCRs)
- (A). is a three-transmembrane protein
 - (B). activate an associated G-protein by exchanging its bound GTP to GDP
 - (C). are involved in a wide variety of physiological process, including visual sense
 - (D). contain helicase activity
 - (E). all of these

見背面

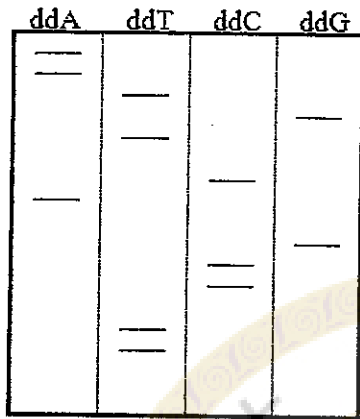
二 問答題 (4-6 points each, 50 points)

16. How does catabolite repression stop transcription of the lac operon in *E. coli* in the presence of glucose? (5 points)
17. Which factors bind to the CTD (carboxy-terminal domain) of RNA polymerase II and what are their functions? (4 points)
18. Under what situation, the translation process will be stopped, and then trigger "nonsense mediated decay" (NMD), explain the mechanisms? (4 points)
19. Why do we usually design PCR primers as 18~22 bp in length? (4 points)
20. Give four research strategies to cause loss of function (LoF) of protein-coding gene. (4 points)
21. A-to-I editing is the main form of RNA editing in mammals. Which enzyme is involved in this reaction? And explain why A-to-I editing can cause alteration of coding capacity. (6 points)
22. The histone code is a hypothesis that the transcription of genetic information encoded in DNA is in part regulated by chemical modifications to histone proteins, primarily on their unstructured ends. Please give at least three well characterized modification ways to histones. And also indicate each modification favors to activate or to repress the gene activity (6 points)
23. In 2012, the Nobel Prize in Physiology / Medicine was awarded to Sir John Gurdon and Dr. Shinya Yamanaka, what are their contributions in molecular biology? (5 points)
24. Please name the numbered regions (1-4) in the intron: (4 points)



25. This is a X-ray autoradiogram film by Sanger sequencing, what is the original sequence of the DNA template, please indicate it from 5' end to 3' end? (4 points)

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26. pCaper 1 is 30kb plasmid, when you digested with EcoRI, one liner fragment results. Then digestion with BamHI results in 3 fragment 10, 3, 17 kb. A double digestion with EcoRI and BamHI results 3, 8, 9, 10 kb. Please draw a circular restriction enzyme map of pCaper1 (4 points)

三 簡答題

27. Define the following terms (4 points each, 20 points)

- (A). morpholino
- (B). bacterial SOS response
- (C). SNP
- (D). cpG islands
- (E). synthetic biology

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