※ 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」。

Please choose the most appropriate terms/phrases/statements that complete or answer the questions. Attention: <u>More than one</u> of the choices provided may be correct. (2.5 points for each question)

1. According to the fluid mosaic model of cell membranes, phospholipids _____.
   (A) have hydrophilic tails in the exterior of the membrane
   (B) frequently flip-flop from one side of the membrane to the other
   (C) occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane
   (D) can move laterally along the plane of the membrane
   (E) can be rearranged during membrane fusion.

2. The genetic code is essentially the same for all organisms. From this, what can be assumed?
   (A) The same codons in different organisms translate into different amino acids.
   (B) A gene from an organism can theoretically be expressed by any other organism.
   (C) Different organisms have different types of amino acids.
   (D) DNA was the first genetic material.
   (E) The abundance of all tRNAs are the same in different organism.

3. Which of the following contradicts the one-gene, one-enzyme hypothesis?
   (A) Alkaptonuria results when individuals lack a single enzyme involved in the catalysis of homogentisic acid.
   (B) Sickle-cell anemia results in defective hemoglobin.
   (C) A mutation in a single gene can result in a defective protein.
   (D) A single antibody gene can code for different related proteins, depending on the splicing that takes place post-transcriptionally.
   (E) Human insulin is encoded by one gene and processed after translation into two conjugated polypeptides for its active form.

4. In 1928, English microbiologist Frederic Griffith demonstrated that DNA is the genetic material to determine the virulence of bacteria cells; what observations helped this conclusion?
   (A) The heat-killed pathogenic bacteria + live non-pathogenic bacteria -> pathogenic.
   (B) The heat-killed non-pathogenic bacteria+ live pathogenic bacteria -> pathogenic.
   (C) The transformation of bacteria was carried by a heat-stable genetic material.
   (D) The heat-treated bacteria protein is pathogenic
   (E) Pathogenicity reflects the action of the capsule gene.

5. What is the mechanism of information transfer in eukaryotes?
   (A) Messenger RNA is transcribed from a single gene and transfers information from the DNA in the nucleus to the cytoplasm, where protein synthesis takes place.
   (B) Transfer RNA takes information from DNA directly to a ribosome, where protein synthesis takes place.
   (C) DNA from a single gene is replicated and transferred to the cytoplasm, where it serves as a template for protein synthesis.
   (D) Proteins transfer information from the nucleus to the ribosome, where protein

見背面

synthesis takes place.

(E) Retrovirus-mediated gene transfer can only occur prenatally during pregnancy

6. Which of the following occurs in prokaryotes but not in eukaryotes?
   (A) post-transcriptional splicing
   (B) translation in the absence of a ribosome
   (C) concurrent transcription and translation
   (D) gene regulation
   (E) alanine can be added to polypeptide chain by tRNA with different codons

7. A ribozyme is _____.
   (A) a catalyst that uses RNA as a substrate
   (B) an enzyme that synthesizes RNA as part of the transcription process
   (C) an enzyme that catalyzes the association between the large and small ribosomal subunits
   (D) an RNA with catalytic activity
   (E) an important component of RNA transport from nucleus to cytoplasm.

8. A mutant bacterial cell has a defective aminoacyl-tRNA synthetase that attaches a lysine to tRNAs with the anticodon AAA instead of the normal phenylalanine. The consequence of this for the cell will be that _____.
   (A) the positions of phenylalanine in proteins will still encode phenylalanine
   (B) the cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons
   (C) the cell is not able to synthesize lysine
   (D) the ribosome will skip a codon every time a UUU is encountered
   (E) proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU

9. A mutation that inactivates a regulatory gene of a repressible operon in an E. coli cell would result in _____.
   (A) continuous transcription of the structural gene controlled by that regulator
   (B) irreversible binding of the repressor to the operator
   (C) complete inhibition of transcription of the structural gene controlled by that regulator
   (D) continuous translation of the mRNA because of alteration of its structure
   (E) defects in cell division

10. The primary difference between enhancers and promoter-proximal elements is that enhancers _____.
   (A) enhance transcription; promoter-proximal elements inhibit transcription
   (B) are transcription factors; promoter-proximal elements are DNA sequences
   (C) are at considerable distances from the promoter; promoter-proximal elements are close to the promoter
   (D) are DNA sequences; promoter-proximal elements are also DNA sequences
   (E) are only identified in eukaryotic cells but not in prokaryotic cells.

接次頁

11. To introduce a particular piece of DNA into a plant, you would most likely be successful with which of the following methods?
(A) construction of a recombinant lambda phage carrying the specific DNA.
(B) introducing a plasmid into the cell
(C) infecting the plant cell with a Ti plasmid
(D) transcription and translation
(E) electroporation followed by recombination

12. Which of the following status may reflect what we know about how the flu virus moves between species?
(A) An animal such as a pig is infected with more than one virus, genetic recombination occurs, the new virus mutates, the virus is passed to a new species such as a bird, and the virus mutates again and can now be transmitted to humans.
(B) The flu virus in a pig is mutated and replicated in alternate arrangements so that humans who eat the pig products can be infected.
(C) An influenza virus gains new sequences of DNA from another virus, such as a herpesvirus; this enables it to be transmitted to a human host.
(D) A farmer is infected by human flu and chicken flu viruses at the same time and the recombinant virus could become highly contagious and virulent for human.
(E) There is no avian flu virus can directly infect human.

13. Please select all the correct description about M phase of cell cycle.
(A) Cyclin dependent kinase 1 (Cdk1) is the key kinase regulate the progression of M phase.
(B) Cellular DNA starts to replicate at M phase.
(C) The nuclear envelope starts to break down at prophase.
(D) The nuclear envelope starts to reorganize at nuclear port complex at telophase.
(E) The nuclear pore complexes are completely disassembled into single molecules before M phase.

14. The product of the p53 gene _____.
(A) causes cells to reduce expression of genes involved in DNA repair
(B) inhibits the cell cycle
(C) allows cells to pass on mutations due to DNA damage
(D) slows down the rate of DNA replication by interfering with the binding of DNA polymerase
(E) locates at the ribosome to ensure RNA translation efficiency

15. Which of the following statements describes the lysogenic cycle of lambda (λ) phage are not correct?
(A) The phage DNA is copied and exits the cell as a phage.
(B) Most of the prophage genes are activated by the product of a particular prophage gene.
(C) The phage genome replicates along with the host genome.
(D) After infection, the viral genes immediately turn the host cell into a lambda-producing

見背面

factory, and the host cell then lyses.

(E) The lysogenic lambda can be induced into lytic cycle.

16. Bacterial cells protect their own DNA from restriction enzymes (endonucleases) by _____.

(A) using DNA ligase to seal the bacterial DNA into a closed circle
(B) adding methyl groups to adenines and cytosines
(C) adding histones to protect the double-stranded DNA
(D) forming "sticky ends" of bacterial DNA to prevent the enzyme (endonuclease) from attaching.
(E) mutation of their genomic sequences to encode alternative proteins.

17. What information is critical to the success of polymerase chain reaction (PCR) itself?

(A) The sequence of restriction-enzyme recognition sites in the DNA to be amplified must be known.
(B) The sequence of restriction-enzyme recognition sites in the DNA to be amplified and in the plasmid where the amplified DNA fragment will be cloned must be known.
(C) The complete DNA sequence of the DNA to be amplified must be known.
(D) The DNA sequence of the ends of the DNA to be amplified must be known.
(E) Similar Tm of both primers in the reaction.

18. Which descriptions are correct for DNA replication.

(A) The specific sites at which DNA unwinding and initiation of replication occur are called origins of replication.
(B) The DNA replicated form a particular origin of the replication is a “replicaon”.
(C) Replicator sequences include initiator binding sites and easily unwound DNA.
(D) Helicase loading is the first step in the initiation of replication in eukaryotes.
(E) Mammalian DNA replication is semiconservative.

19. RNAi methodology uses double-stranded pieces of RNA to trigger breakdown of a specific mRNA or inhibit its translation. For which of the following might this technique be useful?

(A) to destroy an unwanted allele in a homozygous individual
(B) to decrease the concentration of a desired protein
(C) to form a knockout organism that will not pass the deleted sequence to its progeny
(D) to decrease the production from a harmful mutated gene
(E) to facilitate a specific gene be transcribed and translated.

20. Okazaki fragments are _____.

(A) short stretches of DNA formed on the lagging strand
(B) short RNA primers needed for initiation of polymerization
(C) the smallest subunits of DNA polymerase III
(D) fragments of DNA polymerase I that lack 5' →3' exonuclease activity
(E) the non-specific side products of cellular DNA replication detected in eukaryotic nucleus

21. Which property of DNA is (are) crucial for the conservation of genetic information?

(A) the amount of A is the same as the amount of T

接次頁

(B) base-pair complementarity
(C) the ability to form a circular DNA
(D) semiconservative replication
(E) antiparallelism

22. There are 45 different kinds tRNA (anticodons) available to serve as amino acid carriers, but there are 64 mRNA codons. Why aren't the tRNA anticodons and mRNA codons equal in number?
(A) The reason is that some tRNA anticodons can misread some of the mRNA codons, which creates a "wobble" in the tRNA anticodons that can be repaired by RNA repair enzymes.
(B) The reason is that the third base pair on the mRNA codon allows some flexibility (wobble); thus, some tRNA anticodons can recognize more than one mRNA codon.
(C) The reason is that the third base pair on the tRNA allows some flexibility (wobble); thus, some tRNA anticodons can recognize more than one mRNA codon.
(D) The reason is that the tRNA has the flexibility to choose which mRNA codons are necessary for building the polypeptide chain.
(E) This broader recognition occurs because of the nonstandard pairing between bases in the wobble position corresponding to the 3′ base in the mRNA and the complementary 5′ base in the tRNA anticodon.

23. Here are two pieces of DNA, one with an adenine plus thymine content of 40%, and the other with a cytosine plus guanine content of 50%. If both are heated under the same experimental conditions, which of the following statement(s) about Tm of these DNAs is (are) correct?
(A) The DNA with 40% adenine plus thymine will have the higher Tm.
(B) The DNA with 50% adenine plus thymine will have the lower Tm.
(C) The DNA with 50% cytosine plus guanine will have the higher Tm.
(D) Their Tm's will be the same.
(E) There's no way to predict for this information.

24. Which of following statements concerning RNA transcription is (are) false?
(A) The template strand is read in the 3' → 5' direction.
(B) The release of pyrophosphate from a nucleoside triphosphate drives the reaction.
(C) Synthesis of RNA is a very accurate process.
(D) Transcription requires the use of a primer.
(E) RNA synthesis begins at the base in the DNA sequence designated as +1 (plus one).

25. Which of the following general statement(s) about a G protein–coupled receptor is (are) true?
(A) It contains seven transmembrane domains.
(B) It is organized with the N-terminus on the cytoplasmic face of the membrane.
(C) It is organized with the C-terminus on the cytoplasmic face of the membrane.
(D) It uses trimeric G proteins, in which GTP binds to the γ subunit, to transduce signals in cells.

見背面

(E) It uses small GTPase proteins to regulate cell division and cell motility.

26. Which of following statements describes a difference between replication of DNA and transcription of RNA?
(A) Nucleoside triphosphates are the precursors for replication, but nucleoside diphosphates are used for transcription.
(B) Both strands of DNA are copied in replication, but only one is copied in transcription.
(C) Base pairing is used to copy the sequence in replication, but not in transcription.
(D) The chain grows from the 5' to the 3' end in replication, but 3' to 5' in transcription.
(E) RNA Primers are required for replication, but not for transcription.

27. Which of the following statements concerning restriction endonucleases is (are) true?
(A) They protect bacterial cells from invasion by viruses (bacteriophages).
(B) They attack RNA, not DNA.
(C) They attack single-stranded sequences only.
(D) They can produce "sticky ends".
(E) They do not display sequence specificity in their site of attack.

28. Which of the following statement(s) about intracellular second messengers is (are) true?
(A) It is a substance that brings about a desired effect in a cell as a result of a hormone binding to its receptor on the cell surface.
(B) It is a hormone that affects the DNA of the target cell.
(C) It is a specialized form of mRNA.
(D) Cyclic ATP can act as secondary messengers.
(E) Ca2+ can function as a secondary messenger by controlling the flow of Ca2+ into the cells.

29. When electrical current is applied during a gel electrophoresis procedure, the DNA fragments are separated by
(A) electrical charge, positive on one side, negatives on the other.
(B) the number of poly-A tails associated with each one.
(C) their response to the staining chemicals used during the procedure.
(D) the size of the fragments.
(E) the enzyme binding activity sites.

30. You are studying the function of a recently identified gene in C. elegans. You have been performing genetic screens for several months in an attempt to isolate loss-of-function mutations in this gene, but unfortunately you have been unsuccessful. Your advisor suggests that you try another approach to eliminate gene function. Which of the following techniques would accomplish this goal?
(A) Design a repressor to bind to the operon of this gene.
(B) Use a histone deacetylase to induce a transcriptionally inactive state.
(C) Use RNA interference to prevent mRNA translation.
(D) Use a wild type strain and mutagenize it with a UV light.
(E) Use antisense DNA to block RNA transcription.

接次頁

31. Proteins give cells structure and perform most cellular tasks, thus functions of proteins could be regulated via several different ways. Which of the following descriptions about regulating protein function are **CORRECT**?
(A) Proteins are regulated at the level of synthesis, degradation or the intrinsic activity.
(B) Proteins are marked for degradation with ubiquitin tag and then degraded within proteasomes or lysosomes.
(C) Ubiquitination of proteins is irreversible.
(D) Phosphorylation and dephosphorylation covalently regulate protein activity.
(E) Protein activity could be regulated by controlling protein location and concentration.

32. Upon adding more NaCl into a protein solution, the electrostatic interaction between charged groups on the protein surface will be
(A) strengthened due to ion exchange.
(B) strengthened due to charge induction effect.
(C) weakened due to charge induction effect.
(D) weakened due to shielding effect.
(E) will not be effected.

33. Once transcription is finished and the primary RNA transcript is produced, it must undergo various processing reactions to yield functional RNAs. Which of the following descriptions about pre-mRNA processing are **CORRECT?**
(A) In eukaryotic cells, pre-mRNAs are processed by 5' capping, 3' cleavage, polyadenylation and splicing in the cytoplasm.
(B) Spliceosome is a large ribonucleoprotein complex catalyzing two transesterification reactions that joint two exons and remove the intron as a lariat structure.
(C) Translation can be repressed by micro RNAs (miRNAs), which form imperfect hybrids with sequences in the 3' untranslated region (UTR) of specific target mRNAs.
(D) RNA interference, which probably evolved as an early defense system against viruses and transposons, leads to degradation of mRNAs that form perfect hybrids with short interfering RNAs (siRNAs).
(E) Many mRNA are transported to specific subcellular location by sequence-specific DNA-binding protein thus permit production of proteins at specific regions.

34. Which of the following descriptions about eukaryotic cells are **CORRECT**?
(A) Eukaryotic cells gain many advantages from organelle development.
(B) Phospholipids are the conserved building blocks of cellular membranes.
(C) Eukaryotic cells utilize a similar cycle to regulate their division.
(D) The genetic information is carried and passed by the messenger ribonucleic acid (mRNA) in most eukaryotes.
(E) Bacteria are eukaryotes and widely used in biology research.

35. Which of the flowing descriptions about gene structure and chromosomal organization are **CORRECT**?
(A) A gene is the entire DNA sequence required for synthesis of a functional protein or RNA molecule, including coding region, control region and intron.

見背面

(B) Many genes encode functional RNAs that are not translated into proteins but perform significant functions, such as rRNA, tRAN, and snRNAs. Among these are the exception micro RNAs (miRNAs), although up to 1000 in humans, have no any biological significance.
(C) Although DNA transposons occur in eukaryotes, retrotransposons generally are much more abundant in vertebrates.
(D) Each eukaryotic chromosome contains a single DNA molecular packaged into nucleosomes and folded into a 30-nm chromatin fiber.
(E) In eukaryotic cells, the organization of DNA into chromatin allows a mechanism for regulation of gene expression.

36. Which of the flowing descriptions about transcriptional control of gene expression are **CORRECT?**
(A) Gene expression in both prokaryotes and eukaryotes is regulated primarily by mechanisms that control the initiation of transcription.
(B) The primary purpose of gene control in multicellular organisms is the execution of precise developmental decisions so that the proper genes are expressed in the proper cells.
(C) Enhancers direct binding of RNA polymerase II to DNA, determine the site of transcription initiation, and influence transcription rate.
(D) The activity of many transcription factors are indirectly regulated by binding of extracellular proteins and peptides to cell-surface receptors.
(E) Epigenetic control of transcription refers to repression or activation that is maintained after cells replicate as the result of DNA methylation or post-translational modification of histones.

37. The advanced fluorescent microscopy not only leads the development of cell biology, but also facilitates the progress of molecular biology. Which of the following descriptions about microscopy are **CORRECT?**
(A) The resolution of light microscope, about 0.2 micro-meter, is limited by the wavelength of light.
(B) Confocal microscopy provides better resolution in fluorescent imaging by removing out-of-focus fluorescent signals.
(C) Electron microscopy gives better resolution by providing shorter wavelength of illumination source.
(D) Total internal refection fluorescence (TIRF) microscopy allows fluorescent sample very close to a coverslip to be seen with great clarity.
(E) Super-resolution microscopy allows for detailed fluorescent images at nanometer resolution by using shorter wavelength of light.

38. Plasma membrane defines the cell and separates the inside from the outside. Which of the following descriptions about the characteristics of biomembranes are **CORRECT?**
(A) Biomemrbranes contain three principle classes of lipids: phosphoglycerides, sphingolipids and sterols.
(B) Most lipids and many proteins are laterally mobile in biomembranes.

接次頁

(C) The asymmetry of lipid composition across the membrane bilayer is a characteristic of all biomembranes, yet the lipid composition would not influence the physical properties of membranes.
(D) The shape of membrane can be changed by transmembrane or peripheral membrane proteins.
(E) Lipid droplets are storage vesicles for lipids, originating in the ER.

39. The existence of water channel had been proposed since 1970 but was eventually identified till 1992 by Peter Agre. Which of the following sentences could support the existing of water channel on the membrane of a cell?
(A) The transport of water is ATP-independent.
(B) Red blood cells, but not the frog eggs, swell with water.
(C) Mercurials would inhibit water transport in red blood cells.
(D) There is a maximal rate (Vmax) for water transport of red blood cells.
(E) Water (H2O) crosses through the red blood cell membrane with almost no resistance, while acid hydronium ion (H3O+) does not permeate.

40. Cells convert external nutrients as sources of energy into biologically universal, intracellular, chemical energy carrier, adenosine triphosphate (ATP). Which of the following descriptions about cellular energetics are **CORRECT?**
(A) Glucose oxidation in eukaryotic cells can be divided into four stages: glycolysis, citric acid cycle, electron transport chain and ATP synthesis, where all take place in mitochondria.
(B) The oxidation of short- to long-chain fatty acids occurs in mitochondria with production of ATP, whereas oxidation of very long-chain fatty acids occurs primarily in peroxisomes and is not linked to ATP production.
(C) The rate of glucose oxidation via glycolysis is regulated by the inhibition or stimulation of several enzymes, depending on the cell's need for ATP.
(D) Neither glycolysis nor the citric acid cycle directly use molecular oxygen.
(E) ATP synthase catalyzes ATP synthesis as electron flow through the inner mitochondrial membrane down their electrochemical gradient.

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