LA GEOMETRIA IN MESOPOTAMIA

Ms 3050 Schoyen collection
periodo paleobabilonese

LA GEOMETRIA IN MESOPOTAMIA

Tavolette di geometria

Varie centinaia

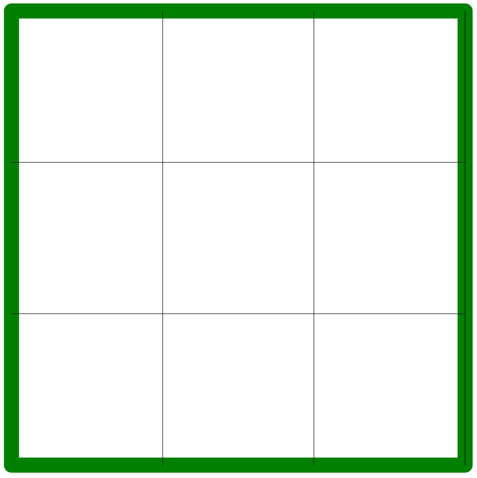
Contenuti
Misura di aree
•rettangoli
•triangoli rettangoli
•trapezi e quadrilateri
•cerchi

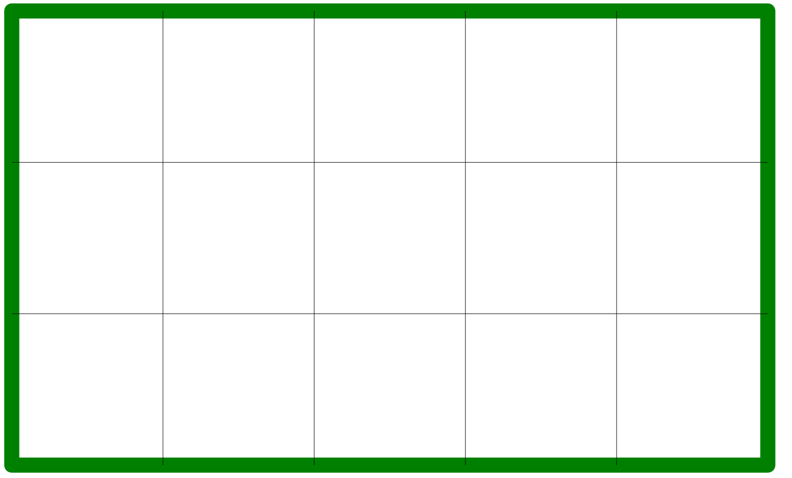
+ alcuni risultati avanzati

Poche differenze lungo tutto il periodo Sumero-Babilonese: 3000-1500

Un sapere che rimane simile per quasi due millenni

QUADRATI e RETTANGOLI





A=lxl

A=bxh

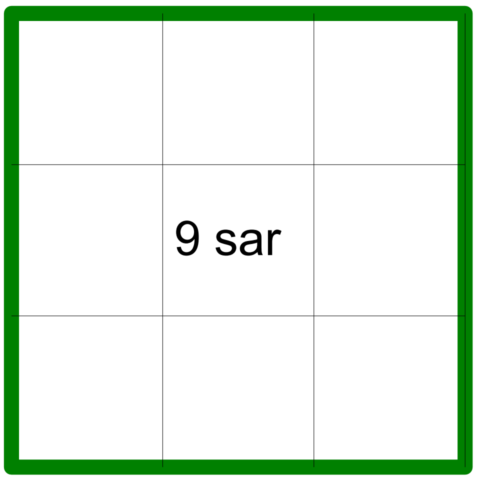
Misure di lunghezza

Unità di misura	Nome sumero	Nome accadico	Equivalenza	Quantità
Dito	SU.SI	ubanum		1,6 cm
Cubito	KUS	ammatum	30 dita	circa 50 cm
Canna	GI	qanum	6 cubiti	circa 3 metri
	NINDA		2 GI	circa 6 metri
	US		60 NINDA	circa 360 metri
	DANNA	berum	30 US	circa 11 Km

Misure di superficie

Unità di misura	Nome sumero	Nome accadico	Equivalenza	Quantità
	SAR	musarum	1 NINDA al quadrato	circa 36 mq
	IKU	ikum	100 SAR	circa 3600 mq
	BUR	burum	18 IKU	circa 64800 mq
	SHAR		60 BUR	circa 3.900.000 mq

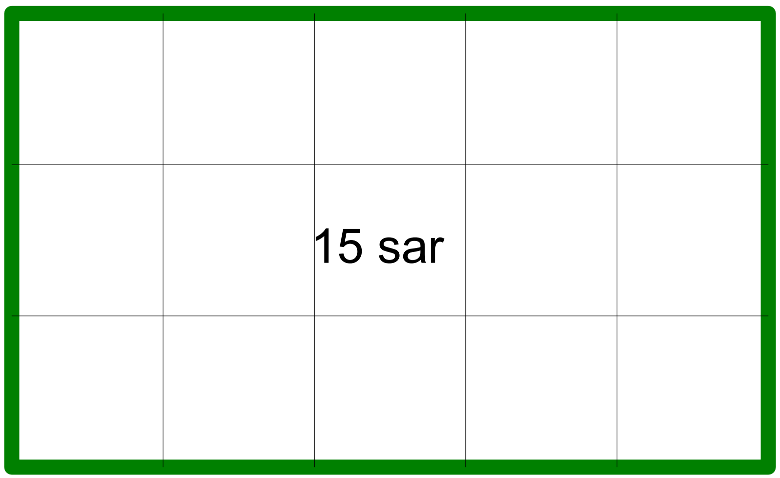
QUADRATI e RETTANGOLI



3 ninda

A=lxl

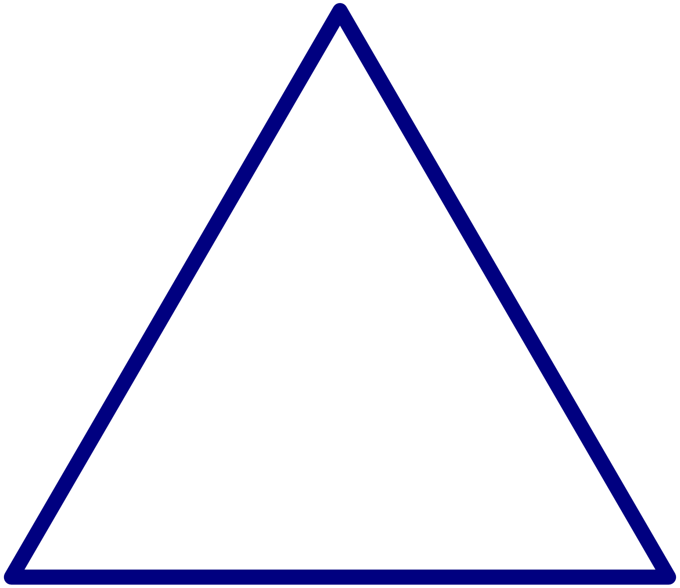
3 ninda



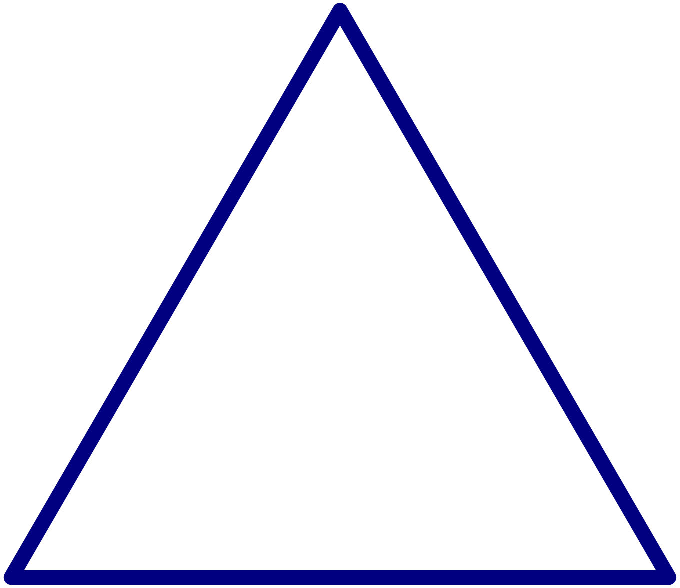
5 ninda

A=bxh

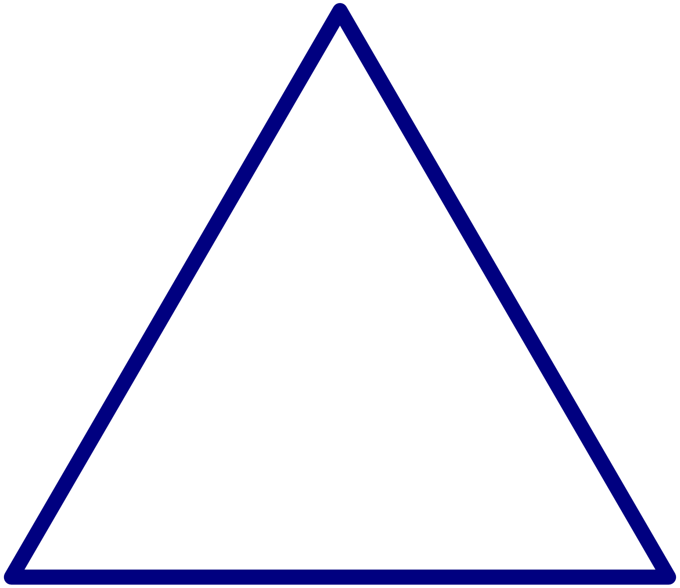
TRIANGOLO o CUNEO?

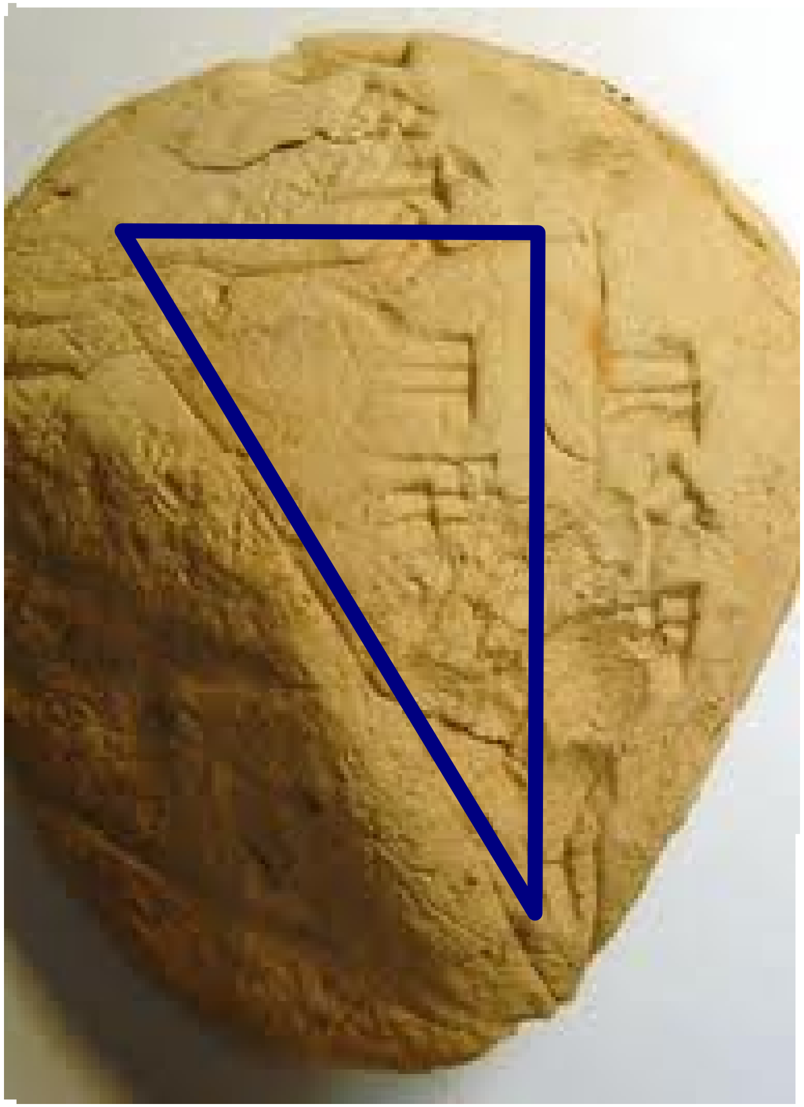


TRIANGOLO o CUNEO?



TRIANGOLO o CUNEO?





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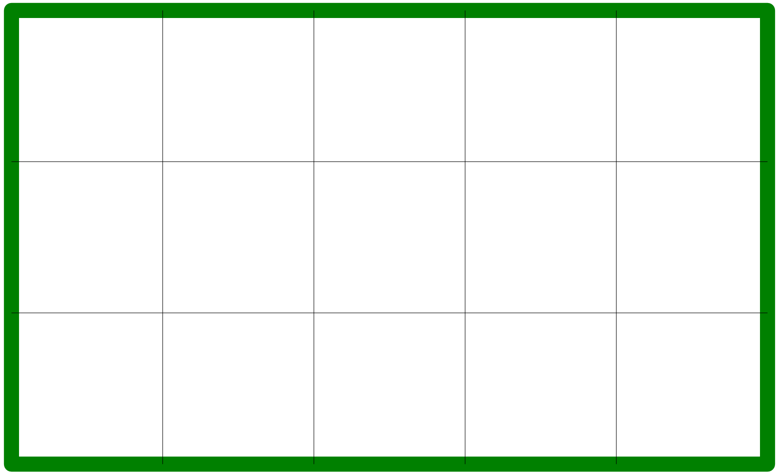
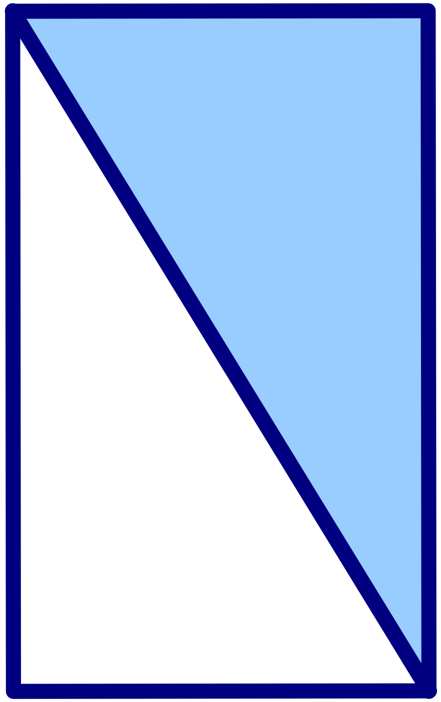
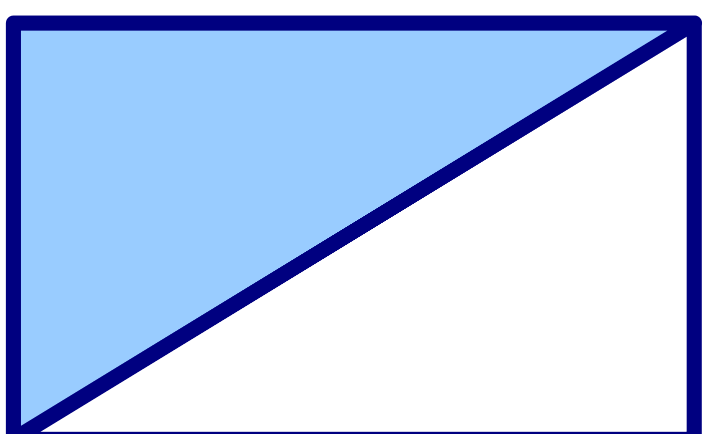


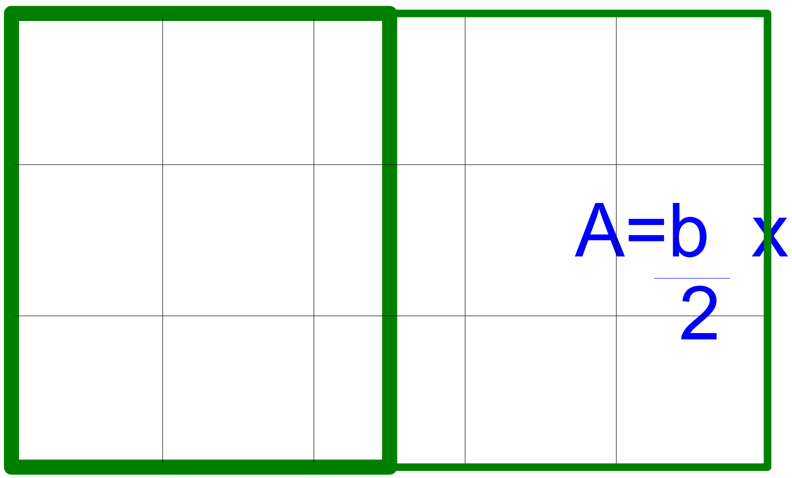
$A = b \times h$

$A = (b \times h)/2$

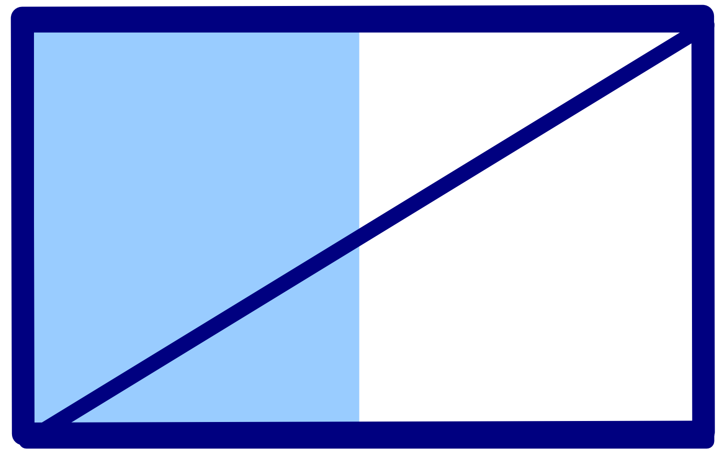


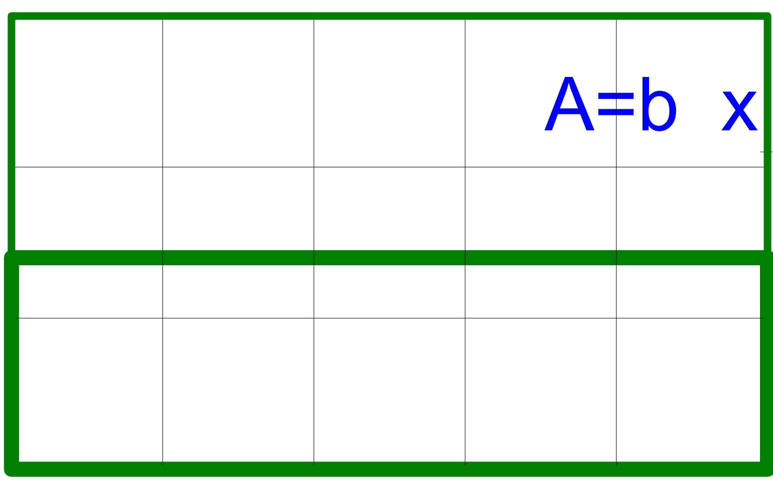


TRIANGOLO o CUNEO?



$$A = \frac{b \times h}{2}$$





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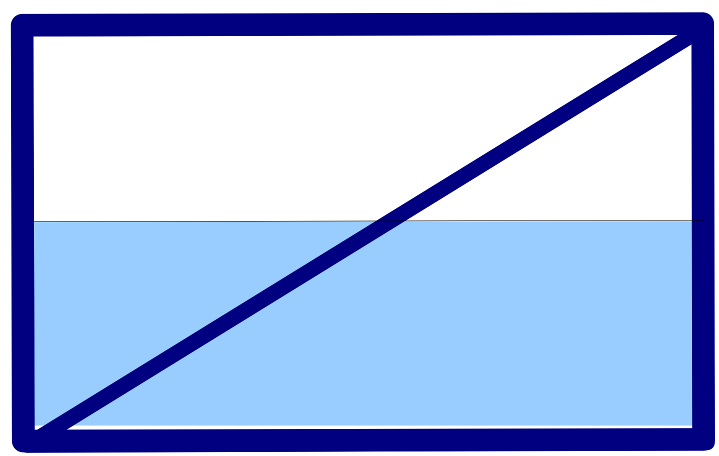

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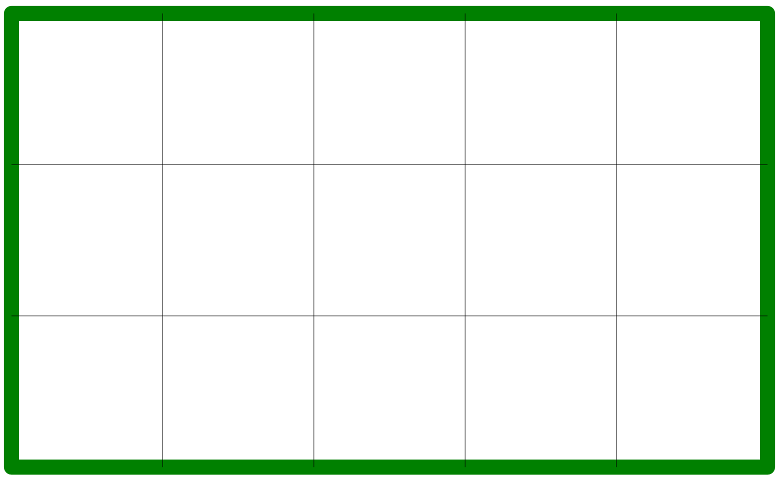
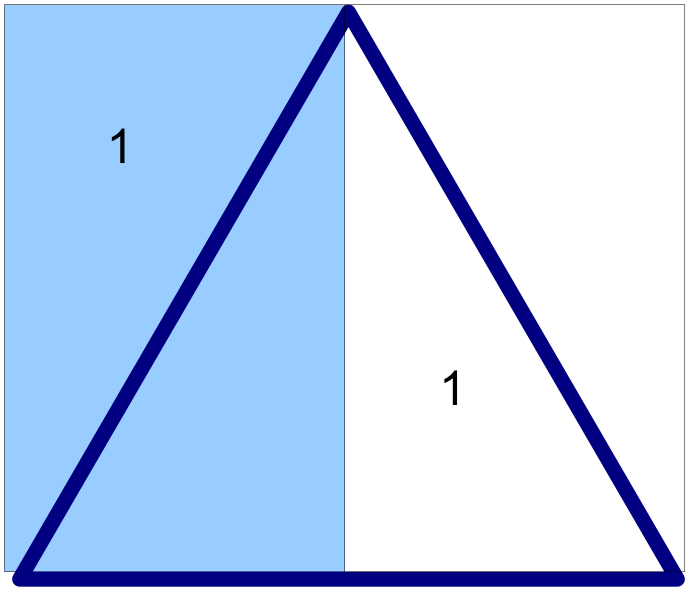
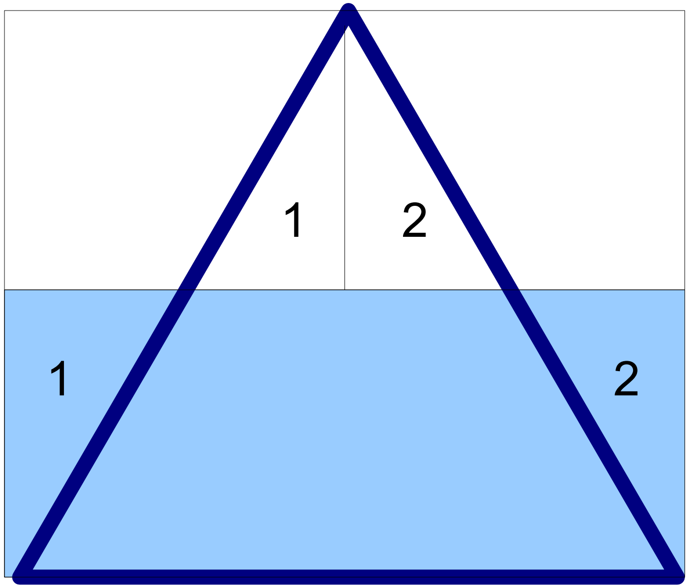




$$A=(b \times h)/2$$

$$A=\frac{b}{2} \times h \qquad A=b \times \frac{h}{2}$$



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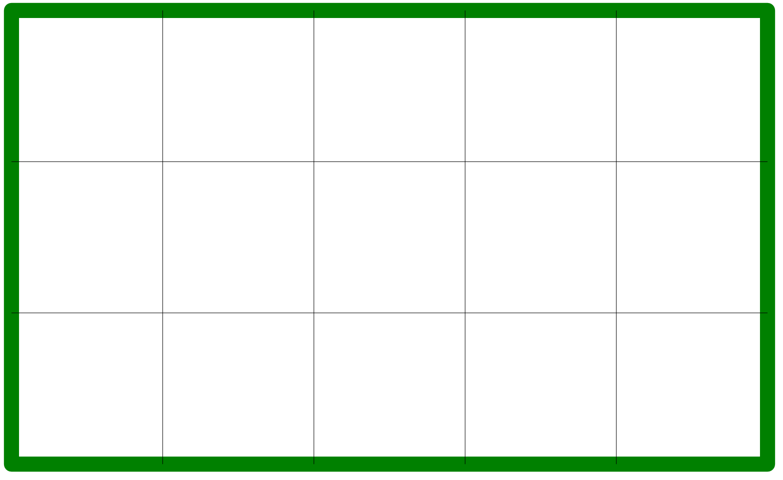

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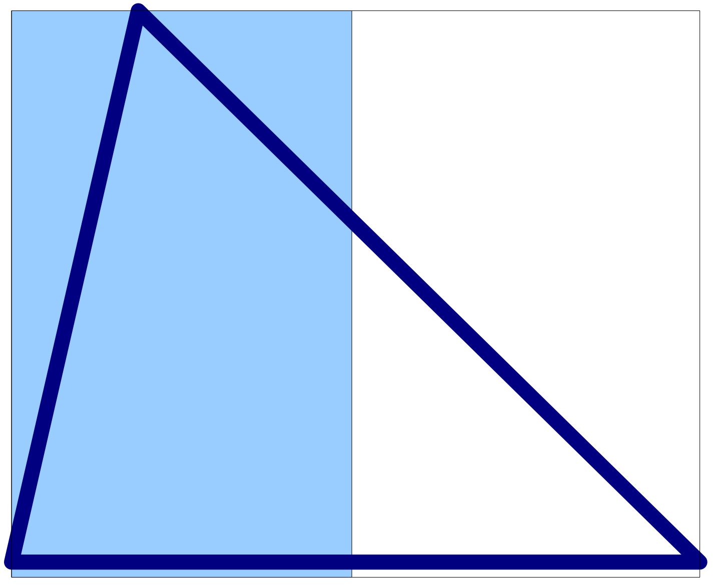

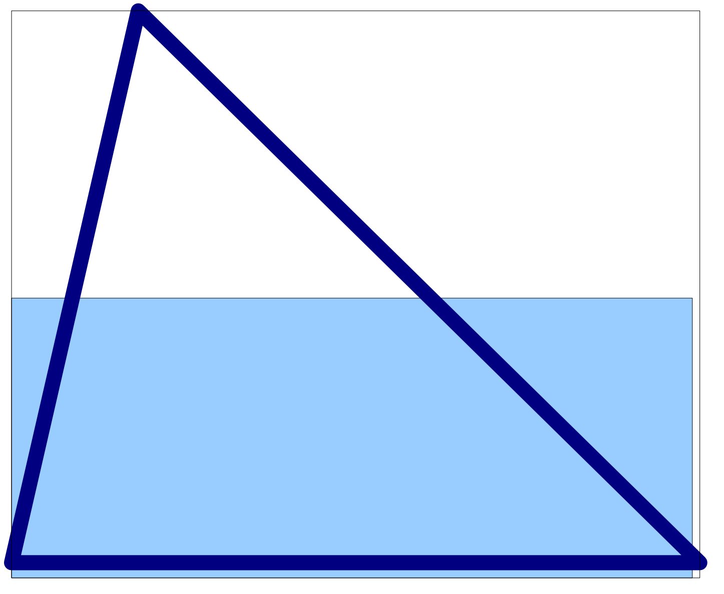

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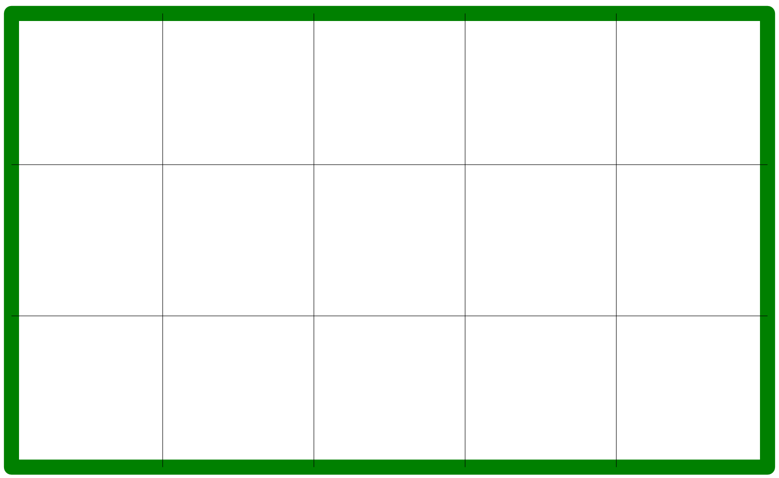

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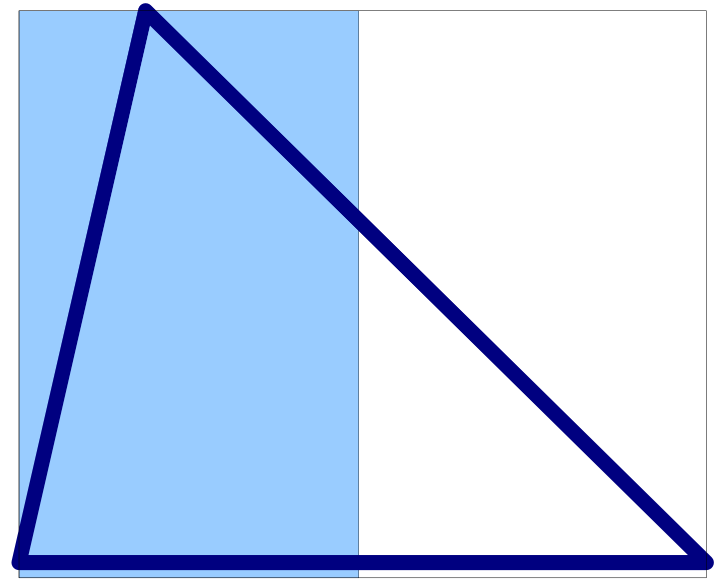

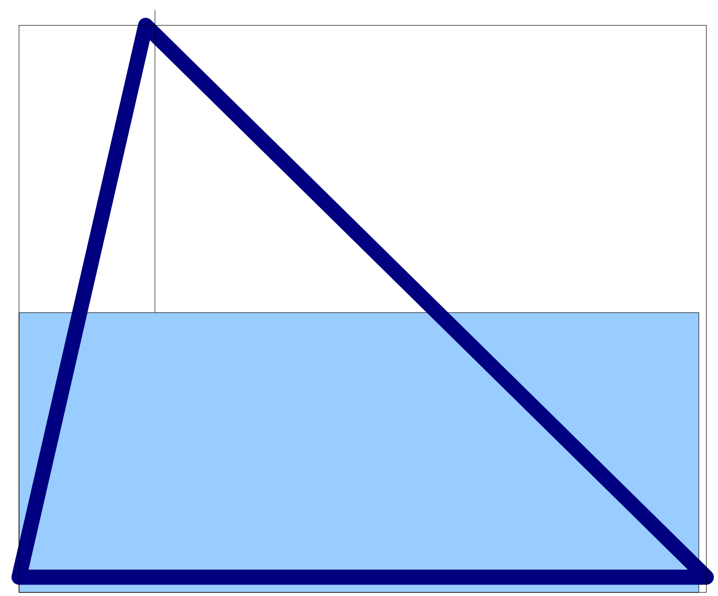

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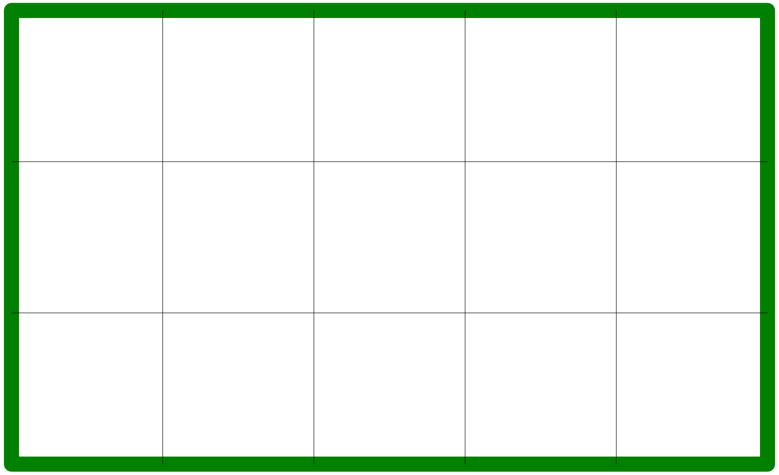
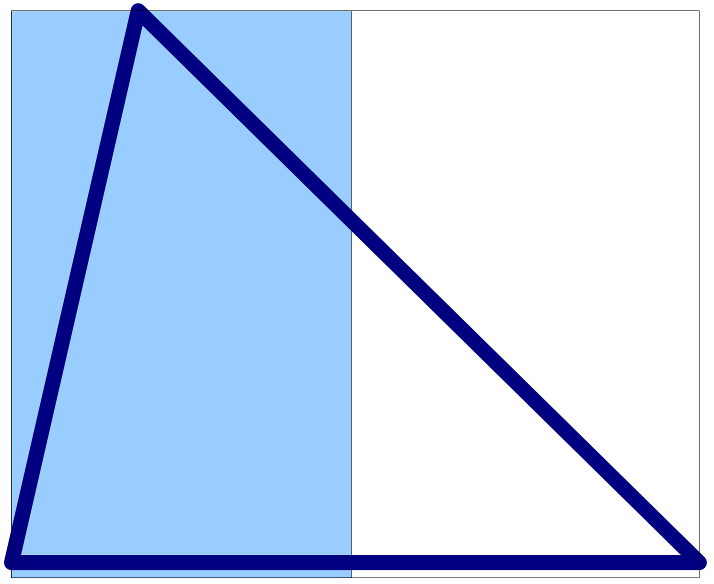
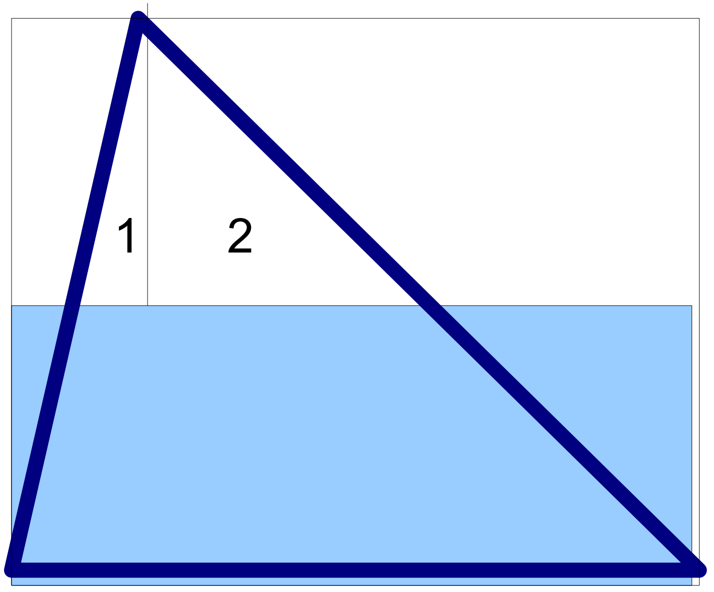




$A=(bxh)/2$

$A=\frac{b}{2} \times h$

$A=b \times \frac{h}{2}$



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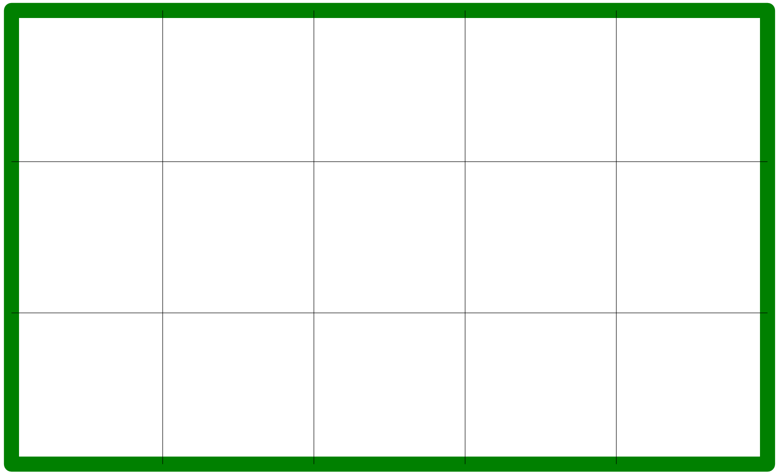

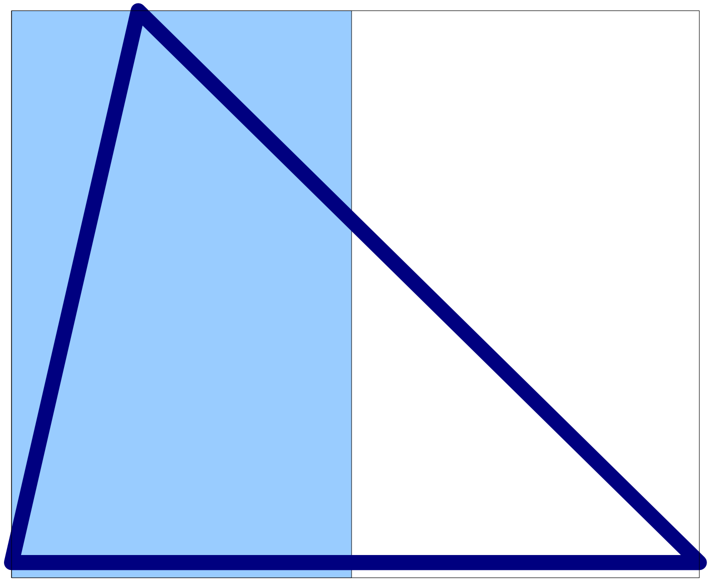

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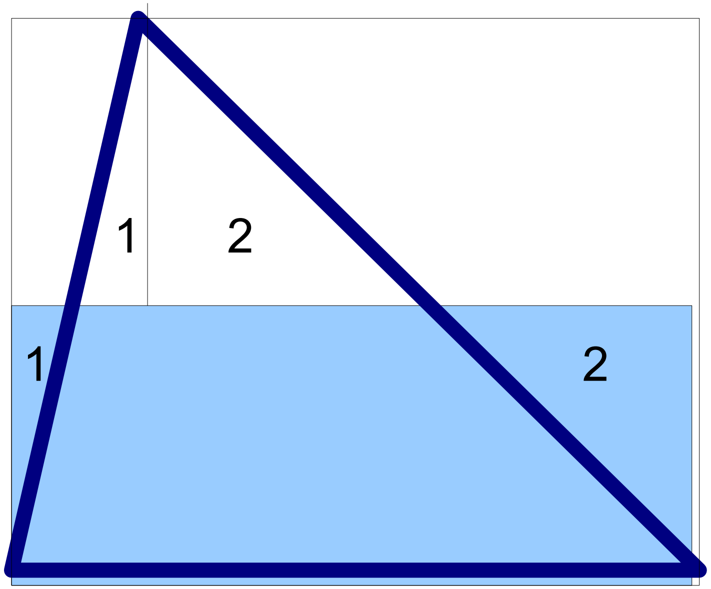
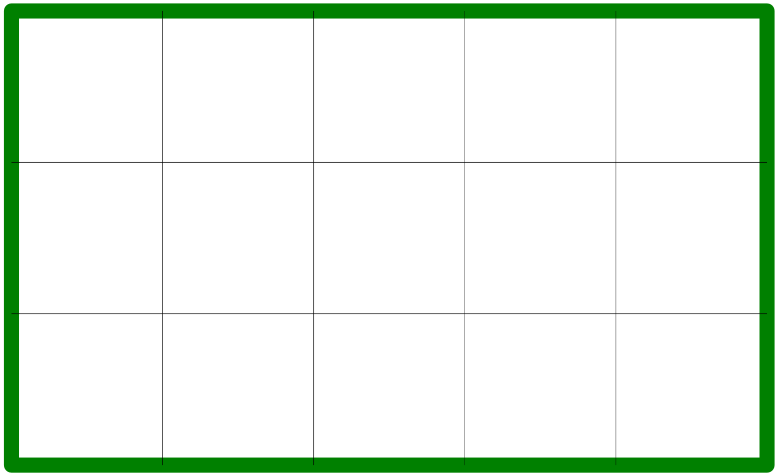
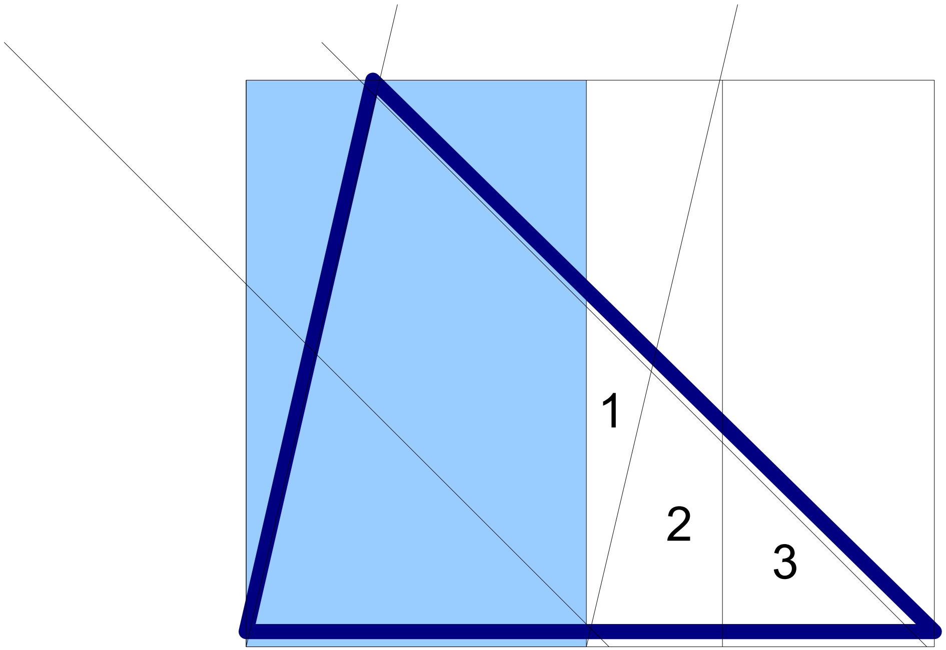
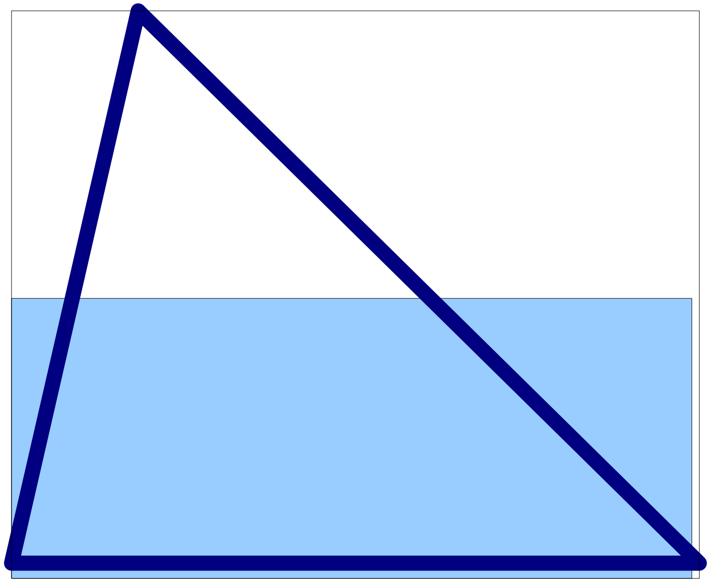


TRIANGOLO o CUNEO?







$$A=(b \times h)/2$$

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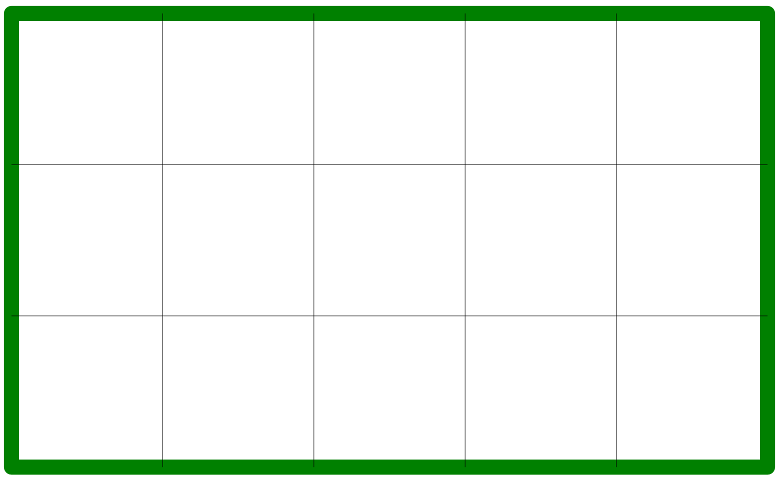
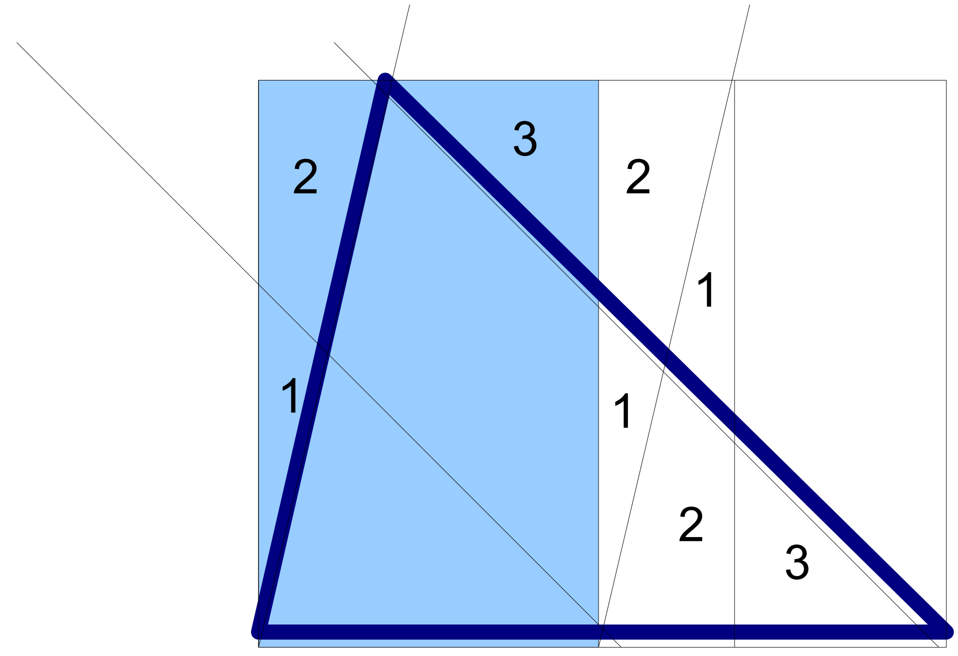
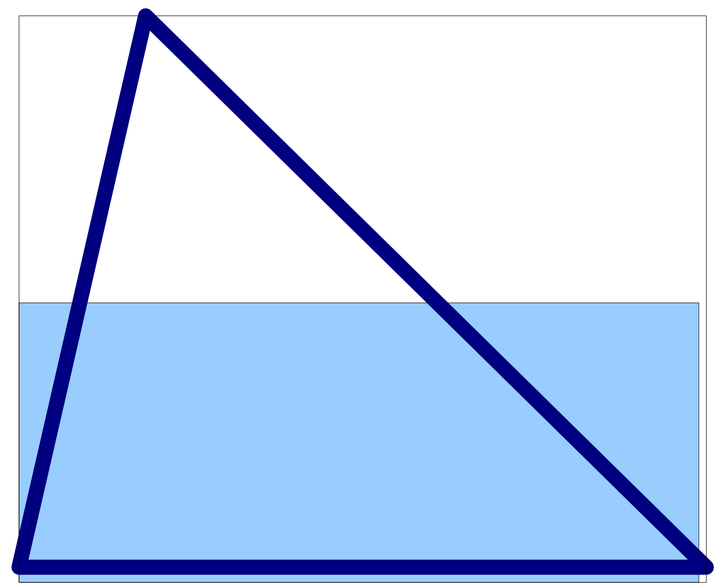
TRIANGOLO o CUNEO?



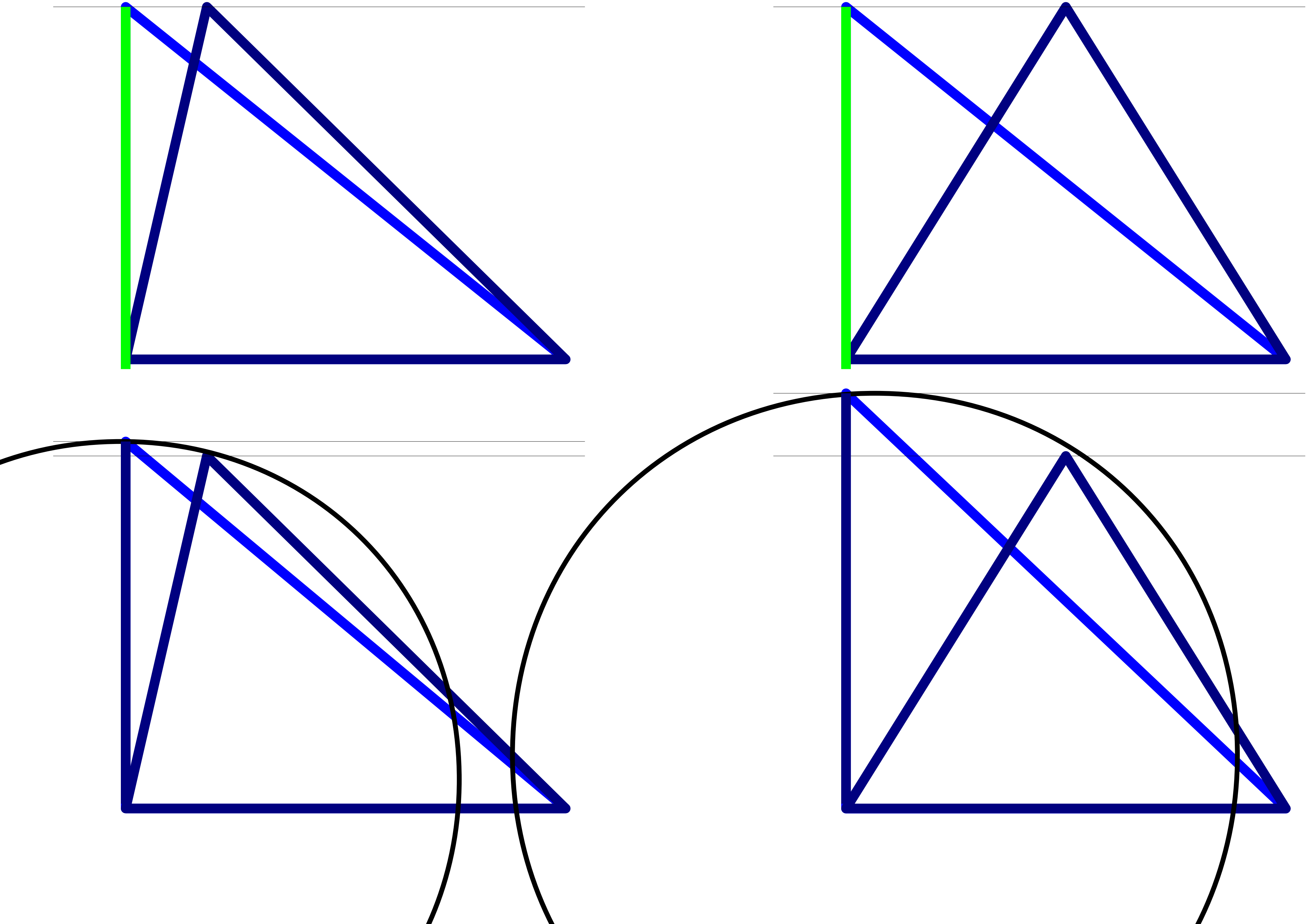




$$A=(b \times h)/2$$

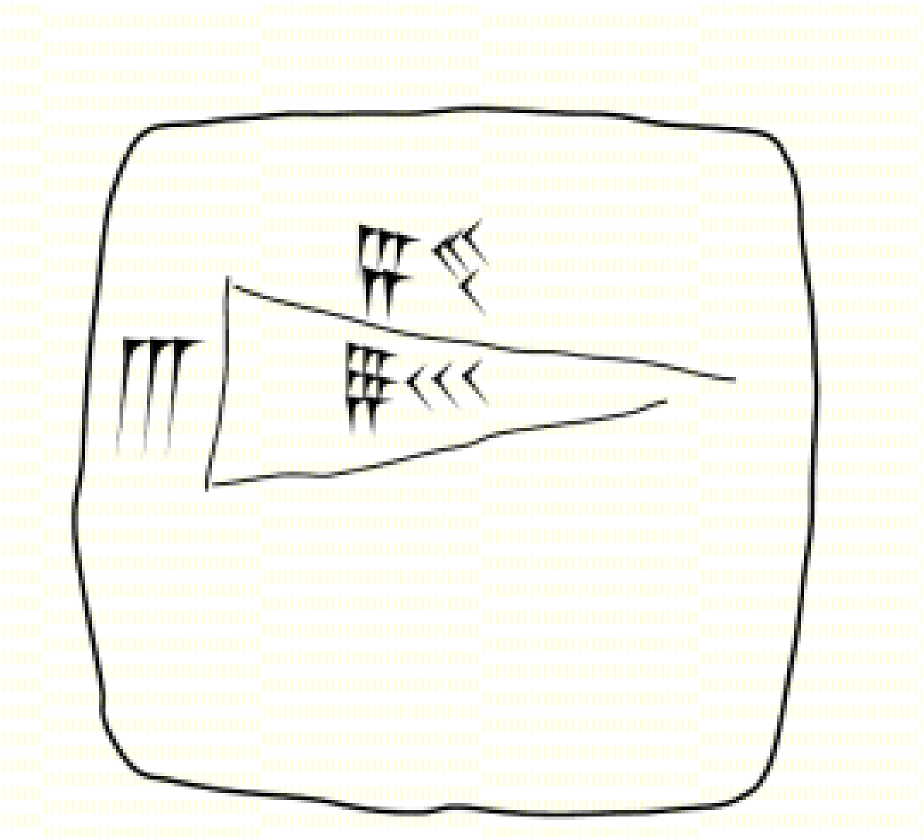
$$A=\frac{b}{2} \times h \qquad A=b \times \frac{h}{2}$$

ALTEZZA o LUNGHEZZA?



MS 3042 Schoyen collection

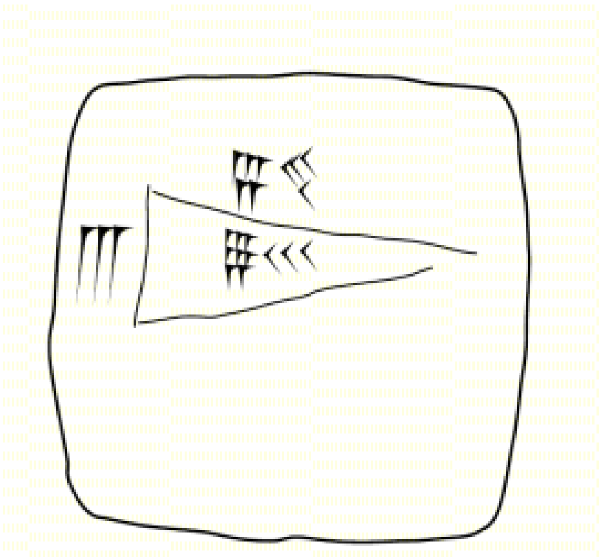
L'area di un triangolo

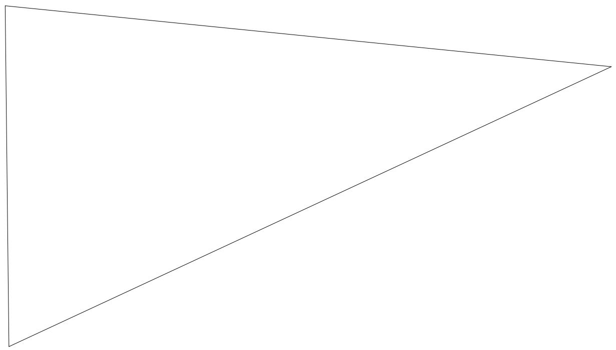


Verso: vuoto

MS 3042 Schoyen collection

L'area di un triangolo





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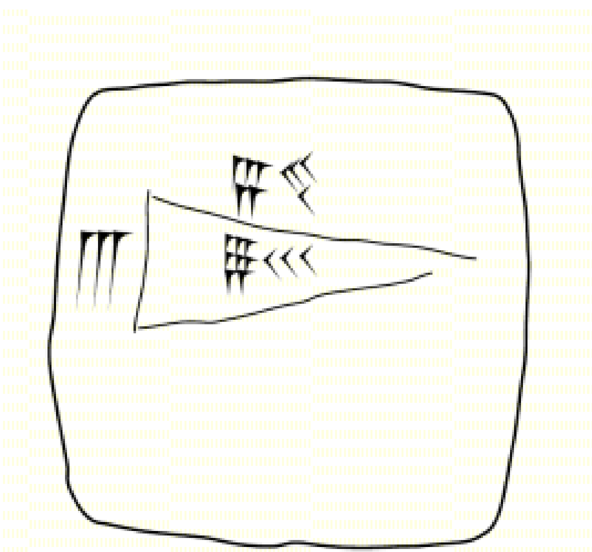
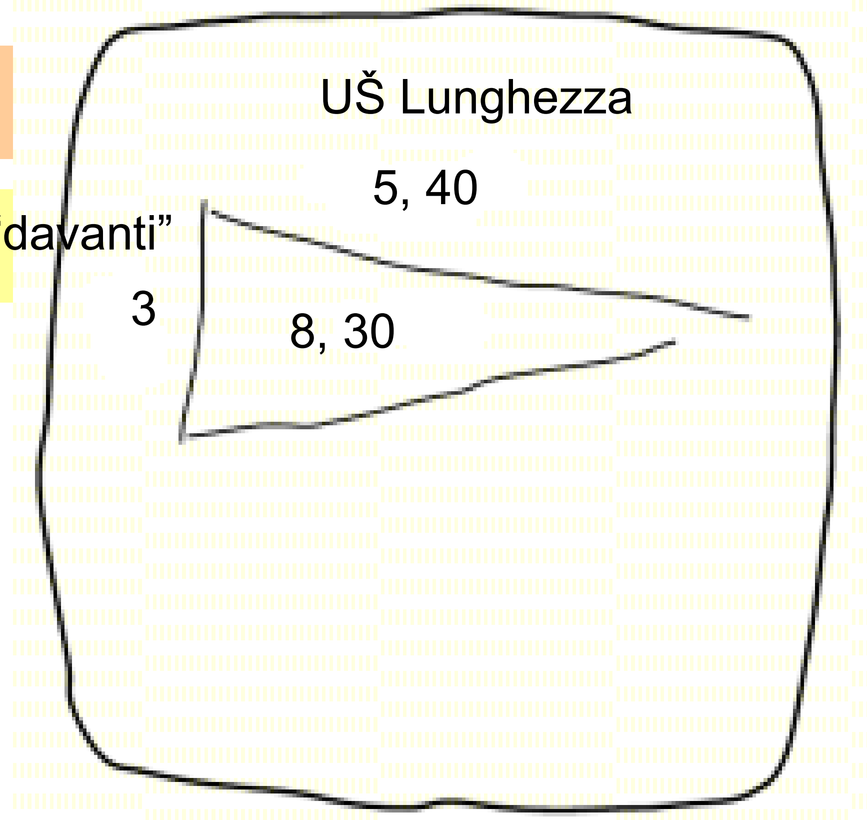
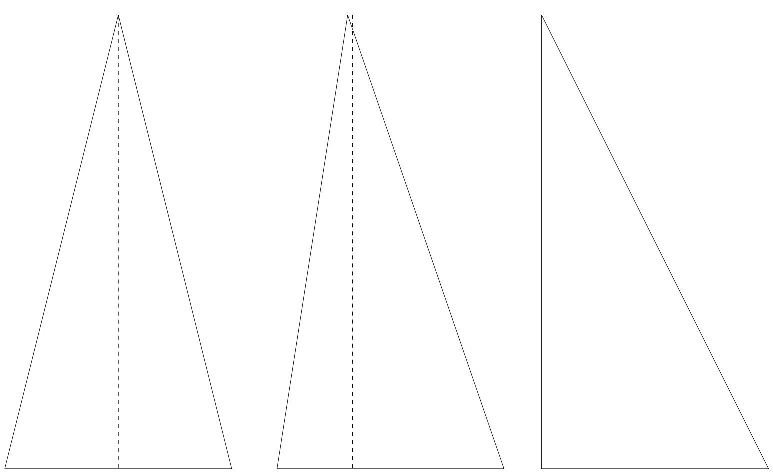




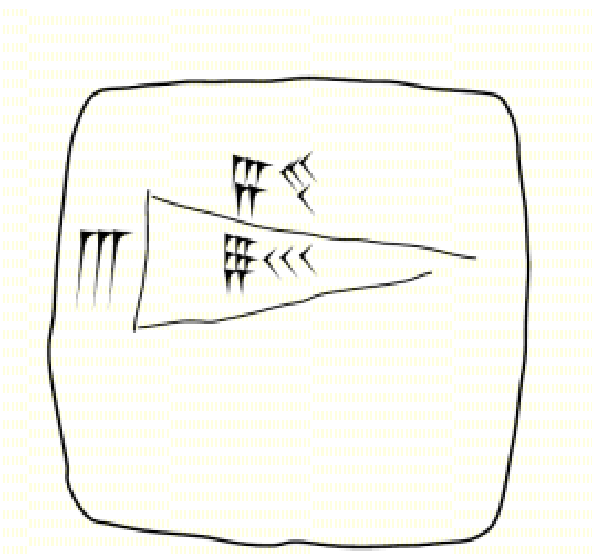
Osservazioni
testo scolastico di insegnamento elementare

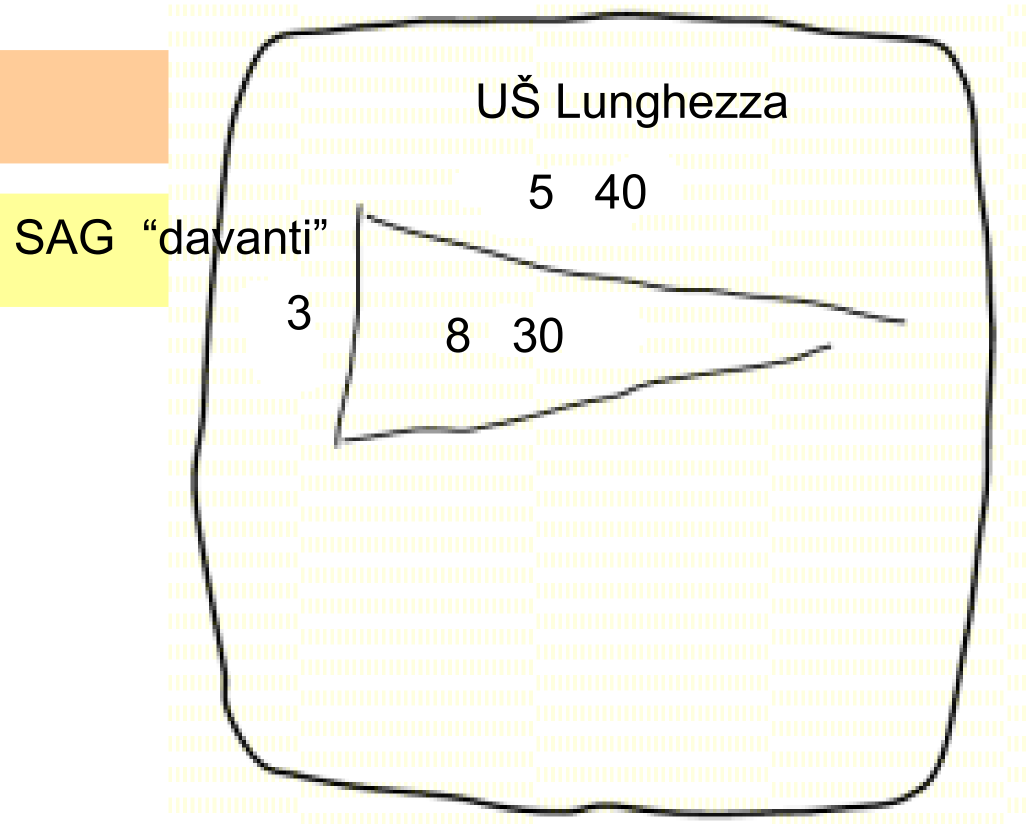
- non si distingue tra “altezza” e “lato lungo”



MS 3042 Schoyen collection

L'area di un triangolo





Unità di misura

lunghezza ninda (circa 6m)

area sar (ninda x ninda)
= 36 mq circa

Osservazioni
testo scolastico di insegnamento elementare

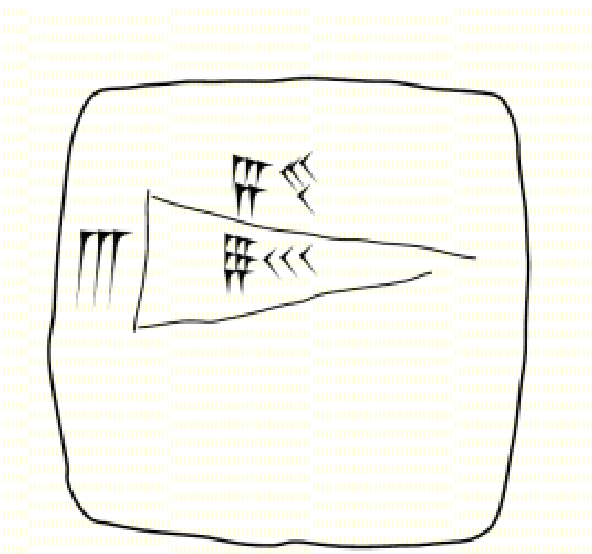
- interpretazione valori numerici

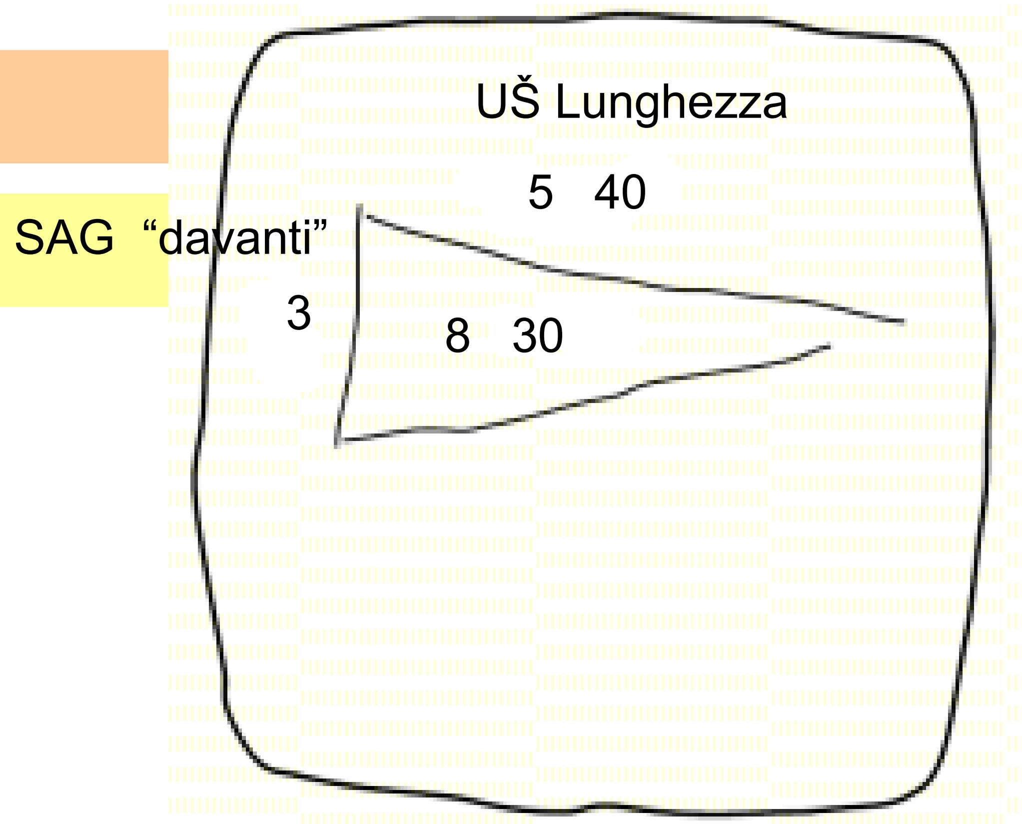
5 40 -----> 5, 40 ninda (notazione sessagesimale)
3 -----> 3, 00 ninda

In generale:
misure corrispondenti a campi coltivati
(problemi concreti ?)

MS 3042 Schoyen collection

L'area di un triangolo





Osservazioni
testo scolastico di insegnamento elementare

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5 40 -----> 5, 40 ninda (notazione sessagesimale)
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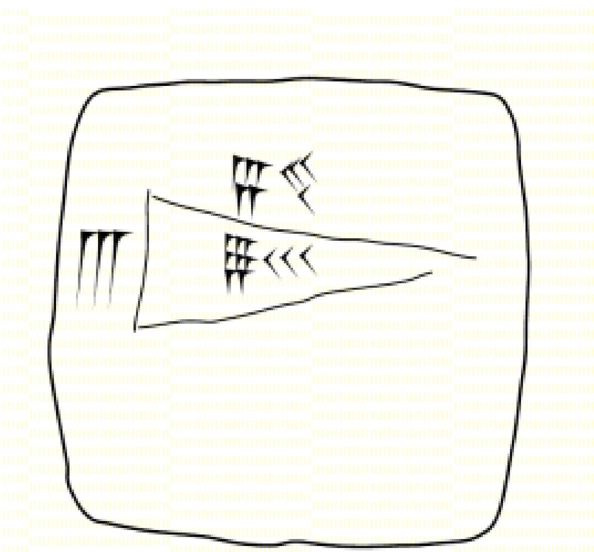
Unità di misura

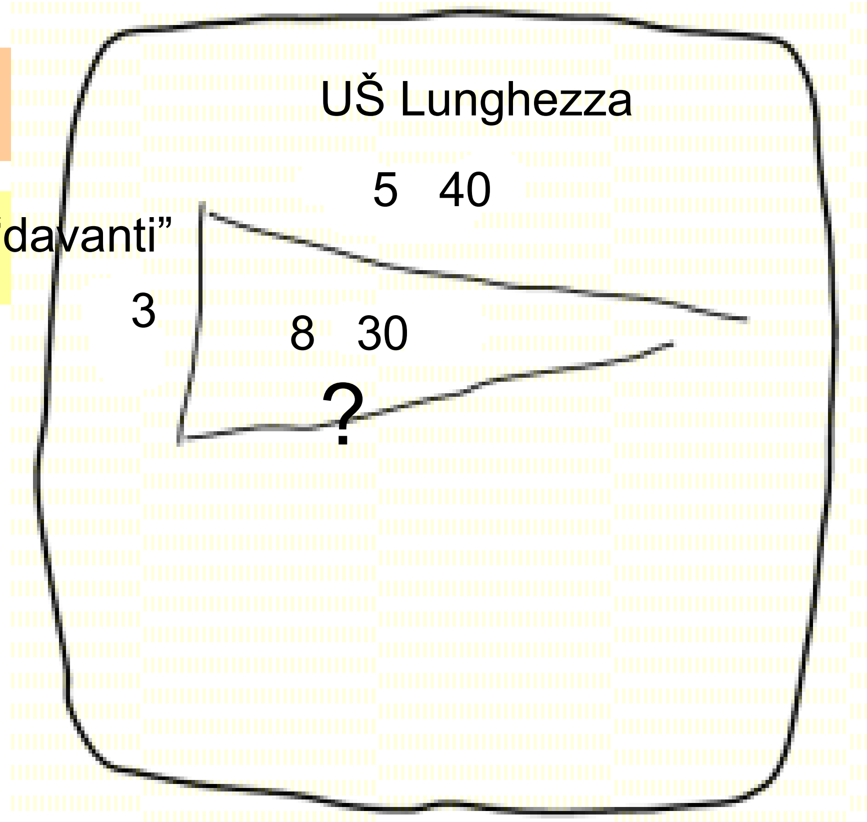
lunghezza ninda (circa 6m)

area sar (ninda x ninda)
= 36 mq circa
iku (1, 40 ninda x ninda)

MS 3042 Schoyen collection

L'area di un triangolo





5 40 x 3 00 / 2 = ?

A=?

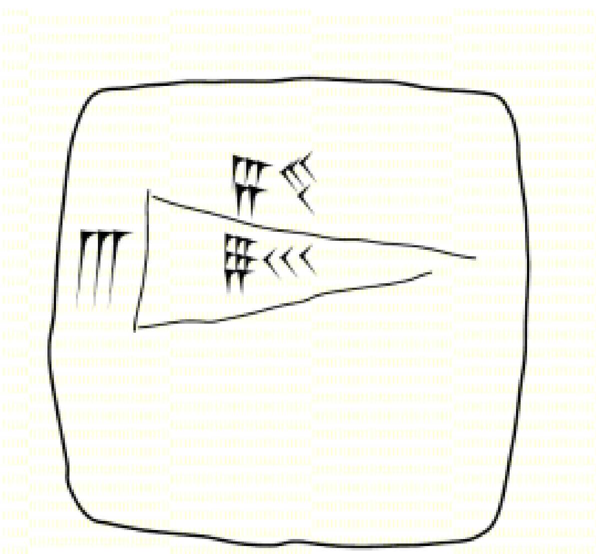
A=(b x h) /2

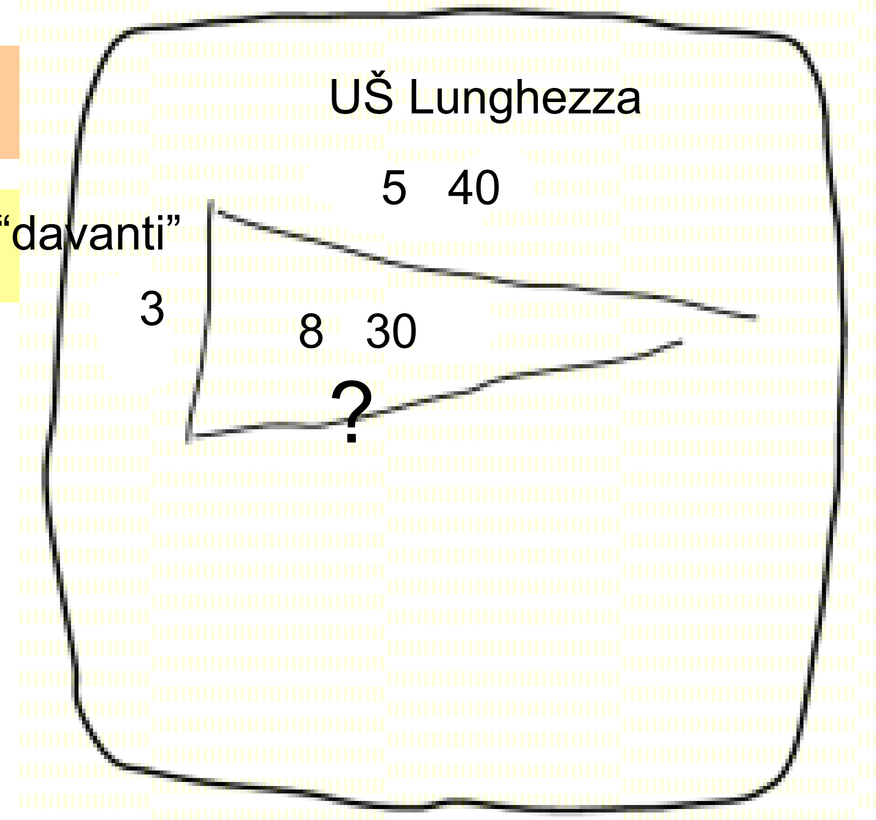
```
  5   40
  3
 ---------
  2   00
 15
 ---------
 17   00
```

```
17   00 | 2
16        8  30
 1
 0   60
     60
      0
```

MS 3042 Schoyen collection

L'area di un triangolo





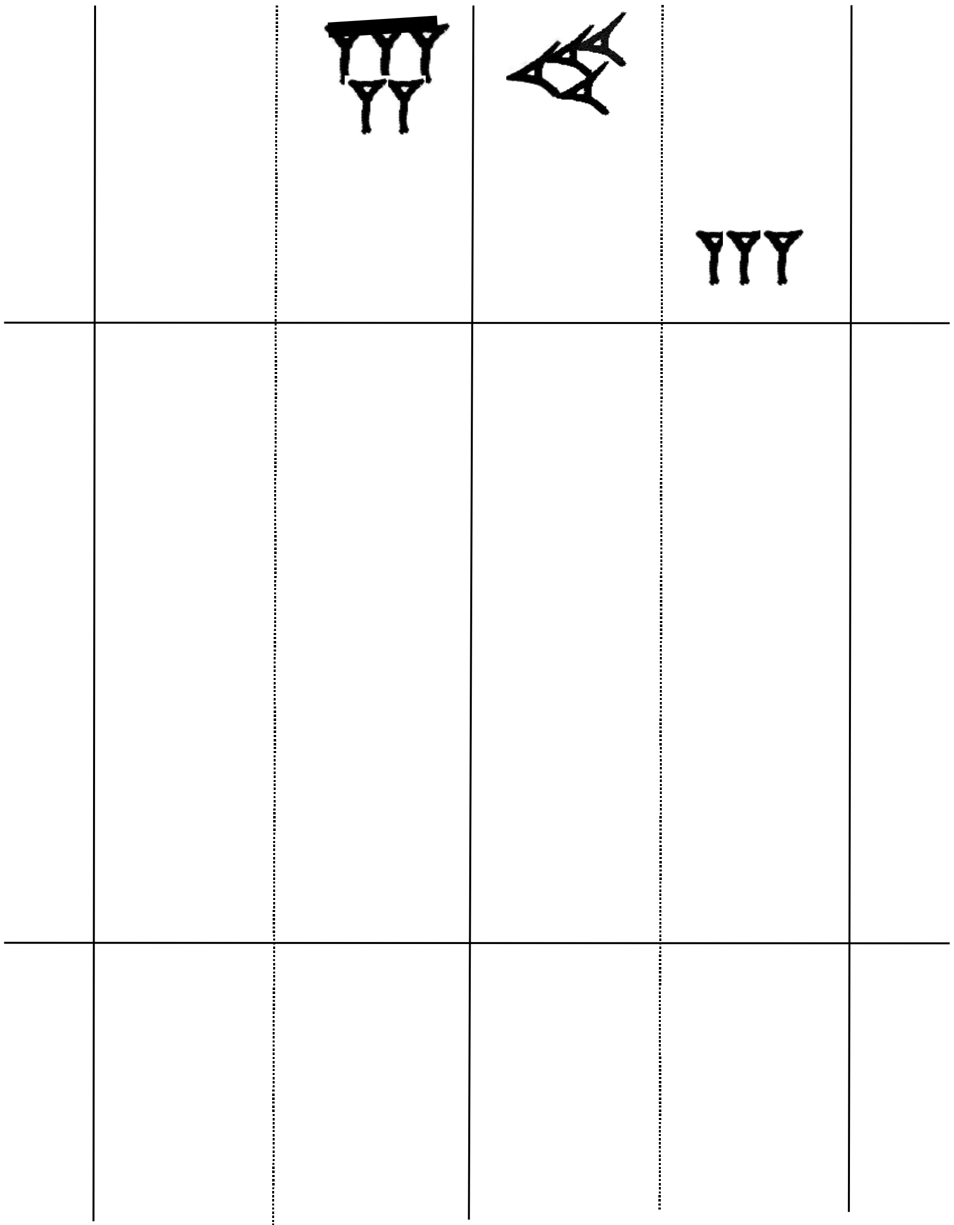
5 40 x 3 00 / 2

5 40 x 3 00 x 30

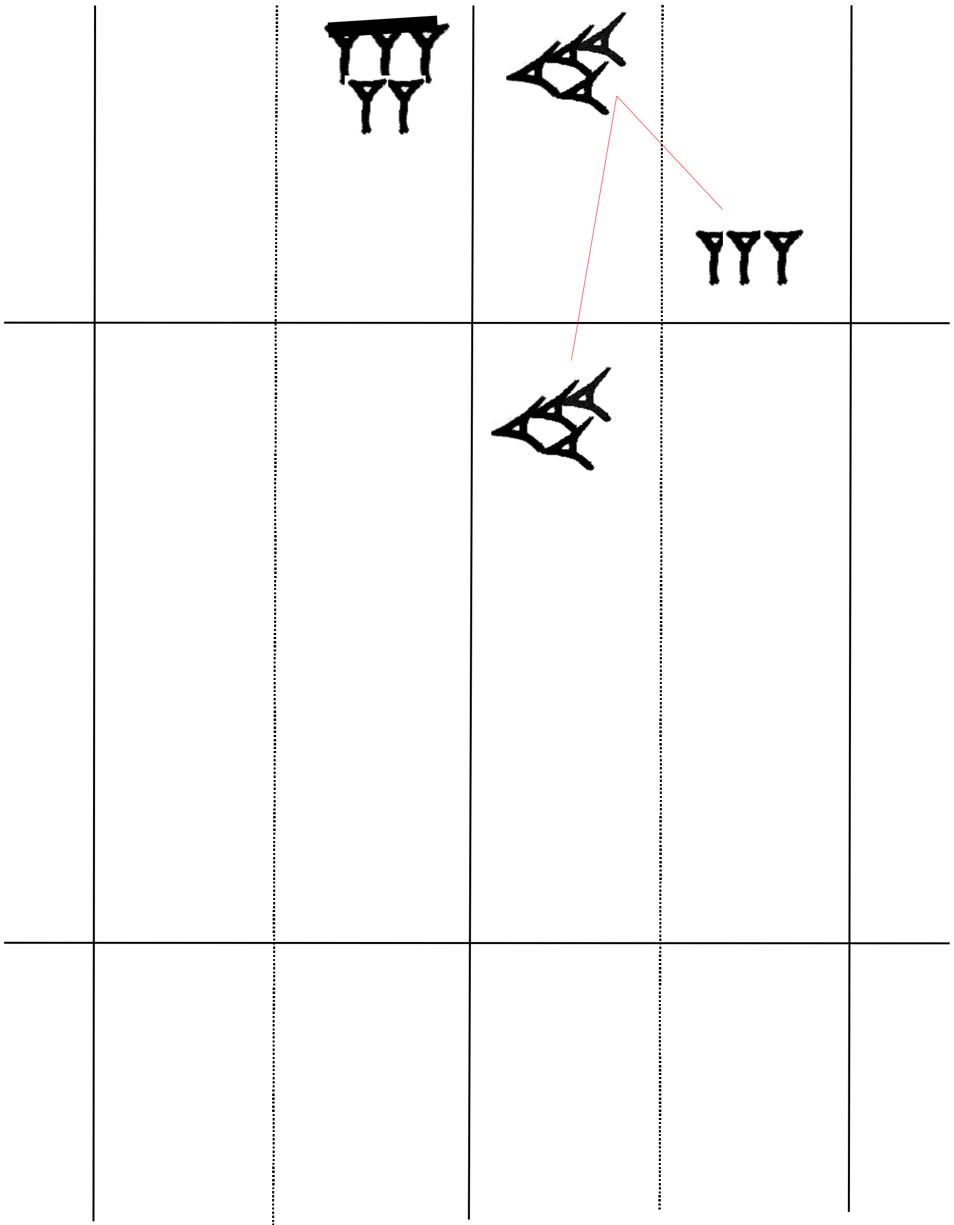
A=?

A=(b x h) /2

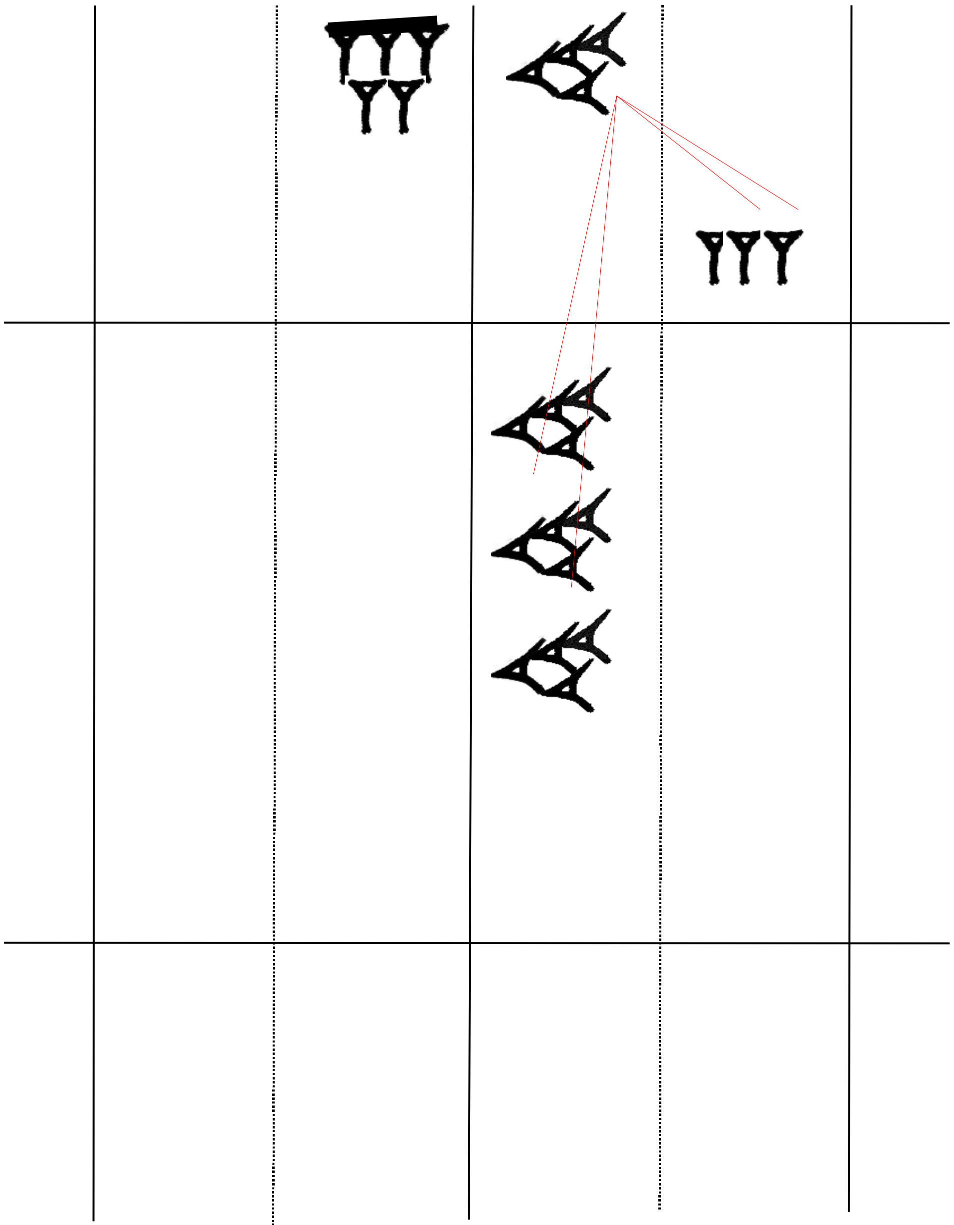
5 40 x 3 = ?



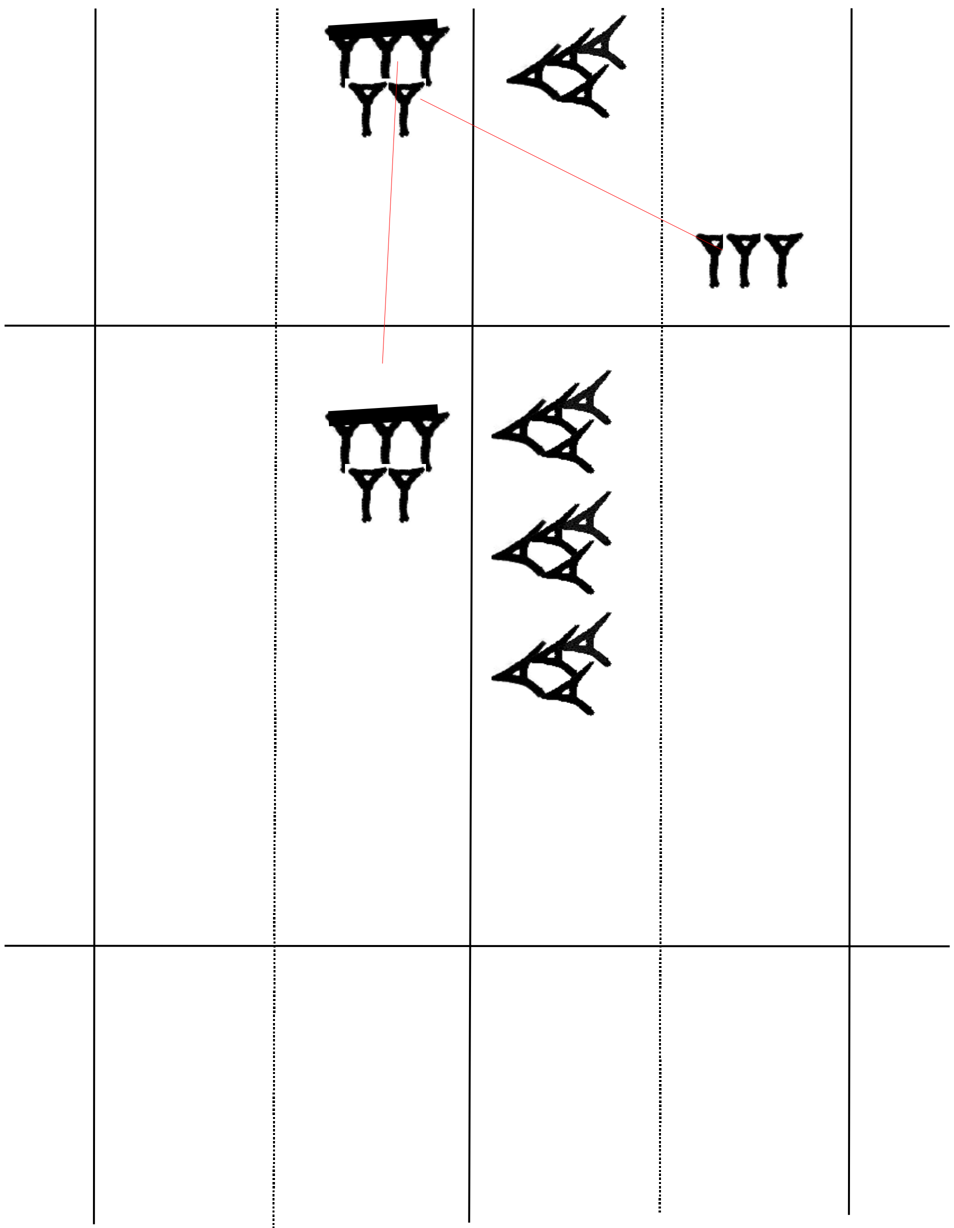
5 40 x 3 = ?



$5\ 40 \times 3 = ?$



5 40 x 3 = ?



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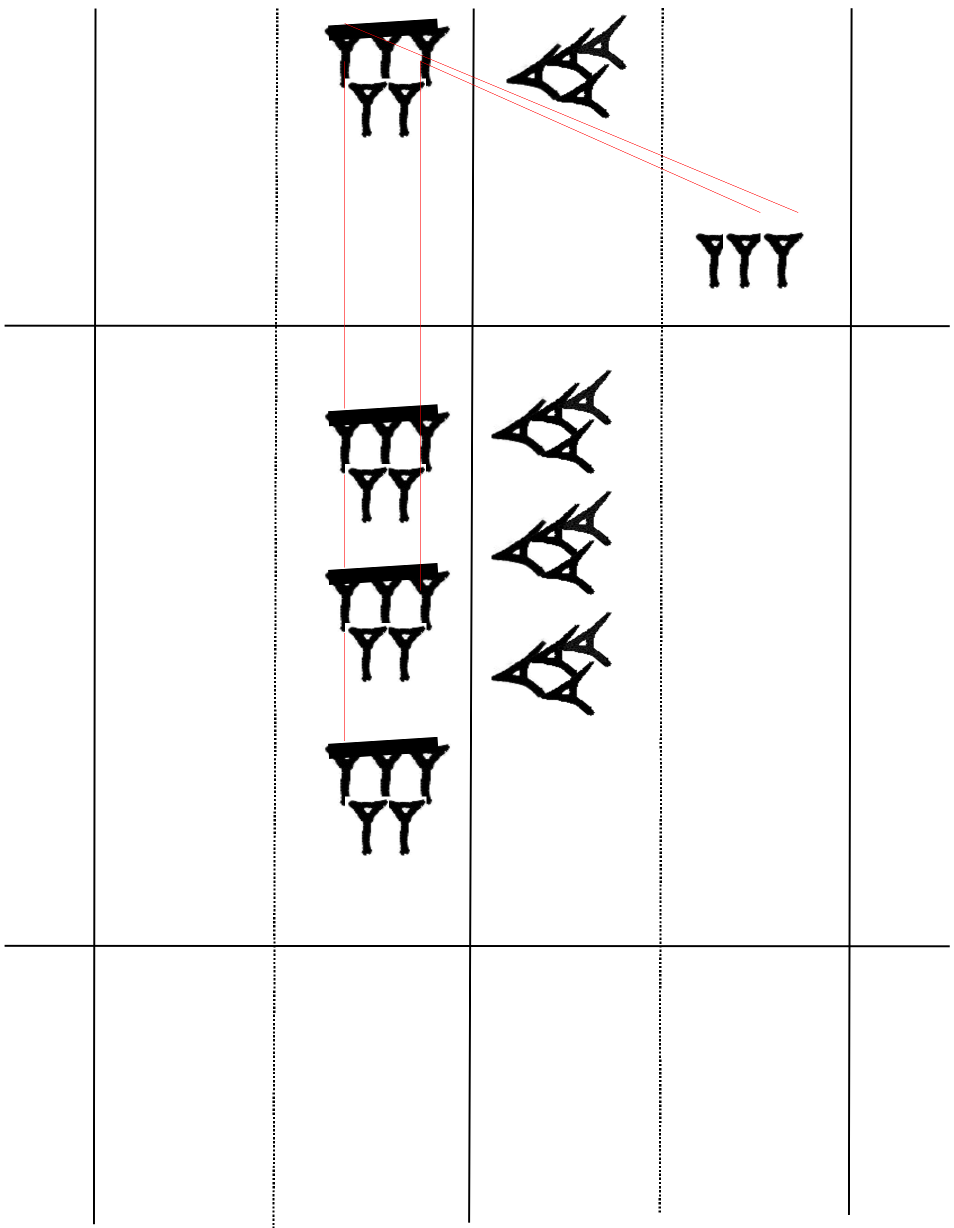

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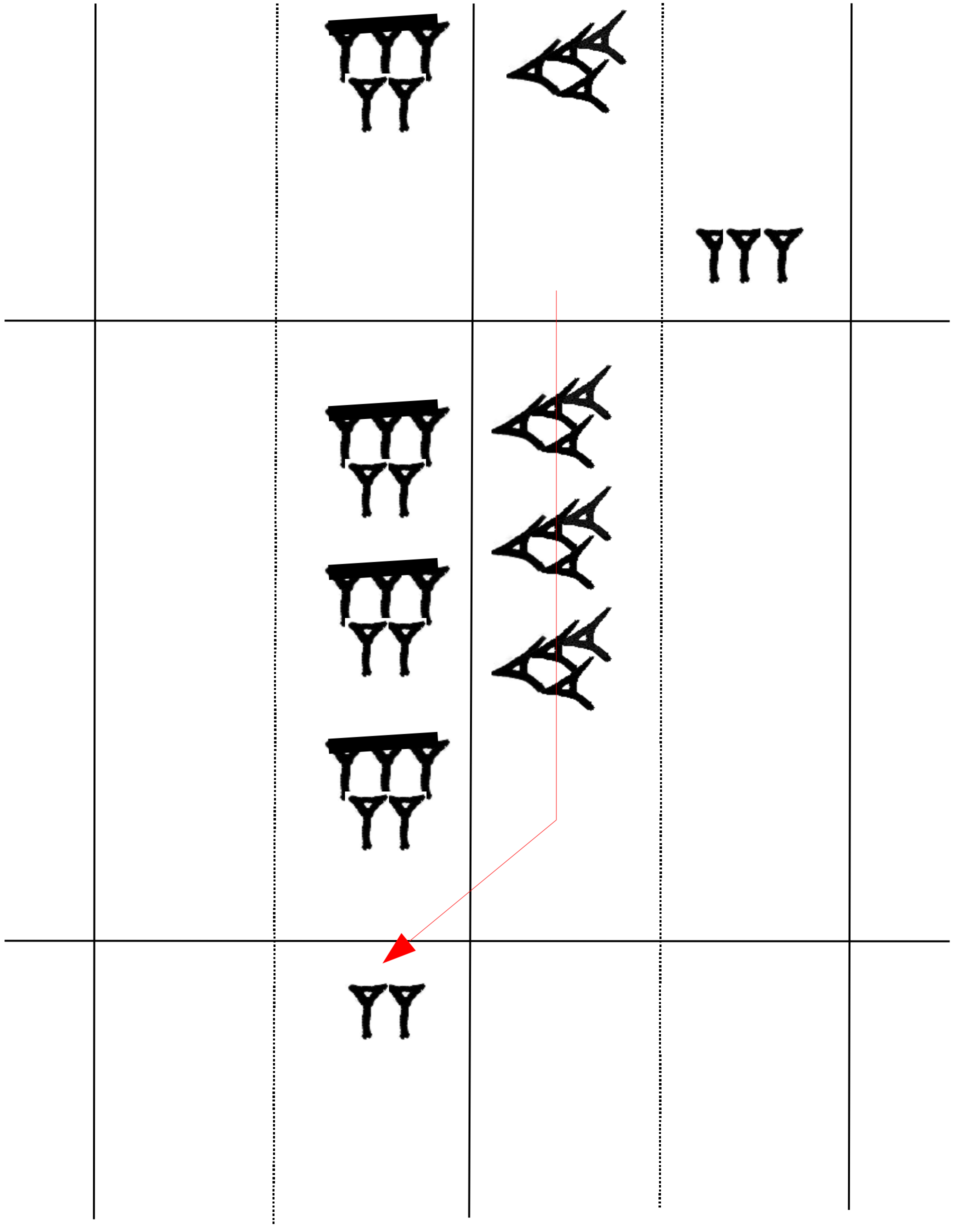
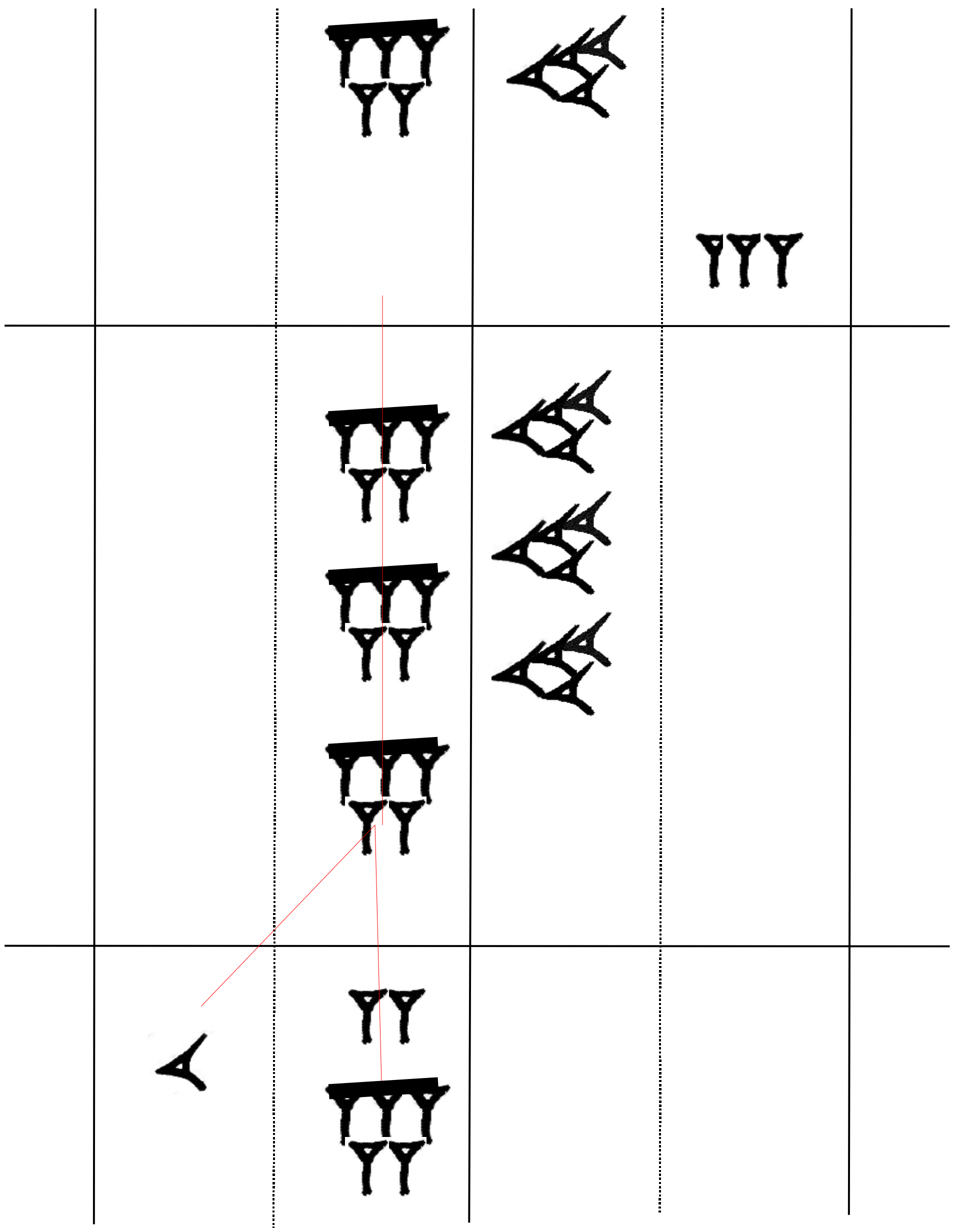
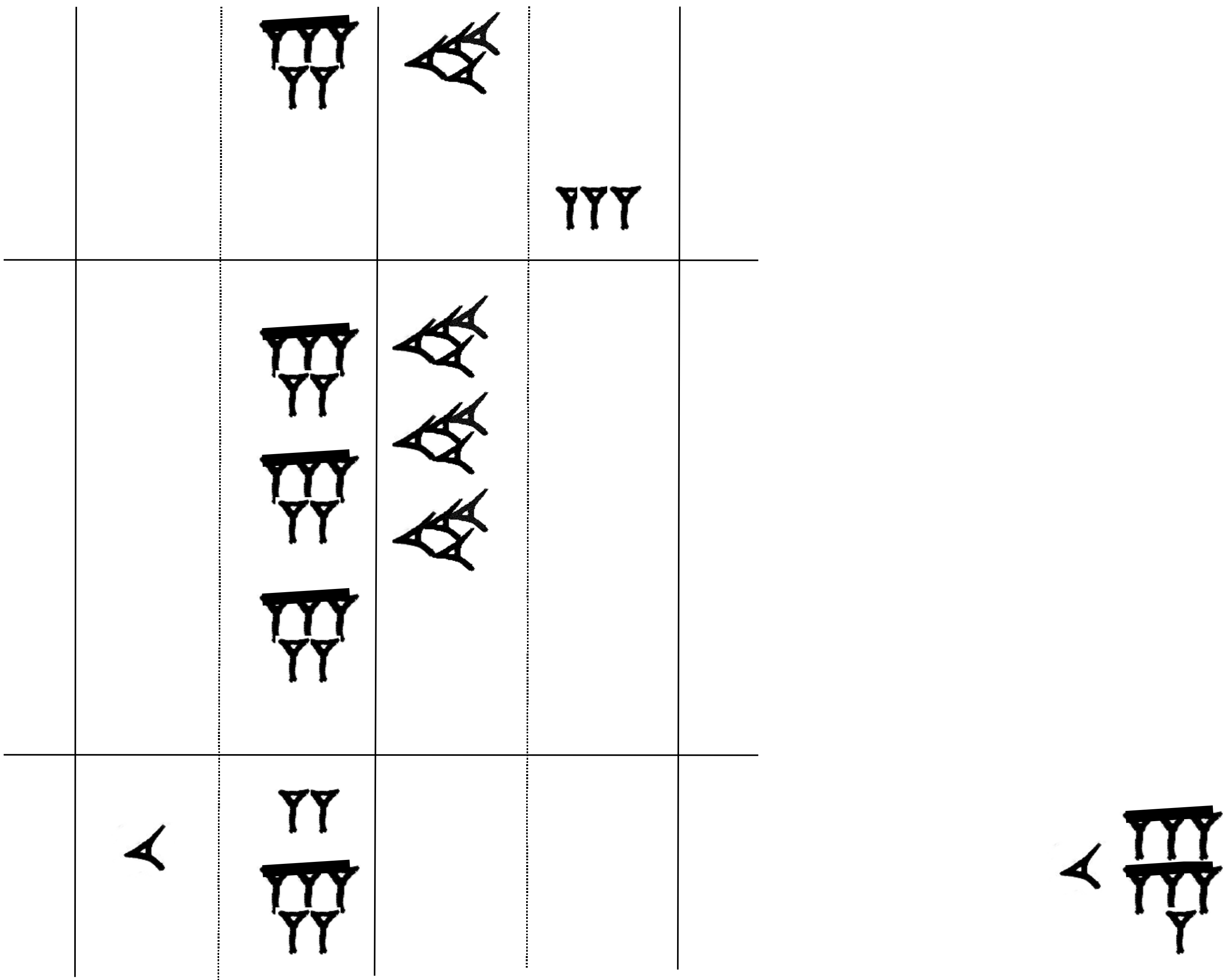


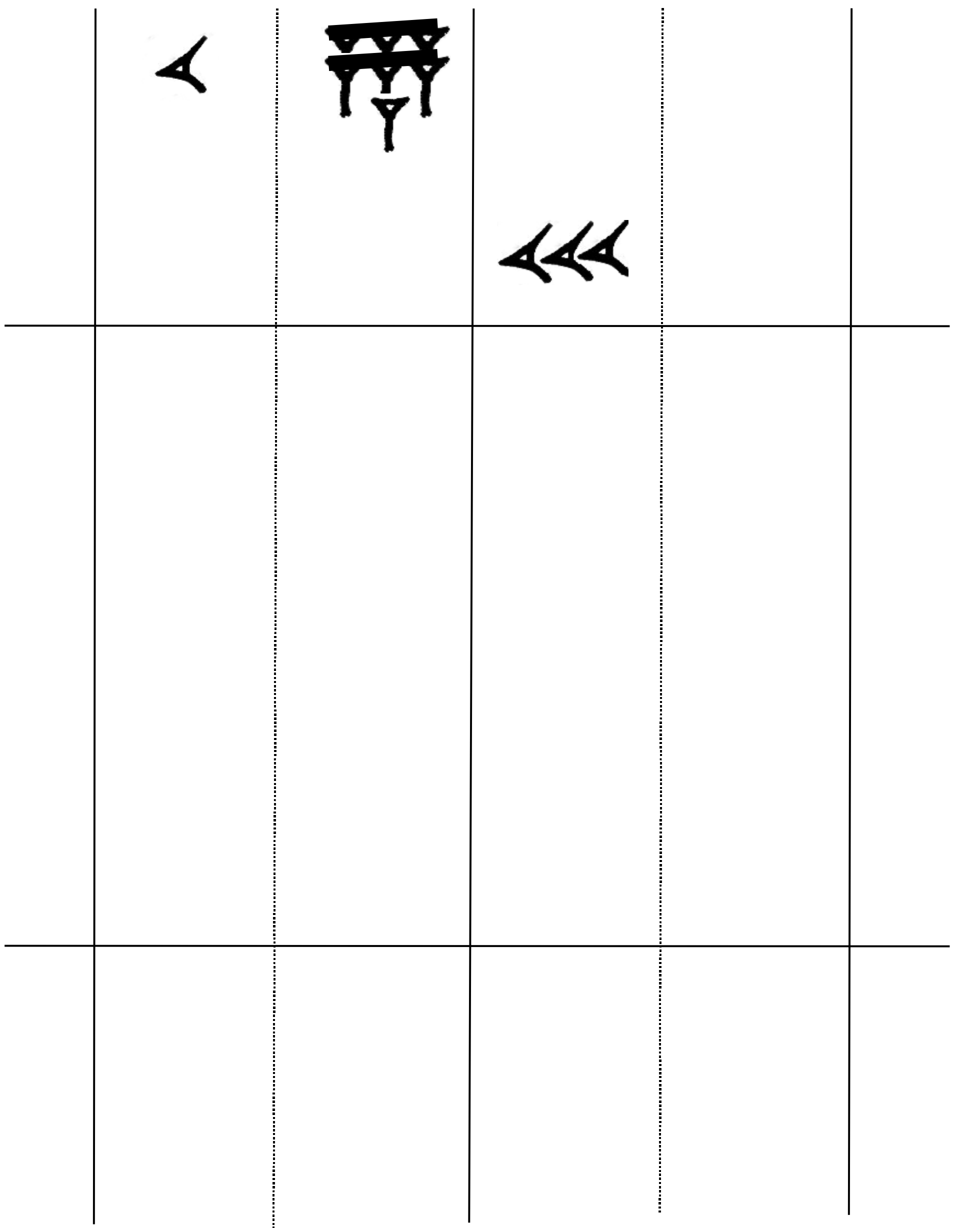
5 40 x 3 = ?



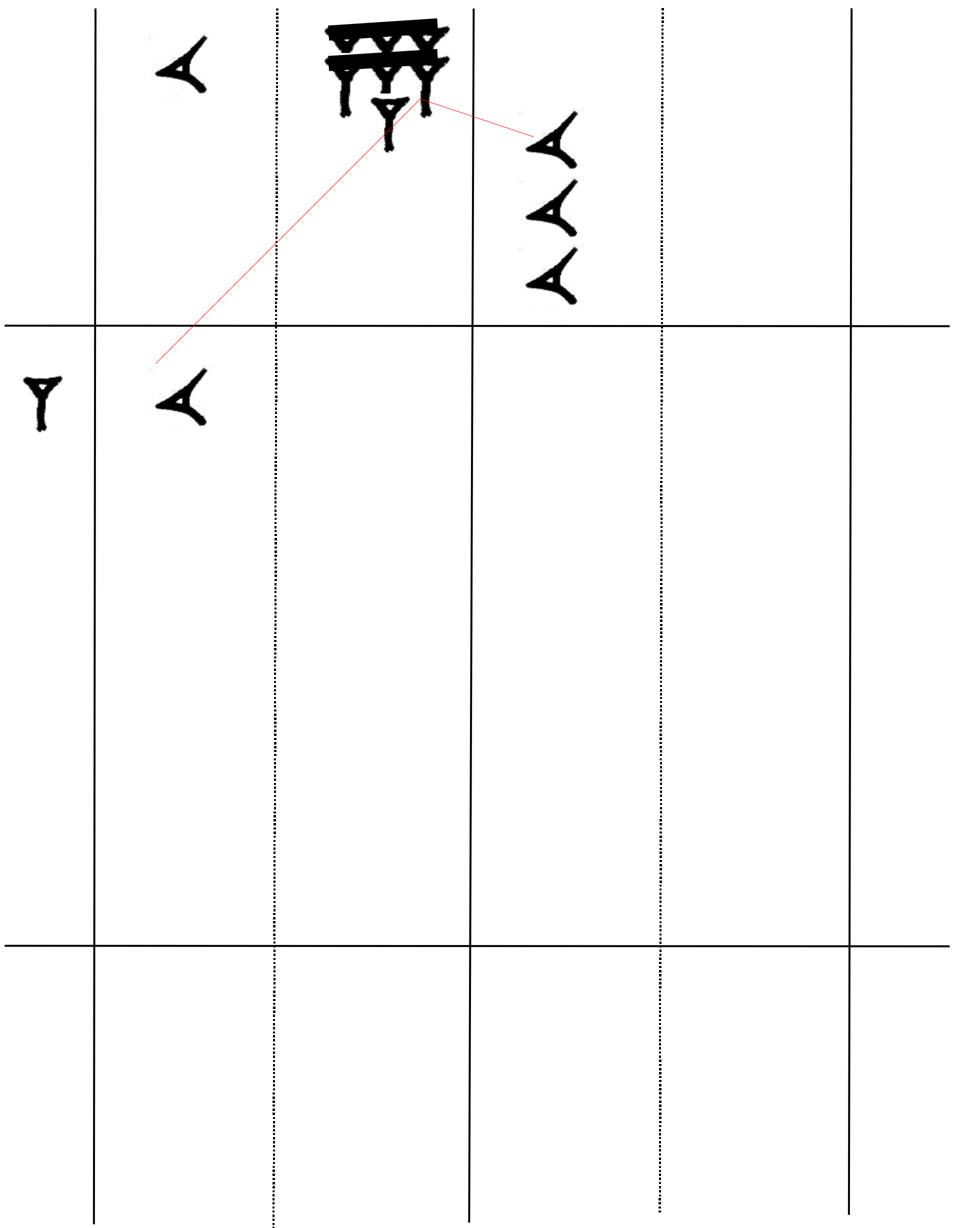
5 40 x 3 = 17

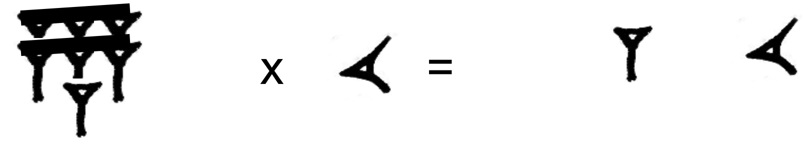


17 00 x 00 30 = ?



17 00 x 00 30 = ?





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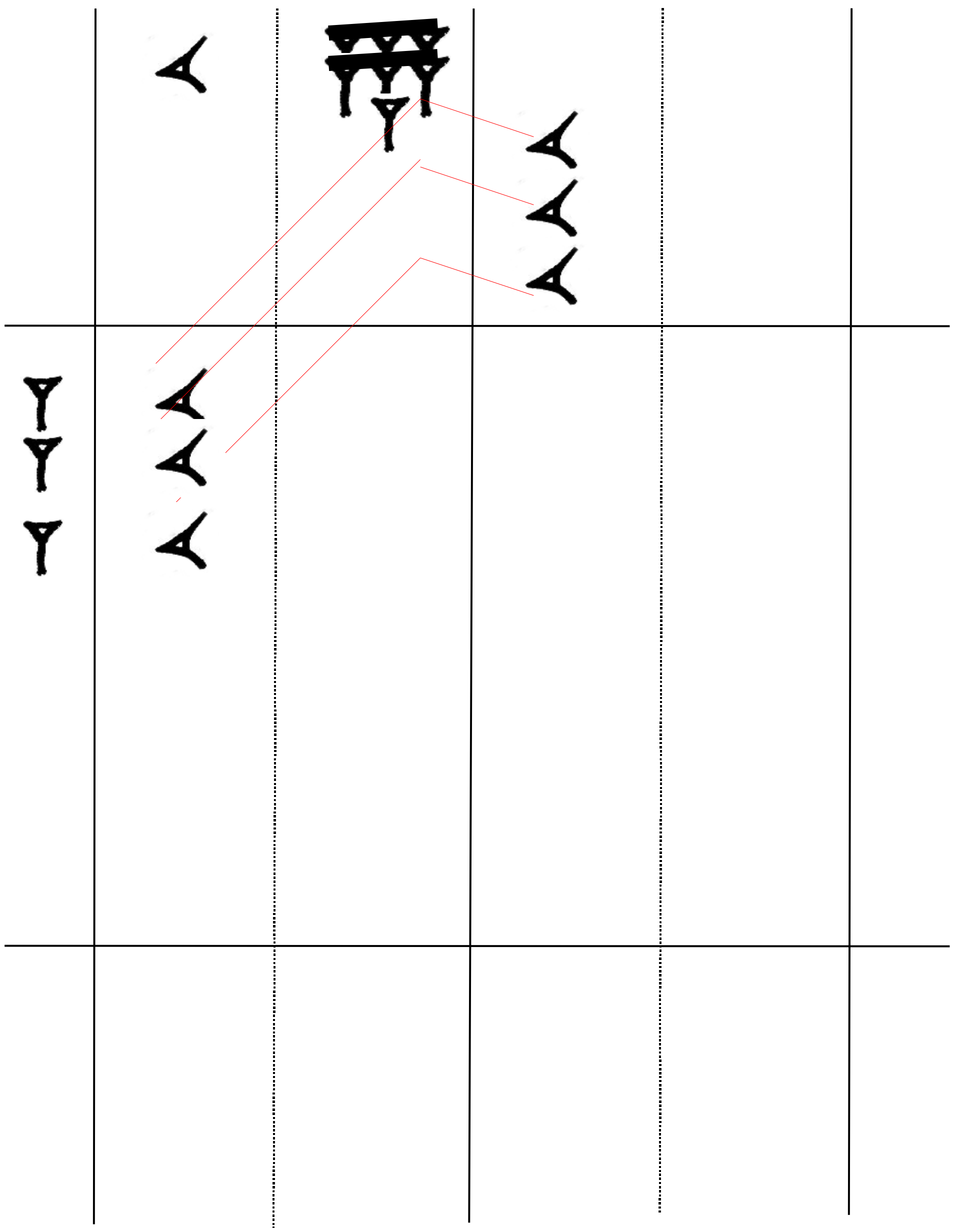
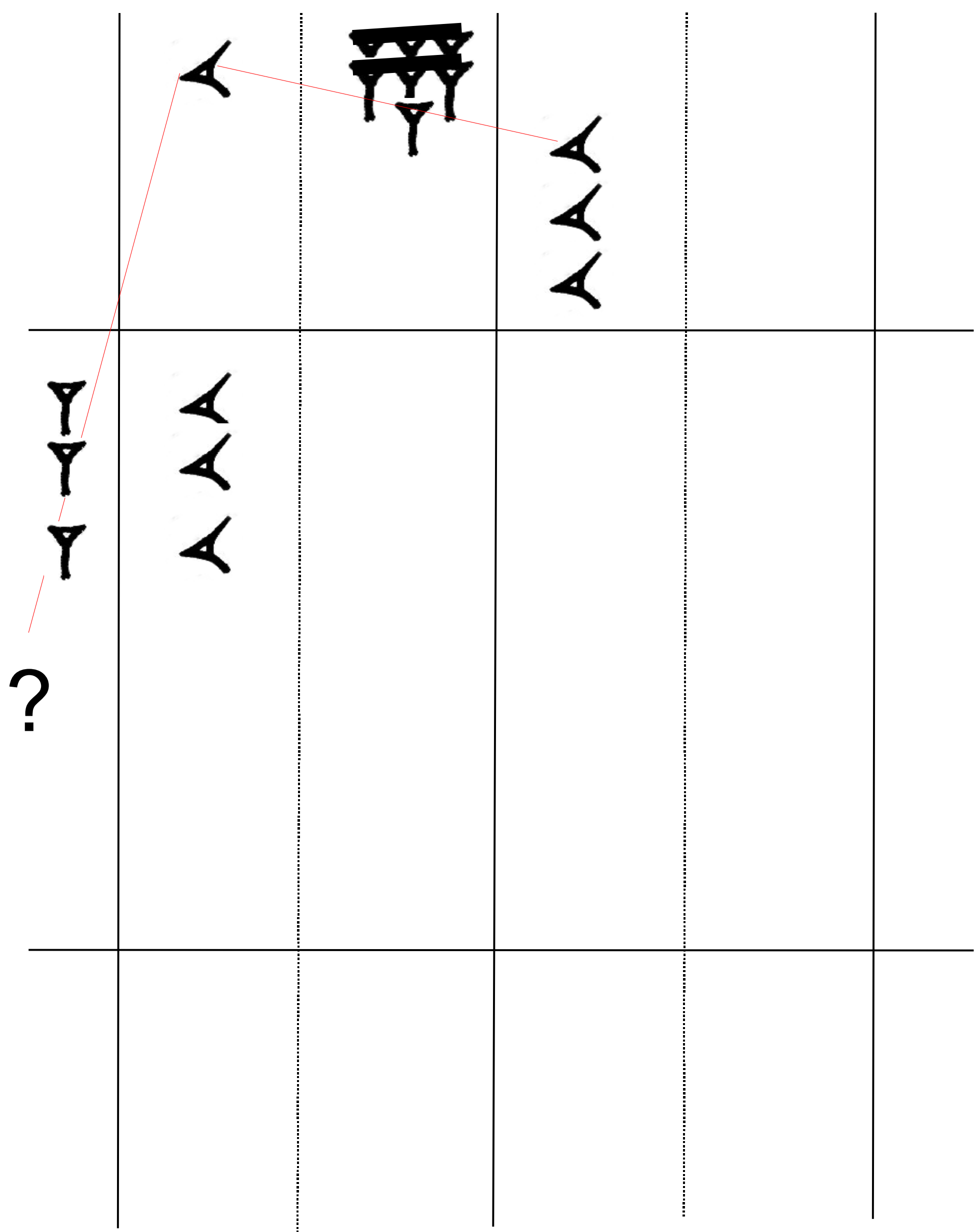
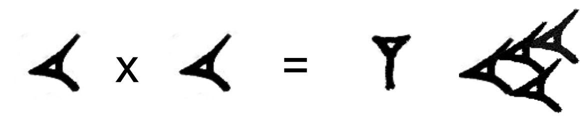
7x10=[1 10]

17 00 x 00 30 = ?



17 00 x 00 30 = ?

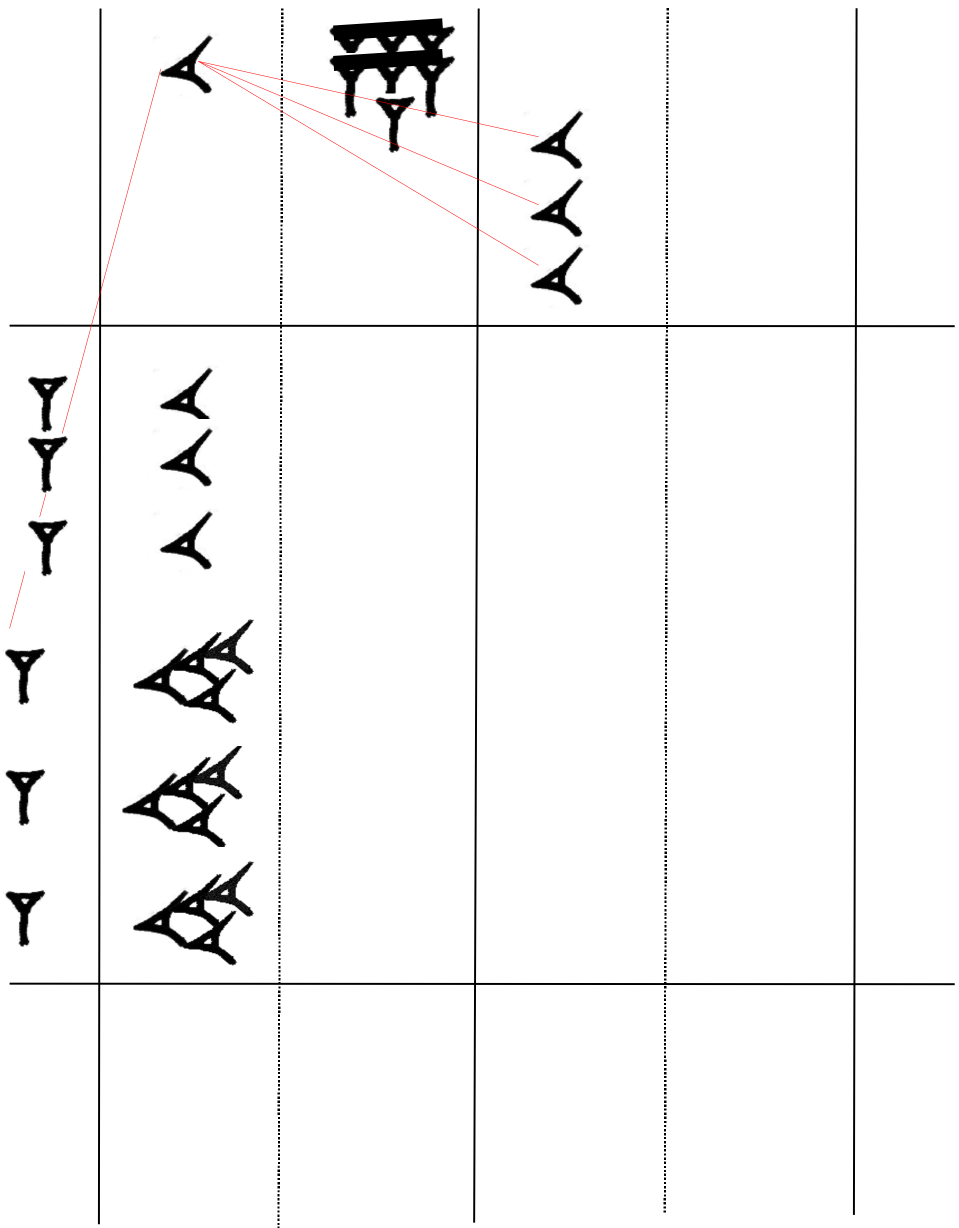




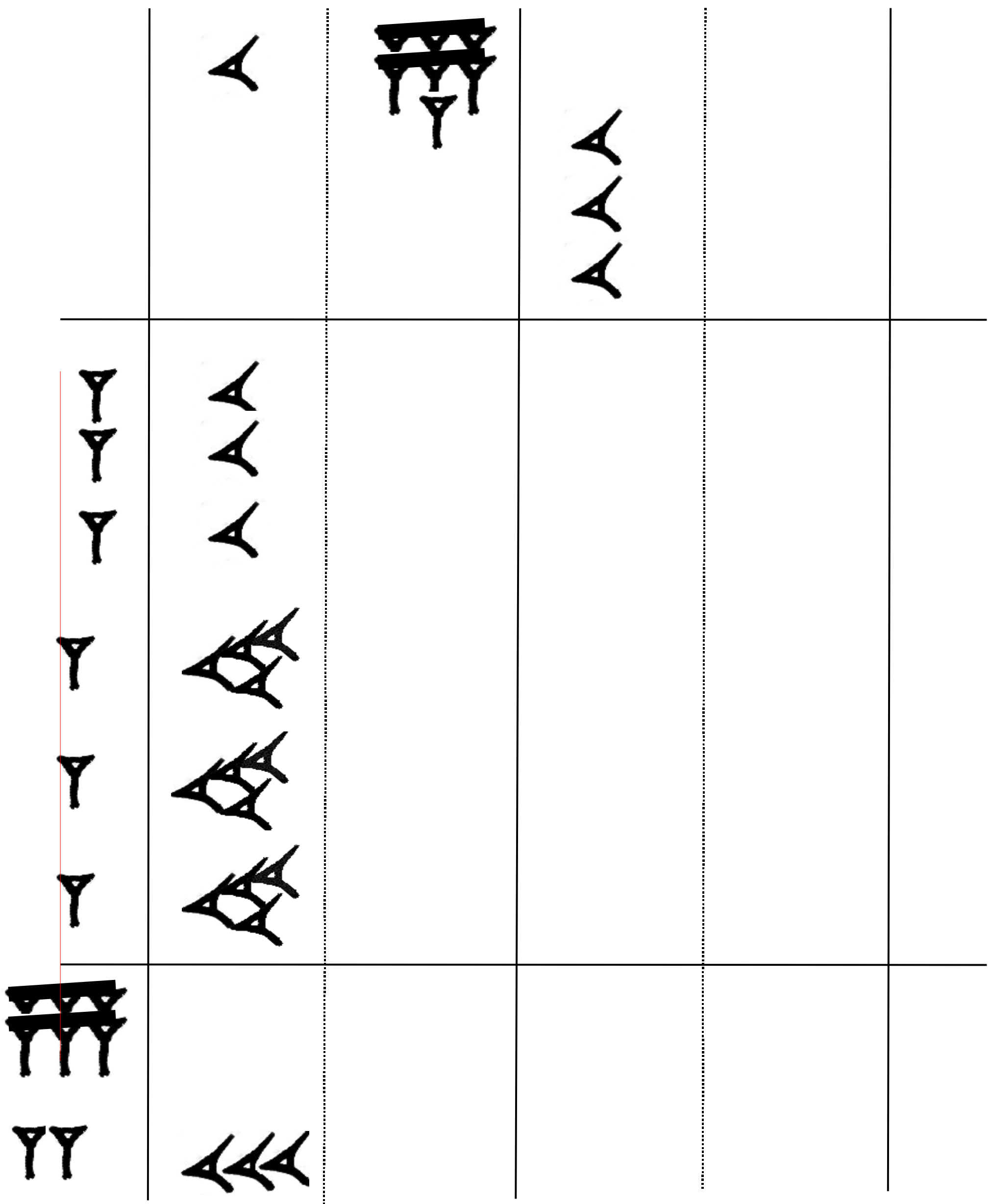
10x10=100
10x10=[1 40]

17 00 x 00 30 = ?

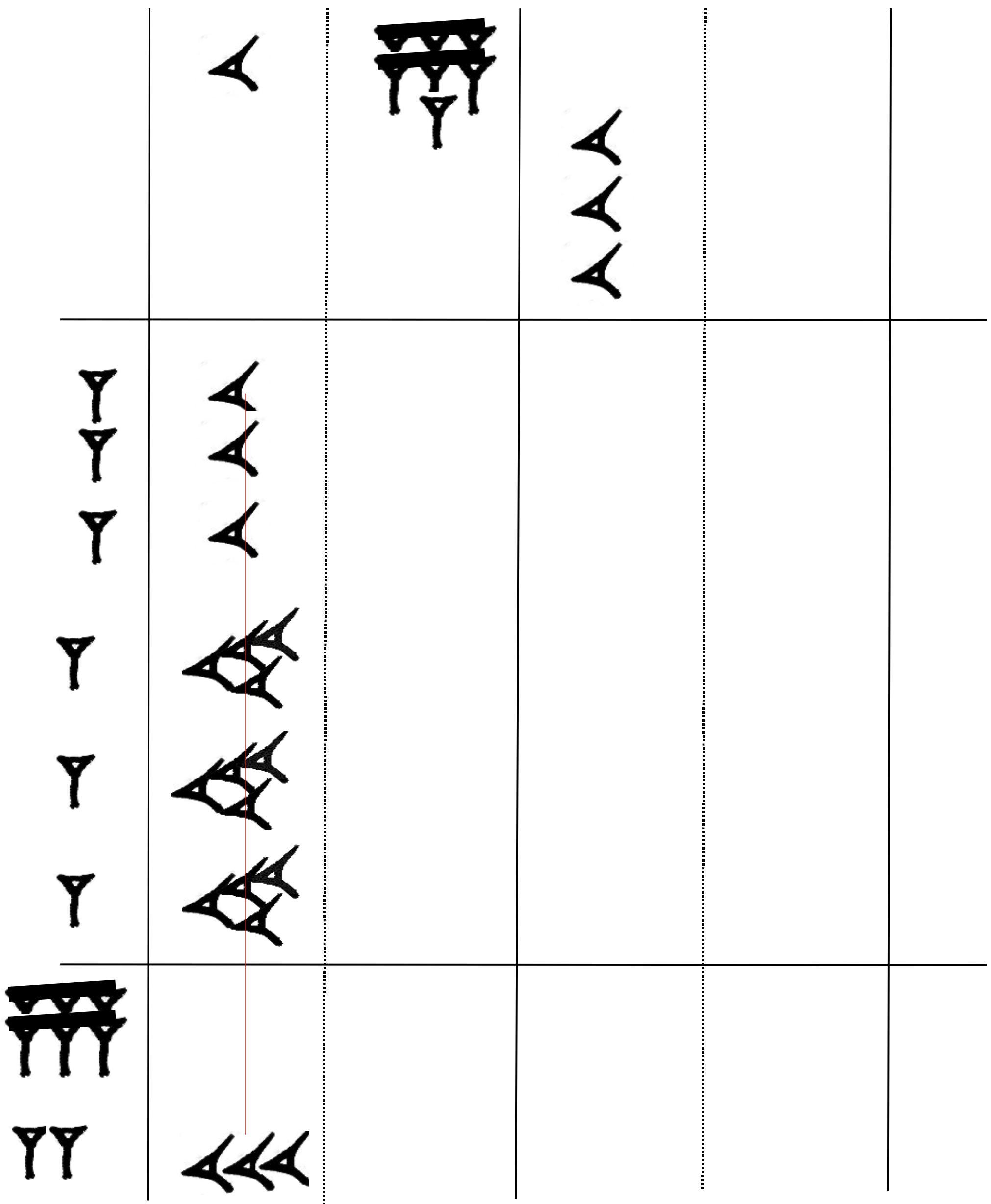
17 00 x 00 30 = ?



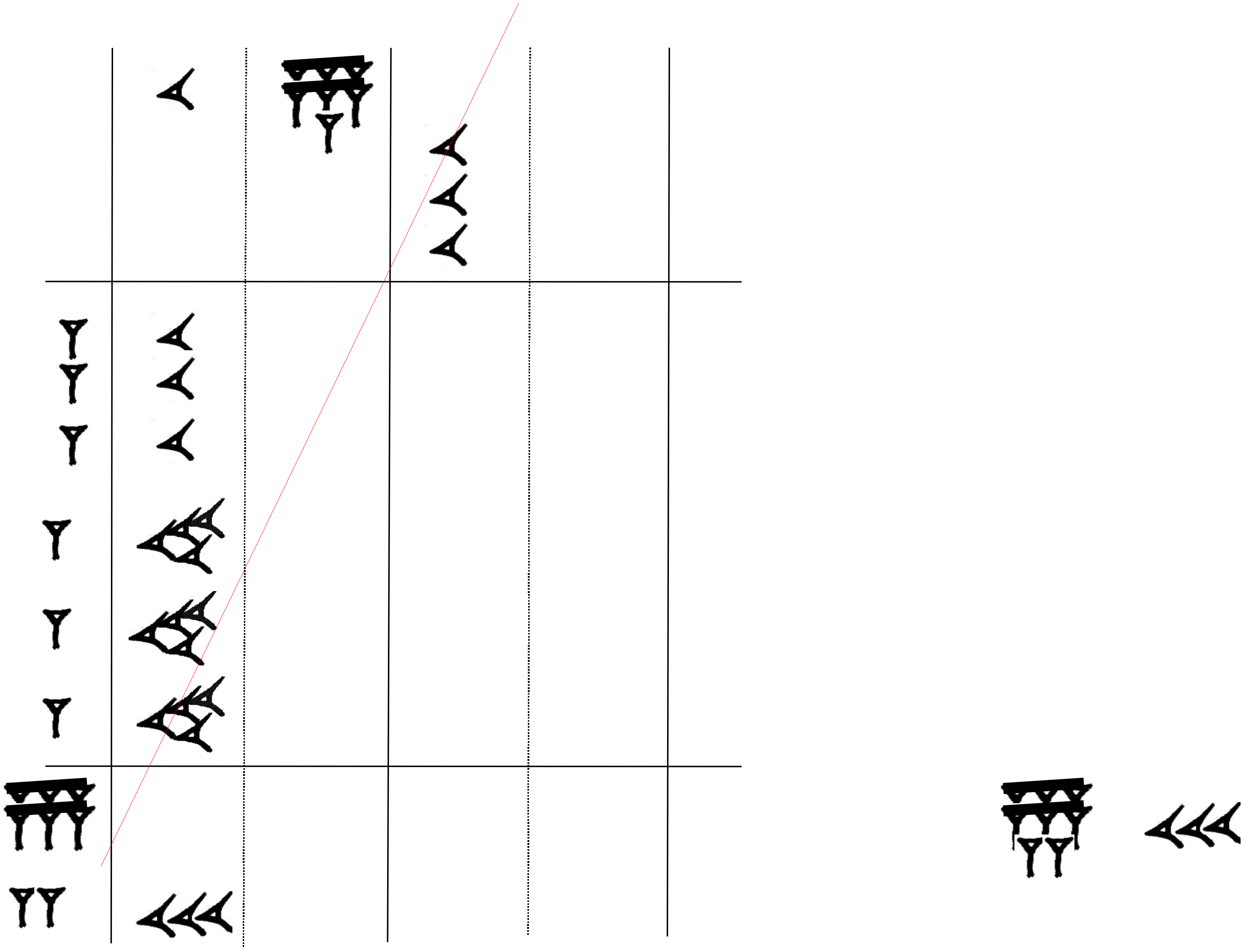
17 00 x 00 30 = ?



17 00 x 00 30 = ?

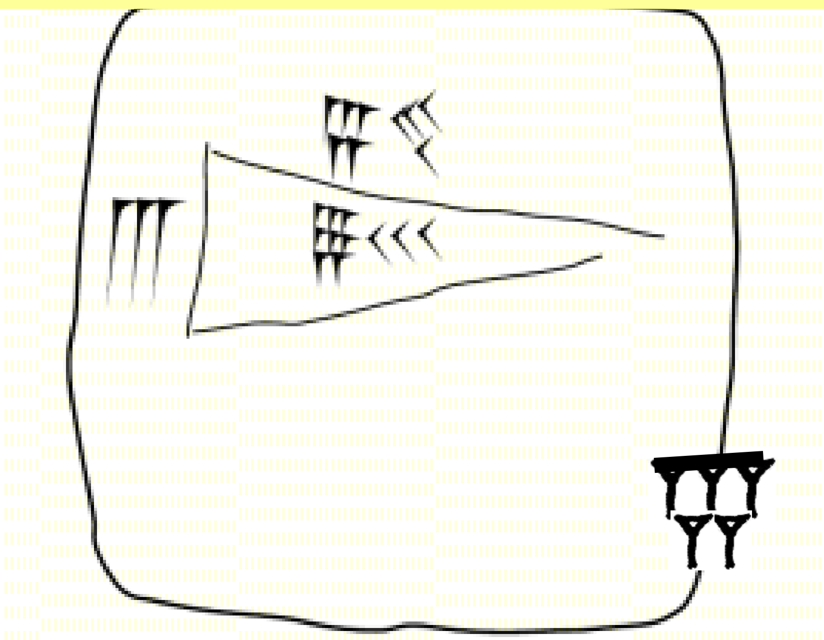


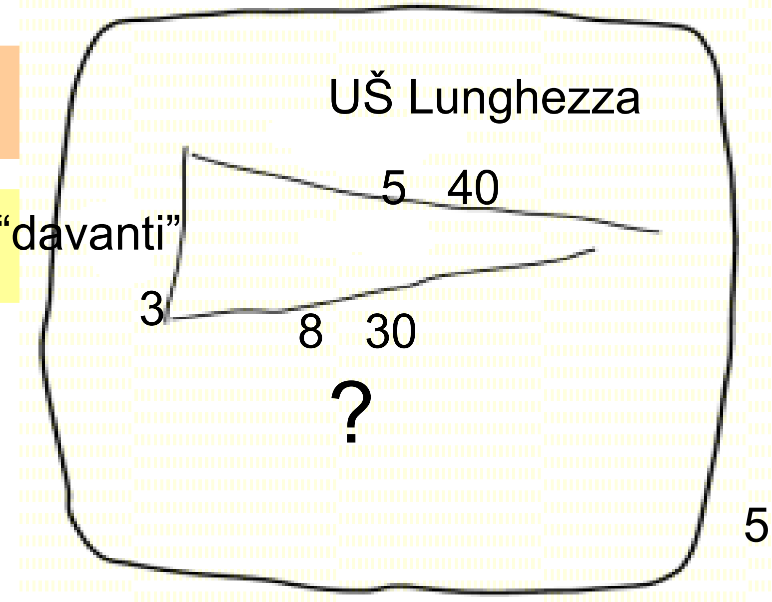
17 00 x 00 30 = 8 30



MS 3042 Schoyen collection

L'area di un triangolo

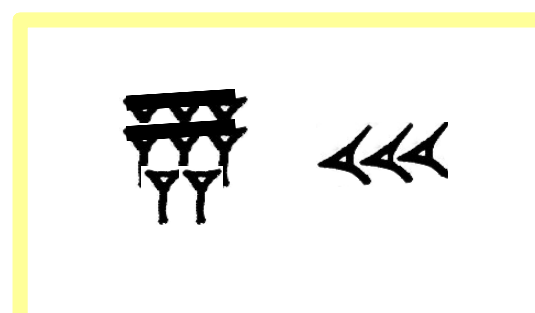




5 40 x 3 00 x 30

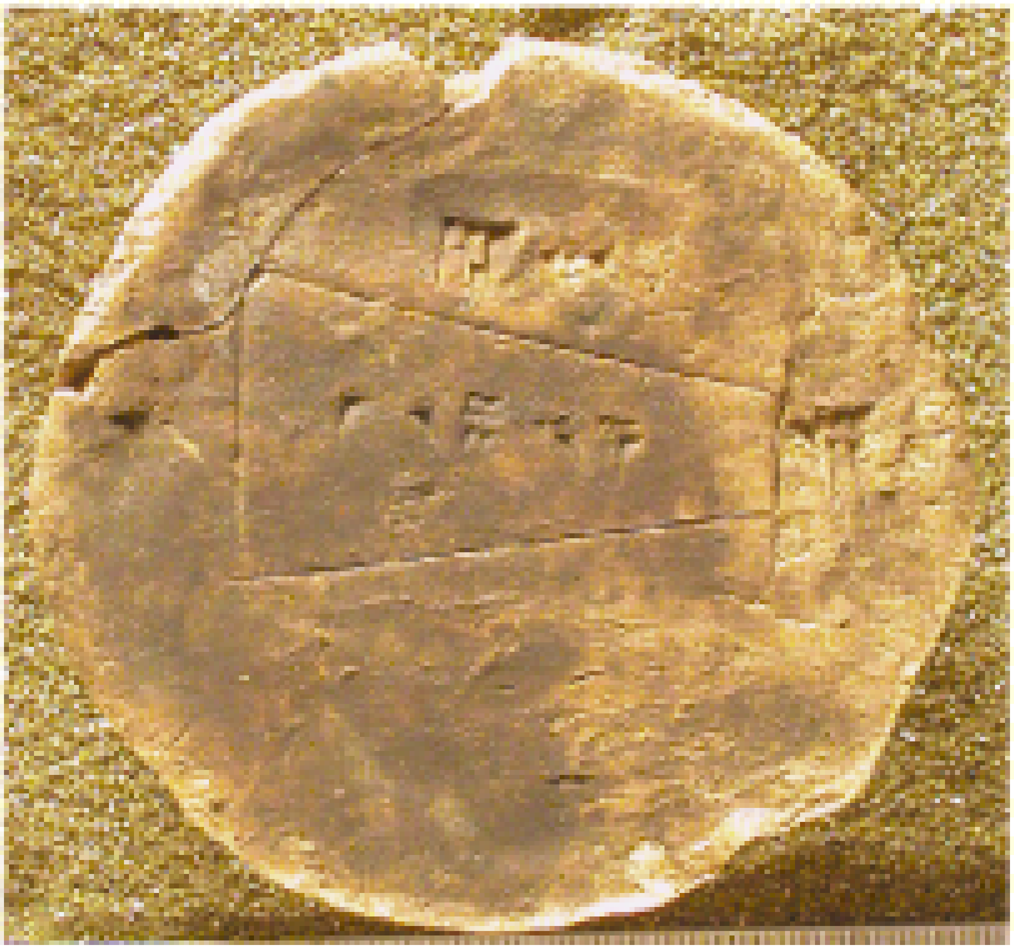
A=?

$A=(b \times h) / 2$



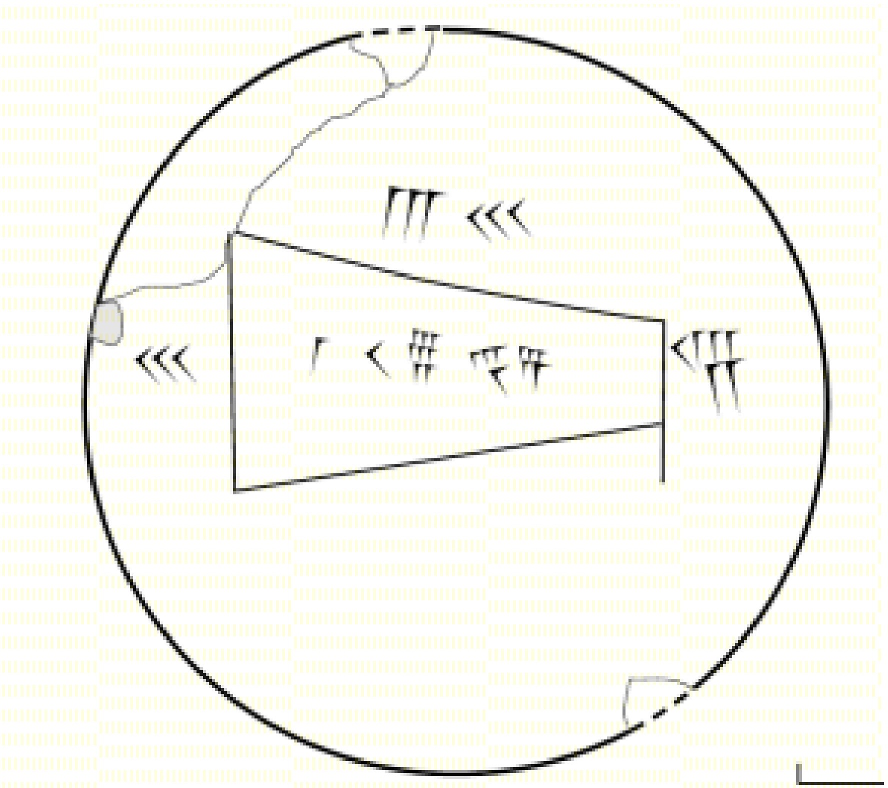
MS 2107 Schoyen collection

L'area di un trapezio



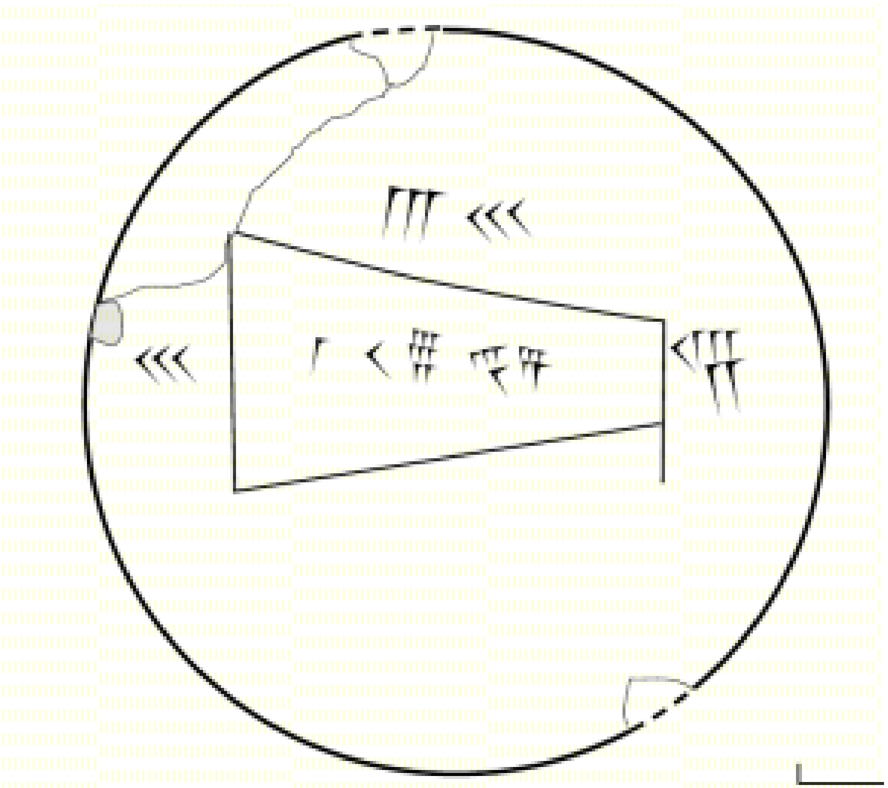
MS 2107 Schoyen collection

L'area di un trapezio



MS 2107 Schoyen collection

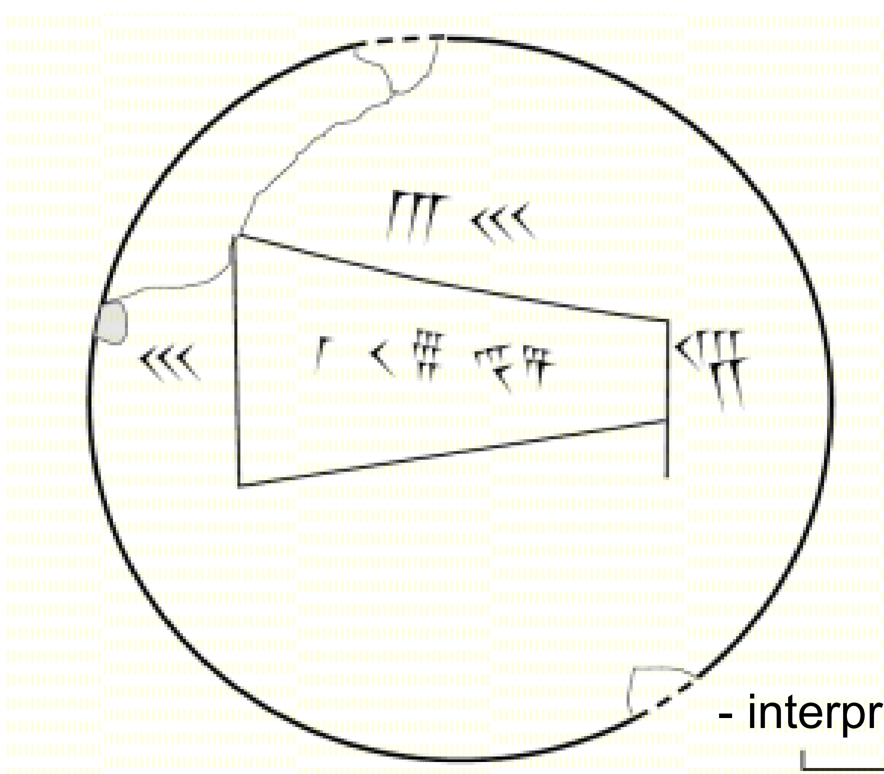
L'area di un trapezio

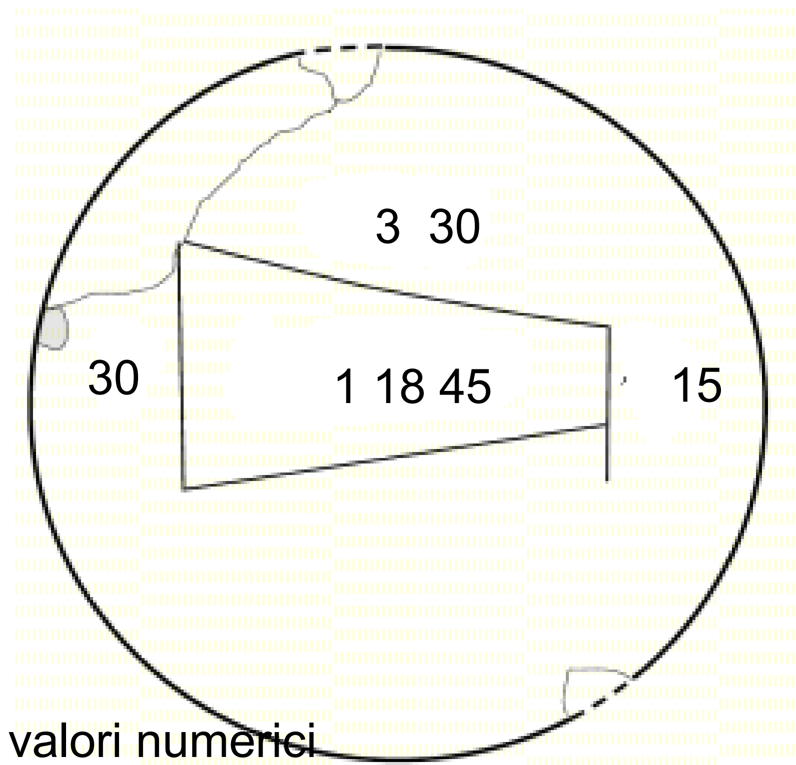


Osservazione: I trapezi sono molto comuni

MS 2107 Schoyen collection

L'area di un trapezio



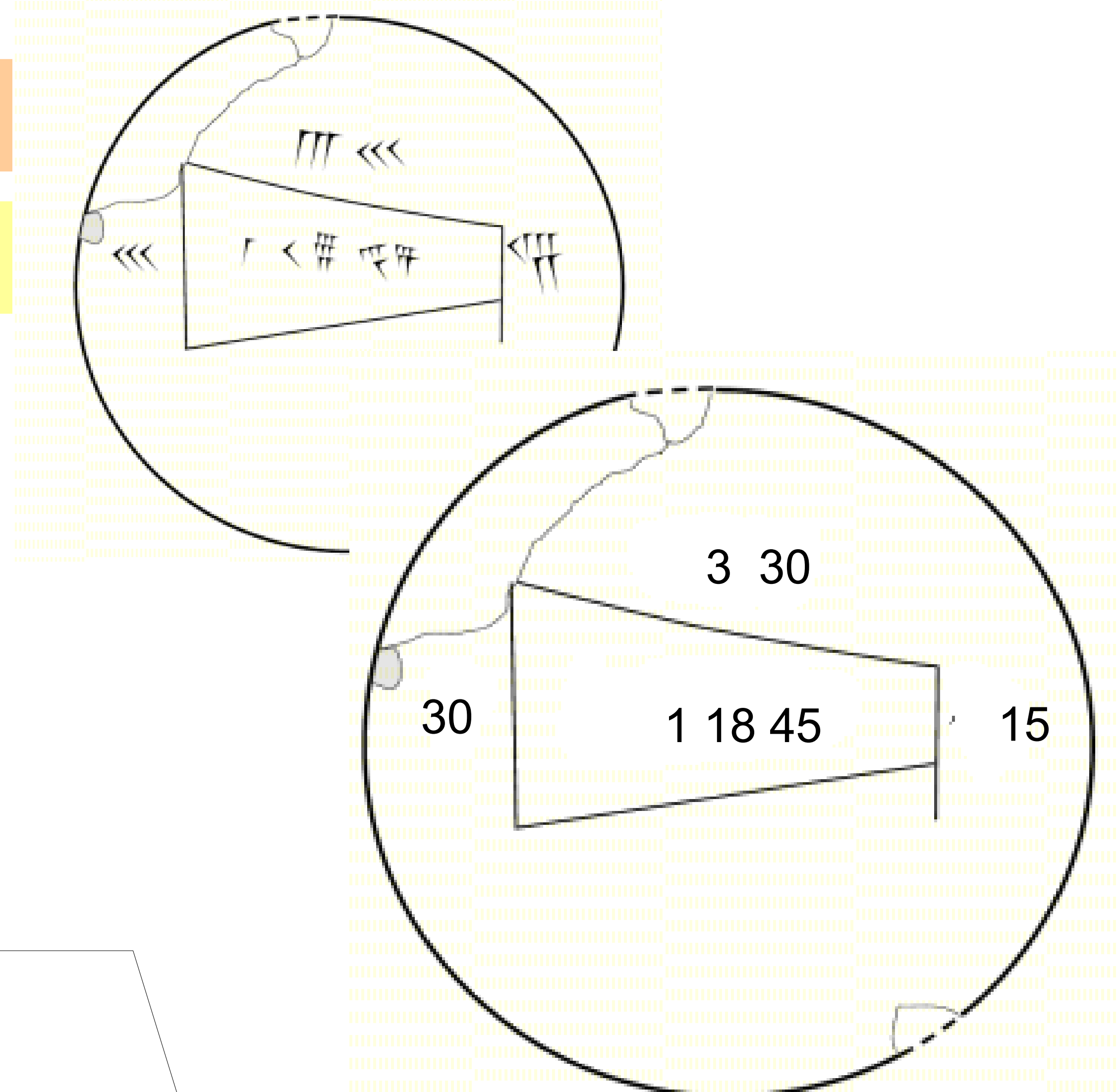


- interpretazione valori numerici

3 30 -----> 3, 30 ninda (notazione sessagesimale)
15 -----> 15 ninda
30 -----> 30 ninda

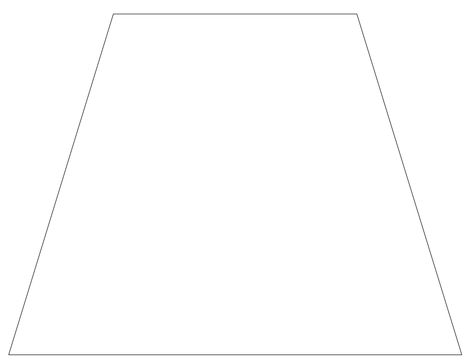
MS 2107 Schoyen collection

L'area di un trapezio



Dati: lunghezze
Incognite: area

$$A = (B+b) \times h / 2$$

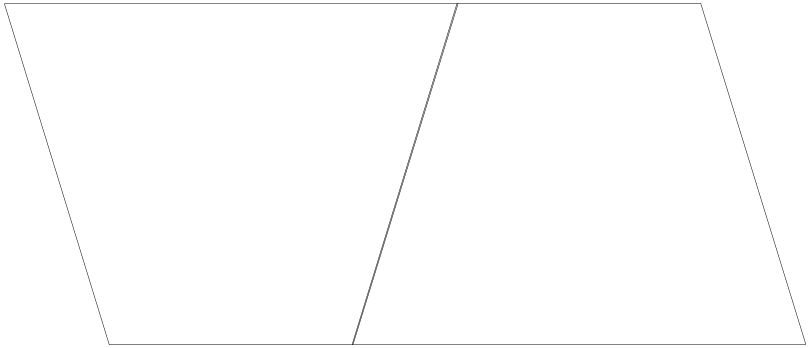


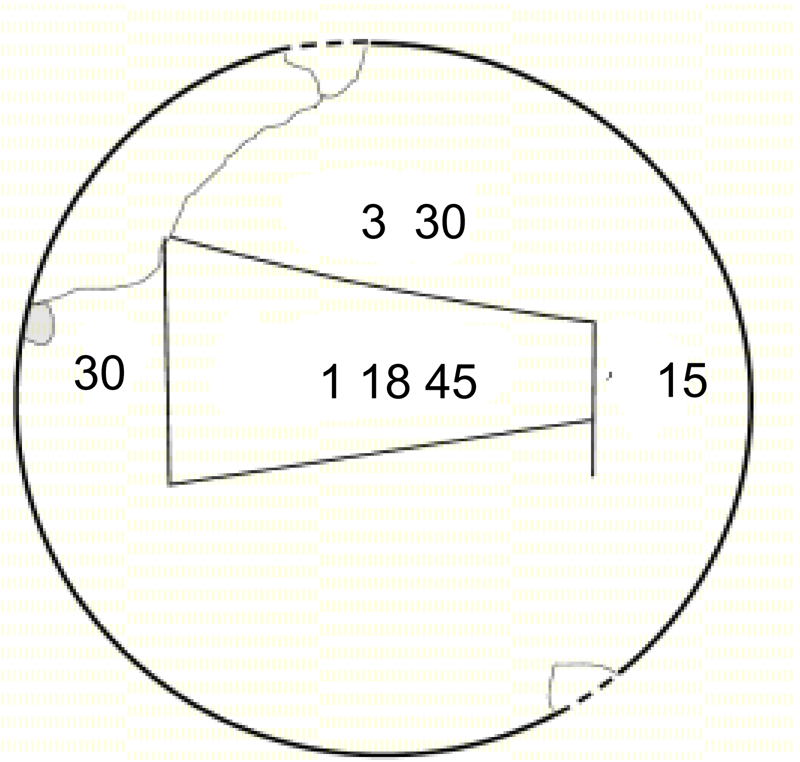
MS 2107 Schoyen collection

L'area di un trapezio

Dati: lunghezze
Incognite: area

$$A = (B+b)xh / 2$$



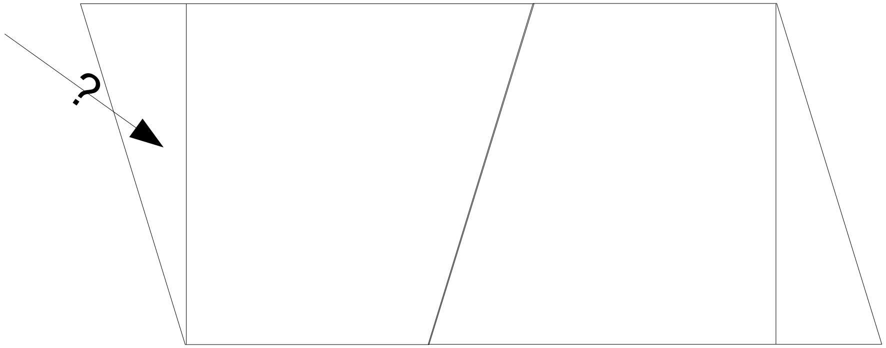


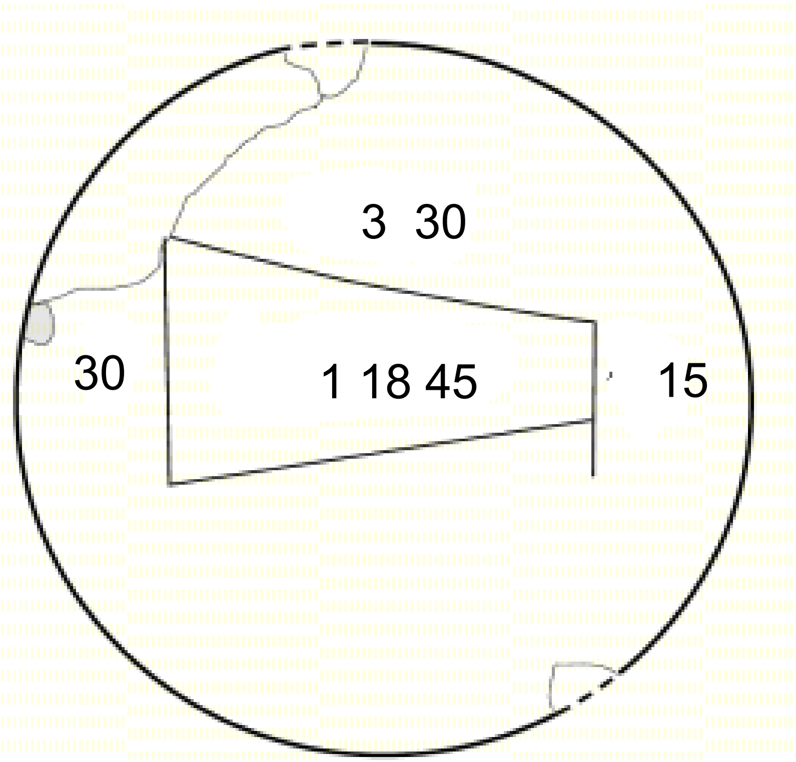
MS 2107 Schoyen collection

L'area di un trapezio

Dati: lunghezze
Incognite: area

$$A = (B+b) \times h / 2$$

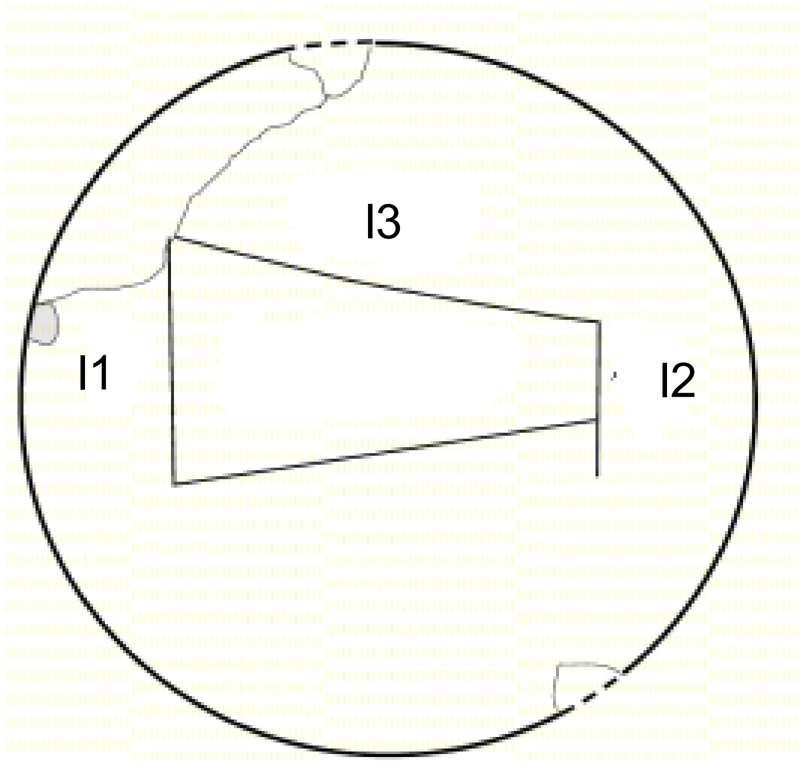




MS 2107 Schoyen collection

L'area di un trapezio

Dati: lunghezze
Incognite: area



Formula del geometra

trapezi isosceli

A = (l1+l2)xl3x30

quadrilateri

A = (l1+l2)x(l3+l4)x15

lati opposti

MS 2107 Schoyen collection

L'area di un trapezio

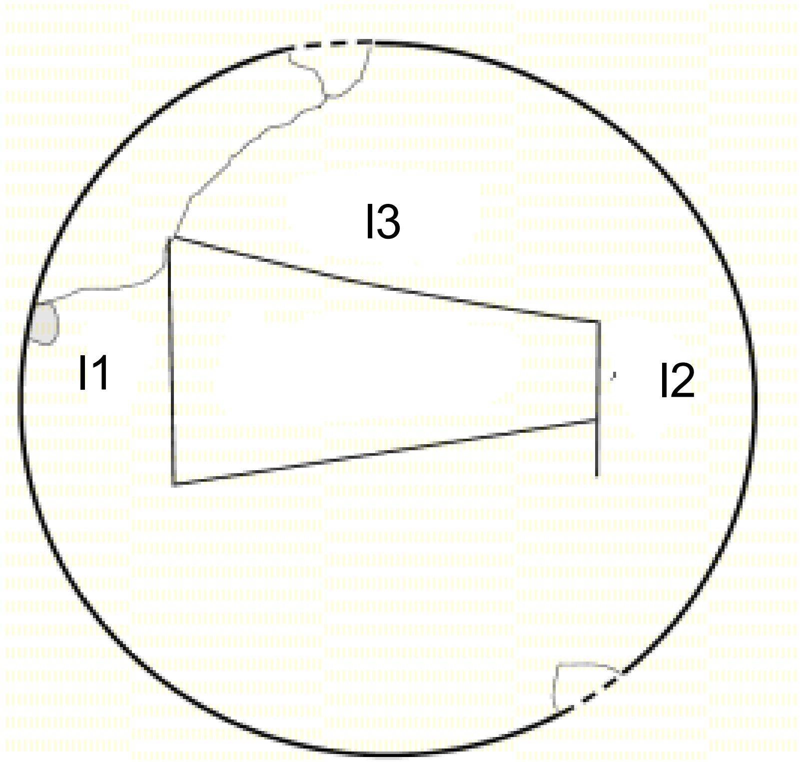
Dati: lunghezze
Incognite: area

Formula del geometra

trapezi isosceli

A = (l1+l2)xl3x30

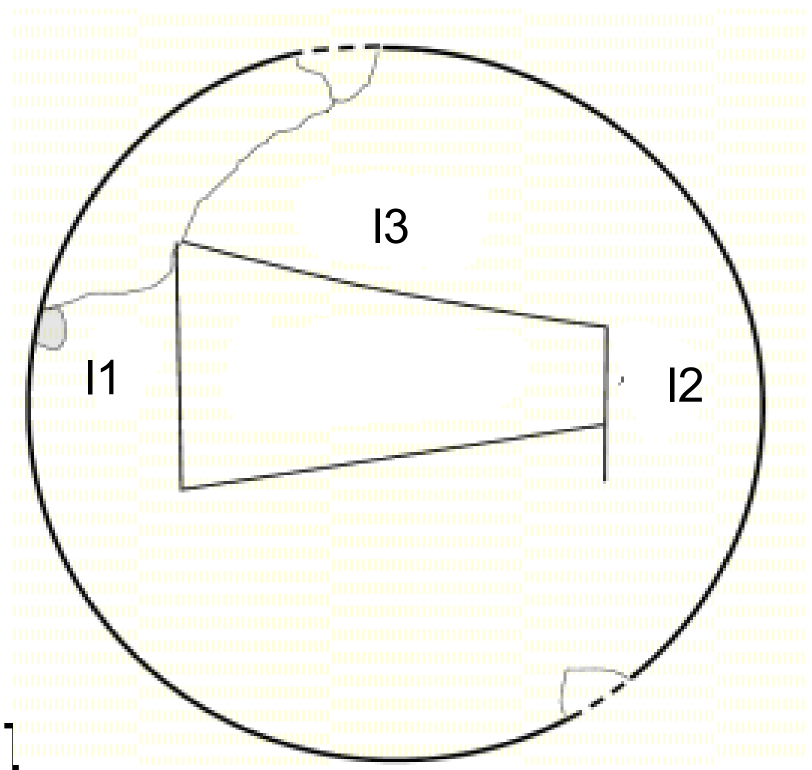
altezza
lato obliquo



MS 2107 Schoyen collection

L'area di un trapezio

Dati: lunghezze
Incognite: area



Formula del geometra

trapezi isosceli

A = (l1+l2)xl3x30

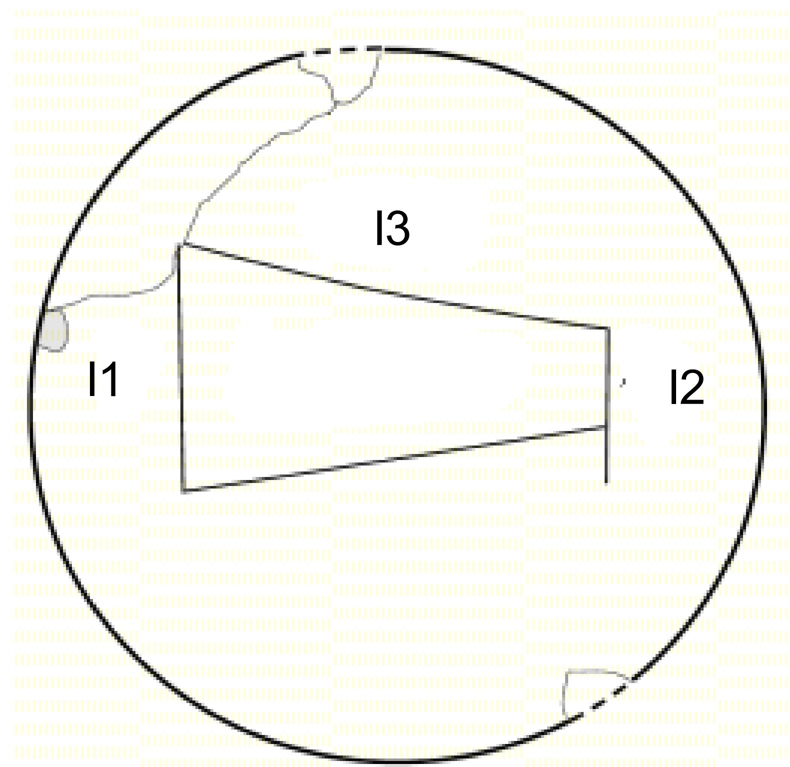
30 = [00; 30]
= 30/60= 1/2

A = (l1+l2)xl3/2

MS 2107 Schoyen collection

L'area di un trapezio

Dati: lunghezze
Incognite: area



Formula del geometra

trapezi isosceli

$$A = (l1+l2) \times l3 \times 30$$

$$15 = [00; 15] = 1/4$$

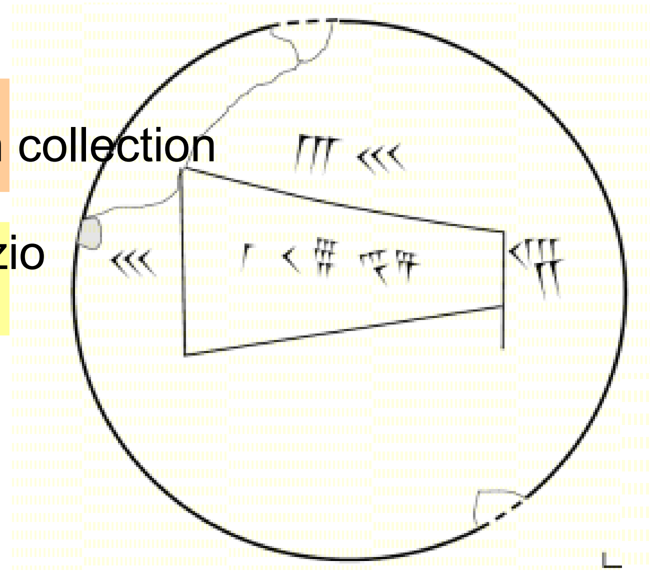
quadrilateri

$$A = (l1+l2) \times (l3+l4) \times 15$$

$$A = \frac{(l1+l2)}{2} \times \frac{(l3+l4)}{2}$$

MS 2107 Schoyen collection

L'area di un trapezio

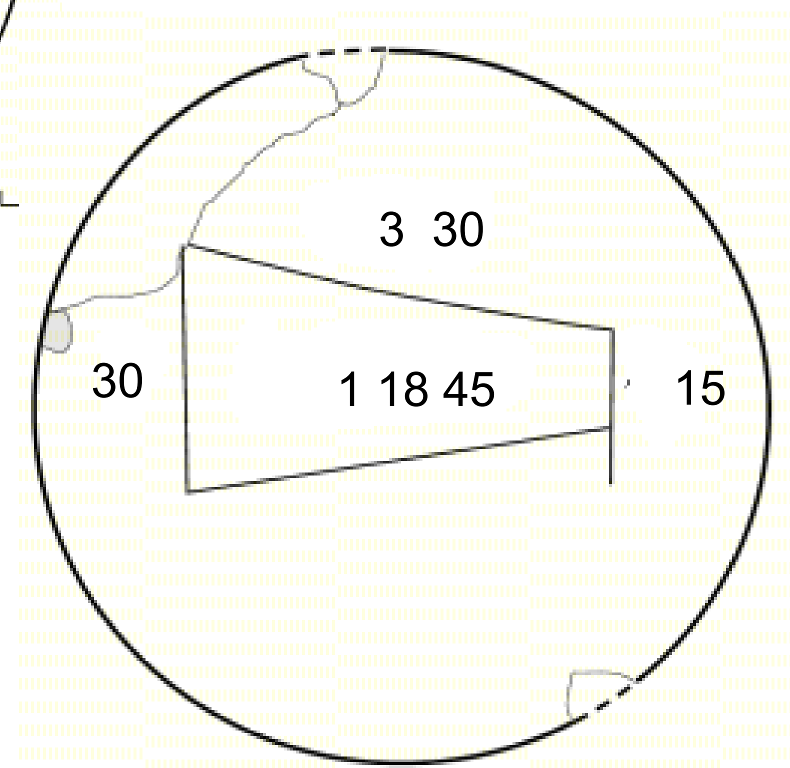


Dati: lunghezze
Incognite: area

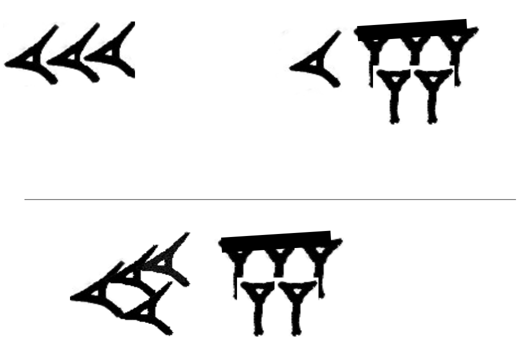
$$A = (l1+l2) \times l3 \times 30$$

Calcoliamo

(30+15)x 3 30 x 30

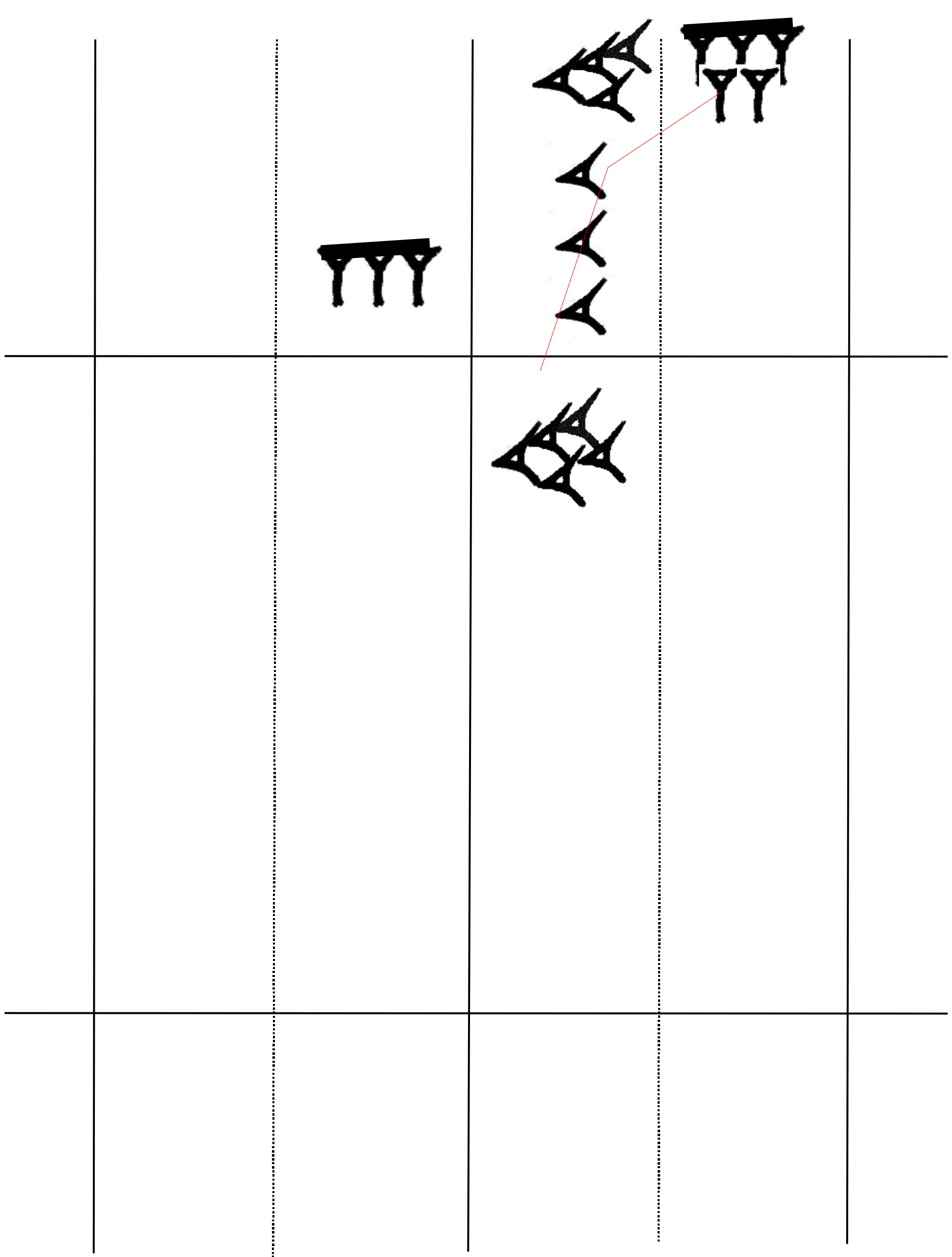


30+1
5

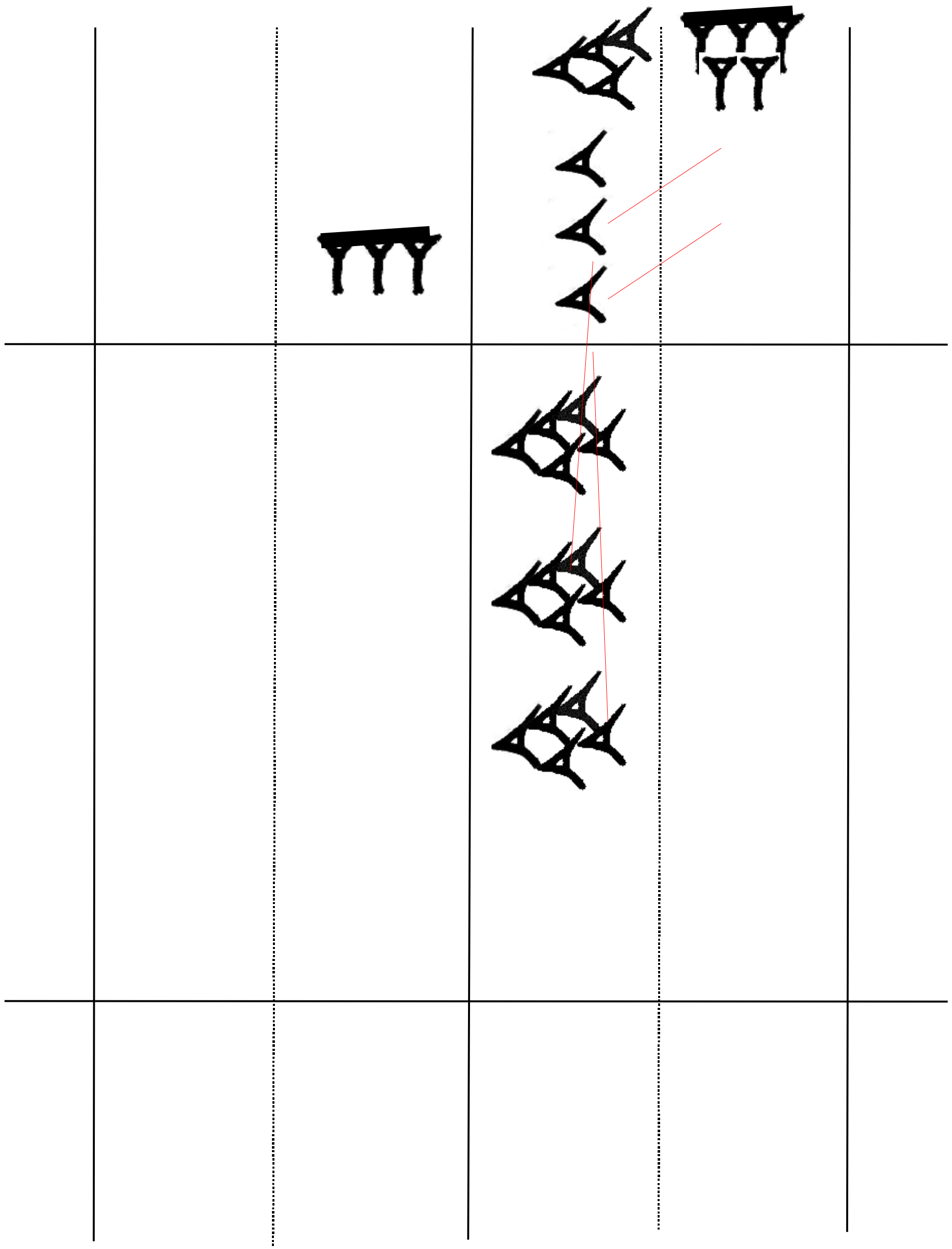


(30+15)x 3 30 x
30

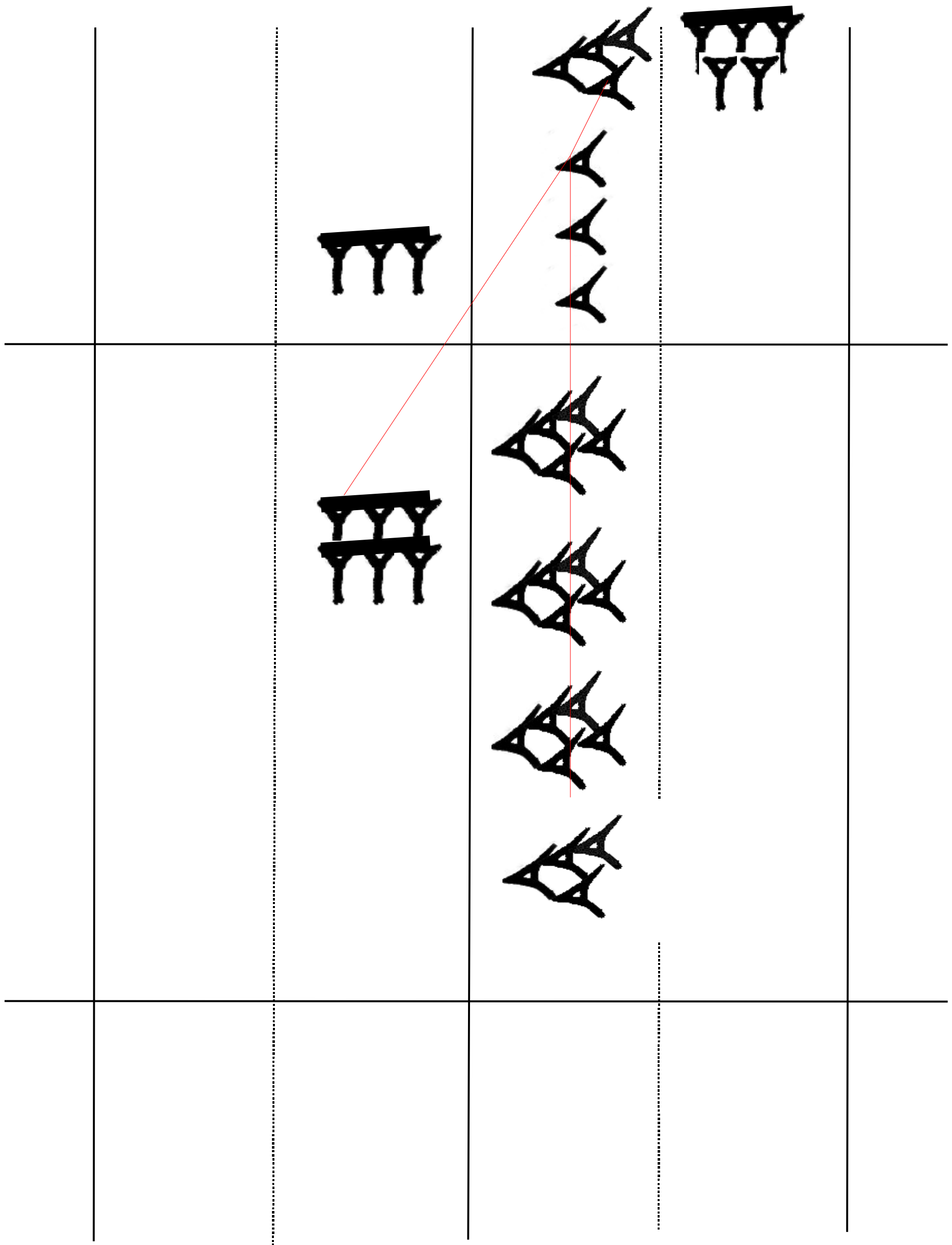
45 x 3 30 = ?

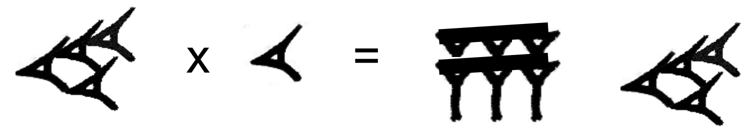


45 x 3 30 = ?



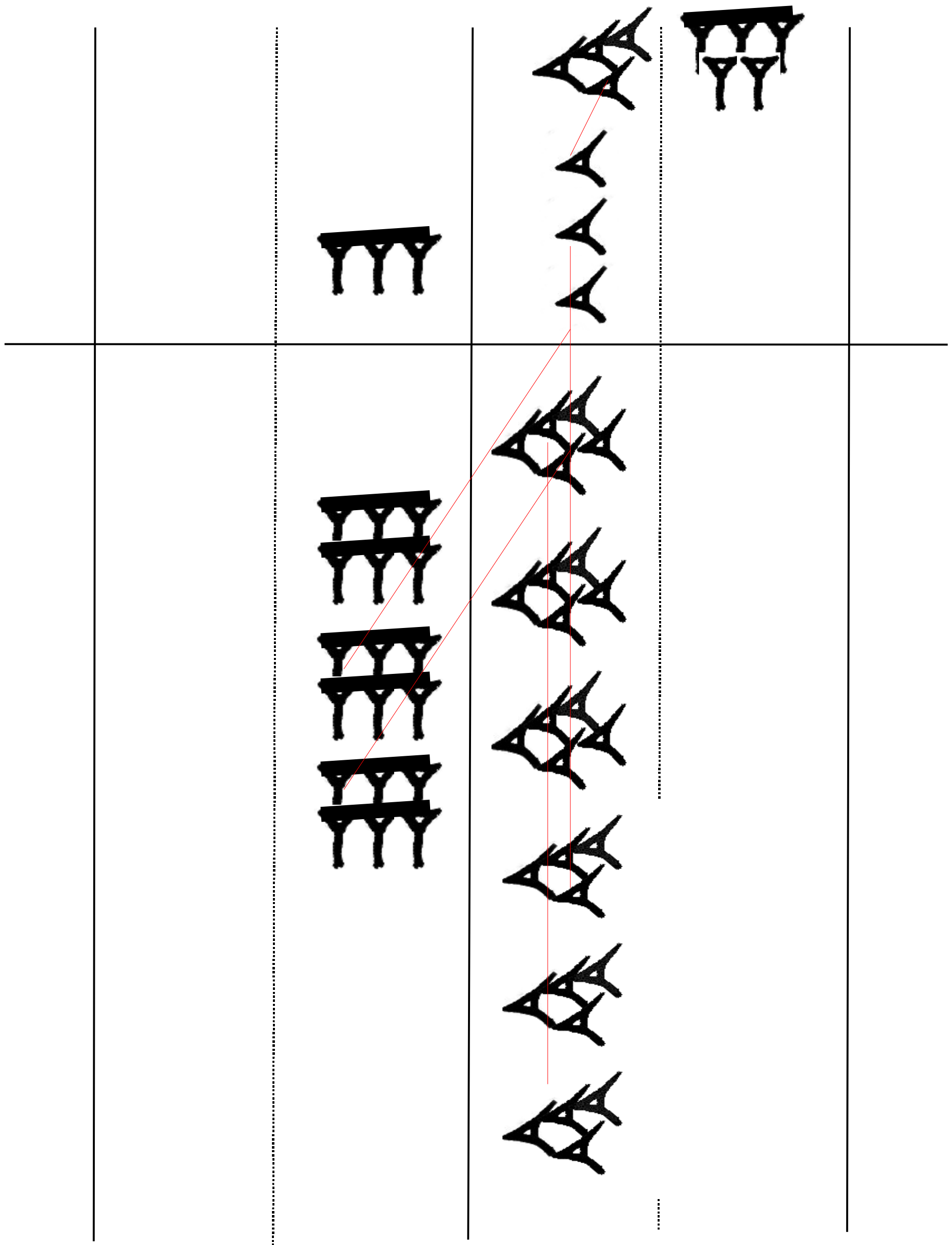
45 x 3 30 = ?

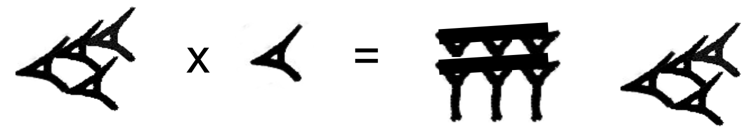




40x10=400
40x10=[6 40]

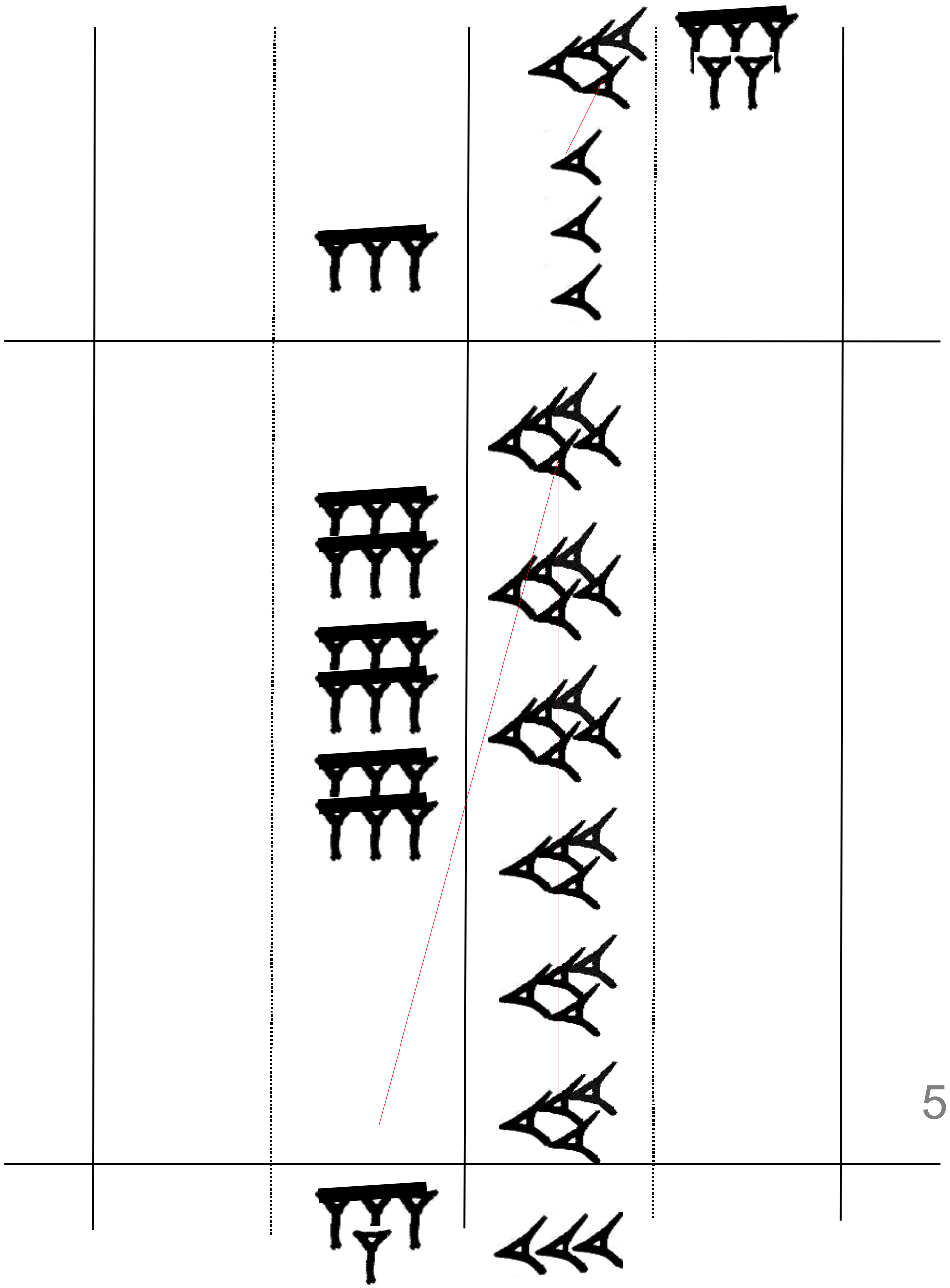
45 x 3 30 = ?





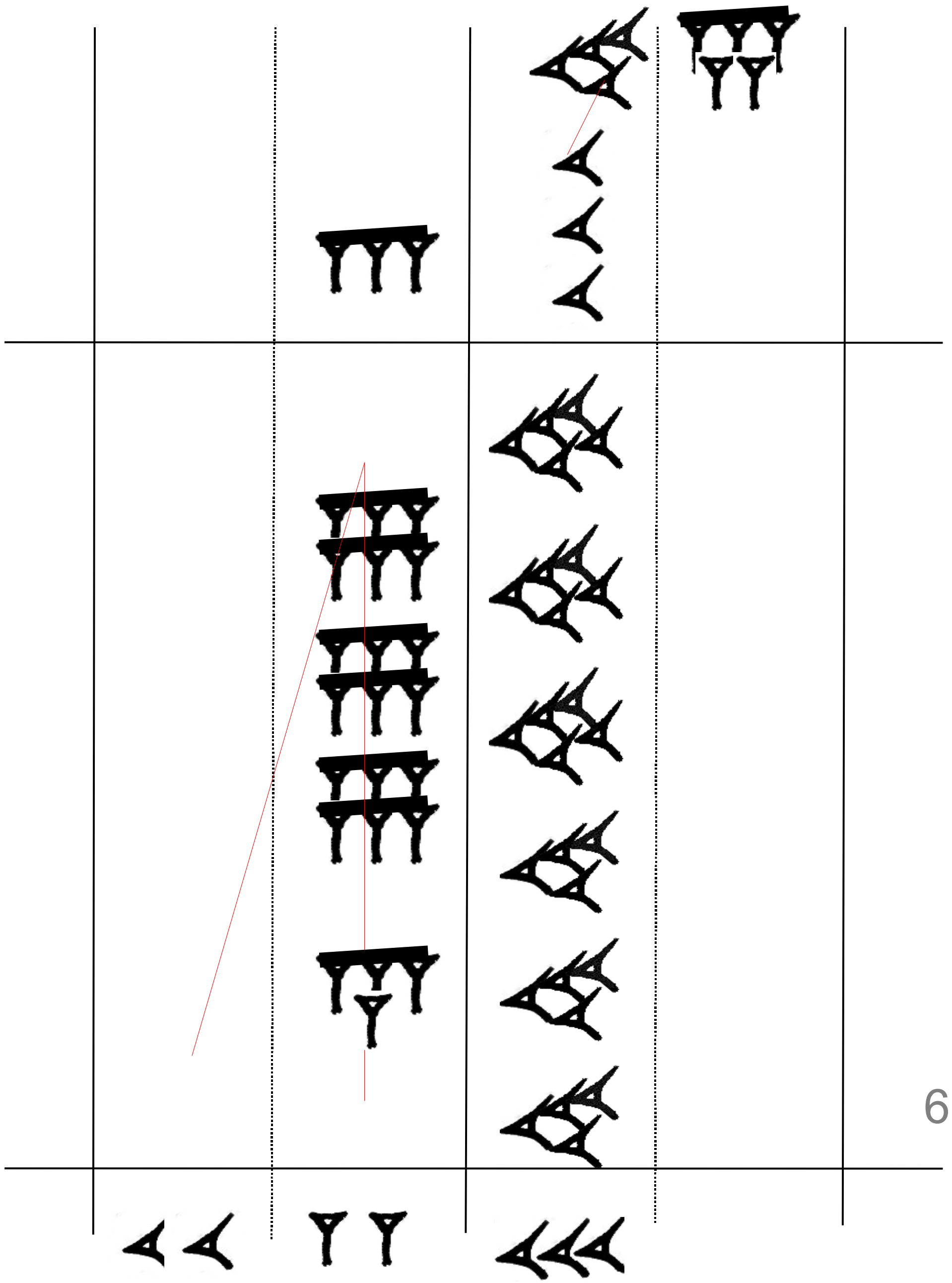
40x10=400
40x10=6 40

45 x 3 30 = ?



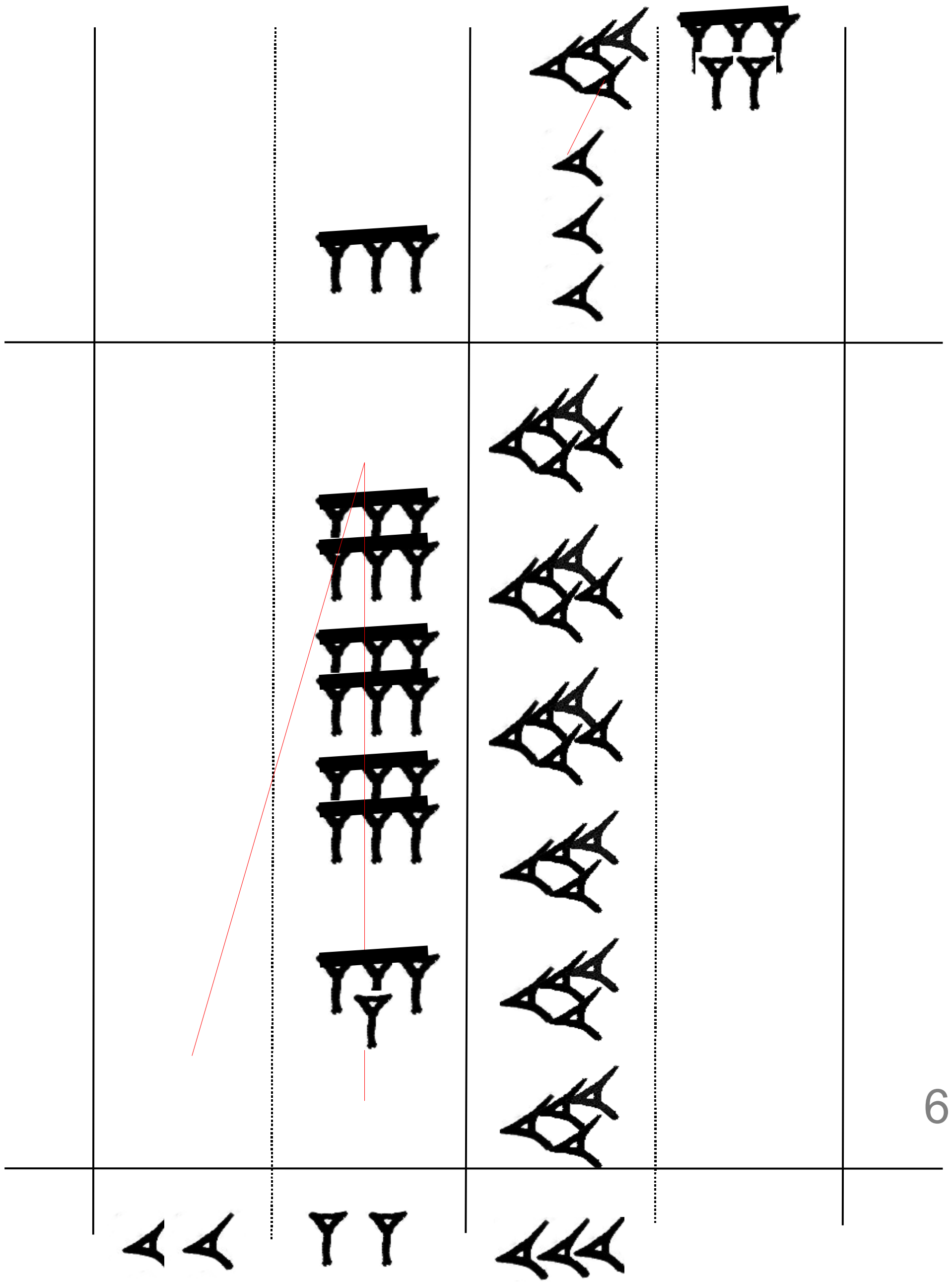
50+50+50+40+40+40=270=4x60+30

45 x 3 30 = ?



6+6+6+4=22

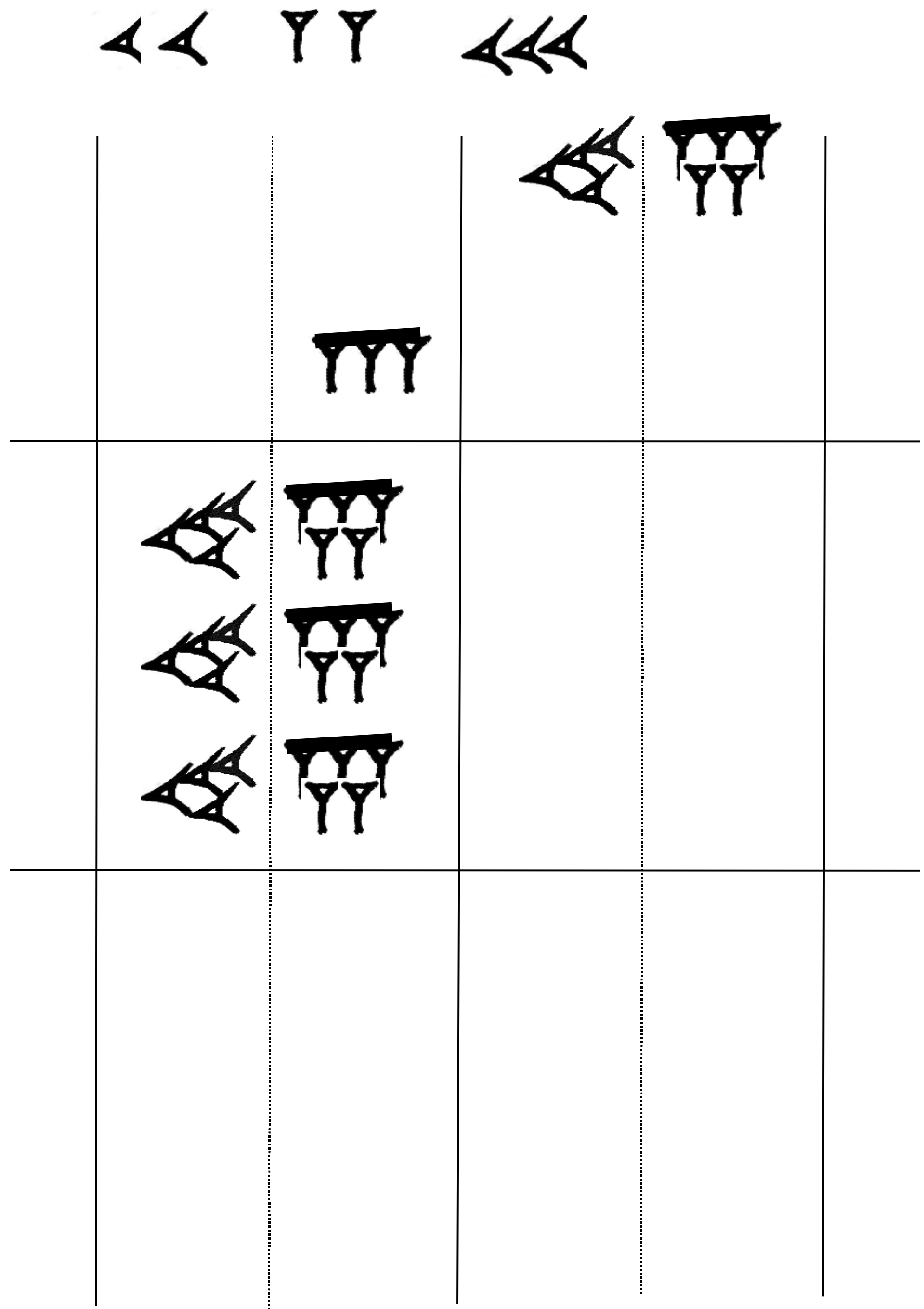
45 x 30 = 22 30



6+6+6+4=22

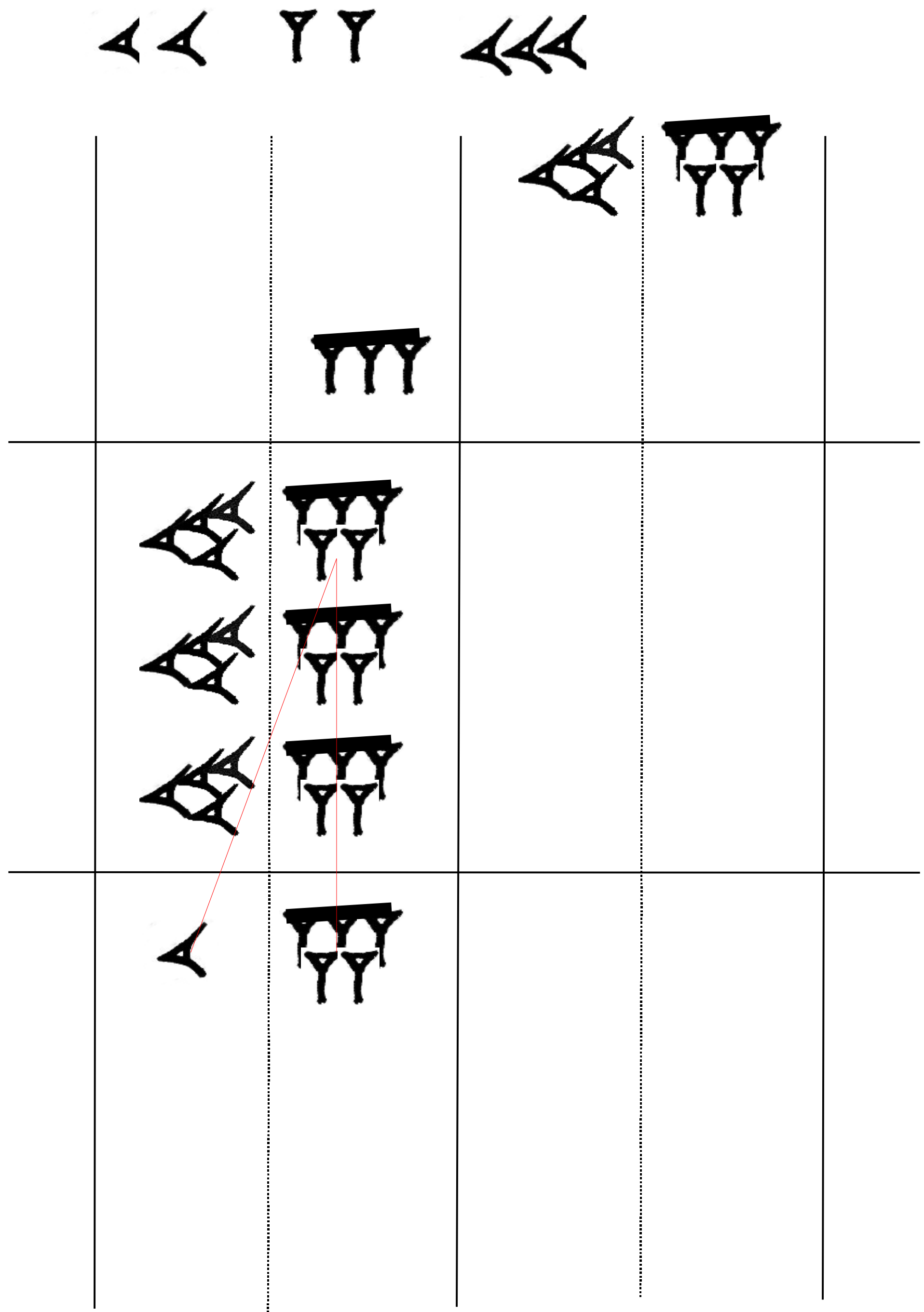
45 x 30 = 22 30

45 x 3 = ?



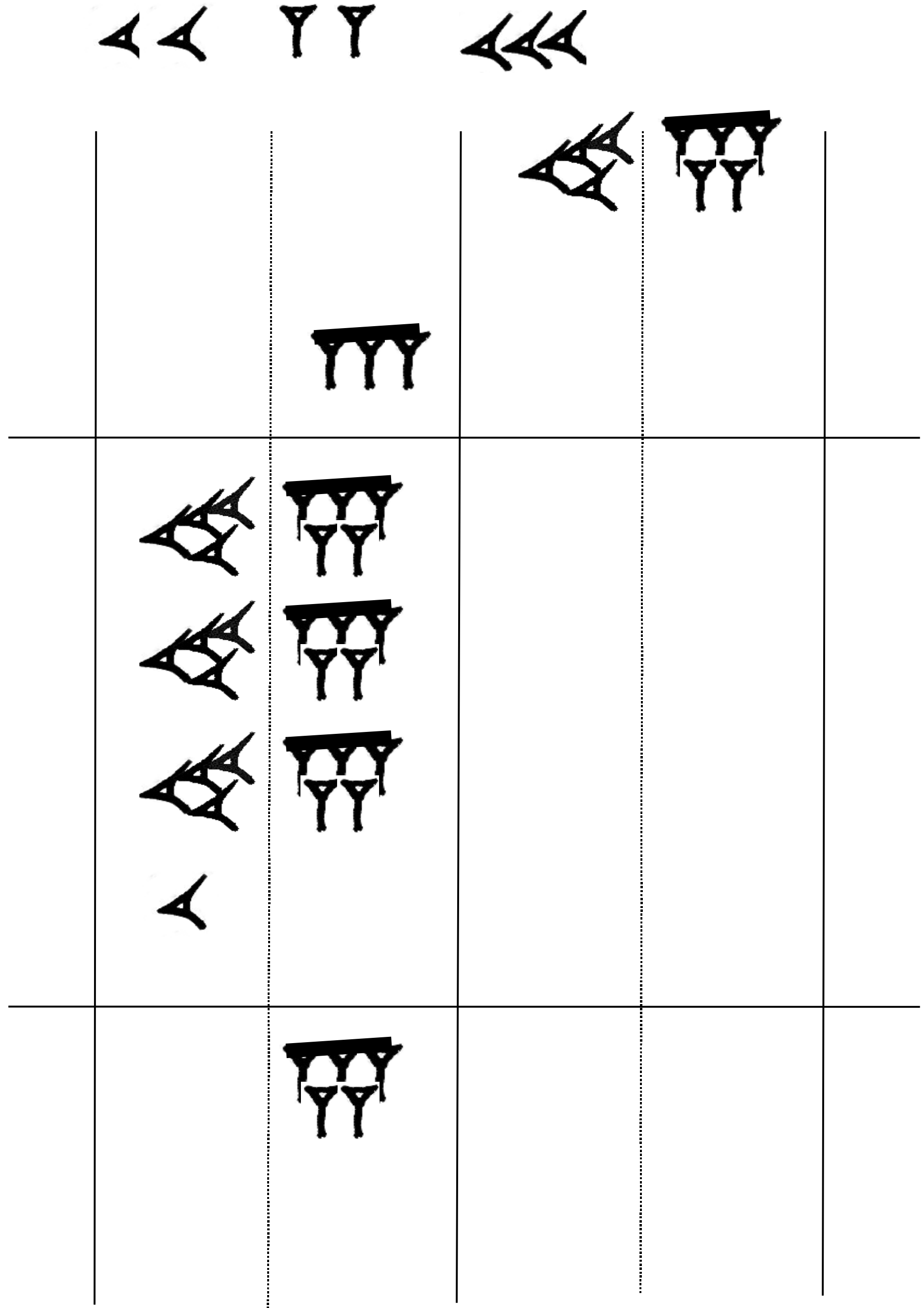
45 x 30 = 22 30

45 x 3 = ?



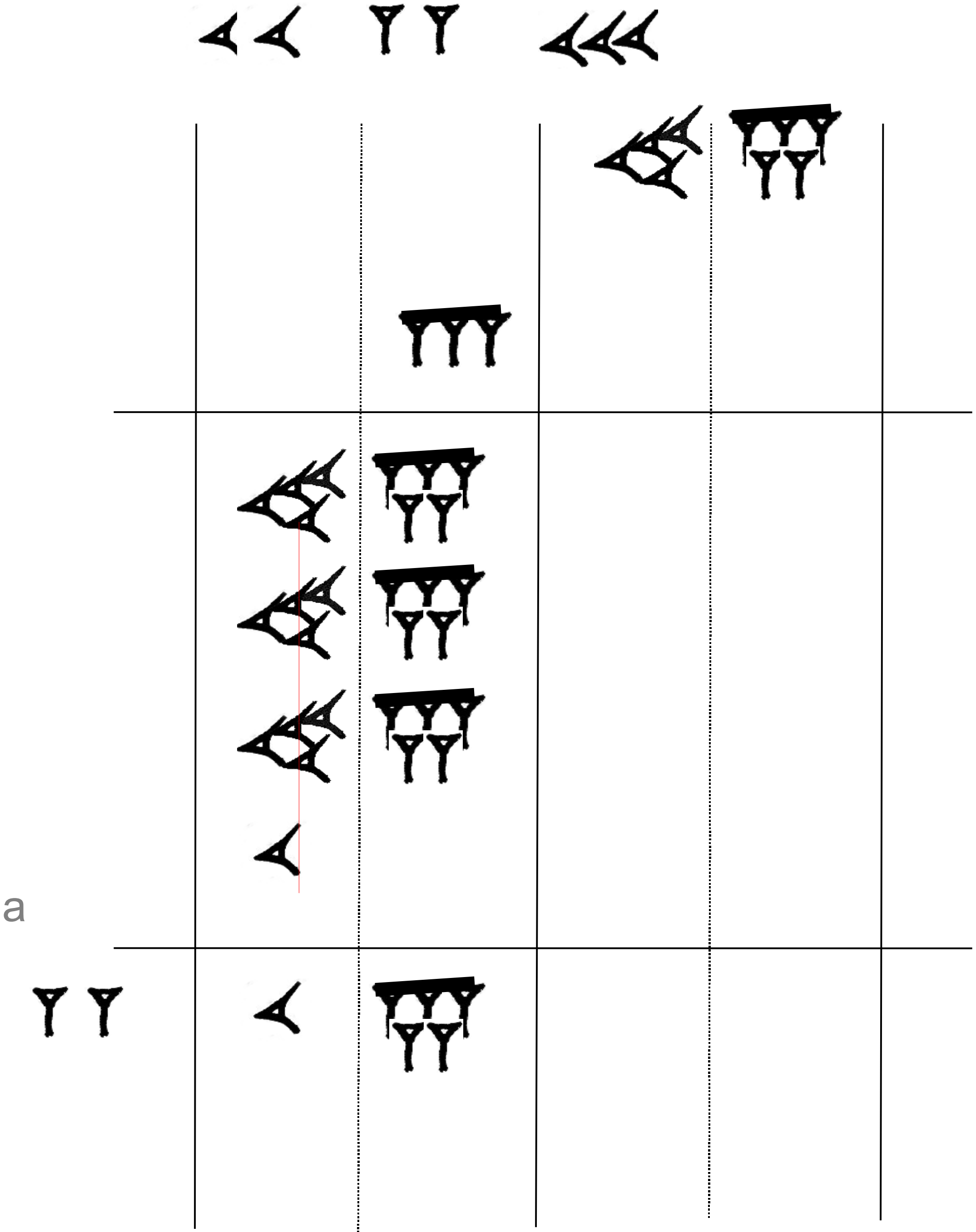
45 x 30 = 22 30

45 x 3 = ?



45 x 30 = 22 30

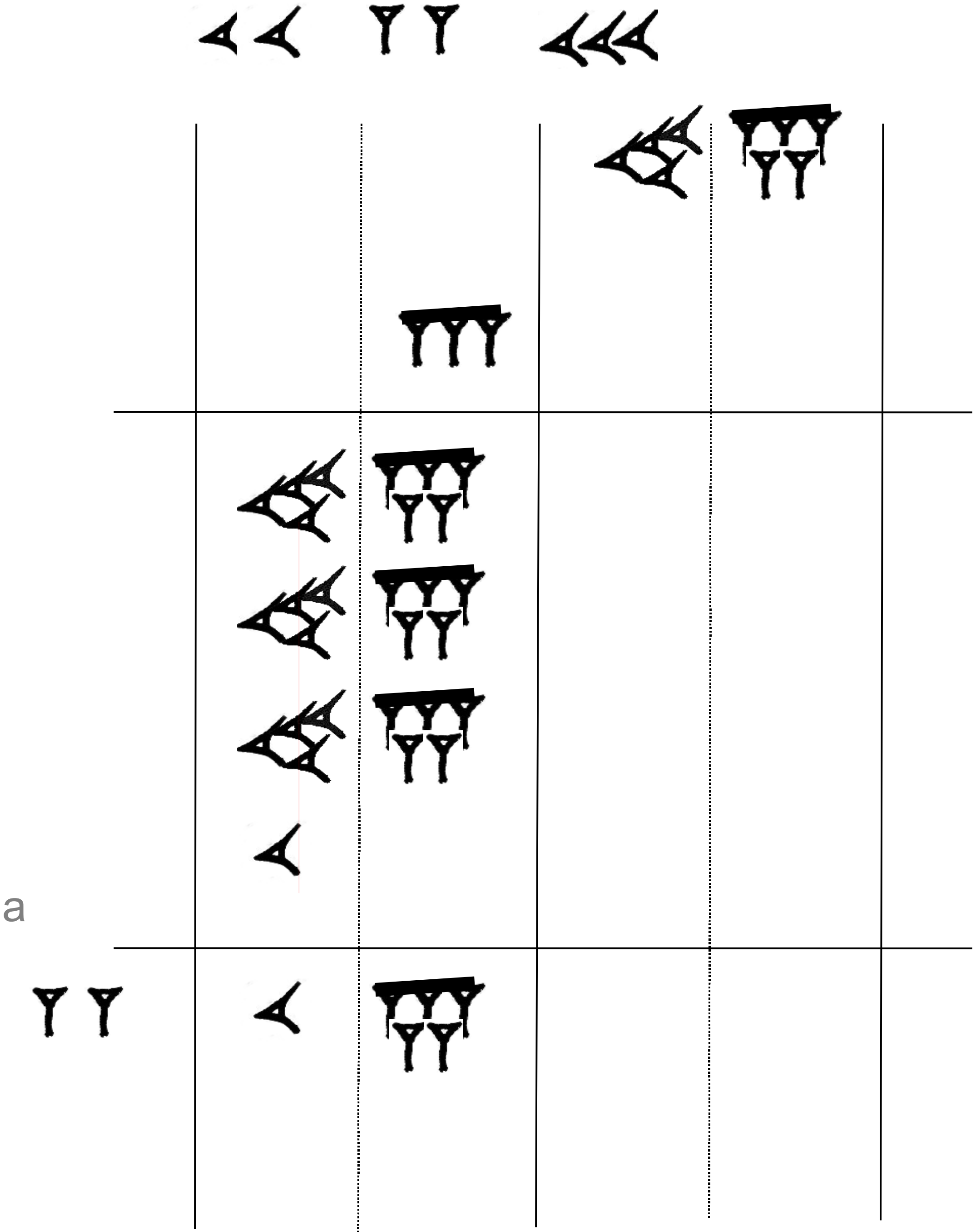
45 x 3 = ?



4+4+4+1=13 decine =
2 sessantine + 1 decina

45 x 30 = 22 30

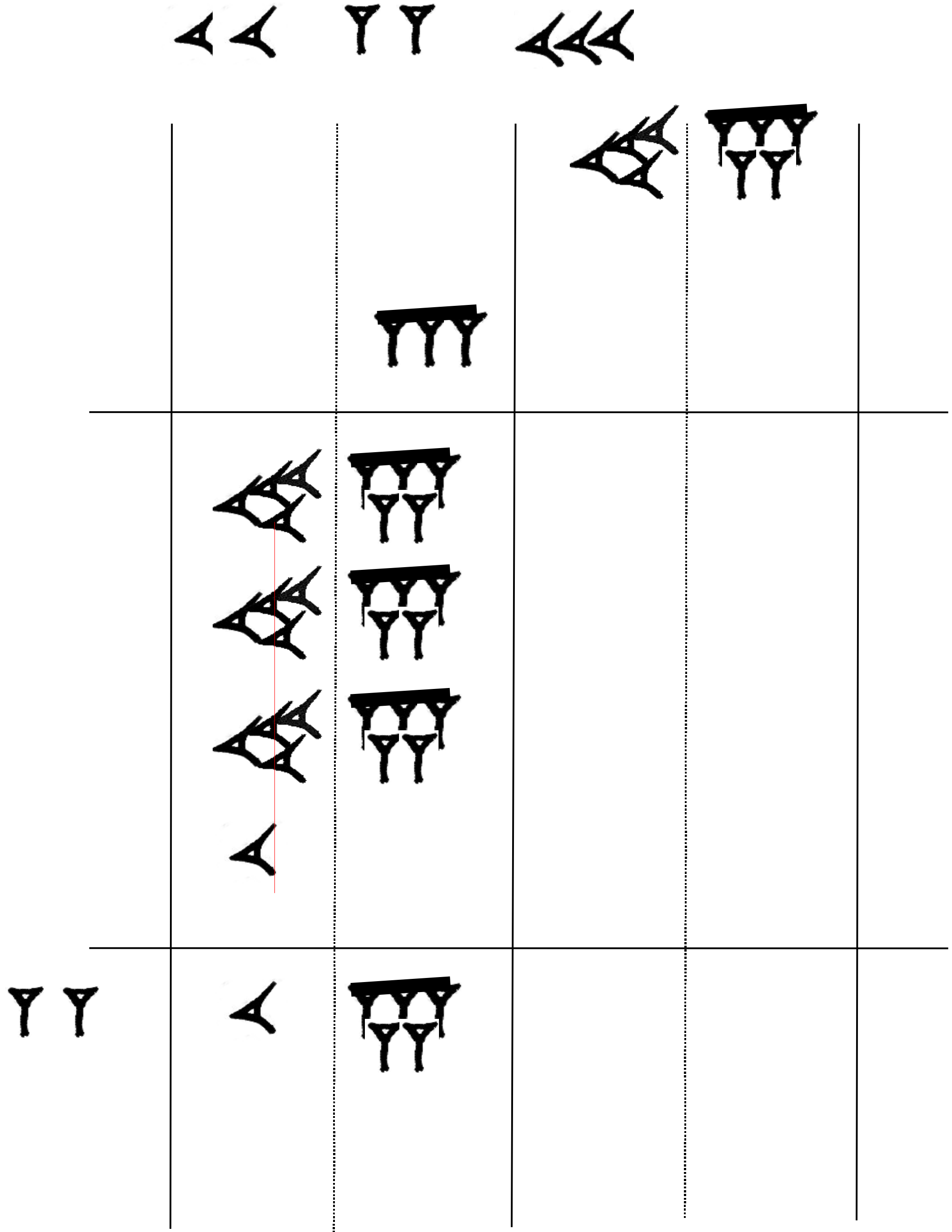
45 x 3 = ?



4+4+4+1=13 decine =
2 sessantine + 1 decina

45 x 30 = 22 30

45 x 3 = 2 15 00



MS 2107 Schoyen collection
L'area di un trapezio

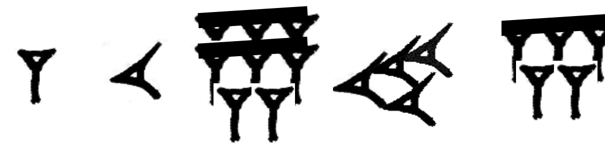
45 x 30 = 22 30

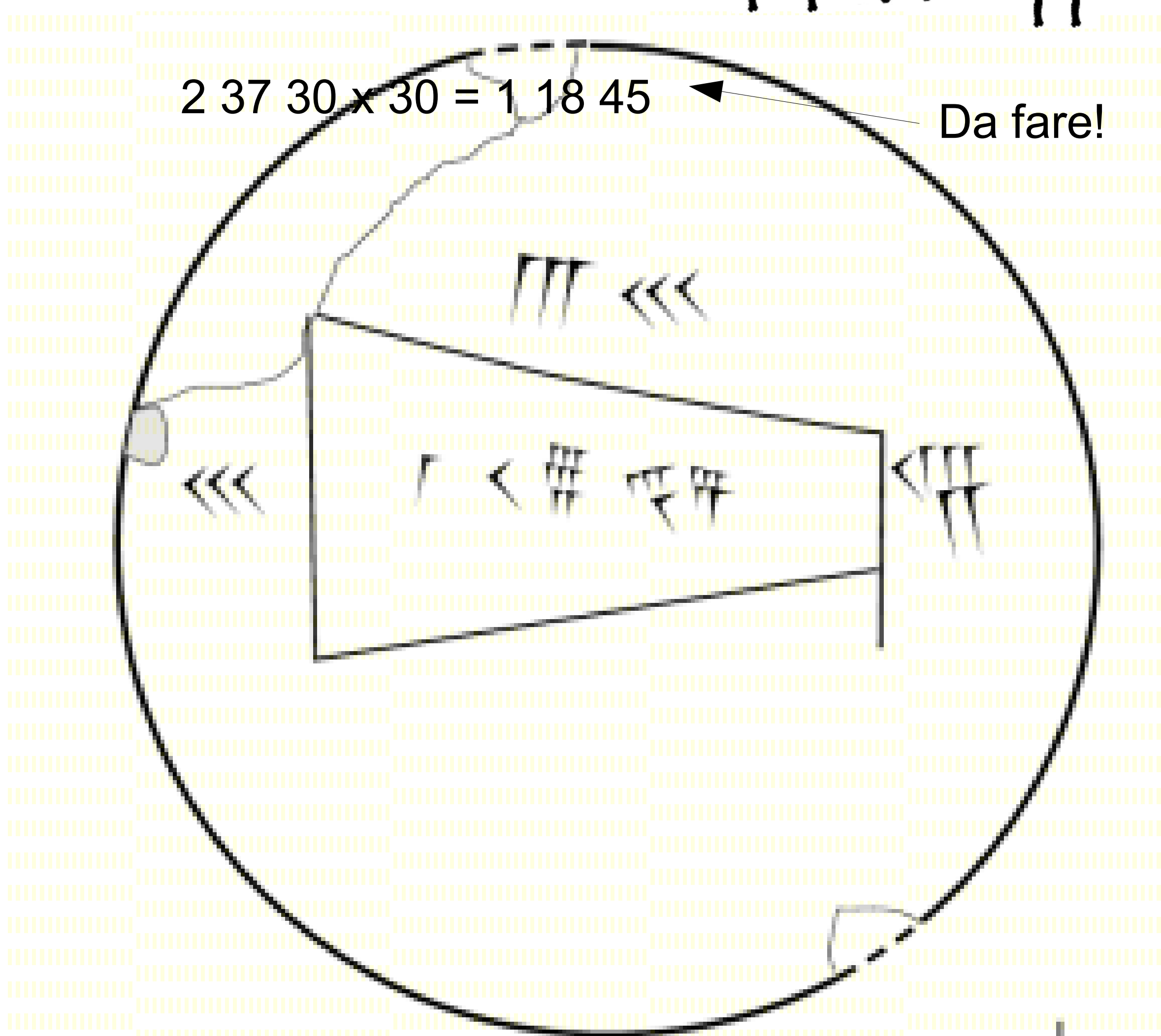
45 x 3 = 2 15 00

45 x 3 30 = 2 37 30

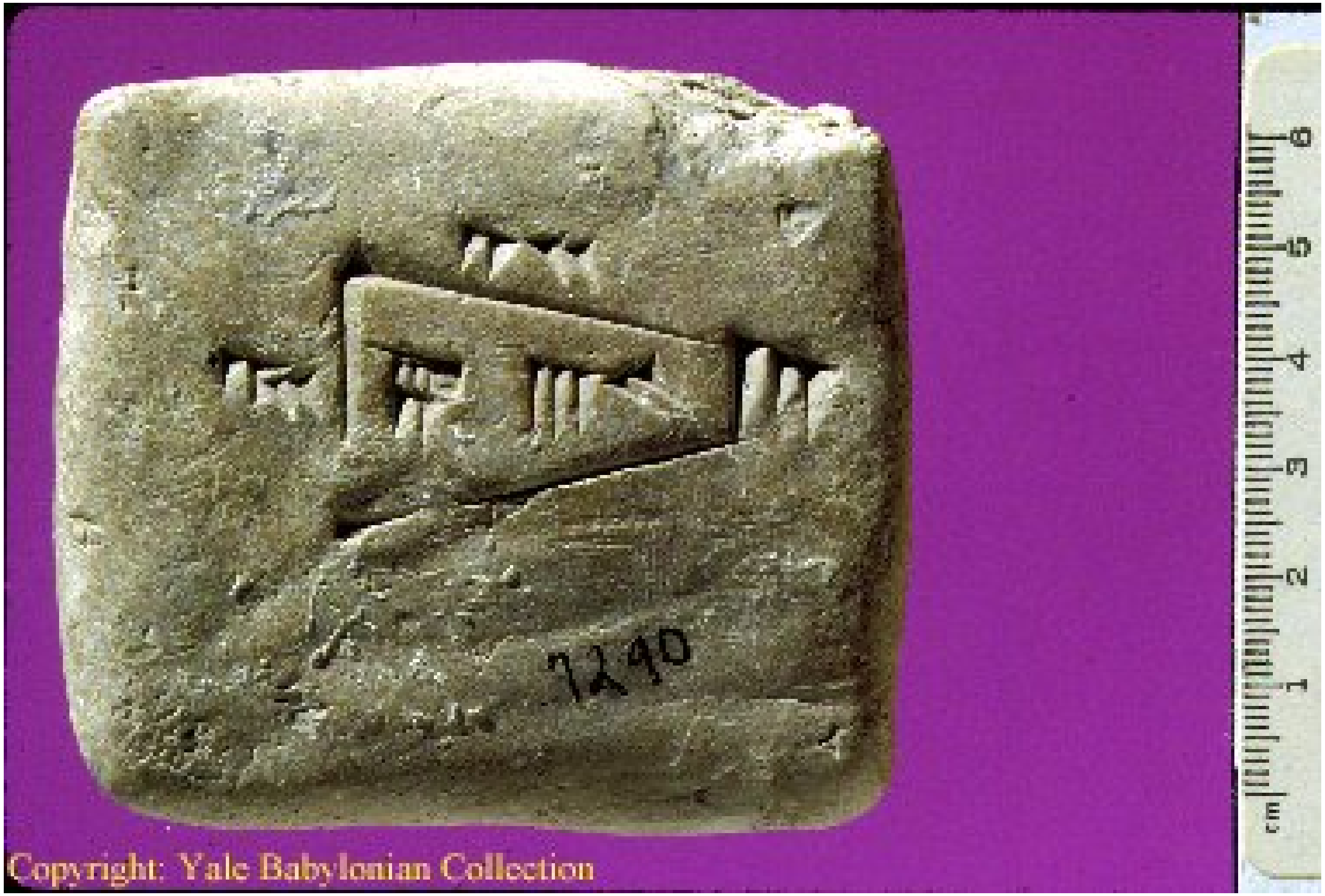
2 37 30 x 30 = 1 18 45

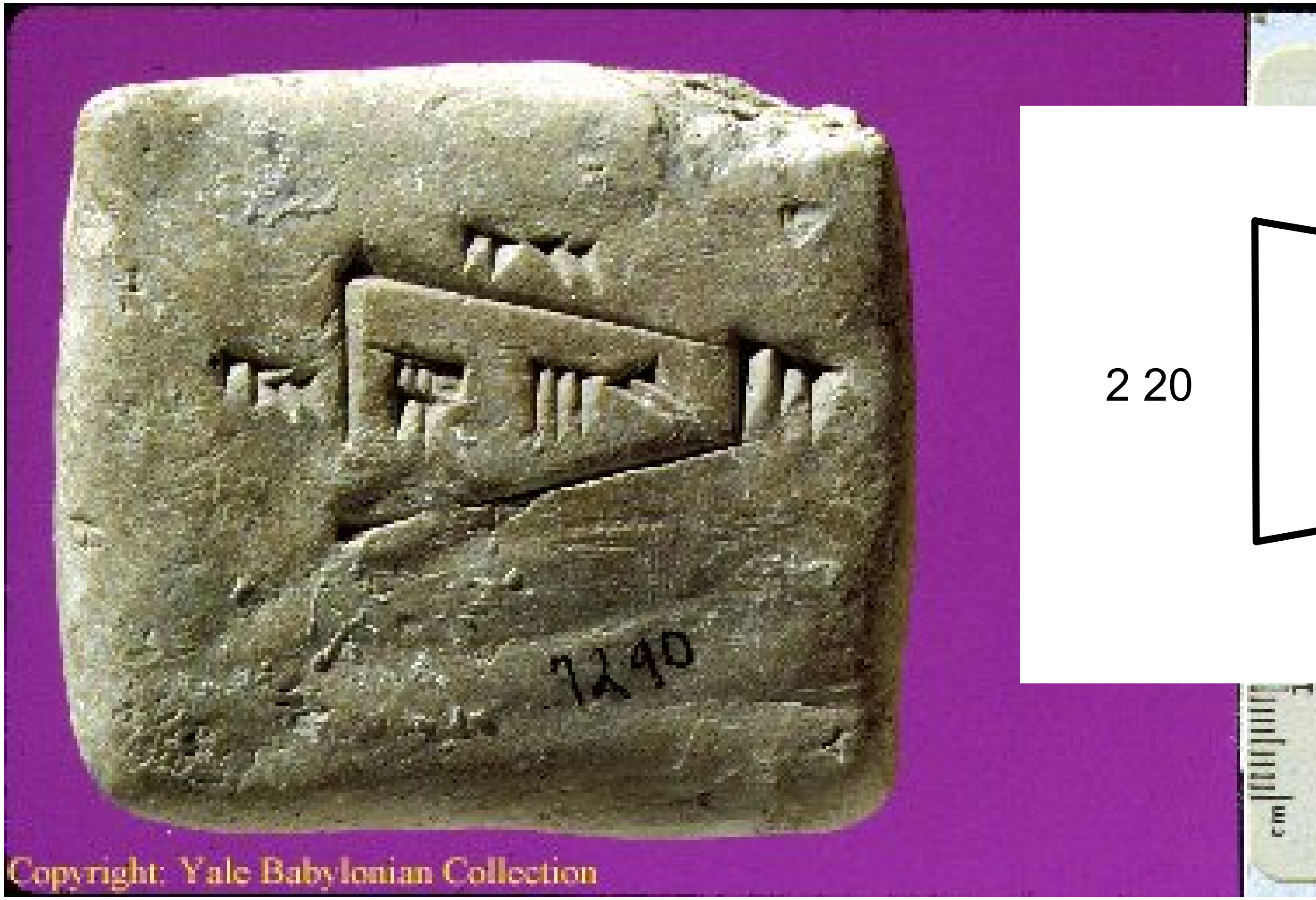
Da fare!

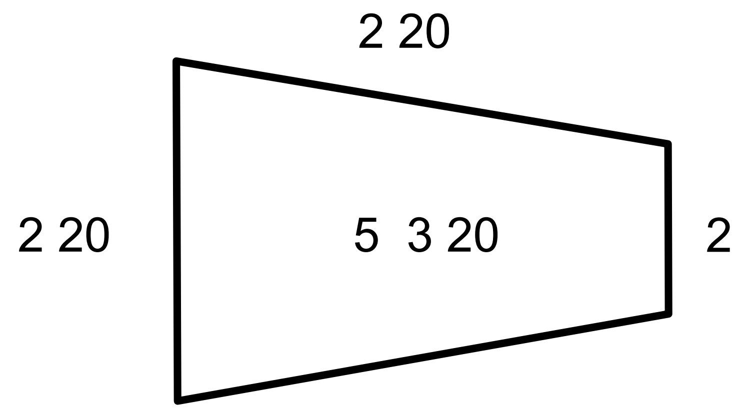




YBC 7240
L'area di un trapezio (2)







Formula del geometra
trapezi isosceli
A = (l1+l2)xl3x30

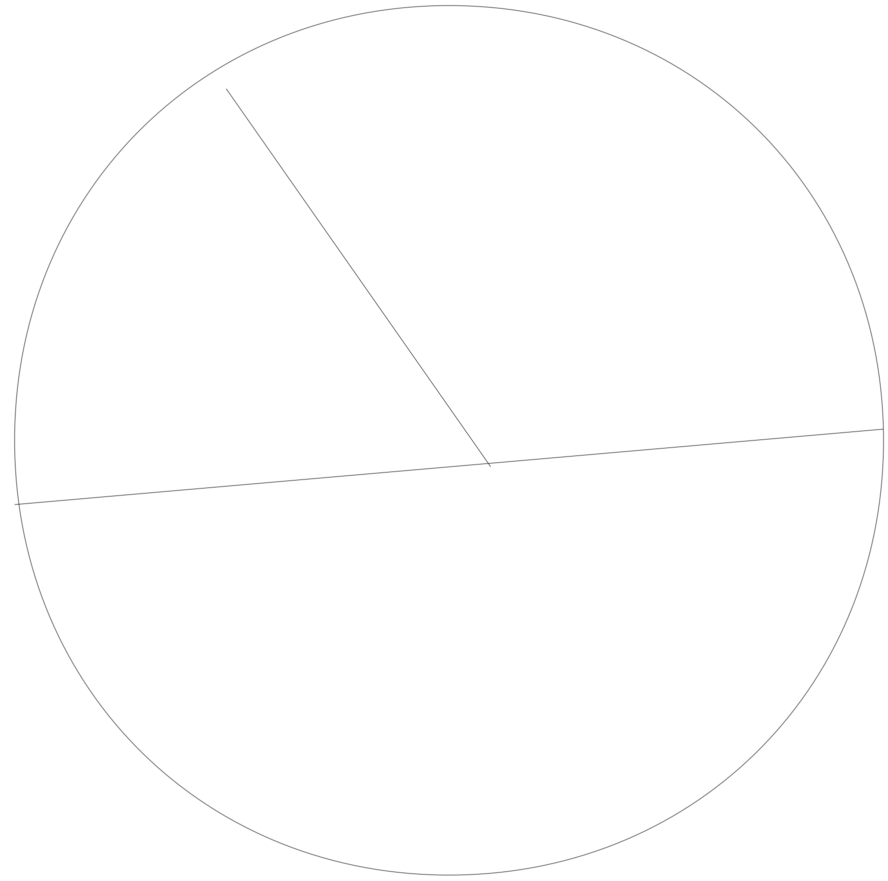
5,3,20 = (2,20+2)x2,20x30.

CIRCONFERENZA e CERCHIO

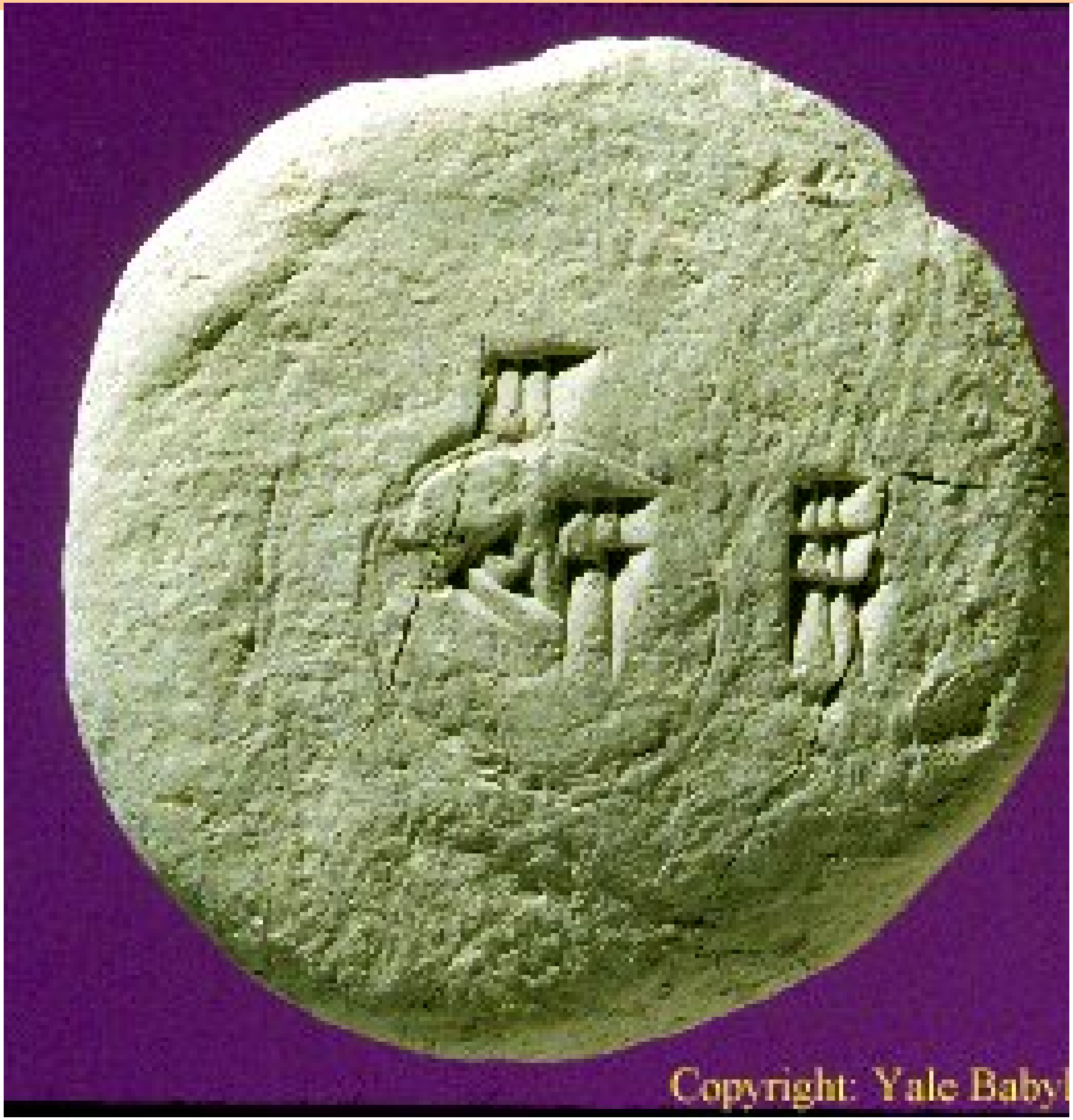
Le “nostre” formule

circonferenza	$c=2\pi r$
diametro	$d=2r$
	$c=\pi d$
area	$A= \pi r^2$

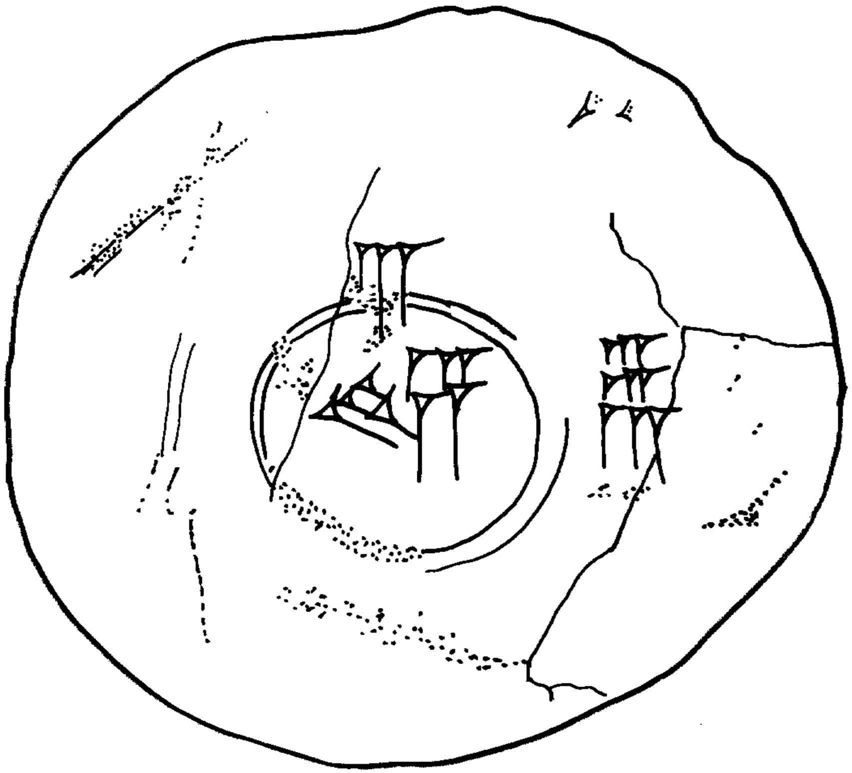
Raggio (o diametro)
misure fondamentali



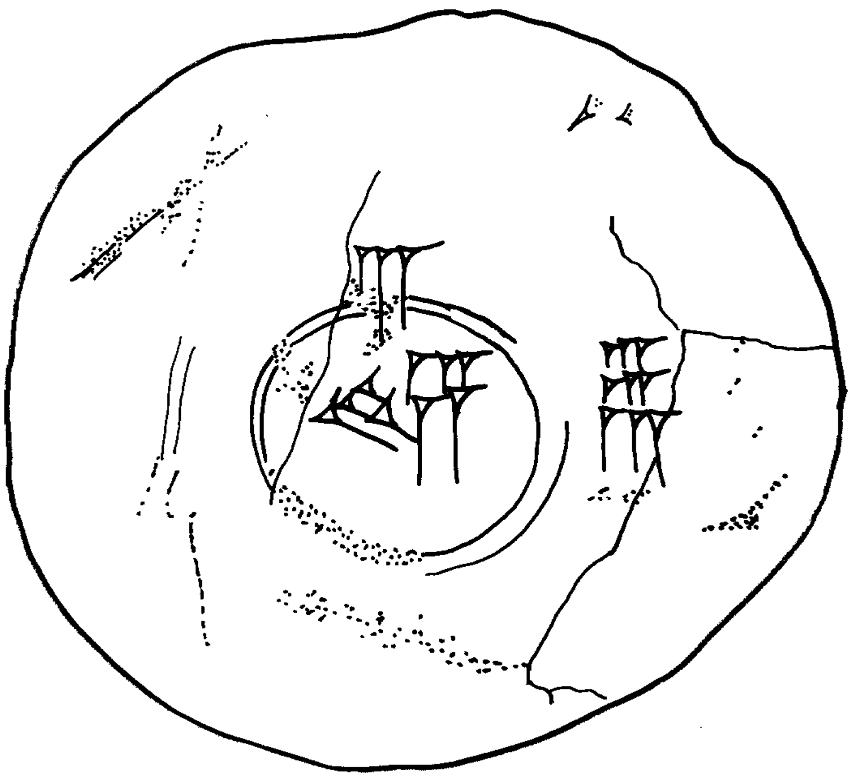
YBC 7302



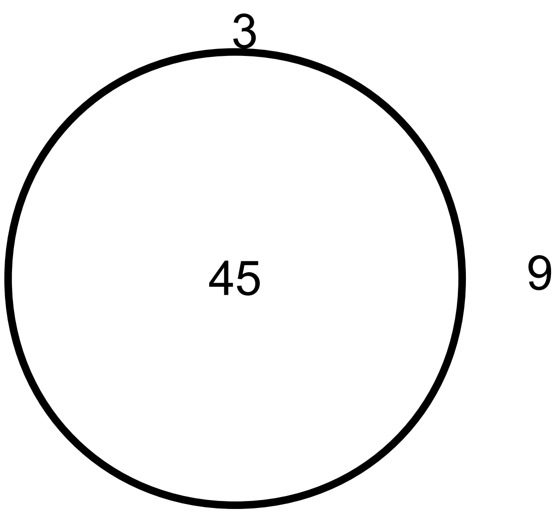
Che numeri?
Che relazione fra loro?



YBC 7302



Che numeri?
Che relazione fra loro?



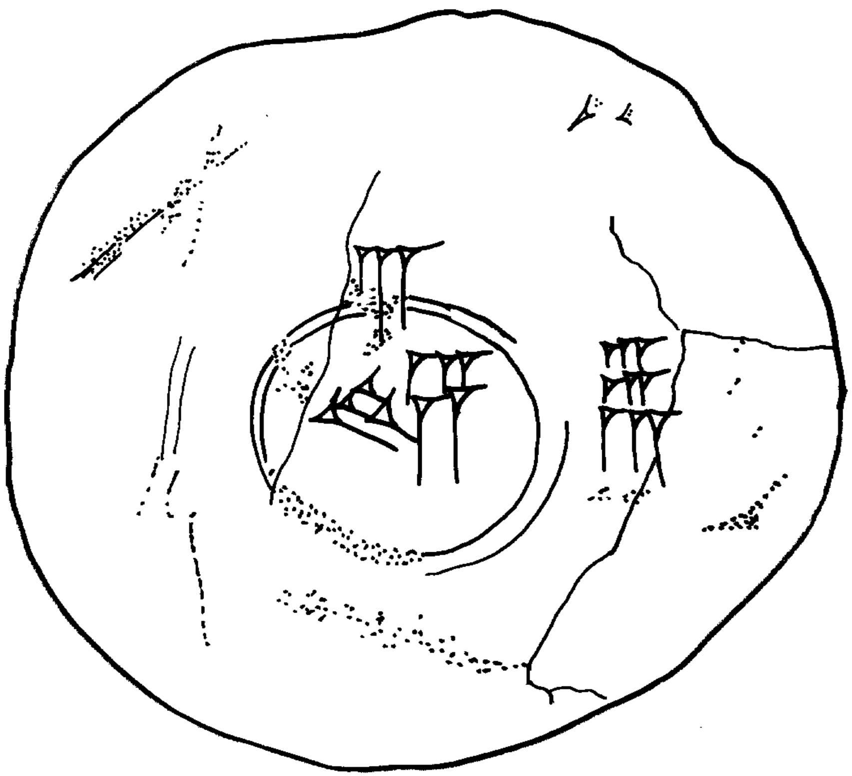
La loro posizione indica il significato:

3 si riferisce al contorno
45 all'"interno"

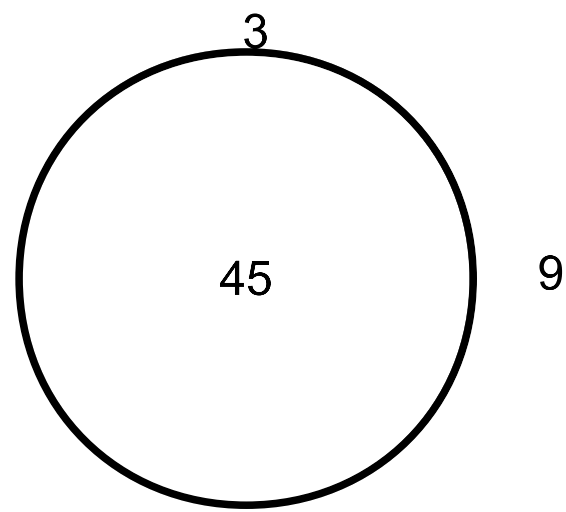
9 = 3 x 3

45 = 9 x 5

YBC 7302



Che numeri?
Che relazione fra loro?



La loro posizione indica il significato:

3 si riferisce al contorno
45 all'"interno"

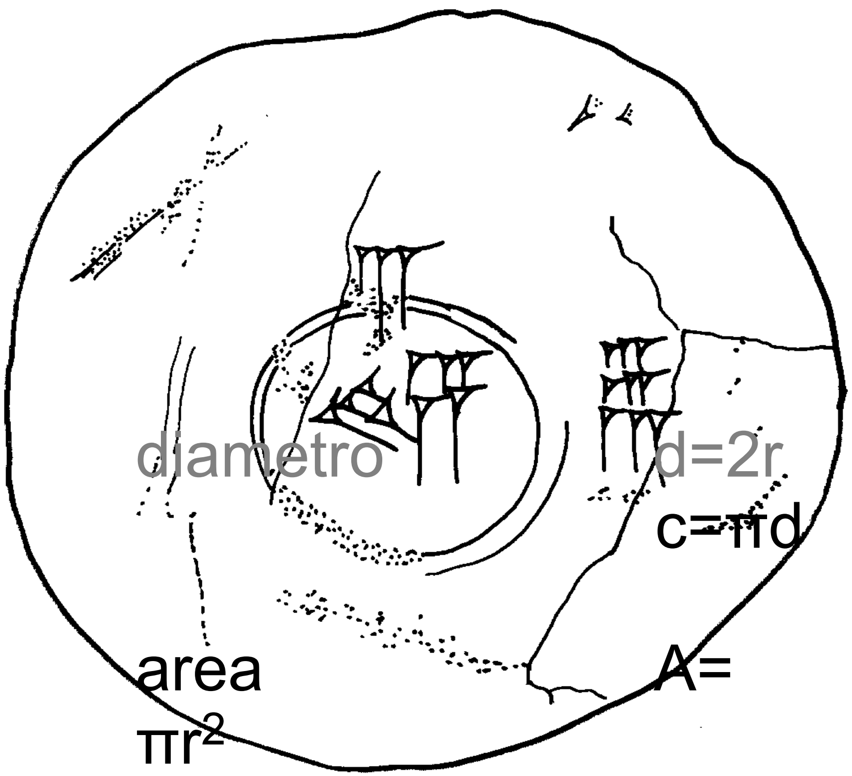
9 = 3 x 3

45 = 9 x 5

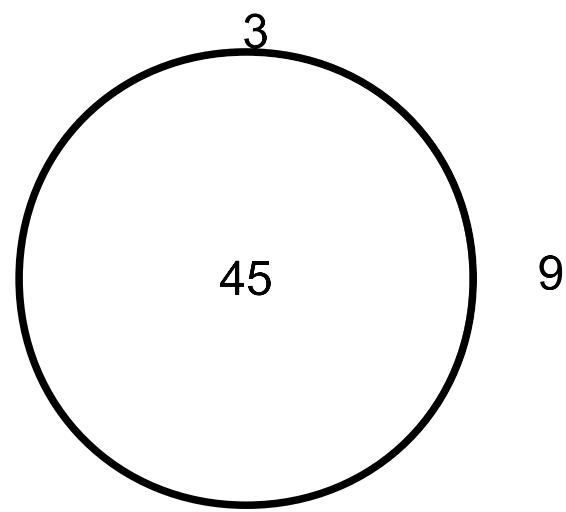
[;45] = [9] x [;5]

9 x 1/12 = 9/12 = 3/4 = 45/60

YBC 7302



Che numeri?
Che relazione fra loro?



Come avremmo fatto noi:

$c=2\pi r \quad r=c/2\pi$

$r= 3/2\pi=3/2\cdot 3{,}14=0{,}4777$

$A= \pi r^2 \quad A=\pi 0{,}4777^2=0{,}71619$

oppure

$A=\pi(c/2\pi)^2=c^2/4\pi=9/4\pi=0{,}71619$

9 = 3 x 3

45 = 9 x 5 [;45] = [9] x [;5]

9 x 1/12 = 9/12 =
3/4 = 45/60
= 0,75

CIRCONFERENZA e CERCHIO

Le “nostre” formule

circonferenza $c=2\pi r$

diametro $d=2r$

$c=\pi d$

area $A= \pi r^2$

$A=c^2/4\pi$

Le formule babilonesi

circonferenza c

area $A=[0; 05] \times c^2$

$A=1/12\ c^2$

diametro $d=c/3$

“contorno” misura fondamentale

molti esempi; l'area è sempre calcolata a partire dalla circonferenza, anche quando si conosce il diametro

la parola “kippatum” (cosa che curva) indica sia il cerchio (“pieno”) che il bordo

CIRCONFERENZA e CERCHIO

Le “nostre” formule

circonferenza	$c=2\pi r$
diametro	$d=2r$
	$c=\pi d$
area	$A= \pi r^2$

Le formule babilonesi

circonferenza	c
area	$A=[0; 05] \times c^2$
	$A= c^2 /12$
	$A= c^2 \cdot 1/12$
diametro	$d=c/3$

La corrispondenza

$$c=2\pi r \rightarrow r=c/2\pi \rightarrow r^2=c^2/4\pi^2$$

$$A= c^2/4\pi$$

$$A= c^2 \cdot 1/4\cdot 3$$

π corrisponde a 3

... qualche altro caso: $\pi \approx 3.1$

CIRCONFERENZA e CERCHIO

Un triangolo equilatero inscritto in un cerchio

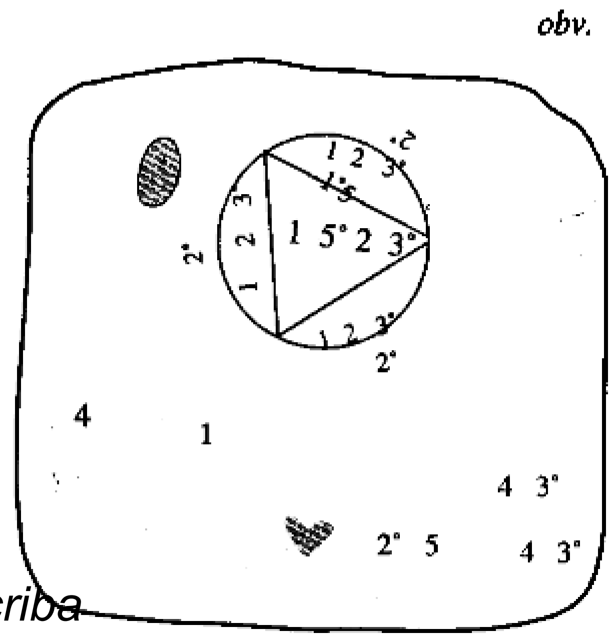
Problema più avanzato
figura estremamente precisa

Friberg p. 207

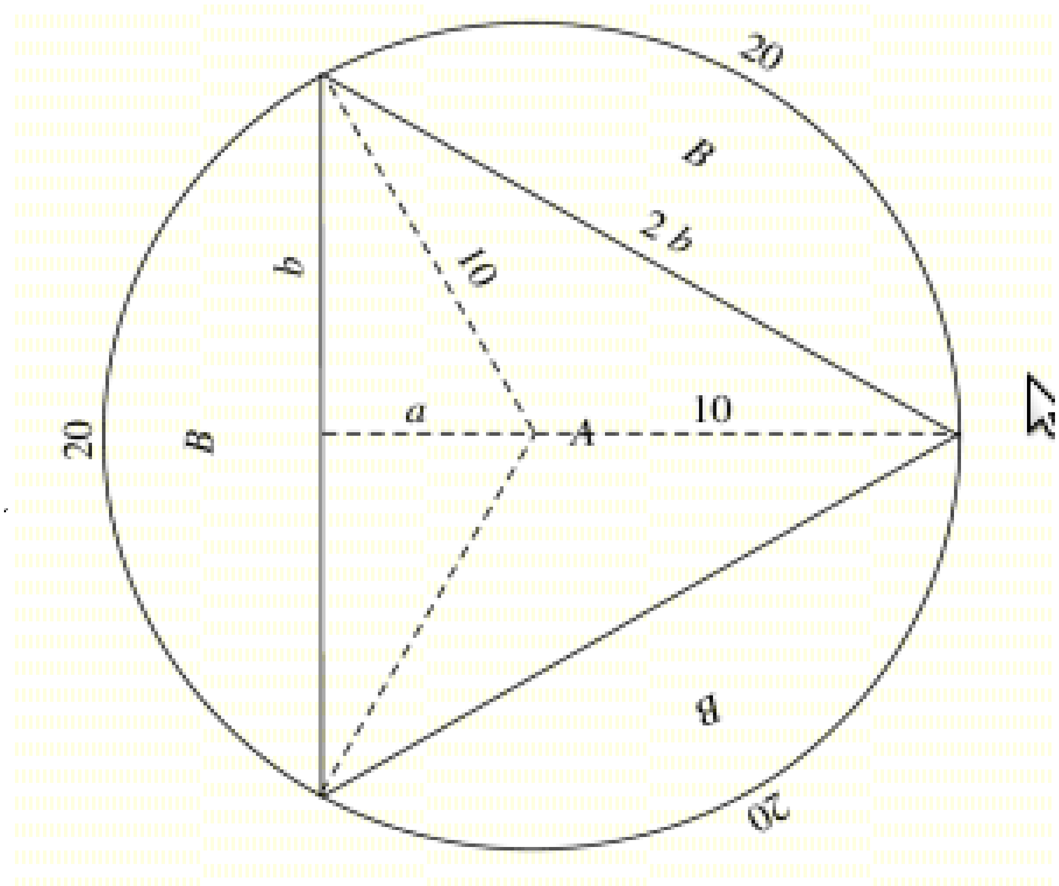
CIRCONFERENZA e CERCHIO

Un triangolo equilatero inscritto in un cerchio

Problema più avanzato
figura estremamente precisa



I calcoli dello scriba



la circonferenza è c=1 00 (ninda)
ciascun arco è 20 (ninda) 20/60=1/3
il diametro è d=c/3 quindi 20, il raggio 10
l'area del cerchio $C=1/12\ c^2 = 0;\ 05\ c^2 = 5\ 00$

Come ha ottenuto l'area dei segmenti circolari?

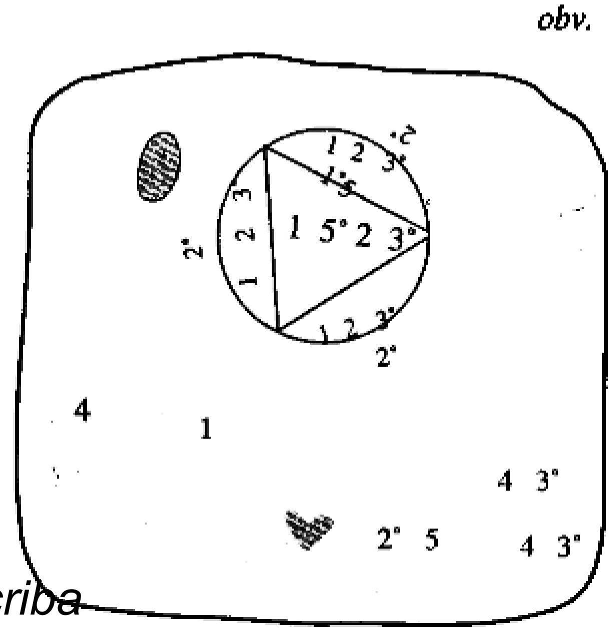
B = (C-A) : 3 = (5 00 – 1 52;30): 3= 1 02;30

l'area del triangolo A?
L'area dei segmenti circolari B?

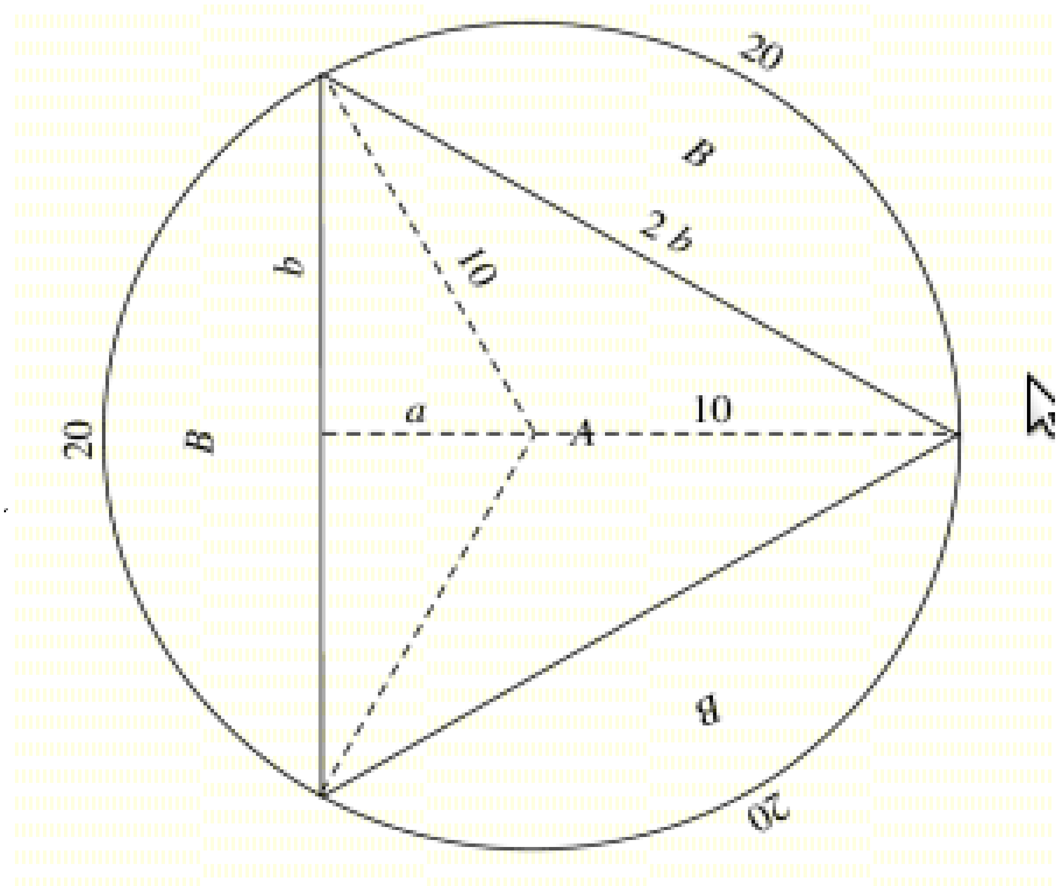
CIRCONFERENZA e CERCHIO

Un triangolo equilatero inscritto in un cerchio

Problema più avanzato
figura estremamente precisa



I calcoli dello scriba



la circonferenza è c=1 00 (ninda)
ciascun arco è 20 (ninda)   20/60=1/3
il diametro è d=c/3 quindi 20, il raggio 10
l'area del cerchio C=1/12 c^2 = 0; 05 c^2 =5 00

l'area del triangolo A?
L'area dei segmenti circolari B?

Come ha ottenuto l'area del triangolo?

1 52 30 si ottiene come 15 x 15 /2
Errore!
h=r+a=10+5=15
Ma non trova b!
Prende la base del triangolo uguale all'altezza!

b:a=(a+r):b
b:5=15:b

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

recto

verso

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

recto

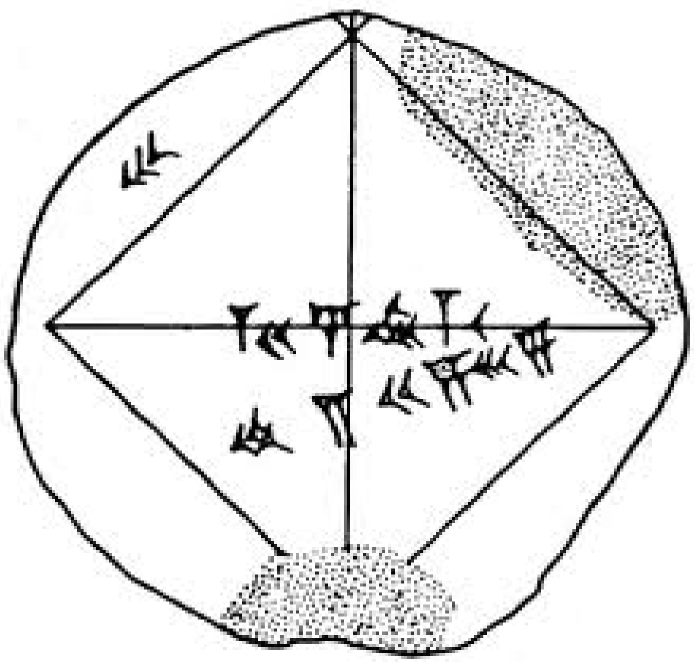
La prima testimonianza nota relativa al teorema di Pitagora

databile tra il 1800 e il 1600 a. C. (periodo paleobabilonese)

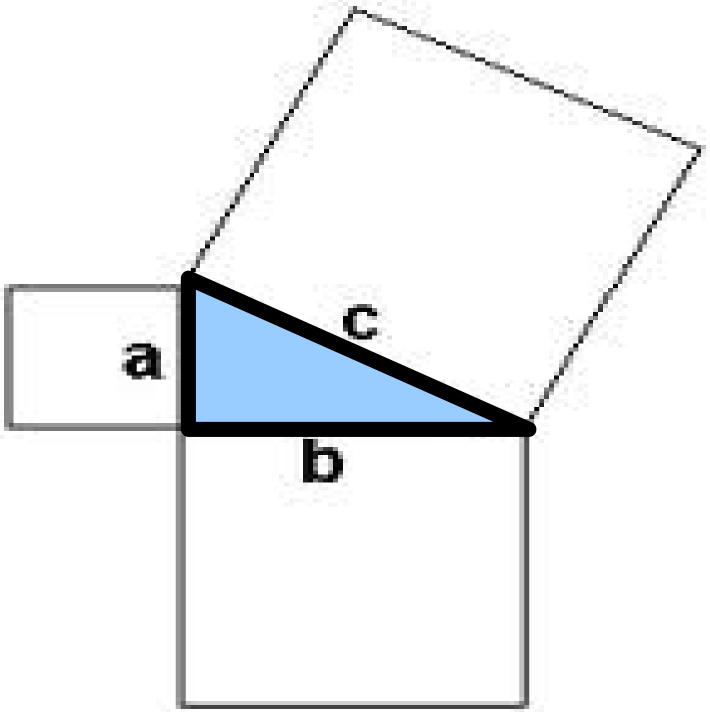
Mesopotamia meridionale

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289



Teorema di Pitagora

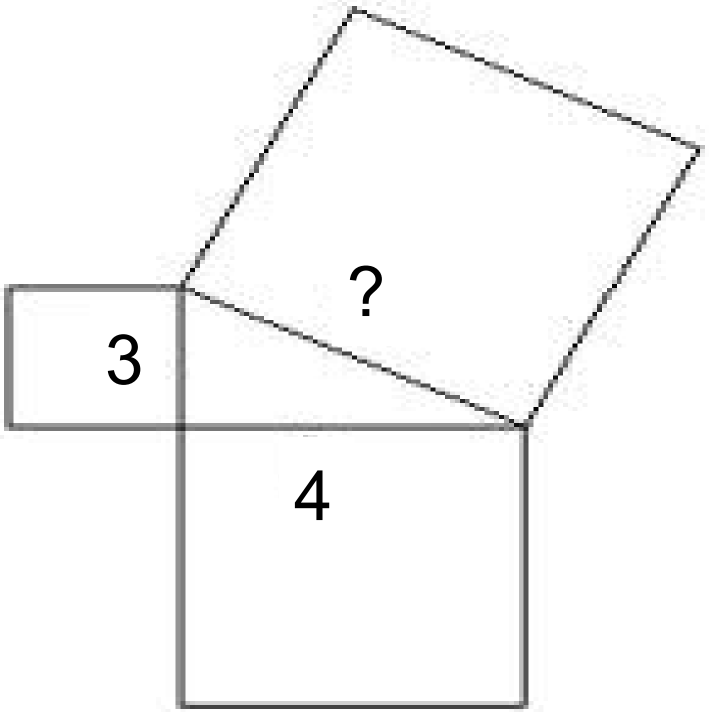


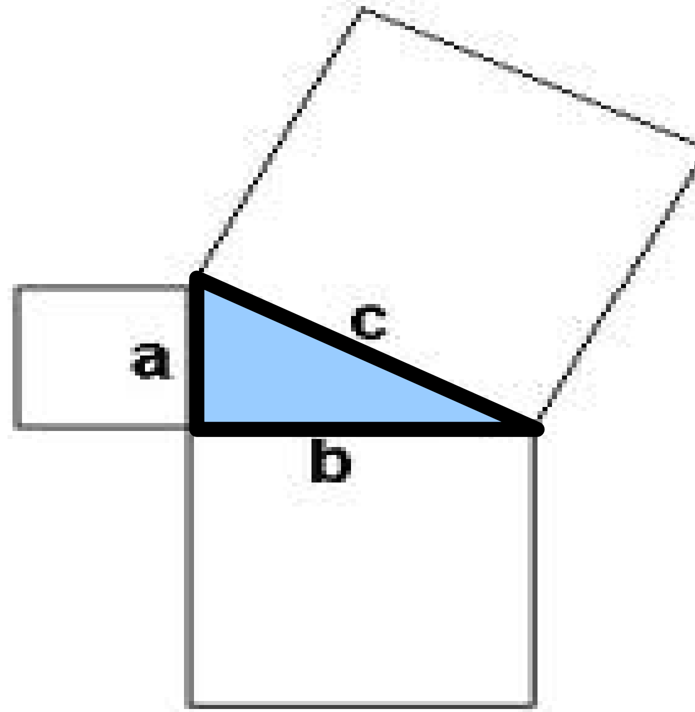
$$a^2+b^2=c^2$$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Teorema di Pitagora





$3^2+4^2=c^2$

$9+16=25$

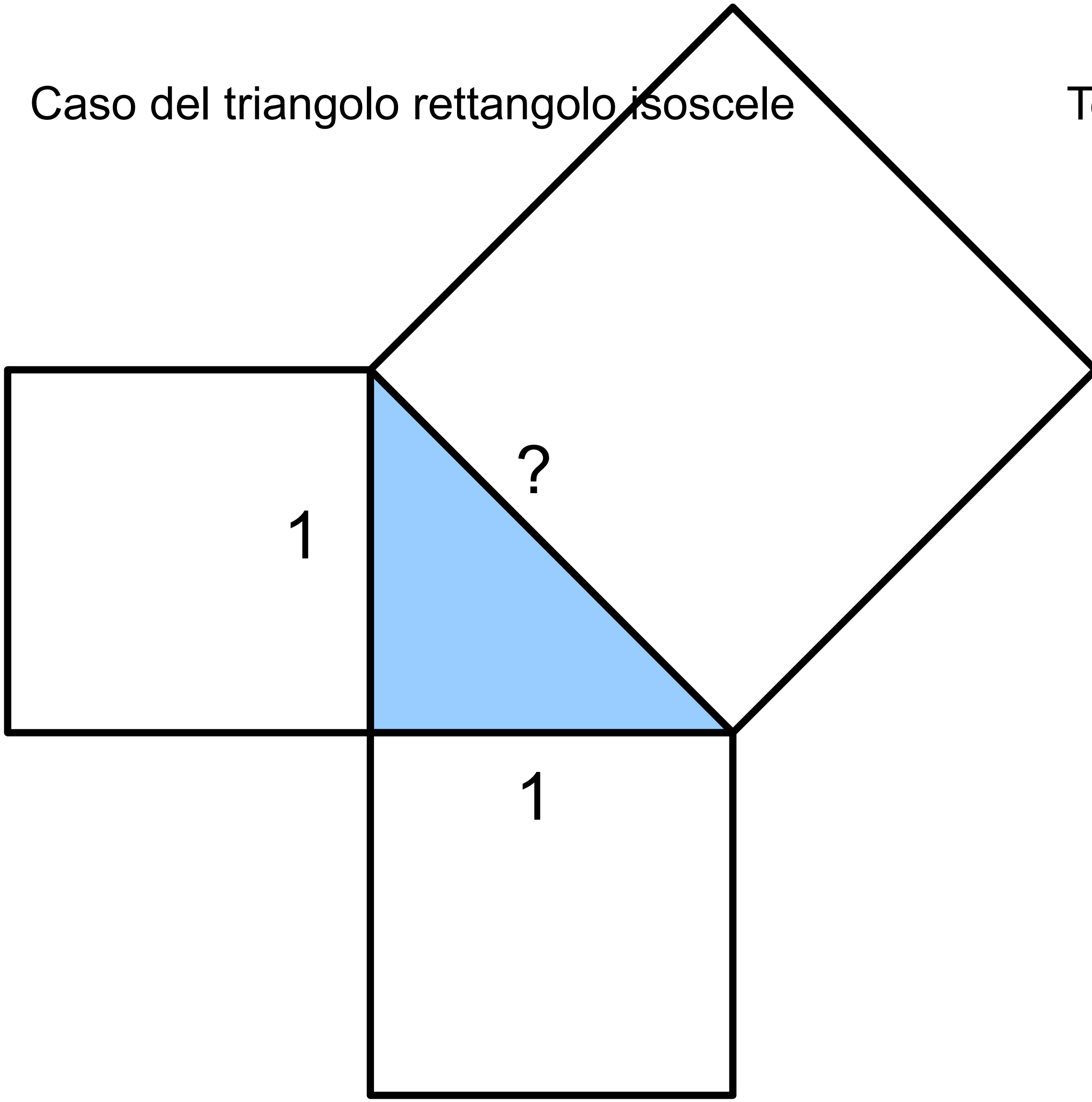
$c^2=25$ $c=5$

$a^2+b^2=c^2$

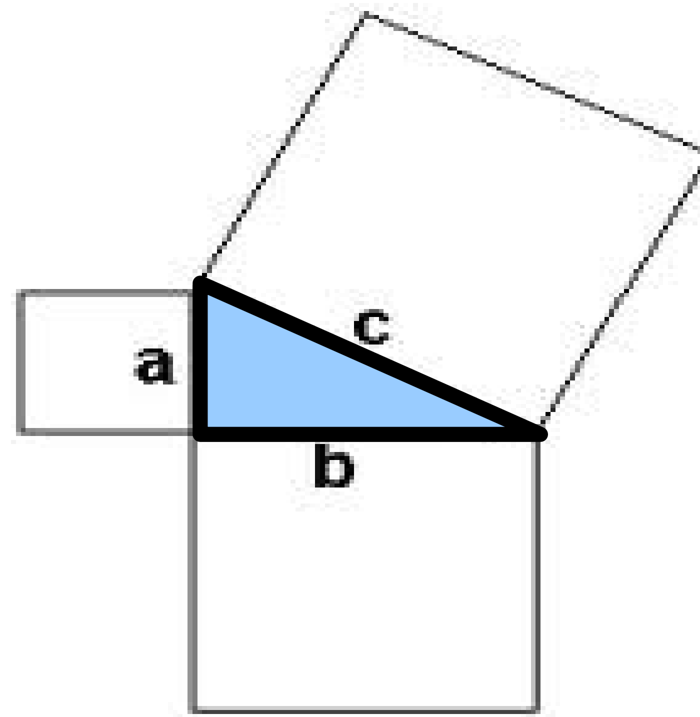
DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Caso del triangolo rettangolo isoscele



Teorema di Pitagora

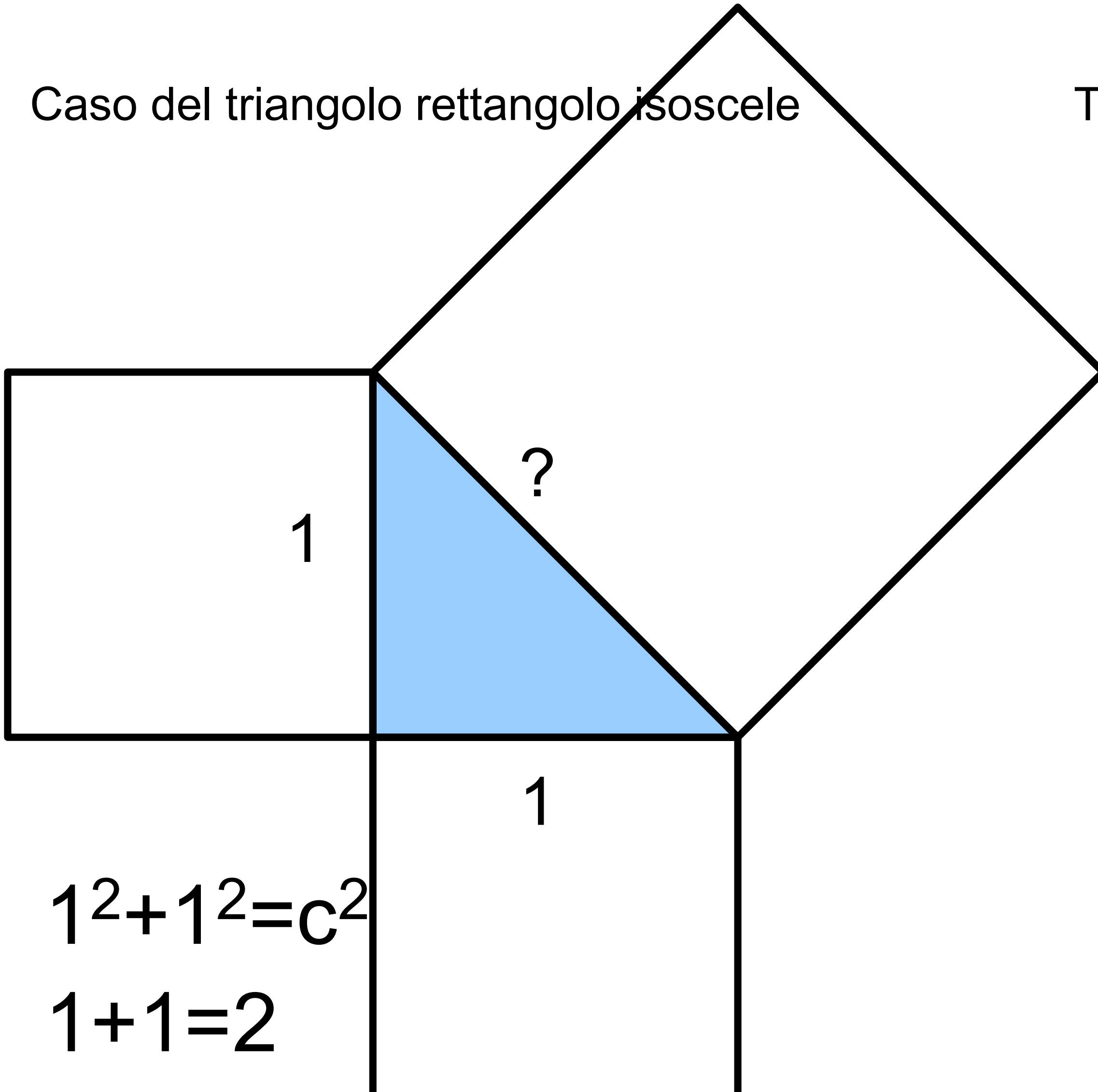


$$a^2+b^2=c^2$$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Caso del triangolo rettangolo isoscele

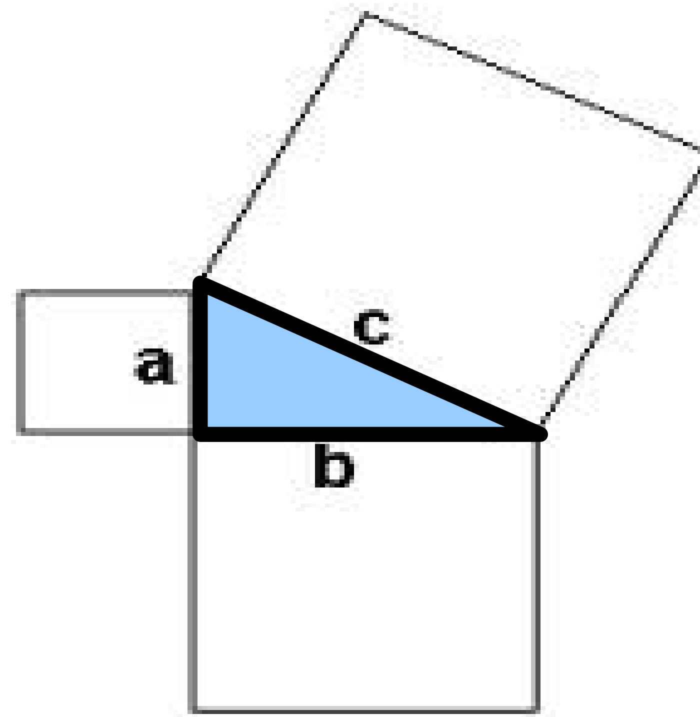


$1^2+1^2=c^2$

$1+1=2$

$c^2=2$ $\quad$ $c=?$

Teorema di Pitagora

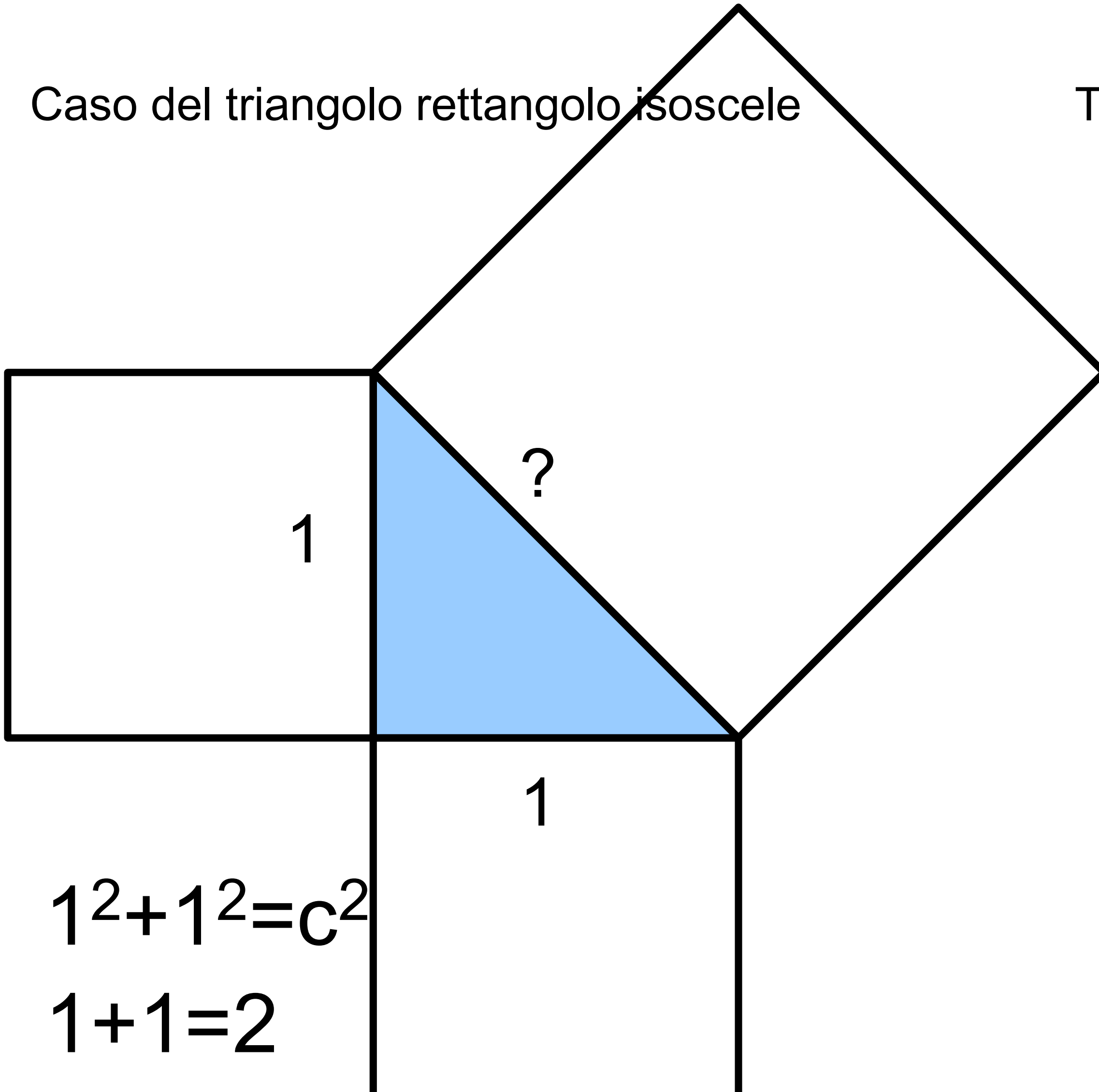


$a^2+b^2=c^2$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Caso del triangolo rettangolo isoscele

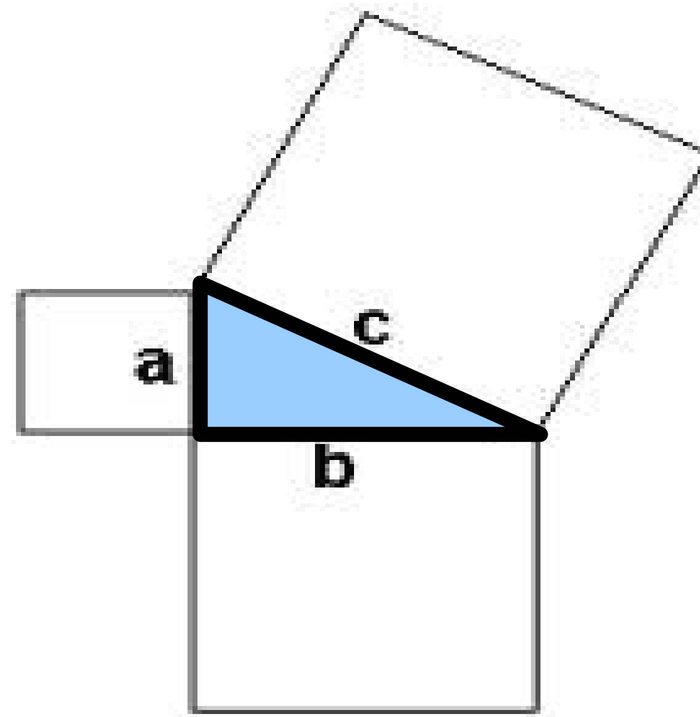


$1^2+1^2=c^2$

$1+1=2$

$c^2=2$

Teorema di Pitagora



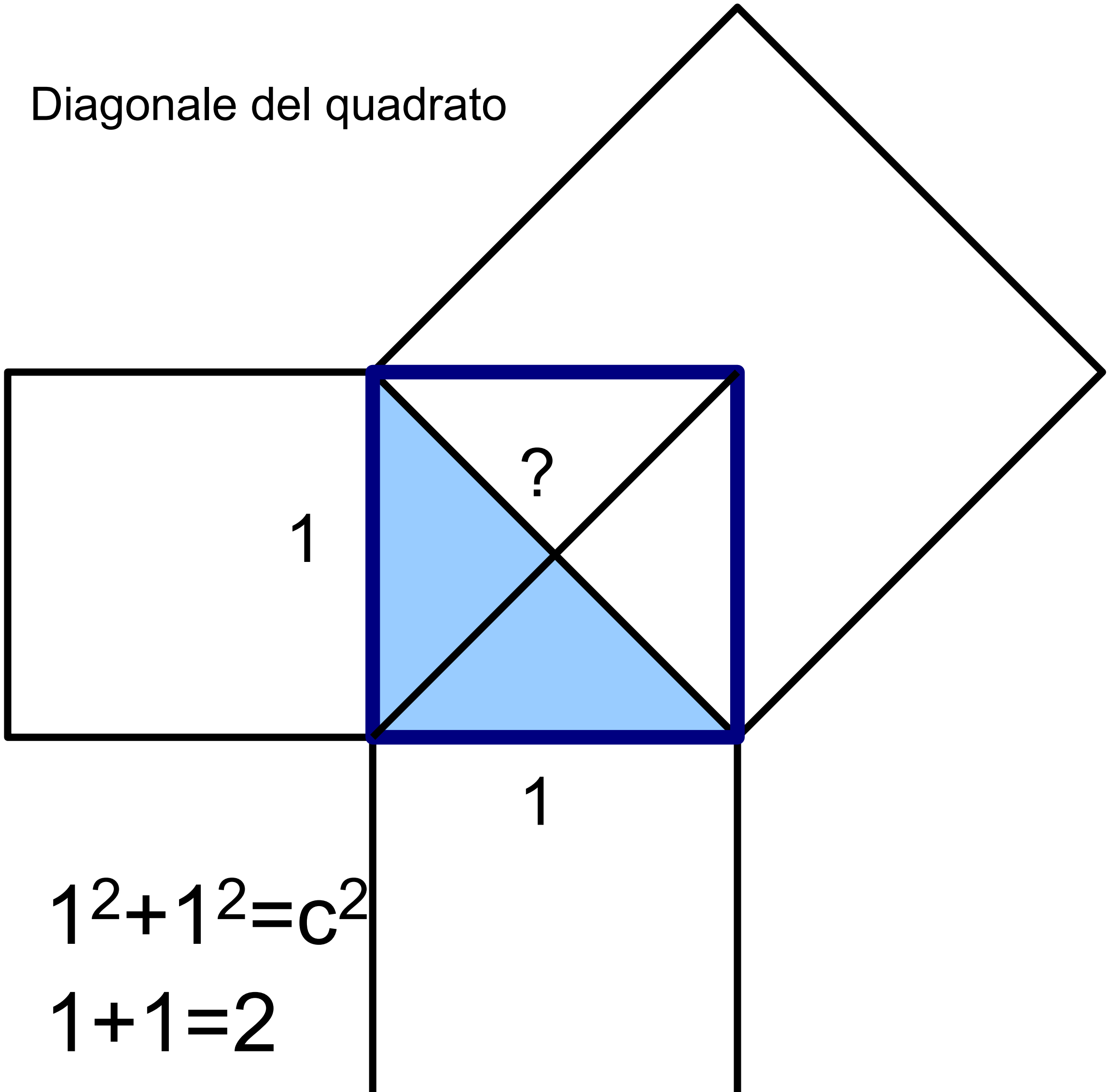
$a^2+b^2=c^2$

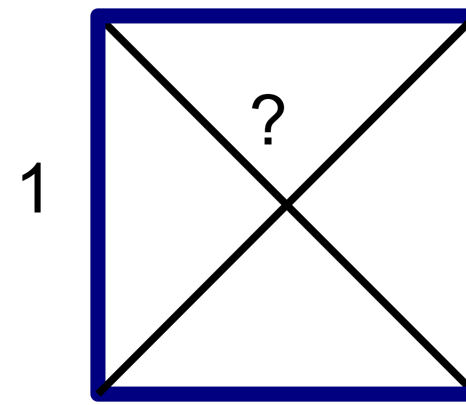
$C=\sqrt{2} = 1,41421356237309504801...$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Diagonale del quadrato





$1^2+1^2=c^2$

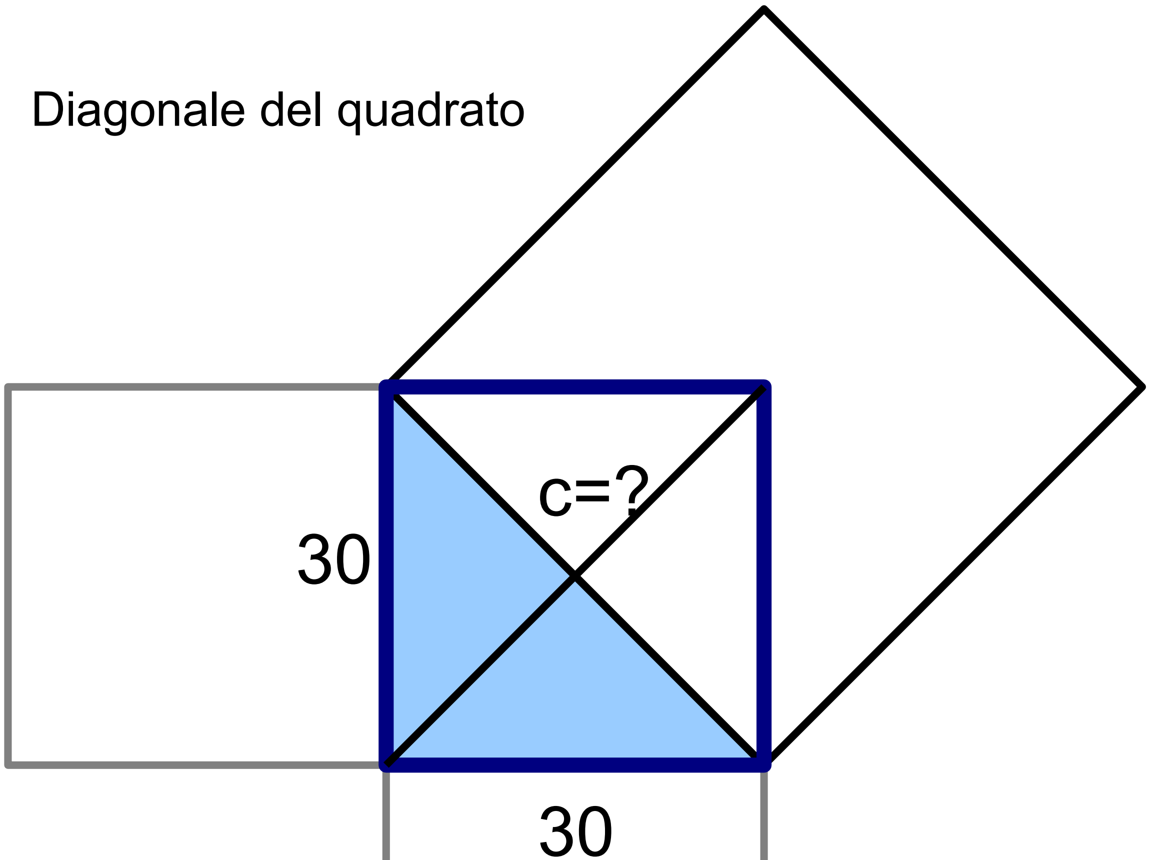
$1+1=2$

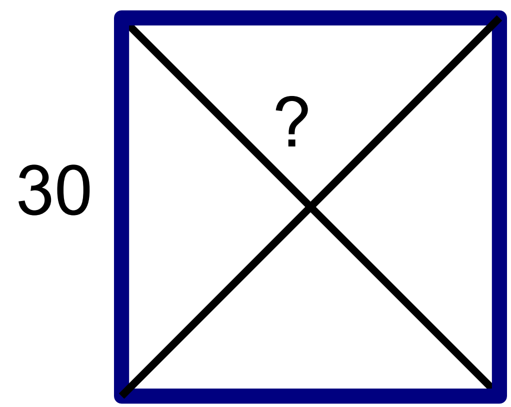
$c^2=2$ $\qquad$ $C=\sqrt{2} = 1,\ 414213562373095048801...$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289

Diagonale del quadrato





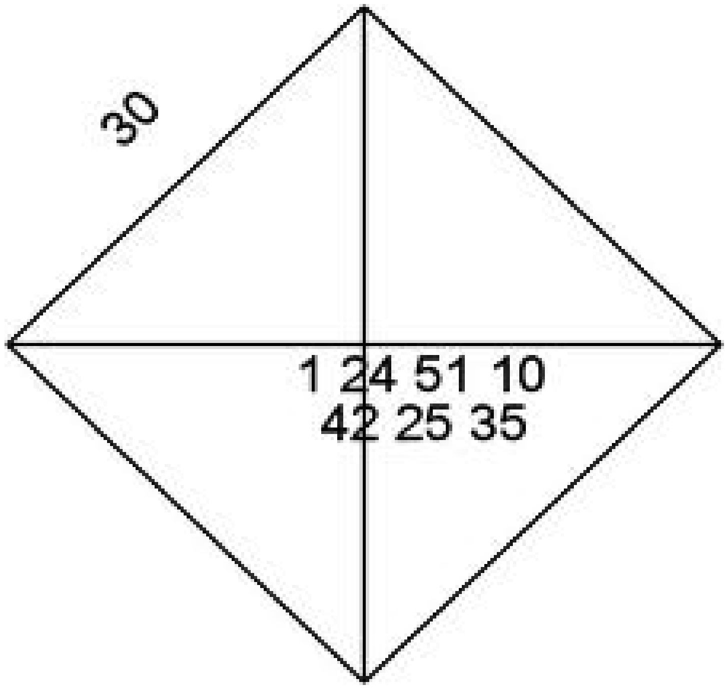
$$30^2+30^2=c^2$$

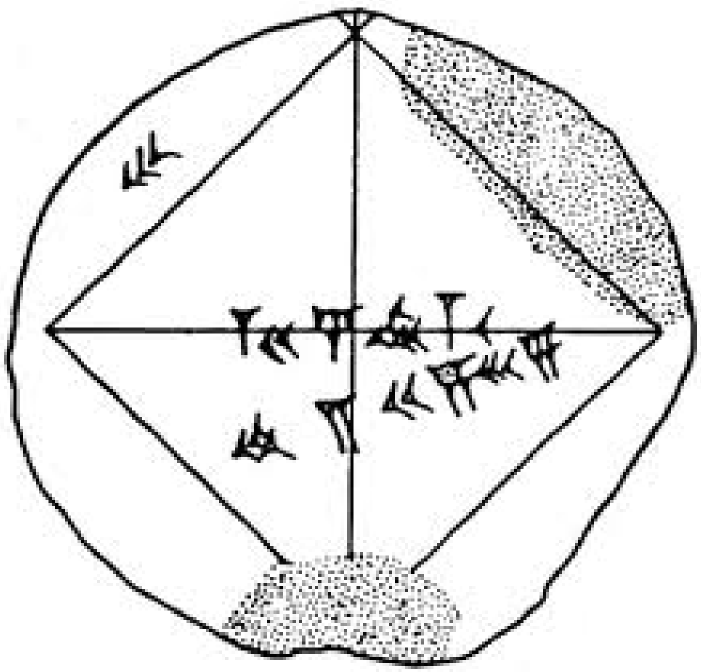
$$c=\sqrt{900+900}=\sqrt{900x2}=\sqrt{1800} = 42,42639 \ldots$$

$$=\sqrt{900}x\sqrt{2}=30x\sqrt{2}= 42,42639 \ldots$$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289





1;24,51,10,

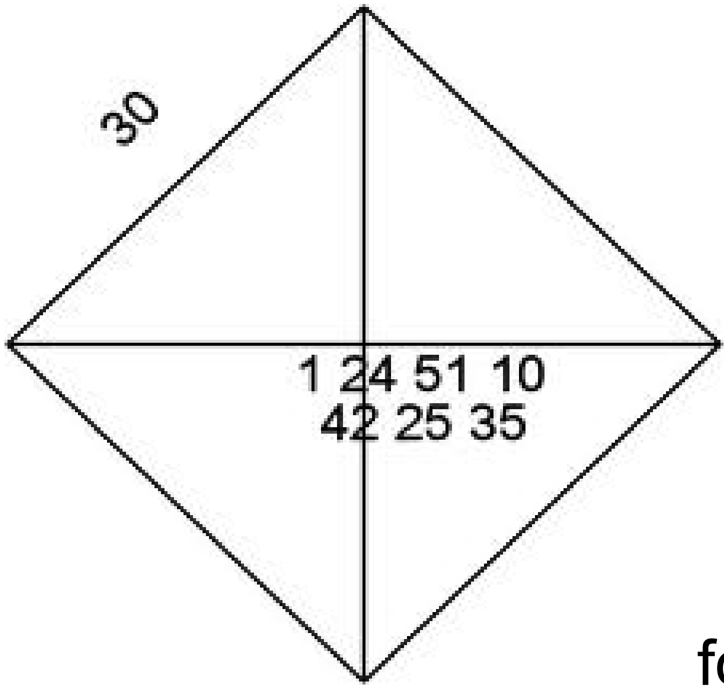
42;25,35,

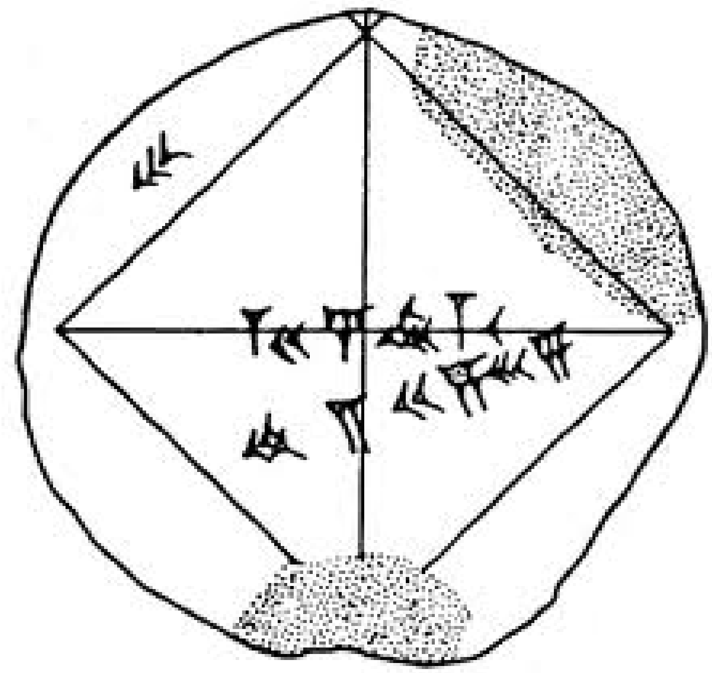
30

Che relazione tra questi numeri?

1;24,51,10 x 30 = 42;25,35

Yale Babylonian Collection YBC 7289





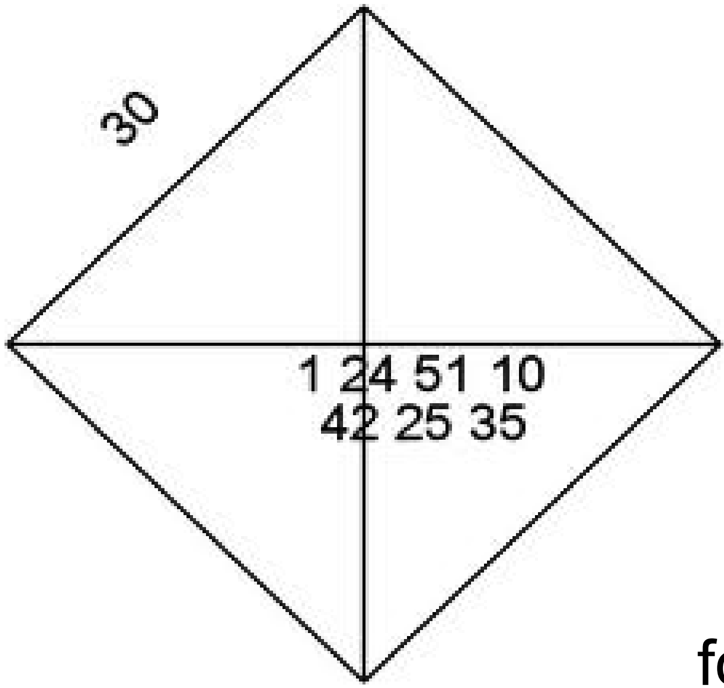
forma decimale

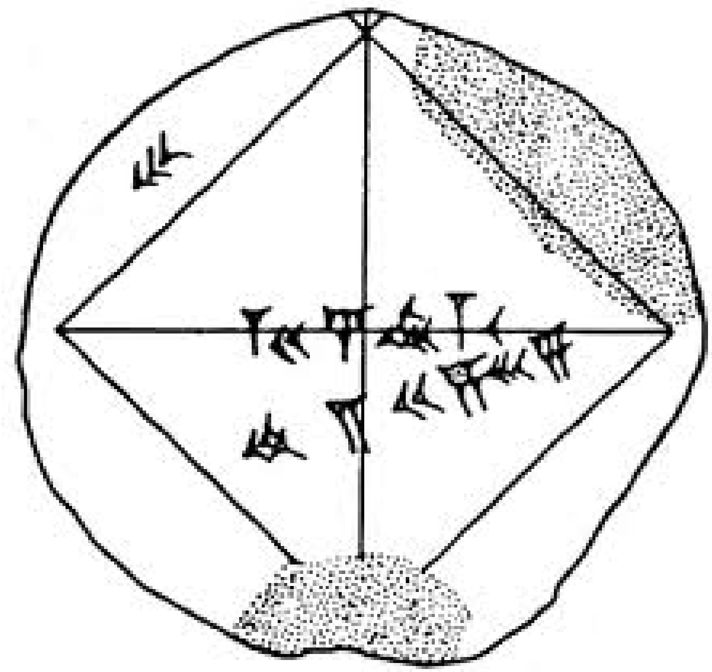
1;24,51,10, $1+24/60+51/60^2+10/60^3$

42;25,35, $42+25/60+35/60^2$

DIAGONALI E TEOREMA DI PITAGORA?

Yale Babylonian Collection YBC 7289





forma decimale

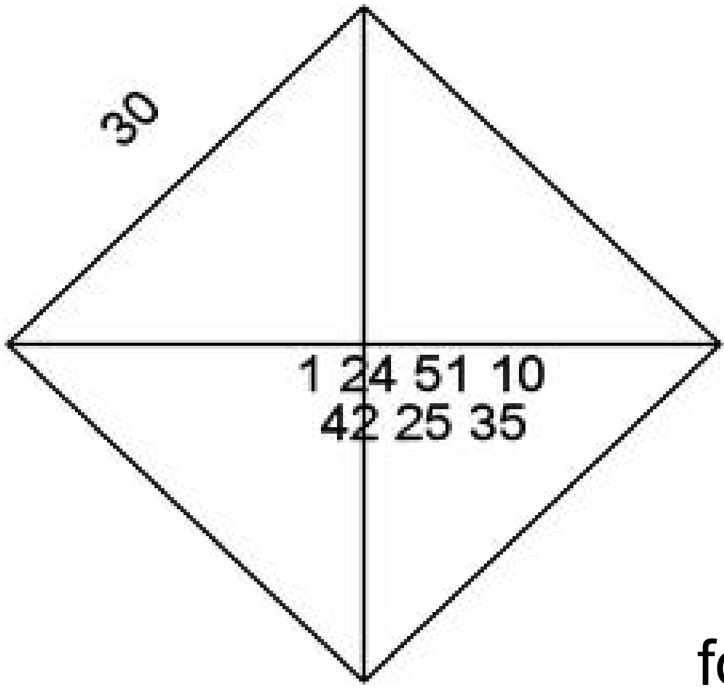
1;24,51,10, $1+24/60+51/60^2+10/60^3$ 1,414213

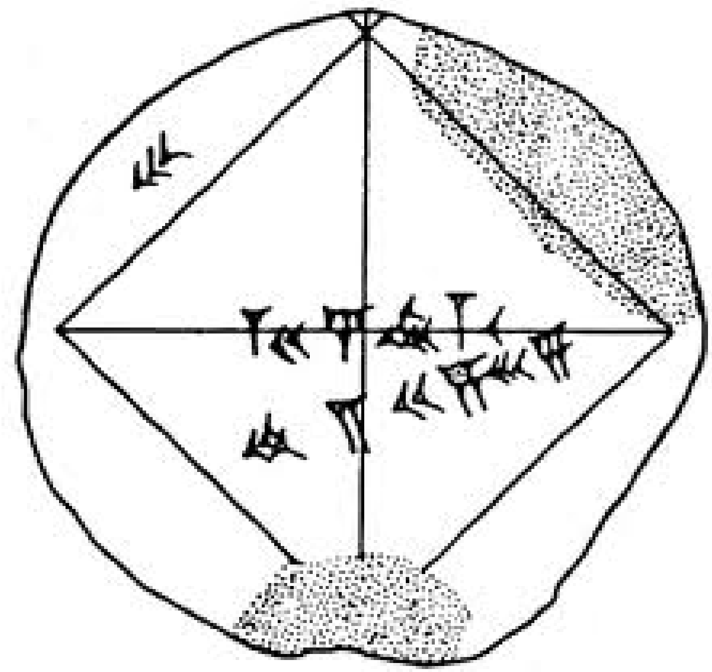
42;25,35, $42+25/60+35/60^2$ 42,42639

Il primo è un’ottima approssimazione della radice di 2;

il secondo è la diagonale del quadrato di lato 30, ed è uguale al prodotto di 30 per il primo numero.

Yale Babylonian Collection YBC 7289





	forma decimale	
1;24,51,10,	$1+24/60+51/60^2+10/60^3$	1,414213
42;25,35,	$42+25/60+35/60^2$	42,42639

conoscenza del teorema di Pitagora, almeno nel caso del triangolo con i cateti uguali ?

Questa tavoletta da sola non dimostra che i Babilonesi conoscessero il “teorema di Pitagora” nella sua generalità, ma esistono altre tavolette ...

Plimpton 322 (1800 a.C. circa)

Plimpton 322 (1800 a.C. circa)

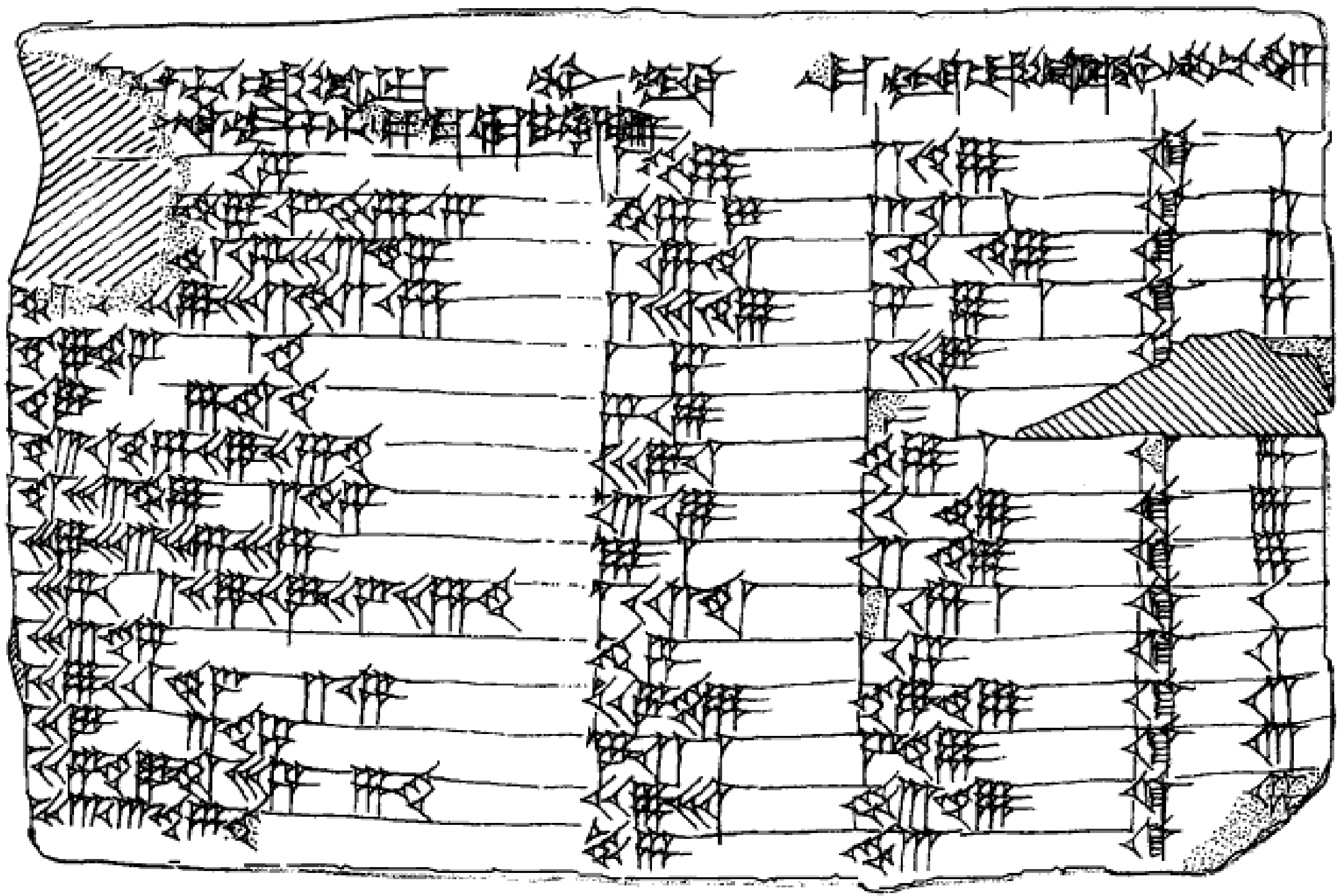


Figure 1. Plimpton 322 (obverse). Drawing by the author.

tabella
quattro colonne di numeri
quindici righe

quarta colonna:
lista di numeri da 1 a 15

seconda e terza colonna
sono completamente visibili

angolo della prima colonna
scheggiato

Plimpton 322 (1800 a.C. circa)

(1:)59:00:15	1:59	2:49	1
(1:)56:56:58:14:50:06:15	56:07	1:20:25	2
(1:)55:07:41:15:33:45	1:16:41	1:50:49	3
(1:)53:10:29:32:52:16	3:31:49	5:09:01	4
(1:)48:54:01:40	1:05	1:37	5
(1:)47:06:41:40	5:19	8:01	6
(1:)43:11:56:28:26:40	38:11	59:01	7
(1:)41:33:45:14:03:45	13:19	20:49	8
(1:)38:33:36:36	8:01	12:49	9
(1:)35:10:02:28:27:24:26	1:22:41	2:16:01	10
(1:)33:45	45	1:15	11
(1:)29:21:54:02:15	27:59	48:49	12
(1:)27:00:03:45	2:41	4:49	13
(1:)25:48:51:35:06:40	29:31	53:49	14
(1:)23:13:46:40	56	1:46	15

tabella
quattro colonne di numeri
quindici righe

quarta colonna:
lista di numeri da 1 a 15

seconda e terza colonna
sono completamente visibili

angolo della prima colonna
scheggiato

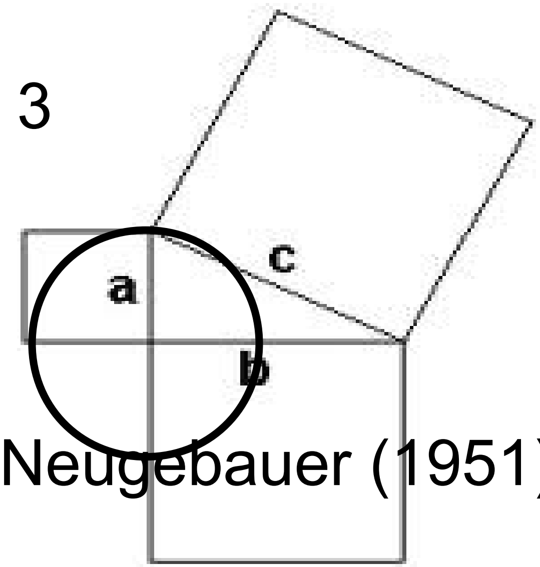
Plimpton 322 (1800 a.C. circa)

colonna 1 b^2/a^2	col. 2 b	col.3 c	
(1:)59:00:15	1:59	2:49	1
(1:)56:56:58:14:50:06:15	56:07	1:20:25	2
(1:)55:07:41:15:33:45	1:16:41	1:50:49	3
(1:)53:10:29:32:52:16	3:31:49	5:09:01	4
(1:)48:54:01:40	1:05	1:37	5
(1:)47:06:41:40	5:19	8:01	6
(1:)43:11:56:28:26:40	38:11	59:01	7
(1:)41:33:45:14:03:45	13:19	20:49	8
(1:)38:33:36:36	8:01	12:49	9
(1:)35:10:02:28:27:24:26	1:22:41	2:16:01	10
(1:)33:45	45	1:15	11
(1:)29:21:54:02:15	27:59	48:49	12
(1:)27:00:03:45	2:41	4:49	13
(1:)25:48:51:35:06:40	29:31	53:49	14
(1:)23:13:46:40	56	1:46	15

Interpretazioni

terne pitagoriche,
terne di numeri interi
$a^2+b^2=c^2$

colonna 1
b^2/a^2
colonna 2
b
colonna 3
c



Neugebauer (1951)

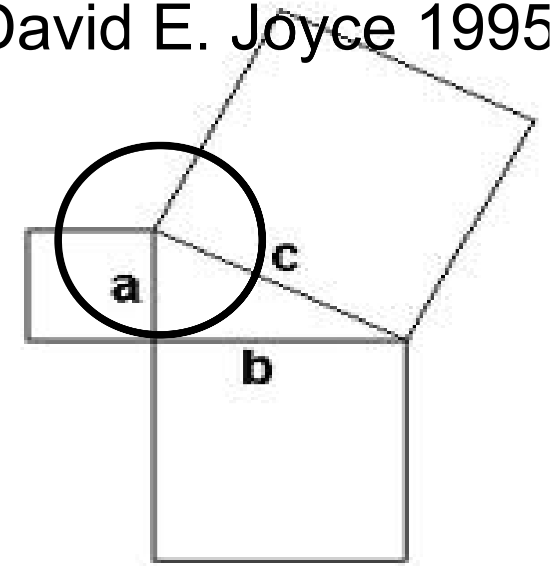
Plimpton 322 (1800 a.C. circa)

colonna 1 b^2/a^2	col. 2 b	col.3 c	
(1:)59:00:15	1:59	2:49	1
(1:)56:56:58:14:50:06:15	56:07	1:20:25	2
(1:)55:07:41:15:33:45	1:16:41	1:50:49	3
(1:)53:10:29:32:52:16	3:31:49	5:09:01	4
(1:)48:54:01:40	1:05	1:37	5
(1:)47:06:41:40	5:19	8:01	6
(1:)43:11:56:28:26:40	38:11	59:01	7
(1:)41:33:45:14:03:45	13:19	20:49	8
(1:)38:33:36:36	8:01	12:49	9
(1:)35:10:02:28:27:24:26	1:22:41	2:16:01	10
(1:)33:45	45	1:15	11
(1:)29:21:54:02:15	27:59	48:49	12
(1:)27:00:03:45	2:41	4:49	13
(1:)25:48:51:35:06:40	29:31	53:49	14
(1:)23:13:46:40	56	1:46	15

Interpretazioni

tavola trigonometrica di quadrati di cosecanti che vanno da 45° fino a 30°

David E. Joyce 1995

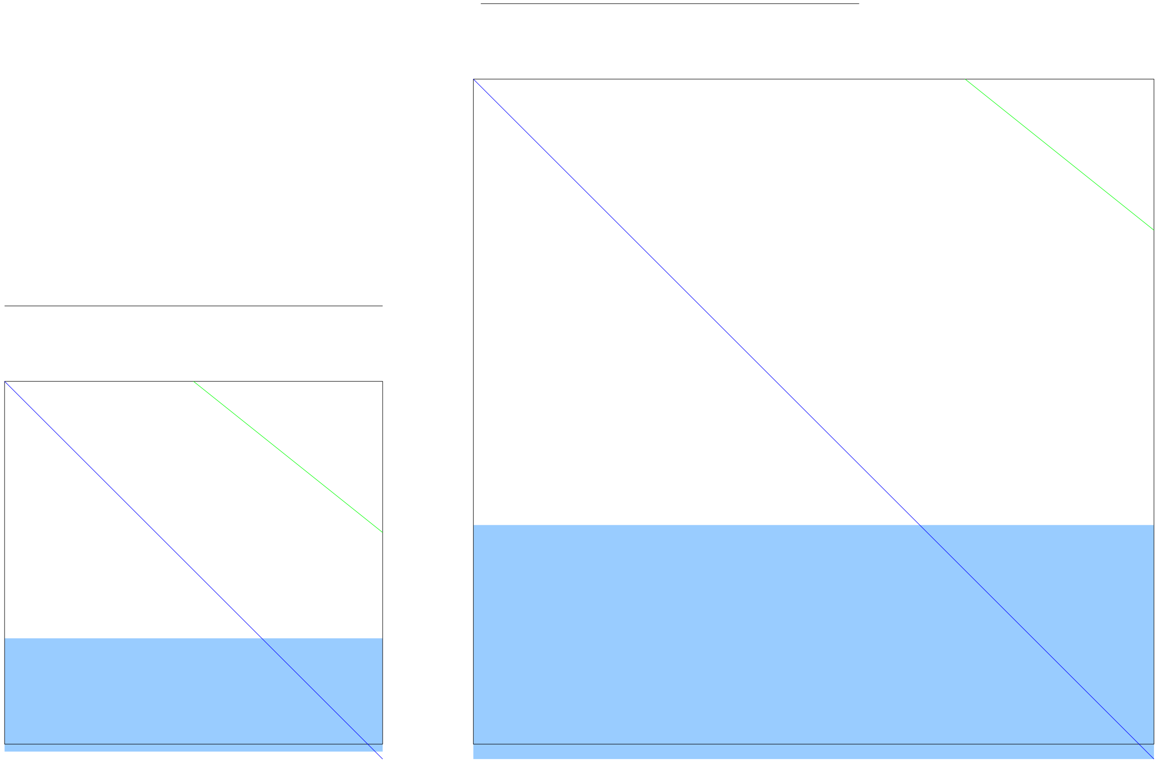


I babilonesi conoscevano l'"angolo"?

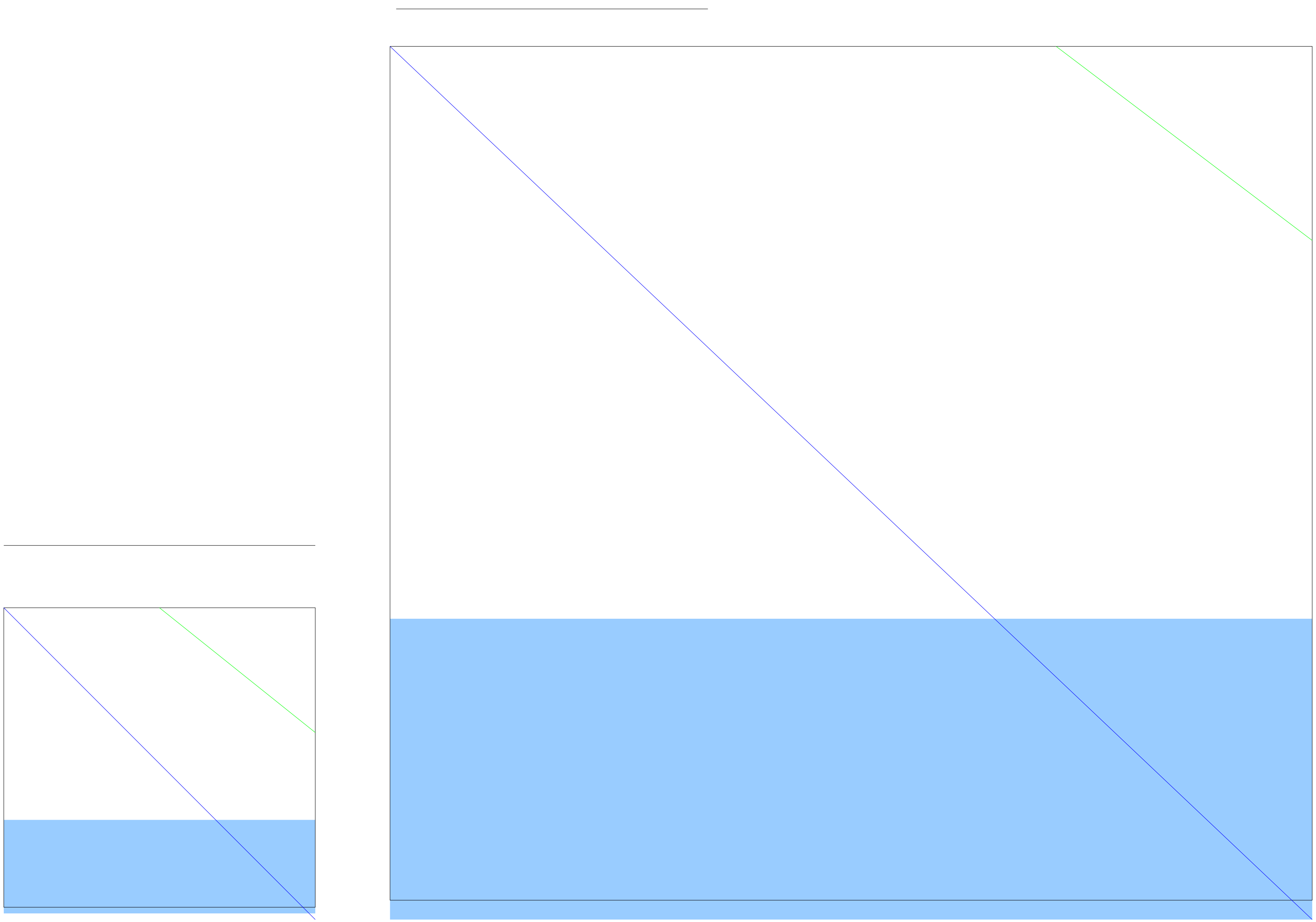
PROPORZIONI E SIMILITUDINE

anche in geometria

- in una configurazione di forma ben definita
  le lunghezze sono proporzionali
  le aree sono proporzionali al quadrato di una dimensione lineare
  --------------> tabelle di “costanti tecniche”



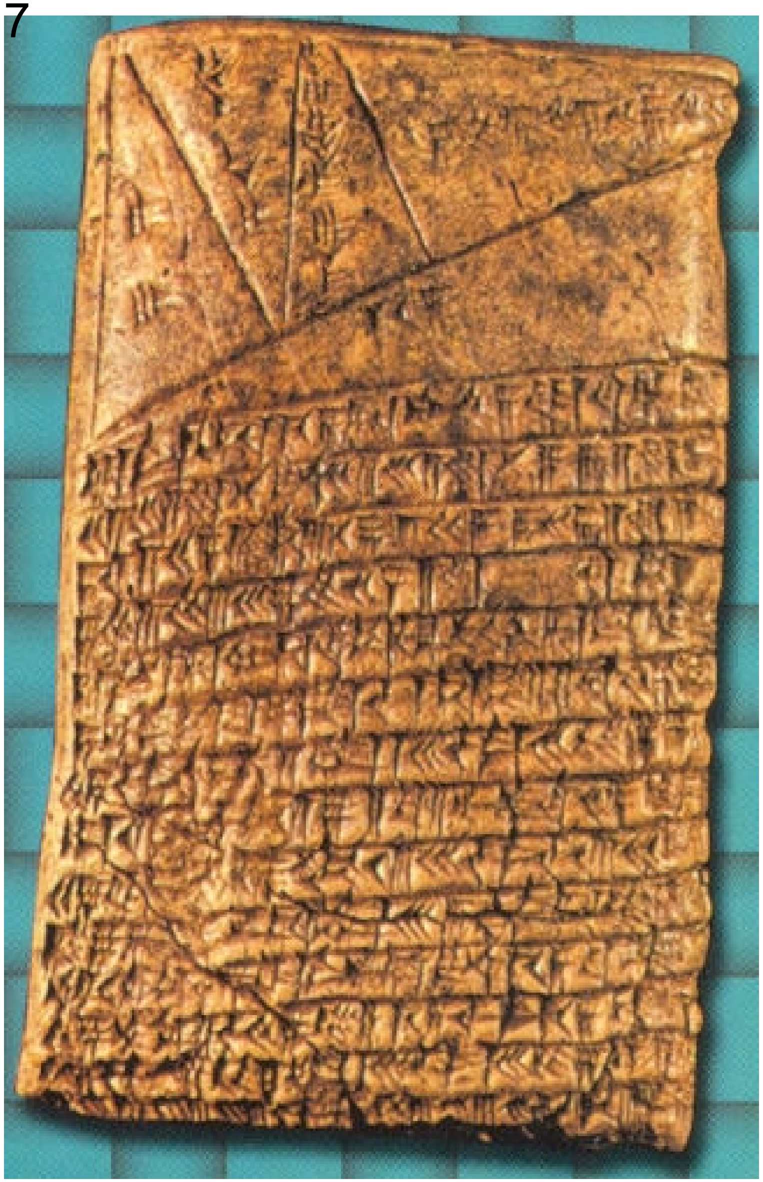
PROPORZIONI E SIMILITUDINE

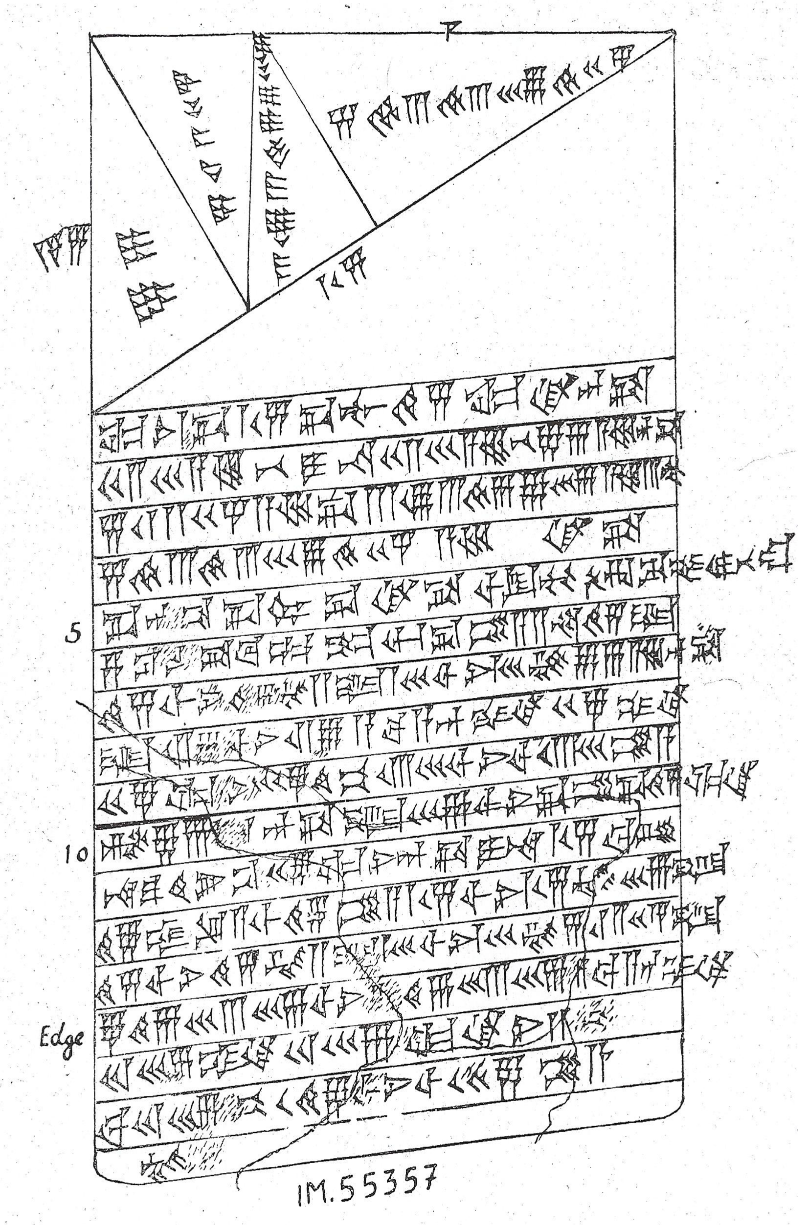


PROPORZIONI E SIMILITUDINE

TRIANGOLI SIMILI

IM5535
7 Datazione: 1800 aC circa



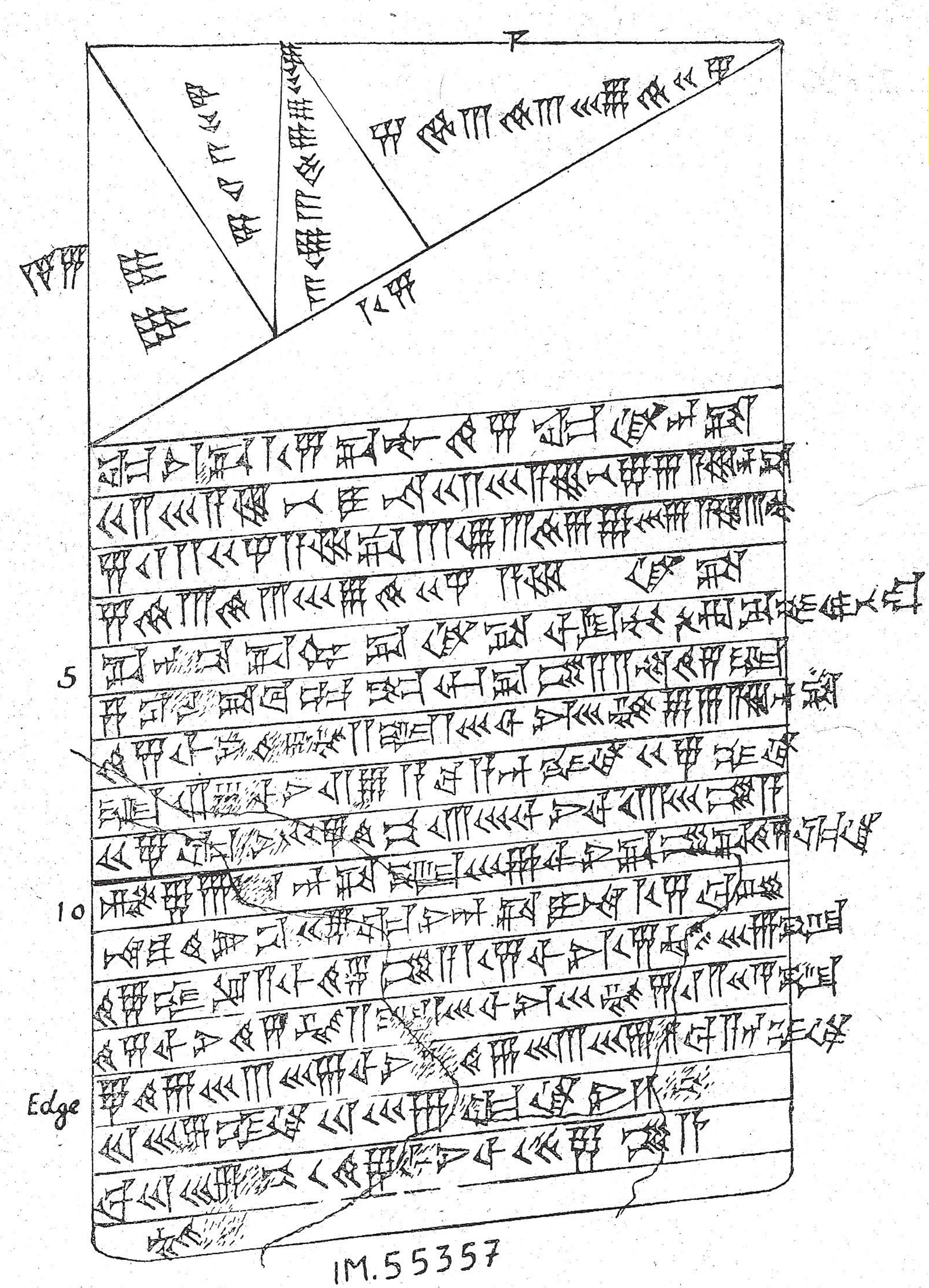


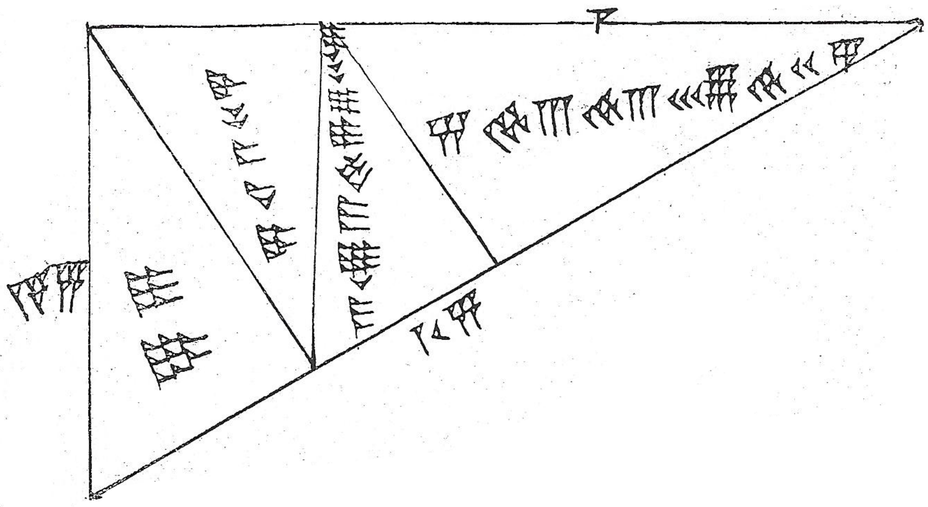
TRIANGOLI SIMILI

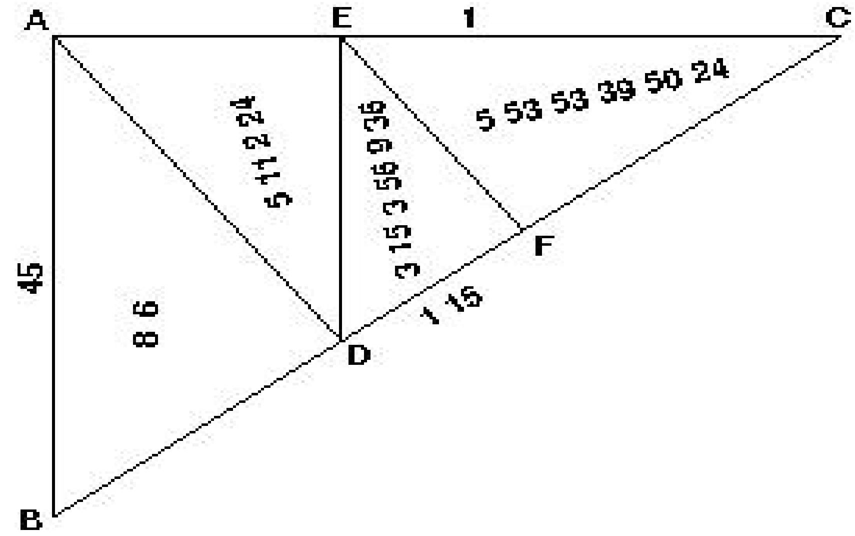
1-4 dati

5 domanda

6-16 risposte con calcoli







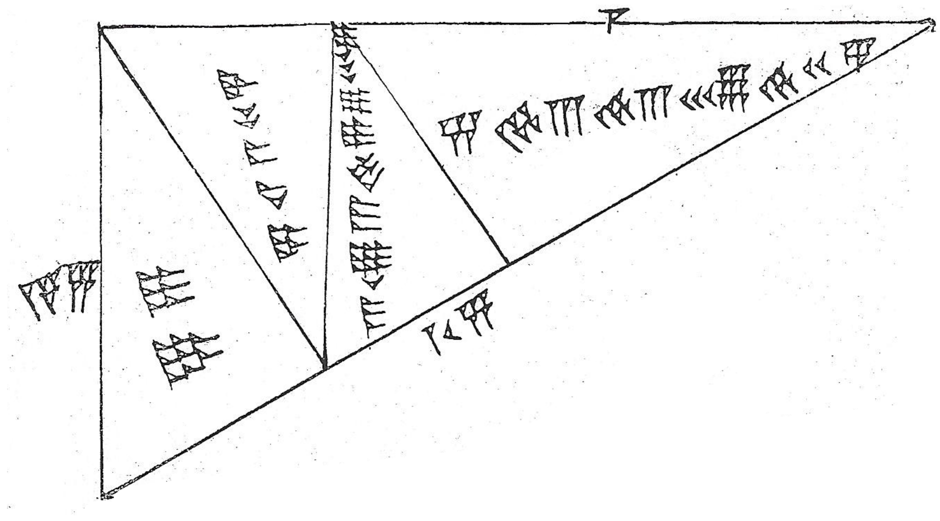
1-4 dati

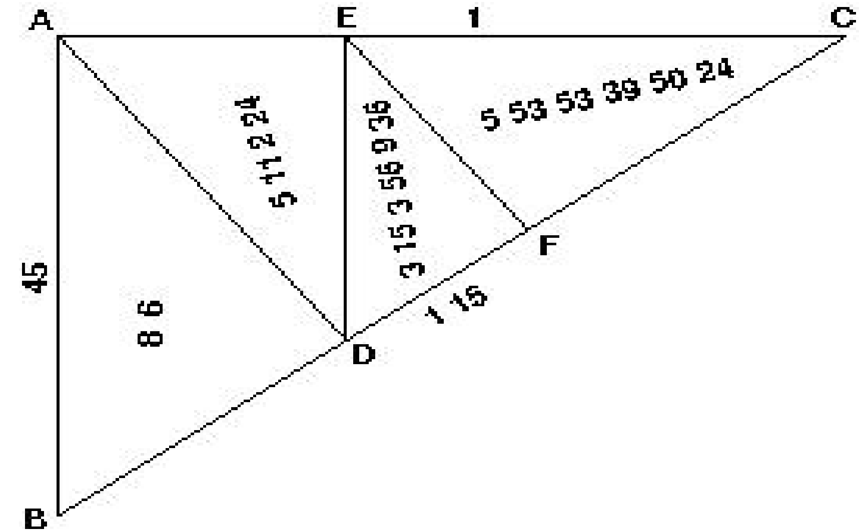
AC=[1,]=60,
BC=[1,15]=75,
AB=[45]=45

NOTA:
Il triangolo è rettangolo

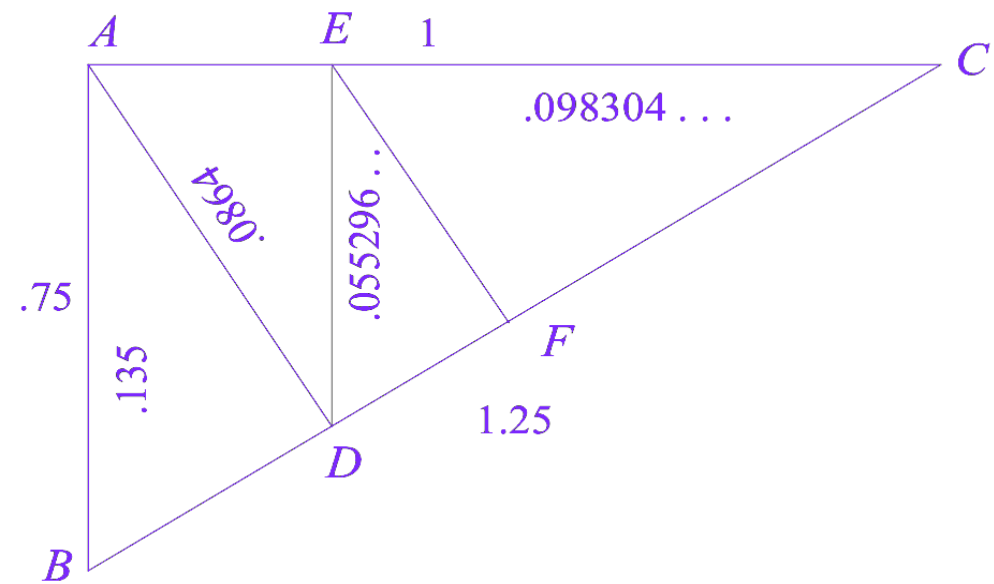
3, 4, 5 terna pitagorica
45=3x15, 60=4x15, 75=5x15

Un cuneo (triangolo). La lunghezza è 1, la lunghezza lunga è 1 25, la larghezza di sopra è 45.
L'area completa è 22 30,
l'area più in alto 8 6,
quella successiva 5 11; 2 24,
la terza 3 19; 3 59, 9, 36
quella più in basso 5,53 ;53,39,50,24



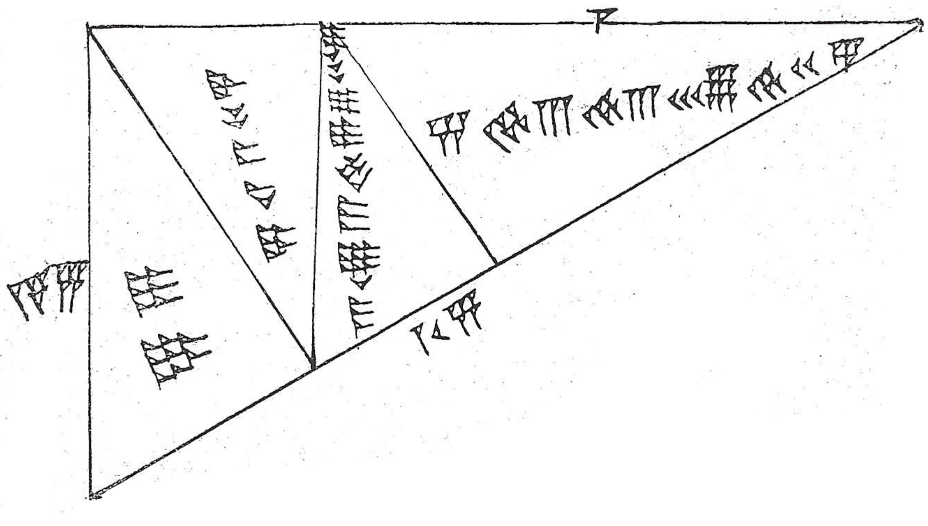


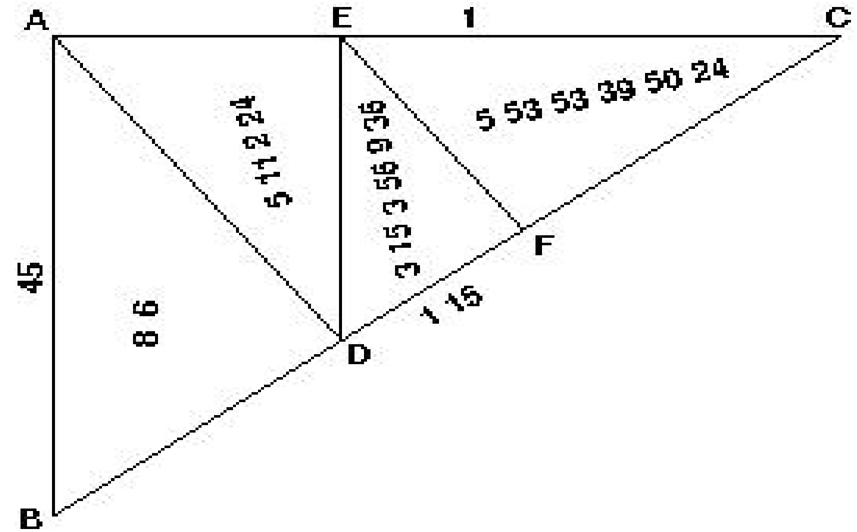
1-4 dati



AC=[1,]=60, =1
BC=[1,15]=75, =1.25
AB=[45]=45 =0.75

ABC=[22,30]=1350 =0.375
ABD=[8,6]=486 =0.135
EAD=[5,11 ;2,24]=311.04, =0.0864
FDE=[3,19 ;3,59,9,36]=199.0664333 =0.055296
FEC=[5,53 ;53,39,50,24]=653.8944 .=0.098304

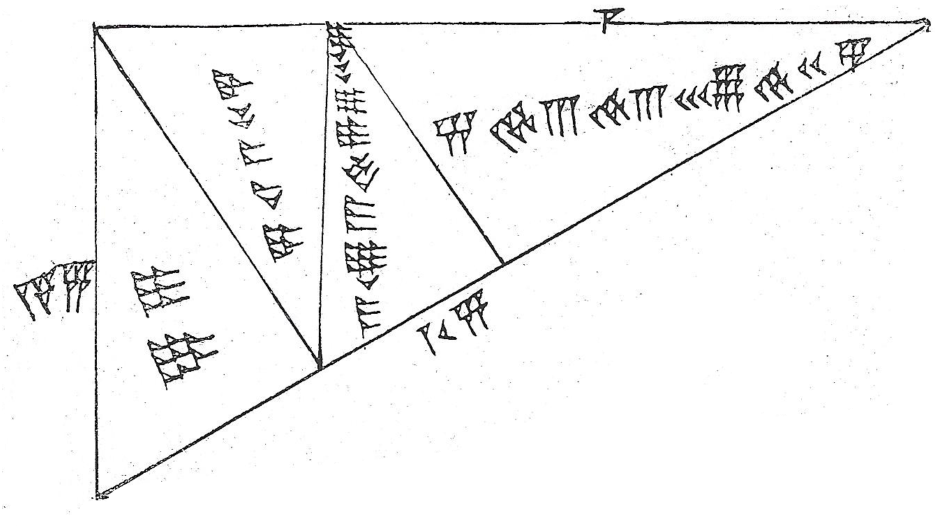


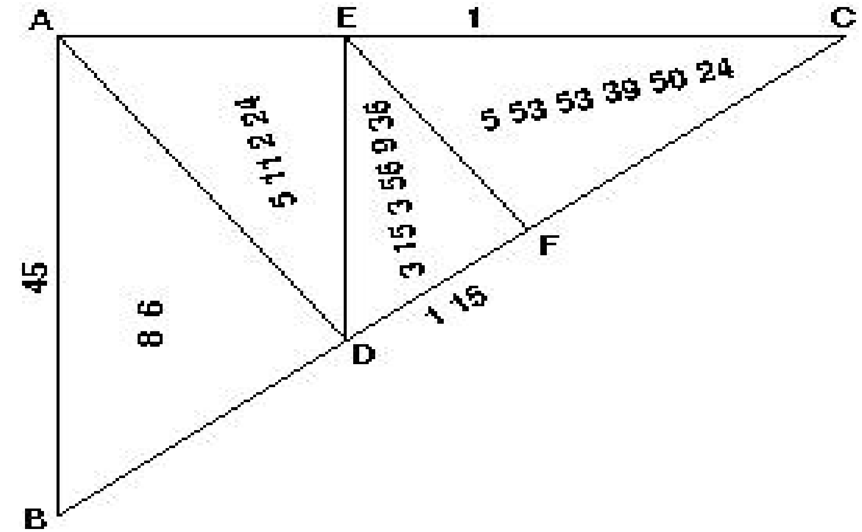


5. domanda

tenendo conto del testo che segue
(lo scriba non finisce)

Quali sono
la lunghezza superiore BD,
la lunghezza del segmento ("spalla") AD,
la lunghezza in basso AE,
la perpendicolare? ED.





anche BAD, ADE, DEF, EFG rettangoli ?

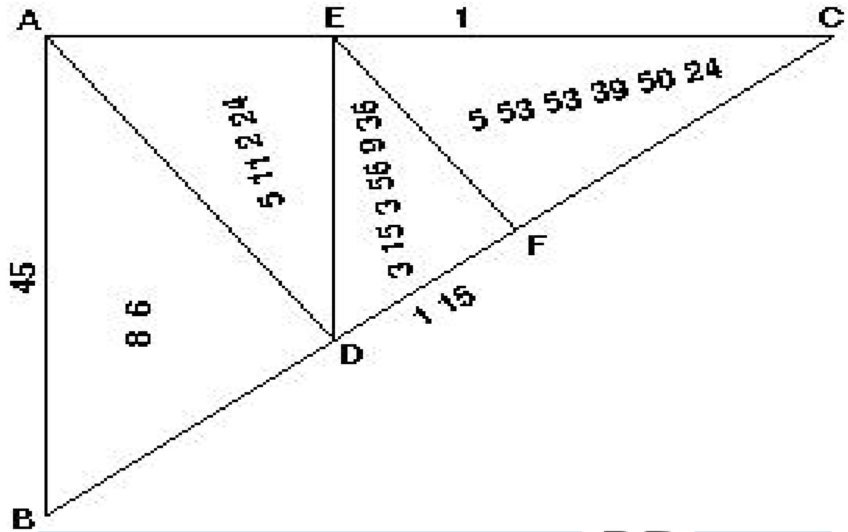
dal disegno e dall'uso
dal procedimento
dai dati

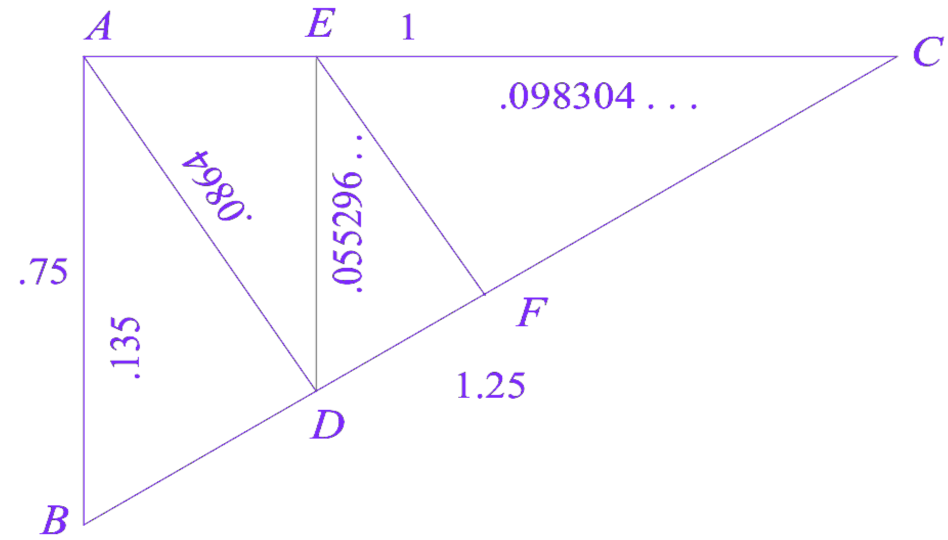
Si usa la "similitudine" dei triangoli ABC, DAB, EAD?

BD,
AD,
AE,
ED.

I babilonesi conoscevano la "similitudine"?

Quali sono
la lunghezza superiore
la lunghezza del segmento ("spalla")
la lunghezza in basso
la perpendicolare?





6-16. soluzione BD

$\Delta ABC \sim \Delta DBA$ *triangolo ABC simile al triangoloDBA*

$$\frac{AB}{AC} = \frac{BD}{AD}$$

$$\frac{45}{60} = \frac{3}{4} = \frac{BD}{AD} \qquad AD = \frac{4}{3} BD$$

$$a(ABD) = \frac{1}{2}(BD)(AD) \qquad a(ABD) = \frac{1}{2}\frac{4}{3} BD^2$$

triangolo rettangolo

[;8,6]

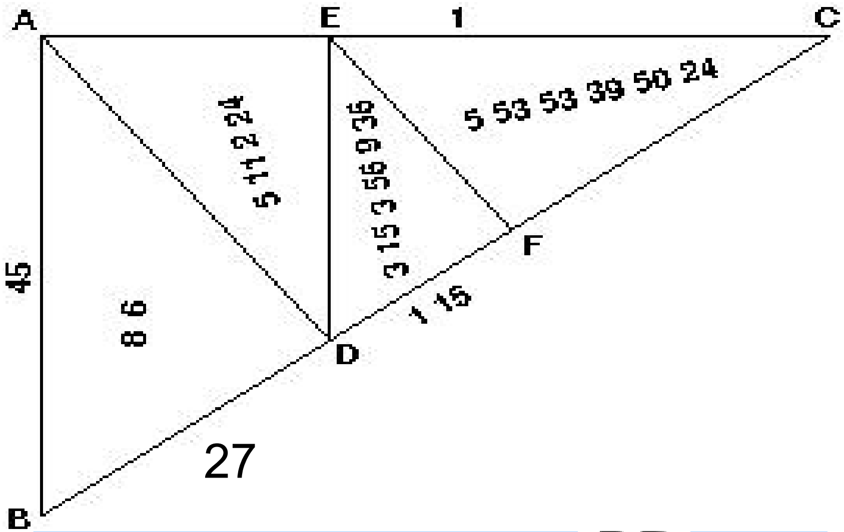
$$BD^2 = 2\frac{3}{4}\, a(ABD)$$

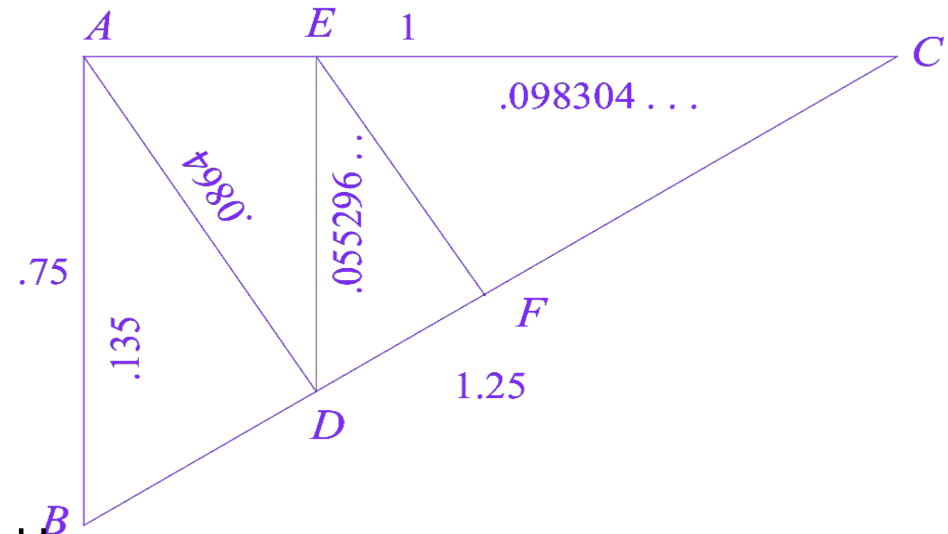
[;8,6]

$$BD^2 = 2\frac{3}{4}\, .135$$

[;0,27]

$$BD = .45$$





Høyrup

6-16. soluzione BD

0;45

$$\frac{45}{60} = \frac{3}{4} = \frac{AB}{AC} = \frac{BD}{AD} \quad ?$$

0;45 [;8,6]

$$2\frac{3}{4}\, a(ABD) = BD^2$$

$$BD = \sqrt{2\frac{3}{4}\, a(ABD)} = \sqrt{0;12\ 9} = 0;27$$

$$= \sqrt{.2025} = 0.45$$

Tu, per sapere come si procede, igi 1, la lunghezza, per 0;45 eleva

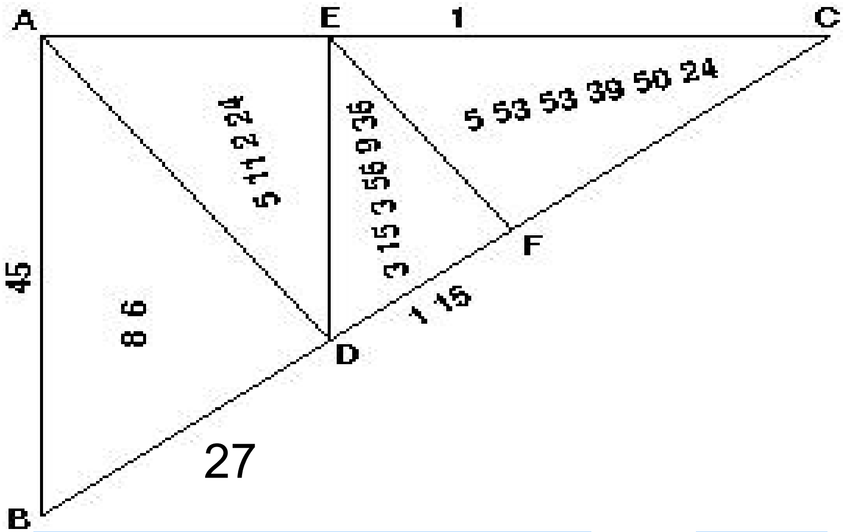
“igi” = “l'inverso di”

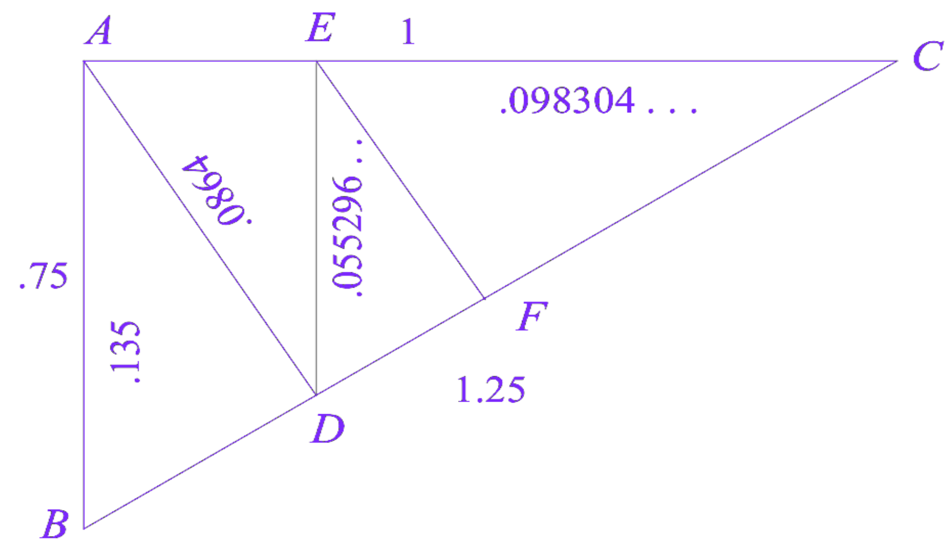
l'inverso di AC per AB $\frac{3}{4}$ =[0,45]

0;45 vedi

0;45 per 2 moltiplica
1;30 vedi
per 0;08 06,la superficie più in alto, moltiplica

0;12 9 vedi. Per 0;12 9, qual è il lato del quadrato?
0;27 è il lato del quadrato





6-16. soluzione AD

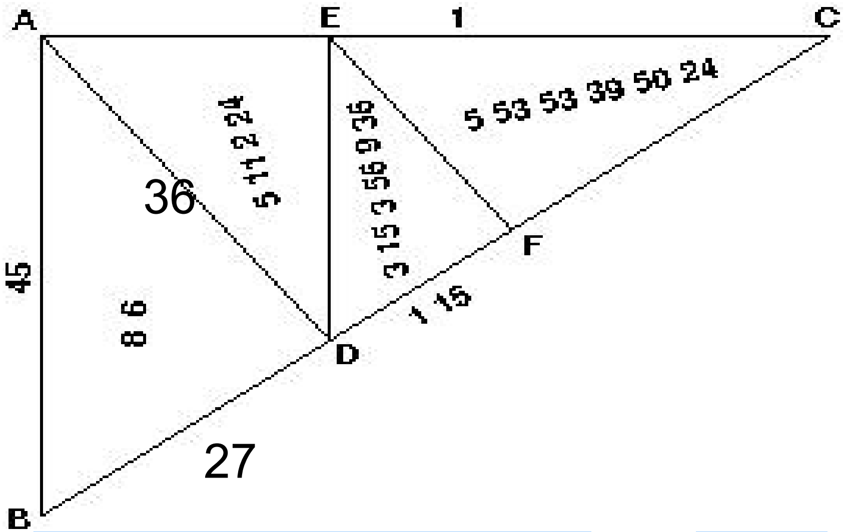
$$\frac{3}{4} = \frac{BD}{AD}$$

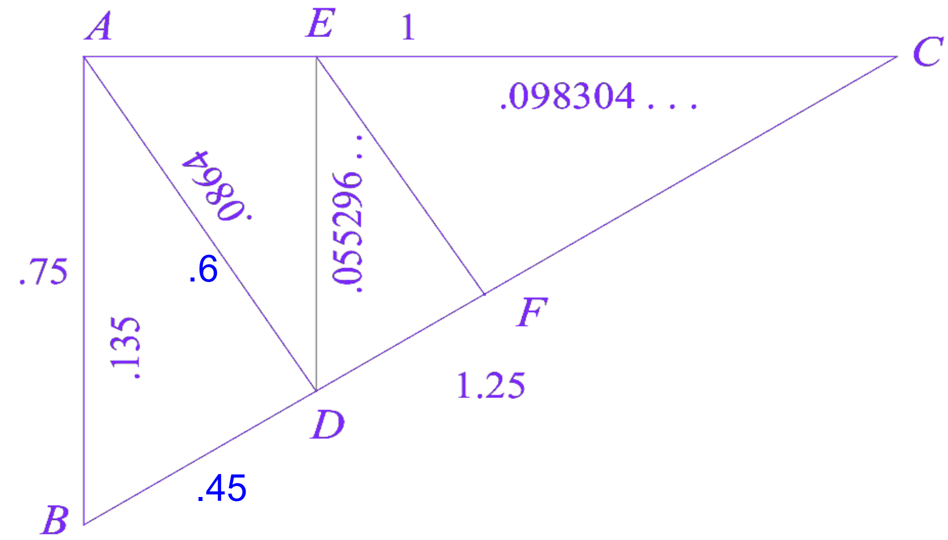
$$AD = \frac{4}{3} BD$$

oppure

$$a(ABD) = \frac{1}{2}(BD)(AD)$$

$$AD = 2\ \frac{a(ABD)}{BD}$$





6-16. soluzione AD

$$\frac{BD}{2} \rightarrow \frac{2}{BD}$$

$$\frac{[0;27]}{2} = 13;30$$

$$\frac{.45}{2} = .225 \rightarrow \frac{1}{.225}$$

$$\frac{2}{BD}a(ABD) = AD$$

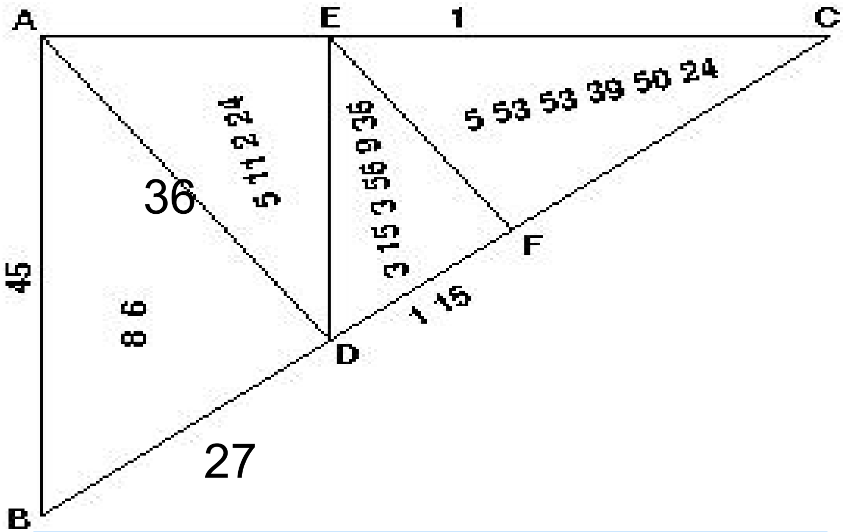
$$\left(\frac{1}{.225}\right)(.135) = .6$$

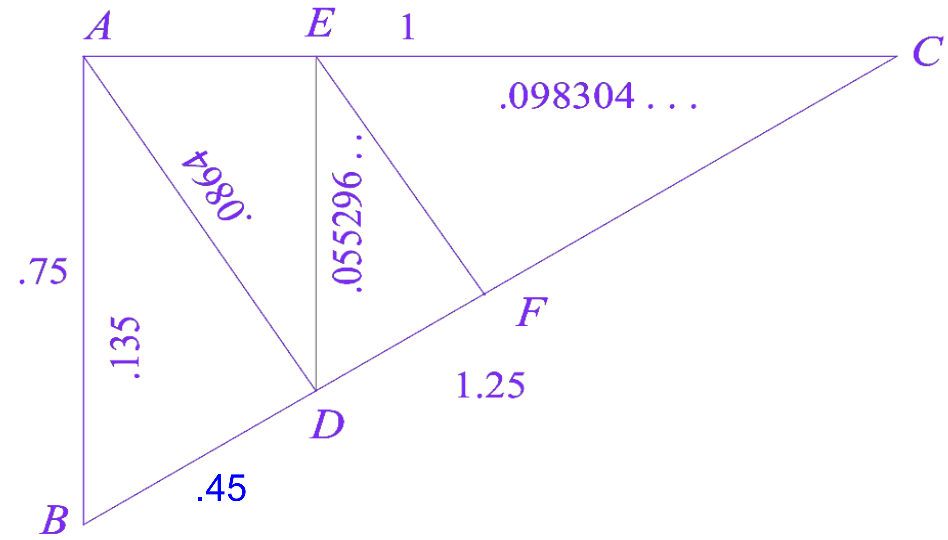
[0;36]

$$a(ABD) = \frac{1}{2}(BD)(AD)$$

$$AD = 2\,\frac{a(ABD)}{BD}$$

Dividi [in due] 0;27.
Vedrai 0;13 30.
Igi di 13;30. reciproco
Moltiplica per 0;08 06, l'area di sopra
Vedi 0;36, la lunghezza che è la corrispondente di 0;45, la larghezza.





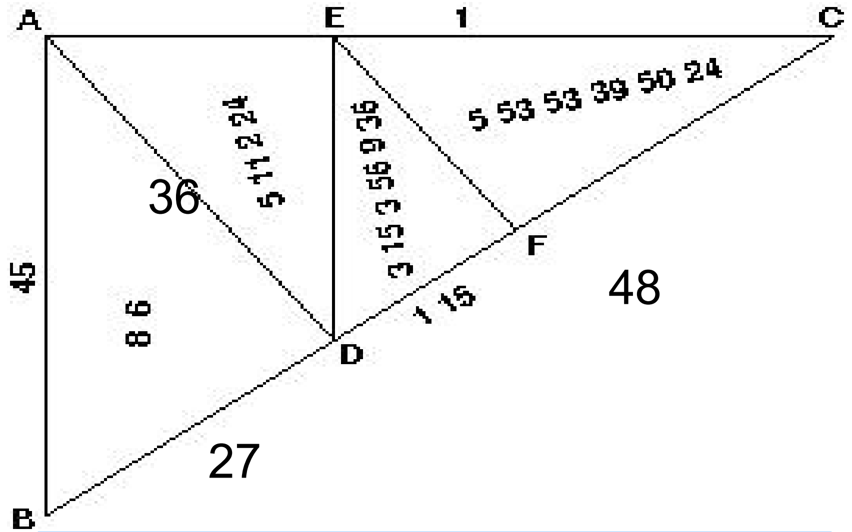
6-16. soluzione

In un triangolo rettangolo 3 4 5

$$a(ABC)= \frac{1}{2}\,\frac{3}{4}\,a^2$$

in un triangolo rettangolo r s t

$$a(ABC)= \frac{1}{2}\,\frac{r}{s}\,a^2$$

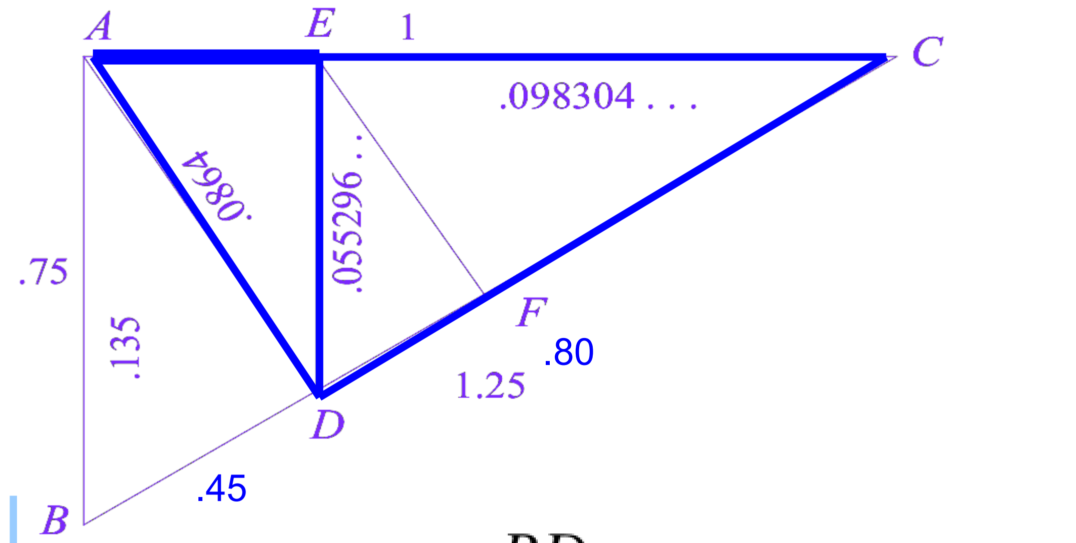


6-16. soluzione AE

Igi di 48; vedi 1;15
1;15 moltiplica per 0;36
0;45 vedi

0;45 per 2 moltiplica
per 0;05 11 02 24 moltiplica

0;07 46 33 36 vedi. Per 0;07 46 33 36, qual è il lato del quadrato?
0;21 36 è il lato del quadrato



BD

Tu, per sapere come si procede, igi 1,
la lunghezza, per 0;45 eleva

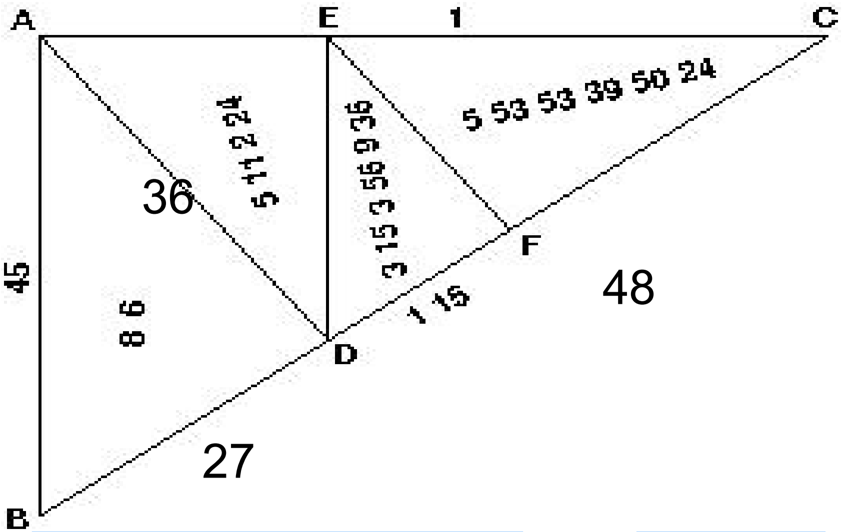
0;45 vedi

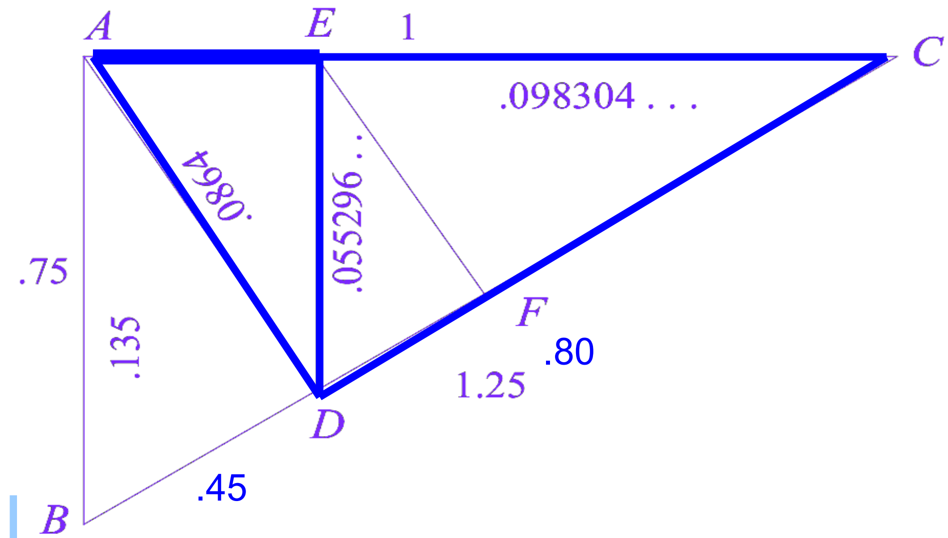
$$\frac{45}{60} = 0;45$$

0;45 per 2 moltiplica
1;30 vedi
per 0;08 06,la superficie piu in alto, moltiplica

$$2\frac{3}{4}\, a(ABD) = BD^2$$

0;12 9 vedi. Per 0;12 9, qual è il lato del quadrato?
0;27 è il lato del quadrato





6-16. soluzione *ED*

Dividi in due 0;21 36
Vedi 0;10 48
Igi di 0;10 48

.....
Il testo è interrotto

AD

Dividi [in due] 0;27.
Vedi 0;13 30.
Igi di 13;30. reciproco
Moltiplica per 0;08 06, l'area di sopra
Vedi 0;36, la lunghezza che è la corrispondente di 0;45, la larghezza.