

※ 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: More than one of the choices provided may be correct. (2.5 points for each question)

- Which of the following steps are involved in generation of recombinant DNA molecules?
(A) DNAs are digested with restriction enzymes.
(B) DNAs are joined by DNA ligases.
(C) DNAs are transfected into *E. coli*.
(D) DNAs are screened with antibiotic pressure.
(E) DNAs are confirmed with DNA sequencing.
- Which of the following methods are applied with flow cytometry?
(A) Gene array (gene-chip) assay
(B) Identification of individual cells by their cell-surface antigens
(C) Intracellular cytokine staining (ICS)
(D) RNA interference (RNAi)
(E) Western blotting
- Which of the following proteins are involved in the rearrangement of immunoglobulin genes?
(A) DNA ligase
(B) Ets-1
(C) NFAT
(D) RAG1
(E) RAG2
- Which of the following snRNP are involved in assembly of the spliceosome?
(A) U1
(B) U2
(C) U3
(D) U4
(E) U5
- Which of the following mechanisms by which protein is/are degraded?
(A) Glycosylation of protein
(B) Lysosomal proteolysis
(C) Methylation of protein
(D) SUMOylation of protein
(E) Ubiquitin-proteasome pathway
- Which of the following components are involved in protein import through the nuclear complex?
(A) Importin
(B) Nuclear localization sequence (NLS)
(C) Nuclear export sequence (NES)
(D) Ran/ATP
(E) Ran/GTP
- Which of the followings are tumor suppressor genes?
(A) *abl*
(B) *c-maf*
(C) *c-myc*
(D) *p53*
(E) *Rb*
- What are the cellular roles of actin-binding proteins?

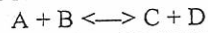
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- (A) Filament cross-linking
(B) Filament de-polymerization
(C) Filament polymerization
(D) Filament stabilization
(E) Monomer binding
9. Which of the followings are cell adhesion molecules?
(A) Cadherins
(B) Integrins
(C) Selectins
(D) T cell receptor (TCR)
(E) Toll-like receptor (TLR)
10. Which of the followings are components of maturation promoting factor (MPF) which regulates the G2 to M transition in eukaryotes?
(A) ATM
(B) Cdk1
(C) Cdk2
(D) Cyclin A
(E) Cyclin B
11. Which of the following statements belong to the central dogma of molecular biology?
(A) DNA can replicate itself
(B) RNA can replicate itself
(C) DNA can transcribe into RNA
(D) RNA can reversely transcribe into DNA
(E) DNA can translate directly into protein
12. Two circular DNAs are isolated, both with 1000 bp. One is supercoiled; the other is not. The two DNAs are placed in an ultracentrifuge.
(A) The supercoiled DNA should sediment faster.
(B) The nonsupercoiled DNA should sediment faster.
(C) They should sediment at the same rate.
(D) The information provided is not enough to determine which will sediment faster.
(E) Ultracentrifugation cannot separate both DNA molecules, because they have the same length of DNA.
13. Regarding to mitochondrion which statements are **CORRECT**?
(A) It is where energy is generated in a cell.
(B) Usually when mitochondria are malfunctioned cells will undergo apoptosis.
(C) Like endoplasmic reticulum (ER), it is single-membraned organelle.
(D) Although it has its own DNA, the codon is exactly the same as nuclear DNA.
(E) The central set of reactions involved in ATP production are collectively known as the citric acid cycle, or the Krebs Cycle.
14. Regarding to apoptosis or program cell death which statements are **CORRECT**?
(A) It can be classified into intrinsic and extrinsic pathways and DNA damage and growth starvation-induced apoptosis belongs to the latter.
(B) Apoptotic cells have features of cell swelling and DNA fragmentation.
(C) The Nobel Prize in Medicine was awarded to the work regarding to apoptosis.
(D) A set of proteases termed caspases are involved in regulating the process of apoptosis.
(E) Apoptosis is a normal physiological process during development and differentiation.
15. Regarding to DNA which statements are **CORRECT**?

- (A) DNA consists of two long polymers of simple units called nucleotides with backbones made of 6-carbon sugars that are joined by phosphodiester bond.
- (B) DNA double helix is stabilized by hydrogen bonds between the bases attached to the two strands.
- (C) If the sequences of the sense strand DNA is 5'-AATTCCGG-3', its mRNA is 5'-CCGGAATT-3'.
- (D) Ethidium bromide, a DNA labeling dye, is a mutagen because it intercalates into DNA and inhibits DNA transcription and replication.
- (E) The four bases found in DNA are classified into purine, such as AT and pyrimidine, such as CG.
16. The followings are stop codons (in DNA) **EXCEPT**
- (A) TGA
- (B) TGG
- (C) TAA
- (D) TAG
- (E) TTA
17. Genetically modified mice (GMM) are powerful tools in biomedical researches. Which statements regarding to GMM are **CORRECT**?
- (A) Transgenic mice are usually introducing an exogenous gene into mice without modifying the endogenous genetic makeup.
- (B) Knockout and knockin mice are essentially using the same techniques.
- (C) PCR technique can be used to do genotyping of the GMM.
- (D) In vivo and in vitro function of a specific gene can be explored using GMM.
- (E) GMM can be used to study gain- or loss-of-function of a gene.
18. Regarding to cytokine and cytokine receptors which statements are **CORRECT**?
- (A) Binding of cytokines to receptor usually triggers dimerization or oligomerization of the receptor subunits
- (B) Tyrosine phosphorylation on receptor will recruit signal molecules that contain SH2 domain
- (C) Termination of the signaling may be mediated by phosphatases or by ubiquitin-mediated degradation
- (D) Cytokines can action in autocrine or paracrine but not endocrine mode because the half-life of cytokines are relatively short in vivo
- (E) Most of cytokines are expressed constitutively at high levels ready for combating infectious agents
19. Which methods are often used to detect protein-protein interactions?
- (A) Chromatin immunoprecipitation (ChIP)
- (B) Immunoprecipitation
- (C) DNA Microarray
- (D) Fluorescence resonance energy transfer (FRET)
- (E) Yeast two-hybrid
20. Regarding to monoclonal antibodies (mAbs), which statements are **CORRECT**?
- (A) The principle of mAbs is to fuse myeloma cells that have indefinite life span with B cells that can produce antibodies.
- (B) One monoclonal antibody can recognize several antigenic determinants.
- (C) mAbs can be used as therapeutic agents to treat patients with cancers and autoimmune diseases.
- (D) The Nobel Prize in Medicine was awarded to the discovery of mAb.
- (E) So far, scientists can generate mAbs from mouse and rat origin but not from human origin.
21. Which of the following statements is/are **TRUE** about "VIRUS"?
- (A) A viral genome is always single-stranded.
- (B) A viral genome is composed of DNA or RNA.
- (C) The capsid of a virus is composed of lipid.
- (D) A virus life cycle that involves the incorporation of the viral DNA into the host chromosome is

lysogeny.

(E) viruses CANNOT infect plants.

22. Consider this reaction which has a $\Delta G^\circ = +0.4 \text{ kJ/mol}$.

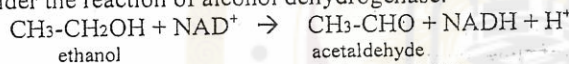
1M A, 1M B, 0.1M C and 0.1M D are added to a container at room temperature. Which of the following statements is/are TRUE?

- (A) The reaction will proceed in the forward direction to reach equilibrium.
- (B) The reaction will proceed in the backward direction to reach equilibrium.
- (C) $\Delta G < 0$ (i.e., it's negative)
- (D) $\Delta G = 0$
- (E) $\Delta G > 0$

23. How do eukaryotic ribosomes prevent false starts at inappropriate parts of the mRNA?

- (A) The Shine-Dalgarno sequence positions the ribosome properly, before the start codon.
- (B) There is a consensus sequence, called the Kozak sequence, surrounding the start codon in eukaryotes.
- (C) Only one start codon ever appears in eukaryotic mRNA, so false starts are not a problem.
- (D) False starts are quite common in eukaryotic translation.
- (E) ribosome's will be only assembled around the start codon.

24. Consider the reaction of alcohol dehydrogenase.



ethanol

acetaldehyde

Which of the following statements is/are TRUE?

- (A) NAD^+ is the oxidizing agent.
- (B) Ethanol is the oxidizing agent.
- (C) NAD^+ is reduced.
- (D) Ethanol loses electrons
- (E) In general, the anabolic pathways tend to involve oxidation reactions.

25. Which of the following statements is/are TRUE?

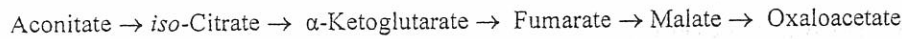
- (A) Liver cells can use acetyl-CoA to make pyruvate, which can then be converted into glucose by gluconeogenesis.
- (B) Under extreme starvation the brain can use ketone bodies for energy.
- (C) The liver is the only organ that can break down fatty acids into acetyl-CoA.
- (D) The liver is the only organ that can synthesize fatty acids from acetyl-CoA.
- (E) None of the above

26. Which of the following statements about "Glycolysis" is/are TRUE?

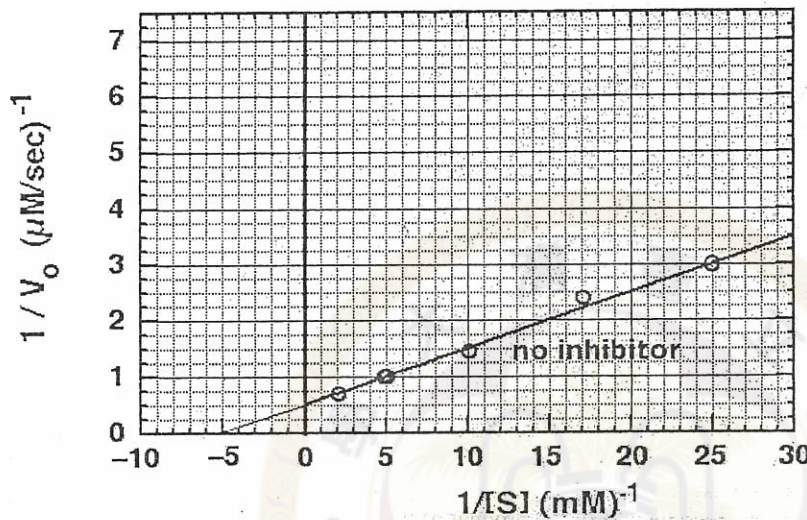
- (A) In humans, pyruvate can be converted to acetyl-CoA and lactate.
- (B) 12 different enzymes are used during conversion of glucose to pyruvate.
- (C) The order of compounds in the conversion of glucose to pyruvic acid is as follows:
Fructose-6-phosphate, fructose-bisphosphate, 1,3-phosphoglyceric acid, 3-phosphoglyceric acid, phosphoenolpyruvate.
- (D) Enolase catalyzes the dehydration of 2-phosphoglycerate.
- (E) 2 ATP are produced per glucose during glycolysis.

27. Which of the following statements about "The Citric Acid Cycle" is/are CORRECT?

- (A) The Citric Acid Cycle is involved in the metabolism of amino acids and lipids.
- (B) The majority of the reactions of the citric acid cycle take place in the endoplasmic reticulum.
- (C) The immediate electron acceptor for the majority of the oxidative reactions of the citric acid cycle is ATP.
- (D) The pyruvate dehydrogenase complex is composed of three distinct enzymes.
- (E) The order of compounds and intermediates found in the citric acid cycle is as follows:



28. Below is a Lineweaver-Burk (double reciprocal) plot, $1/V_o$ vs. $1/[S]$ for an enzyme in the absence of any inhibitor.



Which of the following statements is/are CORRECT?

- (A) The K_m for this enzyme in the absence of inhibitor is 0.2 mM
- (B) The V_{max} for this enzyme in the absence of inhibitor is 0.2 µM/sec
- (C) The K_m for this enzyme in the absence of inhibitor is 2.0 mM
- (D) The V_{max} for this enzyme in the absence of inhibitor is 2.0 µM/sec
- (E) The K_m for this enzyme in the absence of inhibitor is -5.0 mM

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

- (A) Phospholipases break down fats by hydrolyzing them.
- (B) Many snake venoms contain phospholipases, whose enzymatic activities act to prevent blood clotting.
- (C) Control of release of fatty acids from triacylglycerols in adipocytes involves cyclic AMP as a second messenger.
- (D) Two-carbon units are successively eliminated with each round of β -oxidation of fatty acids.
- (E) The metabolically activated form of a fatty acid is a thioester.

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

- (A) The light reactions drive the redox process that involves H_2O/O_2 and $NADH/NAD^+$
- (B) Light energy absorbed in chloroplasts is used in the light phase to reduce water.
- (C) The oxygen evolving complex consists of ferredoxin.
- (D) The electrons used in photosynthesis come first from water (H_2O).
- (E) The synthesis of ATP in chloroplasts uses a proton gradient similar to the one used in mitochondria.

31. Which statements about water molecule are correct?

- (A) The electrons of water molecule are distributed symmetrically in the molecule.
- (B) The hydrogen atoms of water molecule are found on one "side" of the molecule.
- (C) The hydrogen bonds give water a lower boiling point than expected.
- (D) It is a bent molecule.
- (E) The hydrogen bonds play a role in the solvent properties of water.

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32. Which statements about amino acids are correct?
- (A) Asn has a hydrophilic side chain.
 - (B) Thr has hydroxyl as side chain.
 - (C) The side chain of Leu can form hydrogen bond to other residues.
 - (D) The side chain of Met is a poor hydrogen bond donor.
 - (E) Arg has a basic side chain.
33. Which statements about competitive inhibition are incorrect?
- (A) Competitive inhibitors bind to the enzyme at a site other than the active site.
 - (B) Competitive inhibitors modify the K_m value.
 - (C) Increasing the concentration of substrates can overcome the effect of competitive inhibitors.
 - (D) The value of V_{max} decreases.
 - (E) The binding of competitive inhibitors to enzyme is reversible.
34. Kinases usually transfer phosphates from
- (A) $NADP^+/NADPH$ in their reactions.
 - (B) inorganic phosphate.
 - (C) $NAD^+/NADH$.
 - (D) Adenosine-5'-triphosphate.
 - (E) amino acids.
35. Which of the following statements is/are false?
- (A) The amino acids in the active site can become part of the product of the reaction.
 - (B) The pH profile of an enzyme usually helps identify specific amino acids in the active site.
 - (C) Amphipathic means having both positive and negative charges.
 - (D) The rate of a reaction is always dependent on the concentration(s) of the reactant(s).
 - (E) Thermodynamically favorable reactions all release energy.
36. Which of the following statements is/are true?
- (A) The fatty acids in triacylglycerols vary, but all phosphoacylglycerols have the same fatty acids in them.
 - (B) Most fatty acids occurring in living systems contain an even number of carbons.
 - (C) Unsaturated fatty acids usually have trans double bonds.
 - (D) Steroids are considered as lipids.
 - (E) Glycolipids are particularly important in the brain and nervous system.
37. Which of the following statements is/are true?
- (A) Membrane lipids in a lipid bilayer are held together by electrostatic forces.
 - (B) Only one stereoisomer is ever seen at the chiral C-2 of the glycerol residue in a membrane lipid.
 - (C) The two leaves of a bilayer contain different collections of lipids and proteins.
 - (D) The presence of *cis*-double bonds in fatty acids doesn't have any specific effect on fluidity.
 - (E) When a membrane reaches its transition temperature, integral membrane proteins dissociate from the bilayer.
38. Briefly washing cells in a buffered solution at pH 11 is effective for isolating a cell membrane-associated hormone receptor. (A standard growth solution for the cells is pH 7.) Which of following best fits this description?
- (A) This is an integral membrane protein that completely traverses the cell membrane.
 - (B) This is an integral membrane protein that only penetrates one leaf of the cell membrane.
 - (C) This is a peripheral membrane protein that probably interacts with membrane phospholipids using aspartate-mediated salt bridges.
 - (D) This is a peripheral membrane protein that probably interacts with membrane phospholipids using lysine-mediated salt bridges.
 - (E) This is a peripheral membrane protein that probably interacts with membrane phospholipids using

hydrogen bonds.

39. Which of the following statements is/are incorrect?
- (A) Wobble allows a single codon to code for more than one amino acid.
 - (B) Wobble allows each codon to interact with more than one tRNA.
 - (C) In the wobble phenomenon, the base that wobbles is found in the mRNA.
 - (D) The genetic code is said to be degenerate. This means that each anticodon can interact with many different triplet sequences in the mRNA, which may differ in any or all of the three nucleotides.
 - (E) The advantage of degeneracy in the genetic code is that fewer tRNA molecules are needed.
40. Two DNA molecules with 2015 bp; DNA I with cytosine plus guanine content of 30%, and DNA II with adenosine plus thymidine content of 70%. If both are heated under the same experimental conditions, which of the followings are correct?
- (A) DNA I will have the higher T_m .
 - (B) DNA II will have the higher T_m .
 - (C) Both will have the same T_m .
 - (D) More energy will be required to open DNA I than DNA II.
 - (E) Not enough information to predict the T_m for both molecules.

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