

TASK 1

ICE

ANSWER SHEET



COUNTRY:

Team:

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Experiment 1

32 marks

1.1

8 marks

1.1.1

T_w	
ρ_w	

1.1.2

m_{w+g}	
D_{ice}	
H_{ice}	
$m_{g+w+ice}$	
$m_{g+w+ice+force}$	

1.1.3

V_{ice}	
m_{ice}	
ρ_{ice}	
ρ'_{ice}	

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1.1.4

$\rho'_{ice} - \rho_{ice}$	
$\Delta m_{g+w+ice+force}$	
$\Delta \rho'_{ice}$	
ΔV_{ice}	
$\Delta \rho_{ice}$	

1.2

1.2.1

2.5 marks

Based on the pressure equation and Figure 1.2, answer if the following sentences are true or false.	True	False
$p(z)$ depends on only the depth z .		
At very large depths $p(z)$ is mostly a function of depth z .		
At sufficiently large depths, the pressure $p(z)$ is roughly a linear function of depth.		
$p(z)$ is independent of depth z .		
$p(z)$ is independent of the cross-sectional area of the column, A .		

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1.2.2

1.5 marks

Calculate the pressure of the ice at the following depths. (remember to show the steps of your calculation)

Depth, z [m]	Density ρ [kgm ⁻³]	Pressure P [kPa]
0		
80		
160		
1000		

1.2.3

2 marks

Calculate the mass of a drilled ice core from the depths:

Depth z [m]	Mass m [kg]
80	
160	

1.2.4

2 marks

Calculate the mass of an ice core drilled with the big drilling machine at the depths:

Depth z [m]	Mass m [kg]
1000	
2000	

1.3

1.3.1

2 marks

➤ Attach "Graph 1.3.1" to the Answer sheet.

1.3.2

2 marks

➤ Attach "Graph 1.3.2" to the Answer sheet.

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1.3.3

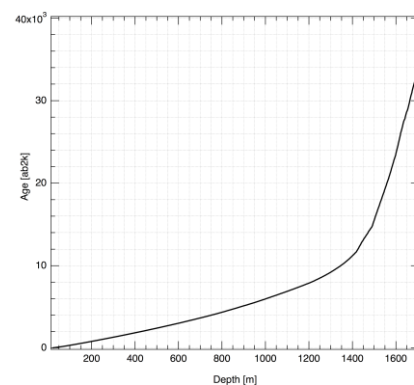
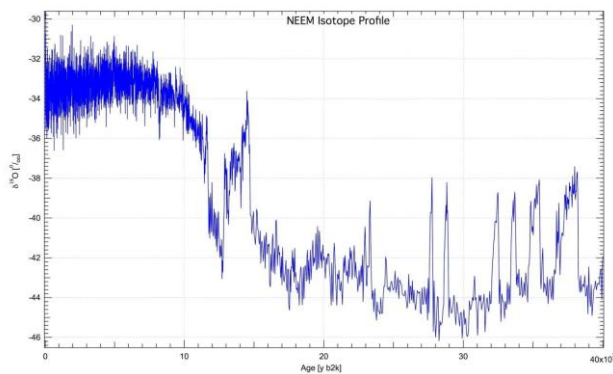
5 marks

Depth z [m]	$1/\lambda$ [m^{-1}]	Age [yr]
0		
500		
1200		
1400		
1500		

1.3.4 Age of samples

3 marks

Age of sample 1	
Age of sample 2	
Isotopic composition ($\delta^{18}\text{O}$) of sample 1	
Isotopic composition ($\delta^{18}\text{O}$) of sample 2	



Tick the correct answer	Sample 1	Sample 2
Which of the two samples do you think originates from a time when climate was significantly colder than present?		

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1.3.5

2 marks

Use the two equations to calculate the temperature above the ice cap at the time of deposition for the two samples you were given. What is the difference in temperature between the two samples?

	Temperature using linear equation [°C]
Sample 1	
Sample 2	
Difference between sample 1 and sample 2	

	Temperature using quadratic equation [°C]
Sample 1	
Sample 2	
Difference between sample 1 and sample 2	

1.3.6

1 mark

Proceed with the sample transfer. Label the sample vials carefully and place them in the tray given to you. Your samples will be analysed with a Cavity Ring Down Laser Spectrometer overnight in order to assess the quality of your work.

<p>➤ <i>Call a lab assistant and hand in your prepared sample.</i></p>
--

Lab assistant's signature

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1.3.7

1 mark

Answer with True/False the four statements given below.

	True	False
The time that a sample is exposed to lab air can affect the quality of the measurement.		
Only one pipette should be used for the transfer of both samples.		
Keeping the samples as cold as possible helps minimizing isotopic fractionation.		
The exact quantity of water transferred to the sample vials is critical for the quality of the isotopic analysis.		

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Experiment 2

32 marks

2.1

4 marks

	1	2	3	$V_{1,av}$
V_1 (mL)				

2.2

2 marks

In the analysis solution (Cu/Zn), calculate $[Zn^{2+}]$ from the value of $V_{1,av}$. Show your calculation and write the result.

Result: $[Zn^{2+}] =$

2.3

1 mark

The complex $Cu(S_2O_3)_2^{3-}$ does not react with H_2edta^{2-} because:

Answer	True	False
The complex is colourless		
Copper has changed oxidation state by the reaction with $S_2O_3^{2-}$		
The complex $Cu(S_2O_3)_2^{3-}$ is very stable		

2.4

2 marks

Equation:	Result:
$[H_3O^+] =$	$[H_3O^+] =$
pH =	pH =

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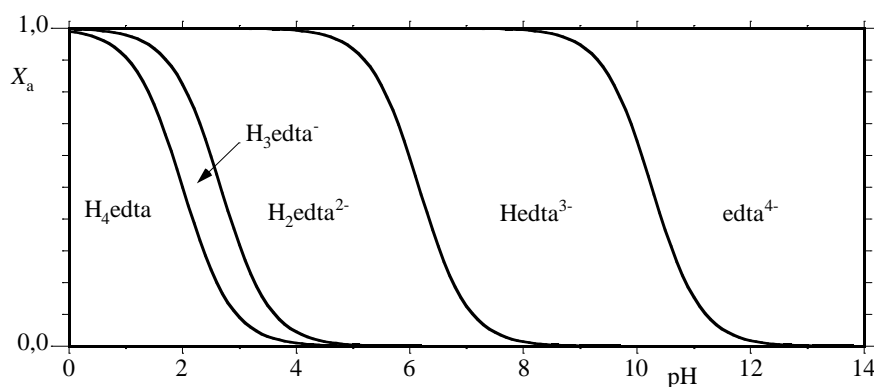
2.5

2 marks

An aqueous solution of $\text{Na}_2\text{H}_2\text{edta} \cdot 2\text{H}_2\text{O}$ will be:

☐ acidic ☐ neutral ☐ basic (tick the correct answer)

Justify the answer by a marking on the pH axis on the figure below.



2.6

3 marks

Solution	Volume of 0.0360 M $\text{Cu}(\text{ClO}_4)_2$ (mL)	$[\text{Cu}(\text{NH}_3)_4^{2+}]$ (M)	A_{618}
1	0.00	0	0
2	5.00		
3	10.00		
4	15.00		
5	20.00		
6	25.00		

2.7

1 mark

The absorbance A_{618} of solution 7

$A_{618} =$

➤ Attach "Graph 2.7" to the answer sheet.

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2.8

6 marks

Calculate the slope and y-intercept for the best straight line:

2.9

2 marks

Calculate the molar absorption coefficient, ϵ , for $\text{Cu}(\text{NH}_3)_4^{2+}$ at $\lambda = 618 \text{ nm}$

Equation: $\epsilon(\text{Cu}(\text{NH}_3)_4^{2+}) =$

Result: $\epsilon(\text{Cu}(\text{NH}_3)_4^{2+}) =$

2.10

2 marks

Calculate $[\text{Cu}^{2+}]$ in the analysis solution (**Cu/Zn**)

Equation: $[\text{Cu}^{2+}] =$

Result: $[\text{Cu}^{2+}] =$

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2.11

2 marks

After the addition of a few drops of the ammonium/ammonia buffer solution to the analysis solution (**Cu/Zn**) a precipitate is formed because of the formation of (answer with chemical formula or formulae):

Reaction scheme:

2.12

4 marks

Calculate the content of Cu^{2+} and Zn^{2+} in pg/g in the ice core ($1 \text{ pg} = 10^{-12} \text{ g}$):

2.13

1 mark

The content of copper and zinc in the ice core can (mark the correct answer):

Statement	True	False
be related to Laki's eruption		

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Experiment 3

20 marks

Fill in one line below for each of the identified metazoans: Fill in the blanks with numbers from the left column of the Identification Key (Appendix A1), as well as the name of the animal group.

E.g.: → → → → →

→ → → → →

→ → → → →

→ → → → →

→ → → → →

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Experiment 4

26 marks

4.1

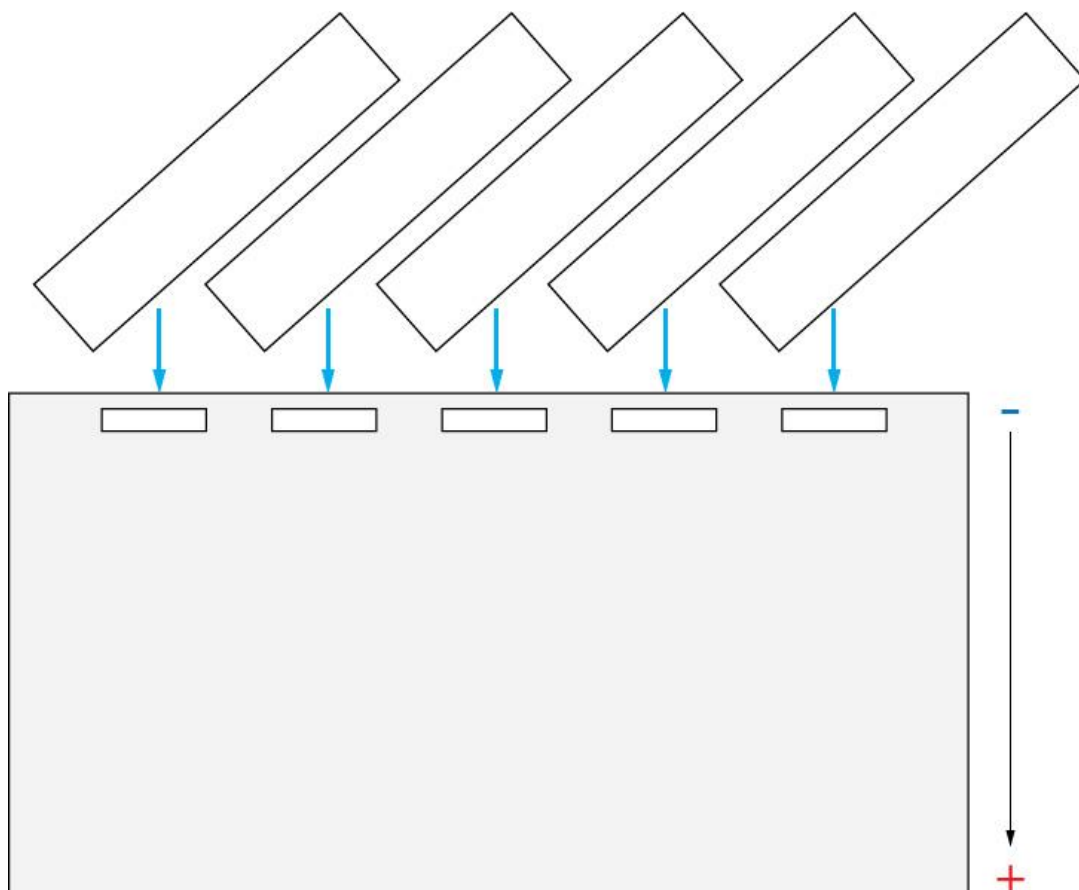
3 marks

	Letter corresponding to the correct word
Word 1	
Word 2 and 3	
Word 4 and 5	
Word 6	
Word 7	
Word 8	
Word 9	

4.2

3 marks

Write the names of the families you have analysed in the boxes and indicate if the family was present or not present in you sample. This is done by + (present) or – (not present) written on the gel under the name.



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4.3

3 marks

Are these statements true or false? Mark with an 'X'

Statements	True	False
No plants were present at the time.		
Only four families existed at the time.		
The winters were below -2°C and the summers were above 10°C .		
Only three families existed at the time.		
Nothing can be concluded about the temperature by information based on only the families.		
Greenland had a forest at the time.		

4.4

2 marks

Which families would be interesting to investigate for further analysis? Highlight your answer by drawing a ring around the names.

Taxaceae

Fagaceae

Pinaceae

Fabaceae

Betulaceae

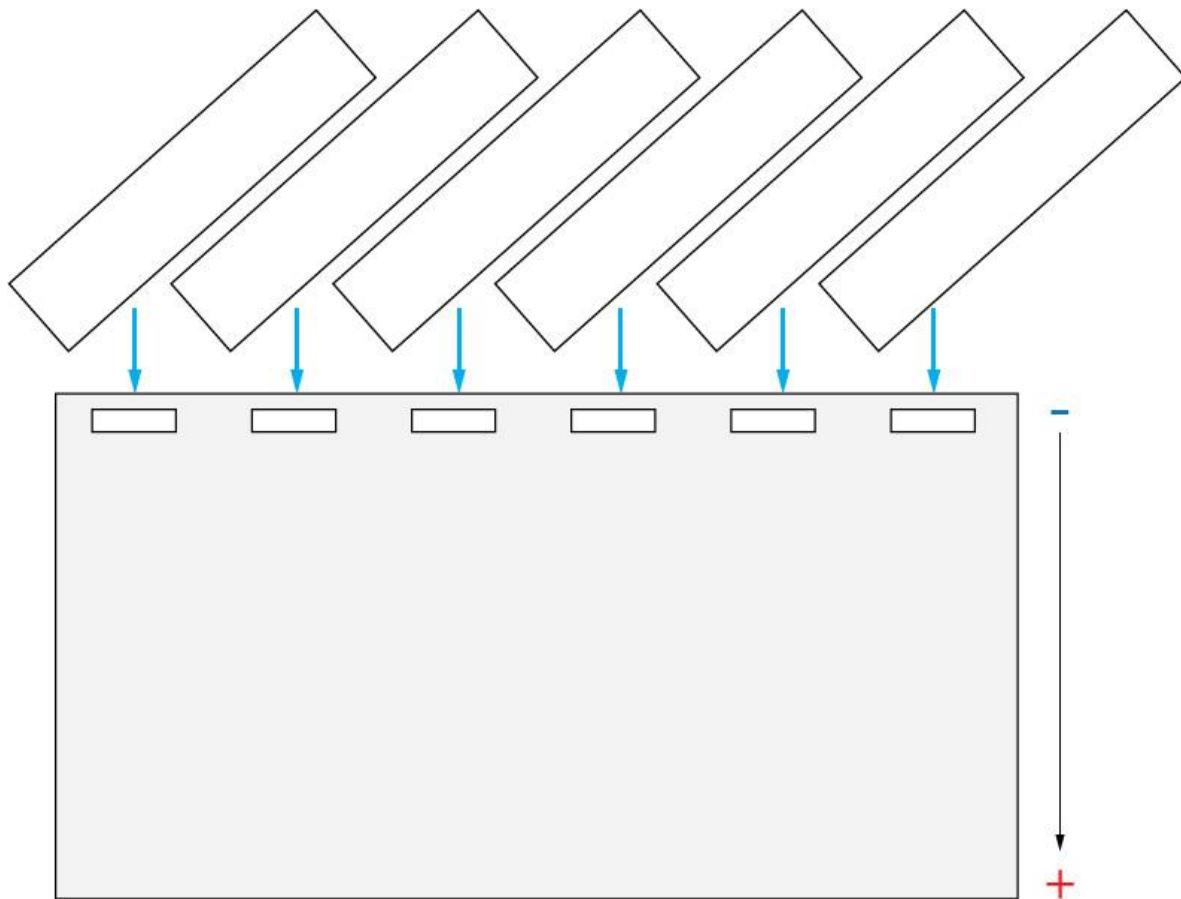
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4.5

3 marks

Write the names of the genera you have analysed in the boxes and indicate if the genus was present or not present in your sample. This is done by marking either + (present) or – (not present) written on the gel under the name.



4.6

2.5 marks

What did the ecosystem of the plant kingdom look like at that time? Tick the correct answer.

Statement	
Rainforest.	
Deciduous temperate forest.	
Mire (a wetland terrain without forest cover, dominated by living, peat-forming plants).	
Meadow (an open area with grassland).	
Boreal forest with a mix of conifers and deciduous trees.	

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4.7

2.5 marks

We want to be sure that the DNA from the basal ice samples are really representing the ancient ecosystems and not just contaminations from the air that was transported to Greenland from other areas through time. Where would you take control samples in the ice core to check for airborne exotic DNA?

Statement	True	False
In the centre of the glacial ice core and close to the basal ice where exotic plant DNA might have been incorporated together with air, airborne contaminants and snow.		
In the clean glacial ice much closer to the surface than to the basal ice.		
Only on top of the ice cap since this place is most likely to be contaminated.		
Atmospheric air samples since this is when the contaminants are.		
Atmospheric air samples and top of the ice cap since both contain the contaminants.		

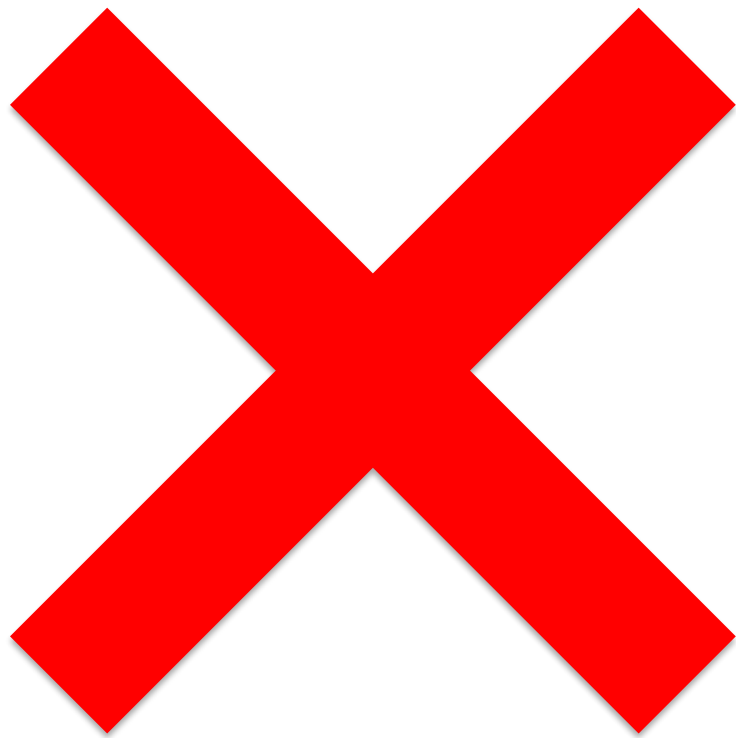
4.8

1 marks

From the indicator genera, make an analysis on what the climate most likely looked like at the time these organisms were living in Greenland – what are the upper and lower temperature boundaries? Use Appendix B.

Statement	True	False
Summers are more than 10 °C warm.		
Winters are down to -40 °C		
Winters are not colder than -17 °C		
Winters does not go below -1 °C		

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4.9

2 marks

Calculate possible RNA-combinations of the protein sequence based on differences in nucleotides. Show your calculations.

4.10

2 marks

Write the possible RNA-sequence for the protein-sequence.

4.11

1 mark

Write the specific primer that you would use for further analysis.

4.12

1 marks

Which of the following statements are correct? Tick your answers

Statement	True	False
Forest occurred in Greenland between 450,000 and 17.5 million years ago		
Forest occurred in Greenland between 450,000 and ca 800,000 years ago		
Forest in Greenland has only occurred in a time period younger than 450,000 years ago in the area of Dye-3		
Forest in Greenland occurred at a time between ca 800,000 and 17.5 million years ago		

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