

一、簡答題 Answer these questions with a few words. (每一題 4 分，共 20 分)

※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

- 1- Name 5 essential macro-elements.
- 2- Which tissues mediate the nutrient transport a- from the root to the shoot, and b- from source tissues to sink tissues?
- 3- Name 5 organelles found in plant cells.
- 4- In roots, a barrier is formed by the deposition of lignin in between cells, and can block the circulation of nutrients. What is the name of this barrier?
- 5- This barrier blocks the movement of nutrients by diffusion. What is the name of the pathway through which the nutrients must circulate in order to reach the xylem?

二、選擇題(單選題) (每一題 2 分，共 30 分) ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

- 1- At alkaline pH, how is Fe in soil?
 - a- It is abundant
 - b- It is bioavailable
 - c- It precipitates
 - d- It is free
- 2- Which protein is responsible for maintaining a proton gradient across the plasma membrane?
 - a- Vacuolar H⁺ ATPase
 - b- Channels
 - c- Plasma membrane H⁺ ATPase
 - d- Symporters
- 3- Which tissues transports the more water in the plant?
 - a- The xylem
 - b- The phloem
 - c- The vacuole
 - d- The Casparian strips
- 4- What is the approximate pH of the symplast?
 - a- very acidic, pH = 4
 - b- very alkaline, pH = 9
 - c- mildly acidic, pH = 5.5
 - d- mildly alkaline, pH = 7
- 5- What is the pH of the xylem?
 - a- very acidic, pH = 4
 - b- very alkaline, pH = 9
 - c- mildly acidic, pH = 5.5
 - d- mildly alkaline, pH = 7

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- 6- Which form of energy directly fuels nutrient uptake into plant cells?
- a- The photosynthesis
 - b- The osmotic pressure
 - c- The proton-motive force
 - d- The vacuole
- 7- What is the function of HAK transporters?
- a- Low affinity potassium uptake
 - b- Proton extrusion
 - c- Sodium secretion
 - d- High affinity potassium uptake
- 8- When is the activity of a low affinity transporter highest?
- a- When the concentration of its substrate is high
 - b- When the concentration of its substrate is low
 - c- When ATP is highly available
 - d- When the K_m is equal to the concentration required to achieve V_{max}
- 9- Which technique is employed to observe the expression pattern of a gene?
- a- GUS assay
 - b- GWAS
 - c- CRISPR/Cas9 genome editing
 - d- Mass Spectrometry
- 10- Why is phosphorus poorly bioavailable in soils?
- a- It binds to arsenic and silicon
 - b- it forms very stable complexes with aluminum, iron and calcium
 - c- It precipitates with ammonium and nitrate
 - d- It is sequestered by mycorrhizal fungi
- 11- Which statement best describes cytosolic calcium concentration?
- a- The concentration is high
 - b- The concentration is very stable
 - c- The concentration is low
 - d- Cytosolic concentration is higher than apoplast concentration
- 12- What is the function of calcium in the cell walls?
- a- It reinforces lignin network
 - b- It stabilizes pectin
 - c- It keeps cellulose fibers straight
 - d- It maintains the structure of starch

13- Which form of sulfur is predominantly taken up by plant roots?

- a- Sulfite
- b- Sulfur dioxide
- c- Sulfate
- d- Methionine

14- What is the main family of sulfur transporters in plants?

- a- ZIP transporters
- b- PHT family
- c- NRT family
- d- SULTR family

15- What happens to roots of phosphate-deficient plants?

- a- The primary root grows longer
- b- The roots accumulate anthocyanins
- c- The growth of the primary root is arrested
- d- The leaves quickly become chlorotic

三、名詞解釋 (每一題 6 分，共 30 分) ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

1. (a) Photochemical quenching ; (b) Non-photochemical quenching, NPQ
2. (a) C4 plants ; (b) PEP carboxylase
3. (a) Long distance transport; (b) Lateral transport
4. (a) Nodulation factors (Nod factors) ; (b) Nitrogenase
5. (a) Plant growth retardants; (b) Plant growth regulators

四、問答題 (每一題 10 分，共 20 分) ※ 注意：請於試卷內之「非選擇題作答區」標明題號依序作答。

1. Describe the biological roles of cytokinin and ABA in plants?
2. How do plants adapt to low phosphorus stress?

試題隨卷繳回