請清楚標示題號並依序作答於試卷上

I. 單選題: (每題 1.5 分，54%)　※請作答於試卷內之「選擇題作答區」

1. A researcher hypothesizes that crocodile gender is determined by the incubation temperature of the egg. The researcher conducts experiments and determines that an average nest incubation temperature of 32 – 33°C results in the birth of male crocodiles, while higher and lower incubation temperatures result in female crocodiles. What is the most likely explanation for this phenomenon?

A) Since this phenomenon is influenced by an external stimuli (temperature), it cannot be attributed to changes in either the genome or the proteome.
B) Incubation temperature results in a change in the crocodilian proteome.
C) Incubation temperature results in a change in the crocodilian genome.
D) Incubation temperature changes both the crocodilian genome and proteome.

2. Which of the following is an example of horizontal gene transfer?

A) the transmission of an eye color gene from father to daughter
B) the transmission of a mutant gene causing cystic fibrosis from father to daughter
C) the transmission of a gene conferring pathogenicity (the ability to cause disease) from one bacterial species to another
D) the transmission of a gene conferring antibiotic resistance from a mother cell to its two daughter cells

3. Sickle cell anemia is a condition in which red blood cells exhibit a characteristic "sickle" shape. This arises from a mutation or change in one of the amino acids found in hemoglobin. A single amino acid mutation would directly affect a protein's _____ structure.

A) primary　B) secondary　C) tertiary　D) quaternary

4. If a specimen contains 30% adenine in its DNA, how much cytosine will it contain?

A) 40%　B) 30%　C) 20%　D) 15%　E) 10%

5. In order to visualize the fine structure of viruses and cytoskeletal filaments at 10-25 nanometers in diameter the type of microscopy that would be most effective is _____.

A) standard light microscope　B) phase-contrast light microscope
C) transmission electron microscope　D) darkfield light microscope　E) confocal laser microscope

6. After drinking too much alcohol, a person will rely on which organelle to help detoxify and recover?

A) lysosome　B) smooth endoplasmic reticulum　C) mitochondrion
D) Golgi apparatus　E) peroxisome

7. Regarding the membrane and action potentials of a neuron, which of the following is <u>not</u> correct?

A) At resting, the intracellular concentration of K^+ is much higher than that of Na^+.
B) At the peak of action potential, the intracellular concentration of Na^+ is much higher than that of K^+.
C) During the depolarization of action potential, there is a net Na^+ influx into the cell.
D) During the hyperpolarization of action potential, there is a net K^+ moving out of the cell.

8. Cellular respiration produces the most energy in the form of ATP from which of the following?

A) glycolysis　B) the citric acid cycle　C) production of lactate
D) substrate-level phosphorylation　E) oxidative phosphorylation

9. A green plant is first grown in blue light and then in green light. The likely outcome for photosynthesis in both phases is

A) Decreased plant growth in blue light and no plant growth in green light.
B) No plant growth in blue light and increased plant growth in green light.
C) No plant growth in blue light and decreased plant growth in green light.
D) Increased plant growth in blue light and no plant growth in green light.

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10. Mutations that inhibit the function of photosystem I but not photosystem II would result in a plant cell that could still generate _____.

A) O_2, ATP, and $NADP^+$ B) ATP and $NADP^+$ C) O_2, ATP, and NADPH

D) ATP and NADPH E) CO_2 and ATP

11. When Calvin injected ^{14}C labeled CO_2 into cultures of green algae, what led him to conclude that rubisco adds CO_2 to ribulose bisphosphate in the Calvin cycle?

A) Radioactivity appeared last in ribulose bisphosphate.

B) Radioactivity first appeared in ribulose bisphosphate.

C) Radioactivity appeared last in glucose.

D) Radioactivity first appeared in 3-phosphoglycerate.

E) Radioactivity appeared last in 3-phosphoglycerate.

12. A C4 plant minimizes photorespiration by

A) stomata that are only opened at night, storing carbon dioxide in malate, and releasing carbon dioxide during the day.

B) having the light reactions and carbon reactions occur in different cells, so oxygen does not come into contact with rubisco.

C) having the light reactions and carbon reactions occur in different cells, so carbon dioxide does not come into contact with rubisco.

D) stomata that are only opened at night, storing oxygen in malate, and releasing oxygen during the day.

13. Which of the following statements about eukaryotic cell is true?

A) If a cell contains 20 chromosomes in G1 phase, it will contain 40 chromosomes at the end of S phase.

B) During prometaphase, the sister chromatids organize into a single row in the center of the cell.

C) One major difference between metaphase I and metaphase II is the presence or absence of bivalents.

D) Sister chromatids are produced during mitosis.

E) If environmental conditions are favorable during the G1 phase, G1 cyclins are degraded causing the cell to prepare to replicate its DNA.

14. In goats, the gene for coat color is on an autosome and light brown color is dominant to black. A light brown male is mated to a black female, producing a black kid (baby goat). If they produce another kid, could it be light brown? If so, what are the chances of it being light brown?

A) No, since the black allele is present all offspring will be black.

B) Yes, 100% since the first kid was black the next one has to be light brown.

C) Yes, 75% since light brown is dominant.

D) Yes, 50% as the male must be heterozygous for color.

15. Which of the following is <u>not</u> accurate regarding the Bicoid protein?

A) Bicoid protein is a molecule that determines fly tail.

B) A homozygote with *bicoid* gene mutation can develop normally if its mother is normal.

C) *Bicoid* gene is transcribed by nurse cells during oogenesis.

D) Bicoid protein activates genes when it reaches a concentration threshold.

16. Alternative RNA splicing _____.

A) can allow the production of proteins of different sizes and functions from a single gene

B) can allow the production of similar proteins from different RNAs

C) is a mechanism for increasing the rate of transcription

D) is due to the presence or absence of particular ribosomal proteins

17. Which of the following is the first event to take place in translation in eukaryotes?

A) Base pairing of activated methionine-tRNA to AUG of the messenger RNA

B) Covalent bonding between the first two amino acids

C) The small subunit of the ribosome recognizes and attaches to the 5' cap of mRNA

D) Binding of the larger ribosomal subunit to smaller ribosomal subunits

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18. Which of the following statements is true?
A) As part of the transcriptional unit, regulatory sequences are the sites where RNA polymerase and transcription factors bind to regulate transcription.
B) All enzymes are proteins.
C) tRNA contains the genetic code for producing a polypeptide.
D) The termination of translation occurs when a release factor recognizes the stop codon.
E) A single gene always encodes an enzyme.

19. MicroRNAs (miRNAs)
A) are long RNA molecules. B) silence the expression of specific mRNAs.
C) are found only in animals. D) are cut by an enzyme called transcriptase.
E) inhibit the catalytic activity of rRNA

20. Which of the following characters is <u>not</u> unique to Metazoa?
A) Multicelluarity B) Having a nervous system
C) An extracellular matrix made up by collagen D) Movement by muscle

21. Protists are <u>not</u> monophyletic. This means that protists
A) are not all members of the same phylum
B) are all more closely related to each other than they are to any other kind of organisms
C) are not all more closely related to each other than they are to some other organisms
D) are all more closely related to bacteria than they are to other organisms

22. Which of the following statements is <u>not</u> true of the stomata on the leaves of vascular plants?
A) They regulate intake of carbon dioxide needed for photosynthesis.
B) They regulate release of oxygen to the air.
C) They regulate loss of water.
D) They regulate the absorption of light by chlorophyll.

23. *Picea glauca* is a seed-bearing plant. What other characteristic must be true of this species?
A) It produces flowers. B) It produces fruits.
C) It has vascular tissue. D) The gametophyte is the dominant generation.
E) Double-fertilization results in the production of endosperm.

24. Which of the following is true?
A) Viruses usually enter host cells by endocytosis.
B) Some viruses can carry out reverse transcription.
C) Viral envelope is produced from the viral genome at the later stage of infection.
D) Viruses all contain small genomes containing fewer than 100 genes.

25. Which structure is correctly paired with its tissue system?
A) root hair — vascular tissue B) guard cell — vascular tissue
C) tracheid — vascular tissue D) companion cell — ground tissue

26. In most plants, phloem transports _____ from the _____ (source) to the _____ (sink) in the late spring.
A) amino acids; root; mycorrhizae B) sugars; leaf; apical meristem
C) proteins; root; leaf D) sugars; woody stem; root

27. Phytochromes are <u>not</u> involved in _____.
A) shade avoidance B) biological clocks C) control of vernalization D) gravitropism

28. Which of these is a major trend in land plant evolution?
A) the trend toward larger gametophytes B) the trend toward a gametophyte-dominated life cycle
C) the trend toward a sporophyte-dominated life cycle D) the trend toward smaller size

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29. Which one of the following is considered to be an important plant hormone that helps plants cope with environmental stresses?
A) auxins B) prostaglandins C) ethylene D) abscisic acid E) cytokinins

30. A plant has sluggish wound healing abilities as well as an inability to store significant food reserves. If you could enhance the growth of a tissue to improve these properties, which tissue would you enhance?
A) parenchyma of the stem cortex B) root apical meristem C) periderm D) lateral meristem

31. Chemical cues that help guide a developing pollen tube toward an ovule are released by the _____.
A) antipodal cells B) synergids C) egg D) central cell E) sperm

32. In the logistic growth model of population growth, at what population size - in terms of the carrying capacity (K) - is the population increasing most rapidly?
A) K B) K/2 C) K/3 D) K/4

33. What is the main reason leading to a uniform dispersion pattern among individuals within a population?
A) Competition B) Mutualism C) Resource availability D) Environmental factors

34. When considering the average food chain, which of the following statements is true?
A) Secondary consumers are the most abundant organisms in an ecosystem.
B) The longer the food chain, the more stable the ecosystem.
C) Biomass decreases moving up the food chain.
D) The trophic level with the highest species abundance is usually the primary producers.

35. Which of the following statements is <u>not</u> true?
A) The risk of stroke can be reduced by avoiding the damage to endothelium of vessels.
B) Increased sympathetic activity raises blood pressure by increasing the strength and rate of the heartbeat.
C) The left ventricle pumps the same amount of blood as the right ventricle.
D) If action potential propagation through the bundle of His was blocked, the SA node would no longer set the pace for atrial contraction.
E) The velocity of blood flow in the veins is faster than that in the capillaries.

36. If adenylyl cyclase were inhibited in animal cells, _____.
A) binding of epinephrine to beta receptors would have no effect on cyclic AMP levels.
B) binding of epinephrine to beta receptors would have no effect on G-protein activation.
C) an increase in mRNA for cyclic AMP would occur.
D) epinephrine would not be able to bind to beta receptors.

※ 注意：請於試卷上「非選擇題作答區」標明大題及小題題號，並依序作答。

II. 解釋名詞: (每題 3 分，21%)

1. chemiosmosis
2. centromere
3. a signal peptide
4. antigen-presenting cell
5. a motor unit (of skeletal muscle contraction)
6. Casparian strip
7. cortical reaction (in egg fertilization)

III. 簡答題 (每題 5 分，10%)

1. Explain how it is possible for **evolution** to result in **unity** among different species and also produce amazing **diversity**
2. Men with **decreased anterior pituitary gland function** often have **decreased sperm production** as well as **low testosterone concentration**. Would you expect the **administration of testosterone alone** to restore sperm production to normal? Answer (2 分) with explanation (3 分).

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IV. 選出一個最適當的答案選項 (2 分)，並說明你選擇該選項的理由 (3 分)。(共 15 分)

1. Imagine that a cell had no motor proteins. Which processes would not be able to occur?

A) RNA transcription B) fertilization of an egg by a sperm cell

C) protein translation D) maintenance of cell rigidity E) action potential of a neuron

2. For a neuron with an initial membrane potential at -80 mV, an increase in the extracellular concentration of potassium ions from 5 mM to 35 mM would result in _____.

A) depolarization of the neuron B) hyperpolarization of the neuron

C) net diffusion of potassium ions into the cell D) no change in the membrane potential

3. If the afferent nerves from the carotid and aortic bodies are cut in a rat,

A) a decrease in arterial PCO_2 will stimulate increased ventilation.

B) an increase of PCO_2 in the cerebrospinal fluid will no longer stimulate increased ventilation.

C) an increase in arterial lactic acid (metabolic acid) will no longer stimulate increased ventilation.

D) an increase in arterial PCO_2 will no longer stimulate increased ventilation.

E) a decrease in arterial PO_2 will stimulate increased ventilation.

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