FUJI SLIDE RULES

INSTRUCTION SHEET

THE SCALES AND THEIR USES

1. C and D scales. These fundamental scales are exactly alike and are used for all operations multiplication and division etc.
2. CF and DF scales. These are C and D scales "folded" at $\sqrt{10}$ and are used with C and D scales in order to decrease the number of operations.
3. CI scale. This is an "inverted" C scale, and is used with C scale in reading directly the reciprocal of a mumber.
4. CIF scale. This is a CI scale "folded" at $\sqrt{10}$, and is used with CF scale in the same relation as CI scale with C scale.
5. DI scale. This is an "inverted" D scale, and is used with Sine S tangent in reading directly the reciprocal of number etc.
6. S scale. This scale gives the sines and cosines of angles.
7. T scale. This scale gives the tangents and cotangents of angles.
8. A and B scales. These scales consist of two half size of C or D scales placed end to end. These scales are used with C and D scales to give squares and square roots.
9. K scale. This scale consists of three one-third size of C scale placed end to end and is used in finding cubes and cube roots.
10. L scale. This scale is used with D scale in giving directly the mantissa of the common logarithm of a number.
11. LL scale. Some of our slide rules have so called log log scales, which are used in calculating expressions such as x^y $(x>1)$. LL scales also give directly the value of the function e^x and are used in reading the natural logarithms of numbers.

Article No.		Scale range
1200	LL	from $e^{0.1}=1.105$ to $e^{10}=22026$ with some extension scales on both ends, used with A and B scales.
	LL_1	from $e^{0.01}=1.010$ to $e^{0.1}=1.105$
	LL_2	from $e^{0.1}=1.105$ to $e=2.718$
	LL_3	from $e=2.718$ to $e^{10}=22026$

used with C and D scales.

12. LL_{01}, LL_{02}, LL_{03} scales. Some of our slide rules also have LL_{01}, LL_{02}, LL_{03} scales, which are used with C and D scales in finding powers of numbers smaller than 1, $x^y(x<1)$. These also give directly the values of the functions e^x for negative values of x.

Article No.		Scale Range
1200	RLL	from $e^{-0.1}=0.905$ to $e^{-10}=0.0000454$ with some extension scales on both ends.
1280	LL_{01}	from $e^{-0.01}=0.999$ to $e^{-0.1}=0.905$
	LL_{02}	from $e^{-0.1}=0.905$ to $e^{-1.0}=0.368$
	LL_{03}	from $e^{-1}=0.368$ to $e^{-100}=0.0000454$
	LL_{-1}	from $e^{-0.99}=0.99$ to $e^{-0.1}=0.905$
	LL_{-2}	from $e^{-0.1}=0.905$ to $e^{-1}=0.367$
	LL_{-3}	from $e^{-1}=0.367$ to $e^{-10}=0.0000454$

SLIDE RULE OPERATIONS

In what follows, the left hand I of a scale is called its Left Index, the right hand I is called its Right Index.

1. Multiplication

Rule : A $(a\times b)$

Example 1. $23\times 4=92$ a. Opposite 23 on D, set the hair line. b. Opposite the hair line set 4 on CI. c. Opposite the Right index of C, read answer 92 on D.

Rule : B $(a\times x)$

Example 2. $7.5\times 3.2=24$ a. Opposite 7.5 on D, set right index of C. b. Opposite 3.2 on C, read answer 24 on D.

Note in this case that the reading would have been "Off Scale" if the left index had been used. The decimal point may be fixed by making a rough mental calculation.

2. Continuous Multiplication

To multiply three factors, first multiply two of them, and then multiply the result by the third.

Example $1.5\times 3.2\times 8=38.4$ a. Opposite 15 on D, set left index of C. b. Opposite 32 on C, set the hair line. c. Opposite the hair line, set right index of C. d. Opposite 8 on C, read answer 38.4 on D.

You need not read the intermediate answer $1.5\times 3.2=4.8$. The decimal point can be determined by a rough mental calculation.

3. Division

Rule: a. Locate the dividend on D, set the diviser on C. b. Opposite the index of C, read the quotient on D.

Example $55\div 7=7.86$ a. Opposite 55 on D, set 7 on C. b. Opposite the left index of C, read 7.86 on D. As you see, this operation is exactly the reverse of multiplication.

4. Mixed Calculation of Multiplication and Division

Example $\frac{3\times 4\times 7}{2\times 5}=8.4$ a. Opposite 3 on D, set 2 on C. b. Opposite 4 on C, set the hair line of cursor. c. Opposite the hair line, set 5 on C. d. Opposite 7 on C, read 8.4 on D.

5. The Folded scale CF and DF

CF and DF scales are similar to C and D scales folded at $\sqrt{10}$ so I of CF and DF scales line about in the middle. These scales can often be used in calculation in order to avoid resetting when the answer runs off scale Example Converse 1.5 and 5 feet in metres. As 1 feet $=0.305$ metres (Table of constant) a. Opposite 0.305 on D, set left index C. b. Opposite 1.5 of C. read 0.457 on D. (1.5f $=0.457$m). c. Opposite 5 of CF. read 1.525 on DF. (5f $=1.525$m)

As you see in above example, when the slide is any position with a number x on D appearing opposite a number on C, then this same number x appears also on DF opposite y on CF, If the reading is off scale on C D it may be found on CF DF.

6. Squares and Square Roots

Opposite 300 on A(left), read $\sqrt{300}=17.35$ on D. Opposite 3000 on A(right), read $\sqrt{3000}=54.8$ on D. Opposite 0.3 on A(left), read $\sqrt{0.3}=0.1735$ on D. Opposite 0.03 on A(right), read $\sqrt{0.03}=0.0548$ on D. Use left or right half of A scale as shown in the following table.

A given number	left half of A	right half of A
	1~10	10~100
	100~1000	1000~10000
	}	}
	0.1~0.01	1~0.1
	0.001~0.0001	0.01~0.001
		0.0001~0.00001

7. Cubes and Cube Roots

Opposite any number on D, read its cube on K. Thus Opposite 3.2 on D, read $3.2^3=3.28$ on K. The decimal point may be fixed by making a rough mental calculation.

Conversely, opposite a number on K. read its cube on D. Opposite 4.5 on K(left), read $\sqrt[3]{4.5}=1.65$ on D. Opposite 45 on K (middle), read $\sqrt[3]{45}=3.55$ on D. Opposite 450 on K (right), read $\sqrt[3]{450}=7.64$ on D. Use left, middle or right third of K scale as shown in the following table.

	left third of K	middle third of K	right third of K
a given number	1~10 1000~10000 0.01~0.001 0.00001~0.000001	10~100 10000~100000 0.1~0.01 0.0001~0.00001	100~1000 100000~1000000 1~0.1 0.001~0.0001

8. Reciprocal

Opposite any number on C, read its reciprocal on CI. The number on CI is given by the red figures. Opposite 2.5 on C, read $\frac{1}{2.5}=0.4$ on CI. Opposite 125 on C, read $\frac{1}{125}=0.008$ on CI.

9. Another Fundamental Calculation

a. $a^2b=x$ $1.5^2\times3.14=7.07$ Opposite 1.5 on D, set left index of C. Opposite 3.14 on B, read 7.07 on A.

b. $a^2b^2=x$ $7.2^2\times0.45^2=1050$ Opposite a on D, set right index of C. Opposite b on C, read x on A.

c. $\frac{a}{d}=x$ $\frac{11^2}{4.9}=24.7$ Opposite a on D, set b on B, Opposite index of C, read x on A.

d. $\frac{a^2b}{c}=x$ $\frac{8.05^2\times0.34}{51.5}=0.428$ Opposite a on D, set c on B. Opposite b on B, read x on A.

e. $\sqrt{ab}=x$ $\sqrt{1.83\times0.26}=0.69$ Opposite a on A, set index of B. Opposite b on B, read x on D.

f. $\frac{a}{\sqrt{b}}=x$ $\frac{79.3}{\sqrt{2.35}}=51.7$ Opposite a on D, set b on B. Opposite index of C, read x on D.

g. $\frac{a\sqrt{b}}{c}=x$ $\frac{31.93\times\sqrt{147}}{3.2}=120.9$ Opposite a on D, set c on C. Opposite b on B, read x on D.

h. $ad^2=x$ $0.65\times2.3^2=7.91$ Opposite a on K, set index of C. Opposite b on C, read x on K.

i. $\frac{ab^2}{c^2}=x$ $\frac{1.95\times6.08^2}{3.9^2}=7.39$ Opposite a on K, set c on C. Opposite b on C, read x on K.

j. $\sqrt{a^2b^2}=x$ $\sqrt{9.42^2\times4.12^2}=242$ Opposite a on A, set index of B. Opposite b on B, read x on K. As a=9.42, take a on left half of B, and as b=4.12 take b on left half of B.

10. The Sine of an Angle

To get the sine of an angle a, we use. S read at 0°45', set A or B and then use when S read at 6°, set scale C or D and then use. Opposite the mark at the right end of the back of the rule. set a on S. Opposite the index of D, read sine a on C.

Example sin 22° Opposite the mark (back), set 22 on S. Opposite index of D, read sine 22° =0.375 on C. If an angle is between 34' and 5°45', use S & T scale. In this range the sine of an angle is between 0.01 and 0.1 . or Slide Rules with DI, you can read DI scale swing index on C.

11. The Cosine of an Angle

We find the cosine of an angle A by reading the sine of its compliment 90°−A, or cos 32°= sin(90°−32°)=sin 58°

12. The Tangent of an Angle

To get the tangent of an angle a, set a on T on the back face of the slide to the mark at the back right end of the rule, and read tan a on C against index of D.

Example tan 33° Opposite the mark (back). set 33 on T. Opposite the index of D, read tan 33°=0.65 on C.

13. Other Trigonometrical Functions

To get cotangent. secant and cosecant of an angle, we use the following formula.

$$\cot a=\frac{1}{\tan a}\qquad \sec a=\frac{1}{\cos a}\qquad \operatorname{cosec} a=\frac{1}{\sin a}$$

Thus, first take the tangent, cosine and sine of a then get their reciprocals.

14. Logarithms

Slide rules give only the mantissa or decimal part of the common logarithm of a number, and the characteristic or the integral part can be determined by inspection. We use in this calculation L and C (D) scale. In former case, we can directly read the mantissa of a number on L scale, but in later case, we operate as folows.

log 27.5=1.493 Opposite 27.5 on D, set index of C. Opposite the mark line of the back face read 439 on L. Add characteristic 1, then the answer is 1.493

15. The LL scales

As mentioned previously, some of our slide rules have LL scales, which give the x^y, and natural logarithms of numbers. We add some brief descriptions on LL_{1-3} scales.

a. e^{-x} $(0.01<X<10)$

These scales give the value e^x for values of x from 0.01 to 10. Opposite x on D, read e^x on LL. LL_1 if x is between 0.01 and 0.1, LL_2 If x is between 0.1 and 1, LL_3 If x is between 1 and 10.

Example Opposite 3 on D, read $e^3=20.1$ on LL_3; $e^{0.3}=1.350$ on LL_2; $e^{0.03}=1.0304$ on LL_1;

b. Natural Logarithms

Logarithms to base e (2.71828) are called natural logarithms. We denote to natural logarithm of a number N by the symbol ln N. We can read from LL scales natural logarithm of a number between $1.010(e^{0.01})$ and $22026(e^{10})$. Opposite 8.4 on LL_3, read ln 8.4=2.13 on D; Opposite 1.45 on LL_2, read ln 1.45=0.372 on D; Opposite 1.04 on LL_1, read ln 1.04=0.0392 on D;

16. The LL_{0-3}~LL_{-0-3}(or RLL) scales.

These scales operate with C or D in the same way that the LL_{1-3} scales combination operate with C and D.

a. e^{-x} $(0.001<X<10)$

Example If x is 3 Opposite −x of set on D, 0.03=0.9704 on LL_{-0}, 0.3=0.741 on LL_{-0}, 3=0.497 on LL_{-0}

b. Natural Logarithms

Using LL_{-0}, LL_{-0}, LL_{-0} scales, we can read natural logarithm of a number between 0.999 and 0.00005.

Example Opposite 0.04 on LL_{-0} read ln 0.04=−3.2188 on D; Opposite 0.65 on LL_{-0} read ln 0.65=−0.431 on D; Opposite 0.94 on LL_{-0} read ln 0.94=−0.0619 on D;

17. Calculation of X^y

Of course we can calculate the value of x^y by multiplying the common logarithm of x by y, and then reading the antilogarithm. More convenient method is as follows.

Example 1. $1.67^{1.1}=2.102$ a. Opposite 1.67 on LL_3, set index of C. b. Opposite 1.45 on C, read 2.102 on LL_3.

Example 2. $2.18^{4.1}=37.1$ a. Opposite 2.18 on LL_3, set index of C. b. Opposite 4.63 on C, read 37.1 on LL_3.

Example 3. $0.64^{1.8}=0.448$ a. Opposite 0.64 on LL_{-0}, set index of C. b. Opposite 1.8 on C, read 0.448 on LL_{-0}.

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