Working with Rainfall Rates and Water Volume

After a local rain storm, your news station might announce that 0.5 inches of rain fell during the morning hours before Noon.

Have you ever wondered just how much water fell out of the sky to cause so much trouble to people trying to get to work or stay dry outside?

Meteorologists classify rain rates for different levels of activity as you can see in the table below:

Type of Storm	Rate
Light Rain	2 - 4 mm/hr
Moderate	5 - 9 mm/hr
Heavy	10 - 40 mm/hr
Violent	more than 50 mm/hr

Problem 1 – Suppose the local news said that 1.6 inches of rain fell between 8:00 am and 1:00 pm. What type of storm was this? (1 inch = 25 mm)

Problem 2 – If 1 mm of rainfall equals 1 liter of water over an area of one square meter, how many liters of water will fall over a town that has an area of 100 km^2 during a light rain shower that lasted 3 hours at a rate of 2 mm/hr?

Problem 3 – About 500,000 cubic kilometers of rain falls on the surface of Earth every year. What is the average rate in mm/hr if the surface area of Earth is 500 million km^2?

Common Core Math Standards:

Grade 6 – *CCSS.Math.Content.6.RP.A.3b Solve unit rate problems including those involving unit pricing and constant speed. For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*

Grade 7 – *CCSS.Math.Content.7.RP.A.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.*

Optional: Grade 8 - *CCSS.Math.Content.8.EE.A.4 Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology*

Problem 1 – Suppose the local news said that 1.6 inches of rain fell between 8:00 am and 1:00 pm. What type of storm was this? (1 inch = 25 mm)

Answer: The depth of the rain was 1.6 inches x 25 mm/ 1 inch = 40 mm. This fell in the time between 8:00 am and 1:00 pm which is 5 hours, so the rate was 40 mm/5 hours = 8 mm/hr. This type of storm would be considered a **moderate storm**.

Problem 2 – If 1 mm of rainfall equals 1 liter of water over an area of one square meter, how many liters of water will fall over a town that has an area of 100 km^2 during a light rain shower that lasted 3 hours at a rate of 2 mm/hr?

Answer: First we have to calculate the total number of millimeters that fell, which is 2 mm/hr x 3 hours or 6 millimeters.

Then we calculate the rate in terms of liters/meter^2 which will be 6 mm x (1 Liter/meter^2) = 6 Liters/meter^2.

Next we convert the area of the town into square meters, which is 100 km^2 x (1000 m/1km)x (1000 m/1 km) = 10^8 meters^2.

Finally we multiply the rate by the area to get 6 liters/meter^2 x 10^8 meters^2 = **6.0x10^8 Liters**.

Problem 3 – About 500,000 cubic kilometers of rain falls on the surface of Earth every year. What is the average rate in mm/hr if the surface area of Earth is 500 million km^2?

Answer: Volume = Height x Area so
500,000 km^3 = height x 500 million km^2 and so
height = 500,000/500,000,000 = 1/1000 km or 1 meter.

This falls in one year. 1 year = 365 days x 24h/1day = 8760 hours so the rate is

R = 1 meter/8760 hours
= 1000 mm/8750 hrs
= **0.11 mm/hr**.