

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. Regarding to vaccines which statement is NOT CORRECT?
 - (A) In history, Edward Jenner used cow pox to administer to humans to protect against smallpox, which is the origin of vaccination
 - (B) Vaccines are dead or inactivated organisms or purified products derived from them
 - (C) Vaccines kill virus or bacteria directly
 - (D) Repeated vaccination provides better immune response, because it generates long-lived immunological memory
 - (E) Tamiflu, the drug developed by the Roche for H5N1 avian flu is an example of vaccine

2. Regarding to cytokine receptor-mediated signal transduction which statements are NOT CORRECT?
 - (A) It usually starts with ligation of ligand with its receptor
 - (B) Dimerization or oligomerization of receptors triggers activation of kinases
 - (C) Most of the kinases involved in cytokine signaling are receptor tyrosine kinases
 - (D) The activated kinases will then phosphorylate signal transducers and activator of transcription (STAT) protein by serine phosphorylation
 - (E) The activated STATs will form trimers, translocate into nucleus and transactivate downstream genes

3. Which abbreviations of amino acid are NOT CORRECT?
 - (A) R=aspartic acid
 - (B) W= tryptophan
 - (C) D=glutamic acid
 - (D) G=glutamine
 - (E) S=serine

4. Regarding to green fluorescent protein (GFP) which statements are NOT CORRECT?
 - (A) The gene encodes GFP is originally cloned from firefly
 - (B) It can be used as an indicator of transfection or transduction rate in cells
 - (C) It can be expressed in certain organs or whole body of experimental animals such as mice
 - (D) It is called because it can emit green light without excitation
 - (E) It can be fused to a protein of interest or expressed separately as a reporter

5. Regarding to polymerase chain reaction (PCR) which statements are CORRECT?
 - (A) The method relies on thermal cycling, consisting of cycles of repeated heating and cooling of the reaction for DNA melting and enzymatic replication of the DNA
 - (B) Mullis was awarded the Nobel Prize in Chemistry for his work on PCR
 - (C) This is a powerful tool for forensic science
 - (D) The polymerase used in this reaction is a heat-stable polymerase isolated in the organisms growing in hot spring
 - (E) If the template DNA sequence is AATTCCGG, the 3' PCR primer sequence is 5'-TTAAGGCC-3'

6. Regarding to telomere which statements are CORRECT?
- (A) It is a structure at the end of chromosome
 - (B) It is a region of repetitive DNA sequence which protects the chromosomes from degradation
 - (C) The telomere shortening mechanism normally limits cells to a fixed number of divisions
 - (D) It protects chromosomes from fusing with each other or rearranging
 - (E) Telomerase is an enzyme that adds DNA sequence repeats to the 5' end of DNA strands in the telomere regions
7. Regarding to antibody which statements are NOT CORRECT?
- (A) It has two light chains and two heavy chains
 - (B) It is part of cellular immunity
 - (C) It is secreted by plasma cells or terminally differentiated B cells
 - (D) Major effect of anti-venom (for example snake poison) is due to neutralizing activity of antibody
 - (E) There are different isotypes, including IgA, IgE, IgD, IgM and IgG
8. Which statements regarding to cell cycle are NOT CORRECT?
- (A) It can be divided into G1, S and G2/M phases
 - (B) Most of resting cells are in G2 phase
 - (C) DNA content in G1 phase is twice as much as G2/M phase
 - (D) Dysregulation of cell cycle may occur to tumor cells
 - (E) Fast growing cells have relatively higher percentage of S phase
9. Regarding to genetic manipulation of mice which statements are NOT CORRECT?
- (A) You can not overexpress a non-mouse gene in the mice because it will get rejected by the mouse
 - (B) You can specifically overexpress a gene in a tissue such as brain
 - (C) The technique used for generating knockout mice is different from that for transgenic mice
 - (D) The strategy for knockout mice is to delete the whole gene instead of a couple of exons
 - (E) There is no way to study the function of a gene when knockout of this gene in mice is lethal
10. Which order is correct in terms of magnification power of the following microscopes?
- (A) Confocal microscope > Light microscope > Electron microscope > Atomic force microscope
 - (B) Electron microscope > Atomic force microscope > Confocal microscope > Light microscope
 - (C) Electron microscope > Atomic force microscope > Confocal microscope = Light microscope
 - (D) Atomic force microscope > Electron microscope > Confocal microscope > Light microscope
 - (E) Atomic force microscope > Electron microscope > Confocal microscope = Light microscope
11. Methods measure protein-protein interaction
- (A) Chromatin Immuno-precipitation (ChIP) assay
 - (B) Co-immunoprecipitation (Co-IP)
 - (C) Electrophoretic mobility shift assay (EMSA)
 - (D) RNA interference (RNAi)
 - (E) Yeast two-hybrid assay.

12. Which triggers apoptosis?
(A) Activation of Fas/FasL signal
(B) Activation of IL-17 signal
(C) DNA damage
(D) p53 pathway
(E) Withdrawal of survival factors
13. Which residues of protein could be modified by phosphorylation in modulating the function of protein?
(A) Alanine
(B) Leucine
(C) Serine
(D) Threonine
(E) Tyrosine.
14. Which chemical properties of water help to make it the most abundant compound in cells?
(A) Ability to act as a solvent
(B) Cohesiveness
(C) High specific heat
(D) Hydrophobic property
(E) Temperature-stabilizing capacity.
15. Which of the following enzymes are involved for DNA replication in bacteria?
(A) DNA gyrase
(B) DNA helicase
(C) DNA polymerase
(D) Primase
(E) RAG.
16. Which of the followings are cell junctions between animal cells?
(A) Adhesive junctions
(B) Connective junctions
(C) Gap junctions
(D) Linked junctions
(E) Tight junctions.
17. Which of the followings are the common structural motifs in DNA-binding transcription factors?
(A) Helix-loop-helix
(B) Leucine zipper
(C) Lysine zipper
(D) Magnesium-finger
(E) Zinc-finger.
18. Which of the followings are energy-requiring processes in cells?
(A) Accumulation of molecules against a concentration gradient

- (B) Biosynthesis
- (C) Bioluminescence
- (D) Heat production
- (E) Movement.

19. Which of the followings about mRNA processing in Eukaryotes are correct?

- (A) Addition of 5' cap
- (B) Addition of 3' poly(A)-tail
- (C) Altered mRNA coding sequences by RNA editing
- (D) Different mRNAs generated from same pre-mRNA by alternative splicing
- (E) Removal of exon by splicesomes.

20. What causes cancer?

- (A) Carcinogen
- (B) Ionizing and ultraviolet radiation
- (C) Oncogene
- (D) Pollen
- (E) Viral infection.

21. Which of the following statements about DNA or RNA is/are TRUE?

- (A) Both DNA and RNA nucleotides contain the nitrogen bases adenine, cytosine, and guanine.
- (B) Both DNA and RNA always double helices.
- (C) Both DNA and RNA contain monosaccharide sugars on their respective nucleotides.
- (D) Both DNA and RNA are involved in the "Central Dogma" of biology.
- (E) DNA molecules that exhibit catalytic activity are called ribozymes.

22. Which of the following statements is/are CORRECT?

- (A) Carbohydrates are polymers formed of structural units called monosaccharides.
- (B) Lipids are the only class of macromolecules that contain fatty acids.
- (C) Nucleic acids are polymers formed of building blocks that contain sugars.
- (D) Cholesterol is a common lipid for energy storage.
- (E) DNA, RNA, and ATP contain functional units known as nucleotides.

23. Which of the following statements is/are CORRECT about the *E. coli trp* operon?

- (A) Tryptophan acts as an effector molecule.
- (B) The *trp* operon is subject to catabolite repression.
- (C) Trp repressor protein is activated in the presence of Tryptophan.
- (D) The *trp* operon is subject to translational repression.
- (E) Tryptophan suppresses the expression of the Trp repressor protein.

24. Which of these processes do/does NOT occur in the nucleus of eukaryotes?

- (A) polyadenylation
- (B) pre-mRNA splicing
- (C) 5'-end capping of mRNAs

- (D) translation
(E) none of the above
25. The completion of the S phase of the cell cycle of a mammalian cell is marked by the following :
(A) Histone content per cell is double that of cells in G1.
(B) In replicated DNA, newly incorporated bases are paired with parental bases.
(C) Each replicated chromosome has four telomeres.
(D) Sister chromatids disjoin from one another.
(E) The nucleus contains the equivalent amount of DNA of a tetraploid cell in G1.
26. Which of the following statements about virus is/are CORRECT?
(A) Viroids are tiny, naked molecules of RNA.
(B) All viruses are constructed of RNA with a protein wrapping, called a capsid.
(C) Mad-cow disease is caused by a virus.
(D) The specific white blood cells that HIV attaches to are the CD8-T cells.
(E) The emerging virus SARS is a completely new form of corona virus.
27. Which of the following statements about enzyme/catalyst is/are CORRECT?
(A) All catalysts work by lowering the activation energy for a reaction.
(B) The rate of a reaction is always dependent on the concentration(s) of the reactant(s).
(C) A catalyst has no effect on the ΔG° of a reaction.
(D) When an enzyme is saturated with substrates, it will display first-order kinetics.
(E) A Lineweaver-Burk plot is useful in the analysis of enzymatic reactions.
28. Which of the following statements about GLYCOLYSIS is/are CORRECT?
(A) Each step is catalyzed by a separate enzyme.
(B) In aerobic metabolism, pyruvate loses carbon dioxide, and the remaining two carbonatoms become linked to coenzyme A.
(C) 10 enzymes are used during conversion of glucose to pyruvate.
(D) 32 ATP yield per glucose during glycolysis.
(E) It requires O_2 to generate energy.
29. Which of the following processes is/are required DNA sequence rearrangements?
(A) intron splicing in ciliates
(B) immunoglobulin gene expression in mammals
(C) mating-type switching in yeast
(D) antigen switching in trypanosomes
(E) transposition of bacteriophage Mu
30. Which of the following statements about the general mechanism of DNA synthesis is/are CORRECT?
(A) One strand is made $5' \rightarrow 3'$, while the other strand is made $3' \rightarrow 5'$ in short discontinuous segments.
(B) The strands become separated during synthesis.
(C) Synthesis occurs in both directions from the starting site of synthesis.
(D) Synthesis of DNA is a very accurate process.

(E) None of the above.

31. A mutation in an integrin protein would likely affect which of the following:

- (A) an interruption in signal transduction.
- (B) the failure to mediate Ca^{2+} binding.
- (C) fibronectin binding.
- (D) defects in attachment of the cell to the extracellular matrix.
- (E) communication between the nucleus and cytoskeleton.

32. Lysosomes are vesicles bounded by membranes that contain oxidative enzymes. Which statements regarding to lysosome's functions are correct?

- (A) catalyze the rapid breakdown of macromolecules.
- (B) break down old organelles.
- (C) break down toxic peroxides.
- (D) digest phagocytized pathogens.
- (E) allow bacteria to pass through unaffected.

33. The functions of the cytoskeleton include which of the following:

- (A) providing scaffolding for some proteins in certain areas of the cell.
- (B) providing movement of molecules in the cell.
- (C) involving in intracellular organelle transport.
- (D) ribosome assembly.
- (E) participating in cytokinesis.

34. During which cellular process do ribonucleic acid molecules involve?

- (A) nucleosome formation.
- (B) formation of the nucleolus.
- (C) centriole assembly.
- (D) ribosome assembly.
- (E) DNA replication.

35. Which of the following mutations would be most likely to interfere with the proper insertion of a protein in the plasma membrane?

- (A) amino acid mutation from L \rightarrow V within a transmembrane domain.
- (B) amino acid mutation from M \rightarrow K within a transmembrane domain.
- (C) amino acid mutation from W \rightarrow R within a transmembrane domain.
- (D) amino acid mutation from L \rightarrow K within a cytoplasmic domain.
- (E) amino acid mutation from I \rightarrow A within a cytoplasmic domain.

36. Which of the following statements about receptor-mediated endocytosis is correct?

- (A) Receptor-mediated endocytosis is a dynamic process.
- (B) Receptor-mediated endocytosis requires a clathrin coat.
- (C) Receptor-mediated endocytosis can be used to downregulate transmembrane signal transduction.
- (D) Receptor-mediated endocytosis indirectly increases membrane fluidity by helping to transport

cholesterol into the cell.

(E) Receptor-mediated endocytosis is used to internalize all outside molecules into the cell.

37. Consider the following representation of four chromatids during prophase I shown below. The paternal homologue is in upper case, while the maternal homologue is in lower case. A B C D E F G; A B C D E F G; a b c d e f g; a b c d e f g

During anaphase I, which of the following pairs will move to opposite poles? (For purposes of this question, assume that there were no crossing over events.)

(A) A B C D E F G and a b c d e f g to one pole; A B C D E F G and a b c d e f g to the other pole.

(B) A B C D E F G and A B C D E F G to one pole; a b c d e f g and a b c d e f g to the other pole.

(C) By anaphase I, only two chromatids remain, so A B C D E F G will go to one pole and a b c d e f g will go to the other pole.

(D) By anaphase I, only four chromatids remain, so A B C D E F G and A B C D E F G will go to one pole, and a b c d e f g and a b c d e f g will go to the other pole.

(E) By anaphase I, only four chromatids remain, so A B C D E F G and a b c d e f g will go to one pole, and a b c d e f g and A B C D E F G will go to the other pole.

38. Which of the following statements are incorrect?

(A) A diploid individual carrying two different alleles on its homologous chromosomes is called heterozygote.

(B) Phenotype is the totality of the alleles present in an organism.

(C) The allelic make up of an individual is referred to as its genotype.

(D) A gene for a particular trait that is only expressed in the presence of another gene of the same kind is called a recessive gene.

(E) The observable expression of the genes present is called phenotype.

39. Which one of the following statements about pseudogenes is correct?

(A) DNA sequences similar to functional genes, but do not produce functional products as far as we can tell.

(B) DNA sequences produced in the laboratory and artificially inserted into a genome to investigate their function.

(C) Pseudogenes encode proteins, but the translated proteins are non-functional.

(D) Pseudogenes may have some gene-like features such as a promoter and splice sites.

(E) Genes that have been inserted from a different species, such as by a retrovirus, and may or may not produce a functional product in the new species.

40. Which one of the following statements comparing the human and mouse genomes is false?

(A) The human genome shares over 90% of its genes with the mouse.

(B) Human and mouse have about the similar number of genes.

(C) Conservation of genes has been rare in the two genomes.

(D) Little rearrangement of genes has occurred in the two genomes.

(E) A comparison of genomes confirms that mouse and humans shared a common ancestor more recently than humans and pufferfish.