

Concerning test material in general, the Swedish Board of Education refers to the Official Secrets Act, the regulation about secrecy, 4th chapter 3rd paragraph. For this material, the secrecy is valid until the expiration of December 2010.

Directions

Test time	240 minutes without a break.
Resources	Calculator and “Formulas to National Test in Mathematics Courses C, D and E”.
Test material	<p>The test material should be handed in together with your solutions.</p> <p>Write your name and the name of your education programme / adult education on all the sheets of paper you hand in.</p>
The test	<p>The test consists of 14 problems.</p> <p>For some problems (where it says <i>Only an answer required</i>) you only need to give a short answer.</p> <p>For the rest of the problems short answers are not enough. They require that you write down what you do, that you explain your train of thoughts, that you, where necessary, draw figures and that when you solve problems graphically/numerically show how you have used your resources.</p> <p>Problem no 14 is a larger problem that may take you up to one hour to solve completely. It is important that you try to solve this problem. Included in the problem is a description of what the teacher will consider when assessing your work.</p> <p>Try all of the problems. It can be relatively easy, even towards the end of the test, to receive some points for a partial solution or presentation.</p>
Score and mark levels	<p>The maximum score is 46 points.</p> <p>The number of points you can receive for your solution is written after each problem. If a problem can give 2 “Pass”-points and 1 “Pass with distinction”-point this is written (2/1).</p> <p>Lower limit for the test-grade</p> <p>Pass: 14 points.</p> <p>Pass with distinction: 26 points of which at least 6 “Pass with distinction”-points.</p>

Name: _____ School: _____

Education programme/Adult education: _____

1. Differentiate

a) $f(x) = x^4 - 5$ *Only an answer is required* (1/0)

b) $g(x) = \frac{2x^3}{3} - \frac{x}{7}$ *Only an answer is required* (1/0)

2. Solve the following equations

a) $x^5 = 28$ *Only an answer is required* (1/0)

b) $\ln x = 4$ *Only an answer is required* (1/0)

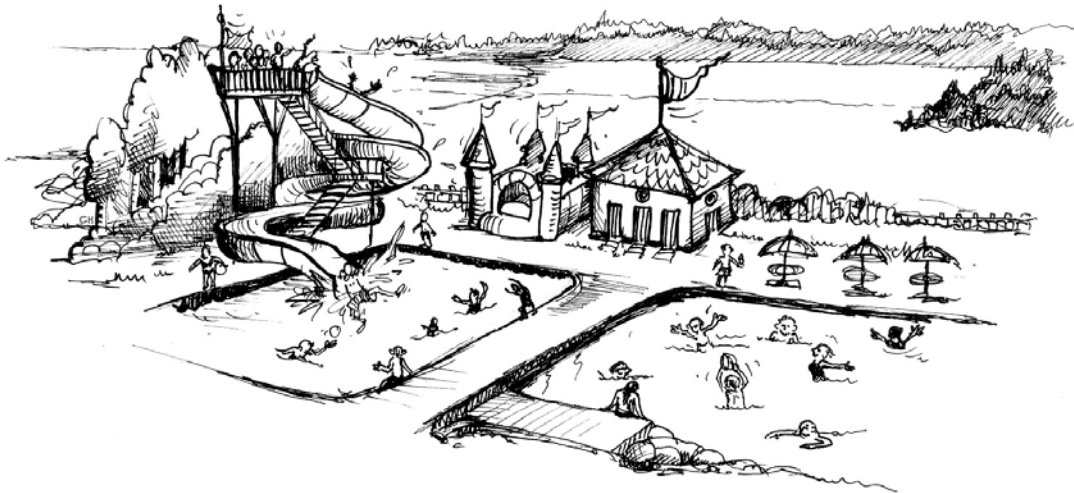
c) $5^x = 8$ *Only an answer is required* (1/0)

3. In mathematics you have among other things studied exponential functions.

a) Give an example of such a function. *Only an answer is required* (1/0)

b) Differentiate your function. *Only an answer is required* (1/0)

4.



An aquatic theme park opened in the spring of 1985 and that summer the park had 12 443 visitors. The number of visitors then increased by 8 % every year.

a) How many visitors did the aquatic theme park have in 1994? (1/0)

b) How many visitors did the aquatic theme park have in total during the first ten years? (2/1)

5. In July 1998 Lovisa worked at a summer café. Her older brother Anders had worked at the same café in 1990 and so had their father Bosse in 1970. Their hourly wages can be seen in the table below as well as the CPI for July the corresponding years.

Year	1970	1990	1998
Hourly wage (SEK/hour)	11	52	65
CPI	237	1189	1467

(The information in the table about CPI is taken from Statistics Sweden. CPI = Consumer Price Index)

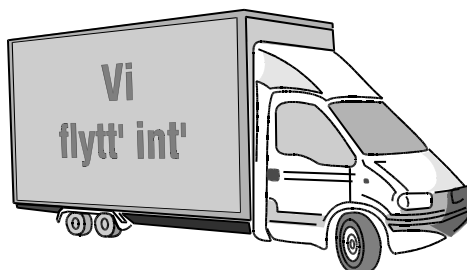
Which of the three had the best hourly wage if CPI is taken into account? (2/0)

6. The table below shows the number of bacteria $N(t)$ in a culture of bacteria at different points of time t measured in hours.

t	$N(t)$
2	5 000
4	15 000
6	40 000
8	109 000
10	300 000

Use the table and make as good estimation as possible of $N'(7)$, i.e. an estimate of the growth rate at the time $t = 7$ hours. (2/0)

7.



A school for adults is maybe moving from the city centre to the western outskirts. Therefore, all 2400 students were given a survey about the move. Out of the 60 % that answered the survey 70 % were positive about moving. Out of those who did not answer the survey, 250 persons were randomly chosen and interviewed over the phone. Out of these, 100 persons were positive about the move.

If the students are to decide, should the school move? (2/0)

8. In some cases the doctor needs to know the area of the patient's body to be able to decide on the amount of medicine the patient should be given. Since there is no easy way to measure the area of the body the following formula has been agreed on:

$$\lg S = 0.425 \cdot \lg M + 0.725 \cdot \lg H + 1.8564$$

where S is the body area in cm^2 , M is the weight in kg and H is the length in cm.

- a) Fredrik's weight is 79 kg and his length is 184 cm.
Calculate Fredrik's body area using the formula above. (1/1)

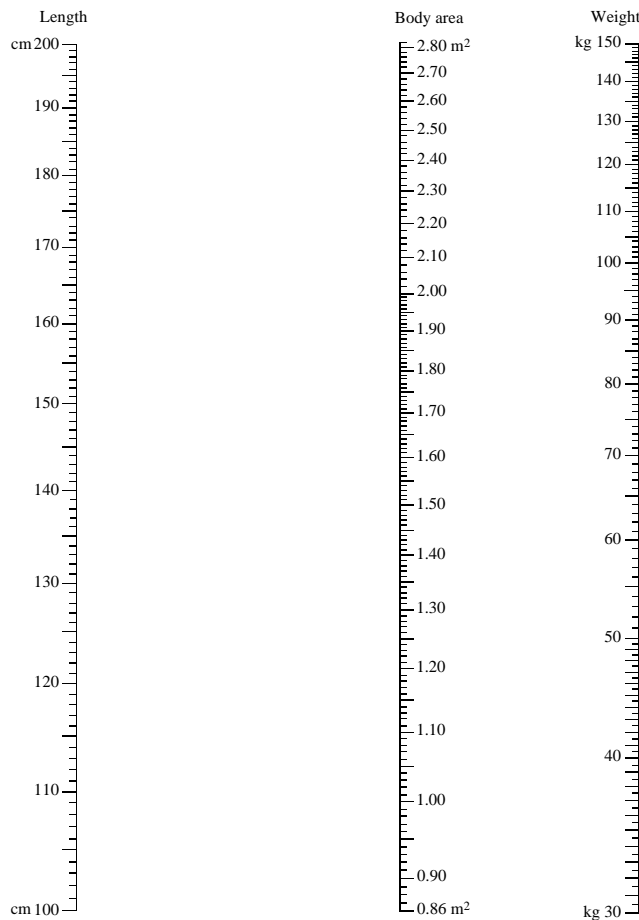
To reduce the work of calculations in difficult situations within the health care environment the formula has been translated into a diagram, a so-called nomogram. The nomogram can be used to directly find a patient's body area.

- b) A patient who weighs 60 kg and is 167 cm tall was prescribed the medicine Methodrexat for the disease rheumatism. The prescription was 7 mg/m^2 .
What amount of medicine should the patient be given? (1/0)
The problem can be solved by using the nomogram below.

Nomogram, adults

For the determination of body area from length and weight¹

Place a ruler between length and weight. The intersection with the middle line is the patient's body area.



¹ From Du Bois and Du Bois. *Arch.intern.Med.*, 17, 863 (1916):
 $S = M^{0.425} \times H^{0.725} \times 71.84$, or $\lg S = \lg M \times 0.425 + \lg H \times 0.725 + 1.8564$
 (S: body area in cm^2 , M: weight in kg, H: length in cm), Adaption from:
 Geigy Scientific Tables, 8th edition. Published by Ciba-Geigy Limited, Basel, Schweiz.

9. For a certain function f it holds that:

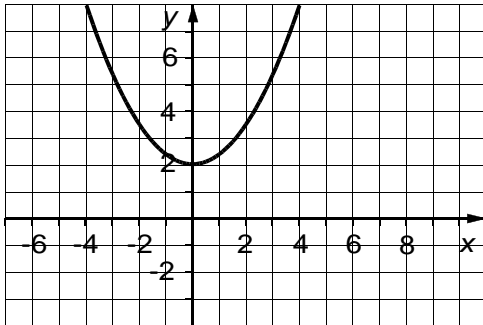
- $f'(x) = ax + 12$
- $f'(2) = 0$

In the figures below the graphs to some functions $y = f(x)$ are drawn.

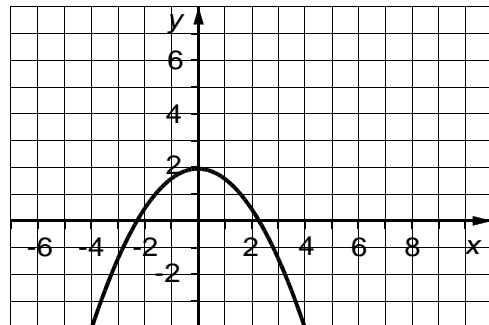
Which of the graphs A to F satisfies the conditions above?
The answer must be justified.

(1/2)

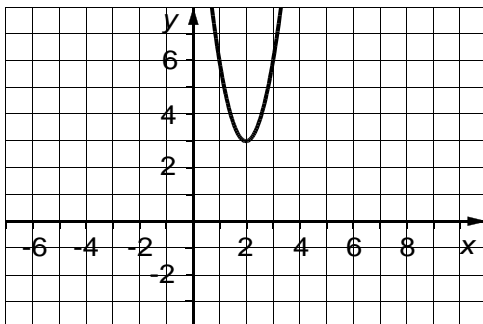
A



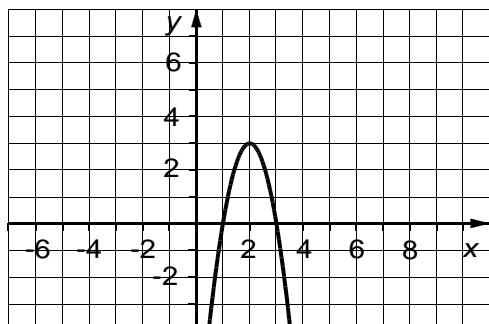
B



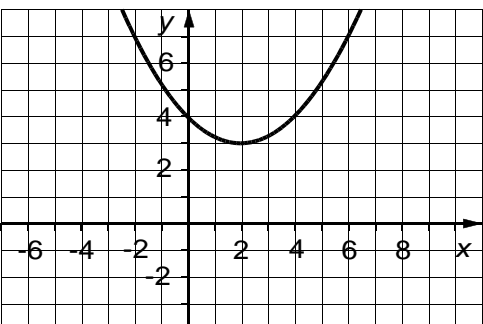
C



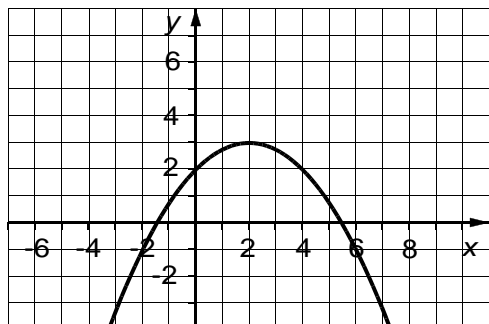
D



E



F



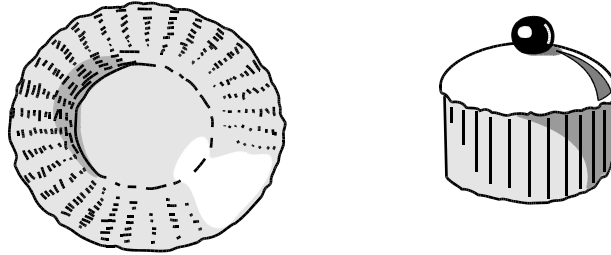
10. Find the smallest number of terms that has to be added in the expression

$$700 + 700 \cdot 1.003 + 700 \cdot 1.003^2 + 700 \cdot 1.003^3 + \dots$$

if the sum is to exceed 85 000.

(1/2)

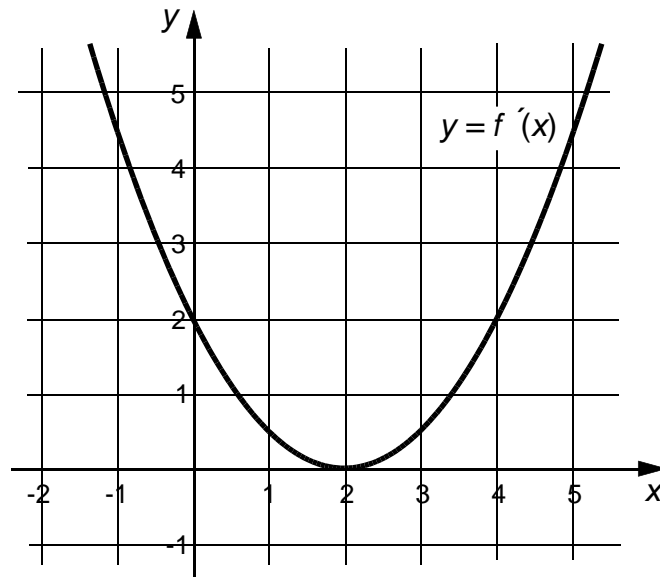
11. A circular piece of paper with radius 6.4 cm is folded so that a cylindrical paper mould for pastries is obtained (see figure).



By using the derivative, calculate how the piece of paper must be folded to obtain the largest possible volume of the paper mould.

(0/4)

12. The figure shows the **derivative** $f'(x)$ of the function $f(x)$.

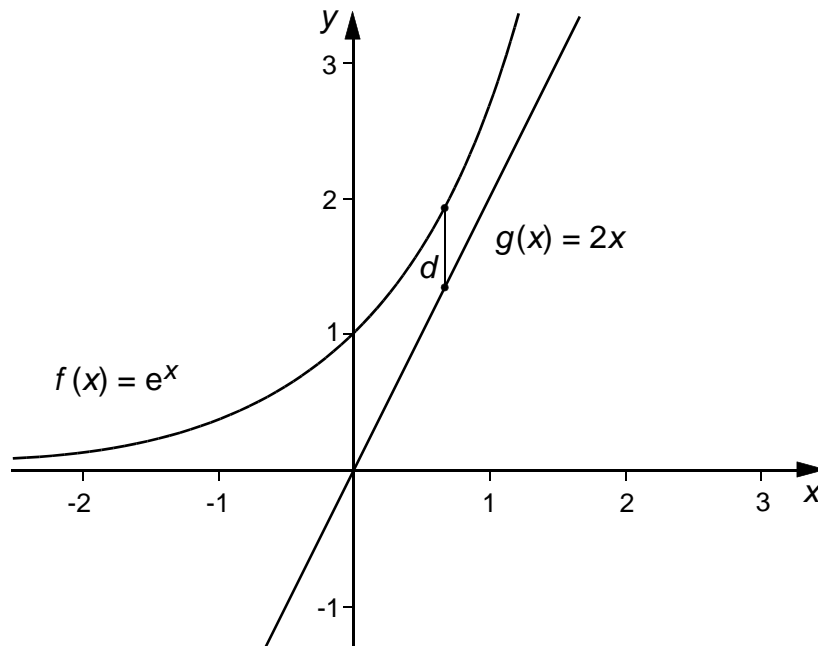


For what value/values of x has the curve of the function $f(x)$ a tangent line that is parallel to the line $x - 2y - 1 = 0$?

(0/3)

13. Calculate the shortest vertical distance d between the curve $f(x) = e^x$ and the line $g(x) = 2x$ (see figure). Give an exact answer.

(0/3)



14.



Helen was born on January 31 1999 and at that time her weight was 3.2 kg. From the age of two weeks her weight was registered at different points of time. The result is shown as points in a diagram. A smooth curve has been adjusted to the points (see figure).

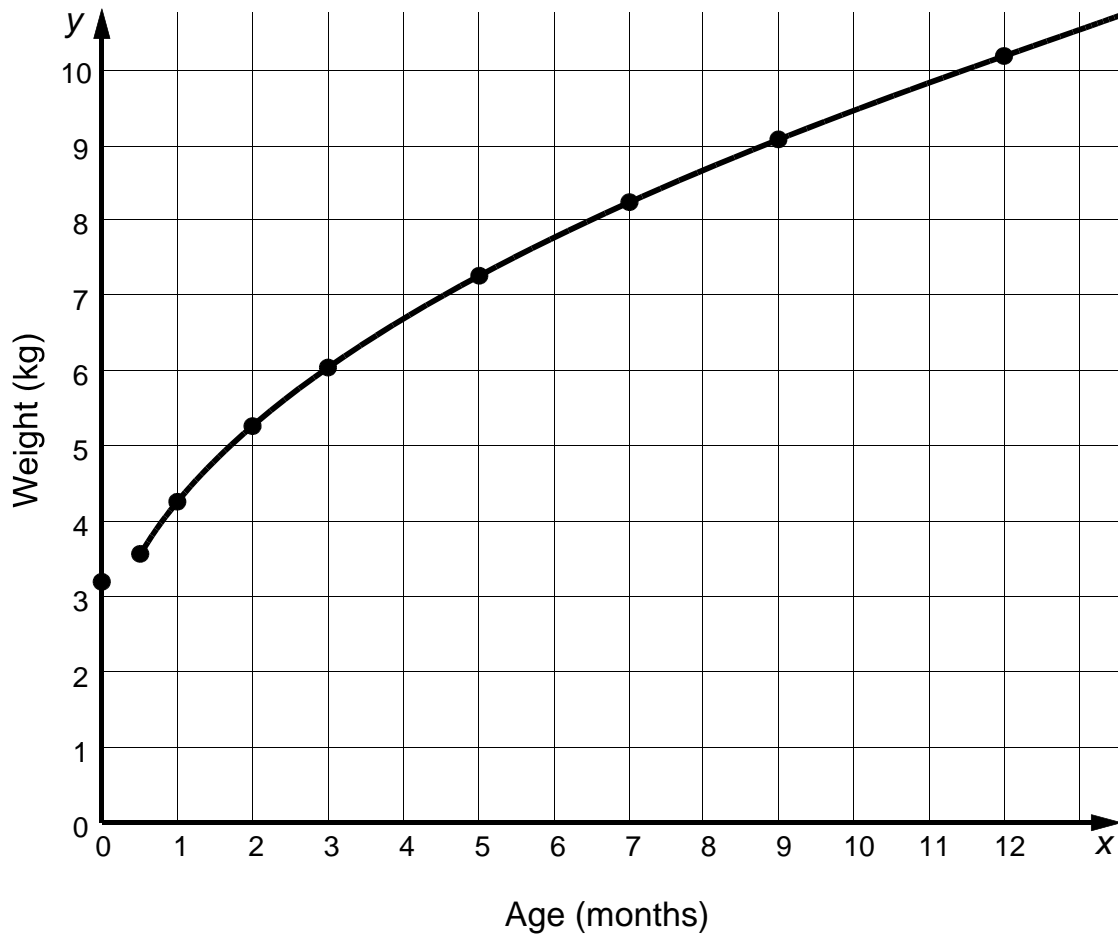


Figure Helen's weight during her first months.

- a) Calculate Helen's growth rate at the age of five months.

The curve can be said to resemble the graph to $y = \sqrt{x}$. Let us therefore assume that the curve can be described by the mathematical model $y = a \cdot \sqrt{x} + b$ where y is the weight in kg and x is the age in months. a and b are constants.

- b) Use the figure to determine the constants a and b so that the model corresponds to the curve.
- c) Investigate if the model is in good correspondence with the curve with respect to weight and growth rate. Does the model have any restrictions?

(4/6)

When assessing your work your teacher will consider the following:

- How many parts of the problem you have solved.
- If your calculations are correct.
- How well you have carried out your investigation.
- How clear and complete your presentation is.