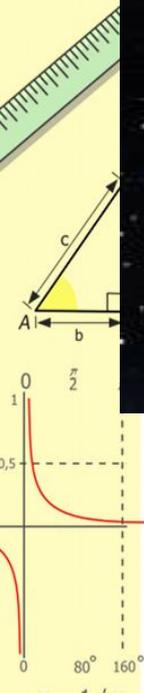




Логарифмическая функция

обликатая

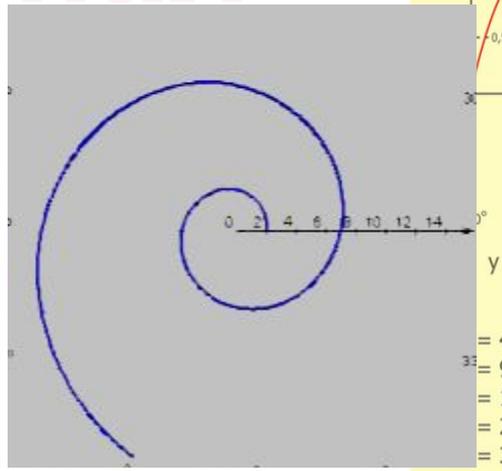


$y = 1/x$

$$\begin{array}{r} 1 \\ \times 2500 \\ \hline 2500 \\ + 84 \\ \hline 105000 \end{array}$$



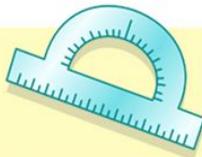
$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$



$y = \cos$

- = 4
- = 9
- = 16
- = 25
- = 36
- 7 x 7 = 49
- 8 x 8 = 64
- 9 x 9 = 81

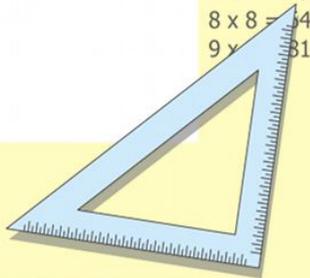
$\sin 90^\circ = 1$



$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

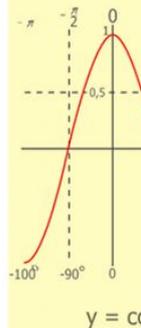
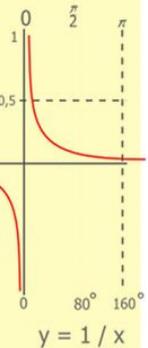
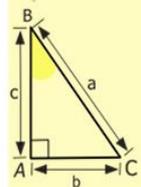
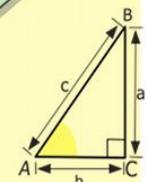
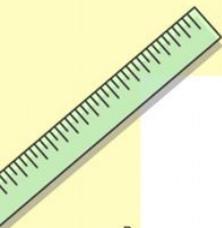
$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



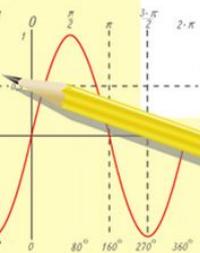
Морской бой

| № | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| a | | | | |
| b | | | | |
| c | | | | |
| d | | | | |



$$\begin{array}{r} 2500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$

- $2 \times 2 = 4$
- $3 \times 3 = 9$
- $4 \times 4 = 16$
- $5 \times 5 = 25$
- $6 \times 6 = 36$
- $7 \times 7 = 49$
- $8 \times 8 = 64$
- $9 \times 9 = 81$



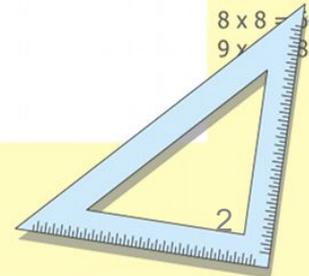
$$\frac{a}{c} = \frac{b}{c} = \sin$$

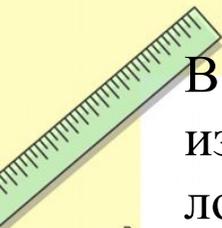
$$\frac{b}{c}$$

sin

$$\frac{x=25+45}{x=70}$$

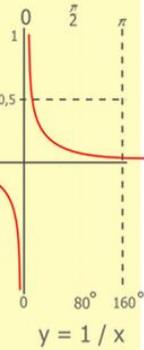
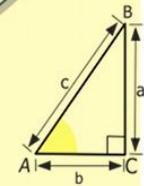
$$x^2 - 4^2$$



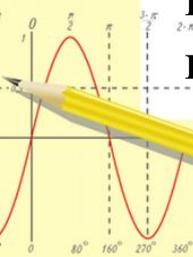


В области математики Джон Непер известен как изобретатель системы логарифмов, основанной на установлении соответствия между арифметической и геометрической числовыми прогрессиями.

В «Описании удивительной таблицы логарифмов» он опубликовал первую таблицу логарифмов (ему же принадлежит и сам термин «логарифм»), но не указал, каким способом она вычислена. Объяснение было дано в другом его сочинении «Построение удивительной таблицы логарифмов», вышедшем в 1619, уже после смерти Непера. Таблицы логарифмов, насущно необходимые астрономам, нашли немедленное применение.



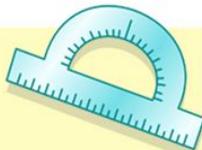
$$\begin{array}{r} 2500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 10500 \end{array}$$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\sin 90^\circ = 1$$



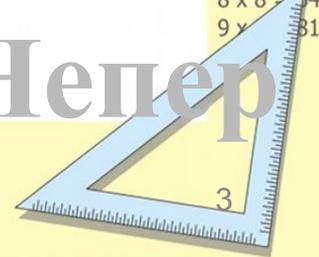
$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

Джон Непер

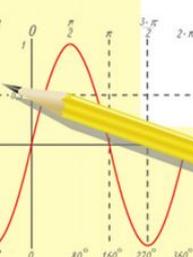
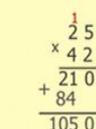
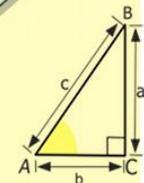
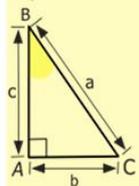
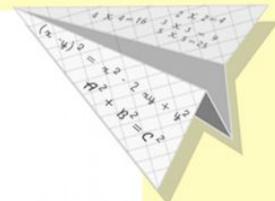
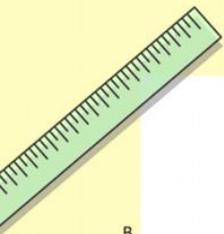
$$(x+y)(x-y) = x^2 - y^2$$

- 5 x 5 = 25
- 6 x 6 = 36
- 7 x 7 = 49
- 8 x 8 = 64
- 9 x 9 = 81



Определение логарифмической функции

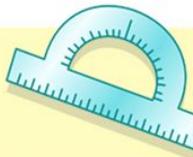
Функцию, заданную формулой $y = \log_a x$ (где $a > 0$ и $a \neq 1$), называют *логарифмической функцией* с основанием a .



$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

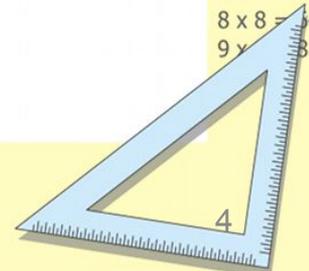
$$\sin 90^\circ = 1$$



$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



| | |
|---------|----|
| 7 x 7 = | 49 |
| 8 x 8 = | 64 |
| 9 x 9 = | 81 |

Построить графики функций

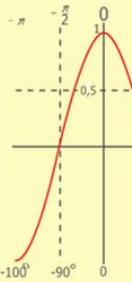
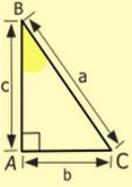
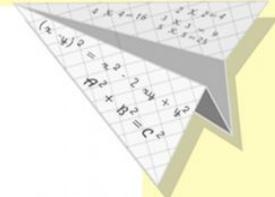
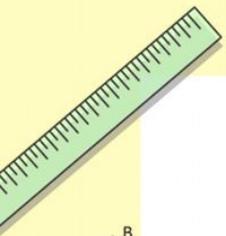
$y = \log_2 x$ и $y = \log_{1/2} x$

$y = \log_2 x$

| | | | | | | |
|----------------|---------------|---------------|---|---|---|---|
| x | $\frac{1}{4}$ | $\frac{1}{2}$ | 1 | 2 | 4 | 8 |
| $y = \log_2 x$ | | | | | | |

$y = \log_{1/2} x$

| | | | | | | |
|--------------------|---------------|---------------|---|---|---|---|
| x | $\frac{1}{4}$ | $\frac{1}{2}$ | 1 | 2 | 4 | 8 |
| $y = \log_{1/2} x$ | | | | | | |



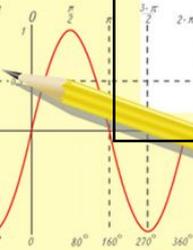
$y = \cos$

- $2 \times 2 = 4$
- $3 \times 3 = 9$
- $4 \times 4 = 16$
- $5 \times 5 = 25$
- $6 \times 6 = 36$
- $7 \times 7 = 49$
- $8 \times 8 = 64$
- $9 \times 9 = 81$



$y = 1/x$

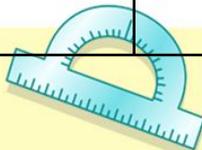
$\frac{1}{2} \times 500$
 $\times 42$
 $\frac{210}{+ 84}$
 $\frac{105000}{}$



$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

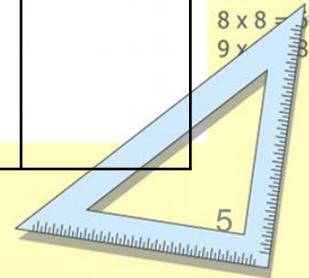
$\sin 90^\circ = 1$

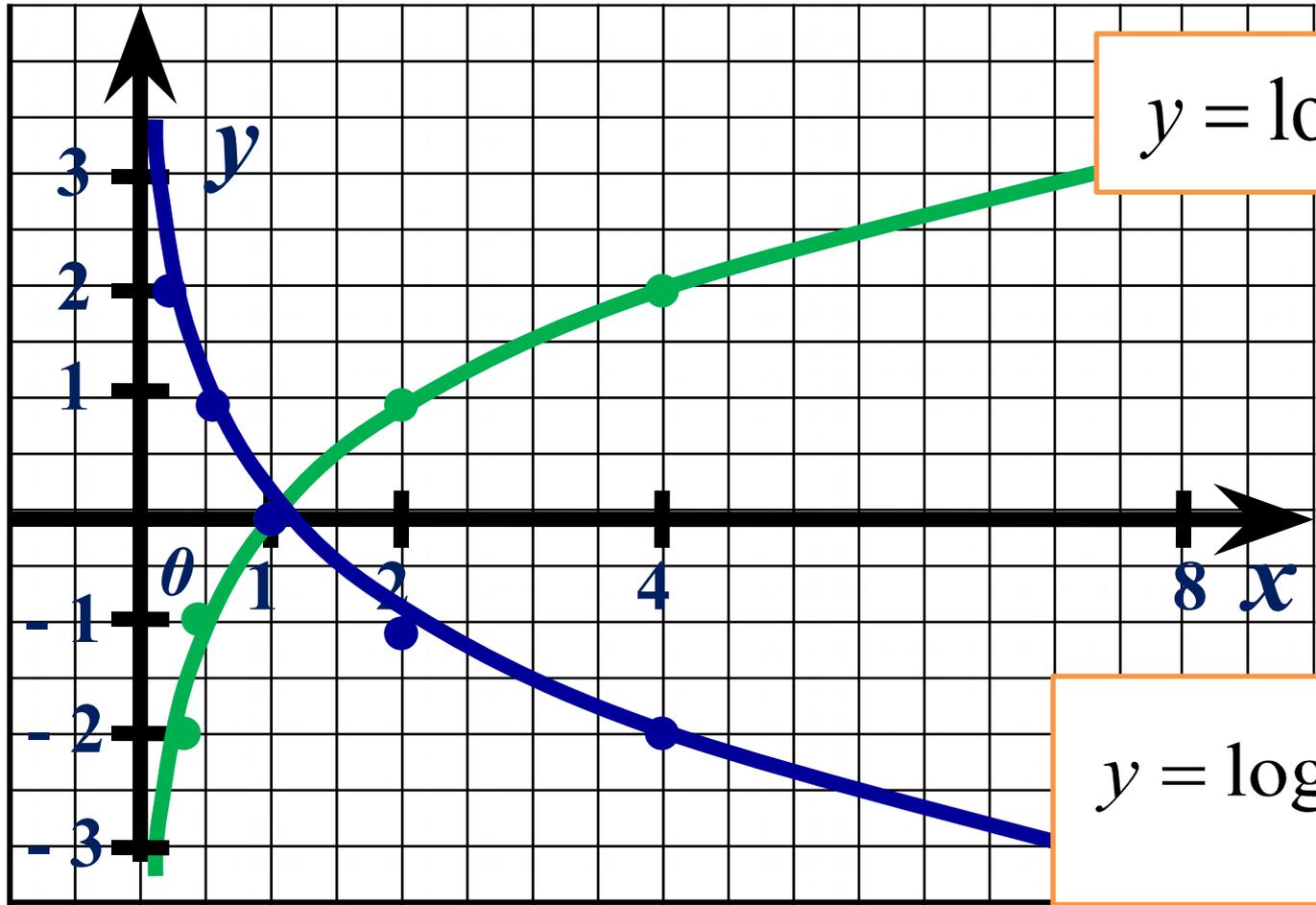
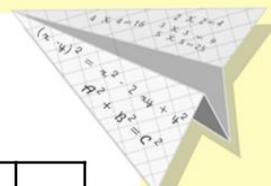
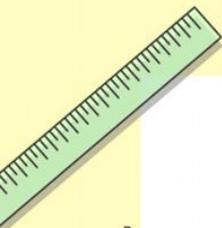


$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$

$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$

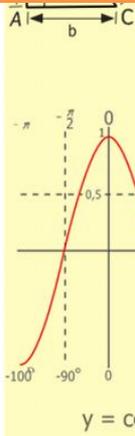
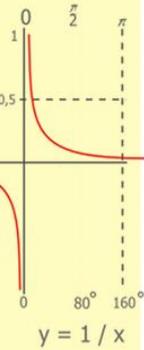
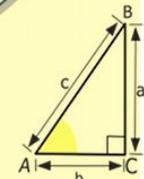
$(x+y)(x-y) = x^2 - y^2$



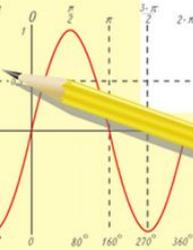


$$y = \log_2 x$$

$$y = \log_{\frac{1}{2}} x$$



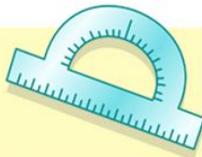
$$\begin{array}{r} 12500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

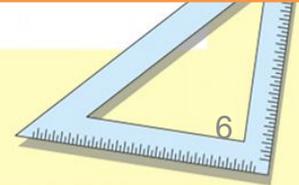
$$\sin 90^\circ = 1$$



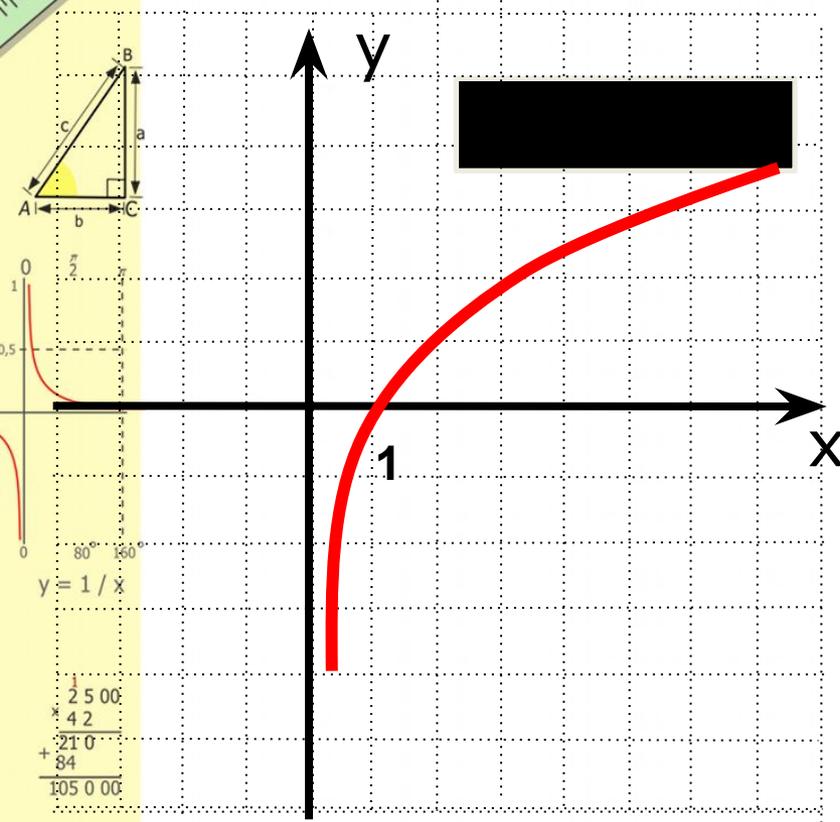
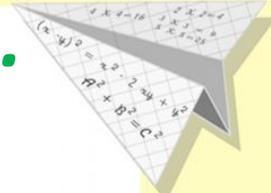
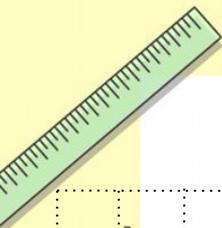
$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

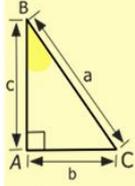
$$(x+y)(x-y) = x^2 - y^2$$



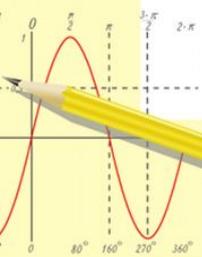
Свойства функции $y = \log_a x, a > 1$.



1. $D(f)$ – множество всех положительных чисел R^+ .
2. $E(f)$ - множество всех действительных чисел R .
3. Функция является ни четной, ни нечетной
4. Три вершины графика функции пересекает ось абсцисс в точке $x = 1$.
5. Промежутки знакопостоянства:
6. Возрастание (убывание).
 $y < 0$ при $x \in (0; 1)$.
7. Функция непрерывна при $x \in (0; +\infty)$.
7. Функция непрерывна.



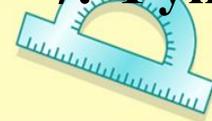
| |
|-------------------|
| $y = \cos$ |
| $2 \times 2 = 4$ |
| $3 \times 3 = 9$ |
| $4 \times 4 = 16$ |
| $5 \times 5 = 25$ |
| $6 \times 6 = 36$ |
| $7 \times 7 = 49$ |
| $8 \times 8 = 64$ |
| $9 \times 9 = 81$ |



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

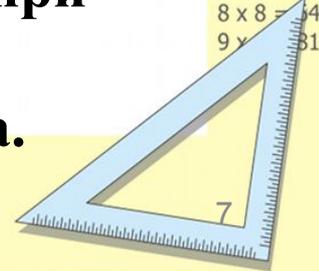
$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

$$\sin 90^\circ = 1$$



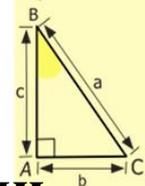
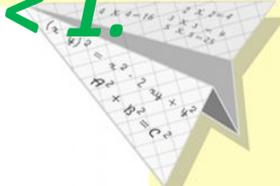
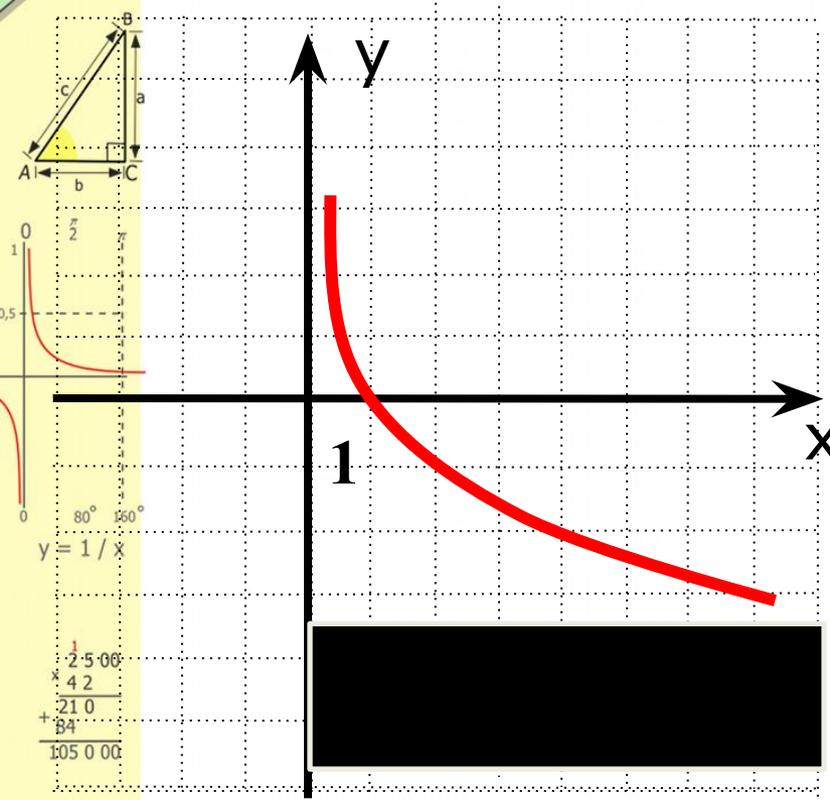
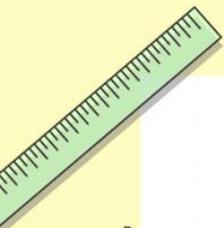
$$\begin{cases} y = \sin 90 \\ x = 25 + 45 \\ x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$

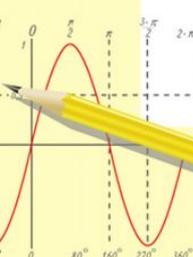


Свойства функции $y = \log_a x, 0 < a < 1$.

1. $D(f)$ – множество всех положительных чисел \mathbb{R}^+ .
2. $E(f)$ – множество всех действительных чисел \mathbb{R} .
3. Функция является ни четной, ни нечетной.
4. При всех значениях a график функции пересекает ось абсцисс в точке $(1, 0)$.
5. Промежутки знакопостоянства:
 6. Возрастание (убывание).
 $y < 0$ при $x \in (1; +\infty)$.
 7. Функция непрерывна.



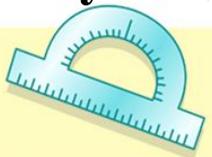
- $2 \times 2 = 4$
- $3 \times 3 = 9$
- $4 \times 4 = 16$
- $5 \times 5 = 25$
- $6 \times 6 = 36$
- $7 \times 7 = 49$
- $8 \times 8 = 64$
- $9 \times 9 = 81$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

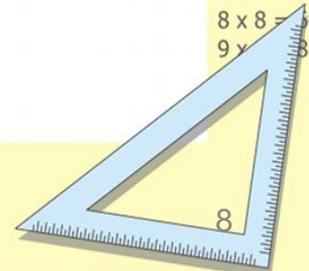
$$\sin 90^\circ = 1$$

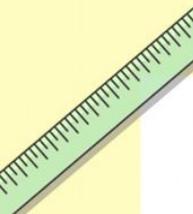


$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



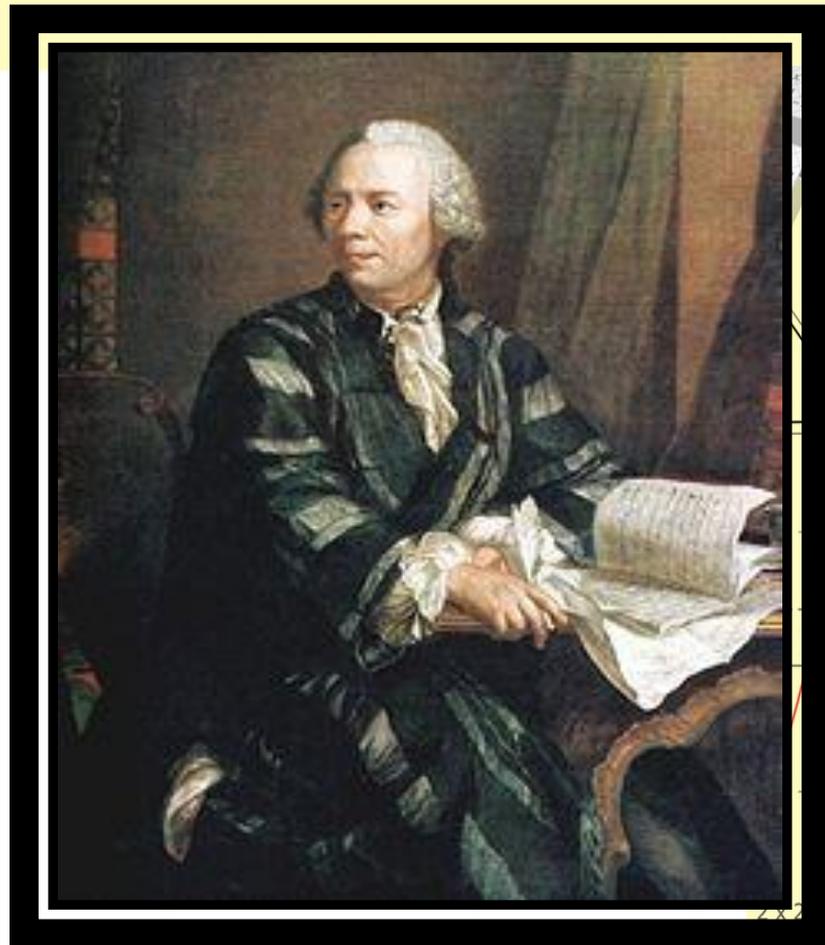


Идеальный математик 18 века - так часто называют Эйлера. Он родился в маленькой тихой Швейцарии.

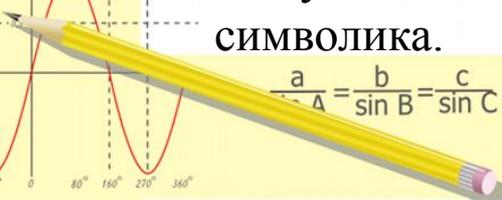
В 1725 году переехал в Россию. Поначалу Эйлер расшифровывал дипломатические депеши, обучал молодых моряков высшей математике и астрономии, составлял таблицы для артиллерийской стрельбы и таблицы движения Луны.

В 26 лет Эйлер был избран российским академиком, но через 8 лет он переехал из Петербурга в Берлин. Там "король математиков" работал с 1741 по 1766 год; потом он покинул Берлин и вернулся в Россию.

Современное определение показательной, логарифмической и тригонометрических функций — заслуга Эйлера, так же как и их символика.

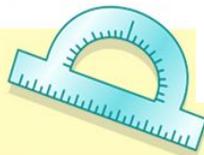


ЛЕОНАРД ЭЙЛЕР


$$\frac{a}{A} = \frac{b}{B} = \frac{c}{C}$$

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

$$\sin 90^\circ = 1$$



$$\frac{x=25+45}{x=70}$$

$$y = x^2 - 4^2$$



Из указанных функций назовите логарифмическую.

$$y = 4x, \quad y = \log_5 25 + x^2, \quad y = \ln(x + 2),$$

$$y = 2,5^x, \quad y = \log_5 125 + \frac{5}{x}.$$

Найти область определения функции $y = \log_2(5 - 3x)$

$$1. \left(-1 \frac{2}{3}; \infty\right). \quad 2. \left(-\infty; -1 \frac{2}{3}\right). \quad 3. \left(1 \frac{2}{3}; \infty\right). \quad 4. \left(-\infty; 1 \frac{2}{3}\right).$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\sin 90^\circ = 1$$

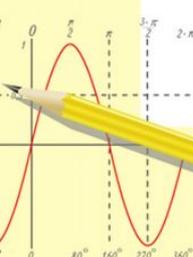
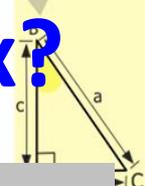
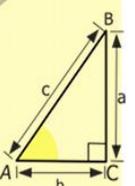
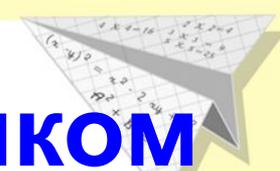
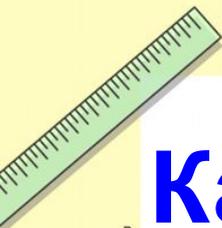
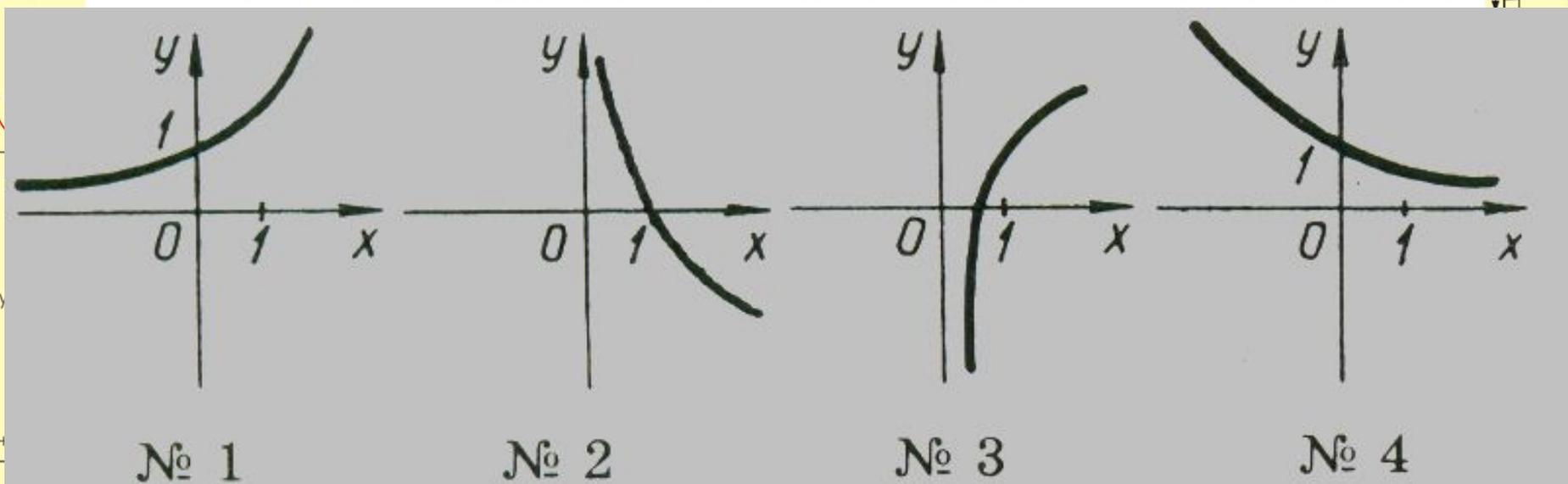
$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \end{cases}$$

$$x = 70$$

$$(x+y)(x-y) = x^2 - y^2$$

Какой график является графиком функции $y = \log_{0,4} x$?



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\sin 90^\circ = 1$$

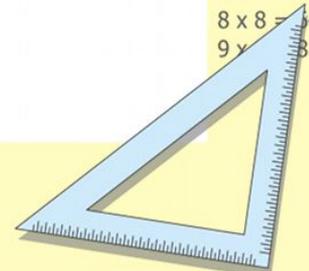


$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

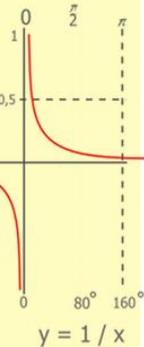
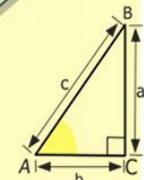
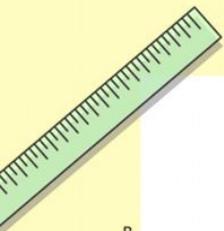
$$(x+y)(x-y) = x^2 - y^2$$

- 5 x 5 = 25
- 6 x 6 = 36
- 7 x 7 = 49
- 8 x 8 = 64
- 9 x 9 = 81

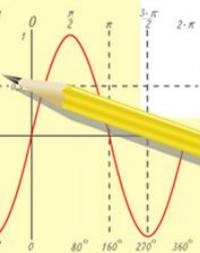


Определите, какие из перечисленных ниже функций являются возрастающими, а какие убывающими:

- 1) $y = \log_3 x$;
- 2) $y = \log_2 x$;
- 3) $y = \log_{0,2} x$;
- 4) $y = \log_{0,5} (2x+5)$;
- 5) $y = \log_3 (x+2)$



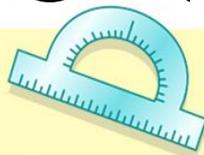
$$\begin{array}{r} 1 \\ \times 2500 \\ \hline 2500 \\ + 42 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\sin 90^\circ = 1$$

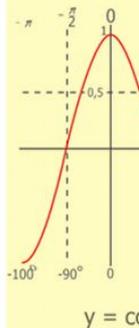
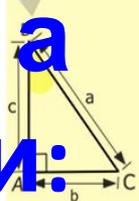


$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

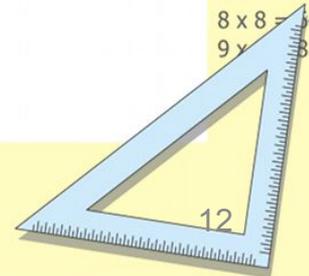
$$\begin{cases} y = 1 \\ x = 25 + 45 \end{cases}$$

$$x = 70$$

$$(x+y)(x-y) = x^2 - y^2$$



$$\begin{array}{l} 2 \times 2 = 4 \\ 3 \times 3 = 9 \\ 4 \times 4 = 16 \\ 5 \times 5 = 25 \\ 6 \times 6 = 36 \\ 7 \times 7 = 49 \\ 8 \times 8 = 64 \\ 9 \times 9 = 81 \end{array}$$



Решить графически уравнения:

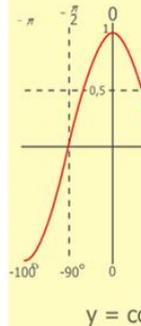
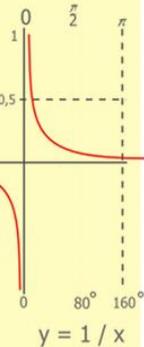
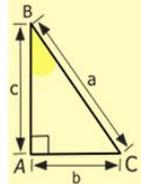
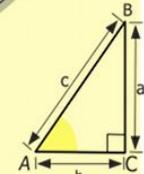
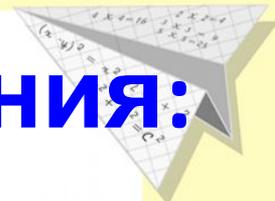
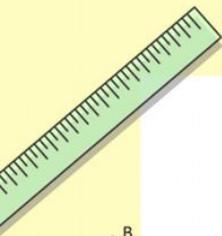
а) $\lg x = 1 - x;$



б) $\log_{1/5} x = x - 6;$

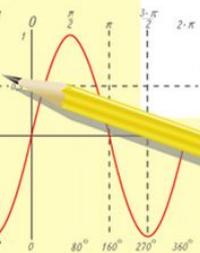


в) $\log_{1/3} x = x - 4;$



$$\begin{array}{r} 1 \\ \times 2500 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$

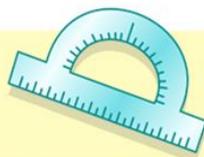
$2 \times 2 = 4$
 $3 \times 3 = 9$
 $4 \times 4 = 16$
 $5 \times 5 = 25$
 $6 \times 6 = 36$
 $7 \times 7 = 49$
 $8 \times 8 = 64$
 $9 \times 9 = 81$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\sin 90^\circ = 1$$

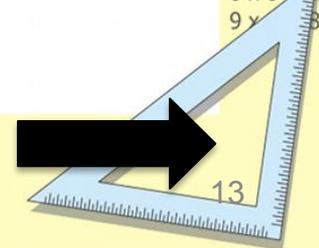


$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

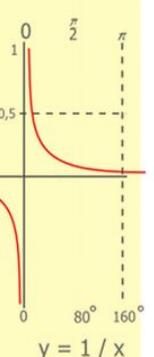
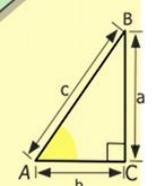
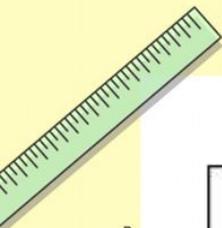
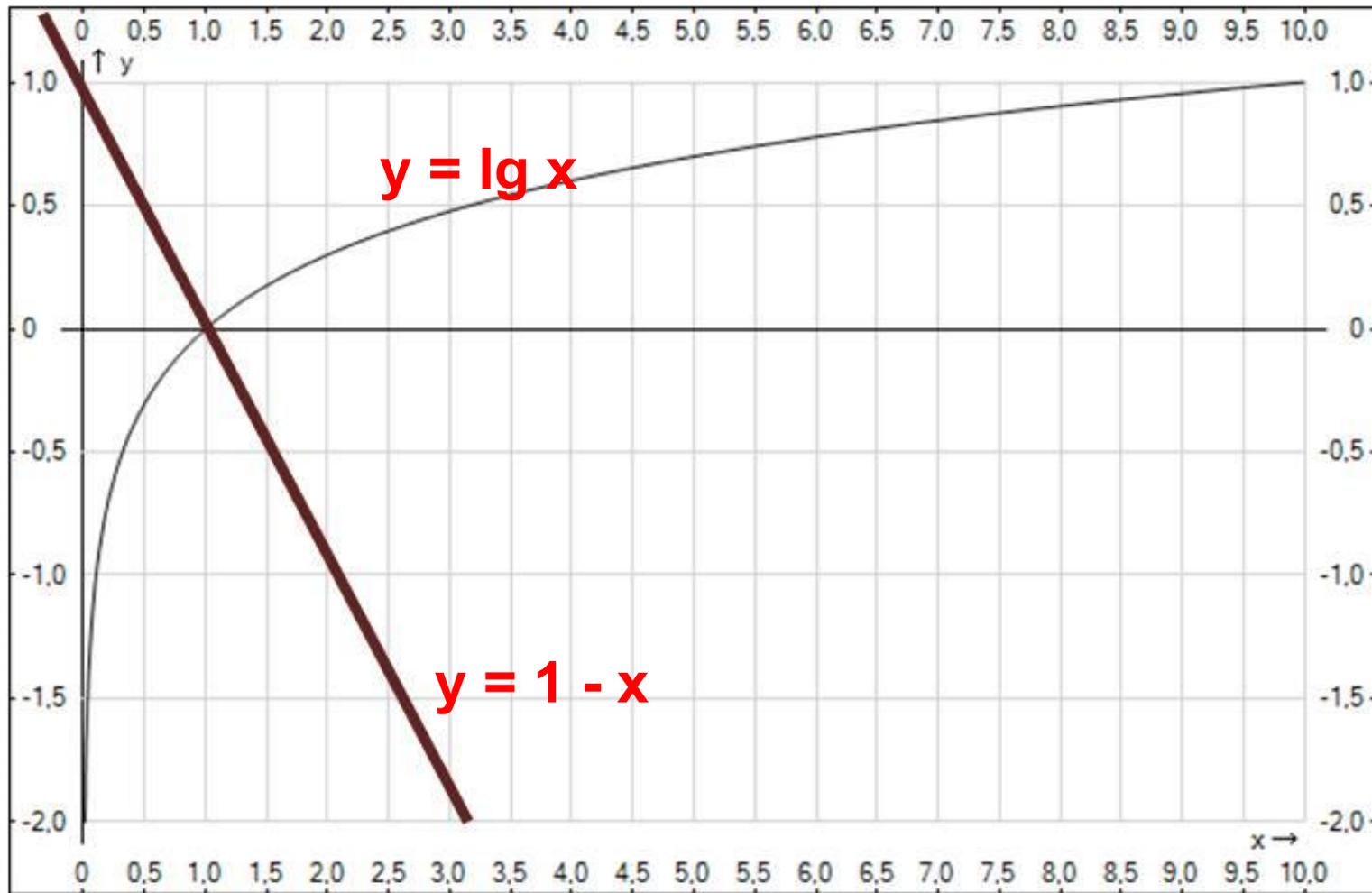
$$\begin{cases} y = 1 \\ x = 25 + 45 \end{cases}$$

$$x = 70$$

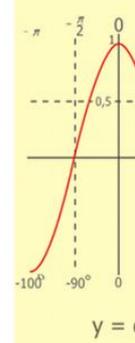
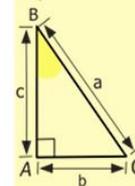
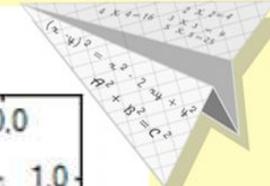
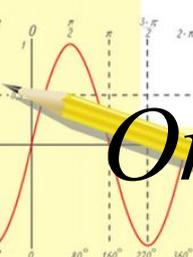
$$(x+y)(x-y) = x^2 - y^2$$



a) $\lg x = 1 - x$



$$\begin{array}{r} 1 \\ \times 2500 \\ \hline 2500 \\ + 42 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$



- $2 \times 2 = 4$
- $3 \times 3 = 9$
- $4 \times 4 = 16$
- $5 \times 5 = 25$
- $6 \times 6 = 36$
- $7 \times 7 = 49$
- $8 \times 8 = 64$
- $9 \times 9 = 81$

Ответ: $x = 1$

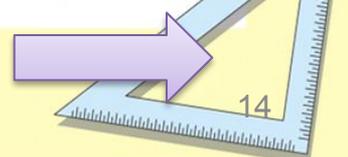
$\sin 90^\circ = 1$



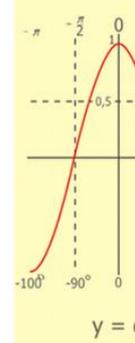
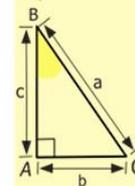
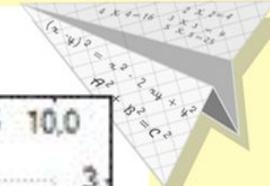
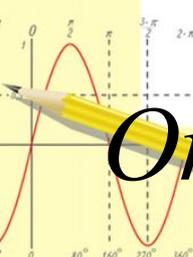
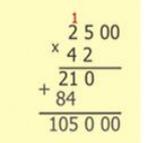
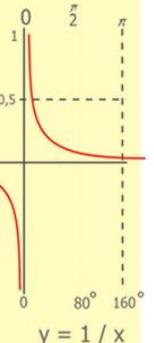
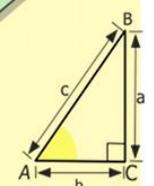
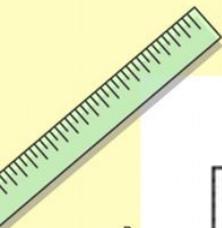
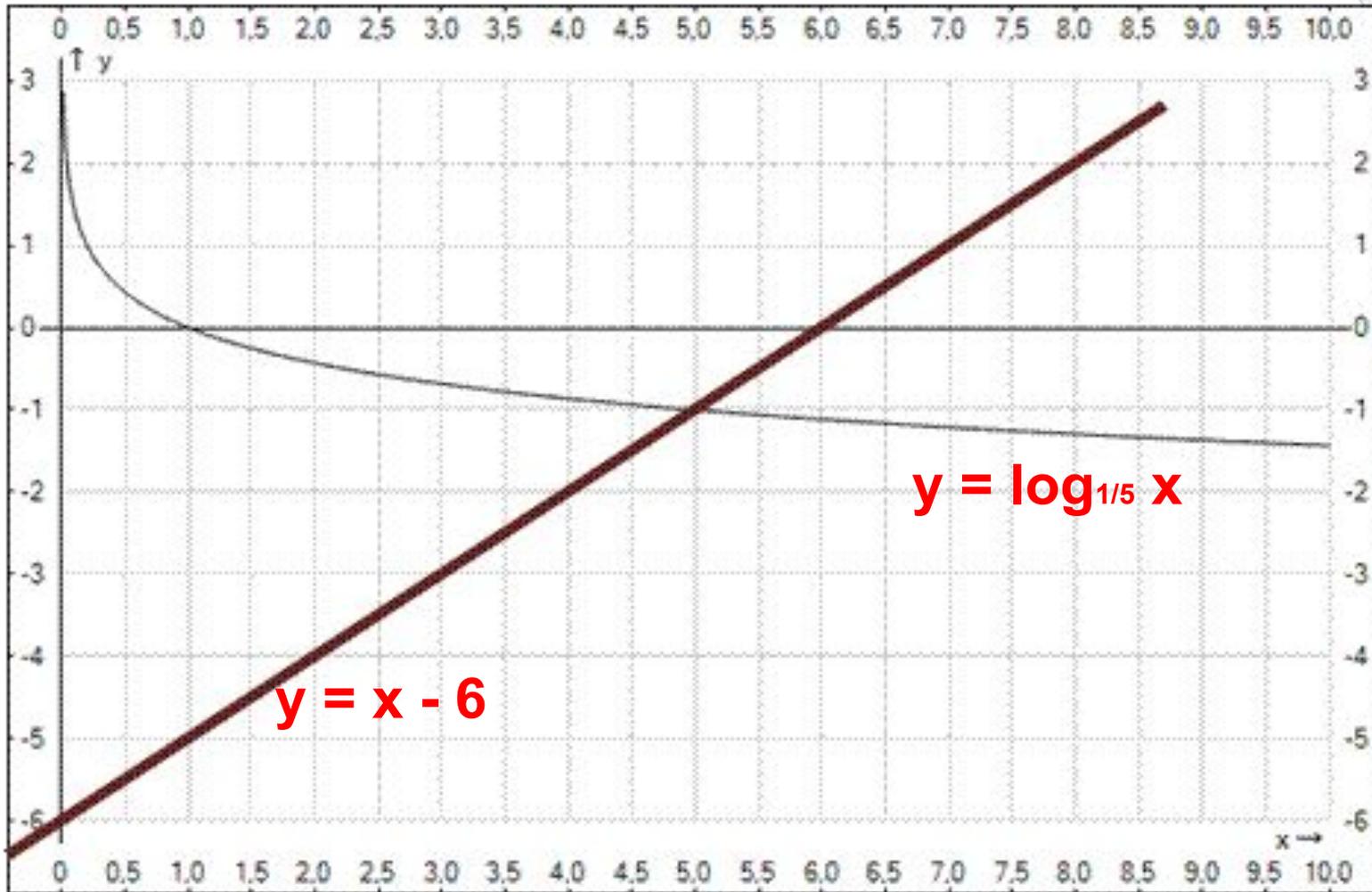
$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

$(x+y)(x-y) = x^2 - y^2$



б) $\log_{1/5} x = x - 6$



- 2 x 2 = 4
- 3 x 3 = 9
- 4 x 4 = 16
- 5 x 5 = 25
- 6 x 6 = 36
- 7 x 7 = 49
- 8 x 8 = 64
- 9 x 9 = 81

Ответ: $x = 5$

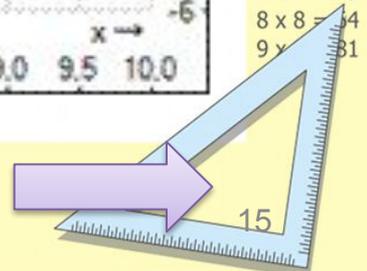
$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

$\sin 90^\circ = 1$

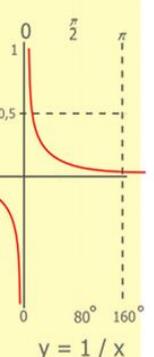
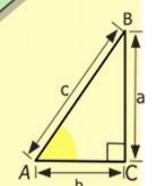
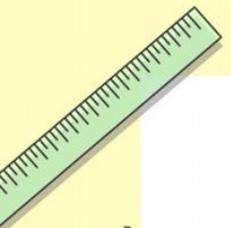
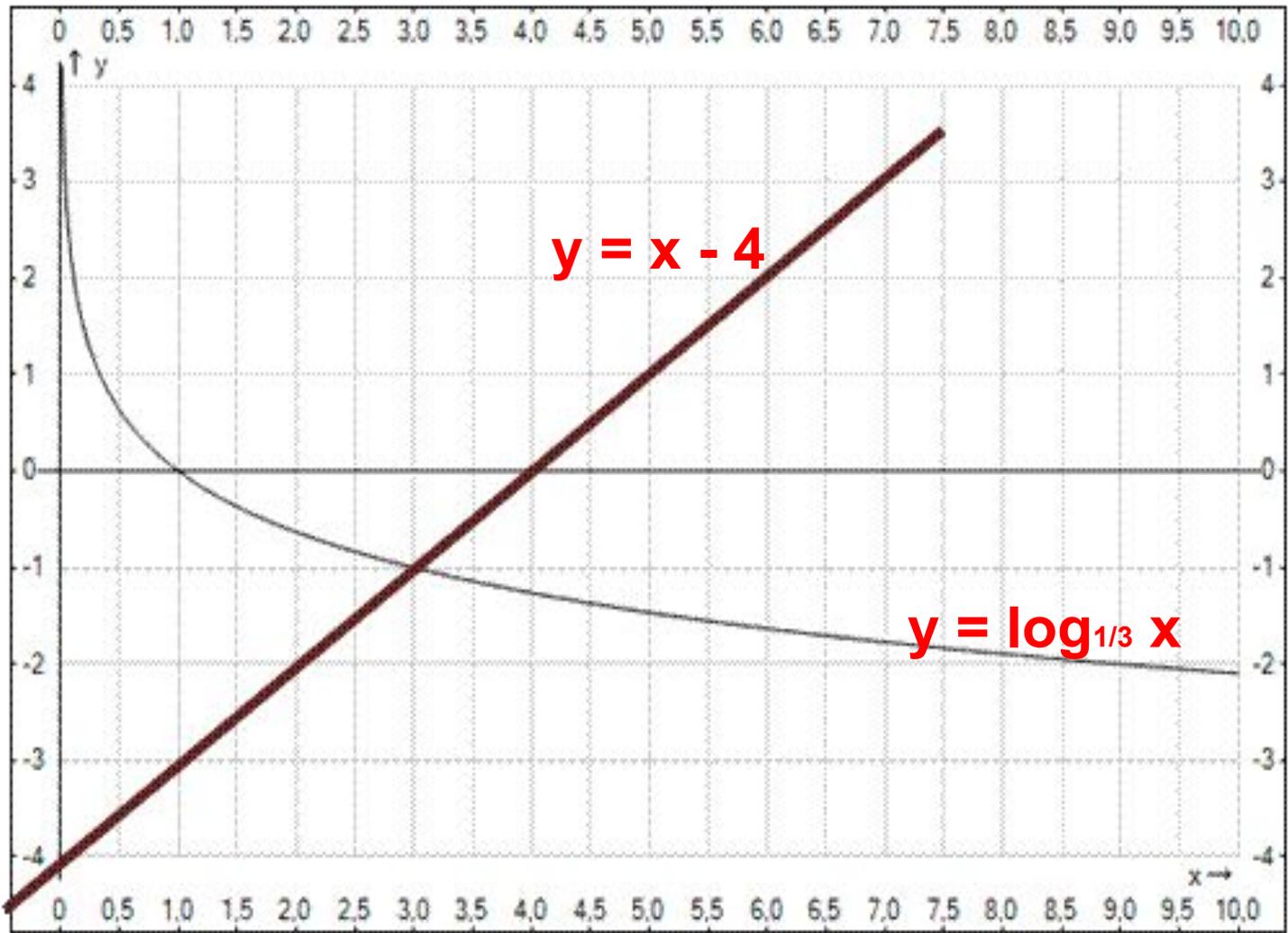


$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \\ y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

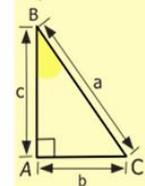
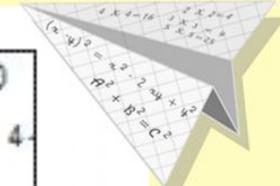
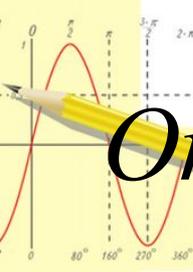
$$(x+y)(x-y) = x^2 - y^2$$



B) $\log_{1/3} x = x - 4$



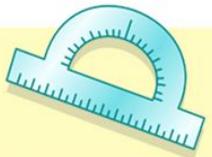
$\frac{1}{2} 500$
 $\times 42$
 $\hline 210$
 $+ 84$
 $\hline 10500$



- $2 \times 2 = 4$
- $3 \times 3 = 9$
- $4 \times 4 = 16$
- $5 \times 5 = 25$
- $6 \times 6 = 36$
- $7 \times 7 = 49$
- $8 \times 8 = 64$
- $9 \times 9 = 81$

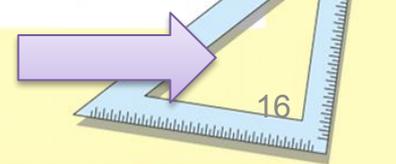
Ответ: $x = 3$

$\sin 90^\circ = 1$



$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \\ y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



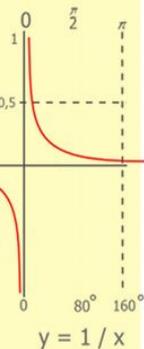
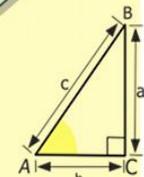
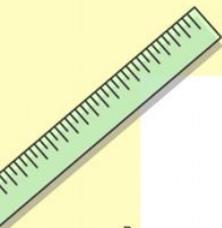
Используя свойства логарифмической функции, сравнить:

а) $\log_2 3$ и $\log_2 5$;

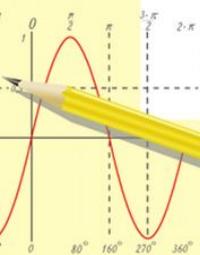
б) $\log_2 1/3$ и $\log_2 1/5$;

в) $\log_{1/2} 3$ и $\log_{1/2} 5$;

г) $\log_{1/2} 1/3$ и $\log_{1/2} 1/5$.



$$\begin{array}{r} 2500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 10500 \end{array}$$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

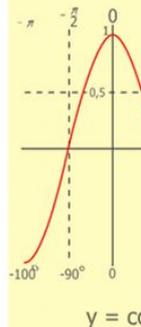
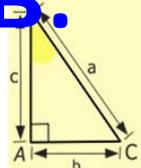
$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

$$\sin 90^\circ = 1$$

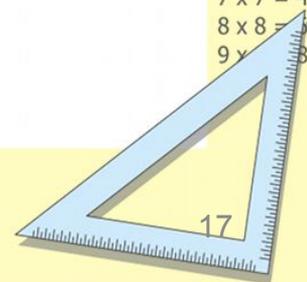


$$\begin{cases} y = \sin 90^\circ \\ x = 25y + 45 \\ y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



$$\begin{array}{l} 2 \times 2 = 4 \\ 3 \times 3 = 9 \\ 4 \times 4 = 16 \\ 5 \times 5 = 25 \\ 6 \times 6 = 36 \\ 7 \times 7 = 49 \\ 8 \times 8 = 64 \\ 9 \times 9 = 81 \end{array}$$



Ответьте на вопросы

1. Ось Oy является вертикальной асимптотой графика логарифмической функции.

2. Графики показательной и логарифмической функций симметричны относительно прямой $y = x$.

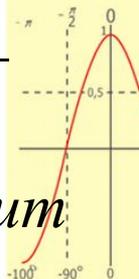
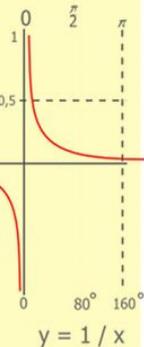
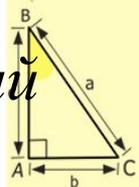
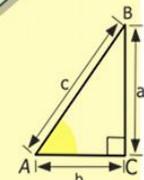
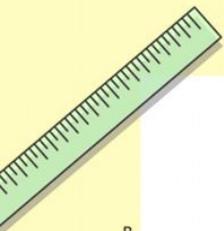
3. Область определения логарифмической функции – вся числовая прямая, а область значений этой функции – промежуток $(0, +\infty)$.

4. Монотонность логарифмической функции зависит от основания логарифма.

5. Не каждый график логарифмической функции проходит через точку с координатами $(1; 0)$.

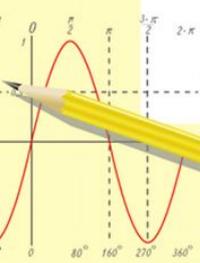
6. Логарифмическая функция является ни чётной, ни нечётной.

7. Логарифмическая функция непрерывна.



$$\begin{array}{r} 2500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$

$$\begin{array}{l} 2 \times 2 = 4 \\ 3 \times 3 = 9 \\ 4 \times 4 = 16 \\ 5 \times 5 = 25 \\ 6 \times 6 = 36 \\ 7 \times 7 = 49 \\ 8 \times 8 = 64 \\ 9 \times 9 = 81 \end{array}$$



$$\frac{a}{A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

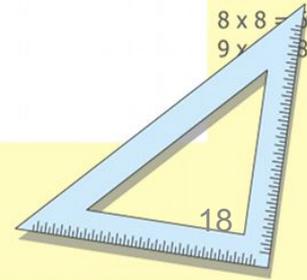
$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$$

$$\sin 90^\circ = 1$$



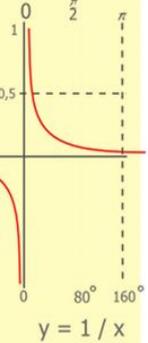
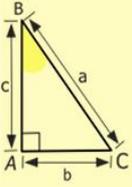
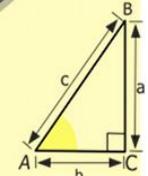
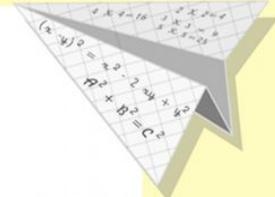
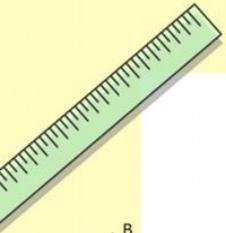
$$\begin{cases} x = 25 + 45 \\ y = 1 \\ x = 25 + 45 \\ x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$



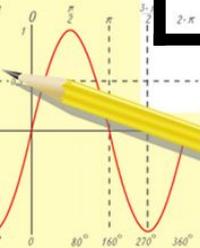
Взаимопроверка:

| | | | | | | |
|----|----|-----|----|-----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| да | да | нет | да | нет | да | да |



$$\begin{array}{r} 1 \\ \times 2500 \\ \hline 210 \\ + 84 \\ \hline 105000 \end{array}$$

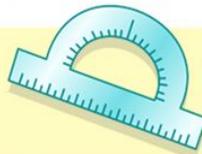
- 2 x 2 = 4
- 3 x 3 = 9
- 4 x 4 = 16
- 5 x 5 = 25
- 6 x 6 = 36
- 7 x 7 = 49
- 8 x 8 = 64
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$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

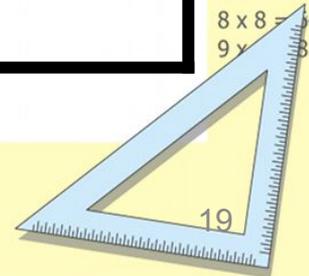
$$\sin 90^\circ = 1$$



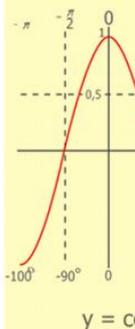
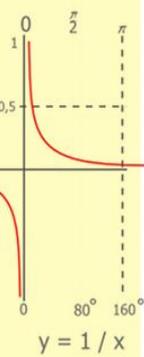
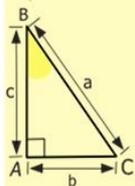
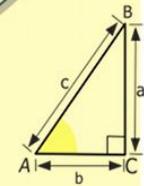
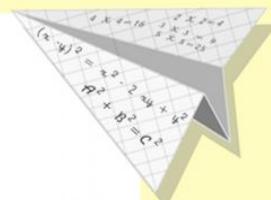
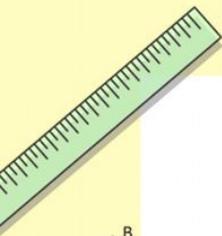
$$\begin{cases} y = \sin 90 \\ x = 25y + 45 \end{cases}$$

$$\begin{cases} y = 1 \\ x = 25 + 45 \\ \hline x = 70 \end{cases}$$

$$(x+y)(x-y) = x^2 - y^2$$

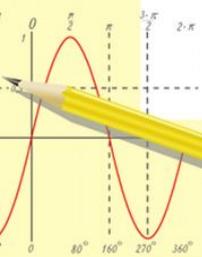


Спасибо за внимание!



$$\begin{array}{r} 1 \\ 2500 \\ \times 42 \\ \hline 210 \\ + 84 \\ \hline 10500 \end{array}$$

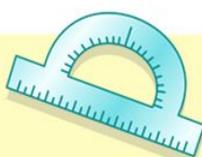
- $2 \times 2 = 4$
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