8ᵗʰ International Junior Science Olympiad
Durban, South Africa

Experimental Examination: Practical 1
Model Answer

7 December 2011

TO DETERMINE THE EFFECT OF CHEMICALS AND TEMPERATURE ON MEMBRANE DESTRUCTION AND PERMEABILITY IN BEETROOT (*Beta vulgaris*)

SECTION A

  a. State whether the following statements are true or false by ticking the appropriate box.

	TRUE	FALSE
1. Betacyanin is not soluble in water. **0.25 mark**		☐
2. Betacyanin is soluble in organic solvents only. **0.25 mark**		☐
3. Damaged cells were empty of betacyanin after repeated washing, and no further cell membrane damage occurred. **0.25 mark**	☐	

(0.25 x 3 = 0.75 marks)

  b. Choose the correct answer by ticking the appropriate box.

TT1☐	TT2	TT3	TT4

(0.5 mark)

  c. Choose the correct answer by ticking the appropriate box.

TT2☐	TT3

(0.5 mark)

  d. Choose the correct answer by ticking the appropriate box.

Upper

Lower   **(0.5 mark)**

  e. State whether the following statements are true or false by ticking the appropriate box.

8th International Junior Science Olympiad   Name:_____

Durban, South Africa   Seat Number:_____
Experimental Examination: 7 December 2011
Biology Answer Sheet
                            Page 2

	TRUE	FALSE
1. The cell membranes in TT1 were not further disrupted.	☐	
2. Cyclohexane damaged the cell membranes in TT4, causing betacyanin to leak out.	☐	
3. Cyclohexane dissolved the lipids in the cell membranes in TT4, causing betacyanin to leak out, which dissolved in the water only.	☐	

(0.5 x 3 = 1.5 mark)

SECTION B

f.

    i.   Draw a table to show the mean absorbance **(to 2 decimal places)** at each temperature and record it in the space provided below.

(0.25 x 5 = 1.25 marks)

Temperature (^{0}C)	Mean
20	0.02
30	0.02
40	0.03
60	0.45
80	0.50

    ii.   Write your answer in the box below.

8ᵗʰ International Junior Science Olympiad   Name:_____

Durban, South Africa   Seat Number:_____
Experimental Examination: 7 December 2011
Biology Answer Sheet
                              Page 3

(0.5 mark)

    iii.   Draw a line graph on the graph paper provided using the mean
absorbance to show the effect of temperature on membrane
permeability in beetroot.

(2.5 marks)

SECTION C

g. Write T or F in the box provided.

    i.   Betacyanin requires water for maximum solubility

    ii.   Betacyanin is more soluble in 100% acetone than in 50% acetone

(0.5 x 2 = 1 mark)

h. Choose the correct answer by ticking the appropriate box/es.

Cyclohexane	☐Room temperature water	☐Hot water

(0.5 mark)

SECTION D

8th International Junior Science Olympiad　　　　Name:_____

Durban, South Africa　　　　　　　　　　　　Seat Number:_____
Experimental Examination: 7 December 2011
Biology Answer Sheet
Page 4

i. Record the masses of the 2 cylinders (TT5 and TT6) in the table below.

	Initial Mass	**Final Mass**	
TT5			
TT6			

(0.25 x 6 = 1.5 marks)

j. Indicate whether the following statements are true or false by ticking the appropriate box.

	TRUE	**FALSE**
i.　NaCl caused plasmolysis in the beetroot cells.	☐	
ii.　NaCl dissolved the lipids in the cell membranes.		☐
iii.　The beetroot cells absorbed NaCl and became turgid.		☐
iv.　The beetroot cells lost betacyanin to the surrounding water.	☐	

(0.5 x 4 = 2 mark)

Figure 1: Effect of temperature on membrane permeability in beetroot

Mark scheme	
0.25	For each plotted point = 1.5
0.25	For each correct axis label = 0.5
	Scale = 0.5
~~0.25~~	~~For caption = 0.25. No penalty if Figure 1 is not written. Must have caption.~~

TOTAL MARK (13)

8th International Junior Science Olympiad
Durban, South Africa

Experimental Examination: Practical 2
Answer Sheet

7 December 2011

Complete the following:

NAME:	
SEAT NO.:	
COUNTRY:	
SIGNATURE:	

This answer sheet consists of 6 pages. Please ensure you have them all.

8th International Junior Science Olympiad
Durban, South Africa
Experimental Examination: 7 December 2011
Practical 2 Answer Sheet

Name:_____
Seat Number:_____

Page 2

DATA TABLE

Record as many data points as necessary.

Time/s	Temperature/°C	
	Ethanol	*Biodiesel*

[2.0 marks]

8ᵗʰ International Junior Science Olympiad
Durban, South Africa
Experimental Examination: 7 December 2011
Practical 2 Answer Sheet

Name:_____

Seat Number:_____

Page 3

DATA PAGE

	Part 1: Ethanol	Part 2: Biodiesel
Initial mass of fuel + oil lamp	g	g
Final mass of fuel + oil lamp	g	g
Mass of fuel burned **[0.5 mark]**	g	g
Mass of stainless steel cup and water	g	g
Mass of empty stainless steel cup	g	g
Mass of water heated **[0.5 mark]**	g	g
Final temperature, t_2	°C	°C
Initial temperature, t_1	°C	°C
Temperature change, Δt **[1 mark]**	°C	°C

Heat, q **[2.0 marks]**	kJ	kJ
Heat of combustion, in kJ g⁻¹ **[1.0 mark]**	kJ g⁻¹ ethanol	kJ g⁻¹ biodiesel
% efficiency **[1.0 mark]**	%	%

8th International Junior Science Olympiad   Name:_____
Durban, South Africa   Seat Number:_____
Experimental Examination: 7 December 2011
Practical 2 Answer Sheet

Page 4

QUESTIONS

1. Give a balanced equation for the complete combustion of biodiesel (use the following formula for biodiesel: $C_{19}H_{34}O_2$).

Balanced Equation	$2C_{19}H_{34}O_2 + 53O_2 \rightarrow 34H_2O + 38CO_2$

0.25   0.25   0.25   0.25

[1.0 Marks]

2. Based on your results, which fuel produces more energy per gram burned?

BIODIESEL or whatever is correct from the results

[0.25 Marks]

3. Which of the following causes the largest error:

  a. Heat lost to the surroundings.

  b. Heat gained by the stainless steel cup.

  c. Condensation on the stainless steel cup.

  d. Evaporation of the water.

[0.25 Marks]

Letter of answer:	a

8th International Junior Science Olympiad   Name:_____
Durban, South Africa   Seat Number:_____
Experimental Examination: 7 December 2011
Practical 2 Answer Sheet

Page 5

4.   Consider the following two statements:

     I.   Incomplete combustion of reactants can form soot.

     II.   Incomplete combustion of reactants can form carbon monoxide.

     Select the correct option.

     a.   Both the statements in I and II are true.

     b.   Both the statements in I and II are false.

     c.   Only statement I is true.

     d.   Only statement II is true.

[0.5 Marks]

Letter of answer:	a

Accuracy mark

Ethanol		Biodiesel	
Range	Mark	Range	Mark
9.20 - 9.60	0.5	11.80 - 12.30	0.5
8.80 - 9.19	1	11.30 - 11.79	1
8.40 – 8.79	2	10.80 – 11.29	2
8.00 – 8.39	2	10.30 – 10.79	2
7.60 – 7.99	1	9.80 – 10.29	1
7.20 – 7.59	0.5	9.30 – 9.79	0.5