

※ 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。

I. Select the best answer (60 points):

1. Which one of the following compounds is **NOT** transported between mesophyll cells and bundle sheath cells in C4 plants?
 - A. alanine
 - B. aspartate
 - C. malate
 - D. pyruvate
 - E. oxaloacetate
2. During photosynthesis, the oxygen atom of O₂ evolved is from?
 - A. CO₂
 - B. glucose
 - C. H₂O
 - D. triose
 - E. sunlight
3. Which statement about nitrogen fixation is **CORRECT**?
 - A. uses oxidized ferredoxin as electron donor
 - B. is an exergonic reaction
 - C. occurs under aerobic condition
 - D. may produce hydrogen gas
 - E. is catalyzed by nitrate reductase
4. Which one of the following statements about photosynthesis is correct?
 - A. Some bacteria may perform photosynthesis and use H₂S as electron donor
 - B. dark reaction can occur in the dark
 - C. electrons will be accepted by ferredoxin in the end of the light reaction
 - D. transthylakoid proton gradient is only generated by Q-cycle
 - E. O₂ is not the substrate of rubisco
5. In contrast to C3 photosynthesis, _____ additional ATP is required to fix one molecule of CO₂ in C4 photosynthesis?
 - A. one
 - B. two
 - C. three
 - D. four
 - E. five
6. The wavelength of absorb light of DNA, RNA, and protein are _____, respectively.
 - A. 230 nm, 230 nm, and 280 nm
 - B. 260 nm, 260 nm, and 280 nm
 - C. 230 nm, 260 nm, and 280 nm
 - D. 260 nm, 230 nm, and 280 nm
 - E. 280 nm, 280 nm, and 260 nm
7. Signal sequences are part of a protein that
 - A. signal the protein synthesis
 - B. signal the protein location
 - C. signal folding of the protein
 - D. signal the protein denature
 - E. signal active site of the protein
8. Which of the following forces is the most favorable for protein folding?
 - A. Vander Waals interactions
 - B. Hydrogen bonds
 - C. Ionic bonds
 - D. Conformational entropy
 - E. Hydrophobic Interactions

9. The substrate X and end product Y of plant glycolysis are
- X=glucose, Y=pyruvate
 - X=glucose, Y=malate
 - X=glucose, Y=pyruvate and malate
 - X=sucrose, Y=pyruvate
 - X=sucrose, Y=pyruvate and malate
10. Which of the following statements about lipid metabolism in plants is **FALSE**?
- Triacylglycerols are an efficient form for storage of reduced carbon
 - Triacylglycerols are synthesized in the ER
 - Fatty acids are synthesized in the cytosol
 - The glyoxylate cycle takes place in glyoxysome
 - In glyceroglycolipids, sugars form the head group
11. Which of the following molecules or substances contain, or are derived from, fatty acids?
- Plant wax
 - Prostaglandins
 - Sphingolipids
 - Triacylglycerols
 - All of the above contain or are derived from fatty acids.
12. The fluidity of a lipid bilayer will be increased by:
- decreasing the number of unsaturated fatty acids.
 - decreasing the temperature.
 - increasing the length of the alkyl chains.
 - increasing the temperature.
 - substituting 18:0 (stearic acid) in place of 18:2 (linoleic acid).
13. Which one of the following signaling mechanisms is used most predominantly in plants?
- Cyclic-nucleotide dependent protein kinases
 - DNA-binding nuclear steroid receptors
 - G protein-coupled receptors
 - Protein serine/threonine kinases
 - Protein tyrosine kinases
14. Complete oxidation of 1 mole of which fatty acid would yield the most ATP?
- carbon saturated fatty acid
 - 18-carbon mono-unsaturated fatty acid
 - 16-carbon mono-unsaturated fatty acid
 - 16-carbon poly-unsaturated fatty acid
 - 14-carbon saturated fatty acid
15. Which one of the following cellular organelles is *not* unique to plant cells, in carrying out the indicated pathway or function of carbohydrate metabolism?
- Amyloplasts (starch synthesis)
 - Chloroplasts (Calvin cycle)
 - Glyoxysomes (glyoxylate cycle)
 - Mitochondria (citric acid cycle)
 - Vacuoles (organic acid storage)

II. Extended Matching Questions (15points)

- | | |
|----------------------|----------------------|
| 1. A). Auxins | H). Jasmonic acid |
| B). Ethylene | I). Peptide hormones |
| C). Cytokinin | J). Polyamines |
| D). Gibberellic acid | K). Salicylic acid |
| E). Abscisic acid | L). Strigolactone |

F). Brassinosteroids

M). Flavonoids

Select the hormone(s) that match to the question:

Q1. Two most common used hormones in manipulating shoot and root morphogenesis under plant tissue culture condition. (2 points)

Q2. Two hormones have antagonistic effects on seed development and germination (2 points)

Q3. Gaseous hormone in plant (1 point)

請將下表畫於答案卷上作答

Answers:

	Q1	Q2	Q3
Answers			

2. A. Thigmotropism

H. Polar growth

B. Apical dominance

I. Gravitropic bending

C. Totipotency

J. de-foliate

D. Habituation

K. Parthenocarpy

E. Apical dominance

L. Phase change

F. Phototropism

M. Vivipary

G. Triple response

N. Crown gall disease

Select the most likely phenomenon or physiological effect,

Q1. When cultured normal callus tissues of many species are subcultured repeatedly over a long period, they can grow on culture medium without hormones (such as auxin or cytokinin). (1 point)

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. (1 point)

Q3. Growth response to light mainly in all shoots and some roots to ensure leaves can receive optimal sunlight. (1 point)

Q4. Spray auxin on the terminal bud of a plant. (1 point)

Q5. Expose pea-seedlings to ethylene leads to swelling of hypocotyl, exaggeration of the curvature of the apical hook and inhibition of root elongation. (1 point)

請將下表畫於答案卷上作答

	Q1	Q2	Q3	Q4	Q5
Answers					

3. A). Isopentenyl transferase (*ipt*) gene

G). systemin

B). JAZ

H). α -amylase

- | | |
|--|---|
| C.) PIN | I). DELLA |
| D.) <i>iaaH</i> and <i>iaaM</i> synthase genes | J). LacZ gene (β -galactosidase) |
| E.) octopine synthase | K). GA 20 oxidases |
| F.) cytokinin oxidase | L). ACC synthase |

Select one appropriate answer for the following questions,

- Q1. The most common gene used in plant transformation to delay leaf and flower senescence. (1 point)
- 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? (1 point)
- Q3. Mutation of which gene in hormone biosynthesis contributed to “Green Revolution” in breeding many semidwarf rice varieties during the 20th century. (1 point)
- Q4. Auxin polar transport enable auxin can only exit the cell through active export by auxin efflux carriers that specifically located at the basal side of the cell. Which gene in the list belongs to this protein family? (1 point)
- Q5. Introduction of antisense constructs to interfere with expression of biosynthesis enzymes is an effective way to control ethylene production. Which gene in the list often use as target for genetic manipulation to limit ethylene synthesis (1 point)

Answers: 請將下表畫於答案卷上作答

	Q1	Q2	Q3	Q4	Q5
Answers					

III. Applying what you known (25 points):

1. In what general ways are plant and animal hormones similar? (5 points)
2. Methanol is highly toxic, not because of its own biological activities but because it is converted metabolically to formaldehyde, though action of alcohol dehydrogenase. Part of the medical treatment for methanol poisoning involved administration of large dose of ethanol. Explain why this treatment is effective. (4 points)
3. Given the following sequence for one strand of a double-stand oligonucleotide:
 5'-ACCGTAAGGC3'
- (a) Write the sequence for the complementary DNA strand (2 points)

(b) Suppose you knew that the strand shown above has phosphate on both ends. Using an accepted nomenclature, write the sequence so as to show this. (2 points)

(c) Write the sequence of the RNA complementary to the strand shown above. (2 points)

4. The combustion of glucose to CO_2 and water is a major source of energy in aerobic organisms. It is a reaction favored mainly by a large negative enthalpy change as shown below: $\Delta H^\circ = -2816 \text{ KJ/mol}$ and $\Delta S^\circ = +181 \text{ J/mol}$

(a) At 37°C , what is the value for ΔG° ? (2 points)

(b) For every mole of glucose oxidized, 38 moles of ATP are produced from ADP ($\Delta G^\circ = 30.5 \text{ KJ/mol}$). Calculate the standard state free energy change for the overall reaction when glucose oxidation is coupled to the formation of ATP? (2 points)

5. Shown below is an R loop prepared for electron microscopy by annealing a purified eukaryotic messenger RNA with DNA from a genomic clone containing the full-length gene corresponding to the mRNA.

(a) How many exons does the gene contain? How many introns? (4 points)

(b) Where would you expect to find a polyadenylic acid sequence? Why? (2 points)

