Botany (XL-R)

Q.1 – Q.7 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

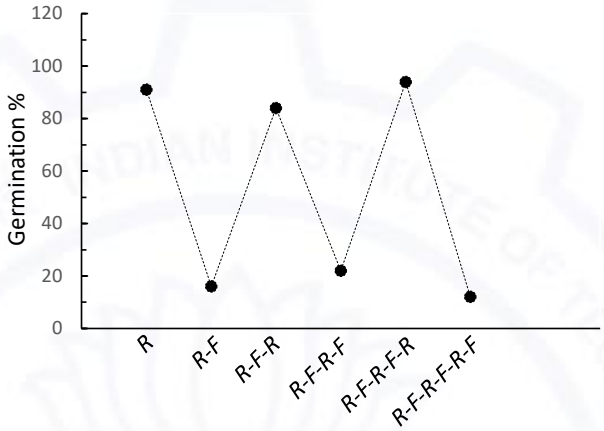
Q.1	**Wheat plants treated with prolonged cold temperature at the seedling stage flower earlier than the untreated control. Seeds collected from these treated individuals, however, give rise to plants that do not flower early. This phenomenon is called**
(A)	vernalization.
(B)	temperature acclimation.
(C)	photoperiodism.
(D)	adaptation.

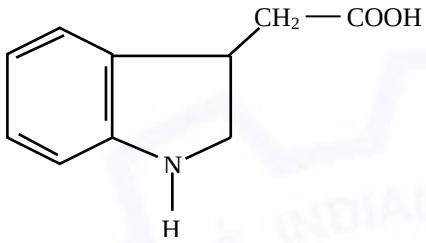
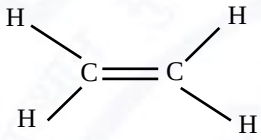
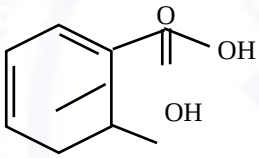
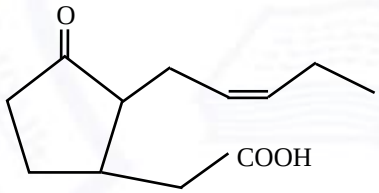
Q.2	**Which ONE of the following plant taxa contains vascular tissue (xylem and phloem) but not woody tissue?**
(A)	Oak
(B)	Moss
(C)	Pine
(D)	Fern

Q.3	**Which ONE of the following statements regarding spores and gametes is CORRECT?**
(A)	Spores can directly undergo mitosis whereas gametes cannot.
(B)	Gametes can directly undergo mitosis whereas spores cannot.
(C)	Neither spores nor gametes can directly undergo mitosis.
(D)	Both spores and gametes can directly undergo mitosis.

Q.4	**Which ONE of the following organelles controls gravitropism in the roots of higher plants?**
(A)	Chromoplast
(B)	Amyloplast
(C)	Chloroplast
(D)	Etioplast

Q.5	**Phytoalexins play important role in plant defense against pathogens. Choose the INCORRECT option related to phytoalexins.**
(A)	Phytoalexins belong to secondary metabolites.
(B)	Phytoalexins have antifungal activity.
(C)	Phytoalexins are abundant in plants under normal condition.
(D)	Different hosts produce phyallexins of varying chemical nature.

Q.6	**The figure shows the germination percentage of imbibed seeds treated with the given sequence of red (R) and far-red (F) light (each exposure lasting 5 min). The percentage of germination was scored after 72 hours in darkness at 25 °C. Based on this, which ONE of the following options is CORRECT?** 
(A)	Red light induces seed germination whereas far-red light inhibits it.
(B)	Red light inhibits seed germination whereas far-red light induces it.
(C)	Both red and far-red light inhibit seed germination.
(D)	Both red and far-red light induce seed germination.

Q.7	**The structures of four plant hormones are shown. Identify the CORRECT hormone that is responsible for bending of coleoptile of canary grass in response to unidirectional white light.**
(A)	
(B)	
(C)	
(D)	

Q.8 – Q.9 Multiple Select Question (MSQ), carry ONE mark each (no negative marks).

Q.8	**Which of the following cellular component(s) is/are NOT part(s) of cytoskeleton in Angiosperms?**
(A)	Microtubules
(B)	Microfilaments
(C)	Intermediate filaments
(D)	Centrioles

Q.9	**Which of the following enzyme(s), when overexpressed, would result in rice grains with increased β-carotene content?**
(A)	Phytoene synthase
(B)	Carotene desaturase
(C)	β-glucoronidase
(D)	Enolpyruvalshikimate-3-phosphate synthase (EPSPS)

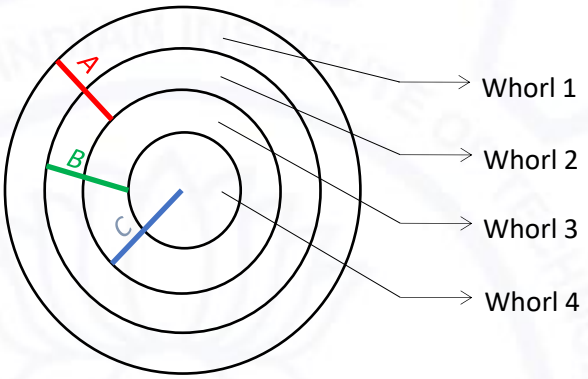
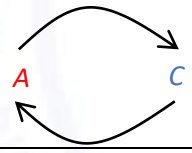
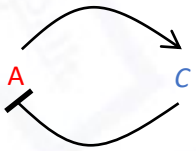
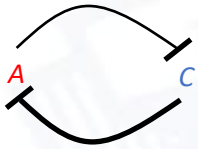
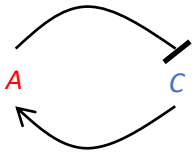
Q.10 Numerical Answer Type (NAT), carry ONE mark (no negative marks).

Q.10	**In spiral phyllotaxis, leaves are initiated sequentially on the meristem with two successive primordia being separated by golden angle. If a plant follows right-handed spiral phyllotaxis when looked down the meristem, then the angle between two successive leaves would be _____degrees (with correct sign, round off to one decimal place).**

Q.11 – Q. 15 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

Q. 11	**Match the cell/tissue types in GROUP I with their corresponding total DNA content in GROUP II of a typical diploid Angiosperm species and choose the CORRECT option (C denotes DNA content in haploid genome).** GROUP I — GROUP II (P) Pollen tube — (1) 1C (Q) Megaspore mother cell — (2) 2C (R) Synergid — (3) 3C (S) Embryo sac prior to fertilization — (4) 4C (5) 8C
(A)	P-1, Q-2, R-3, S-5
(B)	P-2, Q-2, R-1, S-5
(C)	P-1, Q-2, R-1, S-5
(D)	P-2, Q-1, R-2, S-4

Q. 12	**Match the modified organs in GROUP I with their corresponding prototypic forms in GROUP II and choose the CORRECT option.** GROUP I — GROUP II P. Tendrils in grape vine — 1. Modified stem Q. Tendrils in garden pea — 2. Modified leaf R. Spines S. Thorns
(A)	P-1, Q-2, R-2, S-1
(B)	P-2, Q-1, R-1, S-2
(C)	P-1, Q-2, R-1, S-2
(D)	P-1, Q-1, R-2, S-1

Q. 13	**The diagram describes the *ABC* model of flower patterning in Arabidopsis where the *A*, *B* and *C* functions are operational in the whorls (1+2), (2+3) and (3+4), respectively, in the wild-type flower. Removal of *A* or *C* function results in the floral organ arrangements as (carpel; stamen; stamen; carpel) or (sepal; petal; petal; sepal), respectively. Based on these observations, which ONE of the following molecular pathways is CORRECT for floral organ pattern generation? Arrow indicates activation and bar indicates inhibition.** 
(A)	
(B)	
(C)	
(D)	

Q. 14	**Find the CORRECT match among the plant species in GROUP I, the predominant phytochemical in GROUP II and the economic/medical use in GROUP III.**

GROUP I	GROUP II	GROUP III
P. *Syzygium aromaticum*	i. Vincristine	1. Toothache relief
Q. *Gracillaria sp.*	ii. Eugenol	2. Dessert jelly
R. *Catharanthus roseus*	iii. Agar	3. Leukaemia treatment
S. *Theobroma cacao*	iv. Morphine	4. Analgesic
T. *Papaver somniferum*	v. Flavonols	5. Beverage

(A)	P-i-1, Q-ii-3, R-iii-4, S-v-5, T-iv-2
(B)	P-ii-1, Q-iii-2, R-i-3, S-v-5, T-iv-4
(C)	P-ii-1, Q-iii-2, R-v-4, S-i-3, T-iv-5
(D)	P-i-2, Q-ii-3, R-iv-1, S-iii-5, T-v-4

Q. 15	**Match the genetically modified crop in GROUP I with the corresponding genetic element in GROUP II.**

GROUP I	GROUP II
P. Tomato with delayed fruit ripening	1. EPSP synthase
Q. Herbicide-resistant soybean	2. Δ12-Desaturase
R. Insect-resistant cotton	3. Polygalacturonase
S. Soybean with modified oil content	4. Bt-Cry protein

(A)	P-3, Q-1, R-4, S-2
(B)	P-1, Q-3, R-2, S-4
(C)	P-2, Q-1, R-4, S-3
(D)	P-3, Q-2, R-4, S-1

Q.16 – Q.18 Multiple Select Question (MSQ), carry TWO mark each (no negative marks)

Q.16	**To understand the mechanism of systemic acquired resistance (SAR), a team of researchers isolated a mutant with reduced SAR response. Sequencing of this mutant revealed homozygous mutations in two genes, *X* and *Y*. Which of the following experiment(s) would test whether the mutant phenotype is caused by mutation in either or both the genes?**
(A)	Complement the mutant with *X* or *Y* and analyze the phenotype in each case.
(B)	Complement the mutant with both *X* and *Y* and analyze the phenotype.
(C)	Cross the mutant with wild-type and analyze the segregation pattern of the phenotype.
(D)	Compare the expression of *X* and *Y* in mutant and wild-type plants.

Q.17 **The observations of an experiment on seed germination in various genotypes under different light conditions are given, where √ and X indicate germination and the lack of it, respectively.**

Genotype	Blue	Red	Far-red	White	Dark
Wild-type	√	√	√	√	X
cry1 mutant	X	√	√	√	X
phyA mutant	√	√	X	√	X
phyB mutant	√	X	√	√	X
vp1 mutant	√	√	√	√	√

Based on these observations, which of the following option(s) is/are CORRECT?

(A) All the three light qualities– blue, red and far-red – are required for seed germination.

(B) Any one of the three light qualities - blue, red and far-red – is sufficient to induce seed germination.

(C) The CRY1, phyA and phyB proteins are required for blue, red and far-red light perception, respectively.

(D) The VP1 protein is unlikely to be involved in light perception.

Q.18 **Which of the following option(s) is/are CORRECT in the context of hybrid plant generation using Barnase/Barstar-based male sterile lines?**

(A) Barnase inhibits Barstar.

(B) Barstar inhibits Barnase.

(C) Barnase and Barstar are used to generate the male sterile line and the restorer line, respectively.

(D) Barnase and Barstar are used to generate the restorer line and the male sterile line, respectively.

Q.19 – Q.20 Numerical Answer Type (NAT), carry TWO mark each (no negative marks)

Q.19	**In a diploid plant species, the *T* allele produces tall individuals and is completely dominant over the *t* allele that produces short individuals. Similarly, the *W* allele produces round seeds and is completely dominant over the *w* allele that produces wrinkled seeds (assume *T* and *W* loci not linked). If a parent with *TTWW* genotype is crossed to another parent with *ttww* genotype, the fraction of the F_2 population produced by the fusion of both recombinant gametes would be _____. (Round-off to two decimal places.)**

Q.20	**In a population of a diploid plant species obeying Hardy-Weinberg equilibrium, a locus regulating flower color has two alleles *R* and *r*. Individuals with *RR*, *Rr* and *rr* genotypes produce red, pink and white flowers, respectively. If the ratio of red, pink and white flower-producing individuals in the population is 6:3:1, then the frequency of *r* allele in the population would be _____%.** **(Round-off to two decimal places.)**

END OF THE QUESTION PAPER