How to Use a Slide Rule

The slide rule was invented by William Oughtred in the 1600's, but only began to be widely used in the mid 1800's after a French artillery officer named Amedee Mannheim developed a version that became popular among engineers. By the early 1900's engineering students in the US were commonly taught to use slide rules. They continued in widespread use until the late 1970's when electronic pocket calculators became available.

Slide rules can be used for multiplication and division, squares, cubes, square roots, cubes roots, trig functions, and exponentials and logarithms. For purposes of the 49er's slide rule competition, you only need to know how to use the slide rule to do multiplication, division, and square and cube roots.

You should recall some basic properties of logarithms. Note that slide rules work with common logarithms (logarithms to the base 10.)

$$\log(xy) = \log(x) + \log(y) \tag{1}$$

$$\log(x/y) = \log(x) - \log(y) \tag{2}$$

$$\log(x \times 10^n) = n + \log(x) \tag{3}$$

and

$$\log(x^p) = p \log(x) \tag{4}$$

Before electronic calculators, students used tables of logarithms to perform calculations. The attached table gives logarithms of numbers from 1.00 to 9.99 to four digits. Students also used wooden or metal slide rules which are basically sliding logarithmic scales that can be used to add and subtract logarithms. There is a very useful online simulator of a slide rule at

`http://sliderules.org/react/pickett_n600.html`

Since the theory behind calculations using the table of logarithms is identical to the theory of calculations by slide rule, we'll show you how to do both.

Multiplication using the table of logarithms is done as follows. To multiply x times y, look up $\log(x)$ and $\log(y)$ and then add the logarithms. Now, using the table in reverse, look up the sum of the logs and read off the product. For example, to multiply 3 times 2, we use the table to find $\log(3) = 0.4771$ and $\log(2) = 0.3010$. Then the log of the product is $0.4771 + 0.3010 = 0.7781$. Using the table in reverse, we find that $10^{0.7781} = 6.00$ (not exactly, but 0.7781 is close to $\log(6.00)$ than to $\log(5.99)$ or $\log(6.01)$.

Similarly, you can perform the same multiplication using the slide rule. We'll use the scales labeled C and D. These two scales are laid out so that each number x is $\log(x)$ times 6 inches from the left end of the 6 inch long scale. The numbers range from 1.0 to 10.0.

Start by moving the slide so that the left index of the C scale (1.00) is over 3.0 on the D scale. Then move the clear cursor so that the line on the cursor is over 2.0 on C scale. You have effectively added $\log(3.0) + \log(2.0$. Look down at the C scale to see that the product is 6.0.

Now try 4.0 times 3.0. Oops- 3.0 is off the right end of the D scale. To correct this, move the right index of the C scale over 4.0 on the D scale and then slide the cursor back to 3.0 on the C scale. You can read off the product 1.2 on the D scale. By switching from the left index of the C scale to the right index you have effective divided by 10. Thus the answer is 1.2×10^1.

Division with the C and D scales works similarly, except that you're subtracting logarithms instead of adding logarithms.

Squares and cubes (or square roots and cube roots) can be computed using the D scale and the A scales (for squares) or the K scale (for cubes.) The A scale is simply a 3 inch logarithmic scale repeated twice. The K scale is a 2 in logarithmic scale repeated 3 times. Since $\log(x^2) = 2\log(x)$, and $\log(x^3) = 3\log(x)$, if we put the cursor at x on the the D scale we can read off x^2 on the A scale and x^3 on the K scale. To compute $\sqrt{x}$, put the cursor at x on the A scale and then read the square root off of the D scale. Cube roots are done similarly with the K scale.

As with multiplication and division, powers of 10 have to be dealt with by hand. As an example, what is $\sqrt{225}$? We write 225 as 2.25×10^2, so we set the cursor at 2.25 on the A scale and read the square as 1.5 on the D scale, times 10^1. Thus $\sqrt{225} = 15$.

It takes practice to become efficient and inaccurate in calculations with a slide rule. Try some of the attached sample problems and see how well you can do!

FOUR-PLACE COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21	25	29	33	37
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19	23	26	30	34
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17	21	24	28	31
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16	19	23	26	29
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15	18	21	24	27
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14	17	20	22	25
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13	16	18	21	24
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12	15	17	20	22
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12	14	16	19	21
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11	13	16	18	20
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11	13	15	17	19
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10	12	14	16	18
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10	12	14	15	17
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9	11	13	15	17
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9	11	12	14	16
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	3	5	7	9	10	12	14	15
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8	10	11	13	15
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8	9	11	13	14
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8	9	11	12	14
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7	9	10	12	13
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7	9	10	11	13
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	6	7	8	10	11	12
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7	8	9	11	12
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	6	8	9	10	12
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	3	4	5	6	8	9	10	11
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6	7	9	10	11
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6	7	8	10	11
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	3	5	6	7	8	9	10
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6	7	8	9	10
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5	7	8	9	10
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5	6	8	9	10
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5	6	7	8	9
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5	6	7	8	9
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5	6	7	8	9
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5	6	7	8	9
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5	6	7	8	9
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5	6	7	7	8
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5	5	6	7	8
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	4	5	6	7	8
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4	5	6	7	8
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4	5	6	7	8
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4	5	6	7	8
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	2	3	4	5	6	7	7
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4	5	6	6	7
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4	5	6	6	7
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

FOUR-PLACE COMMON LOGARITHMS

N	0	1	2	3	4	5	6	7	8	9	Proportional Parts								
											1	2	3	4	5	6	7	8	9
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	2	2	3	4	5	5	6	7
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	4	4	5	6	6
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	6	6
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	5	5	6
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	2	3	4	4	5	6
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3	3	4	4	5
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3	3	4	4	5
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2	3	3	4	4
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	3	4
N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

NMT Slide Rule Competition, Practice Test

Name: ____

These practice problems were taken from test number 107 of the Texas University Interscholastic League. The UIL had state wide slide rule competitions from 1947 through 1979 and the high school students who participated in these contests were extremely skilled- the competition had 75 similar problems to be solved in 30 minutes!

1.

$$3.84 \times 0.0127$$

2.

$$\frac{7.93 \times 387}{3.18}$$

3.

$$\frac{187 \times \sqrt{712}}{0.376}$$

4.

$$\frac{37\pi \times 976}{3180}$$

5.

$$\frac{217 \times 910^2}{114 \times \sqrt{814}}$$

6.

$$\frac{\sqrt[3]{19\pi} \times 0.127}{\sqrt{716} \times 0.0231 \times 24.1}$$

7.

$$\frac{\sqrt[3]{311} \times \sqrt[3]{51.7}}{\sqrt{304}}$$

8.

$$\frac{(304)^2 \times \sqrt[3]{71.2}}{\sqrt{216\pi}}$$

9.

$$\sqrt[3]{(70.2)^2 \times \pi}$$

10.

$$\frac{321 \times \sqrt{871} \times (24.1)^2}{\sqrt{8.71}}$$

11.

$$\frac{(18)^3 \times 0.00000171}{0.0824 \times (0.011)^2 \times \sqrt[3]{518}}$$

12.

$$\left(\sqrt[3]{\frac{\sqrt{391 \times 0.251}}{\sqrt[3]{91.3}}}\right)^2$$

13.

$$\frac{(311)^2 \times \sqrt{9.04} \times (318)^3}{\sqrt[3]{71.6} \times 435\pi}$$

14.

$$\sqrt[3]{\left(\frac{8820}{612000}\right)^2}$$

15.

$$\frac{\sqrt[3]{0.00000321}}{\sqrt[3]{\pi^2}}$$

16.

$$\sqrt{\frac{942}{315}} \times \sqrt[3]{\frac{304}{115}} \times 0.0183$$

17.

$$\sqrt[3]{3.71} \times \sqrt{84.5} \times \frac{\sqrt{7.11}}{\sqrt[3]{1.17}}$$

18.

$$\sqrt[3]{\sqrt{\sqrt[3]{0.0000385\pi}}}$$

19.

$$\frac{8.82 \times \frac{3\pi}{\sqrt{4.75}} \times \sqrt{0.000317}}{\sqrt{\sqrt[3]{2.22}}}$$

20.

$$\sqrt{\sqrt[3]{\sqrt{91.6}}} \times \sqrt[3]{\sqrt{\sqrt[3]{61.9}}}$$

Answers:

1. 4.88×10^{-2}
2. 9.65×10^{2}
3. 1.33×10^{4}
4. 3.57×10^{1}
5. 5.52×10^{4}
6. 3.33×10^{-2}
7. 1.45×10^{0}
8. 1.47×10^{4}
9. 2.49×10^{1}
10. 1.86×10^{6}
11. 1.25×10^{2}
12. 1.69×10^{0}
13. 1.65×10^{9}
14. 5.92×10^{-2}
15. 6.88×10^{-3}
16. 4.38×10^{-2}
17. 3.60×10^{1}
18. 6.06×10^{-1}
19. 5.95×10^{-1}
20. 1.83×10^{0}

NMT Slide Rule Competition Rules (Live Audience Version)

You will be given a series of 20 challenging calculations to be performed using the slide rule. The problems will be displayed one at a time. The first contestant to raise their hand will get a chance to answer the question. If the answer is correct (2 significant digits and the power of 10), then that contestant wins the point. If not, other contestants can raise their hand and try to answer until all contestants have made an attempt or 2 minutes have elapsed.