S5P4 — Exercises from http://www.barsamian.am/mathsexams/

Contents

1 Chapter 1 — Powers and roots

Exercise 1 — June 2024 Calc.: ✗

Determine the real number(s) for which the following equations are true:

a) $3^{x+2} = 1$ — 2

b) $5^{x-1} = \sqrt{5}$ — 2

c) $\left(\frac{1}{4}\right)^{x} = 64$ — 3

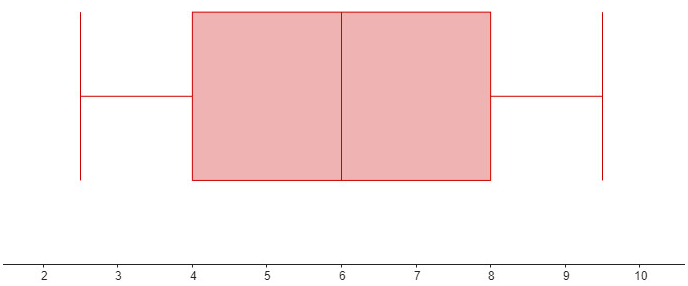
2 Chapter 2 — Statistics

Exercise 2 — June 2024 Calc.: ✓

A teacher wants to analyze the performance of two classes (Class A and Class B) in a recent math exam. The exam scores for class A are recorded as follows:
Class A: {3, 4, 5, 5, 6, 6.5, 7, 7, 7, 8.5, 9, 10}

1. **Calculate** the mean and **interpret** it. — 2
2. **Give** the standard deviation and **interpret** it. — 2
3. **Draw** a boxplot of the data set. — 4

The teacher accidently deleted the exam scores for class B and just has the Boxplot, that he plotted of the scores, left. The boxplot looks like this:



4. **Compare** the two boxplots and describe what it means for the results of the two different classes. **Give** at least two important conclusions. — 3

Exercise 3 — June 2023 Calc.: ✗

We have put together the December B tests in mathematics, for S5 pupils of EEB1. Among those tests, we look at the grades of 6 students. Their 6 grades were as follows:

5, 5, 6, 6, 6, 8

1. **Calculate** the mean of these 6 grades. 1
2. **Check** that the standard deviation of these 6 grades is 1. 2
3. In another group of students, the mean is the same but the standard deviation is higher. **Interpret** this difference in terms of results of the two groups of students. 1
4. **Give** an example of a series of 6 grades with the same mean, but with a higher standard deviation. 1

Exercise 4 — June 2021 Calc.: ✓

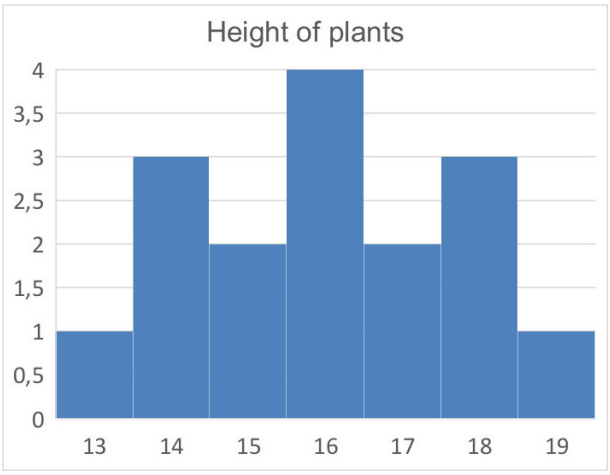
The table below shows the distribution of times obtained by 10 contestants during a sport competition.

Time x	10	20	30	40	50
Frequency f	1	2	4	2	1

1. Determine the mean of x. 4
2. Determine the standard deviation σ. 4
3. Determine the interval related to 68% of the time. 3
4. Draw a histogram representing the situation. 4

Exercise 5 — June 2021 Calc.: ✗

The following histogram represents the height of the plants of the new garden.



1. Fill in the table below using the data from the histogram. 2

height (cm)							
frequency							

2. Determine the number of plants. 2
3. Determine the mode. 2
4. Determine the mean. 2
5. Determine the median. 2

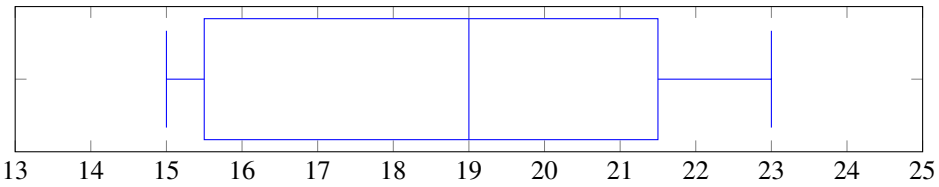
Exercise 6 — June 2023 Calc.: ✓

An athlete, specialist in the shot put, participates in the eliminatory events with a view to his possible selection for the European championships. He is required to make 12 throws, the lengths of which, in meters, are given below:

18.6, 19.4, 20.8, 15.9, 17.7, 21.1, 19.8, 15.2, 17.2, 16.5, 20.5, 21.9

1. **Find** the mean of the series of throws. **Interpret** this result with a sentence. 1
2. **Find** the median of the series of throws. **Interpret** this result with a sentence. 1
3. **Determine** the quartiles of the series of throws and **draw** the box-plot. 2

Another athlete has also made 12 throws, and the box and whiskers plot of those throws, in meters, are given below:



4. **Compare** the series of throws of those 2 athletes. 2

Exercise 7 — June 2021 Calc.: ✓

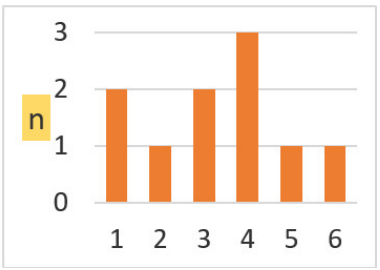
In two classes A and B the same test was given. The maximum score was 10. The results are below.
Class A.

score	absolute frequency
1	2
3	1
5	6
8	2
10	1

Class B.
There are 6 students in this class. One of them got a 10, four students scored 5, and one scored 4.

1. How many students are there in class A? 2
2. Calculate the mean of both classes. (round to 3 d. p.) 2
3. Calculate the standard deviation of class B. (round to 3 d. p.) 3
4. What is the meaning of a standard deviation? 2

Exercise 8 — June 2021 Calc.: ✗



A dice is thrown 10 times. The diagram above shows the absolute frequency n of the 6 possible results.
Based on the diagram above determine the mean and the median. 5

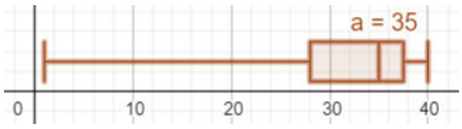
Exercise 9 — June 2021 Calc.: ✗

Mr Maier is a maths teacher in a rural area. Most of his P1 students live on a farm. In order to teach the children how to count, he asks the class to write down the total number of animals on the farm as homework.

Name	Kim	Tim	Ali	Ben	Sue	Peter	Hugo	Anna	Kira
Number of animals	16	19	18	47	12	18	18	19	17

Then he uses this information to test his S5 students in statistics, asking them to:

1. State the following values: 9
   (a) The minimum and the maximum
   (b) The range
   (c) The median
   (d) The first quartile and the third quartile
2. Draw a box plot for the number of animals. 4
3. Compare the box plot shown below to the one from part 2). Make three statements based on the statistical parameters comparing the two box plots. 3



4. Calculate the mean of the following values: 3

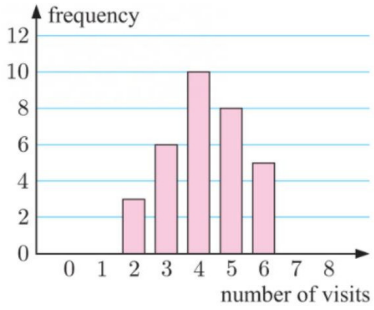
   16, 15, 13, 30, 27, 15, 24

5. Explain what is an outlier based on one of the previous examples. 1

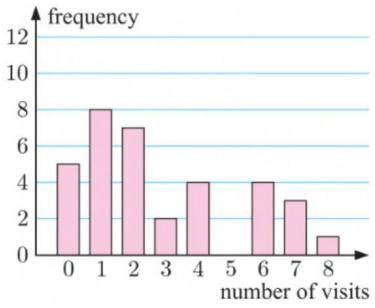
Exercise 10 — June 2021 Calc.: ✗

The S1 and S5 students in our school were asked how many times they visited their grandparents in the last month. The results are shown in the graphs below.

S1 students



S5 students



1. For the S5 students, find the: (Show your working) 5
   (a) Median
   (b) Range
   (c) interquartile range
2. Comparing the two graphs, decide which class: 4
   (a) generally visited their grandparents more often (Justify your answer)
   (b) had greater variation in their number of visits? (Justify your answer)

Exercise 11 — June 2021 Calc.: ✓

Below you will find information about temperatures in Greece and Sweden. The information for one of the countries is in Table 1:

Table 1.

Month	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	-2	-2	1	6	10	14	18	17	13	7	4	0

For the other country, we know the information below:

Table 2.

Mean (°C)	19
Median (°C)	19
Mode (°C)	25
Range (°C)	18
Interquartile range (°C)	10

1. Calculate the mean, median, mode and interquartile range for the data set given in Table 1. (Show your working) 4
2. Using statistical data, which of the data sets is for Sweden and which one is for Greece? Explain your choice. 2
3. In which country the temperatures are more homogenous? Explain why. 2

3 Chapter 3 — Quadratic and polynomial models

Sorry, no exercise in English for this chapter. Please have a look for exercises in other languages at the following link: `http://barsamian.am/mathsexams/resultats?level[3]=1&algebra[6]=1&algebra[8]=1&algebra[9]=1&analysis[5]=1&analysis[6]=1&analysisnotbeyond=10`.

4 Chapter 4 — Trigonometry (1/2)

Exercise 12 — June 2023 Calc.: ✗

1. **Match** each angle in degrees (from a to e) to the corresponding angle in radians (from i to v): 2.5

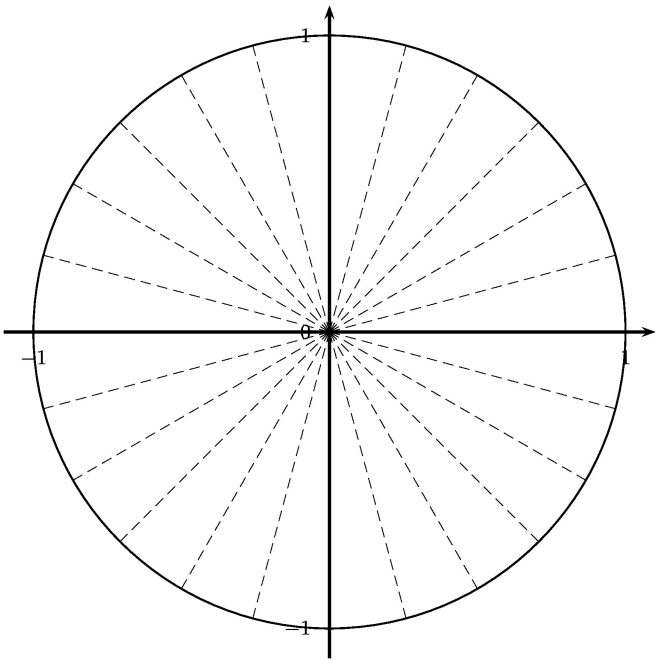
   a) 90° b) 30° c) 300°

   d) 270° e) 135°

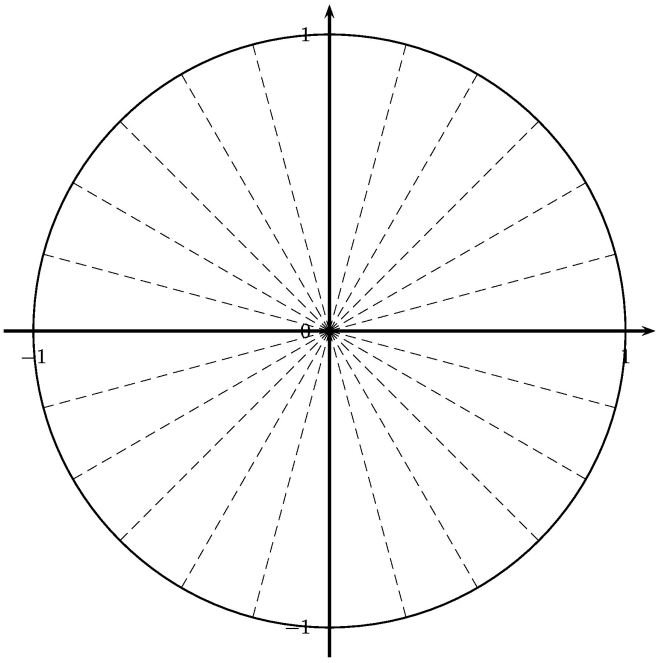
   i) $\frac{5}{3}\pi$ ii) $\frac{1}{2}\pi$ iii) $\frac{3}{4}\pi$

   iv) $\frac{1}{6}\pi$ v) $\frac{3}{2}\pi$

2. **Place** these five angles on the Unit Circle on the right. 2.5



Exercise 13 — June 2024 Calc.: ✗



1. **Determine** what each angle in degrees is equivalent to in radians: 3

   i. 45° ii. 150° iii. 300°

2. **Determine** what each angle in radians is equivalent to in degrees: 2

   i. $\frac{1}{3} \cdot \pi$ rad ii. $\frac{5}{4} \cdot \pi$ rad

4. **Insert** those 5 angles listed above on the unit circle. 2

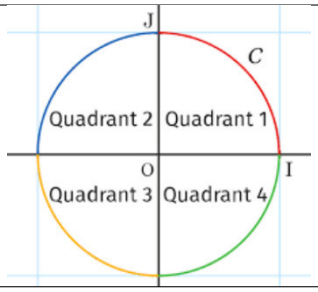
4. Given is $\cos(60°) = \frac{1}{2}$.

   Based on this information, **find** the value α $(0 < \alpha < 360°)$ for which $\cos(\alpha) = -\frac{1}{2}$. 5

   Enter the answer in radians and **plot** it on the above unit circle.

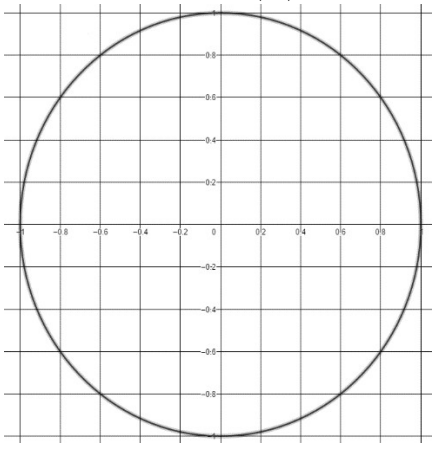
Exercise 14 — June 2021 Calc.: ✗

True or false? Justify your answer.
If $\sin(\alpha) > 0$ and α is in Quadrant 2, $\tan(\alpha) > 0$. 4



Exercise 15 — June 2021 Calc.: ✗

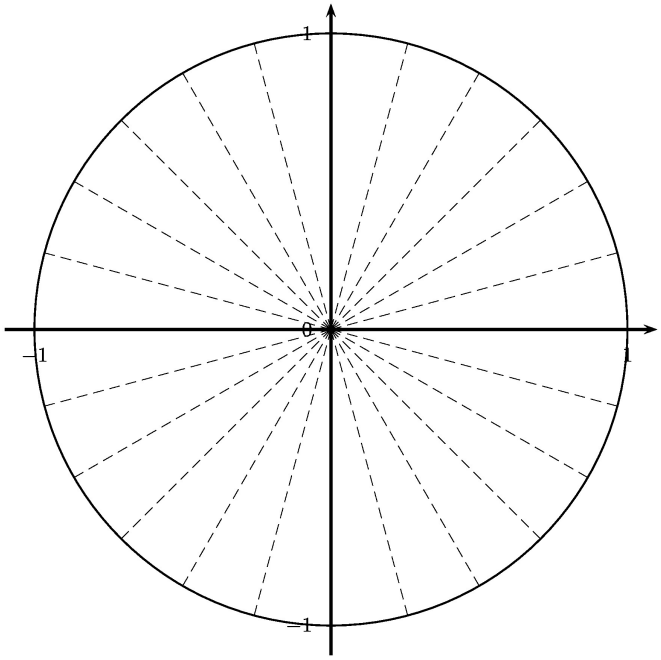
Find the value of $\cos\left(\frac{7\pi}{4}\right)$ using the unit circle below. 4



Exercise 16 — June 2021 Calc.: ✗

Place on the unit circle the following angles and for each one of them give the sin and the cos: 8

1. $\frac{5\pi}{4}$
2. $\frac{11\pi}{6}$
3. $\frac{\pi}{3}$
4. π



5 Chapter 5 — Exponential models

Exercise 17 — June 2024 Calc.: ✗

Determine the real number(s) for which the following equations are true:

a) $3^{x+2} = 1$ 2

b) $5^{x-1} = \sqrt{5}$ 2

c) $\left(\frac{1}{4}\right)^{x} = 64$ 3

Exercise 18 — June 2024 Calc.: ✓

Value of a house in one of the European capitals can be described using a model

$$V(t) = 425\ 000 \cdot 1.025^{t}$$

where t is the number of years since it was purchased by its current owner, Mr Anderson, and $V(t)$ is expressed in euros.

1. **Determine** how much did Mr Anderson pay for this house. 1
2. **Calculate** what the house will be worth 6 years after it was purchased by Mr Anderson (rounded to two decimals) 2
3. **Calculate** what the house will be worth 18 months after it was purchased by Mr Anderson (rounded to two decimals). 3
4. **Calculate** how many years after the purchase by Mr Anderson, the value of the house will exceed 600,000 euro. 4

Mr Johnson has just bought a house in different European capital for 350,000 euros. The value of houses in this city increases by 7% per year.

5. **Calculate** what will the value of the house be in 5 years. 4

Exercise 19 — June 2023 Calc.: ✓

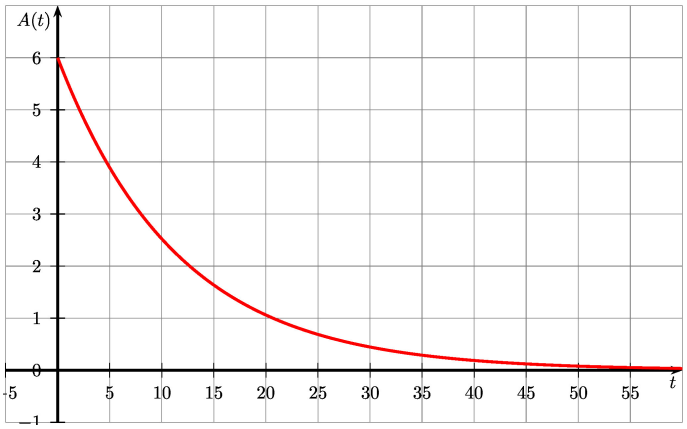
Medical doctors often use radioactive iodine a tracer when diagnosing some thyroid gland disorders. The iodine decays in such a way after t days, the amount left is given by:

$$A(t) = 6 \cdot 0.917^t$$

where $A(t)$ is measured in grams.

1. **Calculate** the initial amount of iodine. 1
2. **Calculate** how much iodine remains after 15 days (**round** to two decimals) 1
3. **Calculate** the date when the amount of iodine drops below 1 gram (**round** to 1 day). 2

The diagram below shows the elimination of iodine from the body:



4. Based on this graph and the expression of the function, **explain** why the iodine is not completely removed from the body. 1

Exercise 20 — June 2024 Calc.: ✗

In a certain country the growth of a certain rabbit population (per week) can be modelled with the following function:

$$f(x) = 100 \cdot 2^x$$

with $f(x)$ describing the number of rabbits after x weeks and $x = 0$ being the time at the beginning of the observation of the rabbit population.

1. **Give** the number of rabbits, that have been in the country at the beginning of the observation. 1
2. **Calculate** how many rabbits will live in the country after 1 week and after 3 weeks and **compare** the values. 4
3. **Sketch** the graph of the function f for $x \in [0, 5]$. **Use** the sheet of graph paper you received at the beginning of the exam. 2

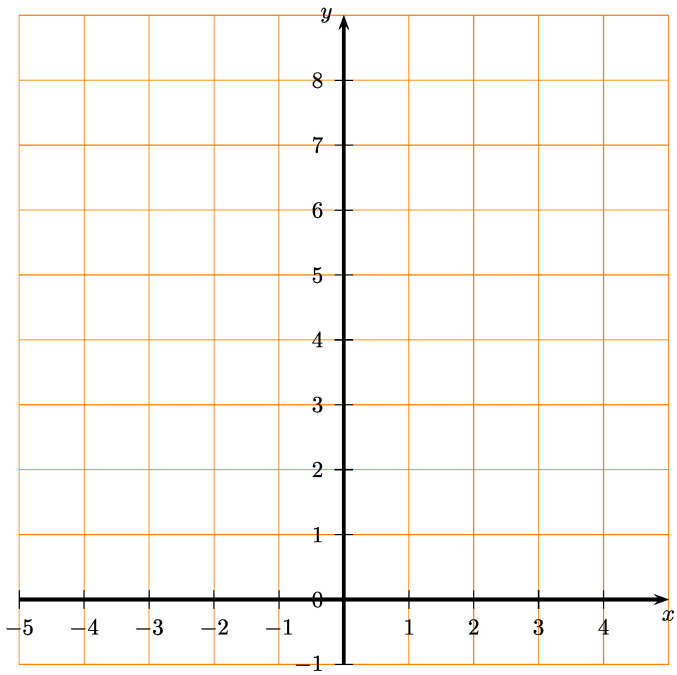
Exercise 21 — June 2023 Calc.: ✗

Let f be the function defined by $f(x) = 2^x$

1. **Complete** the table of values below: 2

x	-3	-2	-1	0	1	2	3
$f(x)$							

2. **Sketch** a graph of the function f below: 2

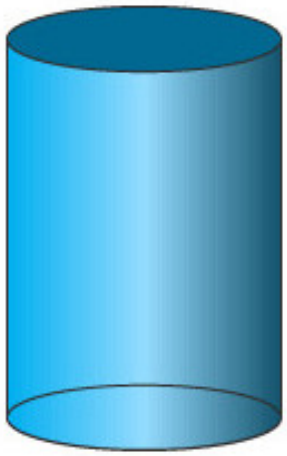


3. **Discuss** if the function f is representing exponential growth or decay. **Justify**. 1

6 Chapter 6 — 3d geometry

Exercise 22 — June 2024 Calc.: ✓

Imagine you're an engineer tasked with designing a water storage system for a remote village. You decide to construct a cylindrical water tank. It has a radius of 3 meters and a height of 8 meters.



1. **Calculate** the total surface area of the cylindrical tank, including the curved surface and the two circular bases, to determine the amount of material needed for construction. 5

The formula for the volume of a cylinder is

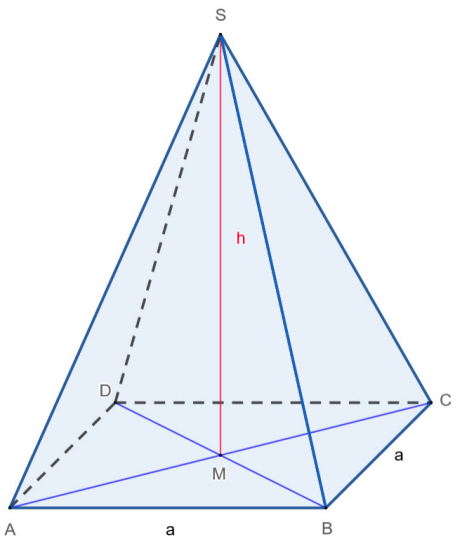
$$V = \text{Base area} \cdot \text{Height}$$

2. **Determine** how many liters of water are there in the cylindrical tank if it's filled up to 3/4 of its height (1 liter = 1 dm^3). 5

Exercise 23 — June 2024 Calc.: ✗

The figure shows a pyramid ABCDS with a square base.
The base is a = AB = 6 cm and the height of the pyramid is h = 4 cm.

Please note: the figure is not to scale.



1. Given that the formula for the volume of a pyramid is

$$V = \frac{\text{Base area} \cdot \text{height}}{3}$$

Calculate the volume of this pyramid. 2

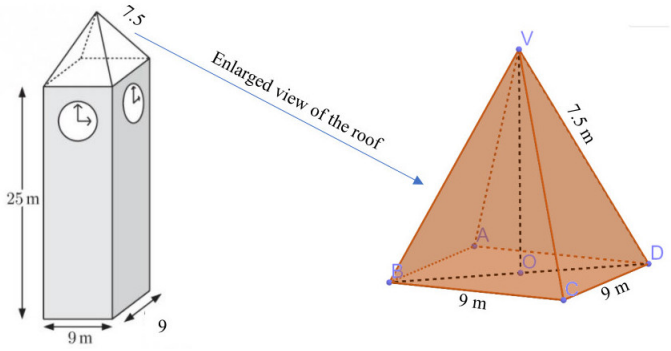
2. **Calculate** the height of triangle BCS from S. 2

3. **Calculate** the area of triangle BCS. 2

4. **Calculate** the surface area of this pyramid. 3

Exercise 24 — June 2021 Calc.: ✓

A clock tower has the dimensions shown. The lateral edge of the pyramid (the roof of the tower) is 7.5 m long.
For every question, you have to show your working and give reasons for your answers.



1. Compute the diagonal BD, to the nearest cm. 2

2. Find the height of the pyramid, to the nearest cm. 2

3. Find the total volume of the clock tower, to the nearest m^3. 2

4. Find how much paint we need for the roof, if we use 0.1 litres for each m^2. 3

Exercise 25 — June 2021 Calc.: ✗

Given a cube of side 3 m:

1. Draw the cube on paper. 3

2. Determine the length of a face diagonal of the cube. 3

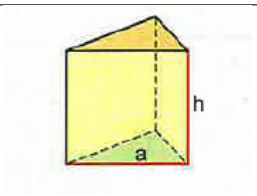
3. Determine the length of a body diagonal of the cube. 3

4. Determine the volume of the cube. 3

5. Determine the surface of the cube. 3

Exercise 26 — June 2021 Calc.: ✓

1. A triangular prism has height $h = 12$ cm. The base of the prism is an equilateral triangle with side length $a = 10$ cm. Calculate the surface area of the prism. 5



2. A cylindrical tin can has a height of 10.2 cm and a circumference of 22.4 cm. Calculate the volume of the tin can in mililiiters. 5

Round to the nearest decimal place.

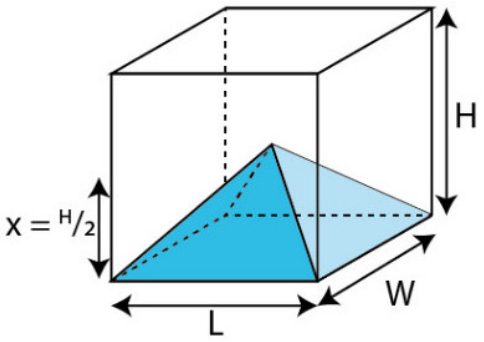
Exercise 27 — June 2021 Calc.: ✗

A solid is made by removing a pyramid from a cuboid. The cuboid has the dimensions: $H = 12$ cm; $L = 4$ cm; $W = 3$ cm.
The pyramid is half the height of the cuboid.

1. Calculate the volume of the cuboid. 3

The formula to compute the volume of a pyramid is:

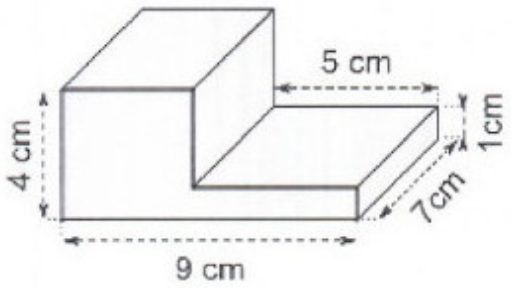
$$\frac{1}{3} \times \text{Area(base)} \times \text{height}$$



2. Calculate the volume of the pyramid. 3
3. Calculate the volume of the solid. 2

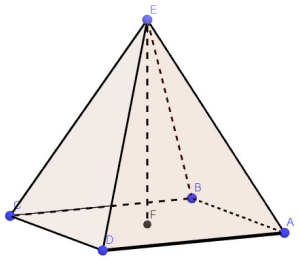
Exercise 28 — June 2021 Calc.: ✗

Calculate the surface area of the following shape: 10



Exercise 29 — June 2023 Calc.: ✓

The Louvre pyramid in Paris is a regular square-based pyramid of 21.6 m height. The square base measures 35 m each side. The triangular faces are made of glass.

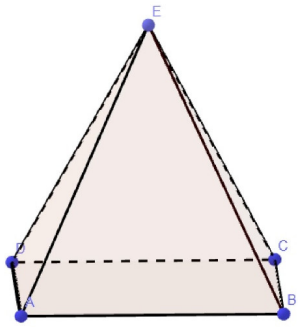


The formula for the volume of a pyramid is:

$$\frac{1}{3} \times \text{area of base} \times \text{height}$$

1. **Calculate** the volume of the space enclosed in the pyramid. 1.5

H is the midpoint of [AB].



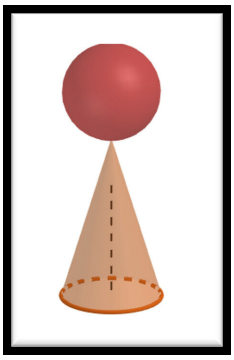
2. In the diagram opposite, **represent** [EH], the height of the triangle ABE from E (by coding the figure), then **show** that EH = 27.8 m, rounded to tenths of a meter. 1

3. **Calculate** the area of the glass. 1.5

4. The Louvre pyramid is a reduction of the Cheops pyramid in 1,5 point Egypt. The base of the Cheops pyramid has a side that measures approximately 230.5 m. **Show** that the height of the Cheops pyramid is approximately 142.3 m. 1.5

Exercise 30 — June 2021 Calc.: ✓

The new spray bottle of the perfume "*Profumo di Parma*" is made by a cone and a sphere on top of the vertex of the cone (see figure below).



The height of the cone is 10 cm and the diameter of the base is 6 cm. The radius of the sphere is 3 cm.

1. Determine the surface of the whole bottle (cone and sphere) 4
2. Determine the volume of the bottle (cone and sphere). 4
3. A gift box contains 3 bottles of perfume. The box is a cuboid whose edges are 20 cm, 20 cm, 10 cm. How much free space is left? 4
4. Determine the angle between the base of the cone and the slant height. 3

7 Chapter 7 — Probabilities

Exercise 31 — June 2021 Calc.: ✗

50% of a hotel rooms have a fireplace, 20% have a radiator and 10% have a fireplace and a radiator. We randomly choose a hotel room.
What is the probability of the room we have chosen to have only a fireplace? 6

Exercise 32 — June 2021 Calc.: ✗

Let A and B be two events such that: $p(A) = 0.4$; $p(B') = 0.3$ and $p(A \cup B) = 0.8$.
Calculate $P(A|B)$. 6

Exercise 33 — June 2021 Calc.: ✓

Students of a college must spend an academic year abroad in a foreign country.
Students have different options. First, they must choose the country where they want to study:
76% of the students want to go to UK, the others in France.
Then, they must choose the accommodation. Students can choose between "homestay" or "residential".
50% of the students going to France choose "homestay" while 25% of students going to UK choose "residential".

1. Represent the situation using a tree diagram. 4
2. Determine the probability that a randomly selected student chooses to go to France. 2
3. Determine the probability that a randomly selected student chooses "homestay". 2
4. Determine the probability that a randomly selected student DOES NOT choose "France" and "residential". 2

Exercise 34 — June 2021 Calc.: ✓

A survey of smoking habits conducted on 200 people (90 women and 110 men) says that only 140 people do not smoke. Amid smokers, 40 are men.

1. Fill in the two-way table below. 4

	Women	Men	TOTAL
Smokers			
Non smokers			
TOTAL			

2. Determine the probability that a randomly selected person is a woman and does not smoke. 3
3. Determine the probability that a randomly selected person is a man, knowing that he is not a smoker. 3

Exercise 35 — June 2021 Calc.: ✓

In a class there are 15 students, 9 students like geography and 10 students like science. Knowing that 2 students like neither geography nor sciences:

1. Represent the situation with a Venn diagram. 3
2. Determine the probability that a student randomly selected likes geography and not science. 3
3. Determine the probability that a student randomly selected among the students who like science, he/she does not like geography. 4

Exercise 36 — June 2021 Calc.: ✗

In a group of 25 people, 14 like pizza and 16 like hamburger. One person likes neither pizza nor hamburger.

1. Represent the situation using a Venn diagram. 2

What is the probability that a person randomly selected:

2. Likes pizza? 1
3. Likes pizza, knowing that he/she likes hamburger? 2

Exercise 37 — June 2021 Calc.: ✗

A candy is randomly selected from a paper box with 6 hard candies and 12 soft candies.
If H is the event of getting a hard candy and S is the event of getting a soft candy, determine the following probabilities:

1. $P(\mathrm{H})$ 2
2. $P(\mathrm{S})$ 2
3. $P(\mathrm{H} \cap \mathrm{S})$ 2
4. $P(\mathrm{H} \cup \mathrm{S})$ 2

Exercise 38 — June 2021 Calc.: ✗

A single fair die is rolled. Let A be the event "number 2" and B the event "even number".
Determine if A and B are independent. Justify you answer. 2

Exercise 39 — June 2021 Calc.: ✓

A statistical survey has shown that 12% of the athletes of a given sport use a certain doping substance. A lab offers a test.

This test is positive in 95% of all cases in which athletes have taken the doping substance.

Unfortunately, this test is also positive in 2% of all cases in which athletes have not taken the drug.

Give your results in percentage.
We define the following events:

T: athlete tested positive

D: athlete taken doping

1. Illustrate the above data by completing the table below or by using a tree diagram. 3

	D		
T		176	
	1 200	8 800	10 000

An athlete is randomly selected.

2. Give the probability that the test of the athlete is positive. 3
3. The test of the athlete is positive. Calculate the probability that the athlete has really used the doping substance. 3

Exercise 40 — June 2021 Calc.: ✓

There are 30 days in November.
18 days had rain,
14 days had fog,
and 7 days had neither fog nor rain.

1. Draw a Venn diagram or a two-way table that illustrates the situation. 4

A day is selected at random

2. What is the probability that there is fog and it rains? 2
3. What is the probability that there is rain and no fog? 2
4. What is the probability that there was fog given that there was rain? 2

Exercise 41 — June 2021 Calc.: ✗

A bag contains 6 plastic counters: 4 red counters and 2 white counters.
A counter is taken out from the bag, its colour recorded and it is not replaced.
A second counter is taken from the bag and its colour recorded.

1. Draw a tree diagram to show all the possible outcomes for this situation. 4
2. Calculate the probability that both counters are red. 2
3. Calculate the probability that both counters are red, given that the second counter was red. 4

Exercise 42 — June 2021 Calc.: ✓

The owner of a house has a red key ring and a green one. There are three keys on the red one and five keys on the green one. There is only one key on each key ring that will open the door of the house. The owner of the house randomly picks one of the key rings and then randomly chooses one of the keys.	
1. Draw a tree diagram illustrating the experiment. (do not forget to write the probability for each branch)	3
2. Calculate the probability that the chosen key will open the door of the house.	2
3. Given that the key is not opening the door, find the probability that the owner chose the red key ring.	3

Exercise 43 — June 2021 Calc.: ✗

In a group of 60 students, 38 play neither football nor tennis, 15 play football, 5 play both football and tennis.	
1. Display the information on a Venn diagram.	3
2. Find the number of students playing only tennis.	2
3. One student is chosen at random. Given that he/she is playing football, calculate the probability that this student plays tennis also.	3

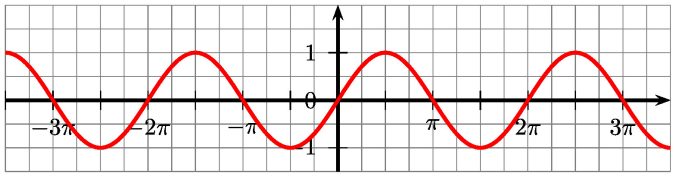
8 Chapter 8 — Trigonometry (2/2)

Exercise 44 — June 2023 Calc.: ✗

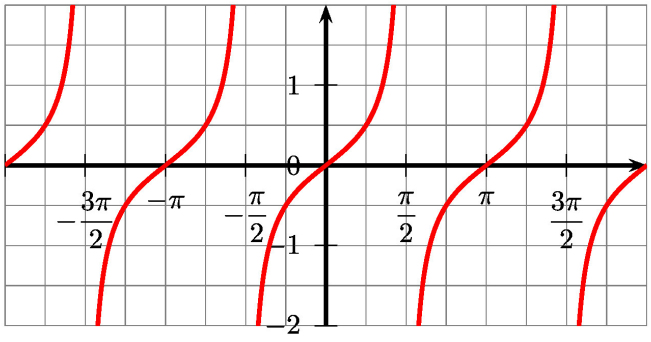
1. **Associate** each function (from f to h) to the graph (from i to iii): 3

$f(x) = \sin(x)$ $g(x) = \cos(x)$ $h(x) = \tan(x)$

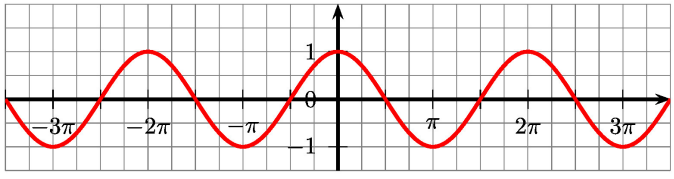
i)



ii)



iii)



2. **Give** the période of the functions i) and ii). 2