※ 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」。

單一選擇題共 40 題，A. B. C. D. E. 五選一，答錯不倒扣，第 1 至 20 題每題 2 分，第 21 至 40 題每題 3 分。

1. Which feature best distinguishes a facilitated diffusion transporter from a passive ion channel?

A. Requirement for ATP hydrolysis.
B. Ability to transport solutes against their concentration gradient.
C. Saturable transport kinetics.
D. Dependence on membrane potential.
E. Coupling to a secondary ion gradient.

2. COPII vesicles are primarily responsible for protein transport:

A. From Golgi to ER.
B. From *trans*-Golgi to lysosomes.
C. Between Golgi cisternae.
D. From plasma membrane to early endosomes.
E. From ER to Golgi.

3. In bacteria, single polycistronic mRNA encodes for

A. a single enzyme although there are many in the metabolic pathway.
B. multiple enzymes of the particular pathway.
C. a single mRNA which is split into multiple mRNAs before translation.
D. a single peptide with multiple catabolic sites.
E. None of the above.

4. Together with _____, _____ provide(s) for genetic variability within species and, ultimately, the evolution of new species.

A. DNA repair; DNA glycosylase
B. DNA glycosylase; recombination
C. recombination; mutations
D. mutations; DNA glycosylase
E. DNA repair; mutations

5. The base in DNA that specifies the first base in the RNA transcript is called a(n) _____ and is numbered _____.

A. promoter; –5
B. enhancer; –35
C. transcription start site; 0
D. transcription start site; +1
E. promoter complex; +5

見背面

6. Which of the following correctly pairs a cytoskeletal filament with its primary monomeric or dimeric subunit?

A. Microtubule – Actin.
B. Microfilament – Actin.
C. Microfilament – keratin or lamin.
D. Microfilament – αβ-tubulin dimer.
E. Intermediate filament – αβ-tubulin dimer.

7. What is the role of cytochrome c release during intrinsic apoptosis?

A. It binds directly to pro-caspase-3, causing its activation.
B. It neutralizes IAP proteins like XIAP, freeing caspases from inhibition.
C. It released proteases from the mitochondria to cleave protein targets.
D. It permeabilizes the mitochondrial inner membrane, causing a loss of ATP production.
E. It triggers the formation of the apoptosome with APAF-1, which then activates caspase-9.

8. What is the primary mechanism of the MTT assay for assessing cell viability?

A. Detecting membrane permeability with MTT dye.
B. Measuring ATP levels within the cell population.
C. Labeling newly synthesized DNA with a thymidine analog.
D. Quantifying proteolytic fragments in response to MTT treatment.
E. Reducing the MTT dye into insoluble purple formazan in the mitochondria of living cells.

9. Which molecule acts as a negative regulator by dephosphorylating PIP_3 back to PIP_2 in the PI3K-AKT signaling pathway?

A. mTORC2
B. p110
C. PTEN
D. PDK1
E. MAPK

10. Which RNA molecule functions as an adaptor that links amino acids to mRNA codons during translation?

A. mRNA
B. rRNA
C. snRNA
D. tRNA
E. snoRNA

接次頁

11. The vacuolar V-ATPase primarily functions to

A. generate ATP from proton gradients.
B. export protons from the cell.
C. acidify intracellular compartments.
D. maintain mitochondrial membrane potential
E. transport Ca^{2+} into the ER

12. Which modification enhances the stability and translational efficiency of eukaryotic mRNA?

A. Lengthening of the poly(A) tail.
B. Shortening of the poly(A) tail.
C. Addition of a 5' cap.
D. Introduction of AU-rich elements.
E. Endonucleolytic cleavage.

13. Which ribosomal site typically holds the tRNA carrying the growing polypeptide chain?

A. A site
B. P site
C. E site
D. Exit tunnel
E. Decoding center

14. A Holiday structure is a(n):

A. intermediate in genetic recombination.
B. double-stranded DNA break.
C. collapsed replication fork.
D. thymine-thymine dimmer.
E. intermediate in nucleotide excision repair.

15. Failure of which cell-cycle checkpoint is most likely to result in nondisjunction?

A. S phase checkpoint.
B. DNA-damage checkpoint.
C. unreplicated DNA checkpoint.
D. chromosome-segregation checkpoint.
E. A and C.

見背面

16. Genetically knocking out both copies of the *p53* gene in rats _____.

A. does not have any effect unless the rats live outside of the laboratory and are exposed to various types of stress.
B. increases cell death by apoptosis, leading to developmental defects.
C. results in a lower malignancy rate, but the rats are otherwise seemingly normal.
D. results in a higher rate of cancer onset, but the rats are otherwise seemingly normal.
E. is embryonic lethal.

17. Which event is most critical for sorting lysosomal hydrolases in the *trans*-Golgi network (TGN)?

A. Recognition of KDEL sequences.
B. Addition of mannose-6-phosphate to N-linked glycans.
C. Binding to AP2 adaptor complexes.
D. Ubiquitination of luminal domains.
E. COPI vesicle formation.

18. Which of the following does not belong to basic neuron types?

A. Bipolar.
B. Unipolar.
C. Multipolar.
D. Pyrimidal.
E. Ependymal.

19. Which of the following does not belong to the major protein families of axon guidance cue?

A. Ephrin.
B. Semaphorin.
C. Slit.
D. Netrin.
E. Shh.

20. Which happens first during an action potential?

A. Opening of voltage-gated Ca+ channels.
B. Opening of voltage-gated K+ channels.
C. Opening of voltage-gated Na+ channels.
D. Closing of voltage gated K+ channels.
E. Closing of voltage-gated Na+ channels.

接次頁

21. The Na^+/K^+-ATPase plays a central role in membrane transport. Which of the following statements is correct?

(1) The Na^+/K^+-ATPase is an electrogenic transporter.
(2) Inhibition of the Na^+/K^+-ATPase promotes Na^+-glucose symport.
(3) The Na^+/K^+-ATPase establishes ion gradients that drive secondary active transport.

A. (1) only.
B. (2) only.
C. (1) and (3).
D. (2) and (3).
E. All of the above are correct.

22. Transcription of the lactose operon in *E. coli* is stimulated by:

A. a mutation in the repressor gene that strengthens the affinity of the repressor for the operator.
B. a mutation in the repressor gene that weakens the affinity of the repressor for the operator.
C. a mutation in the repressor gene that weakens the affinity of the repressor for the inducer.
D. binding of the repressor to the operator.
E. the presence of glucose in the growth medium.

23. Treatment of the RNA polymerase/DNA complex with DNase in vitro is a DNA footprinting technique used to:

A. identify the termination sequence for transcription.
B. locate the start site for transcription.
C. locate the promoter site.
D. identify the position of enhancer sequences.
E. None of the above.

24. What is the primary mechanism by which pyroptosis is executed following cleavage of Gasdermin D (GSDMD) by inflammatory caspases?

A. The GSDMD N-terminal fragment oligomerizes and forms pores in the plasma membrane.
B. The GSDMD N-terminal fragment binds to and permeabilizes the mitochondrial outer membrane, releasing cytochrome c.
C. The GSDMD N-terminal fragment directly activates the kinase RIPK3 to initiate a secondary death signal.
D. The GSDMD N-terminal fragment translocates to the nucleus to induce pro-inflammatory gene expression.
E. The GSDMD is degraded by caspases.

25. What is a major advantage of Antibody-Drug Conjugates (ADCs) compared to conventional chemotherapy?

A. ADCs are completely non-immunogenic because they are fully human antibodies.
B. They selectively deliver a cytotoxic payload to cancer cells expressing a specific target antigen.
C. They activate the patient's own T cells to attack the tumor, a mechanism known as T cell engagement.
D. ADCs have a much lower molecular weight, allowing for better penetration into all tissues.
E. ADCs bring phagocytes and tumor cells together.

見背面

26. What is the function of the single-chain variable fragment (scFv) in a Chimeric Antigen Receptor (CAR)?

A. It recruits downstream adaptors.
B. It anchors the entire CAR construct into the cell membrane.
C. It provides co-stimulatory signals to enhance T-cell or NK-cell activation.
D. It acts as the extracellular, none-HLA-restricted antigen recognition domain.
E. It serves as the primary intracellular signaling domain, typically derived from *CD3ζ*.

27. During pre-mRNA splicing, which molecular event directly generates the 2'-5' phosphodiester bond characteristic of the lariat intermediate?

A. ATP-dependent helicase activity of the spliceosome.
B. Nucleophilic attack by the 2'-OH of the branch-point adenosine on the 5' splice site.
C. Cleavage of the 3' splice site by U2AF.
D. Base pairing between U1 snRNA and the 5' splice site.
E. Dephosphorylation of the 5' cap.

28. Which statement best explains why peptide bond formation does not require direct GTP hydrolysis, despite being a highly specific and directional reaction?

A. The ribosome acts as a protein enzyme that substitutes for GTP.
B. GTP hydrolysis is used exclusively during termination.
C. The peptidyl transferase center positions substrates to exploit intrinsic chemical reactivity.
D. ATP hydrolysis provides the required energy instead.
E. Peptide bond formation is driven by elongation factor phosphorylation.

29. A mammalian mRNA encoding a cytokine is rapidly induced and then quickly degraded. Its 3' UTR contains multiple AU-rich elements (AREs). Which mechanism best explains how this architecture enables tight temporal control of protein expression?

A. AREs block translation initiation until removed by endonucleases.
B. AREs prevent nuclear export, delaying translation.
C. AREs enhance ribosome pausing to reduce the elongation rate.
D. AREs promote nonsense-mediated decay via premature stop codons.
E. AREs recruit RNA-binding proteins that couple deadenylation to decapping.

30. Multiple models have been proposed to explain intra-Golgi transport. Which of the following statements is correct?

(1) Vesicular transport models propose that cargo proteins move between stable Golgi cisternae via transport vesicles.
(2) Cisternal maturation readily explains the transport of very large cargo such as procollagen.
(3) Continuous retrieval of Golgi enzymes to earlier cisternae via transport vesicles is defined by the vesicular transport model.

A. (1) only.
B. (1) and (2).
C. (2) and (3).
D. (1) and (3).
E. All of the above are correct.

接次頁

31. The *Rb* gene in retinoblastomas is similar to the *Apc* gene in polyposis colon carcinomas in that both genes _____.

(1) are tumor suppressors
(2) are in a locus that shows loss of heterozygosity in the hereditary form of the cancer
(3) should be inactivated in both copies to cause the nonhereditary form of the cancer
(4) are mutated in one copy in all cells of patients with a hereditary form of the cancer

A. (1) only.
B. (1), (2), (3).
C. (2), (4).
D. (1), (3), (4).
E. (1), (2), (3), (4).

32. Exocytosis contributes to both secretion and plasma membrane homeostasis. Which of the following statements is correct regarding exocytosis?

(1) Constitutive exocytosis occurs in all eukaryotic cells and does not require a specific sorting signal in cargo proteins.
(2) Regulated exocytosis depends on Ca^{2+}-triggered membrane fusion events.
(3) SNARE proteins provide specificity and energy for vesicle fusion by forming *trans*-SNARE complexes.

A. (1) only.
B. (2) only.
C. (1) and (3).
D. (2) and (3).
E. All of the above are correct.

33. Endocytosis allows cells to internalize extracellular material through multiple pathways. Which of the following statements is correct regarding endocytosis?

(1) Clathrin-mediated endocytosis requires adaptor proteins to link cargo receptors to the clathrin coat.
(2) Caveolae-mediated endocytosis is dependent on clathrin assembly at the plasma membrane.
(3) Dynamin-mediated GTP hydrolysis is required for vesicle scission in clathrin-mediated endocytosis.

A. (3) only.
B. (1) and (2).
C. (1) and (3).
D. (2) and (3).
E. All of the above are correct.

34. Which statement best describes how endosomes determine whether internalized receptors are recycled or degraded?

A. Receptors destined for degradation are selectively packaged into intraluminal vesicles within multivesicular bodies.
B. Recycling receptors are preferentially sorted in late endosomes after acidification.
C. All internalized receptors transiently enter intraluminal vesicles before recycling.
D. Ubiquitination directs receptors to recycling endosomes rather than lysosomes.
E. ESCRT-mediated sorting occurs only after fusion with lysosomes.

見背面

35. Which mechanism best explains actin treadmilling?

A. Simultaneous polymerization and depolymerization at both filament ends.
B. Net addition of ATP-actin at the barbed end and loss of ADP-actin at the pointed end.
C. Periodic severing of filaments by cofilin.
D. Continuous ATP hydrolysis without filament growth.
E. Retrograde flow driven by myosin II.

36. PARP inhibitors can efficiently kill many breast cancer cells that lack functional *Brca1* or *Brca2* genes. How do these drugs accomplish this?

(1) By increasing the occurrences of homologous recombination.
(2) By increasing the ability of the cancer cells to repair the mutations in their cancer-critical genes.
(3) By inhibiting a DNA repair pathway.
(4) By increasing the ability of p53 in cancer cells to limit cell proliferation.
(5) By inhibiting proteins that are normally inhibited by the *Brca1* or *Brca2* gene products.

A. (1) only.
B. (1), (4), (5).
C. (3) only.
D. (2), (3), (4), (5).
E. All of the above are correct.

37. Which statement listed below regarding stem cells is correct?

(1) Stem cells can be found in both mouse embryonic and adult tissues.
(2) Totipotent stem cells can form all the cell types in a body, plus the extraembryonic or placental cells.
(3) Pluripotent stem cells can differentiate into endoderm, mesoderm or ectoderm cells.
(4) The multipotent SCs showed higher differentiation potency than the pluripotent SCs.

A. (1) and (2).
B. (1) and (3).
C. (1), (2), and (3).
D. (1), (2), and (4).
E. All of the above are correct.

38. Pluripotent stem cells are found in which of the following in the mouse embryo?

A. trophectoderm
B. inner cell mass
C. blastocoel
D. zona pellucida
E. None of above contains pluripotent stem cells.

接次頁

39. Mouse fibroblasts can be reprogrammed to form pluripotent stem cells when transfected with vectors expressing:

(1) c-Myc (2) Ngn1 (3) Sox2 (4) Oct4 (5) Klf4

A. (1), (2), (3), (5).
B. (1), (2), (3), (4).
C. (1), (2), (4), (5).
D. (1), (3), (4), (5).
E. (2), (3), (4), (5).

40. A competitive inhibitor of a glucose transporter is added, and extracellular glucose is increased tenfold. Which conclusions are most consistent with classical transport kinetics?

(1) Maximal transport rate can be restored at sufficiently high glucose concentration.
(2) Transport affinity for glucose is effectively reduced.
(3) Transporter cycling between conformations is permanently impaired.

A. (1) only.
B. (2) only.
C. (1) and (2).
D. (2) and (3).
E. (1) and (3).

試題隨卷繳回