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Mina Nouri

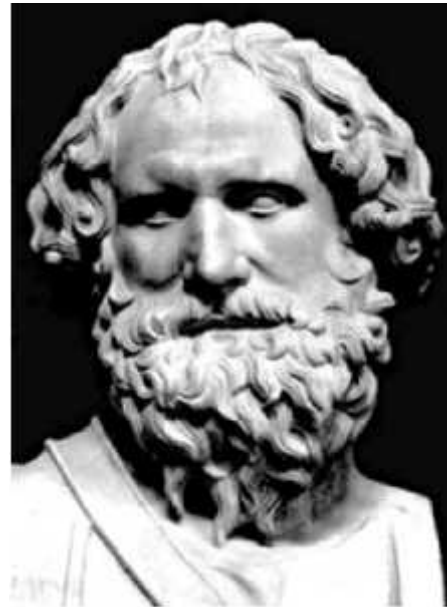
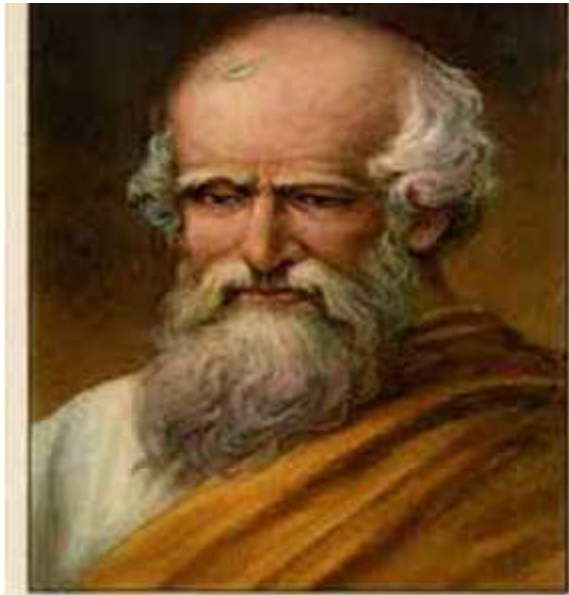
Mehdi BAbAee

Mohsen Rahmati



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Archimedes



Guess who ???



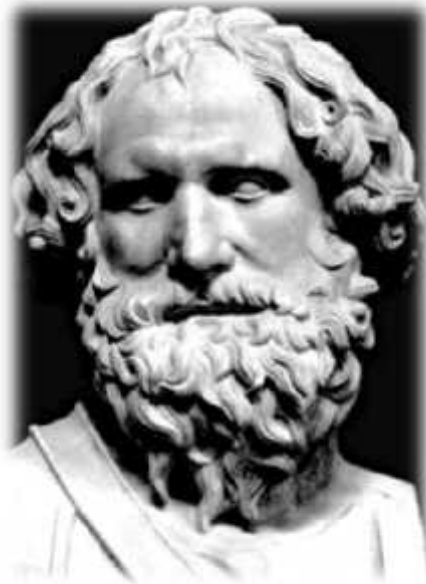
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Eureka ! Eureka !





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Mechanic
SCIENCE



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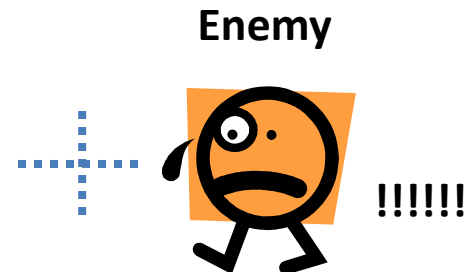
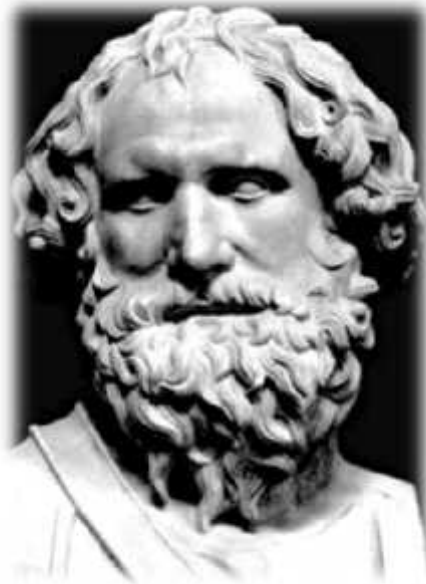
"

"Well isn't this a small world!"

."



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اما !

• دستاوردهای ریاضی

2000.. محیط، مساحت، حجم

• ایده های نو و اثبات های منطقی

✓ • اقلیدس و آپولونیوس

نیوتن و گاوس



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«The Works of Archimedes»•

• "در باب کره و استوانه"

• "اندازه گیری دایره"

• "در باب شبه مخروط ها و شبه کره ها"

• "در باب مارپیچ ها"

• "در تعادل های صفحه"

• "ماسه شمار"

• "تربیع سهمی"

• "در باب اجسام شناور"

• "کتاب لم ها"

• "روش"



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• سهم او بسیار بزرگتر از آنی است که عنوان این کتاب ها ممکن است به نظر آید!!!!



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روش شناسی (Methodologies)





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تناسب

• ریاضیات یونان باستان: مساحت ها و نسبت ها

• اقلیدس: هر دو روش

• آپولونیوس: مساحت ها y^2

$y^2 = px$: سهمی $y^2 = px \pm \frac{p}{a} x^2$: هذلولی و بیضی

• ارشمیدس: $y^2 : (a^2 \pm x^2) = b^2 : a^2$: سهمی



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روش "Exhaustion" و اثبات با تناقض

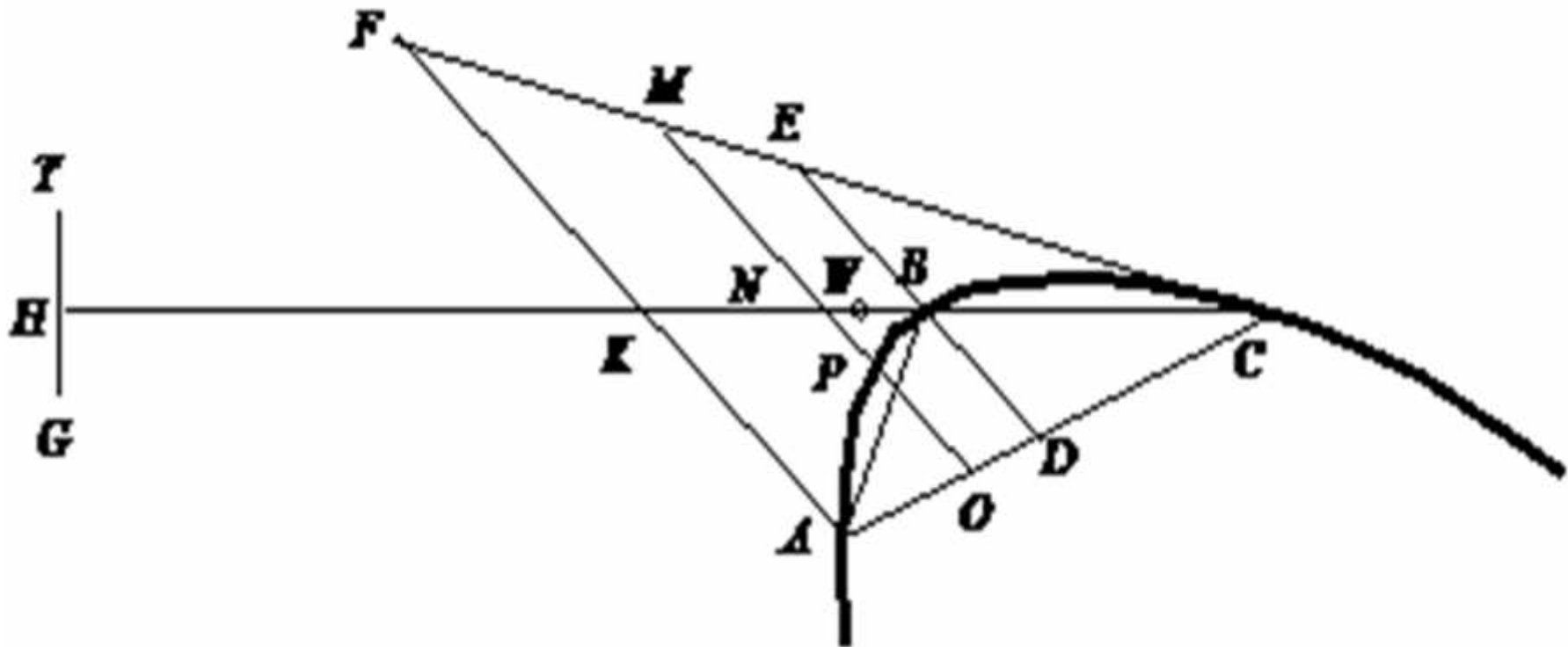
- عبارت دوم فصل 12 کتاب "عناصر" اقلیدس
- ارشمیدس :

"در باب کره و استوانه"، "اندازه گیری دایره"، "تربیع سهمی"، "در باب شبه مخروط ها و شبه کره ها" و "مارپیچ ها"



مکانیک او را بر بسیاری از کشفیات ریاضی اش سوق داد.

مساحت های محدود شده توسط سهمی



"در باب کره واستوانه"
"On the sphere and cylinder"





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•شش تعریف و پنج فرضیه

•فرضیه پنجم :

•اصل مشهور ارشمیدس:

" برای هر دو پاره خط با طول a و b اگر $a < b$ ، عدد طبیعی n وجود دارد که $na > b$ "



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"در باب کره واستوانه"

"On the sphere and cylinder"



44 Statements

3 MAIN Results





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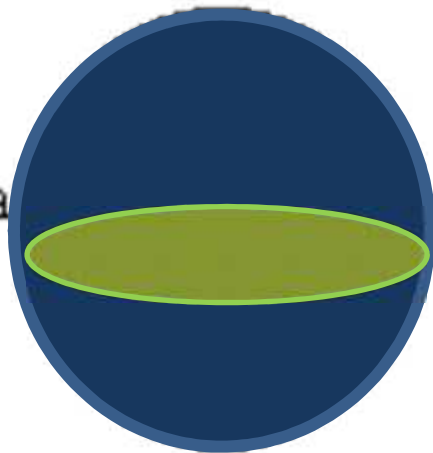
Result **ONE** :



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The surface area
of the sphere



=

4

×

the area of



$4\pi r^2$



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- **Statement 34**
- **Statement 33**



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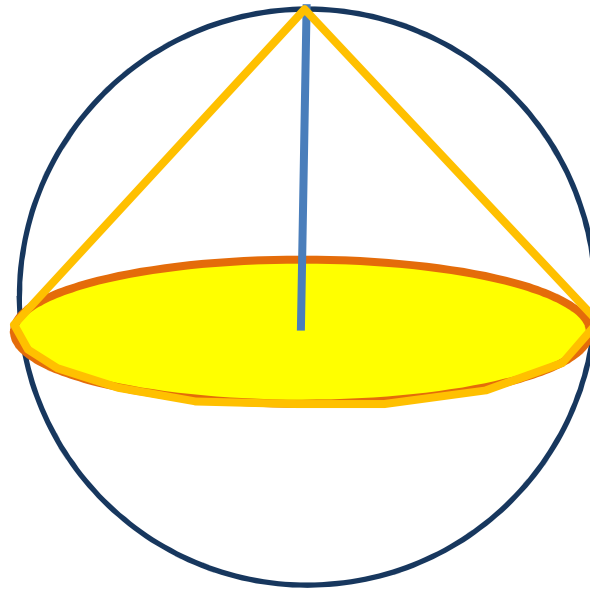
=

4 x



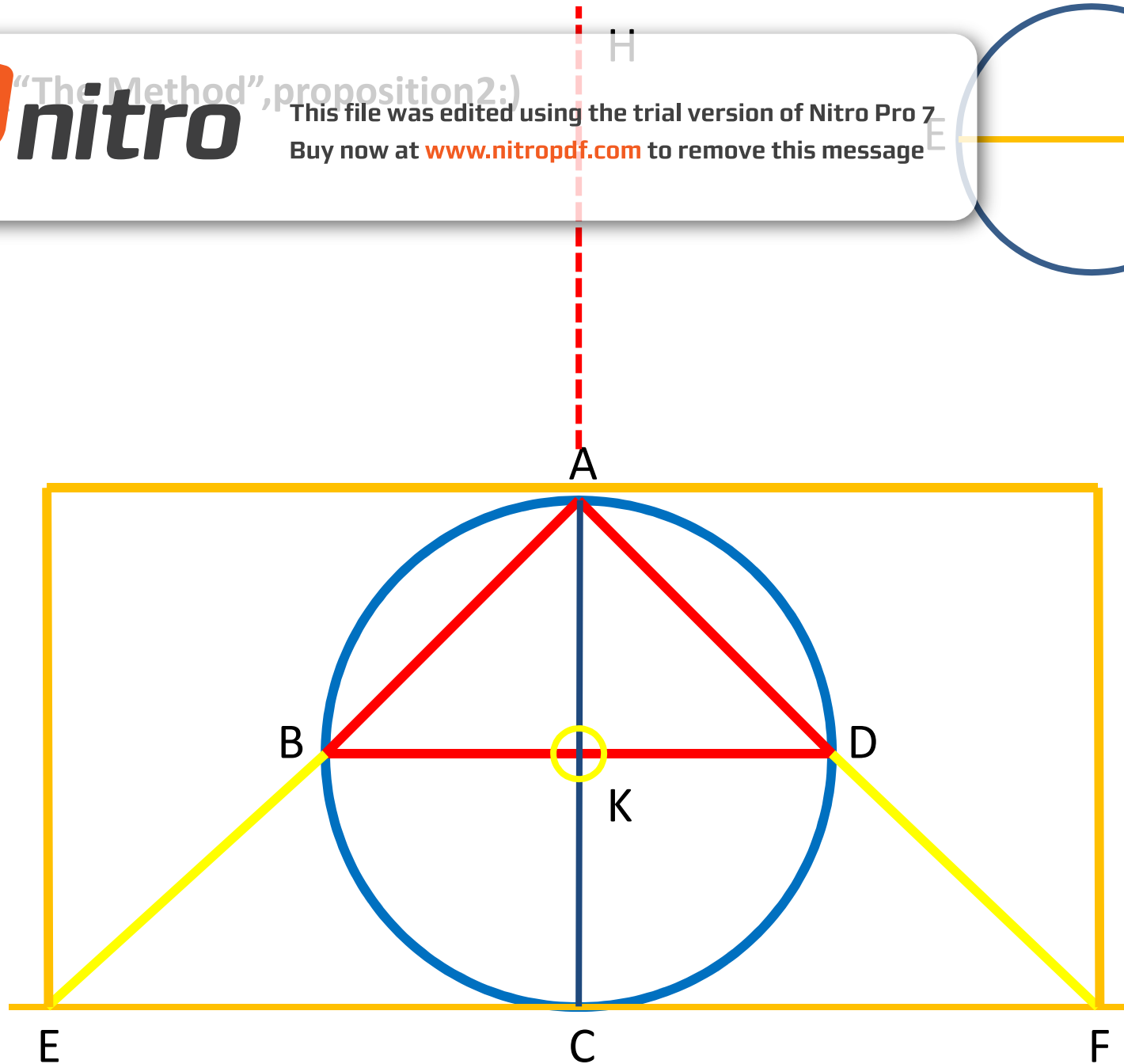


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H



K مرکز ثقل استوانه :



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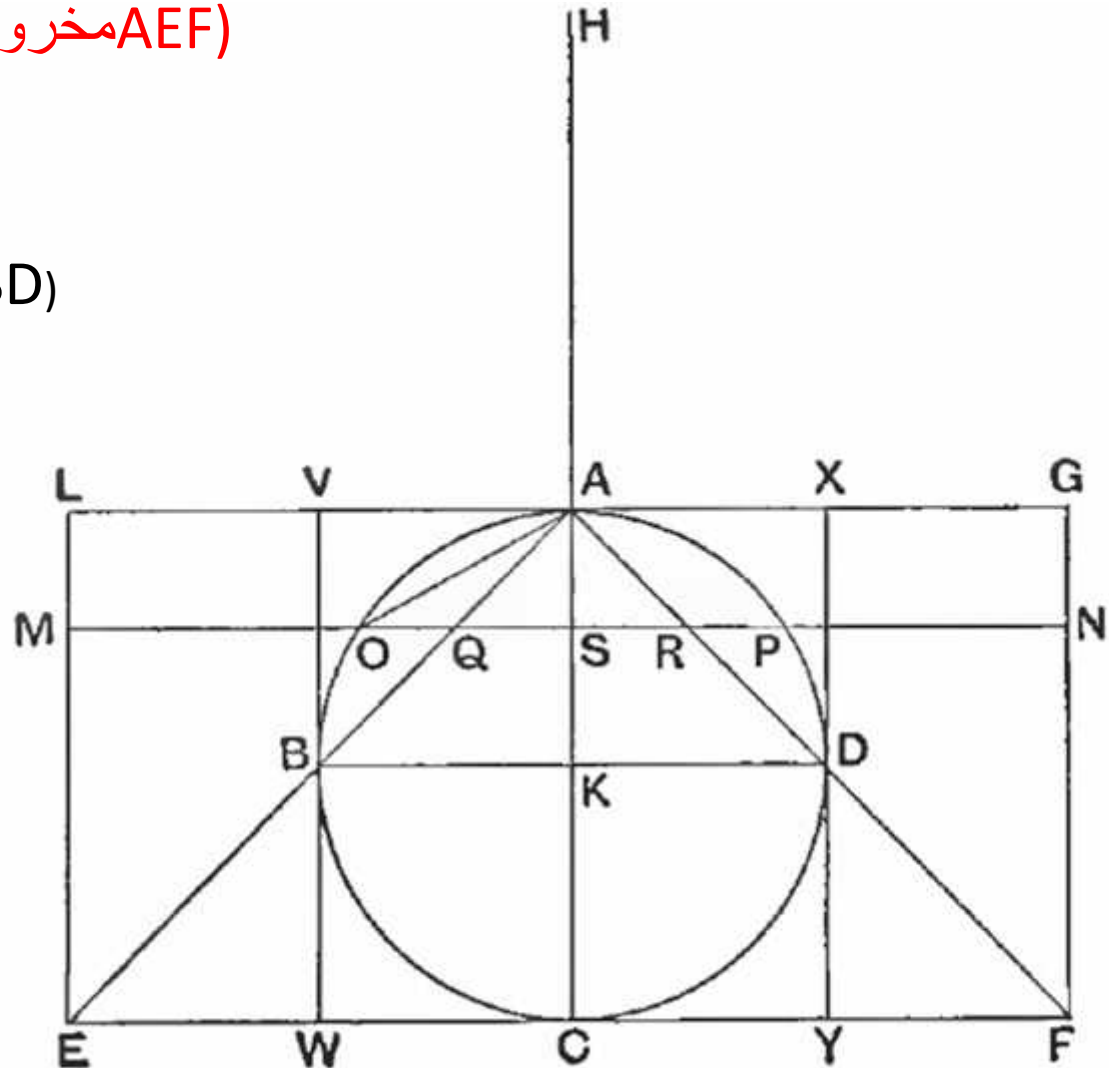
$HA=2AK \rightarrow$ استوانه = 2 (کره + مخروط AEF)

اقلیدس: $(AEF \text{ مخروط}) = 3 = \text{استوانه}$

$(\text{کره}) = 2 = AEF \text{ مخروط}$.

$(ABD \text{ مخروط}) = 8 = AEF \text{ مخروط}$

$(ABD \text{ مخروط}) = 4 = \text{کره} \rightarrow$





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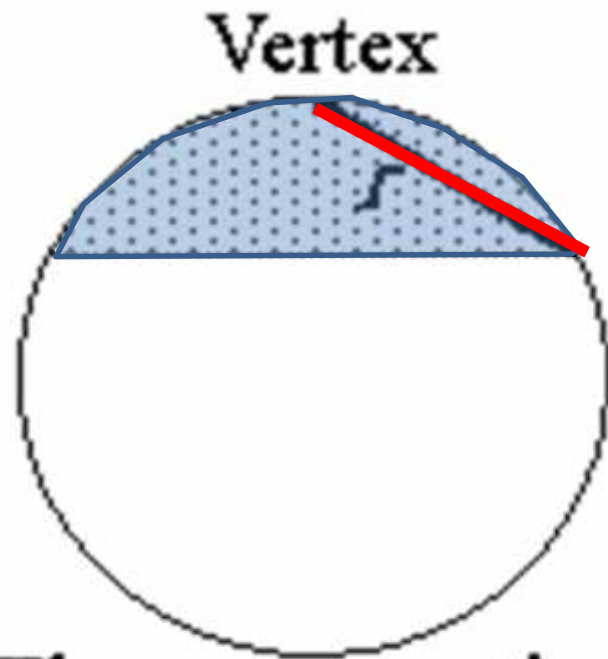
Result **two+three** :



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Curved surface area (shaded) = Area of circle of radius r



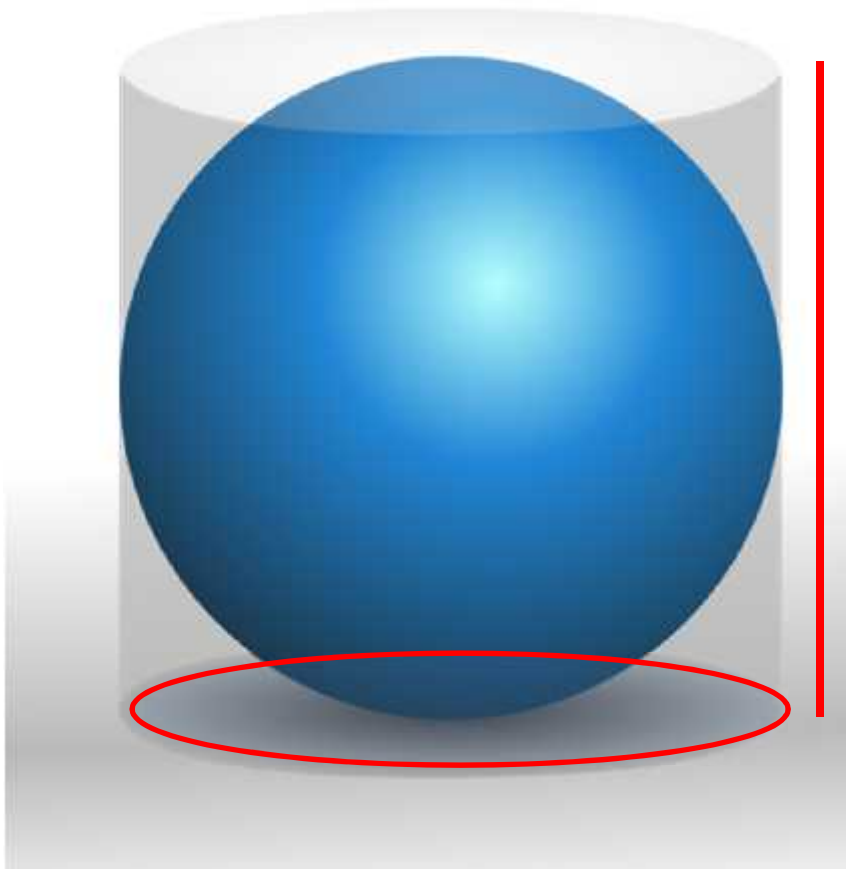
The cross-section
of a spherical cap



nitro

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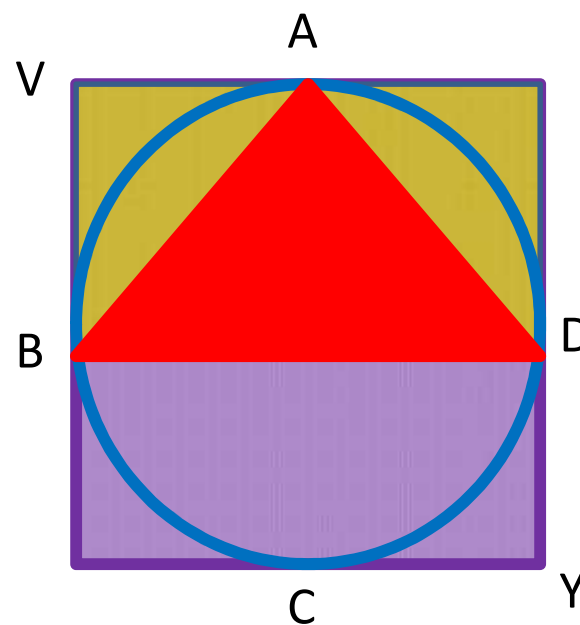
Cylinder = $\frac{3}{2}$ Sphere = $2\pi r^3$



ABD مخروط = 6 (استوانه VD) = 2 استوانه VY

→ (اقلیدس: استوانه VD = 3 مخروط ABD)

(با توجه به عبارت 34) $\frac{3}{2}$ (کره) =





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اندازه گیری دایره

Measurement of the circle





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• تقریباً هر تمدن یونانی از میان مسئله ی دایره ها خواهد آمد.

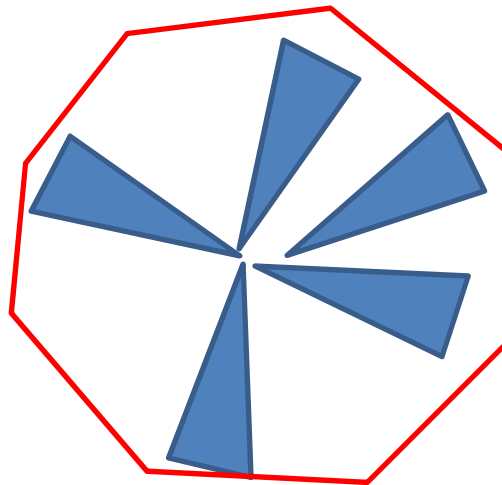
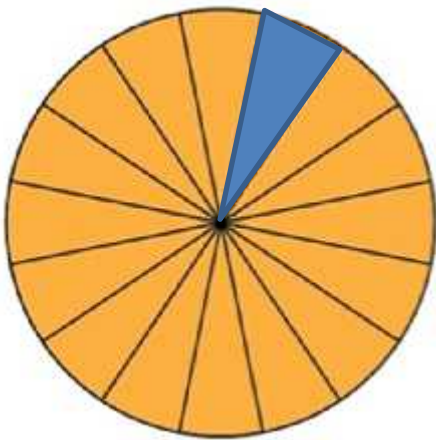
• ارشمیدس :

”در باب اندازه گیری دایره“



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Area of circles

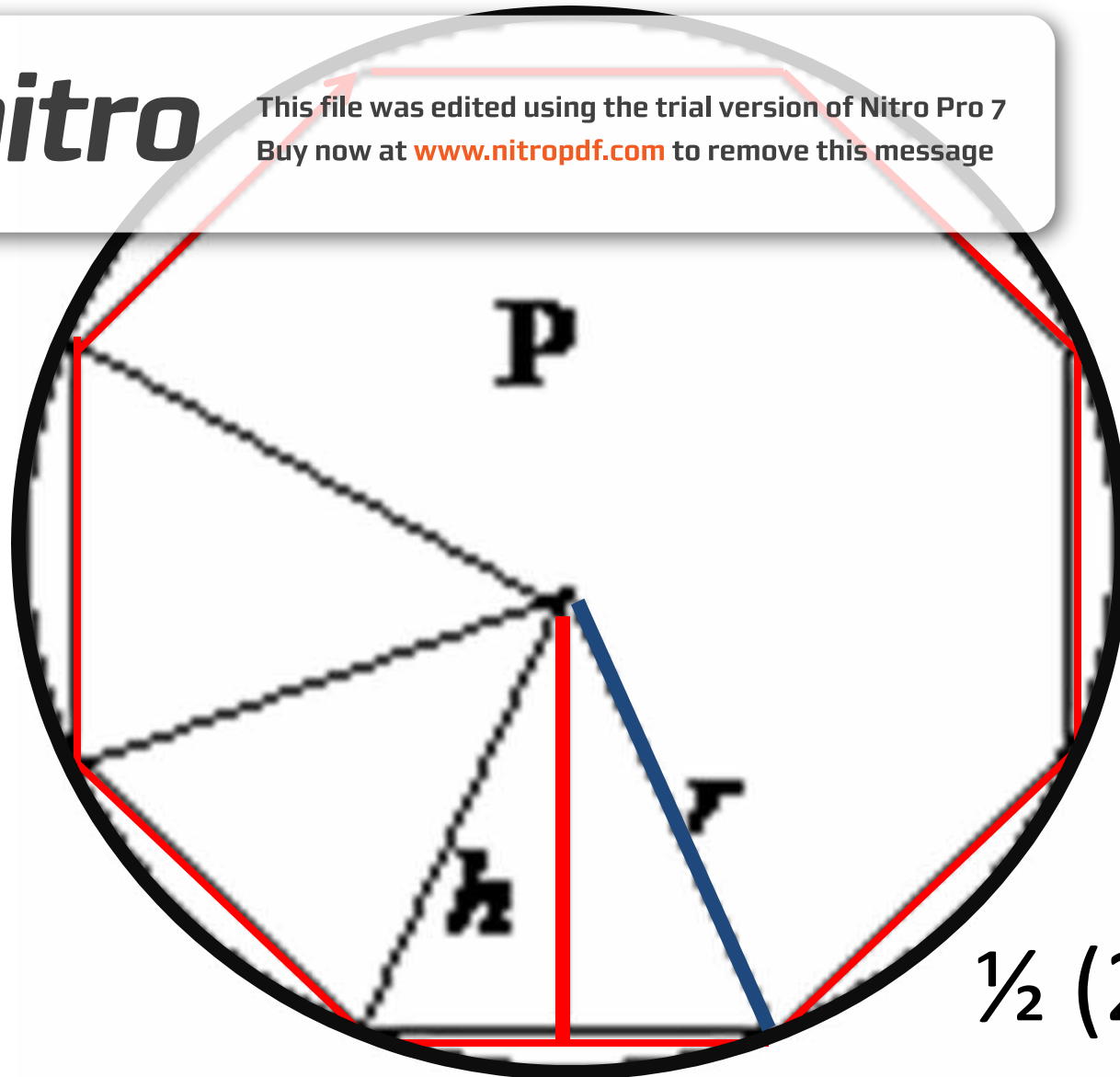


=

Low
boundary
Of circle



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$$\frac{1}{2} (2\pi r) r$$

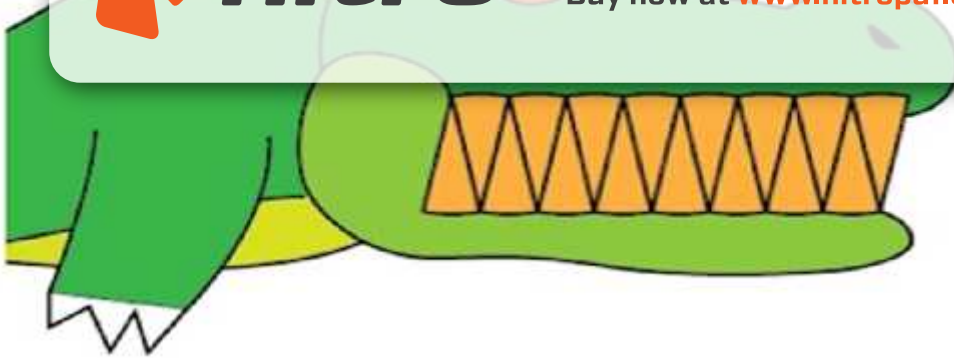
Archimedes' crocodile



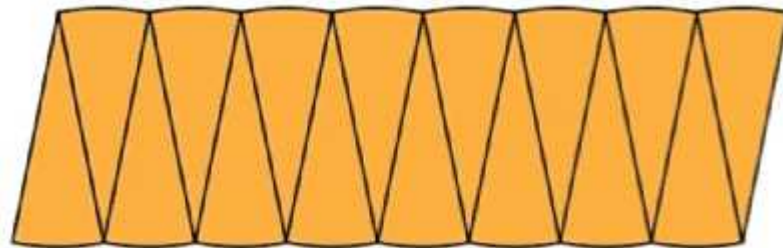
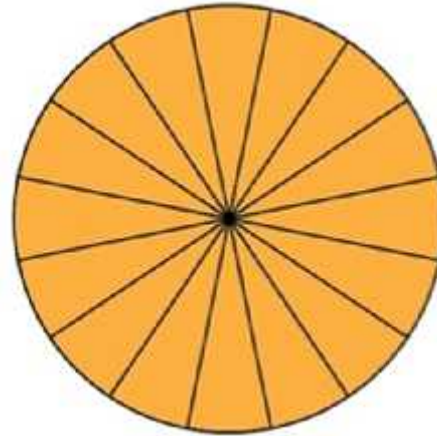
nitro

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Area of circles



by Burkard Polster and Marty Ross
The Age, 5 September 2011





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نسبت محیط به قطر دایره (Pi):

• اقلیدس ، “Elements” : بسیاری از ویژگی های دایره
ارزیابی نسبت محیط و قطر دایره، مساحت دایره و طول محیط

• ارشمیدس : تکنیک محدود کردن:

• عبارت 3 :

”نسبت محیط به قطر هر دایره ای بین $\frac{10}{71}$ و $\frac{1}{7}$ 3 است.“



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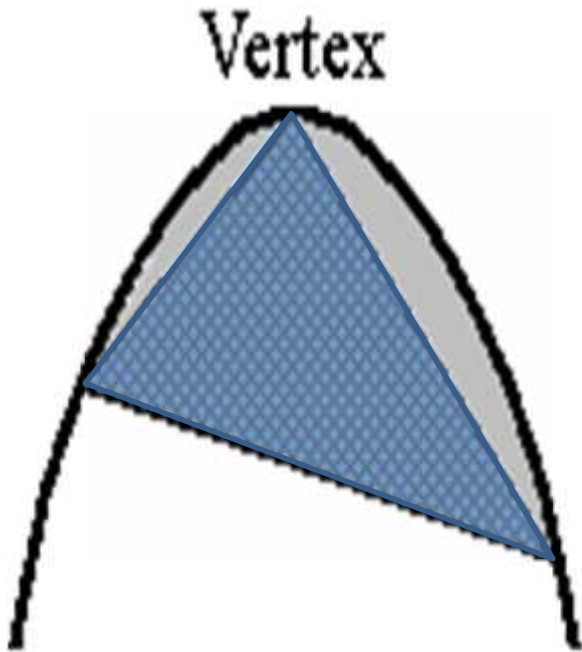


تربيع سهمی، شبه مخروط ها و شبه کره ها

Quadrature of parabola , conics & spheroids

• Statement 24:

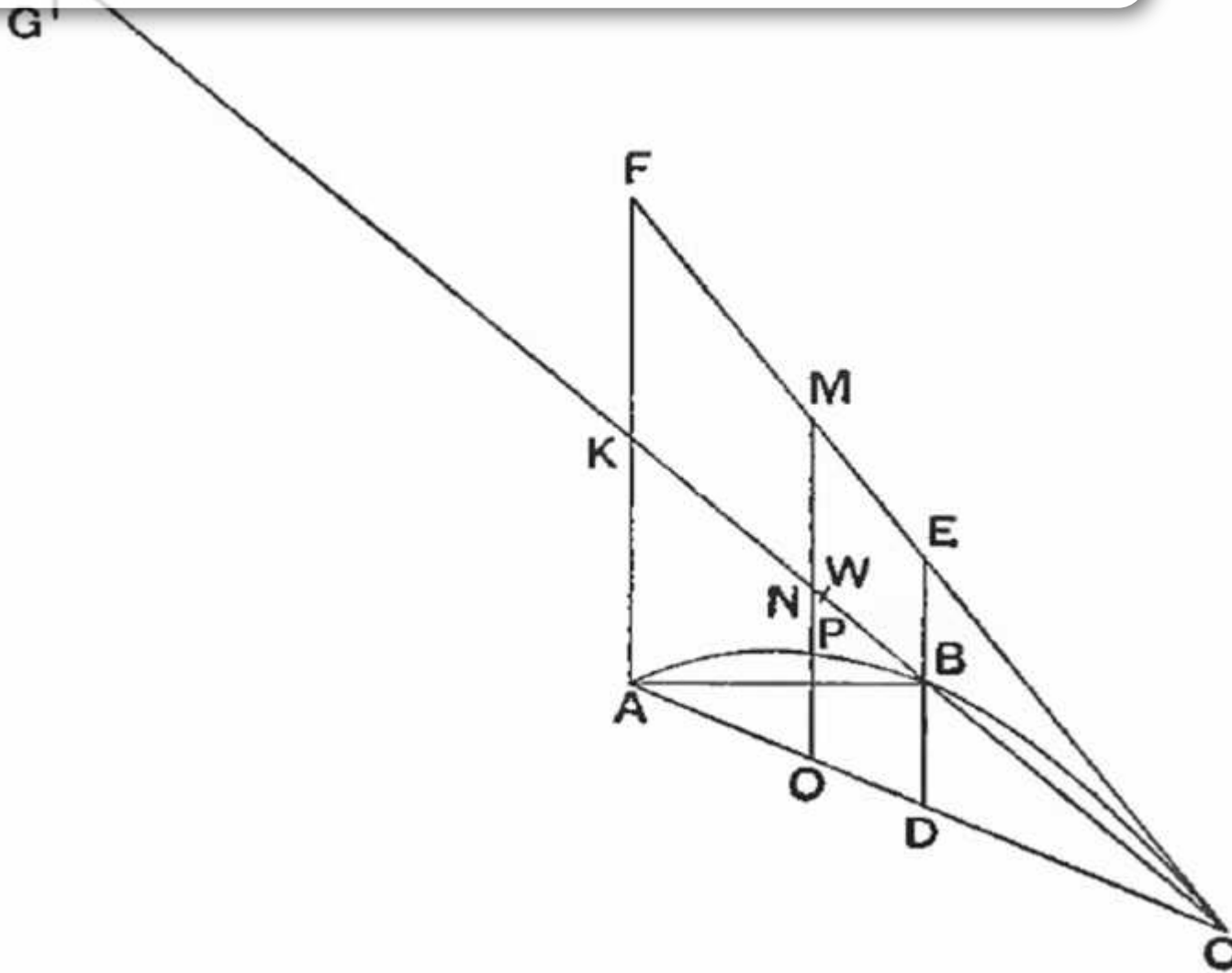
"parabolic segment = $\frac{4}{3}$ triangle





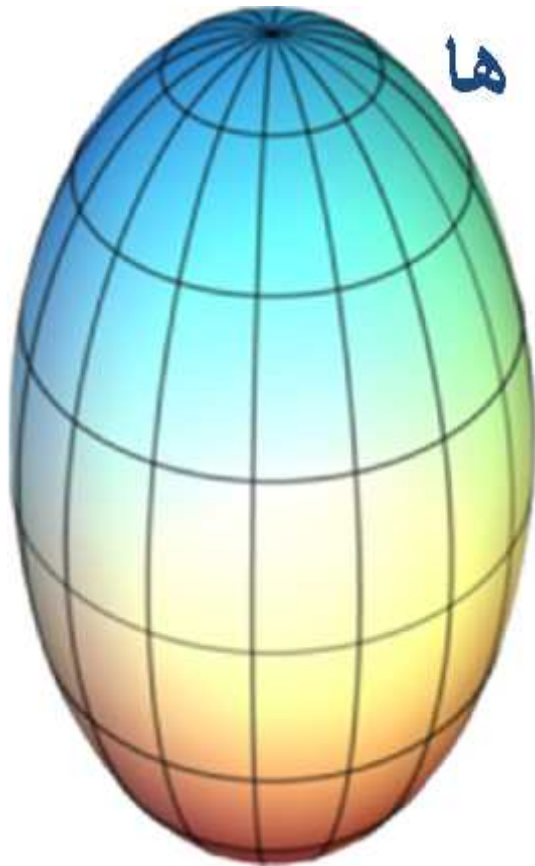
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شبه مخروط ها و شبه کره ها

conics & spheroids

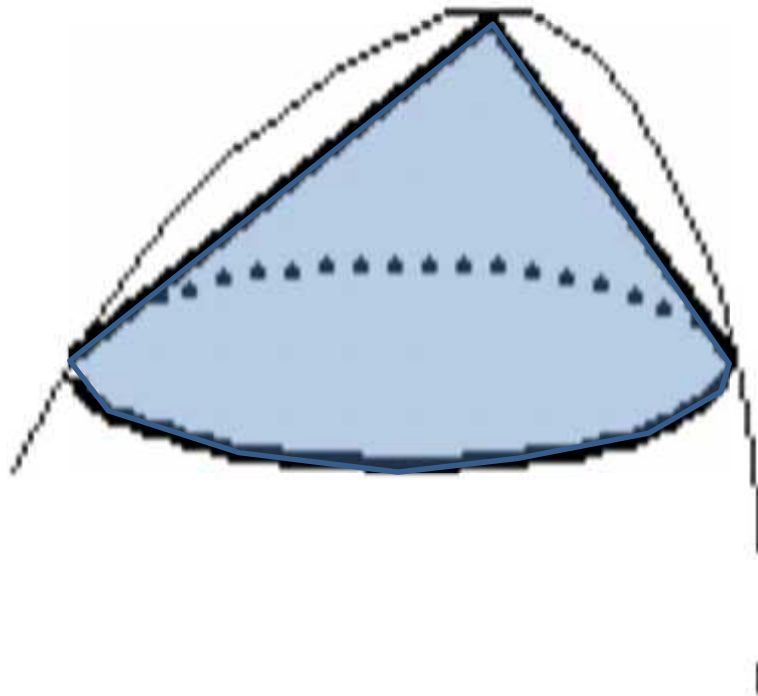


nitro

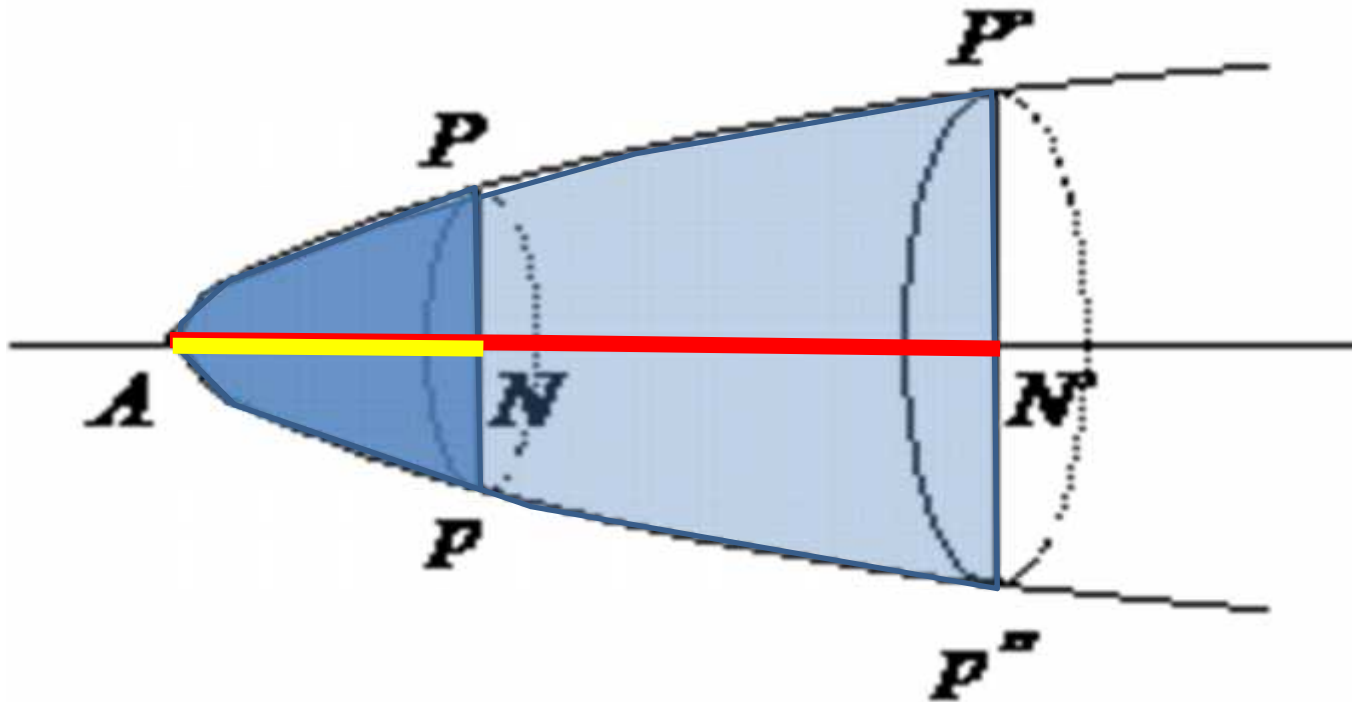
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"parabolic segment $V = \frac{3}{2}$ CONE

Vertex



(ii) عبارت 24 : نسبت دو قطعه که با بریدن یک جسم محدود شده یا یک سهمی (در نریسم) و در آن نریسم با یک افق موازی می شوند (بریدن بطور دلخواه) برابر است با مربع طول محورهای آنها.



$$APp / AP'p' = AN^2 / AN'^2$$



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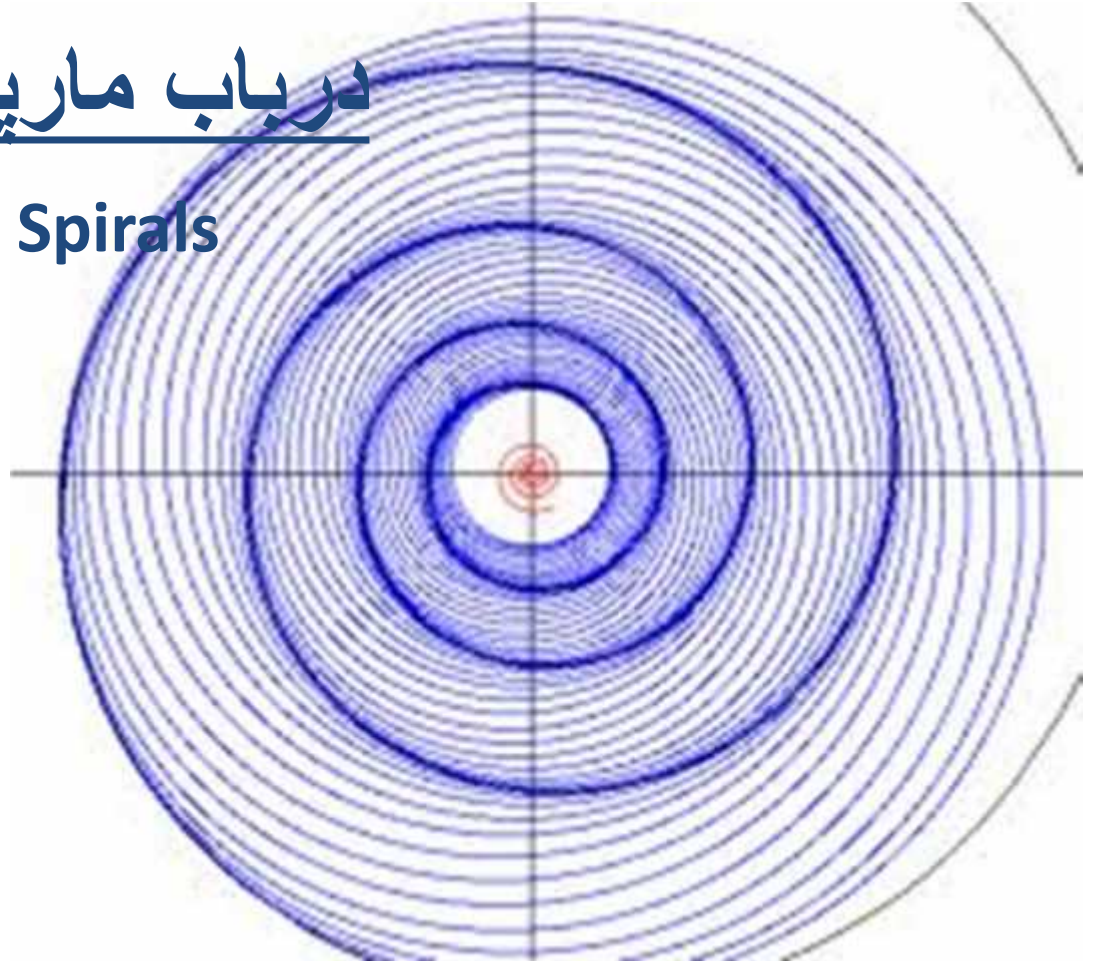
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درباب ماریچ ها

On Spirals





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•مطالعات هندسه یونان . اشکال قابل کنیسی

Alexanderian•

•قانون شکن



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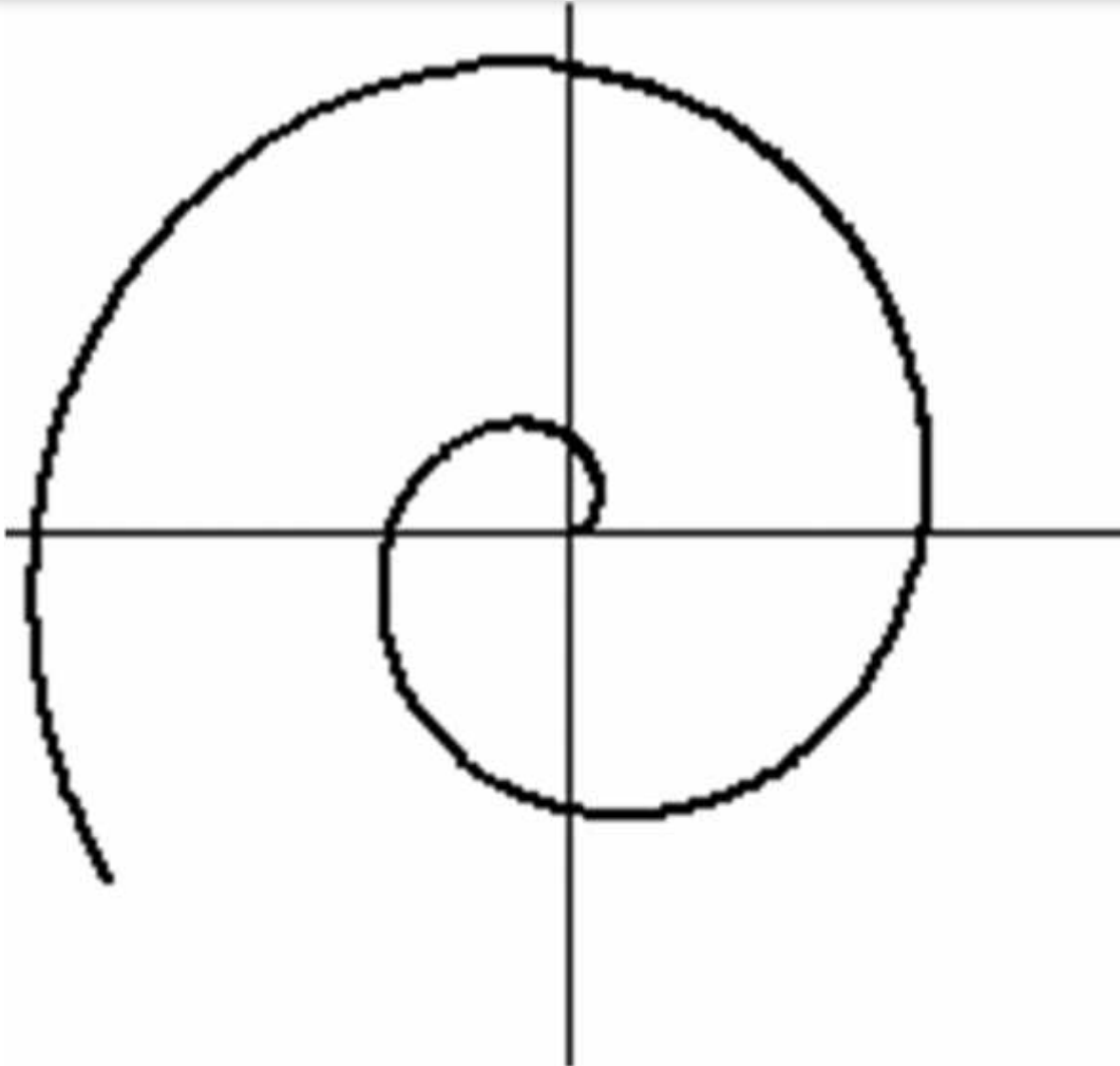
“On spirals”

• نوعی خاص از خم:

- مکان هندسی نقطه انتهایی یک قطعه خط که بطور یکنواخت در حال چرخش است و نقطه انتهایی دیگرش (مبدا) ثابت است و طول خط با نسبت یکنواختی افزایش می یابد.-



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$$\rho = a\theta$$



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• چرا؟!!!

• مفهوم مکانیک

• اولین مفهوم دیفرانسیل

• فرما, 1629

• تقریبا حیرت انگیز:

• تکنیک هایی برای ساختن مماس ها

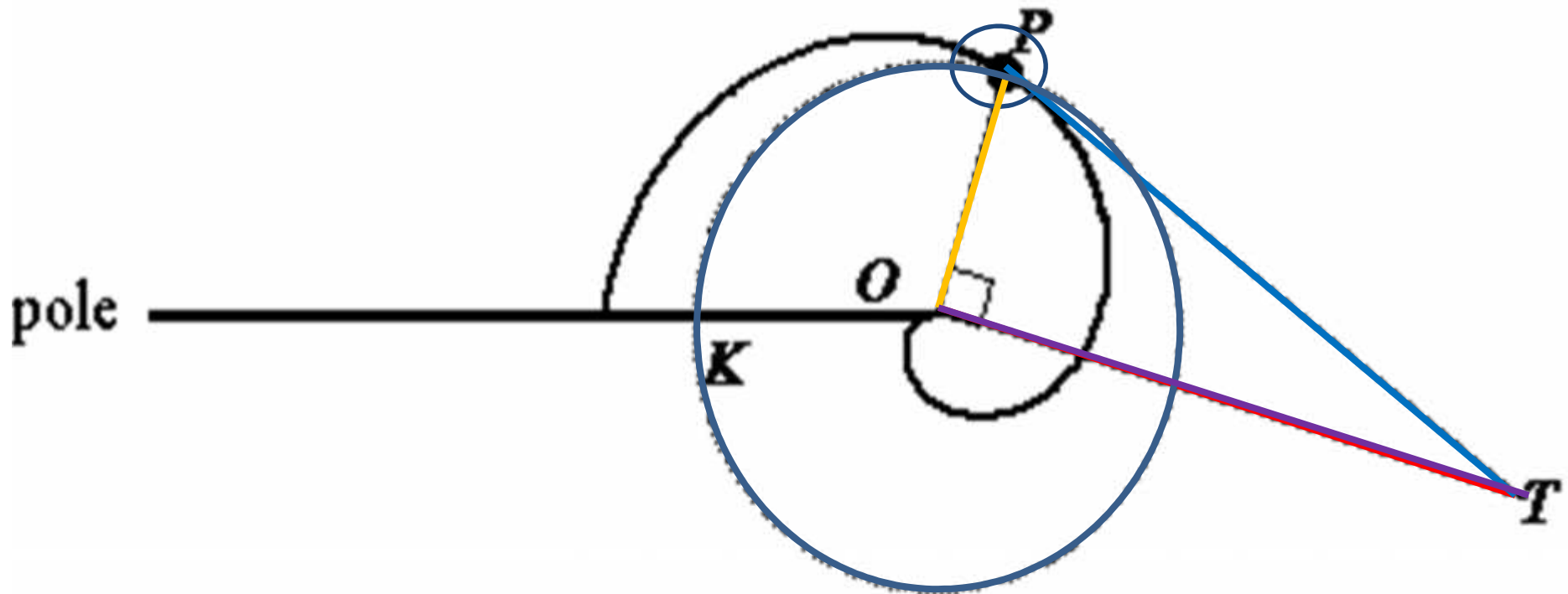
• 9 تاى اول : نسبت هاى بين دايـره ها و مماس هايشان

• 9 تا 12 : درباره ي تصاعد حسابى:

$$1^2 + 2^2 + 3^2 + \dots + n^2 > \frac{n^3}{3} > 1^2 + 2^2 + 3^2 + \dots + (n-1)^2$$

• 13 تا 20 : مماس ها بر مارپیچ ها

• روش ساخت مماس





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• عبارت 21 به بعد

• مساحت

• "Exhaustion"

• مساحت محدود شده توسط چرخش اول مارپیچ و قطب:

$$\frac{1}{3} \pi (2\pi a)^2$$



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• درک اشتباه یونانیان:

تعداد ذره های شنی در جهان بی نهایت است و نمی توان آن را با یک عدد نشان داد.



• ارزشمیدس:

• "حساب دانه های شنی"

• علامت گذاردن اعداد بزرگ

• تعداد دانه های شن در جهان



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M (ده هزار)

"BM"

بزرگترین واحد:

بیست هزار :

بزرگترین عدد : ده هزار × ده هزار : 10^8

1 تا 10^8 : رده اول

10^8 تا 10^{16} : رده دوم

⋮

$10^{(10^8-1)}$ تا $10^{(10^8)}$: رده (10^8) -ام

• دوره اول



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$$P : 10^{8(10^8)}$$

• دوره دوم:

$$\underline{P * 1} \text{ تا } \underline{P * 10^8} \quad \text{رده اول} :$$

:

$$P * 10^{8(10^8)} \text{ تا } P * 10^{8(10^8 - 1)} : \text{ورده } 10^8\text{-ام}$$

بنابراین:

دوره 10^8-ام :

$$1 * 10^{8-1} \text{ تا } 10^8 * 10^{8-1} : \text{رده اول}$$

:



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رده 10^8 -ام :

•تعداد خرده های شنی در جهان : 10^{51}

بسیار کمتر از $10^{8(10^8)} * 10^8 - 1$



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Approximation of a Square Root



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دو دستاورد مهم و اصلی:

• مقدار تقریبی $\sqrt{3}$

• مقادیر تقریبی ریشه های مربعی بعضی اعداد بزرگ

مقدار تقریبی $\sqrt{3}$:

• اندازه گیری دایره :

$$265/153 < \sqrt{3} < 1351/780$$

*نزدیکترین تقریب ها به $\sqrt{3}$



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$$a \pm \frac{b}{2a} > \sqrt{a^2 \pm b} > a \pm \frac{b}{2a \pm 1} \quad (a > b, a > 1)$$

$$a = \frac{5}{3} \quad a^2 = \frac{25}{9}$$

$$3 = \frac{27}{9} \quad b = \frac{2}{27}$$

$$a + \frac{b}{2a} \rightarrow \frac{26}{15} (> \sqrt{3})$$

مقدار جدید a

$$\frac{1351}{780} > \sqrt{3} \quad \text{در پایان :}$$



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$$\frac{1351}{780} > \sqrt{3} > \frac{265}{153}$$

7/4 به جای 5/3

تکرارهای بیشتری

به اندازه کافی به $\sqrt{3}$ نزدیک بوده



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مقادیر تقریبی بعضی اعداد بزرگ

"اندازه گیری دایره"

$$3013\frac{3}{4} > \sqrt{9082321}$$

$$1838\frac{9}{11} > \sqrt{3380929}$$

$$1009\frac{1}{6} > \sqrt{1018405}$$

$$2017\frac{1}{4} > \sqrt{4069284\frac{1}{36}}$$

$$1172\frac{1}{8} > \sqrt{1373943\frac{33}{54}}$$

$$2339\frac{1}{4} > \sqrt{5472132\frac{1}{16}}$$

قضیه اقلیدس

$$(a + b)^2 = a^2 + 2ab$$

مخرج های 60



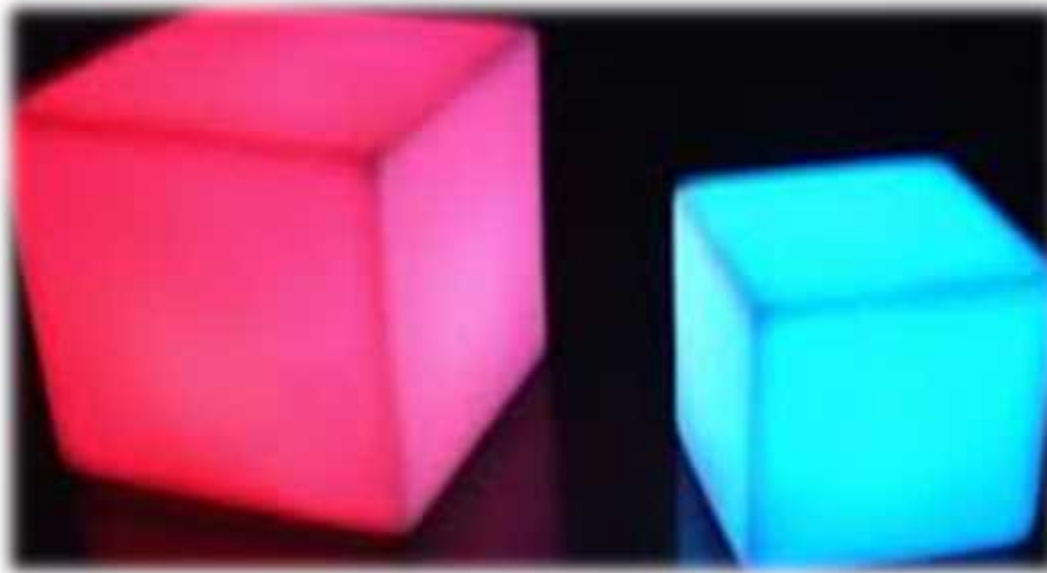
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معادلات مكعبی Qubic Equations





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ریاضیدانان یونان باستان

$$a^2/x = x/b$$

ارشمیدس: عبارت های 1 و 5، "در باب کره و استوانه"

Al-Khazin (965) ، Ibn Al-Haytham (965-1040) و Abu'l Jud (≈ 1000)

راه حل های مخروطی برای همه انواع معادلات مکعبی : خیام (1048-1131)



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سایر دستاوردهای ریاضی

Other mathematical achievements

دستاوردهای مهم اما کمتر شناخته شده



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فرمول برای مساحت مثلث


$$\sqrt{s(s-a)(s-b)(s-c)}$$

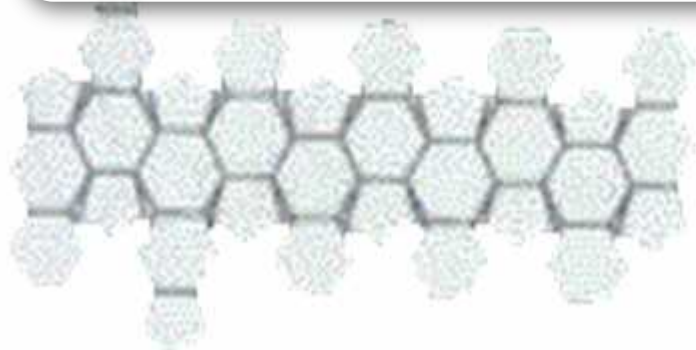
فرمول Heron

چند وجهی نیمه منتظم (Semi-Regular polyhedron)

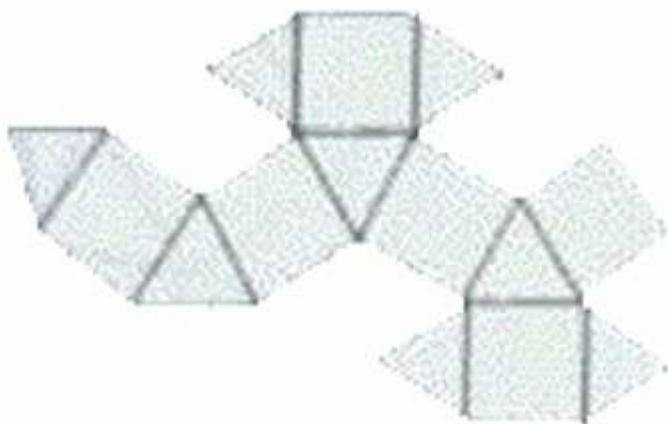
13 نوع مختلف چندوجهی نیمه منتظم



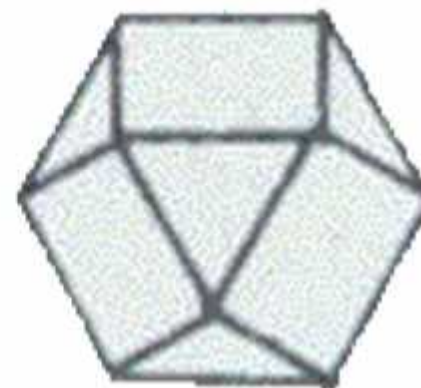
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icosahedron

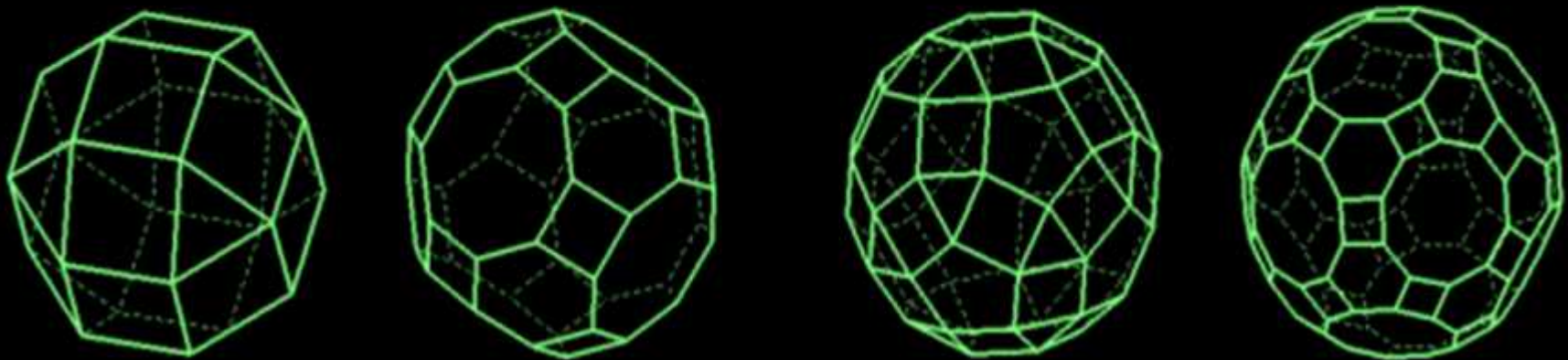
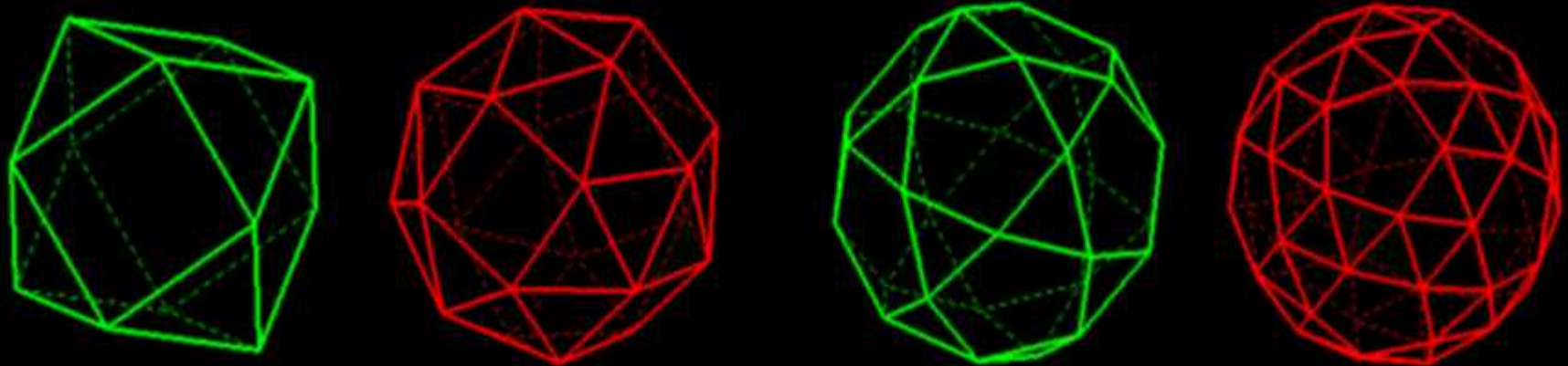


cuboctahedron





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ساختن یک هفت ضلعی منتظم

ترجمه یک ریاضیدان عرب



مسئله گاوها (گله گاوها)

Hieron

w و W : بترتیب تعداد گاوهای نر سفید و گاوها باشند.

x و X : بترتیب تعداد گاوهای نر سیاه و گاوها باشند.

y و Y : بترتیب تعداد گاوهای نر زرد و گاوها باشند.

z و Z : بترتیب تعداد گاوهای نر خال خالی و گاوها باشند.



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$$w = \left(\frac{1}{3} + \frac{1}{4} \right) (X + x), \quad x = \left(\frac{1}{4} + \frac{1}{5} \right) (Z + z), \quad z = \left(\frac{1}{5} + \frac{1}{6} \right) (Y + y), \quad y = \left(\frac{1}{6} + \frac{1}{7} \right) (W + w)$$



تلاش زیادی برای پیدا کردن جواب کرد که حکم عدد داده 7 رقمی Hieron

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$W + X =$ مربع كامل

$Y + Z =$ عدد مثلثی



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حل این مسئله باوان بود در Hieron

:1965

جواب مسئله 206500 رقم داشت !!!



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کتاب لم ها ("Book Of Lemmas")

• کتاب عربی

• 15 مسئله در مورد دایره ها

• نوادگان ارشمیدس

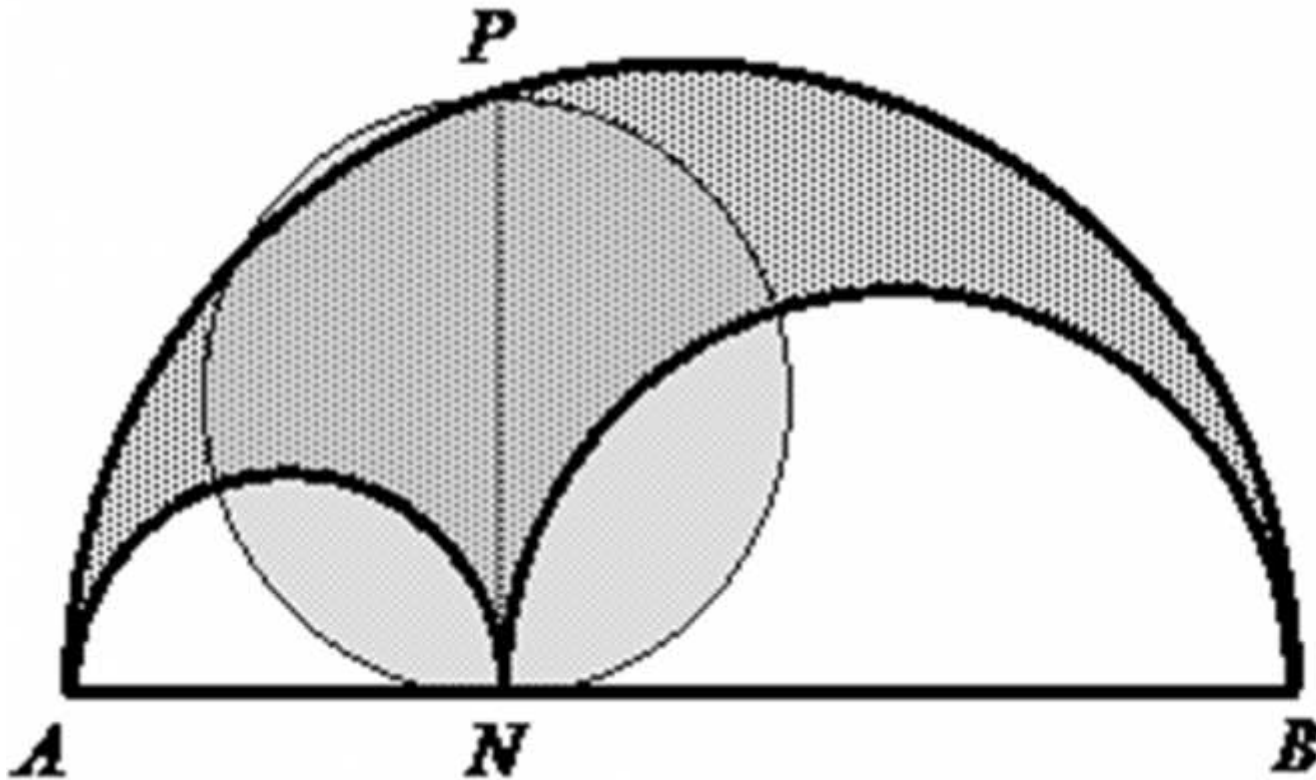
Theme کلی

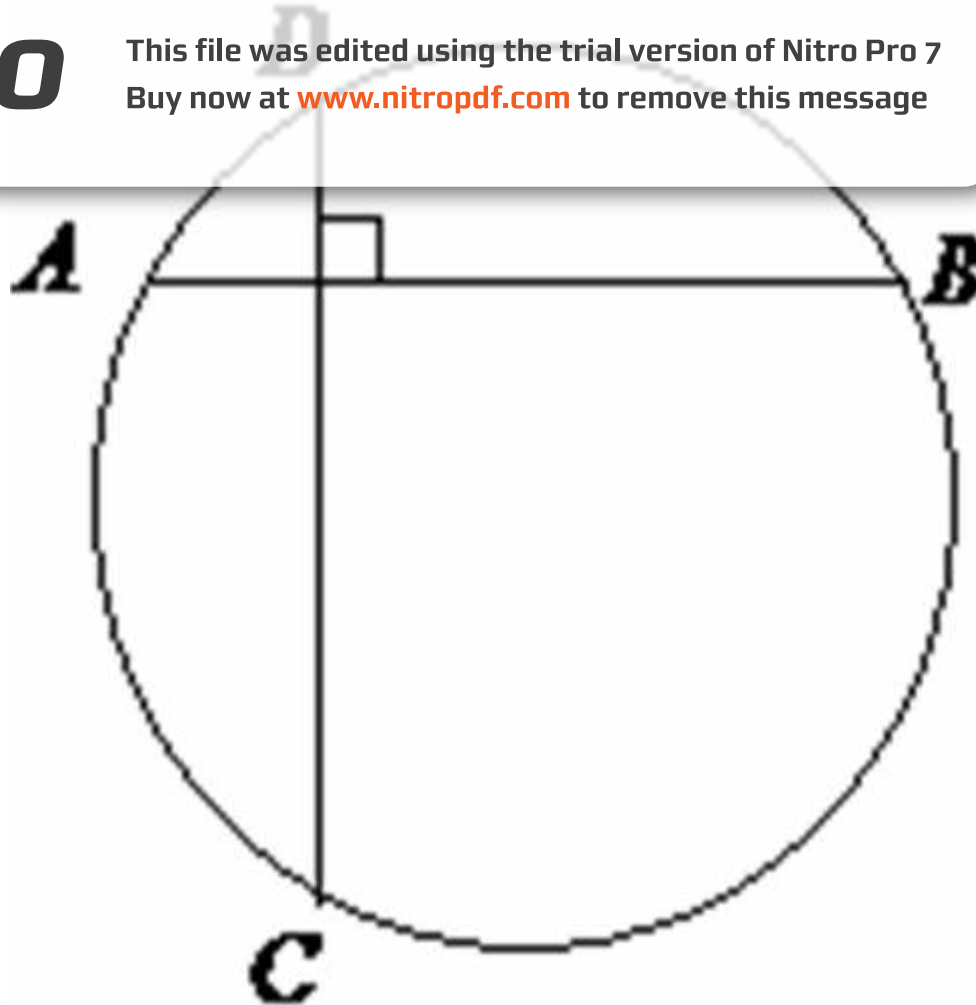


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عبارت 4 : مجموع مساحت های دو نیم دایره کشیده شده با قطرهای AN و BN = مساحت دایره ای با شعاع PN





$$(AD \text{ کمان}) + (BC \text{ کمان}) = (AC \text{ کمان}) + (DB \text{ کمان})$$

V. References



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