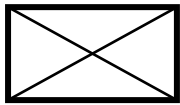# IJSO 2021
BIOLOGY THEORY
10 points
Solutions & Marking
Scheme

General Instruction :

1. Only the answers marked or written in the answer sheet will be evaluated.

2. Instruction to mark a column with a cross (X) as an answer is to be marked as follows:

1. Theory I – Date palm (6.75 points)

1.1 (0.5 points)

Label	Tissues					
	1	2	3	4	5	6
A			X			
B				X		
C		X				
D	X					
E						X

0.1 point for each correct label

1.2 (0.25 point).

Tissue	Yes	No
1	X	
2	X	
3	X	
4	X	
5		X
6		X

0.25 point for all correct answer (no partial marking)
You loose 0.25 points if a wrong box is ticked

Ans: 1, 2, 3, 4 [since they are derived from ovary (2, 3, 4) and ovule (1), with no participation of the male parent]

1.3 (1.0 points)

Statement	Yes	No
1	✕	
2		✕
3	✕	

1 point for all correct answers
0.5 point for 2 correct answers
0 point for 1 correct answer

Statement 1 – At stage 2 there is breakdown of starch and thus enzyme B is active.
Statement 2 – There is only basal level of sugar in stage 1, which is contributed entirely by sucrose, thus enzyme A is not active.
Statement 3- As there is basal level of sugar in stage 1, and higher levels at stage 2 and 3 with depleting levels of sucrose and starch, thus both enzymes are active.

1.4.1 (0.5 point)

Space for calculation
The sucrose stock is of 400 mM   i.e. 400 millimoles in 1000 ml   or 400,000 µmoles in 1000 ml   or 400 µmoles in 1ml   As the volume of substrate added to reaction mixture is 0.2 ml, the amount of sucrose in the reaction mixture is 80 µmoles
Answer   **Amount of sucrose = 80 µmoles**

No partial marking.

1.4.2 (0.25 point) Concentration (mg/ml) of Glucose = 0.1

0.1 OD corresponds to 0.1 mg/ml of glucose.

No partial mark

1.4.3 (0.75 point)

Space for calculation
Mass of glucose is 180.
180 g in 1 liter corresponds to 1M solution. 180 mg in 1 ml corresponds to 1M solution. 0.1 mg in 1 ml corresponds to $0.1/180 = 0.000555555M = 555.555\ \mu M$ $555.555\ \mu M = 555.555\ \mu$ moles/liter Since the reaction volume was 1 ml, the amount of glucose formed is $0.556\ \mu$ moles.

Answer **Amount of Glucose = 0.556 μmoles**

Deduct 0.1 mark if not written to 3 decimal points.

No double penalty, marks to be given if calculation is correct based on the answer to 1.4.2

If the value of.0.4 mg/ml is used for this calculation, the answer will be 2.222 μ mols

1.4.4 (1.5 point)

Space for calculation **(write your final calculation in the answer sheet)**
Given that: 1μ moles of glucose formed in 1 min corresponds to 1 U invertase.
The present reaction was carried out for 30 minutes and 0.2 ml of the stock enzyme was taken for the reaction.
$0.555\ \mu$ moles of glucose was formed after a reaction time of 30 min (No double penalty, value at 1.43 will be taken for further calculation)
Thus in 1 minute $0.556/30 = 0.0185\ \mu$ moles of glucose was formed which is equal to 0.0185U invertase enzyme actvity
0.0185U invertase enzyme actvity was present in 0.2 ml of stock enzyme used in the reaction
Therefore 1 ml of the stock enzyme would have $(0.0185*1)/0.2 = 0.0927 = 0.093$ U

Answer **Invertase activity = 0.093 U/ml**

Deduct 0.25 if not rounded off correctly to 3 decimal points.
If 0.973 μ mole is used for calculation the answer will be 0.162

1.5.1 (1 point)

Table 1.2 :

Step Number	Purification step	Invertase activity (U)	Total protein (mg)	Specific activity of invertase	% recovery of invertase
1	Crude extract	13,773	13,746	**1.002**	
2	Ammonium sulphate precipitation	12,469	8,234	**1.514**	**90.532**
3	Affinity chromatography	11,487	836	**13.740**	**83.402**
4	Anion exchange chromatography	11,156	567	**19.675**	**80.999**

0.1 point for each correct answer of specific activity
0.2 marks for each correct answer of % recovery

1.5.2 (0.5 point)

Steps	2	3	4
		✕	

After affinity chromatography (step 3) there is 10 fold reduction in total protein with a minimal loss in enzyme activity.

1.5.3 (0.5 point)

Steps	2	3	4
	✕		

The difference between the enzyme activity between a step and a preceding step. After step 2 the difference is (13773-12469 = 1304).

After step 3 the difference is (12469-11487 = 982).

2. Theory 2 – Bird populations (3.25 points)

2.1. **(0.25 point)**

S.No.	Relationship	Yes	No
1.	Co-dominance		✕
2.	Incomplete dominance	✕	
3.	Over dominance		✕
4.	Dominant-recessive		✕

2.2. (0.5 point)

Space for calculation

Total number of B^R alleles is 6400 + 1600 = 8000

8000 out of 10000 alleles = 0.8

Total number of B^W alleles is 400 + 1600 = 2000

2000 out of 10000 alleles = 0.2

Answers

> **2.2.1** Frequency of $B^R =$ **0.8**
> **2.2.2** Frequency of $B^W =$ **0.2**

Marking scheme: 0.5 point (for both correct answers no partial marking)

2.3. (0.50 points)

Statement	Yes	No
1	✕	
2	✕	
3	✕	

Marking scheme: 0.50 points for all three correct answers
0.25 point for 2 correct answers
0 point for 1 correct answer

2.4. **(1.5 point)**

Space for calculation **(write your final calculation in the answer sheet)**
The reproductive population is 840.
B^R= 336 + 252 = 588/840= 0.7
B^w= 252/840 = 0.3
Therefore red beak genotype $B^R B^R = 0.7 * 0.7 = 0.49 = 49$ out of 100 and
pink beak genotype $B^R B^W = 0.3 * 0.7 *2 = 0.42 = 42$ out of 100
Answers
2.4.1. Red beak = **49**
2.4.2. Pink beak = **42**

Marking scheme: 1.5 points for both correct answers
0.5 point for one correct answer

2.5. (0.5 point)

S.No.	Condition	Yes	No
1.	Occurrence of mutations		✕
2.	No gene flow	✕	
3.	Random mating	✕	
4.	Natural selection		✕
5.	Small population size		✕

Marking scheme: 0.1 point for each correct answer.