INTERNATIONAL BIOLOGY OLYMPIAD e. V. IBO

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Question 1 = 23.5 marks

Task 1

Specimen	1: Species	2: Ploidy level of specimen
A	4 = Fern	**2n + n**
B	3 = Conifer	**2n + n + n**
C	2 = Liverwort	**n**
D	1 = Angiosperm	**2n + n + n**

[4 marks]

(1) ½ mark per correct answer (right or wrong) = 2 marks
(2) ½ mark per correct answer (right or wrong) = 2 marks

Task 2

Flower specimen	1: Family	2: Gynoecium position	3: Carpel structure
E – Arabidopsis	2=Brassicaceae	7=H	11=F
F - Bean	4=Fabaceae	7=H	10=S
G - Fuschia	5=Rosaceae	8=E	11=F
H - Ragwort	1=Asteraceae	7=H	12=M
I – Catmint	3-Lamiaceae	7=H	11=F

[7.5 marks]

(1) ½ mark per correct answer (right or wrong) = 2.5 marks
(2) ½ mark per correct answer (right or wrong) = 2.5 marks
(3) ½ mark per correct answer (right or wrong) = 2.5 marks

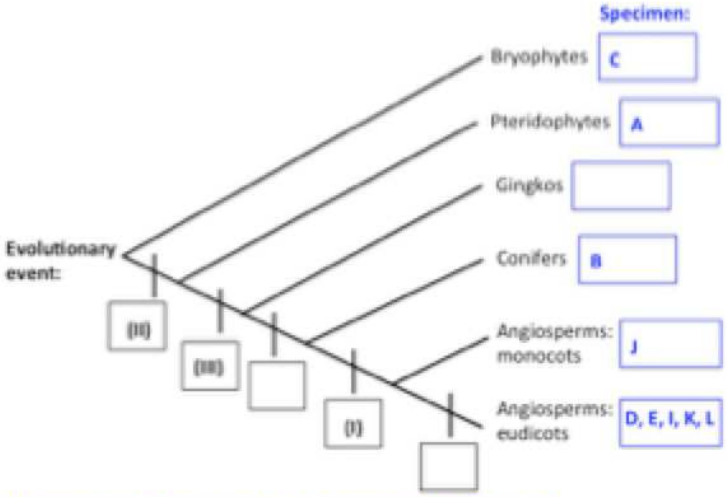
Task 3

Specimen	i: Vascular bundle type	ii: Vascular bundle organisation	iii: Stem rigidity enabled by
E - Arabidopsis	2=collateral	5=arranged in a ring	8=turgor pressure
I - Catmint	2=collateral	5=arranged in a ring	8=turgor pressure
J - Maize	2=collateral	6=scattered	8=turgor pressure
K* – *Helianthus*	2=collateral	5=arranged in a ring	9=secondary thickening
L*- Tilia	2=collateral	7=annual rings	9=secondary thickening
M*- *Curcubita*	1=bicollateral	5=arranged in a ring	8=turgor pressure

[9 marks]

(i) ½ mark per correct answer (right or wrong) = 3 marks
(ii) ½ mark per correct answer (right or wrong) = 3 marks
(iii) ½ mark per correct answer (right or wrong) = 3 marks

Task 4



[3 marks]

¼ mark per correct answer (right or wrong) = 3 marks

Question 2 = 10 marks

Task 5a

	1: Floral organ identity	2: Homeotic gene activity	3: Wild-type/mutant?
Specimen O (*apetala*)	3 (Stamens and carpels only)	10 (B, C)	15 (mutant)
Specimen P (wild-type)	1 (Sepals, petals, stamens and carpels)	7 (A, B, C)	14 (wild-type)
Specimen Q (*agamous*)	5 (Sepals and petals only)	8 (A, B)	15 (mutant)

(1) 1 mark per correct answer (right or wrong) = 3 marks
(2) 1 mark per correct answer (right or wrong) = 3 marks
(3) 1 mark per correct answer (right or wrong) = 3 marks

[9 marks]

Task 5b

Question	Answer
What would form in a homozygous BC double mutant?	2 (sepals in all 4 whorls)
What would form in a homozygous ABC triple mutant?	1 (leaves in all 4 whorls)

[1 mark]

½ mark per correct answer (right or wrong) = 1 mark

Question 3 = 10 marks

Task 6a

	Average number of seeds	% seeds at globular stage	% seeds at heart stage	% seeds at torpedo stage	% seeds at mature stage
Plant R	14	70%	30%	0	0
Plant S	14	70%	30%	0	0

[4 marks]

For both R and S there should be very similar answers (example (but not actual precise answer) above); scaling as:

(full) 2 marks for each if >60% recorded at globular stage with rest at heart stage

(partial) 1 mark for each if 40-60% recorded at globular stage with rest at heart stage

(partial) ½ mark for each if globular+heart stage <80%

'Average number of seeds' does not have a score; it is just a recording; this is an example

Task 6b

Question	Which plant has abnormal seed development?	In what way is seed development abnormal?	What is the approximate frequency of abnormal embyros?	Explanation for abnormal embryos:
Answer	R	3 = multiple embryos	0-33%	6

[6 marks]

1 mark for 'which plant' (right or wrong)

2 mark for 'what way' (right or wrong)

2 mark for 'abnormal %' (right or wrong)

1 mark for explanation (right or wrong)

Question 4 = 10.5 marks

Task 7a

Specimen	**Root hair phenotype**
U - *nph4-1 / arf19 -2*	8 = No lateral roots
V – *mlo4-4 / mlo11-4*	5/7= More root hairs /longer lateral roots (either is correct)
W– *RHD3*	1/6 = Short root hairs / shorter lateral roots (either is correct)
X – *rhd2*	2 = No root hairs

[6 marks]

1.5 marks each row for correct answer (right or wrong)

Task 7b

Choose one pattern by marking an X	**Root hair formation pattern**
	A – Root hairs are in rings of rows of epidermal cells
	B – Root hairs form from random cells
X	C – Root hairs are in files or columns of epidermal cells
	D – Root hairs form a checkerboard pattern on the epidermis

[2 marks]

2 marks for correct answer (right or wrong)

Task 8a

Choose one pattern by marking an X	Root hair phenotype
	Normal length root hairs
X	No root hairs
	Extra long root hairs
	Long root hairs

[0.5 marks]

0.5 marks for correct answer (right or wrong)

Task 8b

	Wild-type		
homozygote		B	B
	b	Bb	Bb
	b	Bb	Bb

[0.5 marks]

¼ mark for filling in the gametes correctly (must get all right)
¼ mark for filling in the F2 genotypes (must get all right)

What were the genotypes of the two plants that were crossed (in terms of B or b)?	Bb and Bb
How many plants would have the Bb genotype?	16
How many plants would have the BB genotype?	8

[1.5 marks]

½ mark for correct answer in each row (right or wrong)

Note for all questions: if more than one code is entered when only one is asked for, the answer will be marked as 0.