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國立臺灣大學 111 學年度碩士班招生考試試題

科目： 普通生物學(B)

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I. Terminology (20 points, 2 points each)

1. acclimatization
2. ecotype
3. epigenetics
4. fermentation
5. osmosis
6. pheromone
7. endosymbiosis
8. systematics
9. trophic level
10. xylem

II. Multiple choice: Choose one best answer from the options (45 points, 3 points each)

1. You are suffering from *Streptococcus* throat infection. You share the following with the bacteria that is responsible for your condition.
 - A) You both belong to the same domain.
 - B) You both are made up of cells.
 - C) You both have genetic material in your nucleus.
 - D) You and *Streptococcus* have nothing in common.

2. The evolution of one species into two or more species as a result of different populations becoming reproductively isolated from each other is best termed as _____.
 - A) adaptive radiation
 - B) creationism
 - C) natural selection
 - D) prototype

3. Cotton-topped tamarins are small primates with tufts of long white hair on their heads. While studying these creatures, you notice that males with longer hair get more opportunities to mate and father more offspring. To test the hypothesis that having longer hair is adaptive in these males, you should _____.
 - A) test whether other traits in these males are also adaptive
 - B) look for evidence of hair in ancestors of tamarins
 - C) determine if hair length is heritable
 - D) test whether males with shaved heads are still able to mate

4. Following a scientific method, which of the following is the correct order of steps?
 - A) Observation → Analysis → Hypothesis → Conclusion → Communicate results → Experiment
 - B) Observation → Hypothesis → Experiment → Communicate results → Analysis → Conclusion
 - C) Experiment → Hypothesis → Observation → Analysis → Conclusion → Communicate results
 - D) Observation → Hypothesis → Experiment → Analysis → Conclusion → Communicate results

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5. Which of the following are compounds?
- A) H_2O , O_2 , and CH_4
 - B) H_2O and O_2
 - C) O_2 and CH_4
 - D) H_2O and CH_4 , but not O_2
6. Molybdenum has an atomic number of 42. Several common isotopes exist, with mass numbers from 92-100. Which of the following can be true?
- A) Molybdenum atoms can have between 50 and 58 neutrons.
 - B) Molybdenum atoms can have between 50 and 58 protons.
 - C) Molybdenum atoms can have between 50 and 58 electrons.
 - D) Isotopes of molybdenum have different numbers of electrons.
7. The cities of Portland, Oregon, and Minneapolis, Minnesota, are at about the same latitude, but Minneapolis has much hotter summers and much colder winters than Portland. Why?
- A) They are not at the same exact latitude.
 - B) The ocean near Portland moderates the temperature.
 - C) Fresh water is more likely to freeze than salt water.
 - D) Minneapolis is much windier, due to its location in the middle of North America.
8. Rank, from low to high, the pH of blood, stomach acid, and urine.
- A) blood, urine, and stomach acid
 - B) stomach acid, blood, and urine
 - C) urine, blood, stomach acid
 - D) stomach acid, urine, blood
9. How would acidification of seawater affect marine organisms? Acidification of seawater would _____.
- A) increase dissolved carbonate concentrations and promote faster growth of corals and shell-building animals
 - B) decrease dissolved carbonate concentrations and promote faster growth of corals and shell-building animals
 - C) increase dissolved carbonate concentrations and hinder growth of corals and shell-building animals
 - D) decrease dissolved carbonate concentrations and hinder growth of corals and shell-building animals
10. Which of the following statements correctly describes *cis-trans* isomers?
- A) They have variations in arrangement around a double bond.
 - B) They have an asymmetric carbon that makes them mirror images.
 - C) They have the same chemical properties.
 - D) They have different molecular formulas.

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11. What is the explanation for how a modern transmission electron microscope (TEM) can achieve a resolution of about 0.2 nanometers, whereas a standard light microscope has a maximum resolution of about 200 nanometers?
- A) Glass lenses in light microscopes refract light, which reduces resolution.
 - B) Contrast is enhanced by staining with atoms of heavy metal.
 - C) Electron beams have much shorter wavelengths than visible light.
 - D) The electron microscope has a much greater ratio of image size to real size.
12. Tay-Sachs disease is a human genetic abnormality that results in cells accumulating and becoming clogged with very large, complex, undigested lipids. Which cellular organelle is most likely defective in this condition?
- A) the lysosome
 - B) the Golgi apparatus
 - C) the smooth endoplasmic reticulum
 - D) the rough endoplasmic reticulum
13. If plant cells are grown on media containing radioactively labeled thymine for one generation, radioactively labeled macromolecules will be detected in which of the following?
- A) only in the nucleus
 - B) only in the nucleus and mitochondria
 - C) only in the nucleus and chloroplasts
 - D) in the nucleus, mitochondria, and chloroplasts
14. Most cells cannot harness heat to perform work because _____.
- A) heat is not a form of energy
 - B) temperature is usually uniform throughout a cell
 - C) heat can never be used to do work
 - D) heat must remain constant during work
15. Research on conditions that are relatively new to human populations such as myopia, breast cancer, and obesity support the conclusion that _____.
- A) human populations have accumulated a number of mutations that have become fixed by genetic drift
 - B) the changes in human lifestyle account for all of the increase in frequencies of these conditions
 - C) these conditions are indeed "diseases of civilization" and are likely caused by the interaction between genes (genetic susceptibility) and novel environments
 - D) these human conditions are mere artifacts of the way in which they have been evaluated

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III. Assay questions:

1. Modern land plants have an array of adaptations to life on land, but they did not evolve all at once. In addition, different adaptations are present in different plant lineages. Describe five adaptations and characteristics which are present in (nearly) all land plants. (15 points)
2. In the battle of Covid-19 pandemics, several vaccines have been developed to prevent SARS-CoV2 infections. Please describe the basic principle of three types of vaccines, mRNA vaccines (Pfizer-BioNTech or Moderna), Protein subunit vaccines (vaccines under development), and Vector vaccines (Johnson & Johnson's Janssen). (10 points)
3. Sickle cell disease is a group of inherited red blood cell disorders. Healthy red blood cells are round, and they move through small blood vessels to carry oxygen to all parts of the body. Researchers found that the sickle cell gene is especially prevalent in areas of Africa hard-hit by malaria. In some regions, as much as 40 percent of the population carries at least one HbS gene. (10 points)
 - (1). In three to five sentences, explain why sickle cell disease became so prevalent in certain East African populations.
 - (2). There are now several effective antimalarial drugs that can treat people who have malaria or prevent them from getting the disease altogether. Predict what will happen to the frequency of the sickle cell allele as these drugs become more widely used.
 - (3). Is the following statement true or false? "Malaria caused the sickle cell allele to appear." Justify your answer.

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