

Name:

Class:

Supplementary Examination for the  
Standardised Competence-Oriented  
Written School-Leaving Examination

AHS

May 2020

# Mathematics

Supplementary Examination 6  
**Candidate's Version**

## Instructions for the supplementary examination

Dear candidate,

The following supplementary examination is comprised of five tasks that can be completed independently of one another.

Each task contains two parts: The statement of the task requires you to demonstrate core competencies, and the guiding question that follows it requires you to demonstrate your ability to communicate your ideas.

You will be given preparation time of at least 30 minutes, and the examination will last at the most 25 minutes.

### Assessment

Each task can be awarded zero, one or two points. There is one point available for each demonstration of core competencies as well as for each guiding question. A maximum of 10 points can be achieved.

For the grading of the examination the following scale will be used:

Grade	Number of points
Pass	4 points for the core competencies + 0 points for the guiding questions 3 points for the core competencies + 1 point for the guiding questions
Satisfactory	5 points for the core competencies + 0 points for the guiding questions 4 points for the core competencies + 1 point for the guiding questions 3 points for the core competencies + 2 points for the guiding questions
Good	5 points for the core competencies + 1 point for the guiding questions 4 points for the core competencies + 2 points for the guiding questions 3 points for the core competencies + 3 points for the guiding questions
Very good	5 points for the core competencies + 2 (or more) points for the guiding questions 4 points for the core competencies + 3 (or more) points for the guiding questions

The examination board will decide on the final grade based on your performance in the supplementary examination as well as the result of the written examination.

**Good Luck!**

# Task 1

## Angle of a Slope

In order to determine the danger of avalanches, it is important to know the angle of a slope.

**Task:**

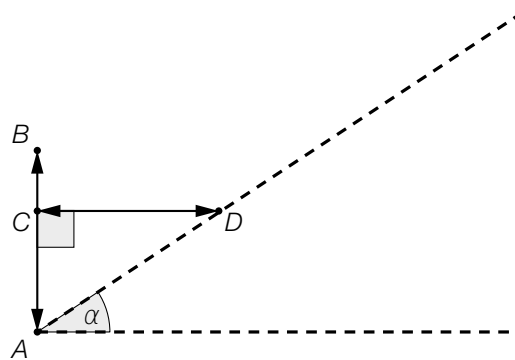
A particular slope has an angle of  $30^\circ$  to the horizontal.

– Determine the gradient of the slope as a percentage.

**Guiding question:**

The diagram below shows a method used to estimate the angle of a slope using ski poles. The angle of the slope,  $\alpha$ , is determined using two ski poles of equal length,  $AB$  and  $CD$ .

The ski pole  $CD$  is held horizontally to the slope; the ski pole  $AB$  is held vertically at the end of the pole  $CD$  (as in the diagram).



– Write down the angle of the slope if using this method it is found that the points  $B$  and  $C$  have the same position as each other.

– Determine the angle of the slope,  $\alpha$ , when the length of the line segment  $\overline{BC}$  is one third of the length of the ski pole  $\overline{AB}$ .

## Task 2

### Ideal Gas Equation

The equation  $p \cdot V = n \cdot R \cdot T$  models the relationship between the pressure  $p$ , the volume  $V$ , the amount of the substance  $n$ , and the absolute temperature  $T$  of an ideal gas. In the equation,  $R$  is a constant.

#### Task:

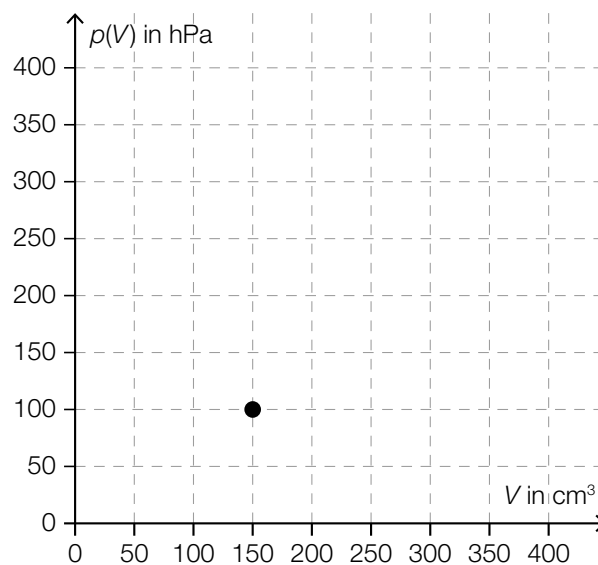
- Justify why the relationship between how the pressure  $p$  changes with respect to the temperature  $T$  can be modelled by a linear function of the form  $p(T) = k \cdot T + d$  (where  $k, d \in \mathbb{R}$ ) if the other values are constant.
- Write down the parameters  $k$  and  $d$  of this linear function (in terms of the values given above).

#### Guiding question:

The pressure  $p$  of an ideal gas can be given as a function of the volume  $V$  if the values of  $n$ ,  $R$  and  $T$  are constant.

- Complete the table of values shown below, sketch the graph of the function  $p$  in the coordinate system and write down which type of function  $p$  is.

$V$ in $\text{cm}^3$	50	100	150	200	300
$p(V)$ in hPa			100		



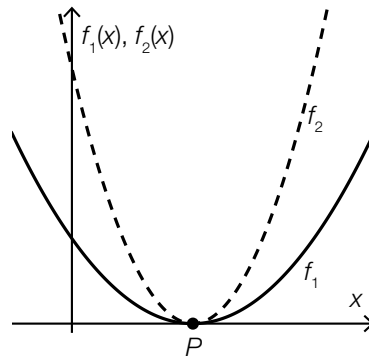
## Task 3

### Two Parabolas

The graphs of two functions  $f_1$  and  $f_2$  where  $f_1(x) = a_1 \cdot x^2 + b_1 \cdot x + c_1$  and

$f_2(x) = a_2 \cdot x^2 + b_2 \cdot x + c_2$  are shown in the diagram below.

The graphs of the two functions only have the point  $P$  on the positive  $x$ -axis in common.



#### Task:

– Complete each of the gaps shown below with a correct symbol “<”, “>” or “=” so that the statements are true and justify your answer.

$$a_1 \text{ \_\_\_\_\_\_ } a_2$$

$$c_1 \text{ \_\_\_\_\_\_ } c_2$$

#### Guiding question:

– Given that  $a_1 = 0.25$  and  $P = (2,0)$ , determine the values of the parameters  $b_1$  and  $c_1$  and explain your method.

## Task 4

### Velocity of a Vehicle

The velocity of a vehicle between two sets of traffic lights in the time interval  $[0, t_1]$  is modelled by the function  $v$  with  $v(t) = -\frac{4}{15} \cdot t^2 + 4 \cdot t$  where  $t$  is given in s and  $v(t)$  is given in m/s.

At the time  $t = 0$ , the vehicle is at the first set of traffic lights.

#### Task:

At time  $t_1$  the vehicle comes to a stop at the second set of traffic lights.

– Write down the time  $t_1$  and determine the distance covered by the vehicle in this time interval.

#### Guiding question:

- Determine the time  $t_0 \in [0, t_1]$  at which the vehicle reaches its maximum velocity and write down this maximal velocity.
- The time  $t_2$  is the time at which the vehicle has covered 80 % of the distance between the two sets of traffic lights. Using  $v$ , write down an equation with which the time  $t_2$  can be found and determine the value of  $t_2$ .

## Task 5

### Expanding a Data Set

A set of data that consists of six numbers is shown below:

$$x_1 = 4, x_2 = 8, x_3 = 2, x_4 = 7, x_5 = 4, x_6$$

The mean of the set of data is  $\bar{x} = 5$ .

#### Task:

– Determine the value of  $x_6$  as well as the median of the set of data.

#### Guiding question:

- Expand the data set by writing down two whole numbers such that both of the following conditions are fulfilled and justify your answer:
- The mean of the new data set is the same as the mean of the original data set.
  - The median of the new data set is greater than the original median.