

國立成功大學

113學年度碩士班招生考試試題

編 號： 62

系 所： 熱帶植物與微生物科學研究所

科 目： 植物生理與分子生物學

日 期： 0202

節 次： 第 1 節

備 註： 不可使用計算機

※ 考生請注意：本試題不可使用計算機。 請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

一、 Simple-Choice Questions 單選題 (2 points for each question. 每題 2 分) (54%)

1. Which of the following organelles cannot be found in plant cells?

- A) Lysosome
- B) Glyoxysome
- C) Ribosome
- D) Mitochondrion
- E) Chloroplast

2. Which of the following reactions is not linked to the “reduced ferredoxin” produced in photosystem I (PSI).

- A) N-cycle in photorespiration
- B) Light activation of rubisco
- C) Light activation of some enzymes involved in regeneration phase of Calvin cycle
- D) Production of NADPH in light reaction
- E) All the above are not linked to the reduces ferredoxin produced in PSI

3. Which carbohydrate among the following is the primary transport sugar in plants?

- A) Glucose
- B) Sucrose
- C) Fructose
- D) Starch
- E) Glycogen

4. Which of the following secondary metabolites (natural products) is ubiquitously found in plants?

- A) Nicotine.
- B) Caffeine.
- C) Ginsenoside.
- D) TaxolTM (Paclitaxel).
- E) None of the above can be found ubiquitously in plants

5. The free energy for the oxidation of glucose to CO₂ and water is -686 kcal/mol, the free energy for the reduction of NAD⁺ to NADH is +53 kcal/mol. Why are only two molecules of NADH formed during glycolysis when it appears that as many as a dozen could be formed?
- A) Most of the free energy here is still preserved in pyruvate.
 - B) Most of the free energy here had been used to produce substrate-level ATP.
 - C) Most of the energy here is released as heat.
 - D) Most of the energy here is released as fluorescent light.
 - E) Most of the energy here is still preserved in NAD⁺
6. How does an increase in solute concentration typically affect plant water potential?
- A) Increases the water potential
 - B) Decreases the water potential
 - C) Has no effect on the water potential
 - D) Indirectly affects root growth
 - E) Enhances nutrient absorption
7. Which of the following sequences describes the regular phase of cell cycle?
- A) G₁ → S → G₂ → M
 - B) G₂ → G₁ → M → S
 - C) S → G₁ → M → G₂
 - D) M₁ → G → M₂ → S
 - E) G₁ → M → S → G₂
8. Which of the following organelles could contain more than two membrane systems?
- A) Mitochondrion
 - B) Ribosome.
 - C) Vacuole
 - D) Chloroplast
 - E) Golgi body
9. Which of the following statements about plasmodesmata is correct?
- A) Plasmodesmata are found exclusively in animal cells.
 - B) Plasmodesmata are membrane-bound organelles responsible for energy production.
 - C) Plasmodesmata are channels that connect the cytoplasm of adjacent plant cells.
 - D) Plasmodesmata are involved in protein synthesis within the nucleus.
 - E) Plasmodesmata are composed primarily of carbohydrates.

10. Which of the following compounds is the precursor used in sucrose synthesis?

- A) UDP-Glucose
- B) Maltose.
- C) Fructose-1-phosphate
- D) ADP-Glucose
- E) Glucan

11. What is the primary function of the enzyme Argonaute (AGO) in the RNA-induced silencing complex (RISC) pathway in plants?

- A) Cleavage of mRNA guided by siRNA
- B) Catalyzing the elongation of small RNAs
- C) Inhibiting translation initiation
- D) Addition of 5' cap to mRNA
- E) Export of mRNA from the nucleus

12. What is the primary role of the enzyme phosphoenolpyruvate carboxylase (PEPC) in plants?

- A) CO₂ fixation during photosynthesis
- B) Starch synthesis in chloroplasts
- C) Regulation of transpiration
- D) Sucrose breakdown in the cytoplasm
- E) Oxidative phosphorylation in mitochondria

13. Which protein family is involved in the recognition and binding of specific DNA sequences, regulating gene expression in plants?

- A) Zinc finger proteins
- B) Heat shock proteins
- C) Myosin motors
- D) Hemoglobin proteins
- E) Keratin proteins

14. What is the primary function of the enzyme RNA-dependent RNA polymerase (RdRp) in plants?

- A) DNA replication
- B) mRNA degradation
- C) Regulation of ribosome assembly
- D) Amplification of small RNA molecules
- E) Transcription initiation

15. Which molecular technique allows for the targeted editing of specific genes in plant genomes by introducing precise modifications?

- A) RNA interference (RNAi)
- B) DNA methylation
- C) Zinc finger nucleases (ZFNs)
- D) Chromatin immunoprecipitation (ChIP)
- E) Homologous recombination

16. Which enzyme plays a pivotal role in repairing DNA double-strand breaks via the non-homologous end-joining (NHEJ) pathway in plants?

- A) DNA polymerase III
- B) Topoisomerase
- C) Ligase IV
- D) Helicase
- E) Primase

17. Which technique is used in high-throughput plant biotechnology to study the interactions between proteins on a large scale?

- A) Yeast two-hybrid (Y2H) system
- B) Fluorescence in situ hybridization (FISH)
- C) In vivo footprinting
- D) Chromatin immunoprecipitation (ChIP)
- E) Mutagenesis

18. What is the primary function of genome-wide association studies (GWAS) in plant genomics?

- A) Identifying quantitative trait loci (QTLs) associated with specific traits
- B) Determining DNA methylation patterns
- C) Analyzing gene expression profiles
- D) Studying protein-protein interactions
- E) Assessing chromatin remodeling events

19. What is the function of the Kozak sequence in plant mRNA translation?

- A) Binding of the ribosome to the mRNA
- B) Recognition of the stop codon
- C) Formation of peptide bonds
- D) mRNA export from the nucleus
- E) Splicing of pre-mRNA

20. Which genomic tool is primarily used for identifying DNA-binding sites of transcription factors across the entire genome in plants?

- A) ChIP-seq
- B) Southern blotting
- C) PCR amplification
- D) DNA microarrays
- E) CRISPR-Cas9

21. The DNA in a bacterial (prokaryotic) chromosome is best described as:

- A) a single circular double-helical molecule.
- B) a single linear double-helical molecule.
- C) a single linear single-stranded molecule.
- D) multiple linear double-helical molecules.
- E) multiple linear single-stranded molecules.

22. The fundamental repeating unit of organization in a eukaryotic chromosome is:

- A) the centrosome.
- B) the lysosome.
- C) the microsome.
- D) the nucleosome.
- E) the polysome.

23. Small signal molecules that regulate transcription are not known to:

- A) cause activator proteins to bind to DNA sites.
- B) cause repressor proteins to bind to DNA sites.
- C) directly bind to DNA sites.
- D) prevent activator proteins from binding to DNA sites.
- E) release repressor proteins from DNA sites.

24. Transcription of the lactose operon in *E. coli* is stimulated by:

- A) a mutation in the repressor gene that strengthens the affinity of the repressor for the operator.
- B) a mutation in the repressor gene that weakens the affinity of the repressor for the operator.
- C) a mutation in the repressor gene that weakens the affinity of the repressor for the inducer.
- D) binding of the repressor to the operator.
- E) the presence of glucose in the growth medium.

25. Protein structural motifs often have general functions in common. Which one of the following motifs is known to be involved in protein dimer formation, but not in direct protein-DNA interactions?

- A) β -barrel
- B) helix-turn-helix
- C) homeodomain
- D) leucine zipper
- E) zinc finger

26. Which of the following statements about type II restriction enzymes is false?

- A) Many make staggered (off-center) cuts within their recognition sequences.
- B) Some cut DNA to generate blunt ends.
- C) They are part of a bacterial defense system in which foreign DNA is cleaved.
- D) They cleave and ligate DNA.
- E) They cleave DNA only at recognition sequences specific to a given restriction enzyme.

27. The PCR reaction mixture does not include:

- A) all four deoxynucleoside triphosphates.
- B) DNA containing the sequence to be amplified.
- C) DNA ligase.
- D) heat-stable DNA polymerase.
- E) oligonucleotide primer(s).

二、Short Answer Questions 簡答題 (26%)

1. Explain how each of the following is used in cloning in a plasmid: (a) antibiotic resistance genes; (b) origin of replication; (c) polylinker region. (6%)
2. What is mineral nutrition? (3%) Why do plants need it? (3%)
3. Rhizobia can form symbiotic relationship with legumes. Once the symbiosis is established, where do they stay in the host plant? (2%) What is the benefit that rhizobia provide to the host plant? (3%) How do they recognize each other? (3%)
4. Phosphate is an important resource to plants. However, it is easy to form insoluble salt in the soil and thereby becomes not ready for plants to use. Generally, how do plants overcome this obstacle? (6%)

三、Matching Questions 配合題 (2 points for each question. 每題 2 分) (20%)

1. Select the most likely phenomenon or physiological effect,

- Q1. When cultured normal callus tissues of many species are sub-cultured repeatedly over a long period, they can grow on a culture medium without hormones (such as auxin or cytokinin).
- Q2. Spray "orange agent" containing a mixture of two synthetic auxins, 2,4-Dichlorophenoxyacetic acid (2,4-D) and 2,4,5-Trichlorophenoxyacetic acid (2,4,5-T), on plants leading to what plant response.
- Q3. Growth response when plants are subject to the shade of other plants to ensure leaves can receive optimal sunlight.
- Q4. The development of fruit without fertilization.
- Q5. Exposing pea seedlings to ethylene leads to swelling of hypocotyl, exaggeration of the curvature of the apical hook, and inhibition of root elongation.

- A) Thigmotropism
- B) Apical dominance
- C) Totipotency
- D) Habituation
- E) Polar growth
- F) Phototropism
- G) Triple response
- H) Shade avoidance
- I) Gravitropic bending
- J) de-foliate
- K) Parthenocarpy
- L) Phase change
- M) Vivipary
- N) Crown gall disease

	Q1	Q2	Q3	Q4	Q5
Answers					

2. Select one appropriate answer for the following questions,

- Q1. The most common gene used in plant transformation to delay leaf and flower senescence.
- Q2. Some hormone receptors initiate protein proteolysis of repressors to activate a transcriptional regulator. Which gene in the list is the repressor for GA response?
- Q3. Mutation of which gene in hormone biosynthesis contributed to the "Green Revolution" in breeding many semidwarf rice varieties during the 20th century.
- Q4. Auxin polar transport enables auxin to exit the cell through active export by auxin efflux carriers specifically located at the basal side of the cell. Which gene in the list belongs to this protein family?
- Q5. Introducing antisense constructs to interfere with the expression of biosynthesis enzymes is an effective way to control ethylene production. Which gene in the list is often used as a target for genetic manipulation to limit ethylene synthesis.

- A) Isopentenyl transferase (*ipt*) gene
- B) JAZ
- C) PIN
- D) *iaaH* and *iaaM* synthase genes
- E) octopine synthase
- F) cytokinin oxidase
- G) systemin
- H) α -amylase
- I) DELLA
- J) LacZ gene (β -galactosidase)
- K) GA 20 oxidases
- L) ACC synthase

	Q1	Q2	Q3	Q4	Q5
Answers					