NATIONAL TEST IN MATHEMATICS COURSE B
SPRING 2004

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, 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 16 problems. **Part I** consists of 8 problems and **Part II** consists of 8 problems.

To 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 16 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 40 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:	13 points
Pass with distinction:	25 points of which at least 7 ”Pass with distinction”-points.
Pass with special distinction:	In addition to the requirements for ”Pass with distinction” you have to show ”*Pass with special distinction*” *qualities in at least one* of the ¤-problems. You must also have at least 13 ”Pass with distinction”-points.

Name: ______________________________ School: __________________________________

Education programme/adult education: ____

Part I

This part consists of 8 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. Solve the equation $x^2 - 2x - 24 = 0$ (2/0)

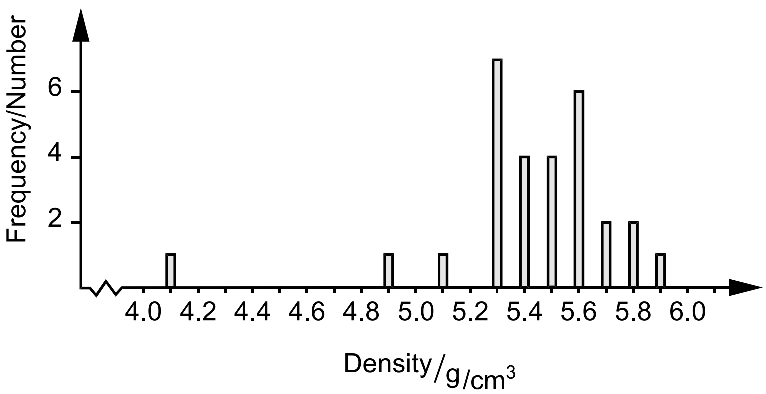
2. Find the equation of the straight line that passes through the points (–3, 2) and (7, 4). (2/0)

3. Solve the inequality $3x - 1 \geq 5 + x$ *Only answer is required* (1/0)

4. Solve the simultaneous equations $\begin{cases} x - y = 13 \\ 2x + y = 26 \end{cases}$ (2/0)

5. In 1798 the Englishman Henry Cavendish tried to determine the density of the Earth. He made a number of measurements with a torsion balance and then calculated values for the density of the Earth.

The diagram below shows the distribution of a number of values for the density of the Earth obtained from a series of measurements with Cavendish's torsion balance.



a) What is the range of the values? *Only answer is required* (1/0)

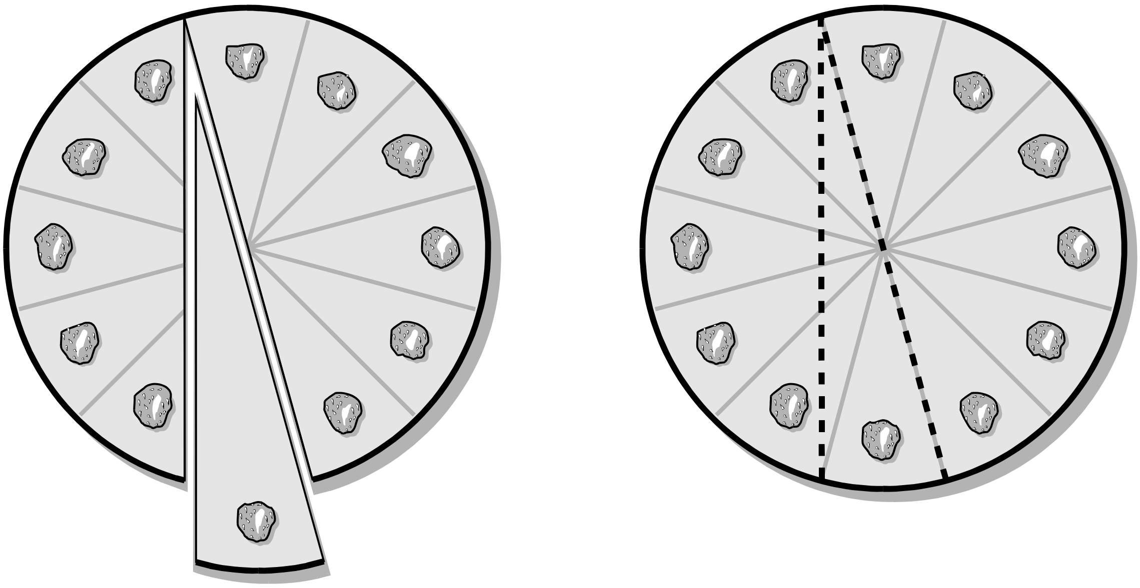
b) The mean value of all values is 5.4 and the median is 5.5. Why might you suspect that the median is a better estimate for the density of the Earth than the mean value? (1/0)

6. Simplify $(3x+2)^2+2(x-2)$ as far as possible. (2/0)

7. Give an example of a quadratic function, $y = f(x)$, where $f(2)=6$

Only answer is required (0/1)

8. On a cake intended for 12 people there are markings around each piece. Gustav cuts a piece that goes straight across the cake instead of to the middle, see figures below.



a) What is the angle at the tip of Gustav's piece of cake? (2/0)

b) Estimate approximately how much bigger is Gustavs piece of cake compared to an ordinary piece of cake. (0/1/¤)

Part II

This part consists of 8 problems and you may use a calculator when solving them. Please note that you may begin working on Part II without your calculator.

9. Knut throws a drawing-pin on a table-top. He throws the drawing-pin 10 times and counts how many times the pin lands point up. He does a total number of twenty of these ”ten-series”. The table below shows the results.

”Ten-series” number:	1	2	3	4	5	6	7	8	9	10
Number of ”point up”	5	9	4	7	10	4	3	4	7	7

”Ten-series” number:	11	12	13	14	15	16	17	18	19	20
Number of ”point up”	4	7	5	6	5	6	7	5	5	6

Approximately how many times should the drawing-pin land with the point up if Knut makes 1550 throws in total? (2/0)

10. Plastic Things & Stuff Ltd manufactures, among other things, rulers. Every week 50000 rulers are produced. All the rulers that were produced during a certain week were sold to a customer in Lund.

After a while, the company began getting complaints from the customer and decided to do a quality check. During one week the quality was checked on every 200^{th} ruler produced. 11 rulers of poor quality were found.

a) A random sampling is described above. How large was the random sample? (1/0)

b) How many of the rulers sent to Lund can be assumed to have been of poor quality? (2/0)

11. A circle passes through the points $A = (-14, 0)$ and $B = (6, 0)$ in a coordinate system. The distance AB is the diameter of the circle.

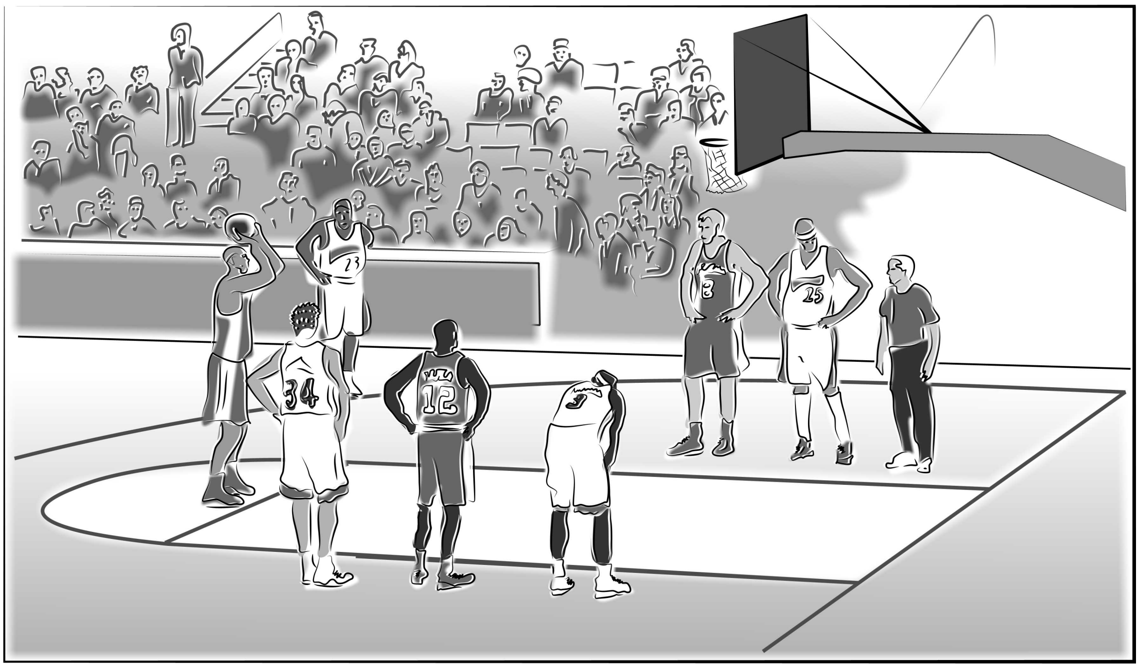
a) Determine the coordinates (x, y) for the centre of the circle.
Only answer is required (1/0)

b) Calculate the y-coordinate for each one of the points where the circle intersects the y-axis. (0/2)

12. During a basketball game Shaquille O'Neal was awarded three free throws. Statistics show that during previous games this season he has been successful in 67 of 108 free throws.

a) What is the probability that he will be successful in all three throws? (1/0)

b) What is the probability that he will be successful in at least one of the three throws? (0/2)

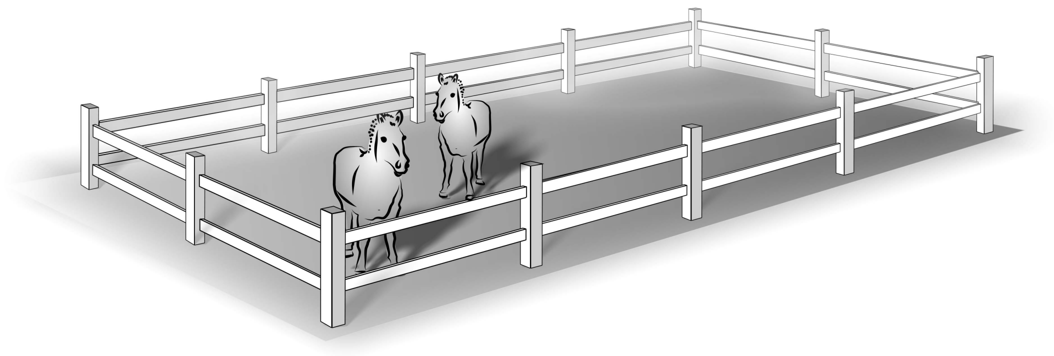


13. Ten students were sitting at a café in Gothenburg. Hanna collected SEK 252, the cost of 4 teas and 6 Cafe Lattes. When she had placed her order and paid she had SEK 34 left. Then Hanna realised that she had mixed up the number of teas with the number of Cafe Lattes when she placed her order.

What was the price of a Cafe Latte at that café? (0/3)

14. Lina has a rectangular paddock , 20 m long and 10 m wide. She is planning to buy another horse and will therefore need a larger paddock. Lina wants a paddock with twice the area. Lina plans to achieve this by increasing the length with just as many metres as the width of the paddock.

How many metres of new fence does Lina have to add to be able to enclose the whole new paddock, assuming that she can reuse all of the existing fencing? (0/3)



15. For a group of linear functions it holds that $f(x+1) < f(x)$ for all x and that $f(0) = 1$

a) Give *one* linear function with these properties.

Only answer is required (0/1)

b) Describe what properties the graphs of this group of functions have. Justify your answer. (0/2/¤)

When assessing your work with the following problem the teacher will consider the following:
- How general your solution is
- What mathematical knowledge you show
- How well you justify your conclusions
- How well you carry out your calculations
- How well you present and comment on your work
- How well you use the mathematical language

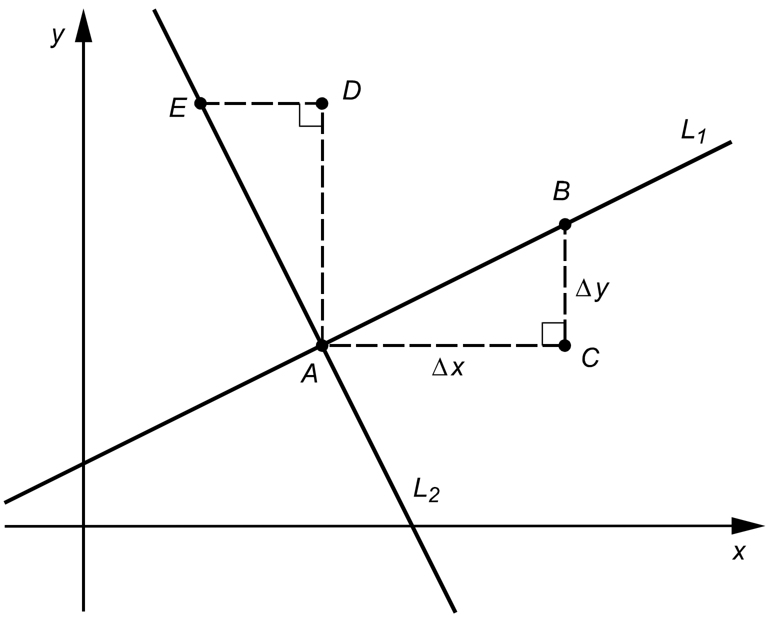
16. The purpose of this problem is to investigate the relation between gradients of lines perpendicular to each other.

The example below may be of help to you in your investigation and shows one method of constructing lines perpendicular to each other.

The equation for a given line L_1 is $y = 0.5x + 1$, see figure below.
The points $A = (4, 3)$ and $B = (8, 5)$ lie on this line. The points A, B and C form the corners of a right-angled triangle where the side AC is parallel to the x-axis.

By rotating the triangle ABC 90° anti-clockwise around the point A a new triangle ADE is formed.

Then the side AE becomes perpendicular to the line L_1 and with that the line L_2 becomes perpendicular to the line L_1.



- Determine the coordinates of the points C, D and E in the figure and calculate the gradients of the perpendicular lines L_1 and L_2 by using the coordinates of the points.
  Then show that the product of the gradients of the lines is -1.

- Show that the product of the gradients of two perpendicular lines on the form $y = kx + m$ ($k \neq 0$) is always -1.

(2/3/¤)