Part B	Problems 1-10 which only require answers.
Part C	Problems 11-16 which require complete solutions.
Test time	120 minutes for Part B and Part C together.
Resources	Formula sheet and ruler.

Level requirements

The test consists of an oral part (Part A) and three written parts (Part B, Part C and Part D). Together they give a total of 73 points of which 27 E-, 27 C- and 19 A-points.

Level requirements for test grades
E: 18 points
D: 28 points of which 9 points on at least C-level
C: 37 points of which 16 points on at least C-level
B: 48 points of which 6 points on A-level
A: 57 points of which 11 points on A-level

The number of points you can have for a complete solution is stated after each problem. You can also see what knowledge level(s) (E, C and A) you can show in each problem. For example (3/2/1) means that a correct solution gives 3 E-, 2 C- and 1 A-point.

For problems labelled "*Only answers required*" you only have to give a short answer. For other problems you are required to present your solutions, explain and justify your train of thoughts and, where necessary, draw figures.

Write your name, date of birth and educational program on all the sheets you hand in.

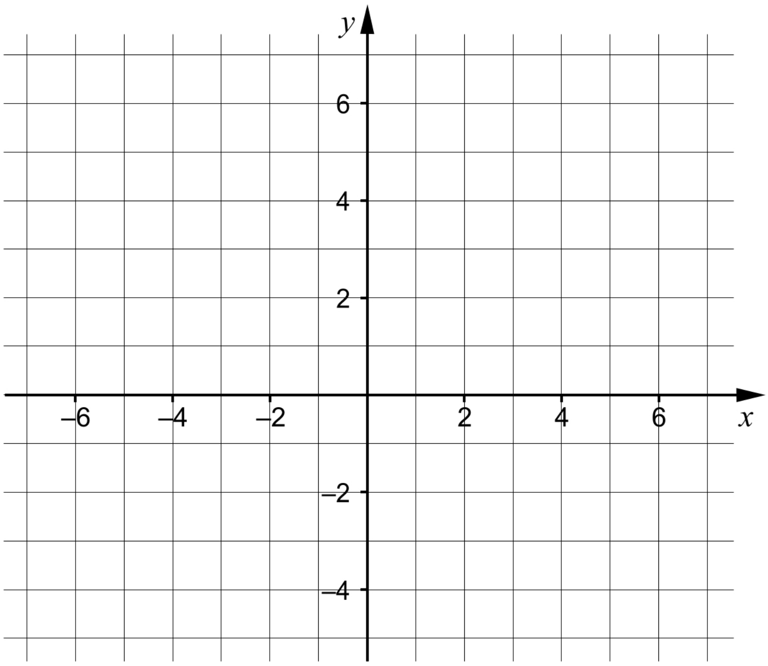
Name: ______________________________

Date of birth: ______________________________

Educational program: ______________________________

Part B: Digital resources are not allowed. *Only answer is required*. Write your answers in the test booklet.

1.

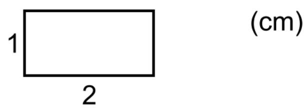


a) Draw the line $y = 2x + 1$ in the coordinate system. (1/0/0)

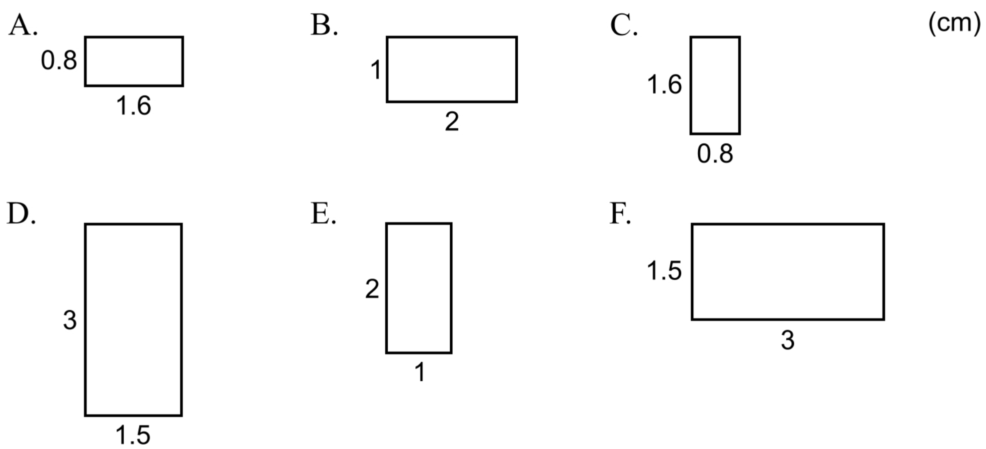
b) Give an example of an equation of another line that is parallel to the line in task a).

______________________ (1/0/0)

2. The figure shows a rectangle.



Which of the rectangles A-F are congruent to the rectangle above?



______________________ (1/0/0)

3. Solve the equations and give exact answers.

a) $x^2 - 4x = 0$ ____________________ (1/0/0)

b) $10^x = 5$ ____________________ (1/0/0)

c) $x^{\frac{1}{2}} \cdot x^{\frac{1}{2}} = 2^{\frac{1}{2}}$ ____________________ (0/1/0)

4. It holds for the quadratic function f that $f(x) = (x-4)(x-8)$

a) State the coordinates of a point on the graph of the function.

____________________ (1/0/0)

b) For what value of x does the graph of the function have a local minimum?

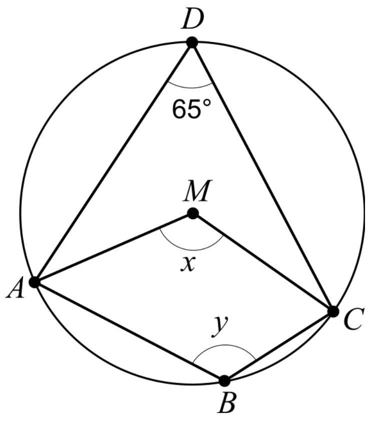
____________________ (0/1/0)

5. Simplify the following expression as far as possible.

a) $(x+3)^2 - x^2$ ____________________ (1/0/0)

b) $4\left(\frac{x}{2}-1\right)\left(\frac{x}{2}+1\right)$ ____________________ (0/1/0)

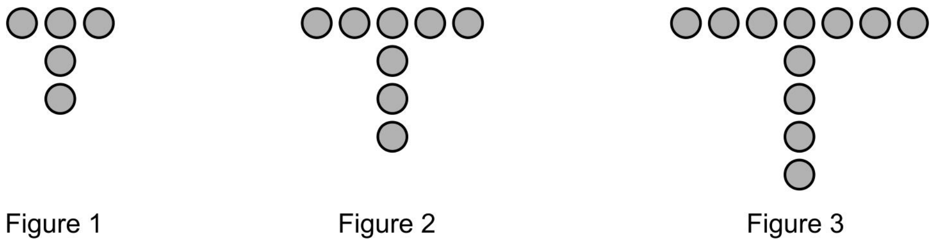
6. The quadrangle *ABCD* is inscribed in a circle with centre *M*.



a) Determine angle x. ____________________ (1/0/0)

b) Determine angle y. ____________________ (0/1/0)

7. Three figures consisting of dots are shown below. The figures are formed according to a pattern. More figures can be formed according to the same pattern.



a) How many dots would there be in Figure 4? _______________ (1/0/0)

b) Find an expression for the number of dots in Figure *n*.

_______________ (0/1/0)

8. Give an example of a quadratic function that does not have any real roots.

_______________ (0/1/0)

9. What should be written in the box in order for the linear system of equations

$\begin{cases} 2x+5y=35 \\ \square x+3y=21 \end{cases}$ to have an infinite number of solutions?

_______________ (0/0/1)

10. Simplify the expression $3^{\frac{n}{2}-1}+3^{\frac{n}{2}-1}+3^{\frac{n}{2}-1}$ as far as possible.

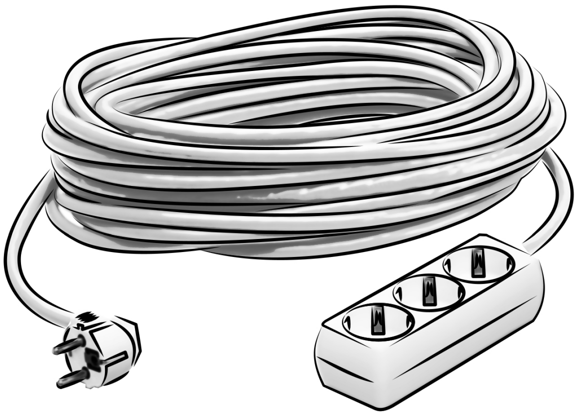
_______________ (0/0/1)

Part C: Digital resources are not allowed. Do your solutions on separate sheets of paper.

11. Solve the equation $x^2 + 2x - 24 = 0$ algebraically. (2/0/0)

12. Solve the simultaneous equations $\begin{cases} 4x + y = 20 \\ x - 2y = -13 \end{cases}$ algebraically. (2/0/0)

13. A company manufactures extension cords. The lengths of the cords are supposed to be normally distributed with a mean of 25 m and with standard deviation 0.10 m. Only cords longer than 24.8 m can be sold.



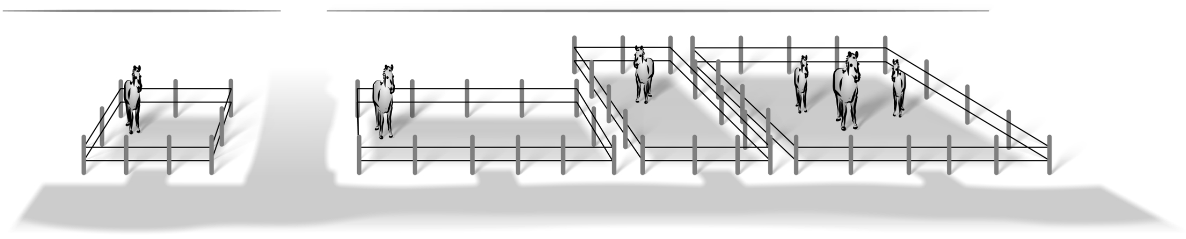
During one day the company manufactures 1000 cords. How many of these can be sold? (3/0/0)

14. Solve the equations.

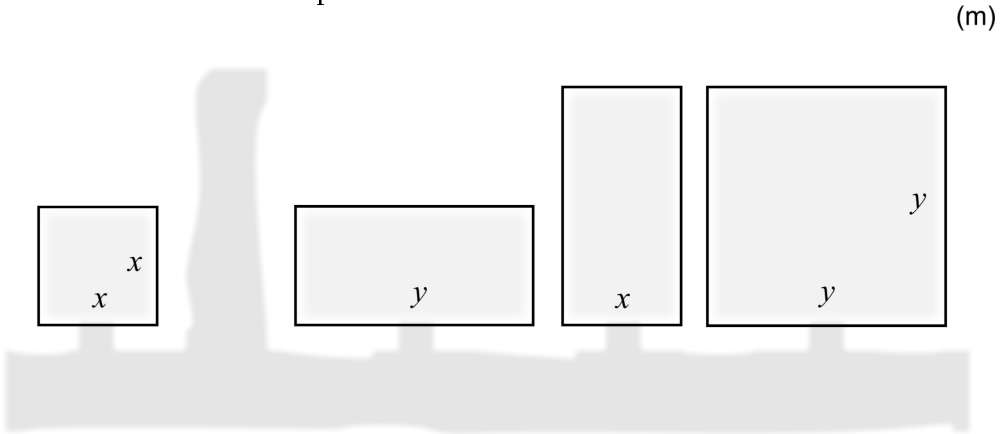
a) $x^{\frac{2}{3}} = 5^2,\ x > 0$ (0/2/0)

b) $4^x = 2^{4x+5}$ (0/0/2)

15. The figure show four pastures that are quadratic and rectangular respectively with side lengths x and y metres.



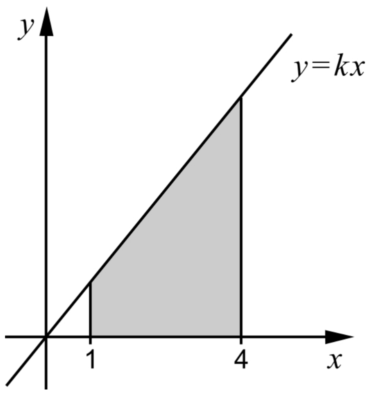
Below is a sketch of the pastures seen from above.



The horses will be moved into a new common pasture. The new pasture is quadratic and the area is equal to the total area of all the four original pastures combined.

Find a simplified expression for the length of the side of the new pasture. (0/1/1)

16. A region is bounded by the x-axis, the lines $x = 1$ and $x = 4$ and the straight line $y = kx$ where $k > 0$



Calculate the gradient k algebraically so that the area of the region is exactly 10 area units. (0/0/4)

Part D	Problems 17-25 which require complete solutions.
Test time	120 minutes.
Resources	Digital resources, formula sheet and ruler.

Level requirements

The test consists of an oral part (Part A) and three written parts (Part B, Part C and Part D). Together they give a total of 73 points of which 27 E-, 27 C- and 19 A-points.

Level requirements for test grades
E: 18 points
D: 28 points of which 9 points on at least C-level
C: 37 points of which 16 points on at least C-level
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The number of points you can have for a complete solution is stated after each problem. You can also see what knowledge level(s) (E, C and A) you can show in each problem. For example (3/2/1) means that a correct solution gives 3 E-, 2 C- and 1 A-point.

For problems labelled "*Only answers required*" you only have to give a short answer. For other problems you are required to present your solutions, explain and justify your train of thoughts and, where necessary, draw figures and show how you use your digital resources.

Write your name, date of birth and educational program on all the sheets you hand in.

Name: ______________________________

Date of birth: ______________________________

Educational program: ______________________________

Part D: Digital resources are allowed. Do your solutions on separate sheets of paper.

17. Karin buys a new computer. The value of the computer SEK V is assumed to decrease according to the model $V = 8000 \cdot 0.67^t$ where t is the number of years after the purchase.

How long does it take until the value of the computer has decreased to one fourth of the purchase value? (2/0/0)

18. At a factory, tins are filled with pea soup. The weight of each tin should be 400 grams. Every day, a random sample of 10 tins is taken to check the weight. One day the weights of the tins (in grams) were measured to the following:

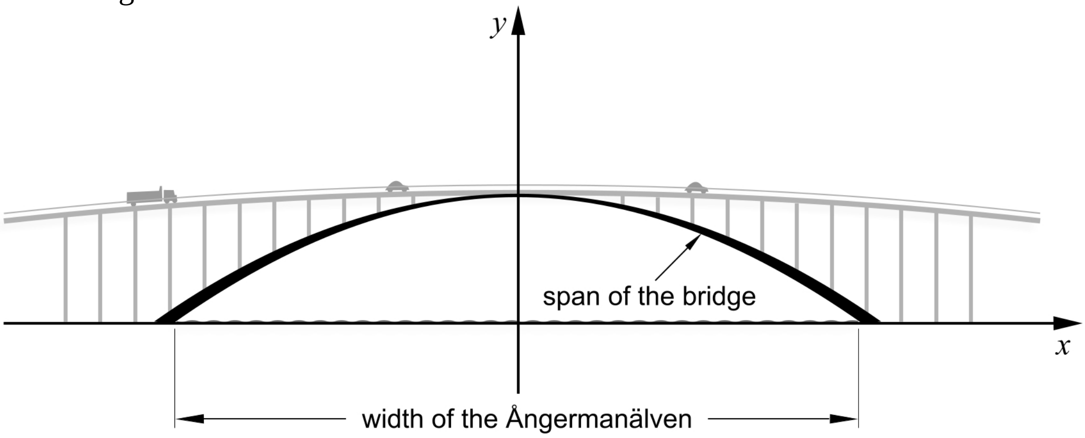
401	396	400	403	399	397	402	404	398	400

The factory requires that the standard deviation is no more than 2.5 grams.

a) Investigate whether the factory meets its requirement on this day. (2/0/0)

b) Describe what the standard deviation says about a statistical material. (1/1/0)

19. The Sandö bridge is a bridge crossing the Ångermanälven river. The bridge was built in 1943 and was until 1964 the world's longest single-span concrete arch bridge.



The shape of the arch can be described by the quadratic function *h* where

$h(x) = -0.0023x^2 + 40$

$h(x)$ is the height above the water in metres.
x is the distance in metres from the middle of the bridge along the surface of the water.

a) How high above the water are the cars when they pass the highest point of the bridge? *Only answer required* (1/0/0)

b) Calculate the width of the Ångermanälven river under the bridge. (0/2/0)

20. A baker wants to calculate the cost for producing a chocolate ball. The cost includes a labour cost and the cost for the ingredients. A large chocolate ball that weighs 80 g is then produced at a cost of SEK 8.

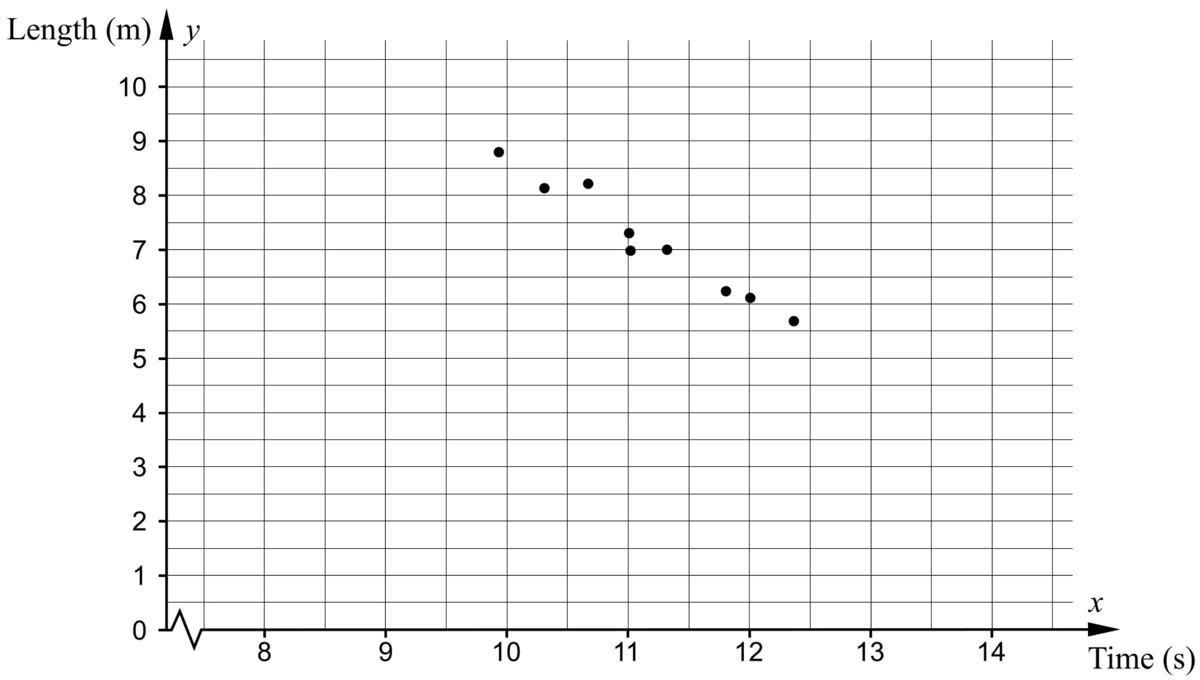
Many customers think that such a chocolate ball is too big. The baker has therefore also started producing small chocolate balls. A small chocolate ball weighs 45 g and is produced at a cost of SEK 6.

The baker assumes that the labour cost is the same for producing a large chocolate ball as for producing a small one.

Calculate the labour cost for one chocolate ball. (0/4/0)

21. Nine people competing in both the long jump and the 100 metres present their best results. These results are presented in the table below and also plotted in the diagram below.

100 metres Time (s)	**Long jump** Length (m)
9.92	8.79
10.3	8.13
10.66	8.21
11.00	7.30
11.01	6.98
11.31	7.00
11.80	6.23
12.00	6.11
12.36	5.69



There seems to be a linear relationship between the length of a jump and the time on the 100 metres.

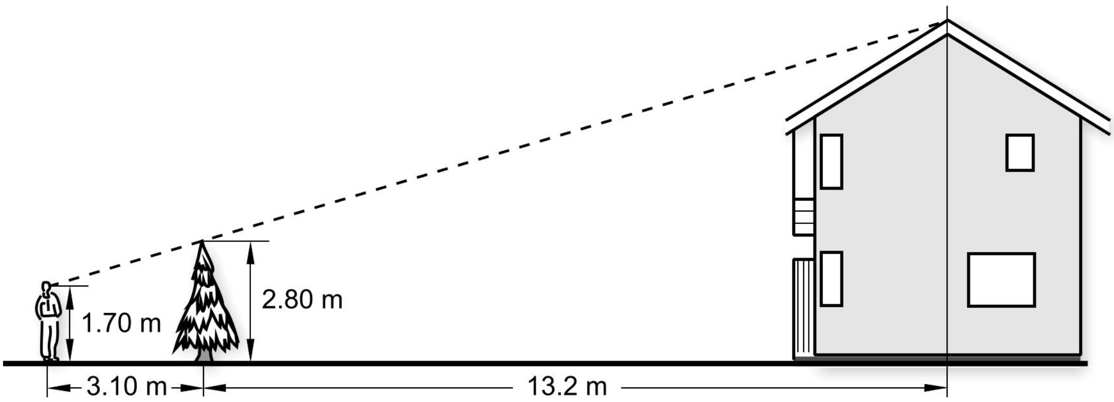
a) Adjust a straight line to the points and find the relationship for the line in the form $y = kx + m$ (0/2/0)

The linear relationship can be seen as a model of how the length of a jump depends on the time of a 100-metre race.

b) Usain Bolt holds the world record on the 100 metres with a time of 9.58 seconds. How far would Usain Bolt be able to jump in the long jump according to this model? (1/0/0)

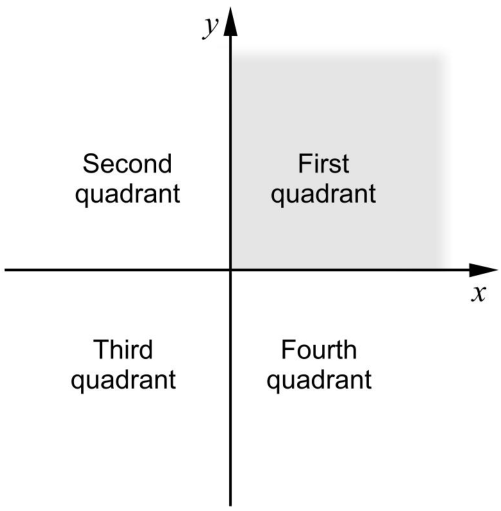
c) Give your comments on whether there is any limitation to the model. (0/1/0)

22. Rickard has been given the task of determing the height of a house. To be able to do this, he makes use of a fir tree in front of the house. Rickard stands so that he sees the tip of the fir tree coincide with the top of the roof. He puts a mark at his position. He then measures the required distances and writes them in the sketch below.



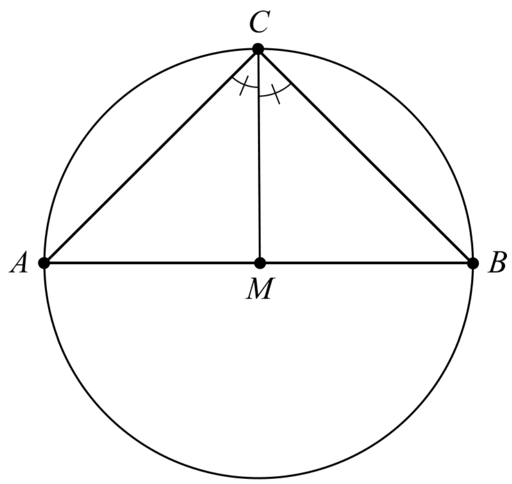
What is the height of the house? (0/4/0)

23. The two straight lines $y = ax - 2$ and $y = x - 1$, where a is a constant, intersect in the first quadrant.



Investigate the possible values of the constant a. (0/1/2)

24. The figure shows a triangle *ABC* which is inscribed in a circle. The side *AB* passes through the centre of the circle, *M*. The angles *ACM* and *BCM* are equal.

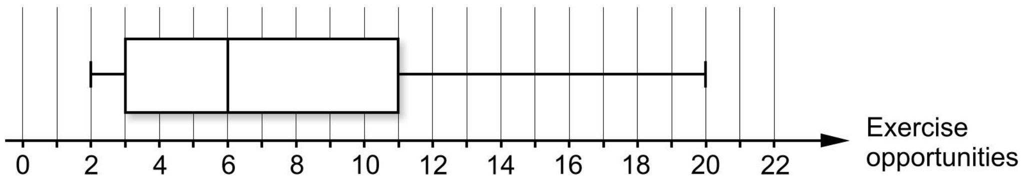


Show that the distance *CM* is perpendicular to the distance *AB*. (1/1/2)

25. In a statistical survey, 11 people were given the question:

”How many times during the last month have you exercised?”

The result of the survey was compiled with a box plot.



In what interval can the mean of the number of exercise opportunities be? (0/1/3)

To the student - Information about the oral part

You will be given a problem that you will solve in writing, and then you will present your solution orally. If you need, you can ask your classmates and your teacher for help when solving the problem. Your oral presentation starts with you presenting what the problem is about and then you describe and explain your solution. You must present all steps in your solution. However, if you have done the same calculation several times (for example in a table) it might be sufficient if you present some of the calculations. Your presentation should take a maximum of 5 minutes, and be held to a smaller group of your classmates and one or more teachers.

The problem given to you should, on the whole, be solved algebraically. You might need a calculator to do some of the calculations but, when presenting your solution, you should avoid referring to the use of your calculator for drawing graphs and/or symbolic handling (if that is the type of calculator you are using).

When assessing your oral presentation, the teacher will take into consideration:

- how complete, relevant and structured your presentation is,
- how well you describe and explain the train of thought behind your solution,
- how well you use the mathematical terminology.

How complete, relevant and structured your presentation is

Your presentation must contain the necessary parts in order for a listener to follow and understand your thoughts. What you say should be in a suitable order and be relevant. The listener must understand how calculations, descriptions, explanations and conclusions are connected with each other.

How well you describe and explain the train of thought behind your solution

Your presentation should contain both descriptions and explanations. To put it simple, a description answers the question *how* and an explanation answers the question *why*. You describe something when you for instance tell *how* you have done a calculation. You explain something when you for instance justify *why* you could use a certain formula.

How well you use the mathematical terminology

In your presentation you should use a language that contains mathematical terms, expressions and symbols, suitable for the problem you have solved.

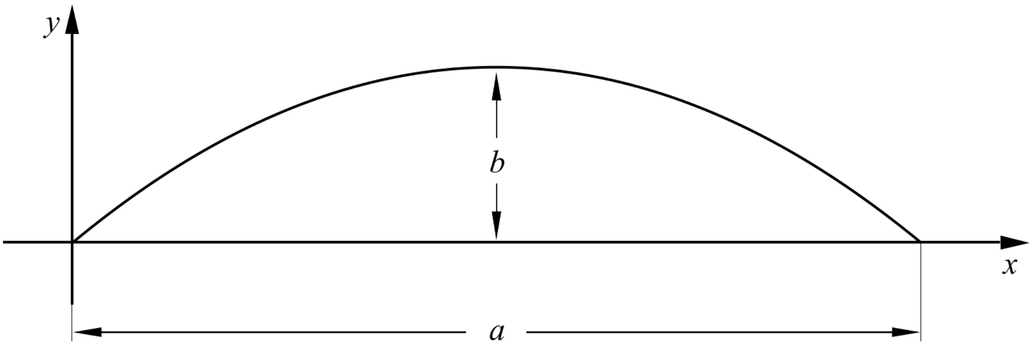
Mathematical terms are for example words like “exponent”, “function” and “graph”.
An example of a mathematical expression is that x^2 is read “*x* to the power 2” or “*x* squared”.
Some examples of mathematical symbols are π and $f(x)$, which are read “pi” and “*f* of *x*”.

Problem 1. Quadratic function

Name:______________________________

When assessing your oral presentation, the teacher will take into consideration:
- how complete, relevant and structured your presentation is,
- how well you describe and explain the train of thought behind your solution,
- how well you use the mathematical terminology.

The figure below shows the graph to the quadratic function $y = 3x - x^2$



a) What is the length of distance *a*?

b) What is the length of distance *b*, that is the distance between the highest point of the curve and the *x*-axis?

Problem 2. School equipment

Name:______________________________

When assessing your oral presentation, the teacher will take into consideration:
- how complete, relevant and structured your presentation is,
- how well you describe and explain the train of thought behind your solution,
- how well you use the mathematical terminology.

School is about to start so Hanna and Lukas go to the book shop to buy note books and other school equipment. The book shop sells note books for SEK 12 each but also pencils and rubbers. Hanna buys four note books, three pencils and six rubbers and pays SEK 78. Lukas buys seven note books, eight pencils and two rubbers and pays SEK 122.

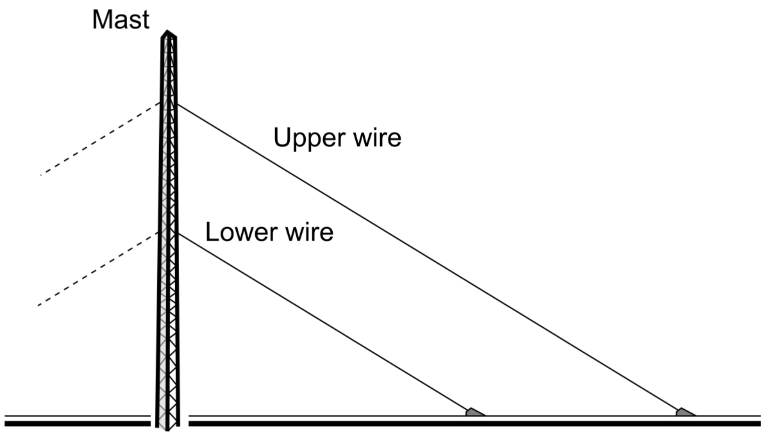
What is the price of a pencil and a rubber respectively?

Problem 3. The mast

Name:______________________________

When assessing your oral presentation, the teacher will take into consideration:
- how complete, relevant and structured your presentation is,
- how well you describe and explain the train of thought behind your solution,
- how well you use the mathematical terminology.

A 30 metres high mast is attached to the ground with wires running from the mast diagonally down to the ground. The upper wire has a length of 40 metres and its abutment is 5 metres below the top of the mast. The lower wire has its abutment a further 10 metres down the mast and it runs parallel to the upper wire. The mast is perpendicular to the ground.



a) How far from the mast is the upper wire attached to the ground?

b) What is the length of the lower wire?

Problem 4. Women's maximum pulse rate

Name:______________________________

When assessing your oral presentation, the teacher will take into consideration:
- how complete, relevant and structured your presentation is,
- how well you describe and explain the train of thought behind your solution,
- how well you use the mathematical terminology.

A group of women are part of a study that investigates how the women's maximum pulse rates vary with their age. The women are 15 years old the first time their maximum pulse rate is measured. Two further measurements are made when the women are 30 years old and 40 years old respectively.

Age x (years)	Maximum pulse rate y (beats/minute)
15	194
30	182
40	174

The table shows values from Lisa, one of the women in the group.

a) Investigate if the values in the table form a linear relationship.

b) Determine, with the aid of the table, an algebraic relationship of how Lisa's maximum pulse rate y beats/minute depends on age x years and use your relationship to determine at what age she has a maximum pulse rate of 146 beats/minute.

Bedömningsmatris för bedömning av muntlig kommunikativ förmåga

Kommunikativ förmåga	**E**	**C**	**A**	**Max**
Fullständighet, relevans och struktur Hur fullständig, relevant och strukturerad elevens redovisning är.	Redovisningen kan sakna något steg eller innehålla något ovidkommande. Det finns en övergripande struktur men redovisningen kan bitvis vara fragmentarisk eller rörig. (1/0/0)		Redovisningen är fullständig och endast relevanta delar ingår. Redovisningen är välstrukturerad. (1/0/1)	(1/0/1)
Beskrivningar och förklaringar Förekomst av och utförlighet i beskrivningar och förklaringar.	Någon förklaring förekommer men tyngdpunkten i redovisningen ligger på beskrivningar. Utförligheten i de beskrivningar och de förklaringar som framförs kan vara begränsad. (1/0/0)		Redovisningen innehåller tillräckligt med utförliga beskrivningar och förklaringar. (1/0/1)	(1/0/1)
Matematisk terminologi Hur väl eleven använder matematiska termer, symboler och konventioner.	Eleven använder matematisk terminologi med rätt betydelse vid enstaka tillfällen i redovisningen. (1/0/0)	Eleven använder matematisk terminologi med rätt betydelse och vid lämpliga tillfällen genom delar av redovisningen. (1/1/0)	Eleven använder matematisk terminologi med rätt betydelse och vid lämpliga tillfällen genom hela redovisningen. (1/1/1)	(1/1/1)
Summa				(3/1/3)