NATIONAL TEST IN MATHEMATICS COURSE B

AUTUMN 2009

Directions

Test time	240 minutes for Part I and Part II together. **We recommend that you spend no more than 60 minutes on Part I.**
Resources	**Part I:** ”Formulas for the National Test in Mathematics Course B” *Please note that calculators are not allowed in this part.* **Part II:** Calculators, also symbolic calculators and ”Formulas for the National Test in Mathematics Course B”.
Test material	The test material should be handed in together with your solutions. Write your name, the name of your education programme/adult education on all sheets of paper you hand in. *Solutions to Part I should be handed in before you retrieve your calculator. You should therefore present your work on Part I on a separate sheet of paper. Please note that you may start your work on Part II without a calculator.*
The test	The test consists of a total of 19 problems. **Part I** consists of 9 problems and **Part II** consists of 10 problems. For some problems (where it says *Only answer is required*) it is enough to give short answers. For the other problems short answers are not enough. They require that you write down what you do, that you explain your train of thought, that you, when necessary, draw figures. When you solve problems graphically/numerically please indicate how you have used your resources. Problem 19 is a larger problem which may take up to an hour to solve completely. It is important that you try to solve this problem. A description of what your teacher will consider when evaluating your work is attached to the problem. Try all of the problems. It can be relatively easy, even towards the end of the test, to receive some points for partial solutions. A positive evaluation can be given even for unfinished solutions.
Score and mark levels	The maximum score is 44 points. The maximum number of points you can receive for each solution is indicated after each problem. If a problem can give 2 ”Pass”-points and 1 ”Pass with distinction”-point this is written (2/1). Some problems are marked with ¤, which means that they more than other problems offer opportunities to show knowledge that can be related to the criteria for ”Pass with Special Distinction”.

Lower limit for the mark on the test

Pass:	12 points
Pass with distinction:	25 points of which at least 7 ”Pass with distinction”-points.
Pass with special distinction:	25 points of which at least 13 ”Pass with distinction”-points. You also have to show most of the ”Pass with special distinction” qualities that the ¤-problems give the opportunity to show.

Part I

This part consists of 9 problems that should be solved without the aid of a calculator. Your solutions to the problems in this part should be presented on separate sheets of paper that must be handed in before you retrieve your calculator. Please note that you may begin working on Part II without the aid of a calculator.

1. Which one of the following functions A-F corresponds to the graph below?

A) $y = -0.5x + 0.5$

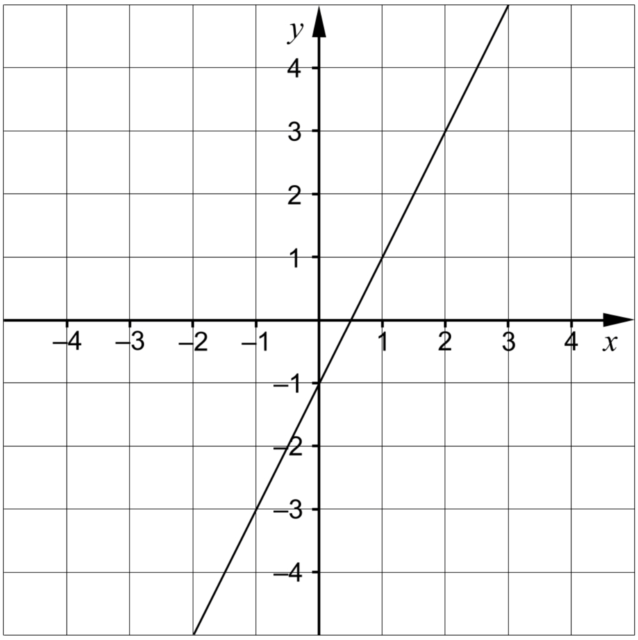
B) $y = 2x - 1$

C) $y = -0.5x + 1$

D) $y = -2x - 1$

E) $y = 2x + 0.5$

F) $y = 0.5x - 1$



Only answer is required (1/0)

2. Solve the equation $x^2 - 4x - 32 = 0$ (2/0)

3. A jar contains only red and black marbles, all of the same size and quality.
The probability of drawing a red marble is $\frac{1}{8}$

Give a suggestion of how many red and black marbles the jar might contain.
Only answer is required (1/0)

4. Simplify the expression $9 - (x-3)(x+3)$ as far as possible.
Only answer is required (1/0)

5. Solve the simultaneous equations $\begin{cases} 2x + 2y = 16 \\ 2x - y = -2 \end{cases}$ (2/0)

6. In the triangle *ABC* below, the lines *DE* and *AB* are parallel.

Determine the length of the line *AB*. (2/0)

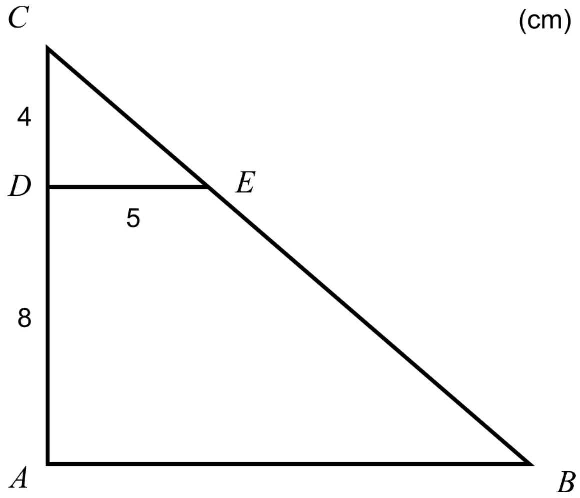


Figure not to scale

7. A straight line is described by the equation $3x + 2y + 1 = 0$

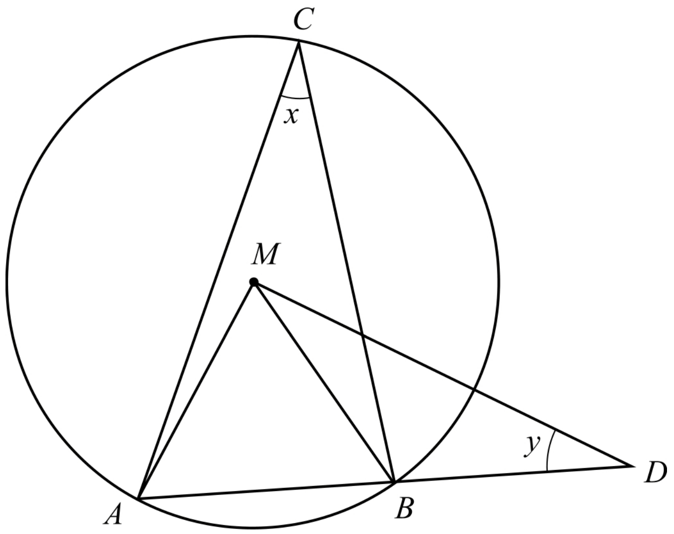
Determine the coordinates for a point on the line.

Only answer is required (0/1)

8. For the function f it holds that $f(x) = x^2$

Is there one or more numbers a such that $f(a) = a$?
If so, determine all such numbers. (0/2)

9. A triangle *ABC* is inscribed in a circle with centre *M*. The line *AB* is extended to the point *D*, so that the line *BD* is of the same length as the radius of the circle. (See figure.)



a) If the angle x is 50°, how large is the angle y? (1/1)

b) The angle x satisfies $0° < x < 90°$
Determine a relationship between x and y. (0/1/¤)

Part II

This part consists of 10 problems and you may use a calculator when solving them.
Please note that you may begin working on Part II without a calculator.

10. Determine an equation for the straight line passing through the points (6, 11) and (10, 17). (2/0)

11. Jane and Axel are considering leasing a mini golf course on the municipal camping ground. The mini golf course is open each summer between May 15 and August 31. For this period of time, they would pay 100 000 SEK in rent to the municipality.

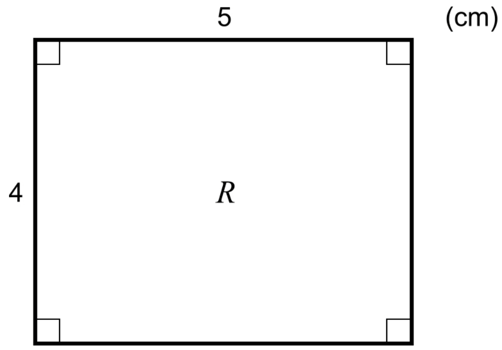
They contacted Diana, who had previously leased the mini golf course, and asked her:
- *Did you have many visitors during that period?*
She replied:
- *The mean was 45 players per day, but the median was 55 players per day.*

The fee for playing is set to 20 SEK per player.

Would Jane and Axel make a profit by leasing the mini golf course? (2/0)

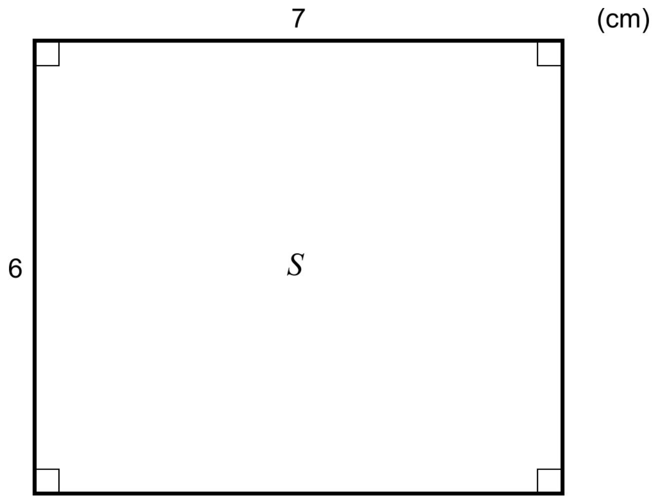
12. The rectangle *R* has sides of length 4 cm and 5 cm.

a) Sketch a new rectangle that is smaller than, and similar to the rectangle *R*.
Write down the side lengths of the new rectangle.



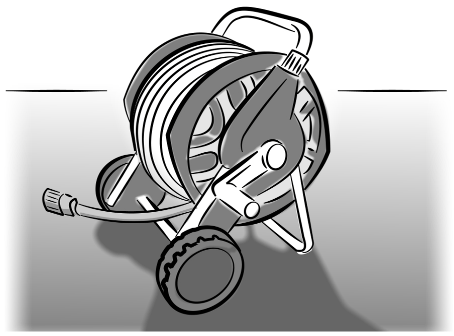
(1/0)

b) Compare the rectangle *R* with the rectangle *S*.
Determine whether the rectangles are similar.



(1/0)

13. A department store stocks garden hose reel carts. The reel cart comes with hoses of different lengths. The table below specifies the price of a reel cart with two different lengths of hose.



Length of hose, x	20 m	45 m
Price, P, of reel cart and hose	359 SEK	499 SEK

The price P can be described by the linear relation

$$P = ax + b$$

where P is the price in SEK for the reel cart and hose, and x is the length of the hose in metres.

a) Calculate the values of the constants a and b. (2/0)

b) How can the constants a and b be interpreted in this context? (0/1)

14. Daniel often watches two of his satellite TV channels. He knows that Channel A has 18 minutes of commercials per hour, and that Channel B has 13 minutes of commercials per hour. He also knows that the times that the two channels broadcast commercials are independent of each other.

a) Daniel switches on Channel B. What is the probability that a commercial is broadcasted? (1/0)

b) At a later time, Daniel switches on his TV. What is the probability that at least one of the two channels A and B is broadcasting something other than commercials at that time? (0/2)

15. A small business manufactures ski gloves in the colours dark blue, grey and black. In order to better estimate how popular the colours are among young people, the manager decided to do a survey.

The survey was distributed to 500 high school students. Among the 297 completed surveys, 19 % preferred dark blue, 41 % grey and 40 % black gloves.

Since so many students did not respond, the manager investigated the nonresponse group. Therefore he contacted 55 randomly-chosen students among those that had not responded. Of these 55 students, 10 answered ’dark blue’, 23 answered ’grey’, and the remaining students answered ’black’.

Comment on the results of this nonresponse analysis. (1/1)

16. Jewelery and trinket store ’Smyckegrottan’ has a storewide sale. Sarah, Wei, Liam and Amanda pay them a visit, in hope of finding some bargains. They discover that all hair clips have the same discount price. All rings also have a set discount price. The same goes for bracelets, too.

Sarah buys three hair clips, four rings and six bracelets and pays 192.50 SEK.
Wei buys eight hair clips, seven rings and two bracelets and pays 230 SEK.
Liam buys five rings and pays 100 SEK.

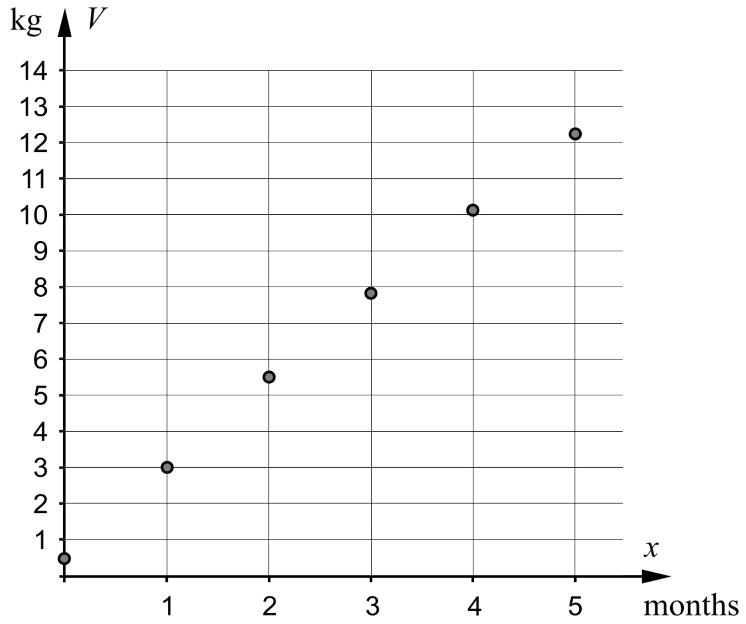
Amanda plans on buying seven hair clips, four rings and two bracelets.
How much will she have to pay? (0/3)

17. Determine five *distinct* positive whole numbers such that the following holds:

- Their mean is 5
- Their median is 4
- The range is maximised (0/1/¤)

18. Nils and Hilma have bought a miniature pet pig. According to the breeder, the pig will be full-grown after about two years. At that time, it is expected to weigh approximately 35 kg.

The pig has been weighed once every month since birth. The results are plotted in the diagram below.



Nils thinks the diagram indicates that the weight of the pig increases by approximately the same amount each month.
He considers a model where the weight increases by the same amount each month until the pig is full-grown.

a) Using the diagram, determine a function that gives the relationship between the weight and age of the pig, in accordance with Nils's model. (0/1)

Hilma has found a model on the internet, which gives the weight of miniature pigs from birth to full-grown,

$$V(x) = -0.05x^2 + 2.60x + 0.50$$

where V is the weight in kg and x is the age of the pig in months.

b) Nils and Hilma now have two different models for the weight of the pig. Investigate how well the models correspond to the claims of the breeder and the weights of the pig from the diagram.
Is either model better than the other? Justify your answer. (0/2/¤)

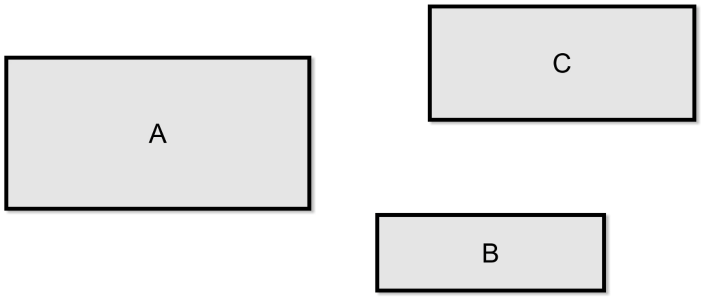
When assessing your work with the following problem, the teacher will take into consideration:

- How general your solution is
- How well you justify your conclusions
- How well you carry out your calculations
- How well you present your work
- How well you express yourself mathematically

19. Your task is to investigate rectangles with a common property:

- The width is always 2 cm greater than the height.

Three examples of such rectangles are given below:



- Is there a rectangle of this type which has a *perimeter* of 5 cm?
  Is there a rectangle of this type which has a *perimeter* of 3 cm?

- Is there a rectangle of this type which has a *area* of 11.25 cm^2?
  Is there a rectangle of this type which has a *area* of 1 cm^2?

- Is there a rectangle of this type which has a *diagonal* of 8 cm?
  Is there a rectangle of this type which has a *diagonal* of 1 cm?

- Write down formulas for the *perimeter*, *area* and *length of the diagonal*, expressed in one single variable, for this type of rectangle.
  Investigate which limitations there are for the values that the *perimeter*, *area* and *length of the diagonal* can have. (4/4/¤)