

# Indian National Biology Olympiad (INBO) -2024

Homi Bhabha Centre for Science Education (HBCSE-TIFR)

## Answer Booklet

Time: 2 hrs

ROLL NO.  –  –

Max. Marks: 300

- Please write your roll number on the top of **every page of this answer booklet** in the space provided.
- Before starting, please ensure that you have received a copy of the answer booklet containing a total of 14 numbered sheets.
- **This answer booklet must be returned to the invigilator.**

Signature of Student: \_\_\_\_\_

Signature of Invigilator: \_\_\_\_\_

Date:

Place:

\_\_\_\_\_  
*(Do not write anything below this line.)*

	X	Y	Not attempted	
Section A				$3X - Y =$
Section B				$3X =$
<b>Total score =</b>				

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ROLL NO.  –  –

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## SECTION A

Q. No.	a	b	c	d	Q. No.	a	b	c	d	Q. No.	a	b	c	d
1.			✓		13.			✓		25.			✓	
2.	✓				14.			✓		26.		✓		
3.			✓		15.			✓		27.			✓	
4.		✓			16.			✓		28.		✓		
5.			✓		17.				✓	29.	✓			
6.				✓	18.				✓	30.		✓		
7.				✓	19.				✓	31.		✓		
8.				✓	20.		✓			32.			✓	
9.			✓		21.				✓	33.	✓			
10.	✓				22.			✓		34.		✓		
11.	✓				23.				✓					
12.		✓			24.		✓							

	X	Y	Not attempted	
Section A				3X - Y =

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**SECTION B****CELL BIOLOGY (14.5 Points)**

35. (2 points)

	a.	b.	c.	d.
True	✓		✓	✓
False		✓		

36. (2 points)

	a.	b.	c.	d.
True			✓	
False	✓	✓		✓

37. (2 points)

	Gene A		Gene B	
	Will Express	Will not express	Will Express	Will not express
I.	✓		✓	
II.	✓		✓	
III.		✓	✓	
IV.	✓			✓

38. (5 points)

(A)

NF- $\kappa$ B responsive genes	X
I $\kappa$ B- $\alpha$ gene	Y

(B)

p65	B
I $\kappa$ B- $\alpha$	C
$\alpha$ -actin	D
Lamin	A

(C)

No.	Effector in the presence of TNF	TNF dependent NF- $\kappa$ B induced gene expression	
		Induced	Inhibited
1.	Inhibitor of kinase activity		✓
2.	Activator of phosphatase activity		✓
3.	Activator of ubiquitin dependent proteasome activity	✓	
4.	Inhibitor of nuclear transport activity		✓

39. (1.5 points)

	a.	b.	c.
True	✓		✓
False		✓	

**40. (2 points)**

Answer: \_\_\_\_\_ 78 - 79 \_\_\_\_\_ molecules (tetrameric)

Calculations:

Conc. of IPTG =  $1.0 \mu\text{M} \equiv 1.0 \times 10^{-6} \times 6.023 \times 10^{23}$  molecules/L .....(i)

Volume of *E.coli* cell  $= \frac{4}{3} \times \frac{22}{7} \times (0.5 \times 10^{-4} \text{ cm})^3$

$= 4.19 \times 0.125 \times 10^{-12}$  mL

$= 0.524 \times 10^{-12}$  mL or  $0.525 \times 10^{-15}$  L or  $5.25 \times 10^{-16}$  L .....(ii)

From (i) and (ii),  $6.023 \times 10^{17}$  molecules/L  $\times 5.25 \times 10^{-16}$  L =  $\sim 31.6 \times 10$  molecules or  $\sim 316$  molecules of IPTG are present in the *E.coli* cell.

$316/4$  IPTG =  $\sim 79$  Repressor molecules (Tetrameric)

**PLANT SCIENCES (13 points)**

**41. (2 points)**

Conditions	a.	b.	c.	d.
Increased water use efficiency	✓			
Decreased water use efficiency		✓	✓	✓

42. (2.5 points)

Sr. No.	Structural / biochemical trait	Sun-loving	Shade-loving
1	Dry mass per area	H	L
2	Spongy parenchyma thickness	S	S
3	Density of stomata	H	L
4	Chlorophyll per dry mass	L	H
5	Chl-a to Chl-b ratio	H	L

43. (2 points)

	a.	b.	c.	d.
True	✓			✓
False		✓	✓	

44. (3 points)

		Plant 1		Plant 2	
		Side facing the sun	Side not facing sun	Downward / side facing the ground	Upward / side facing sky
(i)	Movement of auxin towards		✓	✓	
(ii)	Rapid cell growth		✓	✓	
(iii)	Bending towards	✓			✓

45. (2 points)

Answer: \_\_\_\_3.75 MPa\_\_\_\_

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Calculations:

$$125 \times 0.02 = 2.5$$

$$125 \times 0.01 = 1.25$$

$$\text{Thus, } 2.5 + 1.25 = 3.75$$

46. (1.5 points)

	a.	b.	c.
True	✓	✓	
False			✓

**ANIMAL SCIENCES (12 points)**

47. (2 points)

a.	b.	c.	d.
✓			

48. (3.5 points)

(A)

P: \_\_\_\_\_ a \_\_\_\_\_

Q: \_\_\_\_\_ b \_\_\_\_\_

R: \_\_\_\_\_ b \_\_\_\_\_



(B)

	a.	b.	c.	d.
Correct	✓	✓		
Incorrect			✓	✓

49. (2.5 points)

I: \_\_\_ii, v\_\_\_

II: \_\_\_vii\_\_\_

III: \_\_\_iv\_\_\_

IV: \_\_\_i, vi\_\_\_

V: \_\_\_iii\_\_\_

50. (2 points)

i) Umbilical vein  Inferior vena cava  Superior vena cava

ii) Pulmonary vein  Pulmonary trunk  Inferior vena cava

51. (2 points)

Physiologic functions	Sympathetic	Parasympathetic
Cardiovascular	b	a
Pulmonary	a	b
Pupillary	a	b
Musculoskeletal	b	a

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**GENETICS & EVOLUTION (12.5 points)**

52. (2 points)

	a.	b.	c.	d.
True		✓	✓	
False	✓			✓

53. (2 points)

Answer: \_\_\_\_\_43.15\_\_\_\_\_ %

Calculations:

Total non-recombinants =  $100 - 13.7 = 86.3\%$ Progeny with phenotype yellow body, cross veinless and normal bristles =  $86.3/2 = 43.15\%$ 

54. (2 points)

	a.	b.	c.	d.
True			✓	✓
False	✓	✓		

55. (3 points)

(A) Answer: \_\_\_\_\_No\_\_\_\_\_

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(B) Answer: A = 0.5000; B = 0.325; C = 0.175

Calculations:

$$\text{Allele 'A'} = 50 + 15 + 35 = 100/200 = 0.500$$

$$\text{Allele 'B'} = 18 + 12 + 35 = 65/200 = 0.325$$

$$\text{Allele 'C'} = 8 + 15 + 12 = 35/200 = 0.175$$

56. (1.5 points)

Mutant 1:   II  

Mutant 2:   II  

Mutant 3:   III  

57. (2 points)

Individual II – 1:   I<sup>A</sup>I<sup>A</sup>, hh   or   I<sup>A</sup>i, hh   or   I<sup>A</sup>I<sup>B</sup> hh   or   I<sup>B</sup>i, hh  

Individual III– 1:   i/i, H/h  

**ECOLOGY** (5 points)

58. (2 points)

  A   >   C   >   B   >   D

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59. (3 points)

(A) Answer: \_\_\_\_1997 - 1998\_\_\_\_

(B) Answer: \_\_\_\_2014 - 16\_\_\_\_

**ETHOLOGY** (7 points)

60. (2 points)

	a.	b.	c.	d.
True		✓	✓	✓
False	✓			

61. (2.5 points)

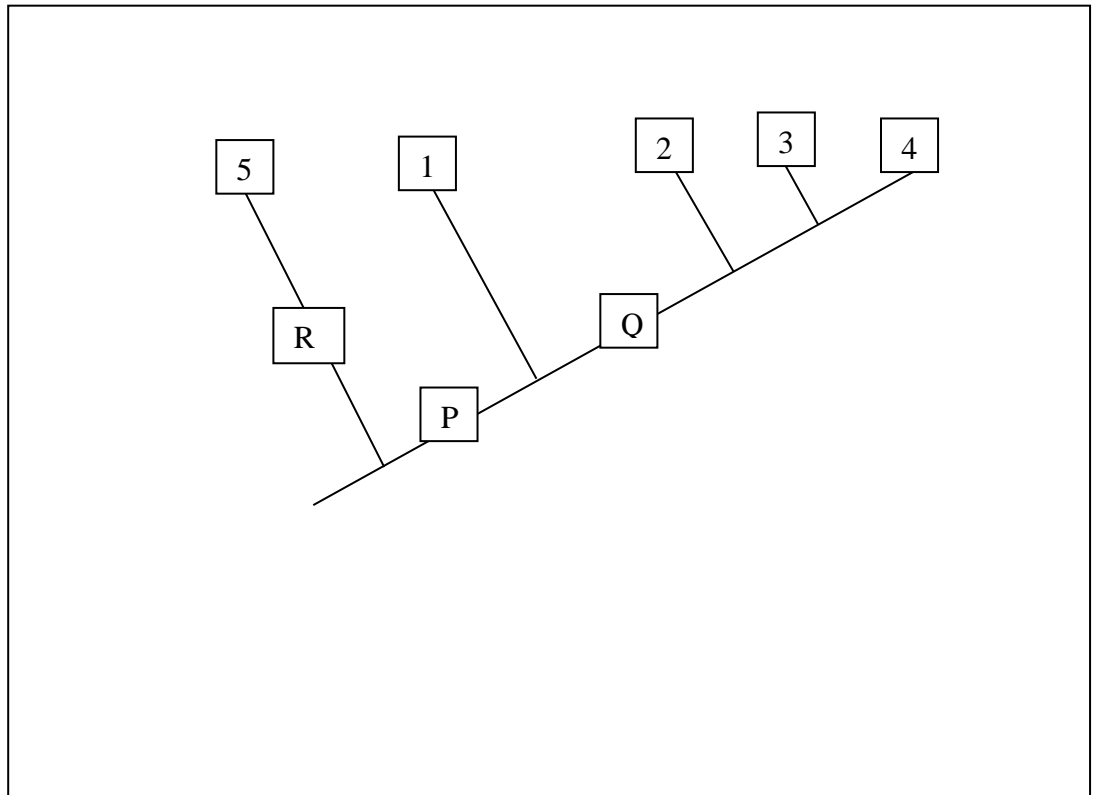
	a.	b.	c.	d.	e.
True					✓
False	✓	✓	✓	✓	

62. (2.5 points)

Altered Selection Pressure	Behavioral adaptation/s
(i)	B, D
(ii)	E, F
(iii)	H
(iv)	I
(v)	A, C, G

**BIOSYSTEMATICS** (2 points)

63. (2 points)



\*\*\*\*\*END OF SECTION B \*\*\*\*\*

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**ROUGH WORK**