

## Worksheet 2 “Caves and human”

### Exercise 1.

*Write proper cave types.*

**Keywords:** tectonic caves, reef caves, gypsum caves, erosion caves, volcanic caves

..... in Poland occur mainly in Nida Basin

Salt mines are examples of .....

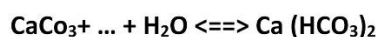
..... are places explored by divers

..... are formed in the forms of solidified lava

..... are formed as a result of tectonic movements

### Exercise 2.

*Look at the reaction below that is responsible for karst processes and then answer the questions.*



Name the compound missing from the chemical reaction

.....

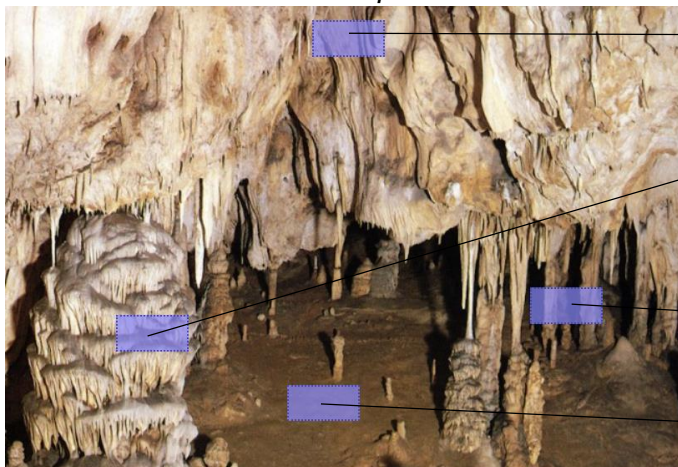
What are the names of the other chemical compounds in the reaction?

.....

.....

### Exercise 3.

*Give the forms shown in the picture the correct names.*







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Projekt EDU-ARCTIC 2: od badań polarnych do naukowej pasji - innowacyjna edukacja przyrodnicza w Polsce i Norwegii otrzymał dofinansowanie w wysokości ok. 240 000 EUR z Islandii, Liechtensteinu i Norwegii w ramach funduszy EOG. Celem projektu EDU-ARCTIC 2 jest: poszerzenie wiedzy o przyrodzie, geografii, zasobach naturalnych, specyfice politycznej dotyczącej regionów polarnych oraz zwiększenie świadomości w zakresie zagadnień środowiskowych i zmian klimatu, zwiększenie zainteresowania kontynuowaniem edukacji i kariery STEM dzięki zwiększeniu wiedzy o badaniach naukowych i ich miejscu we współczesnym świecie; przybliżenie młodym ludziom możliwości kariery naukowej; wprowadzenie innowacyjnych narzędzi i efektywnych metod nauczania przedmiotów ścisłych w szkołach.

Keywords: stalactites, stalagmites, stalagnates, rock pillar

#### Exercise 4.

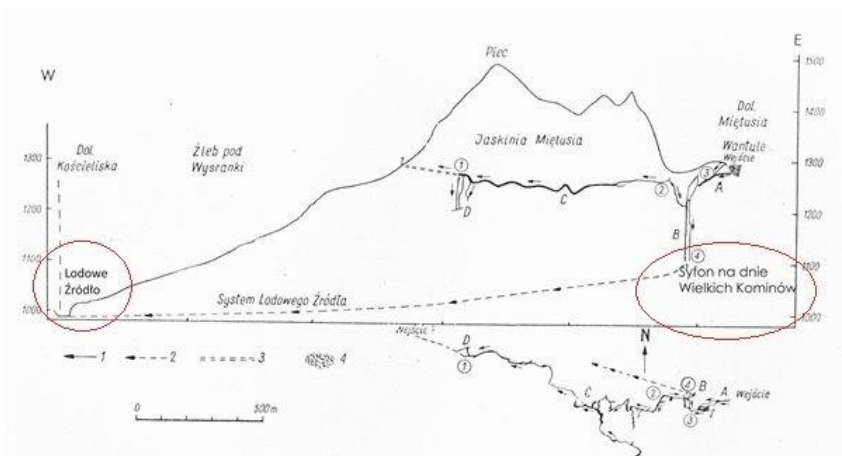
Look at the paintings below and then indicate where they came from.

Keywords: **A.** Cueva de las Manos, Santa Cruz, Argentina, **B.** Kakadu National Park, Australia, **C.** Lascaux, France, **D.** Leang Bulu Sipong, Celebes, Indonesia, **E.** Altamira, Spain



#### Exercise 5.

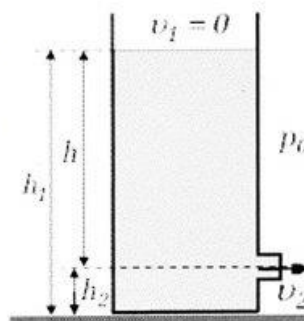
The outflow surface of Lodowe Źródło is at an elevation of 975 m above sea level. At low water level, the siphon level in the Wielkie Kominy is at 990 m above sea level, and the discharge rate is 200 l/s.



Bernoulli's law applies to the calculation of flows.

$$\frac{\rho \cdot v_1^2}{2} + \rho \cdot g \cdot h_1 + p_0 = \frac{\rho \cdot v_2^2}{2} + \rho \cdot g \cdot h_2 + p_0$$

$$\rho \cdot g \cdot h_1 = \frac{\rho \cdot v_2^2}{2} + \rho \cdot g \cdot h_2$$



**Key:**

$V_1$  - flow velocity at the upper surface of the reservoir (fall velocity)

$V_2$  - outflow velocity

$P_0$  - atmospheric pressure

$\rho$  - liquid density

$h$  - height difference between the liquid surface in the reservoir and the discharge axis

$h_1$  - height of liquid surface

$h_2$  - height of the drain axis

After assuming that the level in the vessel is constant, that the pressure at the inflow and outflow is the same and constant, as well as that the density of the fluid is constant and that the fluid is perfect (flow resistance is not considered), Bernoulli's law takes a form called Torricelli's law.

We assume that at low tide the water level in a vessel - a glacier mill, a cave chimney - is constant. We neglect the flow resistance at the section between the bottom of the well (outflow) and the spring. Then the outflow velocity is:

**Torricelli's law**

$$v_2 = \sqrt{2 \cdot g \cdot h}$$

Key:

$v_2$  – outflow velocity [m/s]

$g$  – standard gravity 9,81 m/s<sup>2</sup>

$h$  - the difference in elevation between the top level of the water in well and the level of the outlet

Assuming that the outflow follows Torricelli's law, the outflow velocity for a low water level is:

$$V = (2 \times 9.81 \times 15)^{1/2} = 17.16 \text{ m/s}$$

**Question:** What will be the discharge if the water level in the Wielkie Kominy is kept at 50 m above the level from the above calculation?

#### Exercise 6.

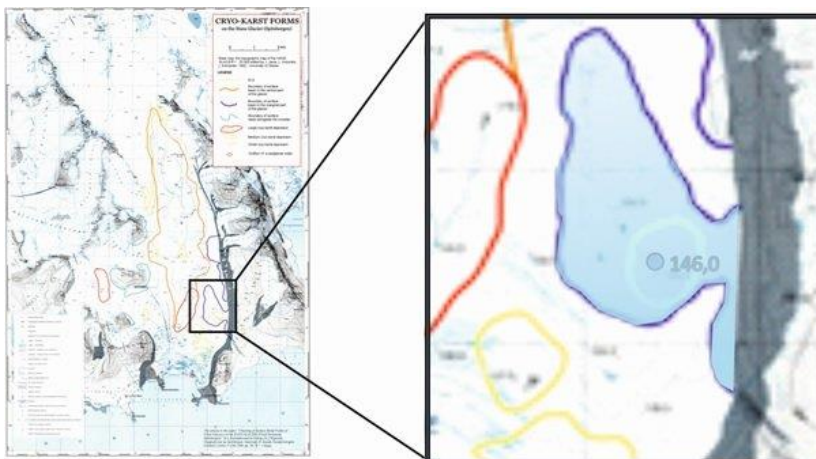
*What will be the discharge for the fill level of the entire chimneys?*

#### Exercise 7.

*To what height will the Wielkie Kominy be filled if the discharge from Lodowe Źródło is 450 l/s?*

#### Exercise 8.

The depression on Hans Glacier is drained by a glacier mill, the edge of which is 146.0 m above sea level. Observations of the snow cover have shown that the mass balance is zero at the surface, meaning that the same amount of ice is added and lost in one year. Measurement of the snow cover at the end of the accumulation period showed that there was 1.30 m of compacted snow on the ice with a density of  $350 \text{ kg/m}^3$ , and 1.75 m of wind-compacted snow above it with a density of  $200 \text{ kg/m}^3$ . The area of the depression on a 1:25,000 scale map is  $16.55 \text{ cm}^2$ .



**Question:** Calculate how many  $m^3$  of water drained from the depression during the ablation period (we assume that the thickness and type of snow cover across the depression were the same).

Exercise 9.

Assuming that the cross-section of the channels draining water from the bottom of the well at sea level is  $1 m^2$ , calculate how long it would take for the entire volume of water from the melting snow to run off if the well were filled to the edge.

Exercise 10.

Do you think there was a period during the ablation period when the well was filled to the edge?