

Combining Your Efforts

Part 1 – The Job

You will be performing a simple task to help understand how combining your efforts affects the time required to complete the task. For this lab the task will be moving some objects from one place to another at a *consistent pace*.

Each group needs to set up their job site. You will need to set up two desks about 10 feet apart from each other. On one of the desks place your given objects (12 pencils) on one of the desks.

Your group will need two *movers* – one will work at a quicker pace and one at a slower pace. For the movers, you will need to find a consistent pace to move each pencil (one at a time) from one desk to the other. Do not try to be SUPER fast or slow – just work in a repeatable, controlled way. The other group members need to keep track of the time while the movers move.

Individual Measurements:

First, the slower paced mover needs to complete the job *hans solo*, alone. Remember to work at a consistent speed – you will need to work at this same speed in the next part of the lab. The rest of the group should track the time. After the slower job is complete, repeat the process with the quicker paced mover working alone. Record the measurements in the following box.

Slower Pace Time = S = seconds

Quicker Pace Time = Q = seconds

Combined Measurement:

Now the movers work together to do the job. The movers need to try to work at the same pace they did earlier. Make sure that you have enough room so that the two workers do not interfere with each others' movement. Record the measurement in the following box.

Actual Combined Effort Time = seconds

Part 2 – Theoretical Combined Effort Time

Using the Slower Pace Time (S) and the Quicker Paced Time (Q), you can use the idea of *combining rates* to compute how fast it should take (in theory) to complete the task by combining the movers' efforts. By combining rates it should follow that

$$\text{Combined Effort Rate} = \text{Slower Rate} + \text{Quicker Rate}.$$

In the problems you will want to find the Theoretical Combined Effort Time (C) and compare it to the Actual Combined Effort Time.

The units for the work rate are *jobs per second*. Using the Slower Paced Time (S) and the Quicker Paced Time (Q) that you measured earlier, you can compute

$$\text{Quicker Rate} = \frac{1 \text{ job}}{Q \text{ seconds}} = \frac{1}{Q} \quad \text{and} \quad \text{Slower Rate} = \frac{1 \text{ job}}{S \text{ seconds}} = \frac{1}{S}.$$

Similarly, the Combined Effort Rate, in theory, relates to the Theoretical Combined Effort Time (C) by the equation

$$\text{Combined Effort Rate} = \frac{1 \text{ job}}{C \text{ seconds}} = \frac{1}{C}.$$

Remember by combining rates we have the equation

$$\text{Combined Effort Rate} = \text{Slower Rate} + \text{Quicker Rate}.$$

Using the analysis above here, this equation becomes

$$\frac{1}{C} = \frac{1}{Q} + \frac{1}{S}$$

The Problems:

1. Solve the equation

$$\frac{1}{C} = \frac{1}{Q} + \frac{1}{S}$$

for C by plugging in your group's time values Q and S . Hint: you might multiply through by a common denominator to "clear the fractions."

In finishing this problem, you did the computation part of the problem: "Worker 1 does a job in S seconds and worker 2 does the same job in Q seconds. How long should it take for them to complete the job together?"

2. Compare your value of C to the Actual Combined Effort Time that you measured earlier. Why might they be different? Why might they be similar?