一、 單選題（每題 2 分，40%）※注意：請於試卷「選擇題作答區」依題號作答。※

1. Which energy-producing process is thought to have come first during cellular evolution?
   a. Photosynthesis b. Glycolysis c. Oxidative phosphorylation
   d. Proteolysis e. All of the above originated at the same time.

2. The interaction of the light and heavy chains to form the immunoglobulin molecule is an example of _____ structure.
   a. primary b. secondary c. tertiary d. quaternary e. domain

3. In allosteric regulation, binding of a small regulatory molecule to an enzyme _____ the enzyme activity.
   a. inhibits b. stimulates c. either stimulates or inhibits
   d. neither stimulates nor inhibits e. both stimulates and inhibits

4. The first enzymatic step in making a cDNA uses which of the following?
   a. *Eco*RI nuclease b. Taq polymerase c. DNA polymerase
   d. RNA polymerase e. reverse transcriptase

5. The *Arabidopsis* genome, like many plant genomes, contains more genes than many animals and this is due largely to _____.
   a. gene duplication b. larger exons c. larger introns
   d. fewer stop codons e. None of the above

6. The proofreading property of DNA polymerase is due to its _____ activity.
   a. 3′ to 5′ exonuclease b. 5′ to 3′ exonuclease c. excision repair
   d. mismatch repair e. endonuclease

7. Small interfering RNAs repress transcription by _____.
   a. binding to and cleaving the gene.
   b. binding to and methylating the DNA of the gene.
   c. hybridizing with and blocking transcription of a gene.
   d. hybridizing with a nascent mRNA and binding a RITS complex, which condenses the chromatin of a gene.
   e. All of the above

8. Eukaryotic ribosomes recognize and initially bind to what structure on the mRNA?
   a. A Shine-Dalgarno sequence b. The 7-methylguanosine cap
   c. A TATA sequence d. An AUG initiation codon
   e. A CAT sequence

9. The nuclear localization signal is recognized by and binds to which protein in the process of nuclear protein import?
   a. Ran b. Exportin c. Importin d. Nucleoporin e. The outer fibril protein

10. Which of the following is not a contiguous membrane domain?
    a. Rough ER b. Nuclear envelope c. Smooth ER
    d. Transitional ER e. Secretory granules

見背面

11. Most higher eukaryotic plasma membrane proteins are synthesized on _____.
    a. free ribosomes and inserted after translation into the plasma membrane
    b. ribosomes associated with the plasma membrane and inserted into the membrane cotranslationally
    c. smooth ER and carried to the plasma membrane by vesicles that pinch off from the Golgi apparatus
    d. rough ER ribosomes and carried to the plasma membrane by vesicles that pinch off from the rough ER
    e. rough ER ribosomes and carried to the plasma membrane by vesicles that pinch off from the Golgi apparatus.

12. Most mitochondrial proteins are synthesized on _____.
    a. mitochondrial ribosomes from nuclear mRNAs
    b. mitochondrial ribosomes from mitochondrial mRNAs
    c. cytoplasmic ribosomes from mitochondrial mRNAs
    d. cytoplasmic ribosomes; they are imported after they are completely synthesized
    e. cytoplasmic ribosomes; they are imported cotranslationally as they are being synthesized

13. Electron transport and oxidative phosphorylation are performed by protein complexes in the mitochondrial _____.
    a. inner membrane b. outer membrane c. intermembrane space
    d. matrix e. Both a and c

14. The GTP bound to β-tubulin hydrolyzes to GDP and Pi _____.
    a. during formation of the $\alpha-\beta$ dimer
    b. during polymerization of dimers onto microtubules
    c. following polymerization but before depolymerization
    d. during depolymerization of dimers from microtubules
    e. following depolymerization of dimers from microtubules

15. Intermediate filaments function in _____.
    a. cell motility b. providing mechanical strength for cells c. nuclear pore structure
    d. All of the above e. None of the above

16. Active transport is transport _____.
    a. of all molecules simultaneously, against their concentration gradients, across the membrane
    b. in an energetically favorable direction coupled to the hydrolysis of ATP
    c. in an energetically unfavorable direction always driven by hydrolysis of ATP
    d. in an energetically unfavorable direction always coupled to another reaction or source of energy
    e. in an energetically unfavorable direction driven only by the flow of another molecule across a membrane

17. The function of gap junctions is to _____.
    a. hold epithelia together b. seal the space between cells
    c. provide direct communication between cells d. All of the above
    e. None of the above

18. Protein kinase A is activated by _____.
    a. binding of cAMP to its catalytic subunits b. binding of cAMP to its regulatory subunits
    c. phosphorylation of its catalytic subunit d. phosphorylation of its regulatory subunits
    e. binding of G protein subunits to its regulatory subunits

接次頁

19. Nuclear envelope breakdown occurs at the _____ of _____.
    a. end; prometaphase b. end; metaphase c. beginning; anaphase
    d. beginning; prophase e. end; prophase

20. A proto-oncogene is a gene _____.
    a. from a normal cell from which an oncogene can arise
    b. that has been picked up by an oncogenic virus
    c. that is in the process of evolving into an oncogene
    d. that is expressed abnormally in a tumor cell
    e. that has been mutated to alter cell growth control

※下列題目請標明題號，依序作答於試卷內「非選擇題作答區」。可用中文或英文作答※

二、 名詞解釋（每題 4 分，20%）

1. Cell transformation
2. Epigenetic inheritance
3. Induced pluripotent stem cell
4. Metastasis
5. Pseudogene

三、 問答題（每題 10 分，40%）

1. 多細胞生物體內，包括但不僅止於內分泌與神經細胞，藉由釋出訊息分子協調不同的器官、組織與細胞的功能，以應對體內、外環境變化。請說明在體內眾多的細胞種類中，訊息分子如何達到僅在其標的細胞（target cell）中引起反應的效果？同一種訊息分子常常在不同種類的標的細胞中誘發不同的生理反應，請解釋此現象的可能原因；請舉一實例，說明哪一種訊息分子，可以在哪兩種細胞中分別引起哪兩種不同的反應。

2. 真核細胞有三種細胞骨架（cytoskeleton）結構，其組成與特性雖然各不相同，但是細胞藉由精巧的控制這些構造完成許多複雜的生理作用。以動物細胞的有絲分裂（mitosis）為例，請說明細胞分裂後期（anaphase）階段，複製後的染色體（sister chromatids）如何經由細胞骨架分離至細胞兩側；在細胞質分裂（cytokinesis）時期，細胞骨架又如何促成細胞分割成兩個獨立的子細胞。

3. 歷經幾億年的演化後，真核生物的細胞質中具有多樣的膜狀胞器（membranous organelles），這些膜狀胞器各自具備其特有的組成物質與執行特定功能，然而就整體細胞生理運作而言，這些胞器間也需要在精準的控制下傳遞物質，例如內分泌細胞所釋出的胰島素（insulin）在粗糙內質網（rER, rough endoplasmic reticulum）合成，在高基氏體（the Golgi apparatus）中進行糖化修飾，最終經由分泌小泡（secretory vesicle）完成分泌作用。膜狀胞器間的物質傳遞受到許多分子調控，請說明 Rab、tethering protein、v-SNARE、t-SNARE 及 NSF 如何控制不同膜狀胞器間的辨識與運輸過程。

4. 多細胞生物的個體由受精卵經過多次有絲分裂而形成，但是在正常發育的同時，生物體體內也有許多細胞透過特定的途徑走向滅亡，這個過程稱為計畫性細胞死亡（programmed cell death）。計畫性細胞死亡的類型很多，其中細胞凋亡（apoptosis）是最早被發現也是研究的最透澈的一種。細胞凋亡的過程可以由細胞內部（intrinsic）的訊號起始，也可以由細胞外（extrinsic）的訊息誘發。請分別說明由細胞內起始的細胞凋亡與由細胞外訊息誘發的細胞凋亡的機制。（答案中，請將以下蛋白質：Apaf-1、Bak、Bax、Bcl-2、caspase-8、caspase-9、cell death receptor、cytochrome c 及 TNF 涵括在適宜的機制內。）

試題隨卷繳回