SC/BIOL 2010.04 Plant Biology Final Exam (winter term, 2013/14)

NAME:_____

Instructions:

• Please have your photo card and sessional card ready to show the invigilator when you sign the sign-in sheet.

• Please make sure that your name and student ID number are entered correctly on the scantron sheet!

• Answer all questions and ensure that they are transferred to the scantron sheet accurately!

• When you have finished, please hand in *both* the exam and your <u>scantron sheet</u> (and please be quiet for the sake of others still taking the exam).

[01] Which of the following atmospheric gas(es) absorb significant amounts of solar radiation at wavelengths more energetic than the visible wavelengths (ca 400-700 nm)?

U	0	U N	,
A. H ₂ O (water vapour)	$B.O_2$ (oxyg	gen) C. Ar (argon)	D. N ₂ (nitrogen)
E. CO (carbon monoxide)	F. He (heliu	um) G. A and B	H. none of the above

[02] Which of the following is/are correct for the electron micrograph from your textbook (choose the best answer)?

- A. The structures labeled 'a' are endoplasmic reticulum.
- H.A,C and F
- - B. The structures labeled 'a' are thylakoids. C. The region labeled 'b' is the nucleoid.
 - D. The region labeled 'c' is the vacuole.
 - E. The structure labeled 'd' is the plasma membrane.
 - F. The structure labeled 'e' is the peptidoglycan coat
 - G. B, C and E

- **[03]** For the molecular structure and spectrum (shown with an arrow), what would be its principle role in photosynthetic organisms (choose the best answer)?
- A. Electron transfer in the electron transport chain (especially the
- cytochrome $b_6 f$ complex)

B. Protection from infra-red radiation

C. As a light-sensing pigment (rhodopsin) that the alga would use

in vision, to identify regions of light suitable for photosynthesis.

D. It is a chlorophyll and would function in light-harvesting to

provide excitons to the reaction centers.

E. 'Splitting' of H_2O to produce H^+ , e^- and O_2

F. It is a bilin and would function in light-harvesting to provide

excitons to the reaction centers.

G. It is a carotenoid and would function in light-harvesting to

provide excitons to the reaction centers.

H. None of the above



[04] During the light reactions, which chloroplast compartment becomes acidic (Choose the best answer)?

,			
A. stroma	B. granal	C. thylakoid	D. lumen
E. intermembrane space	F. plastoquinone	G. matrix	H. cristae

[05] What is an action spectrum of photosynthesis?

A. It is the wavelengths of fluorescence: the light emitted when an excited electron returns to the ground state

B. It is the wavelengths of absorbance: when light is absorbed to cause the electron to 'jump' to the excited state

C. It is the absorbance spectrum of the reaction center chlorophyll that undergoes photochemistry $(Chl^* \longrightarrow Chl^+ + e^-)$

- D. It is the absorbance spectrum of the light-harvesting chlorophylls, responsible for transferring the exciton to the reaction center (resonance energy transfer)
- E. It is the wavelengths of light causing oxygen production
- F. It is the combined spectra for absorbance and fluorescence (A and B)
- G. It is the combined spectra for exciton transfer and photochemistry (D and E)

H. None of the above

[06] Which of the following molecule(s) is synthesized from 3-phosphoglycerate and is used as the building block to regenerate ribulose 1,5 – bisphosphate for continued carbon dioxide fixation by RuBisCO (ribulose 1, 5 – bisphosphate carboxylase / oxygenase)?





F. A and B G. C and D H. D and E

[07] Which one of the following carbon compounds is produced from phosphoenolpyruvate in the C4 carboxylase reaction?

- A. glyceraldehyde-3 phosphate D. sedoheptulose 1,7-bisphosphate
- G. xyulose 5-phosphate
- B. 3-phosphoglycerate E. ribose 5-phosphate H. none of the above
- C. glycolate 1-phosphate F. erythrose 4-phosphate

[08] The graph shows an example of the complex relationship between light intensity and CO_2 concentration and their effect(s) on photosynthetic rate. Which of the following interpretation(s) are valid for the data?

A. It's clear from the graph that elevated CO_2 will not increase the photosynthetic rate and therefore accumulation of carbohydrate.

B. It's clear from the graph the elevated CO_2 causes a dramatic increase in the photosynthetic rate under all conditions.





concentrations above about 300 ppm; at high light intensities, elevated CO₂ is limiting.

D. Light intensity limits the photosynthetic rate under all conditions.

E. Light intensity only limits the photosynthetic rate at elevated CO_2 .

F. A and D G. B and D H. None of the above

[09] Which of the following characteristics could not be used to classify (eu)bacteria? A. metabolic requirements B. anaerobic versus aerobic respiration C. lactose production D. pigment composition E. cocci/bacilli/spirilli morphology F. ribosomal RNA sequence G. genome DNA sequence H. all of the above can be used [10] Which of the following distinguishes Gram-negative from Gram-positive bacteria? A. Only Gram-negative bacterial walls (peptidoglycan) are dissolved by solvents (e.g., acetone or ethanol) B. Only Gram-positive bacterial walls (mucopolysaccharide) are dissolved by solvents (e.g., acetone or ethanol) C. Crystal violet stains only Gram-positive bacteria D. Safranin stains only Gram-negative bacteria F. B and C H. None of the above E. A and C G. B and D [11] Which one of the following groups contains carageenans? A. Chrysophyta B. Euglenophyta C. Dinophyta (dinoflagellates) D. Haptophyta E. Bacillariophyta (diatoms) F. Xanthophyceae G. Cryptophyta H. none of the above Match the three unicellular, autotrophic divisions of the Protists with the most distinguishing characteristic(s) for each division. Choose the best answer. [12] Euglenophyta A. Fucoxanthin

[12] Eugenophyta
[13] Cryptophyta
[14] Chrysophyceae (golden algae)
[15] Cryptophyta
[16] Chrysophyceae (golden algae)
[16] Chrysophyceae (golden algae)
[17] Chrysophyceae (golden algae)
[16] Chrysophyceae (golden algae)
[16] Chrysophyceae (golden algae)
[17] Chrysophyceae (golden algae)
[18] Chrysophyceae (golden algae)
[19] Chrysophyceae (golden algae)
[10] Chrysophyceae (golden algae)
[11] Chrysophyceae (golden algae)
[12] Chrysophyceae (golden algae)
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[14] Chrysophyceae (golden algae)
[15] Chrysophyceae (golden algae)
[15] Chrysophyceae (golden algae)
[15] Chrysophyceae (golden algae)
[16] Chrysophyce

Match the three major multicellular, autotrophic divisions of the Protists with the one most distinguishing characteristic for each division. Choose the best answer.

[15] Rhodophyta	[16] Phaeophy	rta	[17] Chlorophyta
A. chlorophyll a	B. carotenoids	C. only chlorophyll b	D. tinsellated flagella
E. isogamous	F. laminarin and sorbitol	G. cellulose walls	H. None of the above



[18] Which of the following groups(s) are heterokonts (Stramenoniles)?

(Strainenopnes).	
A. Chrysophyceae (golden algae)	B. Crytophyta
C. Euglenoids	D. Haptophyta
E. Myxomycetes (plasmodial slime)	F. Chlorophyta (green algae)
G. A and B	H. B and E

[19] For the life cycle shown (from your lab manual), identify the group (Choose the best answer).

- A. Ulvophyceae (green algae) C. Charophyceae (green algae) E. Phaeophyceae (brown algae) G. Polysiphonia
- B. EctocarpusD. Chlorophyceae (green algae)F. Rhodophyta (red algae)
- H. Laminaria

[20] Which one of the meiotic life cycles does the life cycle represent (Choose the best answer)?

A. zygotic B. gametic C. sporic D. None of the above

Match the following definitions with the appropriate term. **[21]** The condition of having dissimilar motile gametes

[22] A lateral connection between adjacent cells of a dikaryotic hypha that ensures each cell of the hypha will contain two dissimilar nuclei.

[23] A sterile filament growing among the reproductive cells in the fruiting body.

[24] Amongst the fungi (Microsporidia, Chytrids, Glomeromycota, Zygomycetes, Ascomycota and Basidiomycota), which one of the following traits is unique to Microsporidia? A. coenocytic (multi-nucleate cell units) B. nonmotile spores C. dikaryotic vegetative colonies

A. coenocytic (multi-nucleate cell units)B. nonmotile sporesD. asexual spore production from conidiophoresE. unicellularG. motile sporseH. None of the above

[25] Rhizopus and Choanephora are examples of genera (members of the Zygomycota) of

economic importance for which of the following reason(s)?

A. They cause soft rot on many species of plants, some of importance as crops (especially fruits and seeds).

B. They are the cause of the Muscii blight, affecting cereal crops such as wheat and barley.

C. Many members of these genera (and other Zygomycota) form an intimate symbiotic relation with the roots of plants (the endomycorrhizae).

D. They are often pathogens of insects and other small animals, and could be used for biocontrol of common insect pests.

E. They are the major fungal genera forming an intimate symbiotic relation with algae (usually Chlorophytes, rarely the prokaryotic cyanobacteria) to create the remarkable lichens.

F. Many members of both genera are common spoilage molds (growing on bread and cheese, for example, making them <u>inedible</u>).

 $G.\,C \text{ and } E$

H. None of the above.

[26] Which of the following is/are correct for the photograph (from your textbook) (choose the



best answer)?

A. The image shows an example of the spore-ejecting structure of Pilobolus (Zygomycota).

B. This is an example of a zygosporangial structure of one of the Glomeromycetes, in which the conidiophores are breaking through the cellulose wall of the plant host.

C. They appear to be basidiospores (Basidiomycota), based on the presence of sterigma.

D. The image shows budding cells of yeast (Ascomycota) being ejected from the mother cell.

E. It appears to be a germinating zoosporangium of Chytridiomycota, within its host.

F. It is the spore-bearing structure of Armillaria (Basidiomycota).

G. They are conidia, borne at the tips of modified hyphae.

H. None of the above

A. anisogamy B. cleistothecium C. dolipore D. clamp connection E. haustoria F. trichogyne

F. chitinous cell walls

G. paraphysis H. dimorphic



[27] Identify the most appropriate group(s) on the basis of the vegetative and reproductive structures diagrammed in the figure (choose the best answer)?

- A. Gasteromycete C. Ascomycete E. A and D
- B. Hymenomycete D. cyanobacteria F. B and D H. None of the above

[28] Which of the labeled region(s) identifies the major location(s) of the mycobiont in the vegetative structure (choose the best answer)?

A. None of the regions	B. All of the regions	C. 2, 4 and 5	D. 3, 4 and 5
E. Only 2	F. Only 3	G. Only 4	H. 2 and 5

[29] Ectomycorrhizae are an example of a fungal/plant symbiotic relationship in which the mycobiont does not penetrate into the plant cells (but may grow between the root cells in a Hartig net), it forms a mantle surrounding the root. Which of the following are characteristic(s) of such a mycorrhizal symbiotic relationship?

A. The mycelial network of the mycobiont increases the volume of soil from which nutrients (most especially sodium and small molecular weight soil acids) are provided to the plant symbiont.

B. In addition to carbohydrate produced by the photobiont, the mycobiont may receive essential vitamins from the plant.

C. If the fungal hyphae do not penetrate *into* the plant root cells, it is not a mycorrhizae relationship.

D. Mycorrhizae are often essential for growth of plant seedlings, in the absence of the fungal symbiont, the seedlings lack vigor and may die.

	E. A, B and D	F. A and B	G. B and D	H. none of the above
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Match the following sub-divisions of the Basidiomycota with the one most distinguishing characteristic for each division. Choose the best answer (you may choose an answer only once).

[20] Ilyman amyrastas	A gill fungi
[30] Hymenomycetes	A. gill lungi
[31] Gasteromycetes	B. club-snaped, aseptate basidia, usually bearing four basidiospores
[32] Pucciniomycotina (rusts)	on a sterigma
	C. conidia
	D. basidomata surrounded by a peridium
	E. dolipore
	F. stable dikaryotic state
	G. ascomata
	H. seldom form basidiomata

I	[33]	Which	one o	of the	follow	ing	charac	teristics	s is	found	only	in	land	plants	5
	00	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0110 0		10110		enan ae	cer iberes	, 10	100110	omy		1001104	pranto	

	-	• •	
A. archegonia	B. non-motile gametes	C. alternation of generations	D. food-conducting cells
E. antheridia	F. cellulose cell walls	G. hydroids	H. none of the above

[34] Which of the following characteristics are found in some or all of the Chlorophyta (green algae) groups and in all land plants (choose the best answer)? A. phycoplastic mitosis B. glyoxylate dehydrogenase C. phragmoplastic mitosis D. leptoids E. A and C F. A and D G. B and C H. B and D

[**35**] Place the following groups in order of increasing complexity of their adaptations to survival on land, or appearance in the fossil record?

1. Ginkgoales	2. Liverworts	3. Hornworts	4. Gnetophyta 5. Bryidae
A. 1,2,3,4,5	B. 2,1,4,3,5	C. 2,3,5,4,1	D. 2,3,5,1,4
E. 5,4,3,2,1	F. 4,5,3,2,1	G. 2,3,4,5,1	H. none of the above

[36] The life cycle of a Anthocerotophyta (hornworts) contains an sexual propagule known as the:

A. archiegoniophore	B. elators	C. sporangium	D. antheridiophore
E. gemma	F. spores	G. microsporangia	H. none of the above



[**37**] For the life cycle shown (from your lab manual), identify the group (Choose the best answer).

A. Anthocerophyta (hornworts)	B. Lycopodium
C. Bryidae (moss)	D. Equisetum
E. Selaginella	F. Psilotum
G. Isoetes	H. Zamia

[38] Which one of the meiotic life cycles does the life cycle represent (Choose the best answer)?

A. zygotic B. gametic D. None of the above

C. sporie

[39] Identify the Gymnosperm shown below to genus using the key.

L J	J J I		0
A. Abies	B. Pseudotsuga	C. Larix	D. Picea
E. Pinus	F. Taxus	G. Thuja	H. Tsuga



[40] Which of the following is true of megagametogenesis in angiosperms (choose the best answer)?

1. meiosis results in the formation of four megaspores (some may then degenerate)	A. 1, 2, 3, 4 and 5
2. two synergid cells 'surround' the egg cell	B. 1, 2, 3, 4 and 6
3. polar nuclei fuse with a sperm cell nuclei to form the triploid endosperm	C. 1, 2, 3, 5 and 6
4. the mature embryo sac contains a total of eight haploid nuclei	D. 2, 3, 4 and 5
5. the micropyle is adjacent to the antipodal cells	E. 1, 3, 4, 5 and 6
6. the integument surrounds the embryo sac	F. 1, 3, 4 and 5
	G. 3, 4, 5 and 6
	H. 1, 2, 3, 4, 5 and 6

[41] Which of the following is true of microgametogenesis in angiosperms (choose the best answer)?

A. Meiosis results in the formation of four spores in a tetrad.

B. Tapetal tissue is haploid.

C. Pollen exine is produced soon after spores are released from the tetrad .

D. In its mature state, a pollen grain will contain at least two nuclei, one a generative cell (from which two sperm cells arise), the other a vegetative nuclei.

E. A, B and C F. B, C and D G. A, C and D

H. All of the above

10 mm

10 mm

B. bees

E. ants

A. hummingbirds	
D. butterflies	
G. A and E	

C. beetles F. A and C H. A and D

[43] For the floral structure shown (tube [trumpet]), what would be the least likely pollinator(s) (choose the best answer)?

B. bees

E. ants

A. hummingbirds D. butterflies G. A and E

C. beetles F. A and C H. A and D



[44] In sporophytic incompatibility, which of the pollen will germinate if the allelic dominance sequence is $S_1 > S_2 > S_2 > S_4$?

A. $1-S_1$ pollen D. $2-S_2$ pollen G. C and E	B. $1-S_2$ pollen E. $3-S_1$ pollen H. E and F	C. 2 -S ₁ pollen F. 3 -S ₂ pollen

[45] And, if the allelic dominance is $S_1 > S_2 > S_2 > S_4$?

A. $1-S_1$ pollen	B . $1-S_2$ pollen	C. $2-S_1$ pollen
D. $2-S_2$ pollen	E. $3-S_1$ pollen	F. $3-S_2$ pollen
G. C and E	H. E and F	

[46] What is gametophytic incompatibility (choose the best answer)?

A. gametophytic incompatibility refers to the abortion of the gametophytic egg cell after fertilization when sperm cells from an incompatible pollen donor fuse with the female gametophyte

B. in gamatophytic incompatibility, the S-allele of the pollen must match the S-allele of the female gametophyte (embryo sac)

C. gametophytic incompatibility is controlled by the G(ametophyte)-locus; sporophytic incompatibility is controlled by the S(porophytic)-locus

D. the S-allele of the pollen must match one of the S-alleles of the sporophyte. Otherwise, pollen does not germinate or stops growth soon after germination

E. the S-allele of the pollen must not match either of the S-alleles of the sporophyte. Otherwise, pollen does not germinate or stops growth soon after germination

F. gametophytic incompatibility refers to the inability of the pollen tube to penetrate the micropyle of the female gametophyte

G. A and B

H. none of the above

[47] Based of palynological data, what tree species would belong in a cold cold climate?

A. fir (Abies)	B. pine (Pinus)	C. oak (Quercus)	D. 8,000 years ago
E. 200 years ago	F. spruce (Picea)	G. 12,000 years ago	G. 5,000 years ago

[48] Based of palynological data, when did ragweed allergies first appear in the Great Lakes region?

A. fir (Abies)	B. pine (Pinus)	C. oak (Quercus)	D. 8,000 years ago
E. 200 years ago	F. spruce (Picea)	G. 12,000 years ago	G. 5,000 years ago

[49]	I A	pp	roximat	ely	what	percentag	e of	plants s	pecies	are	dioeciou	s?
	-			~								

A.0% B.2% C.24% D.50% E.74% F.95% G.1

[50] How is embryonic development in plants and mammals (and insects) similar (choose the best answer)?

- A. homeotic gene control of the expression of other genes
- B. segmentation is common in embryogenesis

C. development of a polar axis

D. development can be modified by mutations in a single gene

E. A, B and C F. A, C and D G. B, C and D

H. all of the above are similar

[51] Which of the following is the correct sequence for embryogenesis in angiosperms (choose the best answer)?

1. dessication	A. 6, 2, 3, 4, 5 and 1
2. Mid-globular embryo	B. 5, 4, 2, 6, 1 and 4
3. suspensor formation	C. 4, 1, 2, 3, 5 and 6
4. heart-shaped embryo	D. 2, 3, 4, 5, 6 and 1
5. protoderm formation	E. 1, 2, 3, 4, 5 and 6
6. quadrant formation	F. 6, 3, 5, 2, 4 and 1
	G. 6, 5, 4, 2, 3 and 1
	H. 2, 4, 6, 5, 3 and 1

[52] Which of the following factor(s) are important in seed longevity (quiescence)?

A. impermeable seed coat	B. thickness of the seed coat	C. large food reserve
D. dessication (absence of internal water)	E. absence of oxygen	F. low temperature
G. all of the above	H. none of the above	

[53] Which of the following are used for food storage in angiosperm seeds?				
A. starch	B. endosperm	C. oil	D. cotyledon	
E. all except A	F. all except B	G. all except C	H. all are used	

[54] Which of the following l	normones play a role ir	n seed dormancy (choo	se the best answer)?
A. Indole-3-acetic acid (auxin)	B. Gibberellin (GA)	C. Zeatin (cytokinin)	D. Abscisic acid (ABA)
E. Ethylene	F. A and B	G. B and D	H. B and C

[55] Which of the following l	normones would cause	seed germination (cho	ose the best answer)?
A. Indole-3-acetic acid (auxin)	B. Gibberellin (GA)	C. Zeatin (cytokinin)	D. Abscisic acid (ABA)
E. Ethylene	F. A and B	G. B and D	H. B and C

Bormann and Likens (1979) Pattern and Process in a)	Number of Seeds (millions/ha)					
Forested Ecosystem.	Estimated Longevity of Dormant Seeds (yr) ^b	Age of Stand in Years					
Species		5	15	20	30	60	>100
Red maple	3–15				0.1	0.2	
Yellow or white birch	3–15	0.6	0.6	1.2	2.4	1.5	0.8
Erigeron sp.	< 3	9.3	0.1	_			
Pin cherry	>15	0.2	_	0.2		0.2	0.1
Raspberry or blackberry	>15	0.1	4.9	1.2	1.3	2.6	3.5
Elderberry spp.	>15	1.1	0.2	1.0	_	0.2	0.8
Goldenrod spp.	< 3		0.3	0.1			
Violet spp.	>15		0.3		0.1	_	_
Grasses spp.	>15		0.3	_	0.4	0.1	_
Sedges spp.	>15	3.8	6.4	0.1	2.0	0.1	_

Table 4-4. Viable Buried Seeds in Northern Hardwood Stands of Various Ages^a

^aDetermined by germination of seeds contained in twenty 10×10 -cm blocks cut out of the forest floor. Germination per block was very variable, ranging from zero to several orders of magnitude greater than the mean (S. Bicknell, unpublished data). ^bAdapted from Harrington (1972).

[56] Based on the data shown above, which of the following are likely to be true for red maple (*Acer rubrum*) trees (choose the best answer)?

A. Red maple would be absent in young northern hardwood stands (<21 years)

B. Red maple is unlikely to be a pioneer tree species, colonizing a meadow or other area immediately after a forest fire or windthrow.

C. The relatively short longevity of dormant seeds indicates that it must be a pioneer species.

D. Since red maple seeds are found at levels and at times similar to grasses, it must be a common meadow species. E. Red maple is likely to colonize a disturbed area later than other trees and plants and may be most important in mature hardwood stands.

F. Red maple must colonize at the same time as birches and Erigeron because of the similar seed longevity.

G. All of the above are likely

H. None of the above are likely.

[57] Which of the following describe the properties of phytochrome?

1. Phytochrome will be transformed into the P_{FR} form by far-red light (730 nm).	A. 1, 3, 5 and 7
2. Phytochrome will be transformed into the P_{FR} form by red light (680 nm).	B. 2, 4, 6 and 8
3. Phytochrome will be transformed into the P_R form by far-red light (730 nm).	C. 2, 4, 6 and 7
4. Phytochrome will be transformed into the P_R form by red light (680 nm).	D. 1, 3, 5 and 8
5. The P_{FR} form of phytochrome is the active form of the chromoprotein.	E. 1, 3, 6 and 8
6. The P_R form of phytochrome is the active form of the chromoprotein.	F. 2, 3, 5 and 8
7. P_R slowly reverts to P_{FR} in the dark.	G. 1, 4, 5 and 8
8. $\mathbf{F}_{\mathbf{FR}}$ slowly reverts to $\mathbf{P}_{\mathbf{R}}$ in the dark.	H. 1, 4, 6 and 7

[58] Under which light conditions would a lettuce seed germinate (choose the best answer)? A. <-RL-><-FR->

B. <kl> <fk -<="" td=""><td>><rl></rl></td><td></td><td></td></fk></kl>	> <rl></rl>		
C. <-RL -><-dark	><>		
D. <	> <dark><-</dark>		
E. A, C and maybe D	F. B and D	G. B, D and maybe C	H. A, B, C and D
[59] Which tropism in r	oots has the highest n	riority (choose the best and	swer)?
	jots has the ingliest p	fiority (encose the best and	,
• • •			

A. +ve gravitropism	B. +ve hydrotropism	C. –ve phototropism
D. +ve "nutri"tropism (e.g., nitrogen or phosphorus)	E. –ve gravitropism	F. +ve phototropism
G. A and F	H. B and E	

[60] How does the root know how to grow down?

A. Root cap cells contain a gravisensor that activates asymmetric cell division in the quiescent zone.

B. Sloughed root cap cells contain an unknown gravisensor that triggers assymetric inhibiton of cell elongation.

C. Elongating cells in the zone of expansion contain a gravisensor that modulates their elongation rate, changing the direction of root growth.

D. Nuclei in actively dividing cells below and above the quiescent zone are dense enough to function as a gravisensor.

E. Statoliths (starch grains) in the root cap cells 'fall' to the lower side of the cells and trigger a release from symmetric inhibition of expansion by cells in the expansion zone.

F. The weight of the root tip 'guides' the root downward.

G Statoliths in the cortical cells above the quiescent zone 'fall' to the lower side of the cells, triggering inhibition of expansion on the lower side of the root.

H. None of the above.

To the right are two seedlings that have grown for 10 days in media supplemented with either 0.1 mM phosphate (left) or 2.5 mM phosphate (right) (Williamson et al. 2001. Phosphate availability regulates root system architecture in Arabidopsis. Plant Physiology 126:875–882.).

[61] Which of the following statement(s) is/are the most reasonable explanation for the growth differences caused by varying phosphate? A. Phosphate is required for proteins, which will allow the seedling to grow more vigorously. Hence the phosphate stimulates root growth.

B. Phosphate is required for nucleic acid synthesis (and ATP), which will allow the seedling to grow more vigorously. Hence the phosphate stimulates root growth. C. The high phosphate is causing an extremely high ratio of lateral roots compared to total main root length. This increases the amount of root area available for nutrient uptake.

D. The low phosphate is causing an extremely high ratio of lateral roots compared to the total main root length. This will increase the amount of root area available for extracting phosphate when phosphate levels are low.

 $E.\ A \ and \ D \qquad F.\ A, \ B \ and \ D \qquad G.\ B \ and \ C \qquad H.\ C \ and \ D$



[62] Root apical meristems of angiosperms are divided into distinct zones. From which of these zones would you expect lateral root primordia to arise?

A. quiescent center	B. tunica	C. apical cell
E. columella cells	F. root cap	G. epidermis

D. corpus H. none of the above **[63]** In a coleoptile, a mica sliver is placed at the locations and orientations shown below (in 5 and 6, the mica sliver is placed *below* the zone of cell expansion). In which position(s) would positive phototropism occur?



C. clonal sectors are the areas on leaf bordered by vascular bundles of xylem and phloem

D. it is an incorrect term, propagated by well-meaning scientists, instead sectors of the leaf develop from a welldefined cell lineage, resulting in columns of cells which are all derived from a single cell

E. a clonal sector is the minimum number of cells required to develop a new plant in clonal propagation

F. clonal sectors refers to the complex interplay between cell division and cellular expansion, which vary depending upon the location of the cells within the leaf, mesophyll sectors, paliside sectors etc.

G. refers to the sector of cells associated with a single stomate.

H. none of the above

[70] What is a sink?

A. the osmotic gradient which 'pulls' (sinks) water into cells during their expansion

B. the bottom of the plant, where all carbohydrate eventually sinks

C. a term used to describe allocation of photosynthate to young growing parts of the plant

D. a term used to describe carbohydrate movement into the quiescent centers of either the apical meristem or the root tip.

E. a region of low pressure which 'pulls' water through the xylem; the 'pulling' force for water movement in the plant F. a term commonly used to describe the absence of cellular division in quiscent regions

G. the sloughing of root cap cells as the root tip 'sinks' into the soil

H. none of the above

Identify the marked regions on the dicotyledon shoot meristem.

[71] Region 1[72] Region 2[73] Region 3

- A. protoxylem C. leaf primordia E. corpus G.peripheral zone
- B. tunica D. shoot cap F. primordial shoot H. none of the above

[74] What is phyllotaxy?

A. leaf taxonomy

B. A classification of the evolution of leaf morphology

C. A classification of 'leaf taxa', that is, hair-like structures growing out of the leaf surface

D. primitive leaf structures in the fern group

E. the changes in leaf morphology, from juvenile leaves to leaves at older stages of the plant development

F. an arrangement of leaves which can often be described by the Fibonacci series (1/1, 1/2, 2/3, 3/5 etc.)G. a taxonomic classification system based on leaf morphology, commonly used in tree identification

H. none of the above

For the following photoperiodic light regimes, which of the following would occur (choose the best answer) (you may use an answer more than once)

[75] <6 hours Light-><18 hours Dark>	
[76] <	
[77] <-10 hours Dark -><-10 hours Light -><-3 hours Dark -><-1 hour Light ->	

- A. short-day plants flower B. long-day plants flower
- C. neither will flower

D. both will flower

[78] Which of the following may have played a role in crop domestication?

A. High crop productivity would have been attained by selecting larger plants in stands of wild progenitors of crop species.

B. Genetic intermixing caused by tetraploidal progeny in crosses between wild progenitor species.

C. Ease of crossing tetraploid wild progenitors of crop species because hybrids were more likely to be fertile than if diploids were crossed.

D. Either deliberate or fortuitous selection for traits that impede seed dissemination.

E. A and B F. A, B and C G. B, C and D H. All of the above





In a wild species of a grain crop plant (for example, wheat and barley) what are the functions of the following components of the floret/inflorescence anatomy?

[**79**] awn [**80**] spike [**81**] rachilla

A. Long slender bristles that may aid in dispersal by attaching to passing herbivores B. The 'pedicel' of the floret that abscises to release the seed upon maturity

C. A structure subtending the glume that in turn protects the anthers and feathery stigma

D. A structure holding a cluster of anthers to maximize pollen release in wind pollination

E. A modified feathery stigma that functions to maximize pollen capture in wind pollination

F. A structure subtending the lemma that protects the ovary of the floret

G. A stiff barbed structure that 'plants' the seed in the ground and may assist in soil penetration

H. None of the above

[82] What still remains a serious problem affecting crop productivity, and was a problem even 4000 years ago for a Sumerian farmer?

A. Finding labor to till the fields.

B. Drought.

- C. Salinization of the soil as a consequence of water shortage.
- D. Salinization of the soil as a consequence of water irrigation.
- E. Loss of soil fertility due to leaching of potassium, phosphorus and nitrogen by irrigation.
- F. B, C and E
- G. B, D and E
- $H.\,B,C \text{ and }E$