Problem 1

Which of these numbers is the smallest?

A $\frac{5}{9}$ B $\frac{15}{28}$ C $\frac{26}{45}$ D $\frac{7}{14}$ E $\frac{13}{23}$

Problem 2

Which of these numbers is the square root of $2^{2^{100}}$?

A $2^{2^{50}}$ B 2^{100} C $2^{2^{99}}$ D $2^{2^{\sqrt{100}}}$ E $\sqrt{2}^{\sqrt{2}^{100}}$

Problem 3

One apple and one banana together cost 11 kroner. One orange and one banana together cost 13 kroner. One apple and one orange together cost 12 kroner. How many kroner must you pay for one apple, one banana, and one orange?

A 12 B 14 C 16 D 17 E 18

Problem 4

Pia has visited Argentina, The Bahamas and Chile, and arrives home with a lot of souvenirs. 70 % of them are not from Argentina. 82 % of them are not from Chile. How many are from The Bahamas?

A 24 % B 38 % C 48 % D 52 % E Umulig å avgjøre

Problem 5

We wish to colour each square in a 3×3 grid either black or white. How many such colourings are there, such that the upper right and the lower left corners are coloured differently?

A 81 B 128 C 256 D 511 E 512

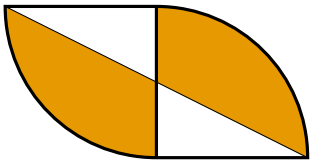
Problem 6

Nils is returning empty bottles for a refund. He gets 11 kroner for each large bottle, and 7 kroner for each small bottle. He receives 100 kroner in total. How many bottles did he return?

A 10 B 11 C 12 D 13 E Impossible to decide

Problem 7

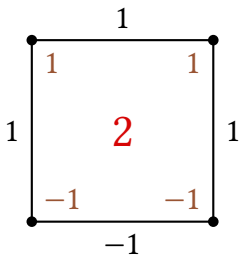
Two quarter circles of radius 1 are placed together as the figure shows. How large is the the area of the shaded part?



A $\frac{\pi-1}{4}$ B $\frac{3\pi-1}{2}$ C $\frac{\pi}{2}$ D $\frac{\pi-1}{2}$ E $\frac{\pi+1}{4}$

Problem 8

Nina is playing a game with a square. First she writes either 1 or -1 on each side of the square. Then, in each corner, she writes the product of the numbers from the two sides that meet in that corner. Finally she adds up the eight numbers she has written so far and writes the sum in the centre of the square. (In the figure you can see the result if she writes -1 on one side, and 1 on the other three.) How many different numbers can Nina end up with in the centre of the square?



A 5 B 7 C 8 D 15 E 16

Problem 9

In a triangle ABC, points M and N are the midpoints of the sides AB and AC respectively. How large is the ratio between the area of the quadrilateral $BCNM$ and the triangle ABC?

A $\frac{1}{2}$ B $\frac{2}{3}$ C $\frac{\sqrt{2}}{2}$ D $\frac{3}{4}$ E $\frac{3}{5}$

Problem 10

Which one of these number (written in base ten) does not end in the three digits 101, if we were to write it in base two (i.e., in binary)?

A 5 B 333 C 549 D 615 E 2021

Problem 11

In the quadrilateral $ABCD$, we have $\angle ABC = \angle BCD = 120^\circ$, $|AB| = |CD| = 3$ and $|BC| = 2$. How long is AD?

A 5 B 6 C $\sqrt{23}$ D $\sqrt{26}$ E $2\sqrt{7}$

Problem 12

Karl Erik struggles with keeping track of time, for the hands of his watch not only go the wrong way, but they also go seven times too fast, so that if the watch shows nine o'clock now, it will show half past five in half an hour. Except for going backwards and much too fast, it is an ordinary, old fashioned watch with a minute hand and an hour hand. How many times each (24 hour) day does his watch show the right time?

A 3 B 6 C 12 D 16 E 18

Problem 13

A stack of cards contains 40 cards. Five of them are golden. You draw six cards at random. How large is the probability that you will get all the golden cards? (In the answers, $n!$ is the product $1 \cdot 2 \cdot 3 \cdot \cdots \cdot n$.)

A $\dfrac{1}{40!}$ B $\dfrac{6}{40 \cdot 39 \cdot 38 \cdot 37 \cdot 36}$ C $\dfrac{6!\,34!}{40!}$ D $\dfrac{6!\,35!}{40!}$ E $\dfrac{6}{40!}$

Problem 14

Determine the number of six digit numbers of the form *abcabc* (where *a*, *b* and *c* are three different digits) which are divisible by 11.

A 72 B 89 C 504 D 648 E 729

Problem 15

Which one of these expressions does not have the same value as the others?

A $(1+\sqrt{2})^2$ B $\sqrt{8}+\sqrt{9}$ C $\dfrac{1+\sqrt{2}}{\sqrt{2}-1}$ D $3+2\sqrt{2}$ E $\dfrac{\sqrt{2}+9}{2-\sqrt{2}}$

Problem 16

A regular octagon with sides of length 1 is the base of an eight sided pyramid with height 3. How large is the volume of the pyramid?

A $2+2\sqrt{2}$ B $4\sqrt{2}$ C $1+2\sqrt{3}$ D $1+\frac{5}{2}\sqrt{2}$ E $1+\sqrt{2}$

Problem 17

Herman eats baby porridge for breakfast, lunch and dinner. He has four types of porridge at his disposal – banana, pear, apple and prune. He does not like prunes, so he does not want to eat prune flavoured porridge more than once per day. How many different porridge menus can he make?

A 27 **B** 38 **C** 46 **D** 54 **E** 64

Problem 18

What proportion of the divisors of 2020 are odd numbers?

A $\frac{1}{2}$ **B** $\frac{1}{3}$ **C** $\frac{1}{4}$ **D** $\frac{1}{8}$ **E** $\frac{1}{16}$

Problem 19

The value of $1 \cdot 2020 + 2 \cdot 2019 + 3 \cdot 2018 + \cdots + 2020 \cdot 1$ is the same as

A $\binom{2022}{3}$ **B** $\binom{2022}{2}$ **C** $\binom{2021}{3}$ **D** $\binom{2020}{3}$ **E** $\binom{2021}{2}$

Problem 20

The inhabitants of Mathland are all point shaped. When they meet indoors, they must all stay at least one metre apart. A group of 25 inhabitants would like to meet in order to discuss singular cohomology. They have the choice of five rectangular rooms, whose measures (in metres) are given below. In one or more of these rooms they cannot all fit in without breaking the one metre rule. Which of these has the largest area?

A 5×5 **B** $(\frac{5}{2}\sqrt{\pi}-1)\times(\frac{5}{2}\sqrt{\pi}-1)$ **C** 4×4 **D** $3\sqrt{3}\times 3$ **E** $\frac{1}{2}\pi^2 \times 2\sqrt{\pi}$