I. 選擇題 [單選題, 每題一分, 題號 1-22; Single-choice questions , total = 22%]

1. Which of the following reagents are components of LB medium?
   I. Bacto agar **II.** Bacto-tryptone **III.** Beef extract
   IV. Sodium chloride **V.** Yeast extract

   (A). I, II, III (B). I, III, IV (C). II, III, IV (D). II, IV, V

2. Which of the following methods is not suitable for transforming a plasmid to bacteria?
   (A). Calcium chloride treatment (B). Electroporation
   (C). Liposome treatment (D). Cobalt chloride treatment

3. Which of the following methods is not suitable to investigate protein-protein interaction?
   (A). ELISA (B). EMSA
   (C). Immunoprecipation (D). Yeast two hybrid screening

4. Which of the following nucleic acids whose abundance is most relevant to the codon usage?
   (A). tRNA (B). rRNA (C). mRNA (D). cDNA

5. Which of the conditions can **not** promote DNA denaturation?
   (A). Urea (B). High temperature
   (C). High ionic strength (D). High pH

6. The unusual property of *Taq* polymerase critical to the PCR is its
   (A). Ability to amplify DNA *in vitro* (B). Ability to use dNTPs as substrates
   (C). Thermostability (D). Ability to use RNA as an template

7. Which of the following has enzyme activity?
   (A). 5S rRNA (B). 16S rRNA (C). 23S rRNA (D). 30S ribosome

8. Which of the following codon can not be recognized by *E. coli* $tRNA_f^{Met}$?
   (A). AUG (B). GUG (C). UGU (D). UUG

9. Which of the following amino acids does **not** use degenarate codons?
   (A). Arginine (B). Glycine (C). Methionine (D). Phenylanine

10. Which of the following does **not** belong to wobble base pairing?
    (A). G-U (B). I-A (C). I-C (D). G-A

11. Which of the following compounds is **not** required for the puromycin assay?
    (A). ATG (B). puromycin (C). ribosome (D). $[^{35}S]$fMet-$tRNA_f^{Met}$

12. Which of the following molecules occupies the ribosomal P site?
    (A). fMet-$tRNA_m^{Met}$ (B). fMet-$tRNA_f^{Met}$ (C). Met-$tRNA_m^{Met}$ (D). AUG

13. What tools can be applied to investigate the ribosome assembly?
I. Immunoelectron microscopy II. 2D SDS-PAGE
III. X-ray crystallography IV. Neutron diffraction

(A). I, II, III (B). I, II, IV (C). I, III, IV (D). II, III, IV

14. Which of the following factors can exchange GTP for GDP?
I. eIF2B II. EF-Ts III. EF-Tu IV. RF3

(A). I, II (B). I, III (C). II, IV (D). III, IV

15. Truncation of the *N*-terminal portion of eIF4G is required for its binding to which part of an mRNA?
(A). Cap (B). IRES (C). PolyA (D). SD sequence

16. Addition of which of the following molecules results in GTP release from the ternary complex consists of EF-T, GTP, and aminoacyl tRNA?
(A). Met-$tRNA_f^{Met}$ (B). fMet-$tRNA_f^{Met}$
(C). Deacylated tRNA (D). aa-tRNA

17. Which of the following methods can separate proteins by size?
(A). Affinity column chromatography (B). Ion exchange chromatography
(C). Gel filtration chromatography (D). Isoelectric focusing

18. Which of the following molecules recognizes the stop codon(s)?
I. RF1 II. RF2 III. RF3 IV. Suppressor tRNA

(A). I, II (B). I, II, III (C). I, II, IV (D). IV

19. Which element is not present in DNA?
(A). Oxygen (B). Nitrogen (C). Sulfur (D). Phosphorus

20. Which one of the following bases is single-ringed nitrogenous base found in DNA and RNA?
(A).Thymine (B). Cytosine (C). Uracil (D). Guanine.

21. In nucleic acids, the free hydroxyl group is attached to the _____ carbon of the sugar.
(A). 5' (B). 4' (C). 3' (D). 2' (E). 1'

22. In a nucleic acid, the bases are always attached to the _____ carbon of the sugar.
(A). 5' (B). 4' (C). 3' (D). 2' (E). 1'

II. 選擇題 [單選題, 每題兩分, 題號 23-40; 總共佔 36 分
Single-choice questions , 2% per each, total score = 36%]

23. The probe used in Far Western blot is _____
(A). DNA (B). RNA
(C). protein (D). antibody

24. Which of the followings is responsible for 3'-splice site selection?
(A). U4/U6 (B). U5
(C). U2AF (D). SR

25. In the splicesome cycle, which of the following is released from the complex LAST?
(A). mRNA (B). U4 snRNP
(C). U1 snRNP (D). intron

26. Which of the following DNA (written in single-stranded forms from 5' to 3', left to right) MOST LIKELY contains an intron?
(A).....CAUGUAAAUACUAACC.....GGUUUAGCCG.....
(B).....CAUGUAAAUACUGGCC.....GGUUUAGCCG.....
(C).. .....CAUGGAAAUACUAACC.....GGUUUAGCCG.....
(D).....CAUGUAAAUACUAACC.....AACCCAGCCG.....

27. Which of the following transcription factors is involved in DNA repair?
(A). TFII B (B). TFII D
(C). TFII E (D). TFII H

28. Which of the following RNA polymerases is most sensitive to α-amanitin?
(A). I (B). II
(C). III (D). I and II

29. Which of the following statement concerning the *Ac-Ds* of maize is NOT TRUE?
(A). Ds element cannot transpose by itself
(B). Ac element cannot transpose by itself
(C). These DNA elements can induce chromosome breakage
(D). These DNA elements can induce the formation of dicentric chromosome
(E). Ds element cannot induce chromosome breakage by itself

30. Which one of the following process requires a RecA activity?
(A). Migration of a Holliday junction
(B). Resolving a Holliday junction during recombination
(C). Resolving cointegrate form during a replicative transposition
(D). Activating SOS gene expression
(E). Integration of λ

31. Which of the following enzymatic activities is involved in replicating the telomeric repeats (telomere) of eucaryotic chromosomes?
(A). DNA-dependent DNA polymerase
(B). RNA-dependent RNA polymerase
(C). RNA-dependent DNA polymerase
(D). Klenow enzyme
(E). DNA-dependent RNA polymerase III

32. The existence of Okazaki fragments demonstrate
    (A). DNA synthesis is semiconservative
    (B). DNA synthesis is discontinuous
    (C). DNA synthesis is conservative
    (D). DNA synthesis is dispersed
    (E). DNA synthesis requires a primer

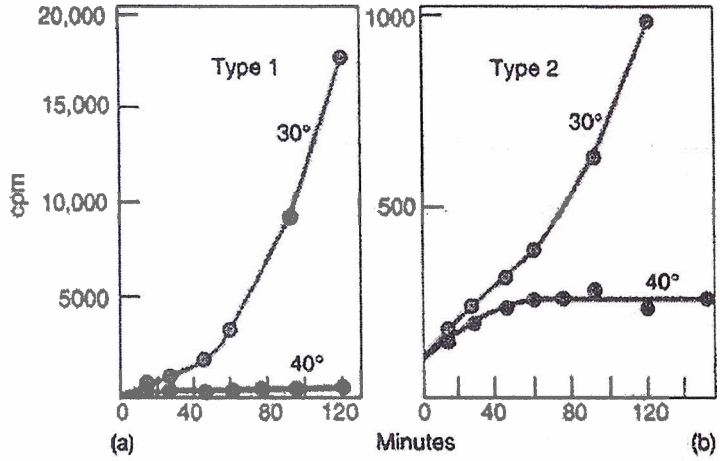
33. Which of the following mechanisms is not responsible for generating a diversified antibody population to recognize various antigens (antibody diversity)?

    (A). Alternative splicing of the exons coding for variable region
    (B). Gene mutation in the antibody producing cells
    (C). Rearrangement of immunoglobulin gene
    (D). A combination of heavy chain with one of the light chains
    (E). Imprecise joining of coding sequence

34. Four different single-stranded plasmids, A, B, C, and D are added to a tube containing substrates for DNA replication. Oligonucleotides complementary to the plasmids A, B and C were annealed to the respective plasmid. Then, the plasmid A is preloaded with β-clamp, which confers processivity to the DNA polymerase III, and the plasmid B is preloaded with DNA polymerase III holoenzyme. **Which of the following statement is correct?**

    (A). Plasmid A will be replicated first.
    (B). Plasmids A and B will be replicated simultaneously.
    (C). Plasmids C and D will never be replicated.
    (D). Plasmid D will be replicated first.
    (E). Plasmids B will be replicated before plasmid C.

35. DNA replications are measured by the incorporation of [^{14}C]thymidine in two types of temperature-sensitive mutants in *Escherchia coli*. 30°C and 40°C respectively indicate the cultures are grown at the permissive temperature and shifted to restricted temperature. Which of the following statement is right?



Two classes of *E. coli* DNA replication mutants.

    (A). Mutation of DnaA (protein binds to the replication origin) is a type 1
    (B). Mutation of the α subunit (polymerase) of DNA polymerase III mutation is a type 2
    (C). Mutation of DNA polymerase 1 is a type 1
    (D). Mutation of ligase is a type 2
    (E). None of above

36. RNA interference (RNAi):
(A). Was named and demonstrated by Su Guo et al. in 1995.
(B). Using sense RNA to inhibit gene expression.
(C). Using antisense RNA to inhibit gene expression.
(D). Using double-stranded RNA to inhibit gene expression.
(E). An artifact due to experimental contamination.

37. Mechanism of RNA interference:
(A). A translational gene silencing.
(B). The dsRNA has to include exon regions.
(C). The dsRNA using introns and promoter sequences also cause RNAi.
(D). Causes the destruction of the targeted protein.
(E). All above are correct.

38. Which statement is correct?
(A). Phillip Zamore et al. used Drosophila embryo lysates to demonstrate RNAi does require ATP.
(B). Double-stranded RNA is cleaved into short pieces RNA of 21-23nt by an enzyme called Dicer.
(C). Dicer is a member of the RNase III family, reported by Hammond et al. in 2001, purified from Drosophila embryo extract.
(D). Dicer with the 21-23nt short RNA and other enzymes form RNA-induced silencing complex(RISC) to degrade the targeted component.
(E). All above are correct.

39. Which statement is correct?
(A). The physiological significance of RNAi is to prevent the infection by certain RNA viruses.
(B). The short pieces of the 21-23 nt RNA can be amplified by DNA-directed RNA polymerase.
(C). RNAi is involved in the heterochromatization.
(D). Only A and C are correct.
(E). All A, B, and C are correct.

40. MicroRNA:
(A). Is a new mode of posttranscriptional gene regulation.
(B). Typically 21-23 nt in length.
(C). Binds to specific sequences in the 3'UTR of messenger RNA(mRNA).
(D). Causes inhibition of protein synthesis or mRNA degradation depending on the degree of microRNA:mRNA complementarity.
(E). All above are correct.

III. 問答題（每題 4-8 分，題號 41-49；總共佔 42%; Total score for questions #41-49 = 42%）

41. What are the unique characters of *E. coli* DNA polymerase I? Klenow fragment is useful for several tasks, what are they? Please compare the Klenow fragment with the T4 DNA polymerase on the aspect of application (5%).

42. What is the structure of the sigma factor that contributes to control transcription? (5%)

43. Chromatin was isolated from the nucleus and was digested with DNAse. DNA was then isolated and run on a gel. A ladder with the smallest size of 200 bp was observed when the digestion was performed for a short while. When the digestion was performed for a loner time, a band with the size of 146 bp was observed. Please explain those observations. (5 %)

44. You are studying a new operon in *E. coli* involved in phenylalanine biosynthesis. (8 %)
    (A). How would you predict this operon is regulated (inducible or repressible by phenylalanine)?
    (B). You sequenced the operon and discovered that it contains a short open reading frame at the 5' region of the operon contains several codons for phenylalanine. What would happen if the sequence of this leader were changed so that the phenylalanine codons were changed.
    (C). What is the kind of regulation called and would it work in eukaryotic cells? Explain your answer.

45. You carried out experiments to study transcriptional termination in an *E. coli* operon. You sequenced the 3' region of the operon and obtained the following sequence 5'…
    CGAAGCGCCG**ATTGC**CGGCGCTTTTTTTTTT……3'

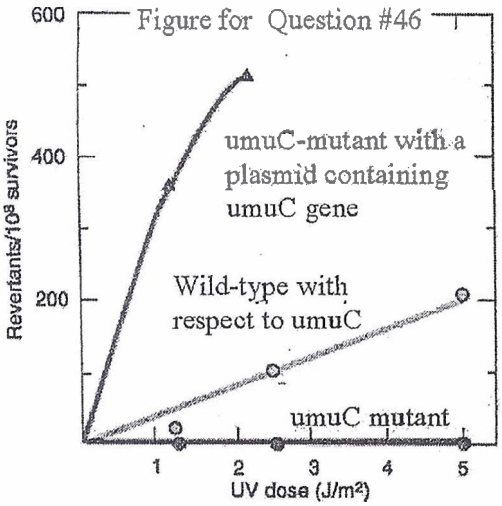
    You then create mutant operons with this sequence changed to the following:
    MT A: 5'…CGAAACTAAG**ATTGC**AGCAGTTTTTTTTTT…….3'
    MT B: 5'…CGAAGCGCCG**TAGCA**CGGCGCTTTTTTTTTT……3'
    MT C: 5'…CGAAGCGCCG**ATTGC**CGGCGCTTACGGCCTC……3'
    (All the sequences are from the nontemplate strand)

    You put each of the operons into an assay that measures termination and get the following results:

Operon	without Rho	with Rho
Wild type	100% termination	100% termination
MT A	40% termination	40 % termination
MT B	95% termination	95% termination
MT C	20% termination	80% termination

    Please explain the results as completely as possible. (5 %).

46. Walker and colleagues tested three *his*$^-$ bacteria for the ability to generate *his*$^+$ revertants after UV irradiation. What can you concluded from the following results? (4 %)



47. Specify two major mistakes in the following PCR result shown on an agarose gel. (2%)

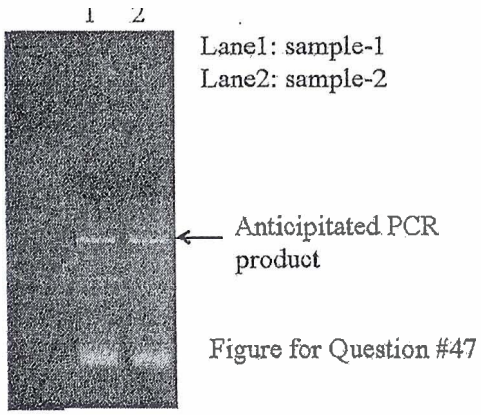


Figure for Question #47

48. Design an experiment contianing three specific steps to prove the existence of an "E site" in a ribosome. Specify the name of one major instrument used in your experiments. (4%)

49. The following experimental protocol failed to generate any recombinant transformant. Specify two mistakes in the protocol and describe how you can improve the experiment. (4%)

(1). Transfer 1 ng plasmid DNA into 100 µl competent cells. Chill the mixture on ice for 5 min.
(2). Rapidly transfer the tubes to an ice bath. Allow the cells to chill for 1-2 min.
(3). Transfer 500 µl of LB medium containing 50 µg/mL ampicillin into the cells and mix gently.
(4). Incubate the tubes at 37 ℃ with shaking at 220 rpm for 45 min.
(5). Gently spread the transformed cells over the surface of agar plates with a sterile L-shape glass rod.
(6). Leave the plates at room temperature until the liquid has been absorbed.
(7). Invert the plates and incubate at 37 ℃ for 12-16 hr.