

Math and Physics Contest “Phystech School 2020”

Problem Set 3 – recommended for grade 9 and above

Math Problems

1. (2 points) Sugar beet contains 25% sugar, and sugarcane contains 18%. How many tons of sugar beets must be processed to get as much sugar as from 7,200 kg of sugarcane?

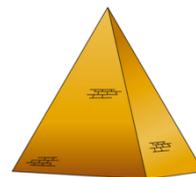


2. (3 points) Stock clerk Paul puts a total of $32\frac{3}{4}$ kg of oranges in three boxes. In the first and second box he puts a total of $25\frac{7}{8}$ kg of oranges, and in the second and third a total of $22\frac{3}{4}$ kg. How many kilograms of oranges are in each box?

3. (5 points) For 3 hours, the boat traveled along the river 32 km with the current and 60 km against the current. The speed of the current is 2 km / h. Find the boat speed in still water.

4. (5 points) In a triangle ABC , a height BH is equal to h , $\angle A = \alpha$ and $\angle B = \beta$. Find the area of the triangle.

5. (8 points) Architects were commissioned to build a smaller copy of one of the Egyptian pyramids in Cairo. The base of this pyramid is a parallelogram with sides of 10 m and 18 m and an area of 90 m^2 . The height of the pyramid passes through the intersection point of the base diagonals and is equal to 6 m. To calculate how the pyramid will heat up from sunlight, architects need to find the total area of the lateral surfaces of the pyramid. What is it equal to?



6. (10 points) Consider all nine-digit numbers where each digit from 1 to 9 occurs only once. Prove that the sum of all these nine-digit numbers is divisible by 111,111,111.

Physics Problems

1. (5 points) The speedometer broke on the subway train. Therefore, the driver Sasha decided to measure the speed of the train on his own, driving over a bridge with a length of 3,400 m. As soon as the head of the train was on the bridge, Sasha turned on the stopwatch. As soon as the tail of the train moved off the bridge, Sasha turned off the stopwatch. At that moment, the stopwatch showed 8 minutes 20 seconds. What was the speed of the train? The train is 100 m long.

2. (8 points) An iron, an electric kettle and a heater with resistances of 50 Ohms, 40 Ohms and 25 Ohms respectively are connected in parallel and connected to a 220 V outlet. Find the current power in each device and in the entire circuit.



3. (8 points) A room 4 m wide, 5 m long and 3 m high is filled with air, the temperature of which is 20 °C and the pressure is 10^5 Pa. There is a boy in the room, his mass is 50 kg and his body volume is 50 liters. Which is greater: the mass of the boy or the mass of air in the room? Consider the air as an ideal gas. The molar mass of air is $29 \frac{g}{mol}$, and the universal gas constant is $8,31 \frac{J}{mol \cdot K}$.

4. Of two thin homogeneous rods, the lengths of which are 12 and 16 cm, an angle joint with perpendicular sides is made (see figure). Each rod is made of a different material. Find:

1) (8 points) the minimum and maximum possible distance from point *A* to the center of gravity *C* of the angle joint;

2) (8 points) the ratio of the mass of the first rod to the mass of the second one, at which the distance *AC* is minimal.

