NATIONAL TEST IN MATHEMATICS COURSE B
SPRING 2005

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 17 problems. **Part I** consists of 8 problems and **Part II** consists of 9 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 17 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 47 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:	14 points
Pass with distinction:	27 points of which at least 6 ”Pass with distinction”-points.
Pass with special distinction:	In addition to the requirements for ”Pass with distinction” you have to show most of the ”Pass with special distinction” qualities that the ¤-problems give the opportunity to show. You must also have at least 12 ”Pass with distinction”-points.

Name: ______________________________ School: ______________________________

Education programme/adult education: ______________________________

Part I

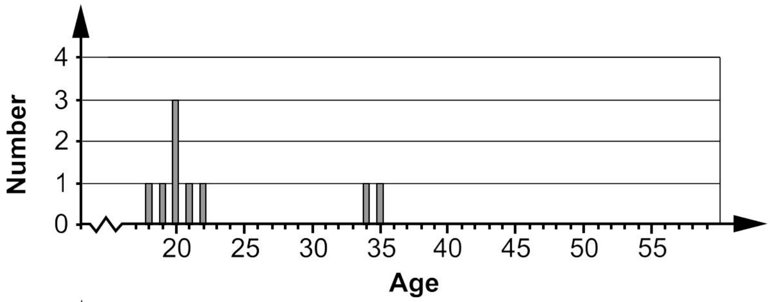
This part consists of 8 problems that should be solved without the aid of a calculator. Your solutions to the problems in this part should be presented on separate sheets of paper that must be handed in before you retrieve your calculator. Please note that you may begin working on Part II without the aid of a calculator.

1. Solve the equations

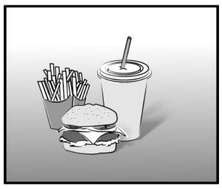
a) $x^2 + 2x - 8 = 0$ (2/0)

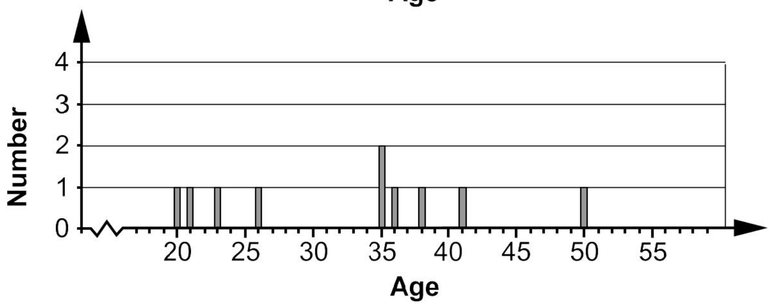
b) $40x + 10x^2 = 0$ (2/0)

2. The diagrams below show the distribution of employee-age at three different places of work.

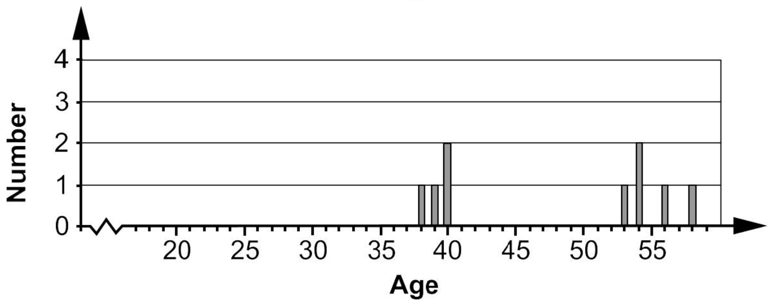


Hamburger bar

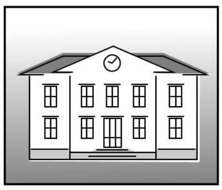




IT - Company



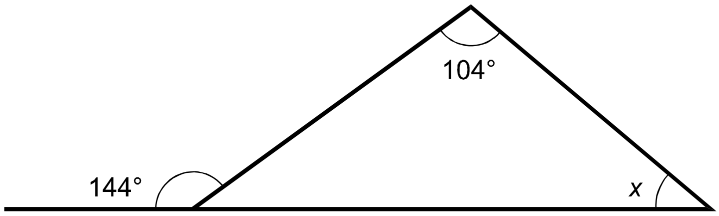
School



Which place of work has the largest range of distribution and how large is it?

Only answer is required (1/0)

3.



a) Determine the angle x (1/0)

b) Which of the following geometric relationships did you use when you determined the angle x? *Only answer is required* (1/0)

A Pythagoras' theorem

B The sum of all angles in a triangle is 180°

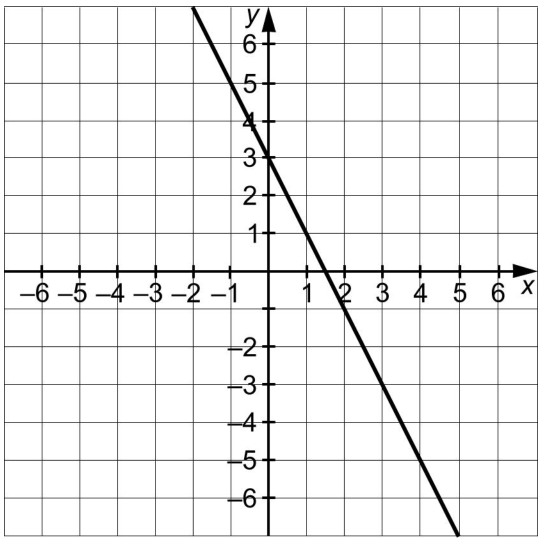
C The sum of supplementary angles is 180°

D Exterior angle theorem

E Triangle proportionality theorem

F Inscribed angle theorem

4.



a) Find the equation to the line drawn in the coordinate system. *Only answer is required* (1/0)

b) Decide whether the point (–4, 11) is on that line. (1/0)

c) Draw a coordinate system and then draw a line that has a gradient $k = \frac{3}{4}$ *Only answer is required* (1/0)

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

6. a) Solve the inequality $3x+13<7$ (1/0)

b) Which value or values for x from the following list will satisfy the inequality $3x+13<7$?

Only answer is required (1/0)

A − 7

B − 6

C − 2

D 2

E 6

F 7

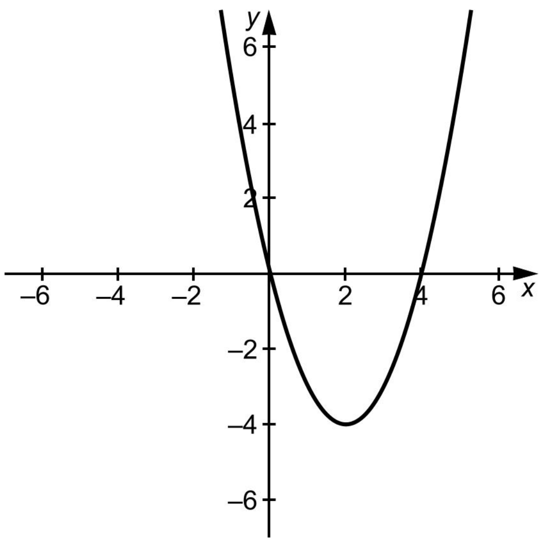
7. You are participating in a game show on TV and you can win SEK 1000 on a game of dice.

The rules are that the host casts two dice that you cannot see. You are then going to guess the number of dots the two dice show together.

If your guess is correct you win SEK 1000.

How many dots should you guess at to have the highest probability of winning? Justify your answer. (0/2)

8. Write down the equation to a straight line that *never* intersects the graph of the function $y=x^2-4x$ *Only answer is required* (0/1)



Part II

This part consists of 9 problems and you may use a calculator when solving them. Please note that you may begin working on Part II without your calculator.

9. Simplify the following expressions as far as possible

a) $(x-4)^2-16$ *Only answer is required* (1/0)

b) $x(2x+5)-2(3+x)$ *Only answer is required* (1/0)

10. In October 2003 the Swedish national team in women's football enjoyed a degree of success by winning a silver medal in the Women's World Cup. Out of the 20 players in the team, 6 came from Umeå IK, the same number of players came from Malmö FF and the rest of the players were from four other football clubs.

At one time during the Women's World Cup, two players were to be picked out at random to undergo a doping test.

a) What was the probability that the first player picked for a doping test came from Umeå IK? *Only answer is required* (1/0)

b) What was the probability that both players picked for a doping test came from Umeå IK? (1/1)

11. Patrik is going to buy 'Pick'n'mix' sweets for his mum Ellen. She tells Patrik that she wants 5 hg of sweets and gives him SEK 30 to spend.

At the shop, there are two different prices of 'Pick'n'mix' sweets. The price of the more expensive sweets is 7.90 SEK/ hg and the cheaper sweets is 4.90 SEK/hg.

Patrik asks himself: Is it possible to buy exactly 5 hg of sweets for SEK 30?

After some thought, he comes up with a way of calculating it and writes down the simultaneous equations:

$$\begin{cases} x+y=5 \\ 4.90x+7.90y=30 \end{cases}$$

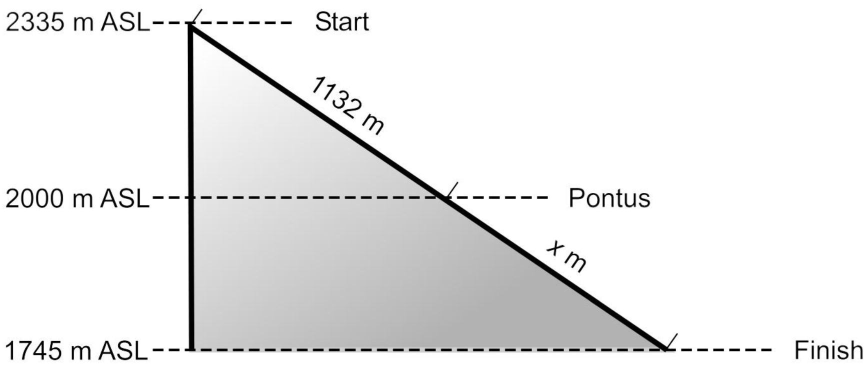
a) Explain what x and y represent in the simultaneous equations. *Only answer is required* (1/0)

b) Choose one of the equations above and explain what the equation describes. *Only answer is required* (1/0)

c) Solve the simultaneous equations and then answer Patrik's question above. (2/0)

12. In the 2005 Alpine World Ski Championships Anja Pärson won the competition in Super G on a course that can be described by the simplified figure below. The course starts at a height of 2335 metres above sea level (ASL) and has a drop of 590 metres.

Figure not drawn to scale

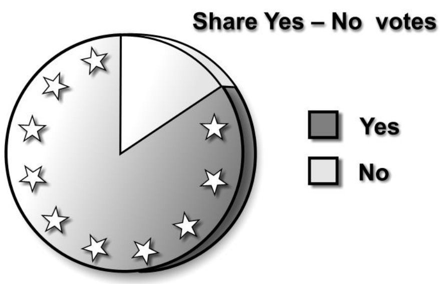


Pontus is standing at a ski lift station along the course, watching the competition. His altitude indicator shows that he is at an altitude of 2000 metres above sea level. A sign at the ski lift station tells him that the lift goes 1132 metres up to the start area, see figure.

How far do the competitors still have to go to get to the finish when they have passed Pontus? (0/2)

13. In April 2003 the citizens of Hungary voted on membership in the EU. At the counting of the votes it turned out that 84% voted Yes to membership in the EU and that 45% of those having the right to vote in the referendum did so.

Investigate between which percentages the share of Yes-votes could be if everyone with the right to vote had participated in the referendum. (0/2)

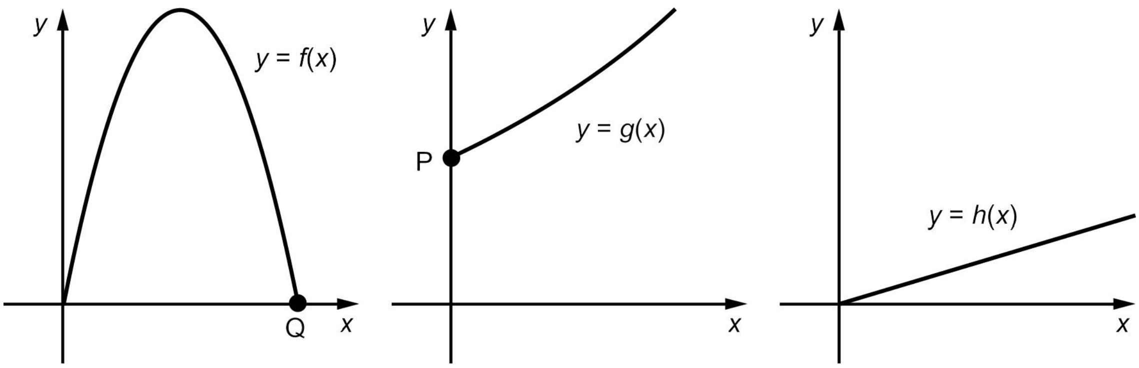


14. Each one of the situations I, II and III applies to one graph in the figure below.

I For many goods, the VAT corresponds to 20% of the price of the item. The amount of VAT is a function of the price of the item.

II You are going to build a rectangular kennel from 40 m of fencing. The area of the kennel is a function of the length of the kennel.

III In the beginning there are 50 bacteria in a culture. Every hour the number of bacteria increases by 20%.
The number of bacteria is a function of time.



a) Combine the situations I, II and III with the functions *f*, *g* and *h*.
Only answer is required (2/0)

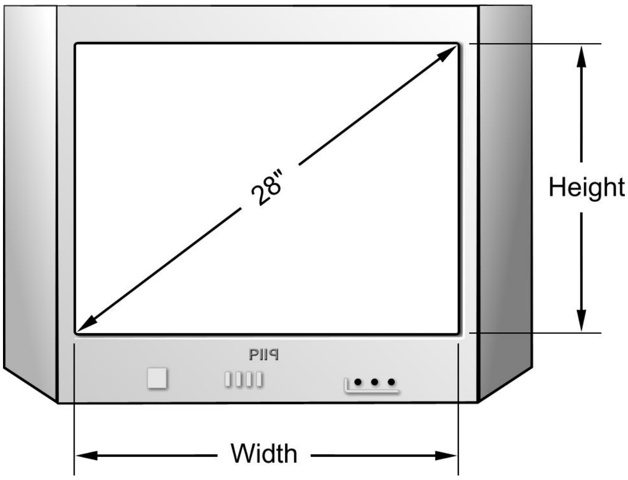
b) What is the *y*-value at point P? *Only answer is required* (1/0)

c) What is the *x*-value at point Q? *Only answer is required* (0/1)

d) Write *y* as a function of *x* for situation II. (0/1/¤)

15. The two most common picture formats for a TV are the *standard picture format* and the *widescreen format*. The length of the diagonal of the screen, measured in inches, is used to describe the size of a TV. One inch is approximately 2.54 centimetres.

Example: A common size of TV is 28” (28 inches).



A *standard picture format* TV has a screen where the width is $\frac{4}{3}$ of the height.

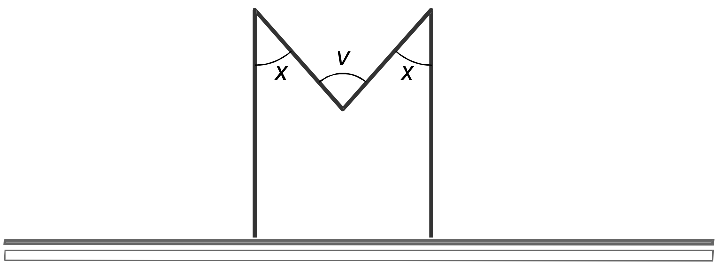
A *widescreen* TV has a screen where the width is $\frac{16}{9}$ of the height.

Consider two TVs that are the same size, which means that the diagonals of the screens are the same length, but where one of them is of the standard picture format and the other one is of the widescreen format.

Determine which format gives the screen with the largest area. (0/3/¤)

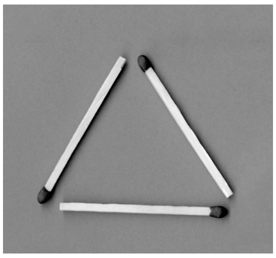
16. The figure shows the letter M standing on a horizontal surface. The two vertical ‘supporting legs’ are of equal length.

Show that $v = 2x$ (0/2/¤)

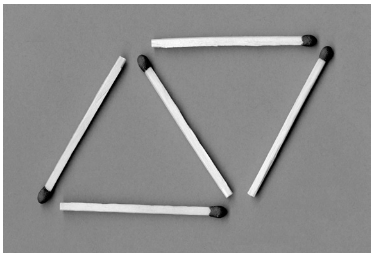


When assessing your work, your teacher will take into consideration:
- How well you carry out your calculations
- How well you present and comment on your work
- How well you justify your conclusions
- What mathematical knowledge you show
- How well you use the mathematical language
- How general your solution is

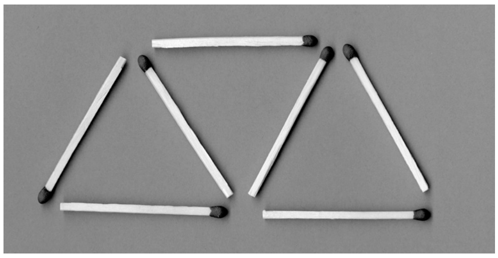
17. This problem is about forming figures by using matches. The object is to connect a number of simple regular polygons after each other into a row. The examples below show how it is done with regular triangles and rectangles.



From 3 matches 1 triangle can be formed.



From 5 matches 2 triangles can be formed.



From 7 matches 3 triangles in a row can be formed.

The relation between the number of matches and the number of connected triangles can be found if they are connected in a row as shown in the picture.

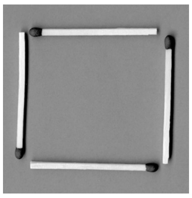
In the table below, x is the number of matches and y the number of connected triangles.

x	y
3	1
5	2
7	3
..	..

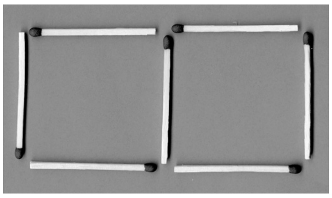
- Plot the points in a coordinate system. The points are on a straight line. Find the equation of the line of the form $y = kx + m$.

- How many triangles can be formed from 20 matches if you connect the triangles as in the pictures above? Comment on your answer and draw a conclusion about the number of matches needed to form a row of triangles in this way.

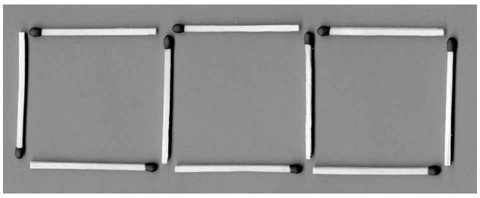
- What will happen if you instead form a row of squares in the same way as shown in the pictures below? Write down and describe a relation between the number of matches and the number of connected squares.



One square.



Two squares.



Three squares placed in a row.

- A polygon is sometimes called an n-gon, where n is a positive integer that states the number of corners. Imagine that you form a line of a certain kind of n-gons that are connected in the same way as before.

  Try to find the relation between the number of matches and the number of connected n-gons. Describe this relation in words and with a formula. Explain why your relation is true to all n-gons. (3/4/¤)