Tamsayılar
-6,-5,-1 0,1 2,10,100

Reel sayılar
-10, -0.65, 0.217, 10, 99, 0.1111..., 0.12121212.....
0.78787878..... π=3.14159265...
$\sqrt{2}=1.4142135..$ $\sqrt{3}=1.7320508...$ $\sqrt{15}=3.8729...$ log(2)=0.301029.. log(6)=0.7781..

Rasyonel sayılar

$\frac{a}{b}$ şeklinde yazılabilen reel sayılar.
-10, -0.65, 0.217, 10, 99, 0.1111..., 0.12121212.....
0.78787878.....

İrrasyonel sayılar

Reel olup $\frac{a}{b}$ şeklinde yazılamayan sayılar

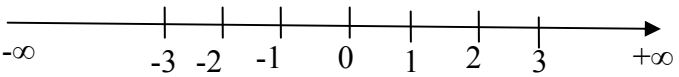
π =3.14159265..., $\sqrt{2}=1.4142135..$, $\sqrt{3}=1.7320508...$, $\sqrt{15}=3.8729...$, log(2)=0.301029..
log(6)=0.7781..
$2^{1.3}$=2.462288826689... $1.4^{2.5}=2.319103274...$

Mutlak Değer

|-9|=9, |9|=9, |-3|=3, |3|=3, |-2.5|=2.5 , |2.5|=2.5, $\left|-\frac{2}{6}\right|=\frac{2}{6}$, $\left|\frac{2}{6}\right|=\frac{2}{6}$,

|- π |= π, |π |= π,
a pozitif bir sayı ise |-a|=a

Eşitsizlikler
3>2, 4>1, 100>99
-3<-2, -4>-1, -100<-99



Temel İşlemler
Toplama ve Çıkarma

(3)=3, (-3)=-3, -(-3)=3,
2+3=5, -2-3=-5, -2+6=+4, +2-6=-4,

(-a+b-c+d-e)= -a + b – c + d -e

-(-a+b-c+d-e)= +a – b + c- d+e

(2+4+10)=(16)=16

(2-4+10)= (8) =8

-(2+4)=-6,

-(-2+6)=-(4)=-4, -(-2+6)=+2-6=-4,

Çarpma

(+)(+)= +, $(3)_x(5)$ =(+)(+) 3_x5 = +15
(+)(–)= – $(3)_x(-5)$ =(+)(–) 3_x5 = –15
(–)(+)= – $(–3)_x(+5)$ =(–)(+) 3_x5 = –15
(–)(–)= + $(–3)_x(–5)$ =(–)(–) 3_x5 = +15

Bölme

$\frac{+}{+} = +$, $\frac{+6}{+3} = +2$

$\frac{-}{+} = -$, $\frac{-6}{+3} = -2$

$\frac{+}{-} = -$, $\frac{+6}{-3} = -2$

$\frac{-}{-} = +$, $\frac{-6}{-3} = +2$

Sıfır ile ilgili işlemler

Bir sayıya sıfır eklense veya çıkarılsa sayının değeri değişmez
3+0=3, 3-0=3, -3+0=-3, -3-0=-3

sıfır ile bir sayının çarpımı sıfırdır.
$3_x0=0$, $(-3)_x0=0$,

Sıfırın bir sayıya bolumu sıfırdır.
$\frac{0}{-3} = 0$, $\frac{0}{+3} = 0$

Bir sayının sıfıra bolumu tanımlı değildir. Matematik işlemlerde

$\frac{3}{0} = \infty$, $\frac{-3}{0} = -\infty$

kabul edilir, fakat bu tanımlar dikkatle kullanılmalıdır.
(∞ sonsuz demektir.)

a=b ise $\frac{a}{0} = \frac{b}{0}$ kabul edilmesi dogru değildir.

∞ normal bir sayı kabul edilirse

$\frac{3}{0} = \infty$, $\frac{5}{0} = \infty$, ∞=∞ o halde 3=5

gibi yanlış sonuçlara sebep olur.

Uslu ifadelerle işlemler

$2^2=2_x2=4$, $2^3=2_x2_{\,x}\,2=8$, $2^4=2_x2_{\,x}\,2_{\,x}\,2=16$

$3^2=3_x3=9$, $3^3=3_x3_{\,x}\,3=27$, $3^4=3_x3_{\,x}\,3_{\,x}\,3=81$

$(-2)^2=(-2)_x(-2)=4$, $(-2)^3=(-2)_x(-2)_{\,x}(-2)=-8$,

$(-2)^4=(-2)_x(-2)_{\,x}(-2)_{\,x}(-2)=16$

$(-3)^2=(-3)_x(-3)=9$, $(-3)^3=(-3)_x(-3)_{\,x}(-3)=-27$,

Uslu ifadelerde Genel Kurallar

A1) $e^m\,a^n=e^{m+n}$, A2) $\dfrac{a^m}{a^n}=a^{m-n}$

A3) $(e^m)^n=e^{mn}$, A4) $\left(\dfrac{a}{b}\right)^m=\dfrac{a^m}{b^m}$, A5) $(ab)^m=e^m\,B^M$,

---

A1) $e^m\,a^n=e^{m+n}$

$2^3\,2^2=(2_x2_x2)\,(2_x2)=(2_x2_x2_x2_x2)=2^5$

$2^3=8$, $2^2=4$, $8_x4=32$, $2^5=32$,

$3^5 \text{ x } 3^7=3^{12}$, $3^5 \text{ x } 3^3=3^8$, $3^5 \text{ x } 3^{-3}=3^2$,

$4^{2.5} \text{ x } 4^2=4^5$, $3^5 \text{ x } 3^3=3^8$, $3^5 \text{ x } 3^{-3}=3^2$,

A2) $\dfrac{a^m}{a^n}=a^{m-n}$ (a sıfırdan farklı ise geçerli)

$$\frac{2^3}{2^2}=2^{3-2}=2^1=2$$

$2^3=8$, $2^2=4$, $\dfrac{8}{4}=2$,

a) $\frac{2^4}{2^3} = 2^{4-3} = 2^1 = 2$

b) $\frac{2^3}{2^3} = 2^{3-3} = 2^0$

Not: $\frac{2^3}{2^3} = 1$, Dolayısıyla $2^0=1$ dir

Herhangidir sayı için

$\frac{a^m}{a^m} = 1 = a^{m-m} = a^0$ olduğundan, bütün sayılar için $a^0=1$ dir.

c) $100^0=1$, $0.5^0=1$, $(-2)^0=1$,

d) $\frac{2^3}{2^7} = 2^{3-7} = 2^{-4}$

$\frac{2^3}{2^7} = \frac{2^3}{2^3\ 2^4} = \frac{1}{2^4}$

dolayısıyla $2^{-4} = \frac{1}{2^4}$

bütün sayılar için (sıfır hariç)

$a^{-m} = \frac{1}{a^m}$, $a^m = \frac{1}{a^{-m}}$

Bağıntıları geçerlidir.

A3) $(e^m)^n=e^{mn}$

$(2^3)^2=2^{3x2} = 2^6$

$(2^3)^2=(2^3)\ (2^3)=2^6$

$2^3=8$, $(2^3)^2=(8)^2=64$, $2^6=64$

$(3^4)^3=3^{12}$, $(3^4)^{0.5}=3^2$,

$(0.5^2)^3=0.5^6$,

$[(-4)^5]^3=(-4)^{15}$

$[-(4)^5]^3=[-(4)^5]\,[-(4)^5]\,[-(4)^5]=-(4)^{15}$

A4) $(ab)^m=e^m\,B^M,$

$(3_x4)^2=(3)^2\,(4)^2,\quad (3)^2=9,\quad (4)^2=16,\quad 9x16=144$

$3_x4=12,\quad 12^2=144,$

$(2_x5)^3=(2)^3\,(5)^3,$

$(0.2_x5)^3=(0.2)^3\,(5)^3,$

$(0.2_x5)^{2.5}=(0.2)^{2.5}\,(5)^{2.5},$

$(-2_x5)^2=(-2)^2\,(5)^2=100$

$-(2_x5)^2=-\,(2)^2\,(5)^2=-100$

A5) $\left(\frac{a}{b}\right)^m=\frac{a^m}{b^m}$ b sıfırdan farklı ise geçerli.

$\left(\frac{4}{2}\right)^3=\frac{4^3}{2^3},\qquad \left(\frac{4}{2}\right)^3=(2)^3=8$

$4^3=64,\quad 2^3=8,\qquad \frac{4^3}{2^3}=\frac{64}{8}=8$

$\left(\frac{1}{2}\right)^3=\frac{1^3}{2^3}=\frac{1}{8}$

$\left(\frac{-3}{2}\right)^3=\frac{(-3)^3}{2^3}=\frac{-27}{8}=-\frac{27}{8}$

$\left(\frac{3}{-2}\right)^3=\frac{3^3}{(-2)^3}=\frac{27}{-8}=-\frac{27}{8}$

Kareköklü İşlemler

$2^2=4 \rightarrow \sqrt{4}=2$,	$3^2=9 \rightarrow \sqrt{9}=3$,
$2^3=8 \rightarrow \sqrt[3]{8}=2$,	$3^3=27 \rightarrow \sqrt[3]{27}=3$,
$2^4=16 \rightarrow \sqrt[4]{16}=2$	$3^4=81 \rightarrow \sqrt[4]{81}=3$

karekök ifadesinde sayı yoksa 2 varsayılır.

$\sqrt{4}=\sqrt[2]{4}=4^{1/2}=2$

$\sqrt{16}=\sqrt[2]{16}=16^{1/2}=4$

$\sqrt{a^4}=\sqrt[2]{a^4}=a^{4/2}=a^2$

$\sqrt{4}=4^{1/2}=2$

$\sqrt[3]{8}=8^{1/3}=2$

$\sqrt[4]{81}=81^{1/4}=3$

$25^{1/2}=5$

$36^{1/2}=6$

A1)

$a^2=b \rightarrow a=\sqrt{b}=b^{1/2}$

$a^n=b \rightarrow a=\sqrt[n]{b}=b^{1/n}$

$a^n=B^M \rightarrow \sqrt[n]{a^n}=\sqrt[n]{b^m} \rightarrow a=\sqrt[n]{b^m}=b^{m/n}$

A2) $\sqrt{xy}=\sqrt{x}\sqrt{y}$

or1) $\sqrt{9\ 16}=\sqrt{9}\ \sqrt{16}=3\ 4=12$

$\left(\sqrt{9\ 16}=\sqrt{144}=12\right)$

or2) $\sqrt{x^2y^2}=\sqrt{x^2}\sqrt{y^2}=xy$

or3) $\sqrt{x^4y^8}=\sqrt{x^4}\sqrt{y^8}=x^2y^4$

A3) $a\sqrt{b} = \sqrt{a^2 b}$

or1) $3\sqrt{4} = \sqrt{3^2 4} = \sqrt{36}$

or2) $4\sqrt{3} = \sqrt{4^2 3} = \sqrt{48}$

Or2) $5\sqrt{4} = \sqrt{5^2 4} = \sqrt{100}$

A4) $\sqrt{a^2 b} = a\sqrt{b}$

or1) $\sqrt{75} = \sqrt{3_x 25} = \sqrt{3_x 5^2} = 5\sqrt{3}$

or2) $\sqrt{12} = \sqrt{3_x 4} = \sqrt{3_x 2^2} = 2\sqrt{3}$

or3) $\sqrt{45} = \sqrt{5_x 9} = \sqrt{5_x 3^2} = 3\sqrt{5}$

or4) $\sqrt{200} = \sqrt{2_x 100} = \sqrt{2_x 10^2} = 10\sqrt{2}$

$$\frac{1}{\sqrt{25-16x^2}} = \frac{1/5}{\frac{\sqrt{25-16x^2}}{5}} = \frac{1/5}{\sqrt{\frac{25-16x^2}{25}}} = \frac{1/5}{\sqrt{1-\frac{16}{25}x^2}} = \frac{1/5}{\sqrt{1-\left(\frac{4}{5}x\right)^2}}$$

Eşitlikler (Denklemler)

a) x+7=10 x=?

Eşitliğin her iki tarafına -7 ekleyelim

x+7-7=10-7

x=3

b) 3x =6 x=?

Eşitliğin her iki tarafını $\frac{1}{3}$ ile çarpalım

$3x\frac{1}{3} = 6\ \frac{1}{3}$

x=2

c) 3x +1=7 x=?

Eşitliğin her iki tarafına -1 ekleyelim

3x +1-1=7-1

3x=6

Eşitliğin her iki tarafını $\frac{1}{3}$ ile çarpalım

$3x\frac{1}{3} = 6\ \frac{1}{3}$

x=2

Kesirli İşlemler

a1) $\frac{a}{x}+\frac{b}{x}=\frac{a+b}{x}$

a2) $\frac{a}{x}+\frac{b}{y}=\frac{a}{x}\frac{y}{y}+\frac{b}{y}\frac{x}{x}=\frac{ay}{xy}+\frac{bx}{xy}=\frac{ay+bx}{xy}$

b1) $\frac{2}{5}+\frac{4}{5}=\frac{2+4}{5}=\frac{6}{5}$

b2) $\frac{2}{5}+\frac{4}{6}=\frac{2}{5}\frac{6}{6}+\frac{4}{6}\frac{5}{5}=\frac{2_x6}{5_x6}+\frac{4_x5}{5_x6}=\frac{12+20}{5_x6}=\frac{32}{30}$

F43) $\frac{a}{b}=\frac{c}{d}$ ise $\frac{a+b}{b}=\frac{c+d}{d}$

ispat: Eşitliğin her iki tarafına 1 ilave edelim.

$\frac{a}{b}+1=\frac{c}{d}+1$

$\frac{a}{b}+\frac{b}{b}=\frac{c}{d}+\frac{d}{d}$

$\frac{a+b}{b}=\frac{c+d}{d}$

F45) $\frac{a}{b}=\frac{c}{d}$ ise $\frac{a-b}{b}=\frac{c-d}{d}$

ispat:

$\frac{a}{b}-1=\frac{c}{d}-1$

$\frac{a}{b}-\frac{b}{b}=\frac{c}{d}-\frac{d}{d}$

$\frac{a-b}{b}=\frac{c-d}{d}$

F45) $\frac{a}{b}=\frac{c}{d}$ ise ad=c dir.

İspat:

Eşitliğin her iki tarafını bd ile çarpalım.

$$\frac{a}{b}bd = \frac{c}{d}bd \rightarrow ad=bc$$

Exercises

In Exercises 1 through 4 designate each of the given numbers as being an integer, rationa irrational, real, or imaginary. (More than one designation may be correct.)

1. $3, \quad -\pi$
2. $\frac{5}{4}, \quad \sqrt{-4}$
3. $6j, \quad \frac{\sqrt{7}}{3}$
4. $-\frac{7}{3}, \quad \frac{\pi}{6}$

In Exercises 5 through 8 find the absolute value of each of the given numbers.

5. $3, \quad \frac{7}{2}$
6. $-4, \quad \sqrt{2}$
7. $-\frac{6}{7}, \quad -\sqrt{3}$
8. $-\frac{\pi}{2}, \quad -\frac{19}{4}$

In Exercises 9 through 14 insert the correct sign of inequality ($>$ or $<$) between the give pairs of numbers.

9. $6 \quad 8$
10. $7 \quad -5$
11. $\pi \quad -1$
12. $-4 \quad -3$
13. $-\sqrt{2} \quad -9$
14. $0.2 \quad 0.6$

In Exercises 15 through 18 find the reciprocals of the given numbers.

15. $3, \quad -2$
16. $\frac{1}{6}, \quad -\frac{7}{4}$
17. $-\frac{5}{\pi}, \quad x$
18. $-\frac{8}{3}, \quad \frac{y}{b}$

In Exercises 19 through 22 locate the given numbers on a number line as in Fig. 1-1.

19. $2.5, \quad -\frac{1}{2}$
20. $\sqrt{3}, \quad -\frac{12}{5}$
21. $-\frac{\sqrt{2}}{2}, \quad 2\pi$
22. $\frac{123}{19}, \quad -\frac{\pi}{6}$

In Exercises 23 through 29 answer the given questions.

23. List the following numbers in their numerical sequence, starting with the smallest: $-1, 9, \pi, \sqrt{5}, |-8|, -|-3|, -18$.
24. If a and b represent positive integers, what kind of number is represented by (a) $a + b$, (b) a/b, (c) $a \cdot b$?
25. Describe the location of a number x on the number scale when (a) $x > 0$, (b) $x < -4$.
26. Describe the location of a number x on the number scale when (a) $|x| < 1$, (b) $|x| > 2$.
27. The pressure P and volume V of a certain body of gas are related by the equation $P = c/V$ for certain conditions. Identify the symbols as variables or constants.
28. In writing a laboratory report, a student wrote "$-20°F > -30°F$." Is this statement correct?
29. After 2 sec, the current in a certain circuit is less than 3 amp. Using t to represent time and i to represent current, this statement may be written, "for $t > 2$, $i < 3$." In this way write the statement, "less than three feet from the light source illuminance is greater than 8 lumens/m^2." (Let I represent illuminance and s distance.)