

Please choose the most appropriate terms/phrases/statements that complete or answer the questions.

Attention: More than one of the choices provided may be correct.

(2.5 points for each question) ※ 注意：請用 2B 鉛筆作答於答案卡，並先詳閱答案卡上之「畫記說明」。

1. Identify the components that is/are **NOT** a part of DNA.
  - (A) Ribose
  - (B) Base A, T, C, G
  - (C) 5'-phosphate group
  - (D) 3'-hydroxyl group
  - (E) Deoxyribose
2. DNA is a structurally dynamic molecule that can exist in a variety of helical forms. Which of the following is/are **NOT** a known DNA structure?
  - (A) A-DNA
  - (B) B-DNA
  - (C) C-DNA
  - (D) X-DNA
  - (E) Z-DNA
3. Which of the following enzymes is/are required for DNA replication?
  - (A) Helicase
  - (B) Topoisomerase
  - (C) DNA polymerase
  - (D) DNA ligase
  - (E) Recombinase
4. Which of the following statements about DNA replication is/are **CORRECT**?
  - (A) 3' to 5' polymerase activity is used to synthesize both strands of DNA
  - (B) DNA replication is semiconservative.
  - (C) DNA polymerase needs a template and a RNA primer to initiate DNA synthesis.
  - (D) Helicase is required to solve the supercoiled structure formed during DNA replication.
  - (E) The 5' to 3' exonuclease proof-reading activity is required maintain the fidelity of DNA replication.
5. The 5' End is potentially lost during replication of linear eukaryotic chromosomal DNA. Which molecules or structures is/are required to prevent the shortening of the 5' end of DNA?
  - (A) DNA gyrase
  - (B) Telomere
  - (C) Telomerase
  - (D) DNA polymerase
  - (E) Helicase
6. Which physical or chemical factors in the following list can cause DNA mutation?
  - (A) Heat
  - (B) Ultra-violet light
  - (C) Acridine
  - (D) Nitrous acid
  - (E) 5-Bromouracil

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7. Which of the following statements about restriction enzymes is/are **CORRECT**?
- (A) Type I restriction enzyme usually cleave DNA within their recognition sequences
  - (B) They are part of a bacterial host defense system to degrade invading viral DNA.
  - (C) Calcium ( $\text{Ca}^{2+}$ ) is typically required for their catalytic activity
  - (D) Cleavage by restriction enzymes can be blocked when a specific base in the recognition site is methylated.
  - (E) Restriction enzymes hydrolyze covalent phosphodiester bonds of the DNA, leaving either "sticky/cohesive" ends or "blunt" ends.
8. Identify the protein modifications present on histones that play a crucial role in the epigenetic regulation of gene functions.
- (A) Acetylation
  - (B) Methylation
  - (C) Palmitoylation
  - (D) Glutamylation
  - (E) SUMOylation
9. Which of the following statements about transposons is/are **CORRECT**?
- (A) Transposons usually contain short inverted terminal repeat sequences.
  - (B) Being named as retrotransposons if RNA intermediates are involved in the transposition.
  - (C) Transposons can cause spread of antibiotic resistance within a bacteria population.
  - (D) Only exist in metazoan genomes
  - (E) Transposases is not necessarily encoded in the transposon.
10. Which of the following statements about transcription is/are **CORRECT**?
- (A) Transcription factors function to help move ribosomes along the mRNA.
  - (B) The release of pyrophosphate from a nucleoside triphosphate drive the reaction.
  - (C) RNA is synthesized from the 5' end to the 3' end.
  - (D) Transcription requires the use of primer
  - (E) DNA and RNA base pairing includes A to U and G to C.
11. Which of the following statements about RNA polymerase is/are **CORRECT**?
- (A) RNA polymerase I is responsible for producing all rRNA.
  - (B) RNA polymerase II is responsible for producing all mRNA.
  - (C) RNA polymerase III is responsible for producing all tRNA.
  - (D) All three RNA polymerase are located in the nucleoplasm for RNA synthesis functions.
  - (E) All three RNA polymerase are sensitive to the mushroom toxin  $\alpha$ -amanitin, which blocks the elongation phase of RNA synthesis.
12. Which of the following elements can be considered as eukaryotic promoters?
- (A) TATA box
  - (B) CAAT box
  - (C) CpG islands
  - (D) Shine-Dalgarno sequence
  - (E) Okazaki fragments
13. Which of the following statements is/are **TRUE**?
- (A) Restriction endonucleases can produce "blunt ends".
  - (B) Enzymes that seal nicks in DNA are called ligases.

- (C) Proteins are the only substrates of kinases.  
(D) Enzymes known as HATs phosphorylate histones.  
(E) Enzymes known as HDACs deacetylate histones.
14. What mechanism can microRNAs, small non-coding regulatory RNAs, utilize to reduce gene expression?  
(A) Repress the translation of target mRNA  
(B) Trigger the cleavage of target mRNA  
(C) Trigger the decapping of target mRNA  
(D) Enhance the polyadenylation of target mRNA  
(E) Accumulate target mRNAs in the P-bodies for degradation.
15. Which of the following techniques can be used to measure the amount of a specific mRNA in a sample?  
(A) Western blot analysis  
(B) Southern blot analysis  
(C) Northern blot analysis  
(D) RNase protection assay  
(E) quantitative reverse transcription PCR
16. Which of the following statements regarding protein synthesis is/are **CORRECT**?  
(A) Ribosomes use the information carried by mRNA to make protein  
(B) Since the genetic code is read in groups of three bases, any nucleic acid sequence contains three possible frames  
(C) In protein synthesis, the anticodon of rRNA recognizes the codon on mRNA by base pairing.  
(D) Codons that differ in either of their first two bases can be recognized by the same tRNA.  
(E) Proteins are linear polymers made from amino acids. Most proteins fold into complex 3D structures.
17. Which of the following methods can separate proteins based on their mass?  
(A) SDS polyacrylamide gel electrophoresis  
(B) Isoelectric focusing electrophoresis  
(C) Ion exchange chromatography  
(D) Gel filtration chromatography  
(E) Centrifugation
18. The fluidity of lipid membrane in cells is influenced by?  
(A) Temperature  
(B) The amount of unsaturated fatty acyl chain  
(C) The length of the fatty acid chain  
(D) The amount of the cholesterol  
(E) The nature of the membrane-associated proteins
19. Which of the following statements regarding to cell cycle is/are **CORRECT**?  
(A) DNA replication starts from the G1 phase  
(B) Mitosis occurs in the M phase  
(C) Degradation of cyclins is important in mitosis  
(D) DNA damage can cause cell cycle arrest  
(E) The G0 phase is the interval between the termination of DNA replication and the onset of mitosis
20. Which of the following events occurs in prokaryotes but not in eukaryotes?  
(A) Post-transcriptional splicing

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- (B) Translation in the absence of a ribosome  
(C) Concurrent transcription and translation  
(D) Post-translational modification  
(E) Alanine can be added to polypeptide chain by tRNA with different codon.
21. A class of mutations that results in multiple contiguous (side-by-side) amino acid changes in proteins is/are probably caused by which the following types of mutations?
- (A) recombinant  
(B) base analog  
(C) transversion  
(D) frameshift  
(E) transition
22. Which of the following is/are functional elements of a plasmid?
- (A) centromere  
(B) drug-resistance gene  
(C) polylinker sequence  
(D) origin of replication  
(E) autonomously replicating sequence
23. Unlike bacterial mRNA, eukaryotic mRNA must undergo \_\_\_\_\_ before it may be used for translation.
- (A) folding mRNA into hairpin loops  
(B) export to the cytoplasm  
(C) capping  
(D) splicing  
(E) polyadenylation
24. Which of the following is/are included in the universal features of DNA replication?
- (A) Release of PPi from a nucleoside triphosphate.  
(B) Synthesis from the 5' end to the 3' end.  
(C) Base pairing of A to U and G to C.  
(D) Use of a primer.  
(E) None of the above.
25. What method can be used to functionally inactivate a gene without altering its sequence?
- (A) gene knockout.  
(B) RNA interference.  
(C) dominant negative mutation.  
(D) CRISP/cas9.  
(E) site-directed mutagenesis.
26. Which of the following statements is/are **TRUE**?
- (A) Protein synthesis in prokaryotes always starts with a methionine residue.  
(B) A Shine-Dalgarno Sequence is a sequence of nucleotides in an mRNA that interacts with the small subunit of a ribosome to begin translation.  
(C) In bacteria, translation of the mRNA begins during the synthesis of the mRNA.  
(D) A polysome is a polypeptide chain in the process of being formed.  
(E) The ribosome is actually a ribozyme.

27. Intracellular second messengers include all of the following?
- (A)  $\text{Ca}^{2+}$ .
  - (B) diacylglycerol (DAG).
  - (C) cAMP.
  - (D) nitric oxide (NO).
  - (E) cGMP
28. Which of the following statements is/are **TRUE**?
- (A) A nucleosome contains 6 histones within its core.
  - (B) Chromatin is composed of DNA and protein.
  - (C) Nucleosomes are composed of about 100 bp of DNA wrapped around a histone core.
  - (D) DNA methylation is the only known natural modification of DNA. It affects cytosine bases.
  - (E) Histones have highly conserved sequences among eukaryotes.
29. Which of the following residues can be phosphorylated by protein kinases?
- (A) Serine
  - (B) Lysine
  - (C) Threonine
  - (D) Tyrosine
  - (E) Alanine.
30. Which of the following statements is/are **TRUE** of supercoiling?
- (A) The relaxed form of DNA is more stable and is therefore the preferred form in the cell.
  - (B) Most organisms maintain their DNA in a slightly overwound state in order to enhance strand separation during transcription and replication.
  - (C) Overwound DNA is in the B form so relaxed DNA has less turns than B-form DNA.
  - (D) Most organisms maintain their DNA in a slightly underwound state in order to compact their DNA.
  - (E) The relaxed form of DNA can only be maintained if the DNA is a closed circle.
31. Which of the following amino acids absorb UV (280nm)?
- (A) Tyrosine
  - (B) Tryptophan,
  - (C) Glutamine
  - (D) Valine
  - (E) Phenylalanine
32. Which of the following lipids are the general constituents of plasma membrane bilayer?
- (A) Phosphatidylcholine
  - (B) Triacylglycerol
  - (C) Free fatty acids
  - (D) Glycolipid
  - (E) Phosphatidylethanolamine
33. Which of the following molecules have the catalytic function in the biological system
- (A) DNA
  - (B) RNA
  - (C) Lipid
  - (D) Carbohydrate
  - (E) Protein

34. Prokaryotes and eukaryotes are similar in having
- (A) cell membrane
  - (B) mitochondria
  - (C) Golgi
  - (D) nuclear membrane
  - (E) chromosome
35. Transcriptional activation of enzymes specified for the utilization of lactose as a carbon source in *E. coli* requires the small-molecule signals by changing the DNA binding activity of two proteins, one being inactivated and the other activated. They are controlled by binding with
- (A) c-AMP
  - (B) ATP
  - (C) Lactose or 1, 6-Allolactose
  - (D) Isopropyl-thiogalactoside (IPTG)
  - (E) glucose
36. The building blocks of RNA molecules are
- (A) Adenylate
  - (B) cytidylate
  - (C) Guanylate
  - (D) Thymidylate
  - (E) Uridylate
37. Which of the following biomolecules have the reducing function in the biological system?
- (A) Glutathione
  - (B) NAD<sup>+</sup>
  - (C) NADP<sup>+</sup>
  - (D) FADH<sub>2</sub>
  - (E) Vitamin C
38. Which of the following RNAs contain high percentage of pseudouridine?
- (A) mRNA
  - (B) HnRNA
  - (C) rRNA
  - (D) Micro-RNA
  - (E) tRNA
39. Choose the following molecules that directly participate in protein folding.
- (A) ATP
  - (B) GTP
  - (C) Disulfide isomerase
  - (D) Chaperone
  - (E) Proteasome
40. The sigma factor ( $\sigma$ ) of procaryotic RNA polymerase is part of the core enzyme. Which of the following statement are **TRUE** for sigma factor?
- (A) it is released from the core enzyme after first bond has been formed.
  - (B) it is inhibited by  $\alpha$ -amanitin
  - (C) it is required for transcription initiation

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- (D) it is dispensable for in vitro RNA polymerization reaction
- (E) it is a component of RNA polymerase holoenzyme

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