

## Experiment 1

100 marks

## Spare Materials

Spare Materials	Amount	Score	Overall
1 <sup>st</sup> replacement		0	
2 <sup>nd</sup> replacement		-5	
3 <sup>rd</sup> replacement		-5	
Sample of Spinach		-5	
TLC Plate		-5	

## Question 1.1.1

25 marks

Question	Category	Category Score	Question Score
1.1.1	$\beta$ -Carotene and Chlorophyll a Separated from Others in Reasonably Straight and Uniform Bands	25	25
	Inappropriate Mobile Phase e.g. Reversed ratio of solvents	20	
	Bands of Chlorophyll a and b Partially Overlapping Still Separable	15	
	Bands Non-Separable	10	
	No TLC Plate	0	

## Question 1.1.2

25 marks

Question	Category	Category Score	Question Score
1.1.2	Correct Spectrum of $\beta$ -carotene	12	25
	Absorbance of the Highest Peak <0.1	-5	
	Correct Spectrum of Chlorophyll a	13	
	Wrong band isolated e.g. Chlorophyll b	5	
	Clearly visible Peak of Chlorophyll b in Spectrum (460 nm) , or other unknown peak	5	

## Question 1.2.1

3 marks

chlorophylls, a and b		$\beta$ -carotene	
ranges $\lambda_{\min}$ – $\lambda_{\max}$ /nm		range $\lambda_{\min}$ – $\lambda_{\max}$ /nm	
400–485 ( $\pm 5$ )	625( $\pm 5$ )–675( $\pm 5$ )	400–515 ( $\pm 5$ )	
Question	Category	Category Score	Question Score
1.2.1	Each Correct point	0.5	3

Task A – Marking Scheme

**Question 1.2.2**

**2 marks**

Range/nm	515 (±5)– 625(±5)		
Question	Category	Category Score	Question Score
1.2.2	Lower Value in Range	1	2
	Upper Value in Range	1	

**Question 1.2.3**

**2 marks**

Answer (A-D):	B		
Question	Category	Category Score	Question Score
1.2.3	Correct Answer	2	2

**Question 1.3.1**

**3 marks**

Least polar			Most polar
<b>C</b>	<b>A</b>	<b>B</b>	<b>D</b>
Question	Category	Category Score	Question Score
1.3.1	Only the correct answer is marked	3	3

**Question 1.4.1**

**3 marks**



Question	Category	Category Score	Question Score
1.4.1	Only the correct answer is marked	3	3

**Data are given in three significant figures. Results should be also in three significant figures. One more figure is allowed (4), excessive figures or decimal places: -0.5 marks per result.**

**Question 1.4.2**

**3 marks**

$m(\text{glucose}) = m(\text{Glc}) = V(\text{solution}) \times \rho(\text{soln}) \times w(\text{Glc}) = 1.00 \text{ L} \times 1.08 \text{ kg L}^{-1} \times 0.200 = 0.216 \text{ kg}$ $m(\text{glucose}) = 216 \text{ g}$			
Question	Category	Category Score	Question Score
1.4.2	Only the correct answer is marked	3	3

## Task A – Marking Scheme

**Question 1.4.3****7 marks**

$$n(\text{EtOH}) = 2n(\text{Glc})$$

$$n(\text{Glc}) = 216 \text{ g} / 180.16 \text{ g mol}^{-1} = 1.20 \text{ mol}$$

$$n(\text{EtOH}) = 2.40 \text{ mol}$$

$$m(\text{EtOH}) = 2.40 \text{ mol} \times 46.07 \text{ g mol}^{-1} = 111 \text{ g}$$

$$m(\text{ethanol}) = 111 \text{ g (or one additional decimal place)}$$

Question	Category	Category Score	Question Score
1.4.3	n(Glc)	3	7
	n(EtOH)	2	
	m(EtOH)	2	

**Question 1.4.4****6 marks**

$$n(\text{CO}_2) = 2n(\text{Glc})$$

$$n(\text{Glc}) = 216 \text{ g} / 180.16 \text{ g mol}^{-1} = 1.20 \text{ mol}$$

$$n(\text{CO}_2) = 2.40 \text{ mol}$$

$$m(\text{CO}_2) = 2.40 \text{ mol} \times 44.01 \text{ g mol}^{-1} = 105.5 \text{ (or 105.6, depending on rounding)}$$

$$m(\text{CO}_2) = 106 \text{ g}$$

Question	Category	Category Score	Question Score
1.4.4	n(CO <sub>2</sub> )	3	6
	m(CO <sub>2</sub> )	3	

**Question 1.4.5****6 marks**

$$m(\text{soln}) = m(\text{soln-initial}) - m(\text{CO}_2)$$

$$m(\text{soln}) = 1080 \text{ g} - 105.5 = 974.5 \text{ g}$$

$$w(\text{EtOH}) = m(\text{EtOH}) / m(\text{soln}) = 110.5 \text{ g} / 974.5 \text{ g} = 0.113 = 11.3 \%$$

$$w(\text{ethanol}) = 11.3\text{--}11.4 \%$$

Question	Category	Category Score	Question Score
1.4.5	m(solution)	3	6
	w(ethanol)	3	

## Task A – Marking Scheme

**Question 1.4.6****5 marks**

$$V(\text{CO}_2) = n(\text{CO}_2) \times R \times T/p$$

$$n(\text{CO}_2) = 1000 \times 2.40 \text{ mol} = 2.40 \times 10^3 \text{ mol}$$

$$V(\text{CO}_2) = 2.40 \times 10^3 \text{ mol} \times 8.314 \text{ kg m}^2 \text{ s}^{-2} \text{ mol}^{-1} \text{ K}^{-1} \times 293 \text{ K} / 100 \text{ kPa} = 58.46 \text{ m}^3$$

$$V(\text{CO}_2) = 58.5 \text{ m}^3$$

Question	Category	Category Score	Question Score
1.4.6	Incorrect temperature	-3	5
	Incorrect volume	-3	

**Question 1.4.7****4 marks**

$$m(\text{CO}_2) = 1000 \times 105.5 \text{ g} = 105.5 \text{ kg}$$

$$\rho(\text{CO}_2) = m(\text{CO}_2) / V(\text{CO}_2) = 105.5 \text{ kg} / 58.5 \text{ m}^3 = 1.80 \text{ kg m}^{-3}$$

$$\rho(\text{CO}_2) = 1.80 \text{ kg m}^{-3}$$

Question	Category	Category Score	Question Score
1.4.7	Only the correct answer is marked	4	4

**Question 1.4.8****3 marks**

Answer (A or B):

**B**

Question	Category	Category Score	Question Score
1.4.8	Correct Answer	3	3

**Question 1.4.9****3 marks**

Answer (A or B):

**B**

Question	Category	Category Score	Question Score
1.4.9	Correct Answer	3	3

Country code and team
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## Experiment 2

100 marks

**Acceptable numerical precision is the number of significant figures of the input precision, plus/minus 1 digit (unless stated differently). If this condition is not met, the question gets - 0.5 Marks penalty (minimum score is 0 Marks). If this mistake occurs in a table, the deduction is - 0.5 Marks per column.**

### Question 2.1.1

1 mark

Voltage:

Question	Category	Category Score	Question Score
2.1.1	In Range 4 V – 7.5 V	1	1
	Incorrect Use of Units	- 0.5	

### Table 2.1.2

8 marks

Wavelength $\lambda$	Voltages [V]			
	Water	Sample A	Sample B	Sample C
495 nm				
515 nm				
530 nm				
550 nm				
570 nm				
590 nm				
610 nm				
630 nm				
645 nm				
665 nm				
Table	Category		Category Score	Table Score
2.1.2	Each Column	Completed Column	2	8
		More than 7 Entered Values	1	

## Task A – Marking Scheme

	Less than 7 Entered Values	0
	Every Value Above 2.1.1 Value	-0.5

Table 2.1.3

30 marks

Wavelength	Voltage differences [V]			Transmittance (Official)			
	Water	Sample A	Sample B	Sample C	Sample A	Sample B	Sample C
495 – 515 nm					0.9624	0.012	0.3905
515 – 530 nm					0.9731	0.042	0.3586
530 – 550 nm					0.9791	0.039	0.3823
550 – 570 nm					0.9844	0.010	0.4811
570 – 590 nm					0.9877	0.000	0.6395
590 – 610 nm					0.9898	0.161	0.7848
610 – 630 nm					0.9914	0.320	0.8783
630 – 645 nm					0.9921	0.512	0.9293
645 – 665 nm					0.9929	0.639	0.9568

Table	Category	Category Score	Table Score
2.1.3 Voltage difference	Each Column (4)	7 Values or More Correct	1
		5 or 6 Values Correct	0.5
		4 or Less Values Correct	0
2.1.3 Transmittance	*Correct Own Calculation	Completed Table	16
		Incorrect Entry	-1
	**Matching Official Transmittance Values	Completed Table	10
		2 Out of Range Entries	-0.5

\* Correct Own Calculation: Values entered in the Transmittance columns will be rechecked to see, whether their calculations are done correctly according to their own measurements.

\*\*Matching Official Transmittance Values: Values entered will be matched with official Transmittance values as seen in this table. If entered values are in the  $\pm 0.05$  range, they will be considered correct.

**Graphs 2.1.4**

**18 marks**

Graph		Category	Category Score	Graph Score
<b>2.1.4</b>	Graph	Axes Names	1	18
		Axes Units	1	
		Lack of Ticks or Values on Axes	-2	
		Appropriate Choice of Range	1	
		Use of Steps (Lines)	1	
		*Use of Steps (Width)	2	
		Entered Values	12	
		Incorrect Values	-0.5	

\* If values are entered as points on the interval edges instead of lines across intervals (step chart), the “entered values” gets reduced to 6 Marks maximum, as it is impossible to determine the interval. Both categories for Use of steps are set to 0 Marks.

\*When histogram (bar chart) is drawn instead of the step chart, both categories for Use of steps are set to 0 Marks.

\*Graph is not named (there is no question number on the graph paper) brings a -0.5 Marks penalty.

**Question 2.2.1**

**6 marks**

Sample	Wine Region		
<b>A</b>	Prekmurje		
<b>B</b>	Kras		
<b>C</b>	Dolenjska		
Question	Category	Category Score	Question Score
<b>2.2.1</b>	Each Correct Entry	2	6

## Task A – Marking Scheme

**Question 2.2.2****11 marks**

Consequence	Changes (one or more letters A-I)		
1	<b>BCEGI</b>		
2	<b>BDEG</b>		
3	<b>AFH</b>		
4	<b>A</b>		
Question	Category	Category Score	Question Score
<b>2.2.2</b>	Correct Table	11	11
	*Each Incorrect Entry	-2	
	**Each Missing Entry	-1	

\* First incorrect entry does not receive punishment. E.g. if 4 entries are incorrect, students get  $-(4-1)*2=-6$  Marks.

\*\* First two missing entries do not receive punishment. E.g. if 4 entries are missing, students get  $-(4-2)*1=-2$  Marks.

**EXAMPLE: If consequence 2 has answer CDEH, we count 2 wrong (C and H) and two missing (B and G).**

**Question 2.2.3****2 marks**

Answer (A,B or C):

**A**

Question	Category	Category Score	Question Score
<b>2.2.3</b>	Correct Answer	2	2

**Question 2.3.1****2 marks**

Answer (A,B or C):

**B**

Question	Category	Category Score	Question Score
<b>2.2.3</b>	Correct Answer	2	2



## Task A – Marking Scheme

Table 2.3.2

10 marks

$\lambda$ [nm]	A	$\lambda$ [nm]	A	$\lambda$ [nm]	A
400-420	0.1325	500-520	0.0232	600-620	0.8477
420-440	0.0550	520-540	0.0540	620-640	1.2518
440-460	0.0155	540-560	0.1314	640-660	0.6144
460-480	0.0110	560-580	0.2890	660-680	0.1409
480-500	0.0119	580-600	0.4962	680-700	0.0255
Question	Category		Category Score	Question Score	
2.2.3	Correct Table		10	10	
	Each Incorrect Entry		-1		

Graph 2.3.3

7 marks

Graph		Category	Category Score	Question Score
2.3.3	Graph	Axes Names	0.5	7
		Axes Units	0.5	
		Lack of Ticks or Values on Axes	-2	
		Appropriate Choice of Range	0.5	
		Use of Steps (Lines)	1	
		Use of Steps (Width)	1	
		Correct Values	3.5	
		Incorrect Values	-0.5	

\*If values are entered as points on the interval edges instead of lines across intervals (step chart), the “entered values” gets reduced to 1.5 Marks maximum, as it is impossible to determine the interval. Both categories for Use of steps are set to 0 Marks.

\*When histogram is drawn instead of the step chart, both categories for Use of steps are set to 0 Marks.

\*Graph is not named (there is no question number on the graph paper) brings a -0.5 Marks penalty.

Question 2.3.4

2 marks

Answer (A-E):

C

Question	Category	Category Score	Question Score
2.3.4	Correct Answer	2	2

**Question 2.3.5****3 marks**

$A = kl$ $A' = kl' = \frac{A}{l} l'$ $A' = 0.2890 / (4 \text{ mm}) \cdot 10 \text{ mm} = 0.7225$			
Question	Category	Category Score	Question Score
<b>2.3.5</b>	Correct Calculation (with own A)	2	3
	Correct Answer	1	

## Experiment 3

100 marks

**Multiple choice questions: Each correct response counts 1 Mark. For each incorrect response, -1 Mark is assigned. If students list more than one incorrect response, 0 Marks are assigned.**

**If students only write one correct answer out of three, they get 1 Mark. For only writing two correct answers, they get 2 Marks.**

### Question 3.1.1

8 marks

Question	Category	Category Score	Question Score
3.1.1	Each Submitted Sample	1	7
	Sample Deviation Over $\pm 2$ mL	0	
	Incubation pH Sample	Correctly Marked and Submitted Samples	1

### Question 3.1.2

8 marks

Question	Category	Category Score	Question Score	
3.1.2	Each Submitted Sample	1	6	
	Incubation Temperature Sample	Sample Deviation Over $\pm 2$ mL		0
		Correctly Marked and Submitted Samples	1	2
		Retrieving the Samples	1	

## Task A – Marking Scheme

Table 3.2.1

28 marks

Sample	Light intensity (temperature)				Light intensity (pH)			
	$T$ (°C)	$U_{\text{without}}$	$U_{515}$	$U_{\text{sample}} = U_{\text{without}} - U_{515}$	pH	$U_{\text{without}}$	$U_{515}$	$U_{\text{sample}} = U_{\text{without}} - U_{515}$
A	0				2			
B	10				4			
C	20				5			
D	30				6			
E	50				7			
F	70				8			
G	/	/	/	/	10			
Distilled water		$U_{\text{without}} = \underline{\hspace{2cm}}$ $U_{515} = \underline{\hspace{2cm}}$ $U_{\text{water}} = U_{\text{without}} - U_{515} = \underline{\hspace{2cm}}$						
Table	Category			Category Score	Table Score			
3.2.1	Samples	Each Measurement $U_{\text{without}}$		0.5	26			
		Each Measurement $U_{515}$		0.5				
		Each Calculation $U_{\text{sample}}$		1				
	Distilled Water	Calculation $U_{\text{without}}$		0.5	2			
		Calculation $U_{515}$		0.5				
		Calculation $U_{\text{water}}$		1				

If students do not or are unable to make measurements, they are graded with 0 points for mentioned. They get the pre-prepared measurement values on a sheet of paper that they can use to make appropriate calculations.

If students break the glass tube with the sample and they do not have time to prepare and incubate another one, they can get a pre-prepared measurement value. For each broken glass tube they get 0 points at the table 3.1.1 or 3.1.2 and at the table 3.2.1. ( $U_{\text{without}}$  and  $U_{515}$ ). Further calculations can be carried out without penalty.

If the calculated value for  $U_{\text{sample}}$  is negative, they get 0 points.

## Task A – Marking Scheme

Table 3.2.2

26 marks

Sam ple	Tempera ture (°C)	Transmittance ( <i>T</i> )	Absorbance ( <i>A</i> )	pH	Transmittance ( <i>T</i> )	Absorbance ( <i>A</i> )
A	0	$T = \frac{U_{sample}}{U_{distilled}}$	$A = -\log_{10} T$	2	$T = \frac{U_{sample}}{U_{distilled}}$	$A = -\log_{10} T$
B	10			4		
C	20			5		
D	30			6		
E	50			7		
F	70			8		
G	/			/		
Table		Category		Category Score	Question Score	
3.2.2	Calculations	Each Transmittance Value		1	26	
		Each Absorbance Value		1		
	Did Not Complete the Calculations				0	0

If students do not or are unable to make calculations of absorbance (*A*), the assignment 3.2.2 is graded with 0 points. Students get the absorbance values on a sheet of paper that they can use to plot a chart and later answer the questions.

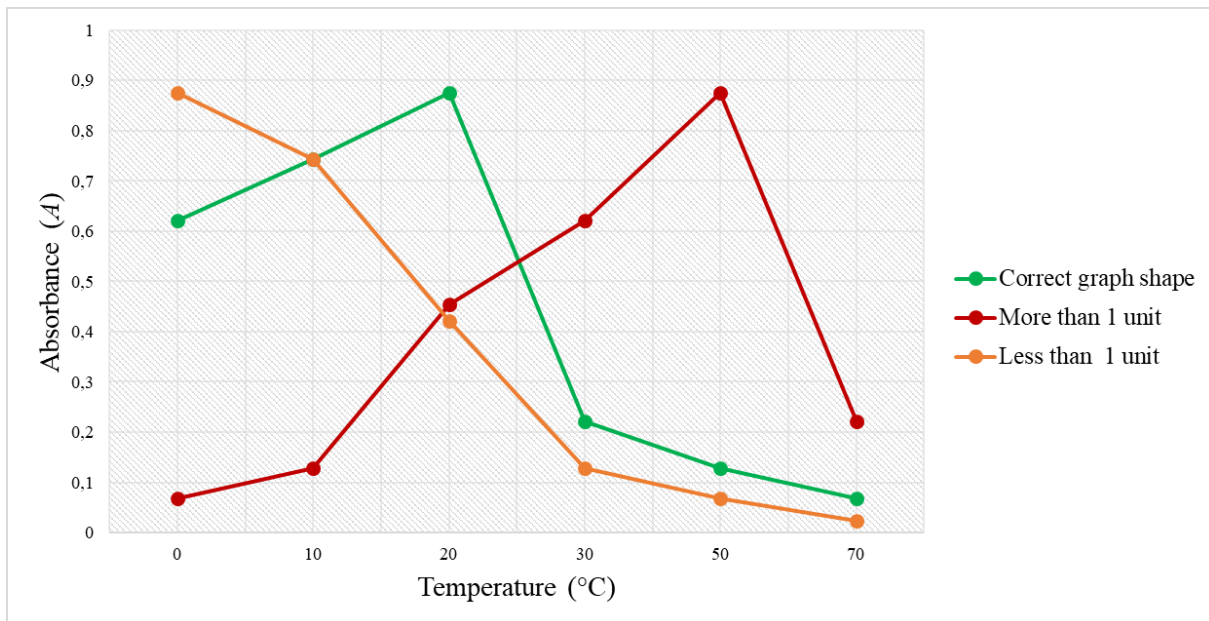
## Task A – Marking Scheme

## Graph 3.2.3

10.5 marks

Graph	Category	Category Score	Question Score	
3.2.3	Graph	X-Axis Name	0.5	10.5
		Y-Axis Name	0.5	
		X-Axis Unit	0.5	
		Y-Axis No Unit	0.5	
		X-Axis Scale (Ticks)	0.5	
		Y-Axis Scale (Ticks)	0.5	
		Each Correct Value	1	
		Linked Points on the Chart	1.5	
		Deviation of the Curve by More Than One Unit*	-5	

\* If the chart curve deviates from the real enzyme curve for more than one measurement unit (each direction).



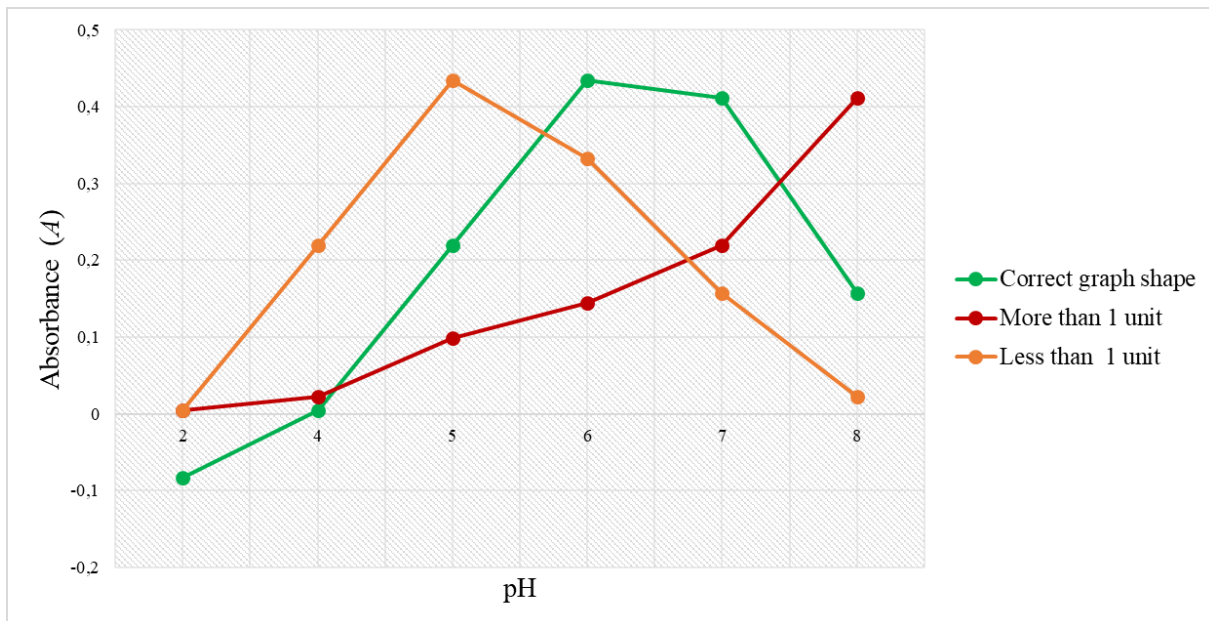
## Task A – Marking Scheme

## Graph 3.2.4

11.5 marks

Graph	Category	Category Score	Question Score	
3.2.4	Graph	X-Axis Name	0.5	11.5
		Y-Axis Name	0.5	
		X-Axis No unit	0.5	
		Y-Axis No unit	0.5	
		X-Axis Scale (Ticks)	0.5	
		Y-Axis Scale (Ticks)	0.5	
		Each Correct Value	1	
		Linked Points on the Chart	1.5	
Deviation of the Curve by More Than One Unit*		-5		

\* If the chart curve deviates from the real enzyme curve for more than one measurement unit (each direction).



## Question 3.3.1

1 mark

Answer (one from A-E):

D, unless chart says otherwise\*

Question	Category	Category Score	Question Score
3.3.1	Correct Answer	1	1

\* This question is graded according to the students' results from the chart. If they find (based on the results of their measurements and calculations) the enzyme optimum to be different from the real optimum of polyphenol oxidase, their answer is graded 1 point. Assessor takes into account the results gathered from students' measurements and from their chart. Correct answer is recognised only if the table 3.3.2 is appropriately filled and if the chart is drawn based on their correct calculations.

**Question 3.3.2** **1 mark**

Answer (one from A-D): 

<b>B</b>
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Question	Category	Category Score	Question Score
<b>3.3.2</b>	Correct Answer	1	1

**Question 3.3.3** **1 mark**

Answer (one from A-F): 

<b>D, unless chart says otherwise*</b>
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Question	Category	Category Score	Question Score
<b>3.3.3</b>	Correct Answer	1	1

\*This question is graded according to the students' results from the chart. If they find (based on the results of their measurements and calculations) the enzyme optimum to be different from the real optimum of polyphenol oxidase, their answer is graded 1 point. Assessor takes into account the results gathered from students' measurements and from their chart. Correct answer is recognised only if the table 3.3.2 is appropriately filled and if the chart is drawn based on their correct calculations.

**Question 3.3.4** **3 marks**

Answers (multiple from A-G): 

<b>C, D, G</b>
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Question	Category	Category Score	Question Score
<b>2.3.4</b>	Each Correct Answer	1	3

**Question 3.3.5** **1 mark**

Answer (one from A-E): 

<b>E</b>
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Question	Category	Category Score	Question Score
<b>3.3.5</b>	Correct Answer	1	1

**Question 3.3.6** **1 mark**

Answer (one from A-E): 

<b>A</b>
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Question	Category	Category Score	Question Score
<b>3.3.6</b>	Correct Answer	1	1