Task. Two solutions of 90% and 97% purity are mixed resulting in 21 litres of mixture of 95% purity. What is the quantity of 97% purity solution?

Solution. Let x be the volume of the 97% purity solution and y be the volume of 90% purity solution. We should find y.

By assumption

$$x + y = 21.$$

On the other hand, the volume of substance in x is 90% of x, that is $0.9x$. Similarly, the volume of substance in y is 97% of y, that is $0.97y$. Moreover, the sum of volumes of substances in x and y constitute 95% of 21 litres, that is $0.95 * 21 = 19.95$. Thus

$$0.9x + 0.97y = 19.95.$$

So we get the following system of linear equations

$$\begin{cases} x + y = 21, \\ 0.9x + 0.97y = 19.95. \end{cases}$$

From the first equation we get

$$x = 21 - y.$$

Substituting into the second equation we obtain

$$0.9(21 - y) + 0.97y = 19.95$$
$$0.9 * 21 - 0.9y + 0.97y = 19.95$$
$$0.07y = 19.95 - 0.9 * 21$$
$$0.07y = 1.05$$
$$y = 15 \text{ litres}.$$

Hence $x = 21 - 15 = 6$ litres.

Answer. The quantity of 97% purity solution is 15 litres.