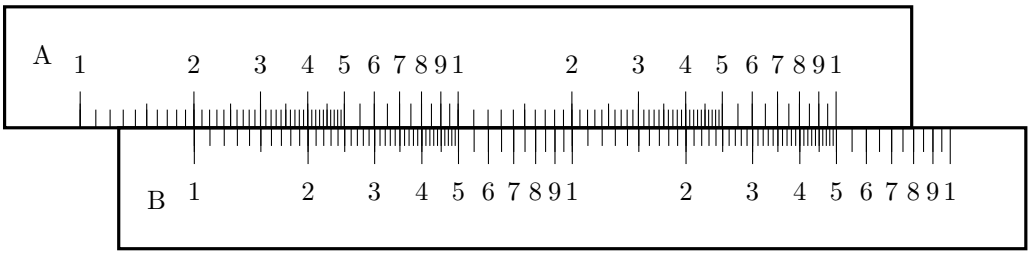
Week 3

This week, we're learning about slide rules!

First, let's try doing some multiplication. To start with, I'll show you how to multiply $\mathbf{2} \times \mathbf{3}$.

1. Take the scales labelled "A" and "B".
2. Line up the 1 on scale B with the 2 on scale A.



3. Find the 3 on scale B, and see where it lines up to on scale A. This is the answer!

Question 1. Is the answer correct?

Question 2. Try some calculations yourself. If you notice anything weird, discuss it with the group!

(a) 2×4
(b) 1.5×4.2
(c) 4×5
(d) 3.6×7.5
(e) 20×300
(f) 12×42
(g) 8549×324

Question 3. What about division? Figure out a way to use a slide rule to compute:

(a) $6 \div 3$
(b) $6.8 \div 1.7$
(c) $30 \div 2$
(d) $3 \div 6$
(e) $45 \div 8$
(f) $5.26 \div 8.3$

Question 4. Let's try some multiplication again. Use the same technique, but use the C and D scales instead of A and B. What multiplications can you do?

It's time to start investigating why slide rules work!

Let's take a closer look at the C and D scales. (They're the same as the A and B scales but just stretched out by a factor of 2, so they'll be easier to read precisely.)

Question 5. Take the L scale, and use it as a ruler to measure the positions of the numbers on the C scale.

Number	Distance from 1
1	0.0 units
2	
3	
4	
5	
6	
7	
8	
9	
1	

Question 6. Now, use a calculator to compute 10 to the power of the measurements you just found. What do you notice. . . ?

These measurements are examples of *logarithms*. The number $\log x$ is the answer to the question "what power of 10 equals x?" In other words,

$$\log x = a \qquad \text{means the same as} \qquad 10^a = x.$$

Question 7. If your calculator has a "log" button, calculate the logarithms of these numbers:

(a) $\log 4$ *(Note: the answer should be* 0.602*. If you get* 1.386 *instead, check in with an instructor.)*

(b) $\log 6$

(c) $\log 24$

(d) $\log 3.162$

Calculate 10 to the power of each of these numbers.

Question 8. WITHOUT USING A CALCULATOR, what are these numbers?

(a) $\log 100$

(b) $\log 1000$

(c) $\log 10$

(d) $\log 1$

(e) $\log 0.1$

(f) $\log(-10)$

Question 9. You might have noticed that $\log 4 + \log 6 = \log 24$. Why?

Question 10. Here are some facts about logarithms. Try to explain them.

(a) $\log x + \log y = \log(x \times y)$

(b) $2 \log x = \log(x^2)$

(c) $-\log x = \log(\frac{1}{x})$

(d) $\log x - \log y = \log(\frac{x}{y})$

Question 11. Now, explain why slide rules work to compute multiplication.

Question 12. How can you use a slide rule to calculate the square of a number? What about the square root? *(Hint: Which scales should you work with?)* Calculate:

(a) 13^2

(b) 2.8^2

(c) $\sqrt{144}$

(d) $\sqrt{73}$

Question 13. Calculate some logarithms using your slide rule.

(a) $\log 8$

(b) $\log 23$

(c) $\log 0.05$

Question 14. What are some advantages and disadvantages to slide rules compared to Napier's bones? Discuss.

We haven't used the scale labelled "S" yet. This scale is used for trigonometry calculations: in particular, if you line up the "S" scale with the "C" scale so that the rightmost marks on each are aligned, then a number on the "C" scale tells you the sine of the corresponding number on the "S" scale.

(Don't worry if you don't know any trigonometry, you don't need to know what this means.)

Question 15. Use the slide rule to calculate:

(a) $\sin 30°$

(b) $\sin 45°$

(c) $\sin 15°$

(d) $\sin 90°$

(e) $\sin 8°$

Double-check your answers with a calculator (if you have one with a "sin" feature). If your answers don't match, check with an instructor.

Question 16. There's a Trigonometry Fact about cosines that says:

$$\cos(x) = \sqrt{1 - \sin(x)^2}$$

Calculate:

(a) $\cos 30°$

(b) $\cos 45°$

(c) $\cos 15°$

(d) $\cos 20°$

Question 17. Here's one last Trigonometry Fact, about tangents:

$$\tan(x) = \frac{\sin(x)}{\cos(x)}$$

Calculate:

(a) $\tan 30°$

(b) $\tan 45°$

(c) $\tan 27°$