

※ 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)

1. Which of the following methods are used to measure cell apoptosis
(A) Chromatin Immuno-precipitation (ChIP) assay
(B) Annexin V staining
(C) DNA ladder assay
(D) RNA interference (RNAi)
(E) TUNEL assay.
2. Which of the following sites protein glycosylation are undergoing:
(A) Endoplasmic reticulum
(B) Golgi apparatus
(C) trans-Golgi network
(D) nucleus
(E) secretory vesicle
3. Signal transduction is critical for cells to respond to various stimuli. Which statements regarding to signal transduction are CORRECT?
(A) Conformational changes of receptors on the cells occur upon ligand binding
(B) Post-translational modifications of signal mediators are accompanied by the conformational changes of receptors
(C) Proteins can be recruited to the receptors before the modifications
(D) Transcriptional factors are eventually activated and translocated into nucleus
(E) Downstream genes are induced by the end of the signaling
4. Generation of combinatorial diversity among immunoglobulins involves the following:
(A) CTLA-4 gene
(B) RAG-1 and RAG-2 gene
(C) recombination signal sequences
(D) TdT enzyme
(E) HDAC gene
5. Which are involved in regulation of apoptosis ?
(A) Bcl-2
(B) Bcl-6
(C) Caspase 8
(D) cFLIP
(E) TLR
6. Which of the methods are used to measure cell proliferation
(A) ³H-Thymidine incorporation
(B) BrdU incorporation
(C) PI staining
(D) CFSE staining

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(E) TUNEL staining

7. Which abbreviations of amino acid are **NOT CORRECT**?

- (A) D= tyrosine
- (B) P=Phenylalaine
- (C) G=glutamic acid
- (D) A=aniline
- (E) K=tryptophan

8. Which of the following proteins are glycoprotein:

- (A) MHC
- (B) CRISPR/Cas9
- (C) GM-CSF
- (D) CD4
- (E) Antibody

9. Which molecule is located within the mitochondria?

- (A) Bcl-2
- (B) Bax
- (C) Caspase 3
- (D) FLIP
- (E) cytochrome c

10. Which cytokine is produced by macrophage?

- (A) IL-1
- (B) IL-2
- (C) IL-6
- (D) IL-17
- (E) TNF

11. Which of the following experimental approaches are used to manipulate the gene expression in cells?

- (A) Flow cytometry
- (B) Gene knockout (KO)
- (C) Gene transfer
- (D) RNA interference (RNAi)
- (E) Yeast two-hybrid.

12. Which of the following molecules are involved in the glycolytic metabolic pathway?

- (A) Fatty acid
- (B) Glucose
- (C) Glutamine
- (D) Lactate
- (E) Pyruvate

13. Which of the following histone post-translational modifications are associated with active or repressed genes?

- (A) Acetylated lysine
(B) Methylated arginine
(C) Methylated lysine
(D) Phosphorylated serine/threonine
(E) Ubiquitinated lysine.
14. Which of the following signaling pathways are controlled by ubiquitinylation and protein degradation?
(A) Hedgehog
(B) NF- κ B
(C) Notch/Delta
(D) Ras/MAP kinase
(E) Wnt.
15. Which are the class II major histocompatibility complex (MHC) proteins in humans?
(A) HLA-A
(B) HLA-B
(C) HLA-C
(D) HLA-DQ
(E) HLA-DR.
16. What are the steps in cell locomotion?
(A) Extension
(B) Adhesion
(C) Synapse formation
(D) Translocation
(E) De-adhesion and endocytic recycling.
17. What are the stages of mitosis?
(A) Anaphase
(B) Interphase
(C) Metaphase
(D) Prophase
(E) Telophase.
18. What are the master transcription factors regulating pluripotency of embryonic stem (ES) cells?
(A) AP-1
(B) Nanog
(C) Oct4
(D) Pax5
(E) Sox2.
19. Which one of following description about human immunodeficiency virus (HIV) is CORRECT?
(A) AIDS is a major disease burden in the world.

- (B) HIV infects and replicates within cells of the immune system.
(C) The rapid replication rate of HIV and lack of proofreading mechanism in the viral reverse transcriptase cause the high mutation rate.
(D) CD4 T cells are important to control HIV infection and eliminate it in the end.
(E) Prevention and education are important in controlling the spread of HIV and AIDS.
20. What are the changes in cell cause cancer?
(A) Sustain proliferative signaling
(B) Evade growth suppressors
(C) Enable replicative immortality
(D) Suppress angiogenesis
(E) Induce cell death.
21. Which is/are the molecule used to conserve energy?
(A) ATP
(B) QH₂
(C) FAD
(D) NADH
(E) Acetyl CoA
22. Which of the following is/are **required** for optimal DNA replication?
(A) Primase
(B) DNA Polymerase II
(C) Single strand binding proteins
(D) Gyrase
(E) None of the above.
23. Which of the following statements is/are **TRUE**?
(A) In eukaryotic cells, chromosomes are composed of DNA and proteins.
(B) The microtubule-organizing center found in animal cells is an identifiable structure present during all phases of the cell cycle. Specifically, it is known as the kinetochore.
(C) The mitotic spindle is a microtubular structure that is involved in separation of sister chromatids.
(D) Metaphase is characterized by separation of sister chromatids.
(E) In human and many other eukaryotic species' cells, the nuclear membrane has to disappear to permit the attachment of microtubules to kinetochores.
24. Which of the following is/are **TRUE**? Both chloroplasts and mitochondria ____?
(A) have multiple membranes.
(B) are capable of reproducing themselves.
(C) are part of the endomembrane system.
(D) have their own DNA
(E) none of the above.
25. Which of the following statements is/are **TRUE**?
(A) Phenylketonuria is an inherited disease caused by a recessive autosomal allele. If a

woman and her husband are both carriers, the probability that their first child will be a phenotypically normal girl is $3/8$.

- (B) Assuming independent assortment for all gene pairs, the probability that the following parents, $AABbCc \times AaBbCc$, will produce an $AaBbCc$ offspring is $1/16$.
- (C) Suppose two $AaBbCc$ individuals are mated. Assuming that the genes are not linked, the probability of the offspring that are homozygous recessive for the three traits is $1/64$.
- (D) Albinism is an autosomal recessive trait. A man and woman are both of normal pigmentation, but both have one parent who is albino (without melanin pigmentation). The probability that their first child will be an albino is $1/4$.
- (E) When Mendel crossed yellow-seeded and green-seeded pea plants, all the offspring were yellow seeded. When he took these F_1 yellow-seeded plants and crossed them to green-seeded plants, the genotypic ratio was expected to be 1:1.

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

- (A) Pyruvate is a product of glycolysis and a precursor of gluconeogenesis.
- (B) 2 ATP molecules are consumed in the hexose stage of glycolysis for every one molecule of glucose.
- (C) Glyceraldehyde 3-phosphate dehydrogenase causes the oxidation of a molecule of NAD^+ to NADH.
- (D) Phosphofructokinase I deficiency results in an overproduction of Fructose 6-phosphate.
- (E) Lactate reductase catalyzes the conversion of pyruvate to lactate.

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

- (A) In eukaryotes the enzymes of the citric acid cycle are found in the endoplasmic reticulum.
- (B) The net effect of the eight steps of the citric acid cycle is to completely oxidize an acetyl group to carbon dioxide.
- (C) After passing through pyruvate dehydrogenase and the citric acid cycle, one mole of pyruvate will result in the formation of 3 moles of carbon dioxide.
- (D) After passing through pyruvate dehydrogenase and the citric acid cycle, one mole of pyruvate will result in the formation of 2 moles of ATP.
- (E) FMN is NOT produced by the citric acid cycle.

28. Which of the following statements about "Electron Transport" is/are **TRUE**?

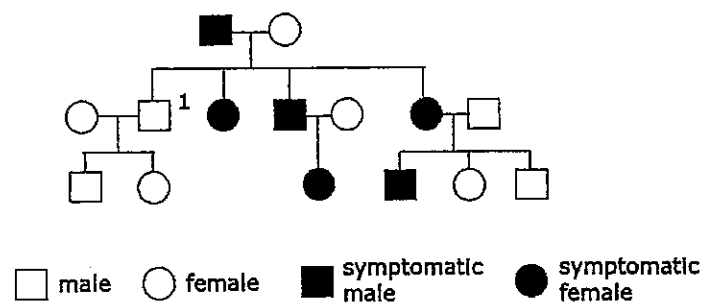
- (A) 2 protons are translocated across the membrane by complex I for every pair of electrons that are passed from NADH to QH_2 ?
- (B) The role of FMN in complex I is to convert a one-electron transfer to a two-electron transfer.
- (C) The ultimate electron acceptor from complex II is Q.
- (D) The terminal electron acceptor for complex III of the electron transport chain is cytochrome c.
- (E) The synthesis of one molecule of ATP from ADP requires 1 mole of protons to be translocated across the inner mitochondrial membrane.

29. Which of the following statements about "Nucleic Acids" is/are **TRUE**?
- (A) Purines which are found mainly in both deoxyribonucleotides and ribonucleotides are adenine and thymine.
 - (B) In DNA, phosphodiester bonds form with hydroxyl groups of carbons number 3' and 5' of each deoxyribose sugar.
 - (C) rRNA carries activated amino acids to the ribosome for assembly into proteins.
 - (D) RNA contains uracil; DNA usually does not.
 - (E) The two strands of double-stranded DNA have the same content of each of the bases A, T, G and C.
30. Which of the following statements about "Enzymes" is/are **TRUE**?
- (A) The rate of a reaction is always dependent on the concentration(s) of the reactant(s).
 - (B) All catalysts work by lowering the activation energy for a reaction.
 - (C) The sign of Gibb's Free Energy is positive ("+") when energy is released.
 - (D) The K_m of hexokinase for glucose = 0.15 mM and for fructose, K_m = 1.5 mM. Fructose is the preferred substrate.
 - (E) A noncompetitive inhibitor binds to the enzyme at a site other than the active site.
31. Which of the following descriptions about immune responses is (are) **CORRECT**?
- (A) Antigen recognition by T cells requires a unique, non-self epitope complexed to a self, MHC molecule.
 - (B) CD8 T cells mediate cytokine production to help B cells produce antibodies, whereas CD4 T cells are involved in cytotoxic killing of infected cells.
 - (C) Immature T cells are selected both positively for MHC interaction and negatively for autoimmunity in the thymus.
 - (D) IgD is the major isotype of antibodies produced in allergic responses.
 - (E) Professional antigen-presenting cells include dendritic cells, neutrophils and B cells
32. Which of the following hormones is (are) synthesized and secreted from the axon terminals of hypothalamic neurons that project to the posterior pituitary gland?
- (A) Gonadotropins
 - (B) Vasopressin
 - (C) Melanocortins
 - (D) Thyroid stimulating hormone (TSH)
 - (E) Oxytocin
33. Which of the following statements is (are) **CORRECT**?
- (A) Retinal ganglion cells use photopigments to capture photons, which is the basis of vision
 - (B) Cilia in the inner hair cells are activated by mechanical signals generated by shock waves transmitted in the endolymph
 - (C) High-threshold mechanoreceptors in the skin detect non-harmful, gentle touch
 - (D) Free nerve endings detect noxious, harmful stimulation of high intensity
 - (E) Specialized muscle fibers serve as interoceptors to detect the stretch of contractile muscle fibers

34. Which of the following statements about animal development is (are) CORRECT?
- (A) The ectoderm gives rise to the skin tissues and the nervous system
 - (B) Muscle and bones are derived from the mesoderm
 - (C) Failure of neural tube closure at the anterior end results in extrusion of spinal cord tissues and the overlying meninges
 - (D) Programmed cell death is a critical step in pattern formation of animal development
 - (E) The potential of a primitive cell to develop into different tissues is progressively restricted as the development proceeds
35. Which of the following statements about prokaryotes and eukaryotes is (are) CORRECT?
- (A) They both have ribosomes
 - (B) They both have mitochondria
 - (C) Classification of prokaryotes is done currently by sequencing messenger RNAs
 - (D) Cell wall composed of cellulose is a universal feature of eukaryotic cells
 - (E) Eukaryotes form endospores that show strong resistance to environmental stress
36. Which of the following statements about animal reproduction is (are) CORRECT?
- (A) Germ line tissues are usually induced by interaction between somatic cells
 - (B) Germ line is segregated from somatic tissues since very early stage of development
 - (C) Parthenogenesis is a form of asexual reproduction in which embryonic development occurs without fertilization
 - (D) Hermaphroditic reproduction, similar to parthenogenesis, occurs without fertilization
 - (E) Sexual reproduction has the advantage of diversification of genomic composition and may increase the fitness of the species under selection pressure of the environment
37. Which of the following processes is (are) energy-driven?
- (A) Glucose transport across the apical (luminal) membrane of the intestinal epithelium
 - (B) Entry of water into the cell under hypotonic condition
 - (C) Accumulation of calcium into mitochondria and endoplasmic reticulum
 - (D) Exchange of intracellular Na^+ for extracellular K^+ in the neuron
 - (E) Movement of kinesin and dynein along microtubule scaffolds
38. Which of the following statements about signal transduction is (are) CORRECT?
- (A) Receptor tyrosine kinases are usually activated by dimerization and cis-phosphorylation
 - (B) The diversity of heterotrimeric G protein complexes is primarily conferred by various $G\beta$ and $G\gamma$ subunits
 - (C) Binding of the catalytic subunit of protein kinase A (PKA) by the regulatory subunit activates PKA enzymatic activity
 - (D) Nuclear hormone receptors translocate into the nucleus upon ligand binding-activation, and can directly bind DNA to regulate gene expression
 - (E) Phosphatidylinositol 4,5-bisphosphate (PIP_2) is catalyzed by phospholipase C to generate inositol 1,4,5-triphosphate (IP_3) and triglycerides
39. Which of the following mechanisms allow(s) the inheritance of phenotypic traits in the absence of DNA sequence alteration?

- (A) Prion-like proteinaceous transmission in yeast
- (B) noncoding, regulatory RNAs
- (C) Transposons
- (D) Histone posttranslational modifications
- (E) Inheritance of maternal ribosomes

40. The following pedigree shows the transmission of a genetic disease of mid-age onset (~40 year old) characterized by progressive motor and cognitive dysfunction.



Which of the following statements is (are) CORRECT?

- (A) The mutation that causes this disease is dominant
- (B) The mutation is very likely to be in the mitochondrial genome
- (C) The asymptomatic (= without symptoms) male (subject 1) in the second generation of this family is a carrier of the mutation
- (D) Linkage mapping and genome-wide association study may help to identify this mutation
- (E) The segregation of symptomatic subjects suggests a Mendelian pattern of transmission

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