VILNIUS 2012

24th of April 2012

Experiment 1

Answer Sheets

$Country

Team $A

Amber

Names and signatures

_____

_____

_____

TASK 1: Identification of arthropods

Task 1.1.1. Use the "Key to arthropods" to identify the samples in each plate. (5.6 pts)

Plate Nr.	Write down the number from the key that corresponds to each step. (write numbers that you follow through the key, like 1, 28, 48 and so on)																	
1.																		
2.																		
3.																		
4.																		
5.																		
6.																		
7.																		

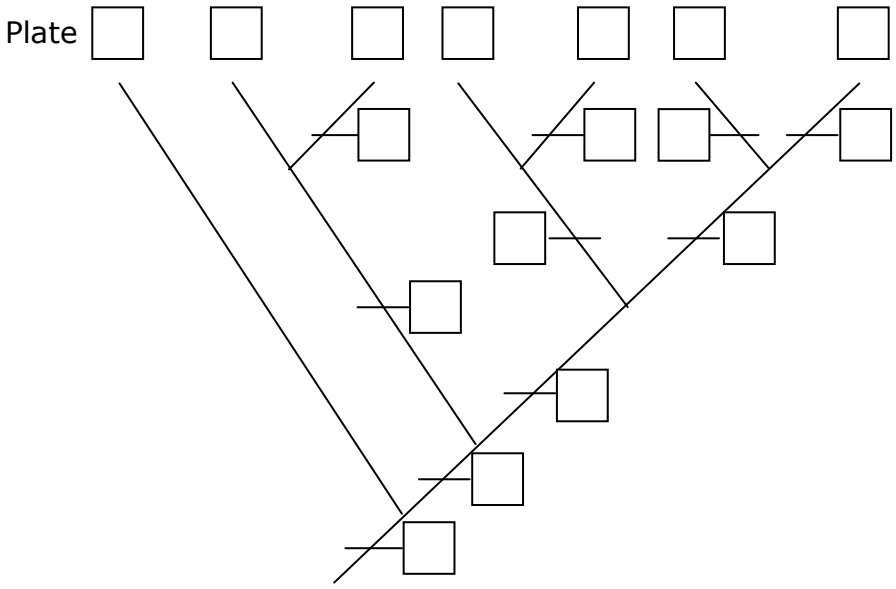
Task 1.1.2. Name the arthropod that you have identified in each plate**.** Write down the name of the arthropod for each of the seven plates: (7 pts)

Plate number	Name of the arthropod in Latin based on the key
1	
2	
3	
4	
5	
6	
7	

Task 1.2.1. Indicate the correct character states (0 or 1). (7 pts)

Arthropods from:	Characters									
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**
Plate 1.										
Plate 2.										
Plate 3.										
Plate 4.										
Plate 5.										
Plate 6.										
Plate 7.										

Task 1.2.2. Put all the letters of characters (A to J) in appropriate places on the given tree (as shown in the example in Fig. 5). Write the respective plate number (1-7) at the end of each branch. (4.9 pts)



Task 1.2.3. (0.5 pts)

Number of the plate: _____

End of **TASK 1** answers.

TASK 2: Colour and intensity of colour measurements

Task 2.1.1. Calculate the volumes of petroleum ether and ethyl acetate needed to prepare 5 ml of the following eluents (1 pt):

v : v ratio (petroleum ether : ethyl acetate)	$V_{petroleum\ ether}$, mL	$V_{ethyl\ acetate}$, mL
9:1		
3:1		

Task 2.1.2. Calculate the R_f values for every spot in each of the TLC plate. Show your calculations. (2 pts)

	9:1	3:1	"Eluent"
R_f(yellow)			
R_f(red)			

Task 2.1.3. Finish the sketch of the TLC plate, which was developed using mobile phase from the flask "Eluent". (1 pt)

Task 2.1.4. What is the concentration of ethyl acetate in the flask "Eluent"? (Circle the correct answer)(1 pt)

a) 0-10% b) 10-25% c) 25-40% d) 40-70% e) 70-100%

Task 2.1.5. What are the minimum and maximum values for R_f? (Circle the correct answer) (1 pt)

a) -∞; 0 b)-∞; 1 c) 0; 1 d) 0; +∞ e) -∞; +∞

Task 2.1.6. What is the most suitable eluent for separation of the mixture in thin layer chromatography? (Circle the correct answer) (1 pt)

a) giving both R_f values as high as possible

b) giving both R_f values as low as possible

c) giving the sum of R_f values equal to 1

d) giving the highest difference between R_f values

e) giving the difference between R_f values smaller than 0.10

Task 2.2. The effectiveness of your colorant separation will be evaluated for maximum 7 pts.

Task 2.3.1. Complete the table. (3 pts)

Yellow colourant			
Volume of collected fraction (from **Task 2.2**)			V_1 =
Experiment number	V_{min}	V_{max}	$V_2 = \frac{V_{max} + V_{min}}{2}$
1			
2			
3			
4			
5			
The value you choose to use in future calculations			V_2 =

Task 2.3.2. Calculate the quantity of the yellow colourant in the analyzed mixture in milligrams. (1.5 pts)

Calculations   Answer: m_{yellow} =

Task 2.3.3. Complete the table. (3 pts)

Red colourant			
Volume of collected fraction (from **Task 2.2**)			V_1 =
Experiment number	V_{min}	V_{max}	$V_2 = \frac{V_{max} + V_{min}}{2}$
1			
2			
3			
4			
5			
The value you choose to use in future calculations			V_2 =

Task 2.3.4. Calculate the quantity of the red colourant in the analyzed mixture in <u>milligrams</u> (1.5 pts)

Calculations Answer: m_{red} =

Task 2.4.1. Use the given formulas and chromatographic results plotted in Fig. 10 to calculate N values. (2 pts)

Calculations
Answer: N_1= N_2=

End of **TASK 2** answers.

TASK 3: The density distribution of amber

Task 3.1.1. The total mass of NaCl in initial solution (c_1 = 13.0 %) in terms of V_1, ρ_1, and $c_1$is (write the equation) (1 pt):

m_{NaCl} =

Task 3.1.2. The mass of water m_w in initial NaCl solution in terms of V_1, ρ_1, and c_1 is (write the equation) (1 pt):

m_W =

Task 3.1.3. The total mass of mixed solution of fluids V_1 and V_0 in terms of V_0, V_1, ρ_0, and ρ_1 is (write the equation) (1 pt):

m =

Task 3.1.4. Mass concentration in mixed solution of fluids V_1 and V_0 in terms of V_0, V_1, ρ_0, ρ_1, and c_1 is (write the equation) (1 pt):

c =

Task 3.1.5. Ratio of volumes V_0 and V_1 as a function of c (use ρ_0, ρ_1, and c_1) is (2 pts):

$$\frac{V_0}{V_1} =$$

Task 3.1.6. Ratio of volumes V_0 and V_1 as a function of ρ (use the densities ρ_0, ρ_1, and ρ) is (3 pts):

Note: use the fact that density linearly depends on concentration, see in Fig. 11

a) $\frac{V_0}{V_1}$ =

Express V_1 in terms of V_0, ρ_0, ρ_1, and ρ.

b) V_1 =

Task 3.1.7. Making the corresponding measurements prepare solutions, count the newly surfaced pieces of amber and fill in **Table 3.1.** (5.5 pts)

TABLE.3.1.

Number of Amber Pieces: _____

Density of solution (g/cm^3) (ρ)	Recommended volume of distilled water (ml) (V_0)	Volume of NaCl 13.0 % solution (ml) (V_1)	The number of newly surfaced pieces of amber (n)	The percentage of newly surfaced pieces of amber of the total number (%)
1.030	80			
1.035	70			
1.040	60			
1.045	60			
1.050	50			
1.055	50			
1.060	40			
1.065	40			
1.070	30			
1.075	30			
1.080	20			
1.085	15			
1.090	10			

1.095	5			
1.100	0			

Task 3.1.8. Draw a bar chart $n(\rho)$ in percentage assuming that the 1st bar corresponds to the density interval from 1.030 g/cm^3 to 1.035 g/cm^3, the 2nd bar corresponds to the density interval from 1.035 g/cm^3 to 1.040 g/cm^3 and so on. The bar height should be equal to the number of corresponding newly surfaced amber pieces expressed as a percentage of the total number of amber pieces (the height of the 1st bar should correspond to the value in the cell of the last column in the 2nd measurement data row of Table 3.1., the height of the 2nd bar should correspond to the last column of the 3rd measurement data row and so on). (5 pts)

Do not forget to include the chart with your Answer Sheet!

Task 3.1.9. Of the investigated pieces of amber**,** determine the density interval within which the number of the newly surfaced pieces of amber was the highest.

(1.5 pt):

…….< ρ_{amber} <…….

Task 3.1.10. The sphere shaped "Sun Stone" has (3 pts):

volume V=

and density

ρ_{amber}=

Task 3.1.11. According to the experiment, please, explain: "Why does amber found in the sea usually have an irregular shape, compared to other stones which look more rounded and polished?" **Circle the correct answer**. (1 pt)

a) Amber is buoyant in salt water;

b) Amber is cut off the big piece;

c) The stones having considerably higher density are much heavier in water in comparison to amber;

d) Stones are intensely etched in salt water while amber is not.

End of **TASK 3** answers.

Task 4: Amber evaluation catalogue

Task 4.1.1. Derive the formula for initial amber value (in swords). (1 pt.)

Amber evaluation table according to mass

Mass of amber (g)	Initial amber value (swords, spears and arrows)
1 g	1 arrow
5 g	2 spears and 5 arrows
10 g	1 sword
15 g	2 swords, 2 spears and 5 arrows
Initial amber value (in swords) is calculated by formula:	

Task 4.1.2. According to the results, obtained in **Task 2**, calculate "Sun Stone" coefficient value with regard to colour tone, using the table below. (1 pt.)

Amber evaluation tables according to colour tone

Colour tone (m_{red}/m_{yellow})	Coefficient
∞	2.00
3	1.75
1	1.50
1/3	1.25
0	1.00
m_{red}/m_{yellow}: Coefficient:	

Task 4.1.3. Assuming that the colorant mixture for Column Chromatography was obtained from a 1 g sample of "Sun Stone", calculate the coefficient value with regard to colour intensity. You will need to use your data from **Task 2** and the data below. (1 pts)

Amber evaluation table according to intensity

Colour intensity $((m_{red}+m_{yellow})/m_{amber})$	Coeficient
0.0010	0.10
0.0025	0.25
0.0050	0.50
0.0075	0.75
0.0100	1.00
$(m_{red}+m_{yellow})/m_{amber}$: Coefficient:	

Task 4.1.4. What is the percentage value loss of the "Sun Stone" according to its density distribution?

Use the density value of the "Sun Stone" from **Task 3.1.10** and find the corresponding percentage according to the density distribution in **Table 3.1** of **Task 3.1.7** or the chart from **Task 3.1.8**. This percentage would be the reduction in the value of the "Sun Stone". (0.25 pts)

Value in %:

Task 4.1.5 It was found that "Sun Stone" contains inclusions, the same that you determined to be the most valuable in **Task 1.2.3.** Calculate what additional value (in swords, spears and arrows) the most valuable inclusion adds to total price. (0.25 pts)

Name of inclusion (from **Task 1.2.3**):
_____
Additional value in swords, spears and arrows:
_____

Added value of amber according to the type of inclusion

	Name of inclusion	Added value
1.	Coleoptera	5 swords
2.	Psocoptera	6 swords, 3 spears
3.	Aphidoidea	7 swords, 6 arrows
4.	Dolihopodidae	8 swords
5.	Trichoptera	10 swords, 5 spears and 5 arrows
6.	Lepidoptera	15 swords, 8 spears
7.	Simuliidae	17 swords, 6 arrows
8.	Hemiptera	20 swords, 9 arrows
9.	Trichoceridae	27 swords, 3 spears
10.	Orthoptera	30 swords, 5 spears and 7 arrows
11.	Empididae	35 swords, 6 spears and 1 arrow
12.	Ephemeroptera	41 swords, 2 spears and 2 arrows
13.	Culicidae	48 swords, 4 spears and 4 arrows
14.	Bibionidae	52 swords, 1 spear and 7 arrows
15.	Mantodea	63 swords, 3 spears and 5 arrows
16.	Embioptera	68 swords
17.	Syrphidae	70 swords, 6 arrows
18.	Plecoptera	84 swords, 2 spears and 3 arrows
19.	Psychodidae	103 swords, 1 spear and 1 arrow
20.	Pollenia	120 swords, 9 spears and 7 arrows
21.	Chilopoda	121 swords, 3 spears and 4 arrows
22.	Strepsiptera	123 swords, 2 spears
23.	Siphonaptera	125 swords, 5 spears and 5 arrows
24.	Solpugida	128 swords, 6 arrows
25.	Isopoda	131 swords, 1 spear and 2 arrows

Task 4.1.6. Calculate the hypothetical value of "Sun Stone" in the Phoenician market (in swords, spears and arrows). Always use the value derived from previous row to calculate the value in the next row. Show your calculations. (1.5 pts)

Initial value of "Sun Stone" according to mass	
Specified "Sun Stone" value according to colour tone	
Specified "Sun Stone" value according to colour intensity	
Specified "Sun Stone" value according to its density	
The final value of "Sun Stone" taking into account the additional value of inclusion	

End of **Task 4** Answer Sheet