



Sixth Form Scholarship Exam 'SAMPLE' BIOLOGY

Name: _____

Date: _____

Time allowed: 60 minutes

- Please use a black pen to complete the paper.
- Calculators are allowed

Q1		/22
Q2		/18
Total		/40

- 1 Beetroot cells contain a red pigment called betalain. This pigment does not leak out of the cells, unless their membranes are damaged.

A student investigated the effect of detergent on beetroot cell membranes.

Discs of tissue were cut from a beetroot. Any betalain on the outside of the discs was removed.

One disc was placed into each of five test tubes, containing 0.2% detergent solution.

The five tubes were left for 30 minutes at 20 °C.

The discs were then removed carefully.

Betalain had leaked from the discs and formed a red solution in each test tube.

Light was shone through this solution. The percentage of the light transmitted through the solution was recorded.

The same procedure was repeated using detergent concentrations of 0.0%, 0.5%, 1.0% and 2.0%.

- (a) (i) State the independent variable in this investigation.

(1)

.....

.....

- (ii) State **two** abiotic (environmental) variables that should be controlled in this investigation.

(2)

1

2

- (iii) Choose **one** of the variables you named in (a)(ii) and state how it could be controlled.

(1)

Variable

How it could be controlled

.....

.....

(iv) Explain why the discs were removed carefully.

(2)

(v) Explain why five discs were used for each concentration of detergent.

(2)

(b) The table shows the results of this investigation.

Concentration of detergent solution (%)	Mean percentage of light transmitted through the solution (%)
0.0	97
0.2	90
0.5	75
1.0	65
2.0	50

(i) Suggest why this investigation included a 0.0% detergent solution.

Use the information in the table to support your answer.

(1)

.....

.....

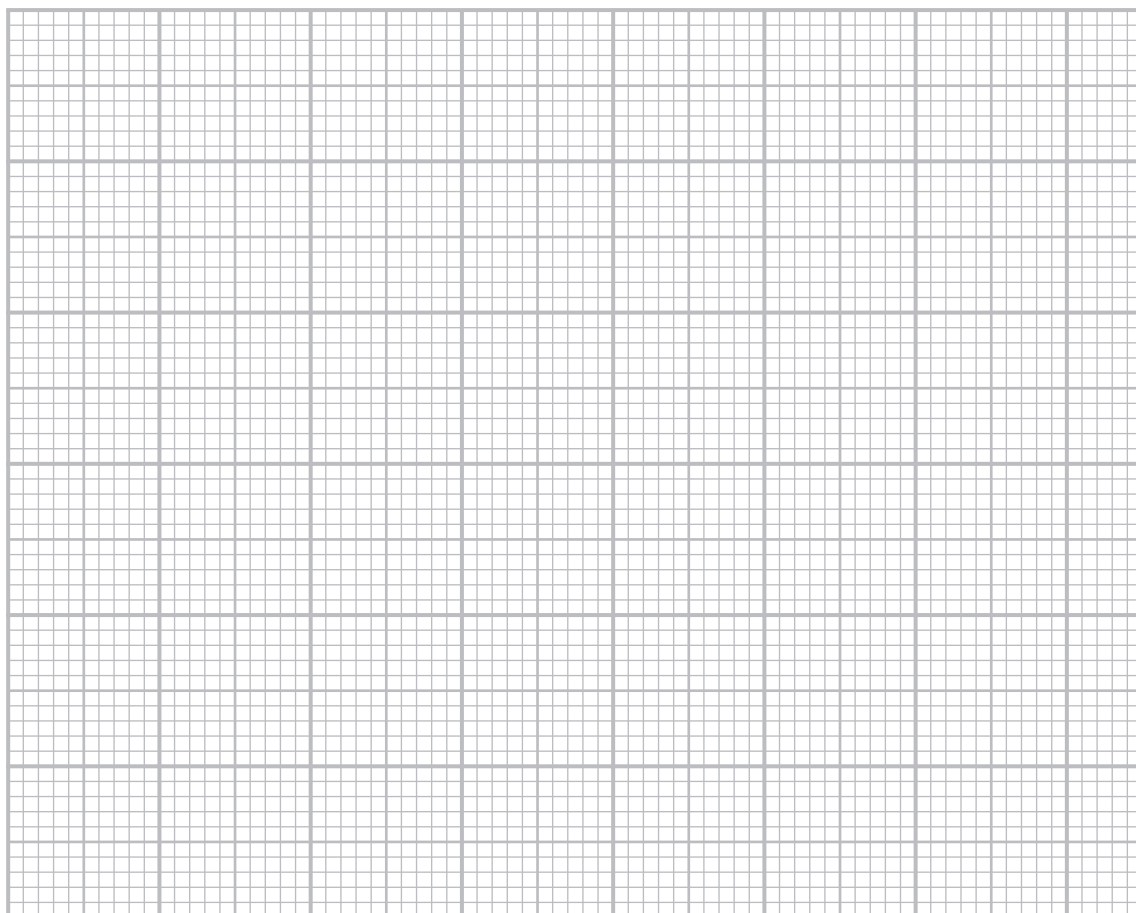
.....

.....

- (ii) Plot a line graph to show the relationship between detergent concentration and percentage of light transmitted.

Join the points with straight lines.

(4)



(iii) Detergent permanently damages beetroot cell membranes.

Explain what will happen to the rate of loss of betalain if these discs are then transferred to test tubes of distilled water.

(3)

.....

.....

.....

.....

.....

.....

.....

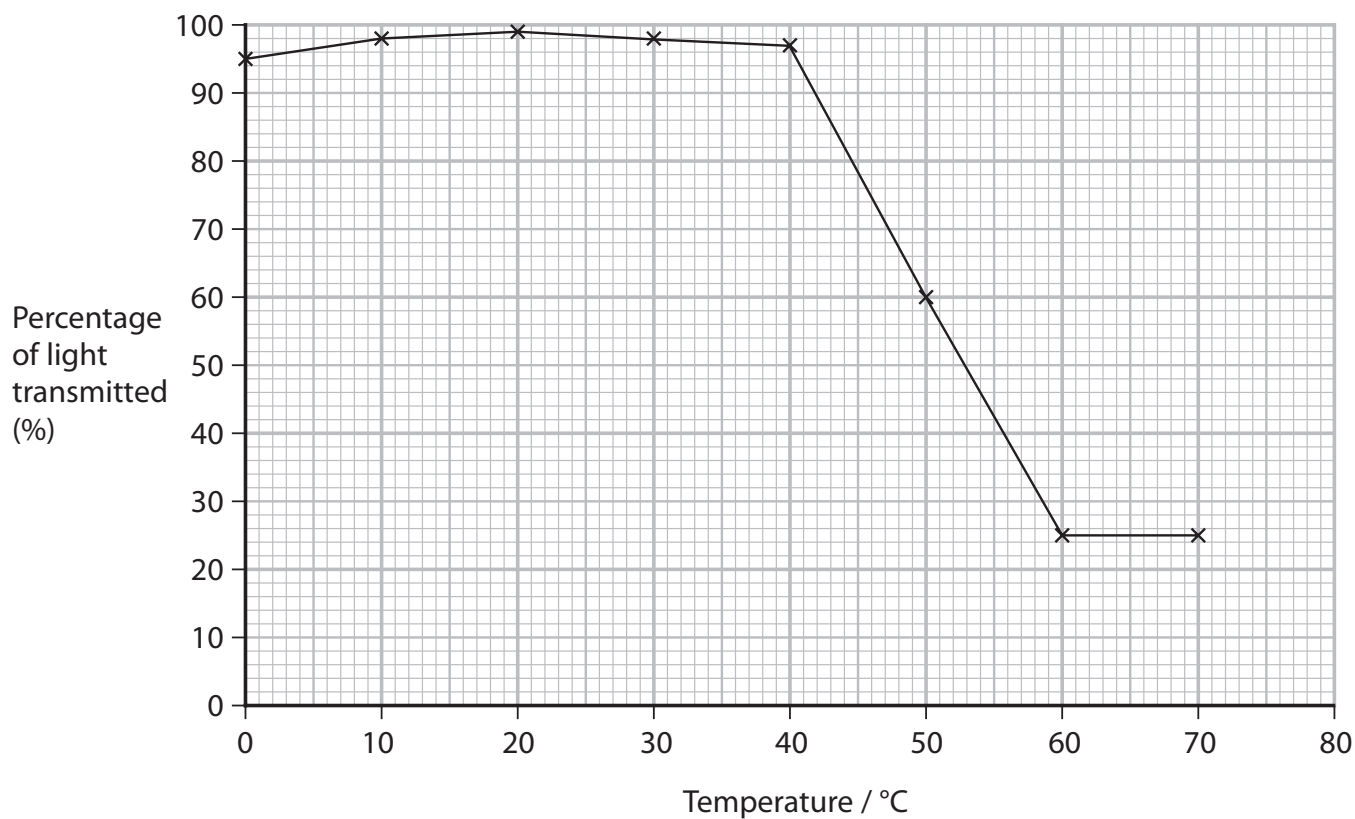
.....

.....

.....

- (iv) In a second investigation, the effect of temperature on beetroot cell membrane permeability was studied.

The graph shows the results of the second investigation.



Compare and contrast the effects of detergent concentration and temperature on the leakage of betalain from beetroot cells.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(v) Estimate the percentage of light transmitted at 80°C.

Use the information in the graph and your own knowledge to support your answer.

(3)

(Total for Question 1 = 22 marks)

2 Antimicrobial chemicals can be used in food preservation to reduce the risk of food poisoning.

Antimicrobial chemicals derived from plants may be used in food preservation.

An investigation was carried out to assess the antimicrobial properties of extracts from five plants: clove, cumin, ginger, pomegranate and thyme.

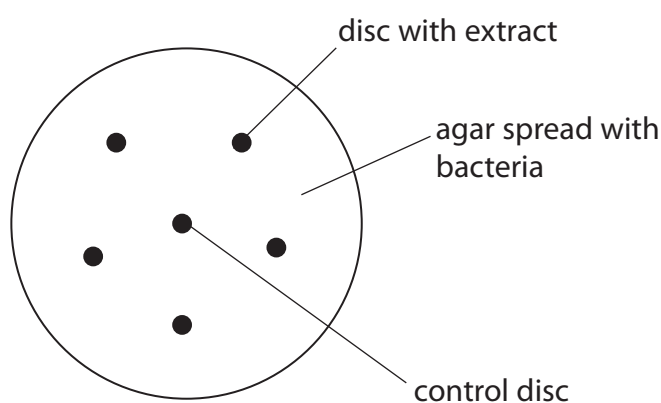
Two types of bacteria were used, type **A** and type **B**.

Filter paper discs were placed in each extract for 10 minutes and then allowed to dry.

Five discs, one for each extract, were placed onto an agar plate spread with bacteria of type **A**. This was repeated for bacteria of type **B**.

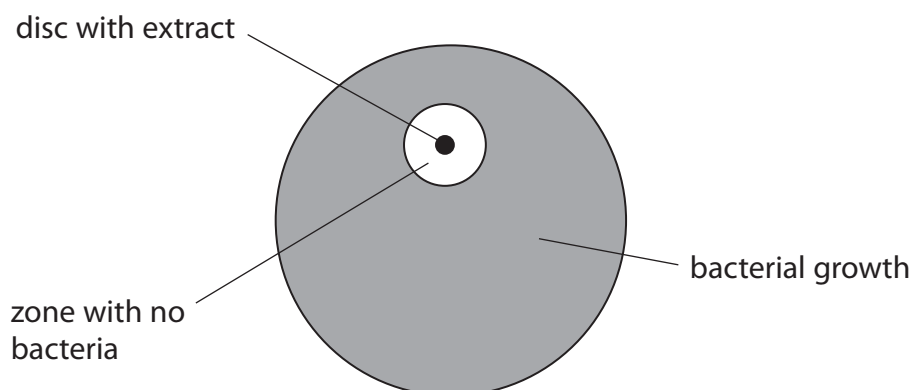
A control disc was added to each plate.

The diagram shows one agar plate after this procedure was completed.



These plates were kept at 5 °C for two hours, and then incubated at 30 °C for 24 hours.

The diagram shows a typical result for one disc.



After this time, the antimicrobial effect was assessed by determining the area of the zone with no bacteria (zone of inhibition).

(a) (i) State the dependent variable in this investigation.

(1)

(ii) Suggest why the plates were kept at 5 °C, before they were incubated.

(1)

BLANK PAGE
QUESTION 2 CONTINUES OVERLEAF

(iii) Describe how the area of a zone of inhibition could be determined.

(2)

.....

.....

.....

.....

.....

.....

(iv) Describe the control disc used in this investigation.

(2)

.....

.....

.....

.....

(b) The table shows the results of this investigation.

Plant extract	Area of zone of inhibition / mm ²	
	Bacteria type A	Bacteria type B
clove	196	111
cumin	71	0
ginger	186	0
pomegranate	269	158
thyme	243	0

- (i) Calculate the percentage difference between the inhibitory effect of clove extract on type **A** and type **B** bacteria.

(2)

Answer%

- (ii) Plot a suitable graph to show the results of this investigation.

(5)



(iii) Comment on the results of this investigation into the preservation of food using plant extracts.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(c) This method can be used to suggest that an extract has an antimicrobial effect. Other factors can affect the size of the zone of inhibition.

State **two** factors, other than the antimicrobial effect, that could affect the area of the zone of inhibition in this investigation.

(2)

1

.....

2

.....

(Total for Question 2 = 18 marks)

TOTAL FOR PAPER = 40 MARKS

Mark Scheme (Results)

EPSOM SIXTH FORM SCH. PAPER SAMPLE

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	concentration of detergent		(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	An answer that includes two of following: - temperature (1) - pH (1) - volume of detergent solution (1)		(2)

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	temperature: - thermostatically controlled water bath / incubator/ac room/environmental chamber (1) volume of detergent solution: - appropriate measuring device (1) pH: - use of buffer (1)	ACCEPT answers from 3(a)(ii)	(1)

Question Number	Answer	Additional Guidance	Mark
1(a)(iv)	An explanation that includes the following points: • in order to avoid (physical/more) damage to the discs/membranes/cells (1) • which would cause more pigment release (1) • causing the results to be invalid (1)		(2)

Question Number	Answer	Additional Guidance	Mark
1(a)(v)	An explanation that includes the following points: • to calculate standard deviation / measure reliability / variability (1) • to identify anomalies (1)		(2)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	• to allow any pigment leakage that is not due to detergent to be measured / as a control / for comparison / the reading of 0% detergent is not 100% / only 97% (1)		(1)

Question Number	Answer	Additional Guidance	Mark
1(b)(ii)	A graph showing the following features: • A axes correctly orientated and linear (1) • L axes correctly labelled, (x – concentration of detergent solution, y - Mean percentage of light transmitted (through the solution) and with units (1) • P correct plotting (1) • S points joined with straight lines (1)		(4)

Question Number	Answer	Additional Guidance	Mark
1(b)(iii)	An explanation that includes three of the following points: - the discs (that were in the detergent) will continue to lose pigment as membrane (permanently) damaged (1) - the discs that were in 0.0% detergent solution will have no loss of pigment as the membranes were not damaged (1) - discs will lose pigment more slowly/stop because there is less/no pigment left in the beetroot (1) - discs which were in higher concentrations of detergent will have slowest rate of loss, because they have the least pigment left (1)	Accept reverse argument	(3)

Question Number	Answer	Additional Guidance	Mark
1(b)(iv)	An answer that includes three of the following points: similarities: • both cause pigment leakage (1) differences: • temperature leads to a greater pigment leakage than detergent (1) • temperature effect on pigment release is sudden above 40/ non-significant below 40 but detergent effect is gradual across the range (1)	ACCEPT answers in terms of light transmission IF link between this and pigment release is made clear	(3)

Question Number	Answer	Additional Guidance	Mark
1(b)(v)	An answer that includes the following points: • would be 25% • from the graph at 60 and 70 / after 60 transmission is same / has levelled off (1) • because all pigment has leaked out/there is an equilibrium (when graph levels off) (1)		(3)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	area of zone {with no bacteria / of inhibition}		(1)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	to allow (chemicals in the extract) to diffuse into agar / to stop growth of bacteria (1)		(1)

Question Number	Answer	Additional Guidance	Mark
2(a)(iii)	An description that includes the following points: - measure {diameter / radius} of zone (1) - apply $\text{area} = \pi r^2$ (1) OR - place dish on {gridded / graph} paper (1) - count squares (1)	ACCEPT $\pi(d/2)^2$ ACCEPT $r = d \div 2$ ACCEPT cut out and weigh	(2)

Question Number	Answer	Additional Guidance	Mark
2(a)(iv)	An answer that includes the following points: • filter paper discs qualified (1) • (soaked in) {solvent / water} (1)	e.g. size, paper type, thickness, same as ones used	(2)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	An answer showing the following steps: • difference calculated (1) • percentage calculated (1)	Correct answer with no working shown gains two marks • 196-111 or 85 (1) • $85 \div 111 = 76.57 / 76.6$ / $85 \div 196 = 43.4 / 43.37$ (1)	(2)

Question Number	Answer	Additional Guidance	Mark																		
2(b)(ii)	A graph showing the following features: • A bar chart (1) • L axes correctly labelled, and with units (mm²) (1) • P correct plotting (1) • K key or labels to show type A and type B bacteria results (1) • S suitable linear scale for area starting at zero with no interruption (1)	area of zone of inhibition / mm² A B <table><thead><tr><th>Species</th><th>Type A (mm²)</th><th>Type B (mm²)</th></tr></thead><tbody><tr><td>clove</td><td>195</td><td>110</td></tr><tr><td>cumin</td><td>70</td><td>0</td></tr><tr><td>ginger</td><td>185</td><td>0</td></tr><tr><td>pomegranate</td><td>270</td><td>160</td></tr><tr><td>thyme</td><td>240</td><td>0</td></tr></tbody></table>	Species	Type A (mm ²)	Type B (mm ²)	clove	195	110	cumin	70	0	ginger	185	0	pomegranate	270	160	thyme	240	0	(5)
Species	Type A (mm ²)	Type B (mm ²)																			
clove	195	110																			
cumin	70	0																			
ginger	185	0																			
pomegranate	270	160																			
thyme	240	0																			

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	An answer that includes three of the following points: • cumin is the least effective extract to use (1) • pomegranate is the most effective extract to use (1) • cumin, thyme, and ginger cannot be used to preserve food against type B (1) • type B is more difficult to control (1)	ACCEPT against Type A ACCEPT pomegranate and clove can be used against B ACCEPT converse / A inhibited by all	(3)

Question Number	Answer	Additional Guidance	Mark
2(c)	An answer that includes two of the following points: • {solubility / concentration / volume} of extract / solvent used (1) • size of molecules in the extract (1) • rate of diffusion of extract into agar (1)	ACCEPT antimicrobial	(2)