MARKING SCHEME PAPER 3 BIOLOGY

Question 1

<table>
<tr><td></td><td>1(a) [KB0603 – Measuring Using Number]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to record all 8 readings of initial mass and final mass of the potato slices in the spaces provided accurately.
Sample answers:

<table>
<tr><td>Concentration of sucrose solution, M</td><td>0.0</td><td>0.2</td><td>0.4</td><td>0.6</td></tr>
<tr><td>Initial mass of potato slices, g</td><td>14.0± 0.5</td><td>14.0± 0.5</td><td>14.0± 0.5</td><td>14.0± 0.5</td></tr>
<tr><td>Final mass of potato slices, g</td><td>18.0± 0.5</td><td>17.0± 0.5</td><td>15.0± 0.5</td><td>12.0± 0.5</td></tr>
</table>
</td></tr>
<tr><td>2</td><td>Able to record any 4-7 reading accurately</td></tr>
<tr><td>1</td><td>Able to record any 1-3 reading accurately</td></tr>
<tr><td>0</td><td>No response or wrong response</td></tr>
</table>

<table>
<tr><td></td><td>1(b)i [KB0601 – Observation]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to state any two observations correctly based on criteria:

□ Concentration of sucrose solution
□ Final mass of potato slices

Sample answer:
1. The final mass of potato slice in 0.2 M/0.4 M/0.6 M/ sucrose solution is 18.0g/17.0g/15.0g/12.0g.
2. The final mass of potato slice in 0.2 M sucrose solution is higher than in 0.6 M sucrose solution</td></tr>
<tr><td>2</td><td>Able to state:
a) One correct observation and one inaccurate observation.
or
b) Two inaccurate observations.

Sample answers:
Inaccurate observations

1. The final mass of potato slice in 0.2 M/0.4 M/0.6 M/ sucrose solution is the high /higher /highest / small/smaller/smallest/ change / different / increase / decrease.</td></tr>
<tr><td>1</td><td>Able to state:
a)Two observations at idea level (based on any 1 criterion.)
or
b) One correct observation and one observation at idea level
or
c) One correct observation and one wrong observation
or</td></tr>
</table>

	One **inaccurate** observation and one observation at **idea level** Sample answers: Idea level 1. The final mass of potato slices change / different / increase / decrease. 2. The concentration of sucrose solution are different / increase / change.
0	No response or wrong response

	1(b)ii [KB0604 – **Making Inferences**]
Score	Criteria
3	Able to make one accurate inference for each observation based on two criteria: □ Hypotonic / Hypertonic solution / Higher / Lower concentration of water □ Water diffuses into / out the cell by osmosis Sample answers: 1. Water diffuses into the cell (of potato) by osmosis because (0.2 M / 0.4 M of sucrose solution) is hypotonic to the cell (of potato). 2. Water diffuses out of the cell (of potato) by osmosis because (0.6 M of sucrose solution) is hypertonic to the cell (of potato). 3. **More** water diffuses into the cell (of potato) by osmosis because (0.2 M sucrose solution) is **more** hypertonic to the cell (of potato).
2	Able to make: a) One **accurate** inference **and** one **inaccurate** inference corresponds to the observation. **or** b)Able to make **two inaccurate** inferences corresponds to the observation based on any one criterion. Sample answers: 1.Water diffuses into the cell (of potato) because (0.2 M / 0.4 M/0.6 M of sucrose solution) is hypotonic to the cell (of potato). 2. Water diffuses out of the cell (of potato) by osmosis . 3. More water diffuses into the cell (of potato) because (0.2 M sucrose solution) is more hypertonic to the cell (of potato).
1	Able to make : a)**Two** inferences at **idea level** (based on any 1 criterion.) **or** b) One **correct and** one inference at **idea level** (based on any 1 criterion.) **or** c) One **correct** and one **wrong** inference. **or** d) One **inaccurate** and one inference at **idea level** (based on any 1 criterion.) Sample answers: 1. Water diffuses into / out of the cell (of potato) 2. Osmosis occurs. 3. (0.2 M / 0.4 M/0.6 M of sucrose solution) is hypotonic (to the cell of potato). 4. The cell / potato slices become turgid / flaccid / plasmolysed.
0	No response or wrong response

SUMMARY OF SCORING FOR OBSERVATION				
SCORE	CORRECT	INACCURATE	IDEA	WRONG
3	2	-	-	-
2	1	1	-	-
	-	2	-	-
1	1	-	1	-
	-	-	2	-
	1	-	-	1
	-	1	1	-
0	-	1	-	1
	-	-	1	1

<table>
<tr><td></td><td>1(c)[KB061001 – Controlling Variables]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to state all the variables and the method to handle the variables correctly.
Sample answers:

<table>
<tr><th>Variable</th><th>Method to handle the variable</th></tr>
<tr><td>Manipulated variable:
Concentration / Molarity of sucrose solution</td><td>Use different concentration of sucrose solution // Change the concentration of sucrose solution from 0.0M to 0.2M / 0.4M / 0.5M // use distilled water / 0.2M / 0.4M / 0.6M of sucrose solution</td></tr>
<tr><td>Responding variable:
Final mass of potato slices //

(Percentage) difference in mass of potato slices</td><td>
Record the final mass of potato slices using weighing machine //

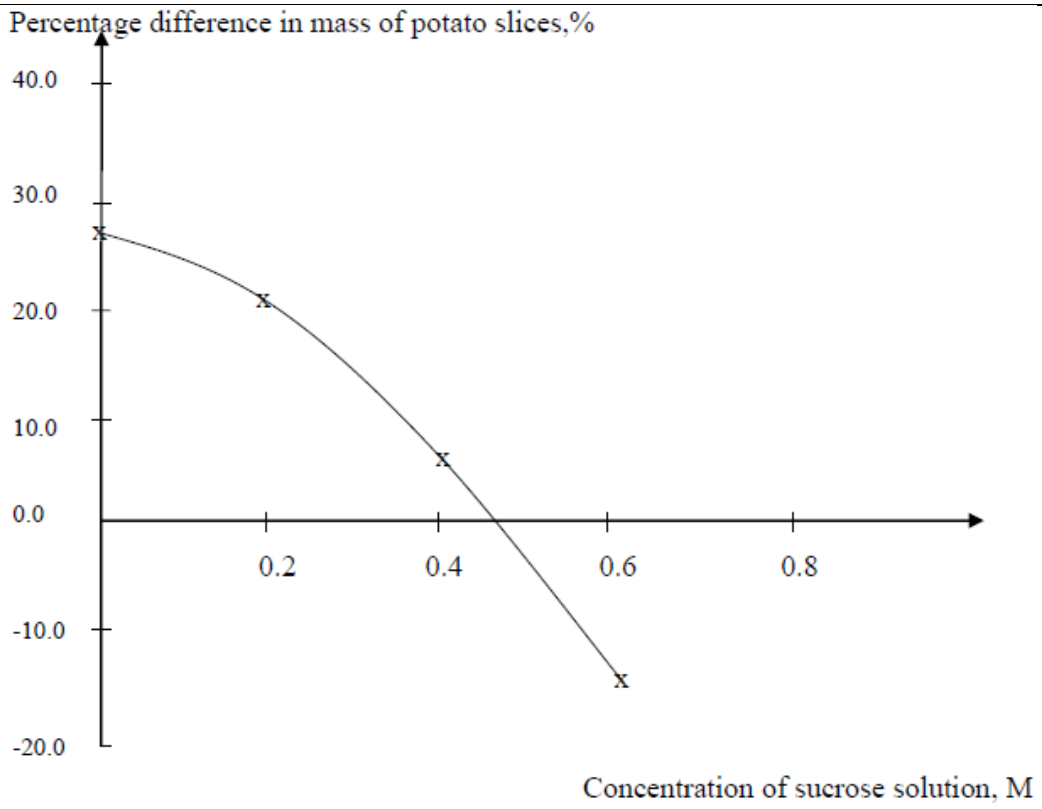
Calculate the percentage of potato slices by using formula:
$\frac{\text{Final mass – initial mass}}{\text{Initial mass}} \times 100\%$</td></tr>
<tr><td>Controlled variable:
Type of solution // Type of plant // Time taken to immerse the potato slices</td><td>
Use only sucrose solution// use only potato // Fix the time of immersion at 20 minutes</td></tr>
</table>
6 ticks</td></tr>
<tr><td>2</td><td>Able to state 4 - 5 of the variables and the method to handle the variables correctly.
4-5 ticks</td></tr>
<tr><td>1</td><td>Able to state 1 - 3 of the variables and the method to handle the variables correctly.
2-3 ticks</td></tr>
<tr><td>0</td><td>No response or wrong response
0 tick</td></tr>
</table>

	1(d)[KB0611 – **Making Hypothesis**]
Score	Criteria
3	Able to state a hypothesis based on **3 criteria**: **P1**: Manipulated variable – Concentration of sucrose solution **P2**: Responding variable – Final mass / (Percentage) difference in mass of potato slice **P3**: Relationship between Manipulated variable and Responding variable Sample answers: 1. The higher the concentration of sucrose solution, the smaller the final mass of potato slices. 2. The higher the concentration of sucrose solution, the smaller the (percentage) difference in mass of potato slices.
2	Able to state a **less accurate** hypothesis based on any **2 criteria**. Sample answers: 1. The higher the concentration of sucrose solution, the smaller the mass of potato slices. 2. The higher the concentration, the smaller the difference in the mass of potato slices. 3. The final mass of potato slices depends on the concentration of sucrose solution.
1	Able to state hypothesis **at idea** level based on **one criterion**. Sample answers: 1. **0.2 M sucrose solution** is hypotonic to the cell sap of potato. 2. **0.6 M sucrose solution** is hypertonic to the cell sap of potato. 3. **Concentration of sucrose solution** between 0.4 M and 0.6 M is isotonic to the cell sap of potato. Note : Accept – Hypothesis with wrong conclusion *Eg: The higher the concentration of sucrose solution, the higher the final mass of potato slices.* Reject – Reverse hypothesis *Eg: As the final mass of potato increases, the concentration of sucrose solution increases.*
0	No response or wrong response

<table>
<tr><td></td><td>1(e)i [KB0606 – Communicating]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to construct a table and fill in the data accurately based on three criteria:
Criteria:
T : Correct title and units
D : Complete and correct data
C : Correct calculation

Sample answers:
T : Correct title and units
<table>
<tr><th>Concentration of sucrose solution,M</th><th>Initial mass of potato slices, g</th><th>Final mass of potato slices, g</th><th>Percentage difference in the mass of potato slice, %</th></tr>
<tr><td>0.0</td><td>14.0</td><td>18.0</td><td>28.6 // 28.57</td></tr>
<tr><td>0.2</td><td>14.0</td><td>17.0</td><td>21.4 //21.42</td></tr>
<tr><td>0.4</td><td>14.0</td><td>15.0</td><td>7.1 // 7.14</td></tr>
<tr><td>0.6</td><td>14.0</td><td>12.0</td><td>-14.3 // -14.29</td></tr>
</table>
D : Complete and correct data C : Correct calculation</td></tr>
<tr><td>2</td><td>Able to construct a table based on any two criteria.</td></tr>
<tr><td>1</td><td>Able to construct a table based on any one criterion</td></tr>
<tr><td>0</td><td>No response or wrong response</td></tr>
</table>

	1(e)ii [KB0608 - **Space and Time Relationship**]
Score	Criteria
3	Able to plot a graph of percentage difference in mass of potato slices against the concentration of sucrose solution based on three criteria: Criteria: P : Both axes with correct units Y axis – Percentage difference in mass of potato slices,% X axis – Concentration of sucrose solution, M T : All points plotted correctly B : Smooth curve joining all points **Sample answer:**

	
2	Able to plot a graph based on any **two** criteria.
1	Able to plot a graph based on any **one** criterion
0	No response or wrong response

	1(f)[KB0607 - **Interpreting Data**]
Score	Criteria
3	Able to explain the relationship between the concentration of sucrose solution and the percentage difference in mass of potato based on the following aspects: P1 : Correct relationship P2 : The solution is (more) hypertonic // Isotonic P3 : Diffusion of water by osmosis Sample answer: 1. (**P1**)The higher the concentration of sucrose solution, the smaller the (percentage) difference in mass of potato slices.(**P2**)The solution is (more) hypertonic to the cell (of potato), (**P3**) water diffuses out of the cell by osmosis. 2. (**P1**)When the concentration of sucrose solution is 0.48M (value of concentration of sucrose solution where the line intercept x-axis ;0.45 – 0.5M) ,the percentage difference in mass of potato is zero. (**P2**)The solution is isotonic to the cell (of potato) ,(**P3**)water diffuses in and out of the cell at equal rate.

2	Able to explain the relationship between the concentration of sucrose solution and the percentage difference in mass of potato based on any two criteria. Sample answer: 1. (**P1**)The higher the concentration of sucrose solution, the smaller the (percentage) difference in mass of potato slices.(**P2**)The solution is (more) hypertonic to the cell (of potato). 2. (**P1**)When the concentration of sucrose solution is 0.48M,the percentage difference in mass of potato is zero. (**P2**)The solution is isotonic to the cell (of potato)
1	Able to state the relationship between the concentration of sucrose solution and the percentage difference in mass of potato without explanation / with wrong explanation. Sample answer: 1. (**P1**)The higher the concentration of sucrose solution, the smaller the (percentage) difference in mass of potato slices. 2. (**P1**)When the concentration of sucrose solution is 0.48M ,the percentage difference in mass of potato is zero. The sucrose solution diffuse in and out of the cell at equal rate.
0	No response or wrong response // Wrong relationship // Reverse relationship

	1(g) [KB0605 - **Predicting**]
Score	Criteria
3	Able to predict the result based on 3 criteria: **P1**: Prediction of final mass of potato slice **P2**: 0.7M sucrose solution is hypertonic to the cell of potato **P3:** Diffusion of water by osmosis Sample answers: The final mass of potato slice is less than 12.0 g / any value less than 12.0 g / decreases (P1) because 0.7M sucrose solution is hypertonic to the cell of potato (P2). Water diffuses out by osmosis (P3)
2	Able to predict the result based on any 2 criteria (P1 and P2/P3)
1	Able to predict the result based on any one criterion.(P1 only)
0	No response or wrong response // Wrong prediction

<table>
<tr><td></td><td>1(h)[KB0609 - Define Operationally]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to define osmosis based on the experiment correctly based on three criteria:

D1 – Movement of water (molecule) into the cell of potato // from the cell of potato // through the semi permeable membrane of potato cell
D2 – Shown by changes in mass of potato slices.
D3 – Affected by concentration of sucrose solution

Sample answer:
1. Osmosis is the movement of water molecule into the cell of potato slices (D1) shown by the changes in mass of potato slices (D2). Osmosis is affected by concentration of sucrose solution (D3).</td></tr>
<tr><td>2</td><td>Able to define osmosis based on any 2 criteria.</td></tr>
<tr><td>1</td><td>Able to state define osmosis based on any 1 criterion // Theoritical definition of osmosis.
Theoritical definition :
Osmosis is the movement of water molecule from high water concentration region to low water concentration region through a semi-permeable membrane</td></tr>
<tr><td>0</td><td>No response or wrong response</td></tr>
<tr><td></td><td>1(i) [KB0602 - Classifying]</td></tr>
<tr><td>Score</td><td>Criteria</td></tr>
<tr><td>3</td><td>Able to classify the apparatus and materials according to the correct variables .
Sample answer:

<table><tr><td>Manipulated variables</td><td>Responding variable</td><td>Fixed variables</td></tr><tr><td>Sucrose solution 1M, 2M and 3M</td><td>Ruler</td><td>Carrot

Beaker</td></tr></table>
All four correct</td></tr>
<tr><td>2</td><td>2 – 3 correct</td></tr>
<tr><td>1</td><td>1 correct</td></tr>
<tr><td>0</td><td>All wrong</td></tr>
</table>

Question 2

Item no	Explanation	Score
2(i)	**Able to state problem statement correctly based on three aspects** C1: Light intensity / distance of light source C2: Rate of transpiration in *Hibiscus sp* / *other named plant.* H : Relationship in question form. Sample answer: 1. Does light intensity affect the rate of transpiration (in *Hibiscus sp) ?* 2. What is the effect of light intensity on the rate of transpiration (in *Hibiscus sp)?*	3
	Able to state problem statement inaccurately based on any two aspects Sample answer: 1. How does light intensity affect the rate of transpiration 2. What is the effect of light intensity on transpiration? 3. Does light intensity affect transpiration process? 4. What factor affects the rate of transpiration?	2
	Able to state the problem statement correctly based on any one aspect or at idea level Sample answer: 1. Light intensity affect transpiration 2. How does transpiration occurs?	1
	No response or wrong answer	0
2(ii)	**Able to state hypothesis correctly based on the following aspect:** C1: Light intensity / distance of light source C2: Rate of transpiration (in *Hibiscus sp*)/ (other named plant.) H : Relationship Sample answer: *1.* The higher the light intensity, the higher the rate of transpiration (in *Hibiscus sp* / other named plant *)* / vice versa. 2. As light intensity increase, the rate of transpiration in *Hibiscus sp.* / other named plant increase / vice versa	3

	Able to state the hypothesis correctly based on any two aspects / two inaccurate aspects Sample answer: 1. Light intensity cause the rate of transpiration in *Hibiscus sp* / other named plant to increase 2. Rate of transpiration is affected by light intensity 3. Different light intensity causes different rate of transpiration 4. More light causes higher rate of transpiration / vice versa	2
	Able to state the hypothesis correctly based on any one aspect or at idea level Sample answer: 1. Transpiration of *Hibiscus sp* / other named plant decrease 2. Transpiration occurs in leaves	1
	No response or wrong answer	0
2(iii)	**Able to state all the 3 variables correctly** Manipulated variable: Light intensity / distance of light source Responding variable: Rate of transpiration in *Hibiscus sp* / other named plant // time taken for air bubble to moves at 5cm distance / Constant variable: Type of plant / same temperature / air movement	3
	Able to state any 2 variables correctly	2
	Able to state any 1 variables correctly	1
	No response or wrong answer	0
2(iv)	**Able to list out all the apparatus and materials /** **4 Materials and 10 Apparatus correctly** Materials: *Hibiscus sp* leafy shoot / other named plant leafy shoot , tissue paper / cloth , grease / vaseline, water Apparatus: Potometer (rubber tubing + capillary tube) , beaker, retort stand, ruler, marker pen, stopwatch, light source, basin , knife and thread	3
	Able to list out 3-4 Materials and 5-9 Apparatus correctly	2
	Able to list out 1-2 Materials and 1-4 Apparatus correctly	1
	No response or wrong answer	0

2(v)	**Able to write the procedures of experiment based on the following aspects:** K1 : Setting apparatus (at least 5 steps / 5K1) K2 : Operating constant variable (1 K2) K3 : Operating responding variable (1 K3) K4 : Operating manipulated variable (1 K4) K5 : Precaution or procedure to get accurate result (1 K5)	
	Able to state all the 5 K 1. A Hibiscus leafy shoot is chosen, and immersed into a basin of water. 2. The bottom of the stem is cut under water using a knife. 3. The leafy shoot is joined to a rubber tubing and capillary tube tightly. 4. Water is filled into the potometer 5. Potometer is clamped to a retort stand and immerse in a beaker of water. 6. The leaves and stem are wiped dry using a cloth / tissue paper 7. Vaseline are placed at all joining so that it is air tight. 8. A distance of 5 cm is marked using marker pen at point A and B on the capillary tube. 9. The end of the capillary tube is lifted out of the beaker to introduce an air bubble. 10. The potometer is placed at 20 cm from a light source. 11. When the air bubble reached point A, the stopwatch is started. 12. Record the time taken for air bubble to moves 5cm distance (from A to B) using a stopwatch 13. This experiment is repeated by using the same plant but by placing the potometer at 30 cm and 40 cm from the light source. 14. The rate of transpiration is calculated by using the following formula: $= \frac{\text{Distance of air bubble / 5 cm (cm)}}{\text{Time taken (s)}}$ 15. The experiment is repeated to obtain two or more readings. Record all results in a Table.	3 K1 K1 , K5 K1,K5 K1 K1 K1,K5 K5 K1, K2 K1 K1, K1 K3 K2, K4 K3 K1/K3/K5
	Able to state 3K - 4 K	2
	Able to state 1K - 2 K	1
	No response or wrong answer	0

<table>
<tr><td>2(vi)</td><td>Able to tabulate a table containing the following aspects:
T : title with correct units
S : value of manipulated variables
Sample data:

<table>
<tr><td rowspan="2">Distance of potometer from the light source(cm)</td><td colspan="3">Time taken by the air bubble to travel a distance of 5 cm (s)</td><td rowspan="2">Rate of transpiration (cm / s)</td></tr>
<tr><td>1</td><td>2</td><td>Average</td></tr>
<tr><td>20</td><td></td><td></td><td></td><td></td></tr>
<tr><td>30</td><td></td><td></td><td></td><td></td></tr>
<tr><td>40</td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Able to state any one aspect</td><td>1</td></tr>
<tr><td></td><td>No response or wrong answer</td><td>0</td></tr>
</table>

Sample answer :

Problem Statement :

Does light intensity affect the rate of transpiration (in *Hibiscus sp) ?*

Hypothesis :

The higher the light intensity, the higher the rate of transpiration (in *Hibiscus sp* / other named plant *)*

Variables :

Manipulated variable: Light intensity/ distance of light source

Responding variable: Rate of transpiration(in *Hibiscus sp)* / time taken for air bubble to moves at 5cm distance //

Constant variable: Type of plant / same temperature / air movement / distance for air bubble to move

Apparatus/materials

Materials:
Hibiscus sp leafy shoot / other named plant leafy shoot , tissue paper / cloth , grease / vaseline, water

Apparatus:
Potometer (rubber tubing + capillary tube) , beaker, retort stand, ruler, marker pen, stopwatch, light source, basin , knife and thread

Procedure :

1. A Hibiscus leafy shoot is chosen, and immersed into a basin of water.

2. The bottom of the stem is cut under water using a knife.
3. The leafy shoot is joined to a rubber tubing and capillary tube tightly.
4. Water is filled into the potometer
5. Potometer is clamped to a retort stand and immerse in a beaker of water.
6. The leaves and stem are wiped dry using a cloth / tissue paper
7. Vaseline are placed at all joining so that it is air tight.
8. A distance of 5 cm is marked using marker pen at point A and B on the capillary tube.
9. The end of the capillary tube is lifted out of the beaker to introduce an air bubble.
10. The potometer is placed at 20 cm from a light source.
11. When the air bubble reached point A, the stopwatch is started.
12. Record the time taken for air bubble to moves 5cm distance (from A to B) using a stopwatch
13. This experiment is repeated by using the same plant but by placing the potometer at 30 cm and 40 cm from the light source.
14. The rate of transpiration is calculated by using the following formula:

$$= \frac{\text{Distance of air bubble / 5 cm (cm)}}{\text{Time taken (s)}}$$

15. The experiment is repeated to obtain two or more readings. Record all results in a Table.

Result :

Distance of potometer from the light source(cm)	Time taken by the air bubble to travel a distance of 5 cm (s)			Rate of transpiration (cm / s)
	1	2	Average	
20				
30				
40				