

一、單選題 (每題 2 分, 40%) ※ 注意：請於試卷內之「選擇題作答區」依序作答。

1. During the evolution of life on Earth, the photo-synthetic organisms initially responsible for raising atmospheric oxygen concentrations from less than 1 percent to about 20 percent were  
(A) cyanobacteria (B) archaea (C) diatoms (D) flowering plants (E) mosses.
2. Immediately after fertilization in animals, the first structural and biochemical changes in the egg are initiated by  
(A) new gene transcription  
(B) the release of  $\text{Ca}^{2+}$  from internal reservoirs  
(C) the initiation of DNA synthesis  
(D) a lowering of cytosolic pH  
(E) a sudden drop in ATP levels
3. The outermost tissue of a tree trunk that is 2 meters in diameter would most likely be  
(A) epidermis (B) cork (C) cortex (D) phloem (E) xylem
4. Which of the following animal phyla is diploblastic, that is, exhibits only two embryonic germ layers?  
(A) Rotifera (B) Mollusca (C) Nematoda (D) Platyhelminthes (E) Cnidaria
5. Which of the following statements is correct with respect to mitochondrial genes?  
(A) They are transmitted, largely intact, from parent to offspring.  
(B) Their inheritance shows Mendel's principle of segregation.  
(C) Their inheritance shows Mendel's principle of independent assortment.  
(D) A and B are correct. (E) A, B, and C are correct
6. All of the following occur during the cleavage stage of animal development EXCEPT  
(A) an increase in the nuclear-to-cytoplasmic ratio of the cells  
(B) an increase in the number of blastomeres  
(C) an increase in the mass of the embryo  
(D) an increase in the surface-to-volume ratio of the cells  
(E) rapid cell divisions
7. The logistic equation on the right is used to describe the rate of change of a population,  $N$ , with time,  $t$ , where  $r$  is the intrinsic rate of increase and  $K$  is the carrying capacity. Which of the following statements is true for this equation?  
(A) For a given population,  $r$  is variable.  
(B) For a given environment,  $K$  is variable.  
(C) As  $N$  approaches  $K$ ,  $dN/dt$  approaches 0.  
(D) As  $N$  approaches  $K$ ,  $dN/dt$  approaches  $K$ .  
(E) As  $N$  approaches  $K$ ,  $dN/dt$  approaches  $r$ .

$$\frac{dN}{dt} = rN \left( \frac{K - N}{K} \right)$$

見背面

8. If two parents that are heterozygous (Aa) at a single locus give rise to offspring that are 25 percent AA, 50 percent Aa, and 25 percent aa, then all of the following are true EXCEPT:
- (A) The parents are diploid organisms.
  - (B) The a allele is recessive lethal.
  - (C) The alleles assort independently.
  - (D) The gametes combine at random.
  - (E) The probability that a given gamete will receive allele A is one-half.
9. Which of the following is true of the polymerase chain reaction?
- (A) It enables a small amount of DNA to be amplified.
  - (B) It involves the addition of a poly-A sequence to mRNA.
  - (C) It cuts DNA into numerous small fragments for analysis.
  - (D) It separates DNA fragments according to size.
  - (E) It requires RNA in order to proceed.
10. Additions or deletions of bases in the nucleotide sequence of a structural gene most often result in
- (A) an altered sequence of amino acids in the protein that the gene encodes
  - (B) insertion of a new intron into the coding sequence of the gene
  - (C) decreased histone binding
  - (D) decreased excision repair
  - (E) increased levels of mRNA production
11. A genetic analysis of an unknown infectious agent reveals that it contains only the nucleotides G, A, U, and C in the proportion 30%, 35%, 15%, and 20%, respectively. Based on this information, this infectious agent is most likely a
- (A) double-stranded DNA virus
  - (B) double-stranded RNA virus
  - (C) single-stranded DNA virus
  - (D) single-stranded RNA virus
  - (E) bacterium
12. Your mood and your learning abilities can be affected by
- (A) Endorphin
  - (B) serotonin
  - (C) acetylcholine
  - (D) nitric oxide
  - (E) estrogen
13. After surgical removal of the gallbladder, a person might need to limit his or her dietary intake of
- (A) starch
  - (B) protein
  - (C) sugar
  - (D) fat
  - (E) water
14. An ecological relationship in which one species benefits while the other is not harmed or helped is called
- (A) symbiosis
  - (B) parasitism
  - (C) commensalism
  - (D) mutualism
  - (E) hermaphrodite
15. A fruit fly population has a gene with two alleles, A1 and A2. Tests show that 70% of the gametes produced in the population contain the A1 allele. If the population is in Hardy-Weinberg equilibrium, what proportion of the flies carry both A1 and A2?
- (A) 0.7
  - (B) 0.49
  - (C) 0.42
  - (D) 0.21
  - (E) 0.09

16. Muscle cells differ from nerve cells mainly because they

- (A) express different genes.
- (B) contain different genes
- (C) use different genetic codes
- (D) have unique ribosomes
- (E) use different RNA polymerases

17. All of the following may serve as intracellular messengers EXCEPT

- (A) calcium ions
- (B) cAMP
- (C) inositol 1,4,5-triphosphate
- (D) acetylcholine
- (E) 1,2-diacylglycerol

18. In *E. coli*, induction of the lactose operon occurs when allolactose binds to

- (A) galactosidase
- (B) lac mRNA
- (C) the operator
- (D) the promoter
- (E) the repressor

19. All of the following cellular events involve actin filaments EXCEPT

- (A) amoeboid movement
- (B) cytokinesis
- (C) cytoplasmic streaming
- (D) flagellar movement in bacteria
- (E) contraction in smooth muscles

20. Blood fibrinogen is converted into fibrin during

- (A) glucose regulation
- (B) oxygen transport
- (C) CO<sub>2</sub> transport
- (D) clot formation
- (E) lipid absorption

二、解釋名詞 (每題 5 分, 30%)

1. Metagenomics
2. Autophagy
3. Genetic imprinting
4. Circadian rhythm
5. Tumor-suppressor genes
6. Covid-19

三、問答題 (每題 10 分, 30%)

1. 請舉一海洋生物體內的構造為例，說明 counter current 的原理機制以及在個體生理上的重要性。
2. 請說明動物細胞以及植物細胞間的連接方式有哪些?其個別功用為何?
3. 請解釋造成溫室效應的原因，以及全球暖化對生態的影響。

試題隨卷繳回