



At most ten problems may be answered. There are several items [marked **a**), **b**), etc.] in some of the problems; all of them are to be considered for a complete answer.

1. Investigate whether there are common roots for the equations $\frac{3}{5}x + 2 = 1$ and $3x^2 - 7x - 20 = 0$.
2. The currency of Finland, as that of the other EMU countries, was the euro from the beginning of 1999. The currencies outside the EMU countries are officially rated in euros and the rates give the value of one euro in these currencies. The table gives the euro rate in US dollars and in Japanese yen.

Foreign currencies	The rate of the euro (EUR)	
	11.1.1999	12.7.1999
US Dollar	1.1569 USD	1.0124 USD
Japanese Yen	126.33 JPY	123.82 JPY

Find the rates of a dollar and a yen in euros and find how much per cent these rates have changed during the time period of the table. Have these rates increased or decreased?

3. Hairdressers' and barbers' shop prices consist of a tax-free price and a value added tax (VAT). VAT is 22% of the tax-free price. A haircut cost 136 mk. Find the price of a haircut provided that VAT is decreased 10 percentage points.
4. A barrel is standing on its bottom and its shape is a right circular cylinder with a height of 1.20 m and a base diameter of 0.70 m. Find the height of the empty space in the barrel when 120 litres of oil have been poured into the barrel.
5. Victor usually cycles 25 km. He has cycled 14 km in 38 minutes. How many minutes can Victor use for the rest of the trip in order for his average speed to be 23 km/h on the whole trip?
6. What is the relation between the derivative $f'(a)$ of a function f and the tangent line of the graph of f at the point $(a, f(a))$? **a**) Find $f'(1)$ when the graph of the function f has the tangent line $4y + 5x = 2$ at the point $(1, -\frac{3}{4})$. **b**) Is it possible that the graph of the function f , $f(x) = x^2$ has the tangent line $y = x - 2$ at some point?
7. Fossil shark teeth have been found on the Florida coast. The teeth belong to a prehistoric white shark which became extinct several tens of thousands of years ago. A tooth contains the radioactive carbon isotope C-14, whose content is only 9% of that found in a living organism. Find the age of the tooth. The half-life of the C-14 isotope is about 5 730 years.

- 8.** The mathematics test in the Finnish matriculation examination consists of 10 problems. The old form of the test had 10 problems but some problems had two options, of which a candidate was allowed to solve one option only. The new test has 15 problems, of which a candidate can freely choose ten. Find the number of ways a candidate may choose 10 problems **a)** in a test of the old form with two options in five problems and **b)** in the new test.
- 9.** The vertices of a triangle are at the points $A = (-2, 2\sqrt{2})$, $B = (-2, -\sqrt{2})$ and $C = (3, \sqrt{2})$. Find the angles of the triangle with an accuracy of 0.1 degrees.
- 10.** Rectangular pieces of cardboard 0.80 m long and 0.50 m wide are the leftovers of a production line in a packing factory. These are used to make rectangular boxes without lids for berries by cutting a square away at each corner. The side of the square corresponds to the height of the box. Find the height of the box which has the maximal volume. How many litres of berries can be put into this maximal box?
- 11.** After an operation a convalescent must exercise his muscles according to a specific rehabilitation plan every day during a month. He starts with a 15-minute physical training exercise and adds 5% to the exercise time each day. **a)** Find the exercise time on the 30th day of the training schedule. **b)** How much time is used in all these exercises during the rehabilitation period? Give the answers with an accuracy of one minute.
- 12.** A regular polygon with 12 sides is inscribed in a circle. Find the perimeter of the polygon expressed as a function of the radius r of the circle. How many correct figures for the value of the number π can be obtained if the circumference of the circle is replaced by the perimeter of the aforementioned polygon?
- 13.** What is the definition for the maximal value of a function? Give an example of a function which does not have a maximal value. Can a function take its maximal value at two different points? Find an example to support your claim.
- 14.** A person had made an investment of 60 000 mk six years ago. The present value of the investment is 95 600 mk. Find the annual **a)** nominal, **b)** real rate of interest for his investment provided that the annual inflation rate has been 2.0% in this period on the average.
- 15.** An economic research center interviewed 1900 Finns in January and in September 1999. It was found that the support for the Finnish Social Democratic Party (SDP) had increased from 23.6% to 24.9% in this period and that the support for the Centre Party of Finland (CP) had decreased from 23.2% to 21.1%. Can we think that the support for the SDP among Finnish voters has really increased on the 95% confidence level? Was the support in January for the SDP really higher than the support for the CP with the probability of 95%?