

$$x^a x^b = x^{a+b}$$

$$(x^a)^b = x^{ab}$$

$$2^3 \cdot 2^2$$

$$= \underbrace{2 \times 2 \times 2}_3 \times \underbrace{2 \times 2}_2 = 2^5$$

①

$$(2^3)^2$$

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

$$\sqrt{2} \times \sqrt{2} = 2$$

$$2^a \times 2^a = 2$$

$$2^{2a} = 2^1$$

$$\sqrt{2} = 2^a$$

$$2a = 1$$

$$a = \frac{1}{2}$$

$$\sqrt{2} = 2^{\frac{1}{2}}$$

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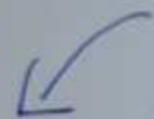
$$a = \frac{1}{2}$$



②

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

$$\sqrt[n]{x} = x^a$$



$$\sqrt[3]{x} \cdot \sqrt[3]{x} \cdot \sqrt[3]{x} = x^1$$

$$(x^a)^3 = x^{3a} = x^1$$

$$3a = 1$$

$$a = \frac{1}{3}$$

$$\sqrt[n]{x} = x^{1/n}$$

↑  
n-th root

(3)

$$x^{2/3} = (x^2)^{1/3} = (x^{1/3})^2$$

$$x^{2/3} = \sqrt[3]{x^2} = (\sqrt[3]{x})^2$$

$$x^{-1} x^1 = x^{-1+1} = x^0 = 1$$

$$x^{-1} x = 1$$

$$\boxed{x^{-1} = \frac{1}{x}}$$



$$x^a x^b = x^{a+b}$$

$$(x^a)^b = x^{ab}$$

$$x^{-a} = \frac{1}{x^a}$$

$$\sqrt[n]{x} = x^{1/n}$$

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$$\frac{-2}{1} \times \frac{1}{5} = \frac{-2}{5}$$

Example

Q1

$$\frac{1}{\sqrt[5]{x^{-2}}}$$

$$\frac{1}{(x^{-2})^{1/5}}$$

$$\frac{1}{x^{-2/5}}$$

④

$$\frac{1}{x^{-2/5}}$$

$$\boxed{x^{2/5}}$$

Q2

$$(\sqrt{xy})^{-3}$$

$$x^{-a} = \frac{1}{x^a}$$

$$x^a = \frac{1}{x^{-a}}$$

⑤



$$\left(\sqrt{xy}\right)^{-3}$$

$$\sqrt{z} = z^{1/2} \quad (6)$$

$$\left((xy)^{1/2}\right)^{-3} = (xy)^{-3/2}$$

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

$$\frac{1}{(xy)^{3/2}}$$

$$= \frac{1}{x^{3/2} y^{3/2}}$$

(7)

$$\sqrt{x} x^3 x^4$$

$$\sqrt{x} x^3 x^4$$

$$x^{1/2} x^3 x^4$$

$$\sqrt{x} y$$

$$\frac{1}{2} + \frac{3+4}{1}$$

$$\sqrt{xy} \quad \sqrt{xy}$$

$$\frac{1}{2} + \frac{7 \times 2}{1 \times 2} = \frac{1}{2} + \frac{14}{2} = \frac{15}{2}$$

$$x^{15/2}$$



(8)

$$x^{15/2} \neq \frac{x^{15}}{2} \quad \text{and} \quad x^{15/2} = x^{(15/2)}$$

computer - order of operations.

P	←	( )
E		exp.
<hr/>		
M	x	
<hr/>		
D	/	
<hr/>		
^	+	
<hr/>		
S	-	
<hr/>		

Q6

$$\frac{\sqrt{x^3}}{\sqrt[3]{x^2}} = \frac{(x^3)^{1/2}}{(x^2)^{1/3}} \quad \frac{3}{1} \times \frac{1}{2} = \frac{3}{2} \quad (9)$$

$$= \frac{x^{3/2}}{x^{2/3}} = x^{3/2 - 2/3} \quad \frac{3 \times 3}{3 \times 2} - \frac{2 \times 2}{3 \times 2}$$

$$= x^{5/6} \quad \frac{9}{6} - \frac{4}{6}$$



10

Q8

$$\frac{\sqrt[3]{x^2} y^3}{\sqrt{y^2} x^5} = \left[ \frac{\sqrt[3]{x^2}}{x^5} \right] \left[ \frac{y^3}{\sqrt{y^2}} \right]$$

$$= \frac{(x^2)^{1/3}}{x^5} \frac{y^2}{(y^2)^{1/2}} = \frac{x^{2/3}}{x^5} \frac{y^2}{y^1}$$

$$= \frac{y^2 y^{-1}}{x^5 x^{-2/3}} = \frac{y}{x^{13/3}}$$

$\frac{3 \times 5}{3} - \frac{2}{3}$   
 $\frac{15-2}{3}$

(11)

Warning

$$(y^2)^{1/2} = y$$

$$y = -2$$

$$\left((-2)^2\right)^{1/2}$$

$$(4)^{1/2} = 2 \neq -2$$

be careful with negative numbers



$$x^{a/b} = (x^a)^{1/b} = (x^{1/b})^a$$

$$\sqrt{(-2)^2}$$

||

$$\left(\sqrt{-2}\right)^2$$

↑ doesn't work.

$$\sqrt{4}$$

||

2

Warning: be careful  
with negative numbers.

usual assumption:

$\sqrt{x}$   
 $x$  is positive

(12)

$$x^{a/b} = (x^a)^{1/b} = (x^{1/b})^a$$

$$\sqrt{(-2)^2} =$$

$$\left(\sqrt{-2}\right)^2$$

↑ doesn't work.

$$\sqrt{4} =$$

2

warning: be careful  
with negative numbers.

usual assumption:

$x$  is positive

$$\sqrt{x}$$



Q6

$$t + (t^2 - 4) - t(t + 3)$$

15

$$\underbrace{t + t^2 - 4 - t^2 - 3t}_{0}$$

$$-2t - 4$$

Q11

$$(x+1)(x-2) = 4$$

(16)

$$x(x-2) + 1(x-2)$$

$$x^2 - \underbrace{2x + x}_{-x} - 2$$

$$x^2 - x - 2$$

	$x - 2$
$x$	$x^2 - 2x$
$+1$	$x - 2$



$$\overset{2}{(x-1)} \overset{x}{\left( \overset{3}{x^2+x-2} \right)} \quad 6. \text{ term}$$

(17)

$$x(x^2+x-2) - 1(x^2+x-2)$$

$$x^3 + \underbrace{x^2 - 2x - x^2 - x + 2}_0$$

$$x^3 - 3x + 2$$

	$x^2$	$+x$	$-2$
$x$	$x^3$	$x^2$	$-2x$
$-1$	$-x^2$	$-x$	$+2$

Q12

(18)

$$(x-1)(x+1) + x^2(x-3)$$

$$x(x+1) - (x+1) + x^3 - 3x^2$$

$$\underbrace{x^2 + \underbrace{x - x}_0 - 1}_{\quad} + x^3 - \underbrace{3x^2}_{\quad}$$

$$x^3 - 2x^2 - 1$$



Q17

$$\frac{1}{x+5} - \frac{x}{x+3}$$

Common denominator (20)

$$(x+5)(x+3)$$

$$\frac{1 \times (x+3)}{(x+5) \times (x+3)} - \frac{x \times (x+5)}{(x+3) \times (x+5)}$$

$$\frac{x+3}{(x+5)(x+3)} - \frac{x^2+5x}{(x+3)(x+5)}$$

~~2~~

$$\frac{x+3-x^2-5x}{(x+3)(x+5)}$$

(21)

$$\frac{x+3-x^2-5x}{(x+3)(x+5)} =$$

$$\boxed{\frac{-x^2-4x+3}{(x+3)(x+5)}}$$

$$= \boxed{\frac{-x^2-4x+3}{x^2+8x+15}}$$

$$\frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

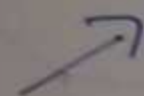
$$\frac{4 \pm \sqrt{16+12}}{-2}$$

$$\frac{4 \pm \sqrt{28}}{-2} \quad -2 \pm \frac{\sqrt{28}}{2}$$



warning

$$-x^2 - 4x + \frac{3}{x^2} + 8x + 15.$$



computer sees.

$$\left( -x^2 - 4x + 3 \right) / \left( x^2 + 8x + 15 \right)$$

(22)

$$\frac{P}{E}$$
$$\frac{P}{S}$$

Q18

$$\frac{u+1}{1} + \frac{u}{u+1}$$

Common denominator

$$(u+1)$$

$$\frac{(u+1) \times (u+1)}{1 \times (u+1)} + \frac{u}{u+1} \leftarrow \frac{\cancel{x(u+1)} 1(u+1)}{\cancel{x(u+1)}}$$

$$\frac{u^2 + u + u + 1}{u+1} + \frac{u}{u+1} = \frac{u^2 + 3u + 1}{u+1}$$

$$\frac{(u+1) \times (u+1)}{(u+1) \times 1}$$

(23)



$$\frac{(u+1) \times 1}{(u+1) \times u-1} + \frac{1}{(u+1)} \times (u-1) \quad \text{Common denominator} \quad (24)$$

$$(u-1)(u+1)$$

$$\frac{(u+1) \times 1}{(u+1) \times (u-1)} + \frac{1}{(u+1)(u-1)} \quad \text{Common denominator}$$

$$(u+1)(u-1)$$