

GEOMETRİ FORMÜLLERİ





İçindekiler

Her kuralın numarası kartının sol üstündedir. Başlıklara dokunarak ilgili sayfaya gidebilirsiniz.

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1. ÜÇGENLER



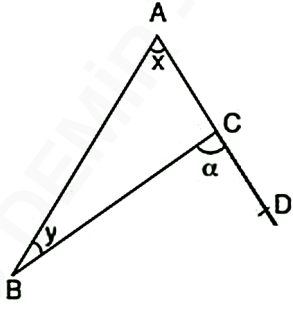
Üçgende Açılar

1.1 – 1.10

1.1

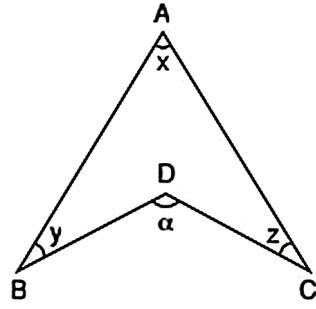
■ Bir üçgende, iç açılarının ölçüleri toplamı 180° , dış açılarının ölçüleri toplamı 360° dir.

1.2



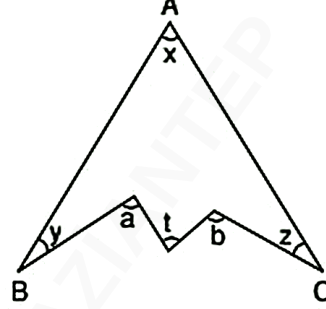
$$\alpha = x + y$$

1.3



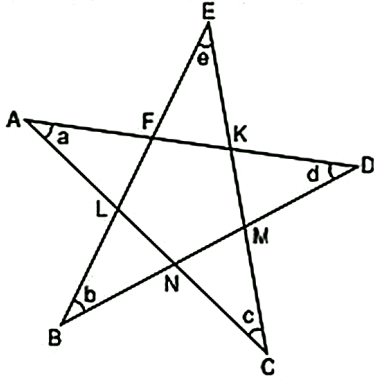
$$\alpha = x + y + z$$

1.4



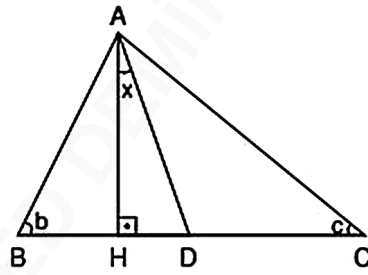
$$a + b = x + y + z + t$$

1.5



$$a + b + c + d + e = 180^\circ$$

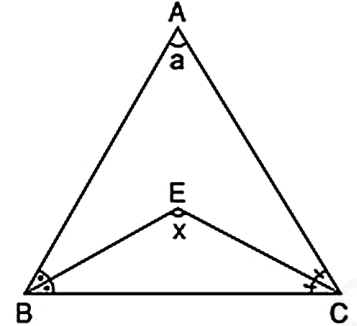
1.6



[AH] yükseklik [AD] açıortay ise

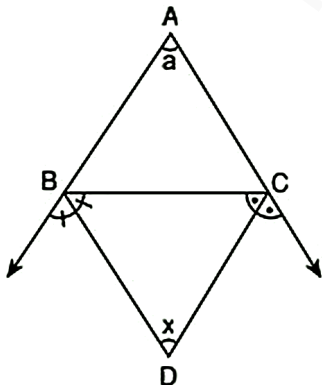
$$x = \frac{|b - c|}{2}$$

1.7



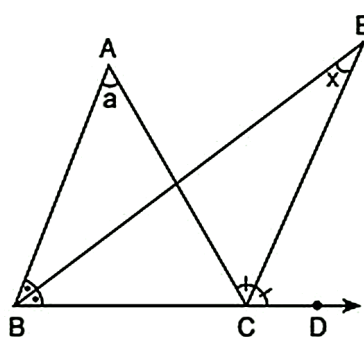
$$x = 90^\circ + \frac{a}{2}$$

1.8



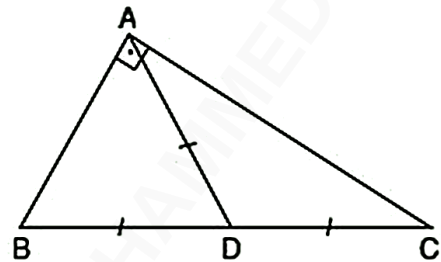
$$x = 90^\circ - \frac{a}{2}$$

1.9



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

1.10 Muhteşem Üçlü



$$|BD| = |DC| = |AD|$$

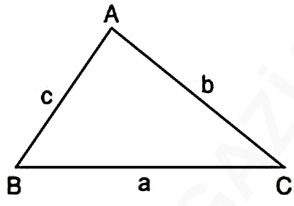
(muhteşem üçlü)



Üçgende Açı-Kenar Bağlılıları

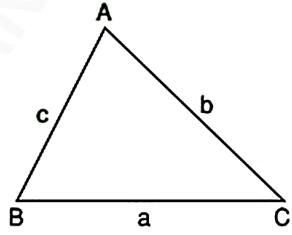
1.11 – 1.18

1.11



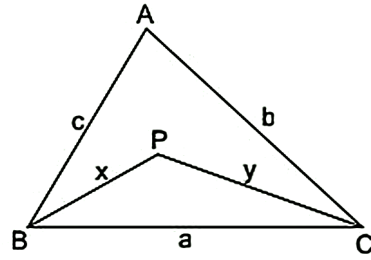
$$a > b > c \text{ ise} \\ m(\hat{A}) > m(\hat{B}) > m(\hat{C})$$

1.12



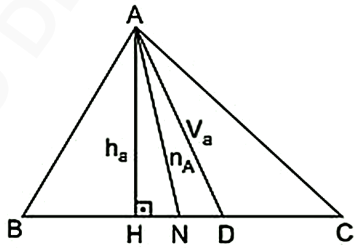
$$|b - c| < a < b + c$$

1.13



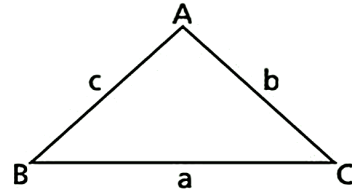
$$a < x + y < b + c$$

1.14



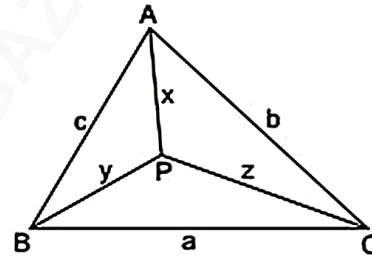
$$h_a \leq n_A \leq v_a$$

1.15



$$\blacksquare m(\hat{A}) < 90^\circ \quad a^2 < b^2 + c^2 \\ \blacksquare m(\hat{A}) > 90^\circ \quad a^2 > b^2 + c^2$$

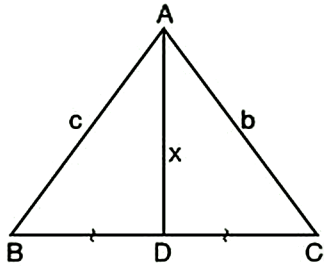
1.16



$$\begin{aligned} \text{Ç}(ABC) = 2u \text{ olarak verilmişse} \\ u < x + y + z < 2u \end{aligned}$$

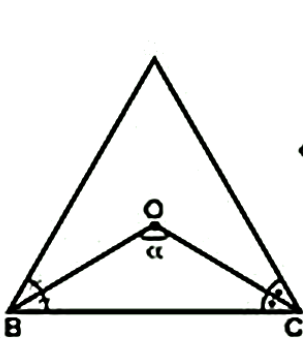
$$a, b \text{ ve } c \text{ kenarları ayrı ayrı verilmişse} \\ u < x + y + z < \text{en uzun iki kenar toplamı}$$

1.17

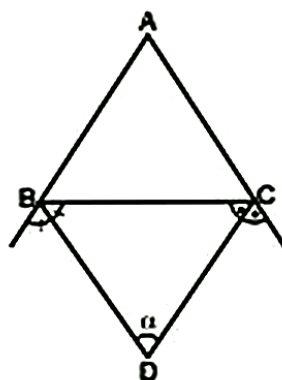


$$\begin{aligned} \text{ABC üçgen, [AD] kenarortay} \\ \frac{|b - c|}{2} < x < \frac{b + c}{2} \end{aligned}$$

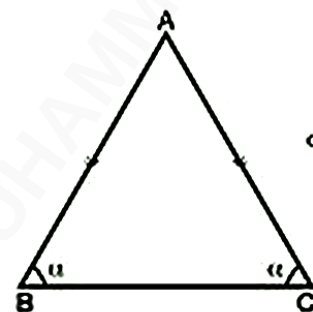
1.18 Uyarı



$$\alpha > 90^\circ$$



$$\alpha < 90^\circ$$



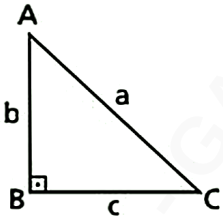
$$\alpha < 90^\circ$$



Dik Üçgen

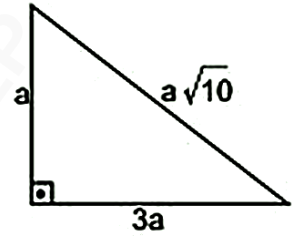
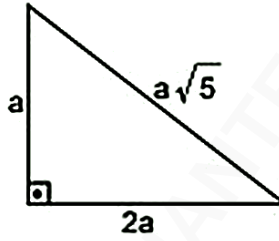
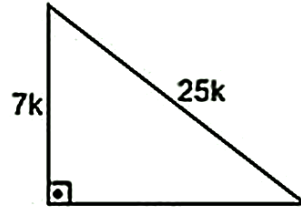
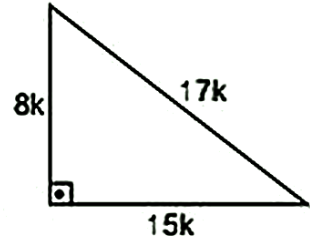
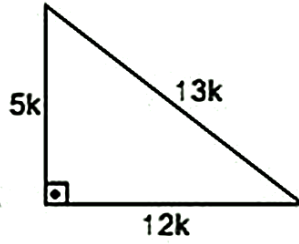
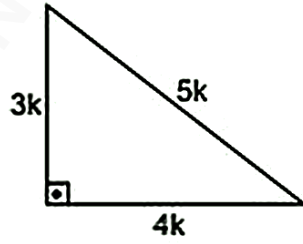
1.19 – 1.27

1.19 Pisagor Teoremi

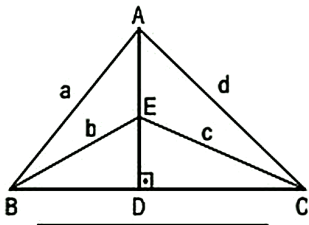


$$a^2 = b^2 + c^2$$

1.20 Özel Dik Üçgenler

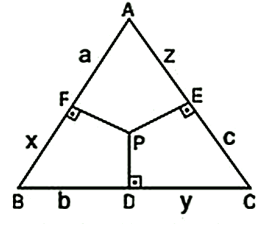


1.21



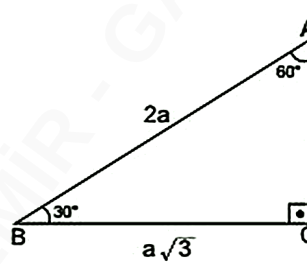
$$a^2 + c^2 = b^2 + d^2$$

1.22

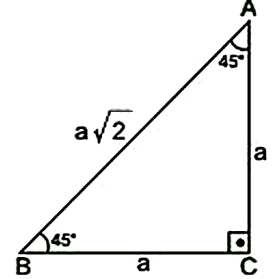


$$a^2 + b^2 + c^2 = x^2 + y^2 + z^2$$

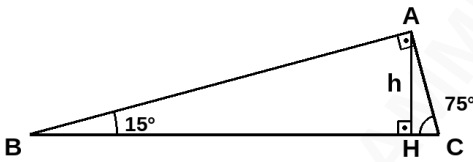
1.23 30° – 60° – 90° Üçgeni



1.24 45° – 45° – 90° Üçgeni



1.25 15° – 75° – 90° Üçgeni

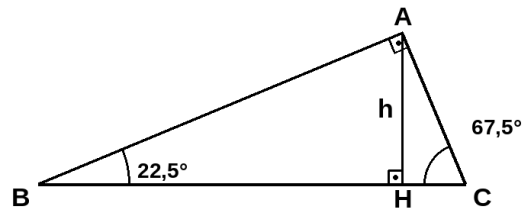


$$|BC| = 4h$$

$$|AB| = h(\sqrt{6} + \sqrt{2}) \quad |AC| = h(\sqrt{6} - \sqrt{2})$$

$$|AC| : |AB| : |BC| = (\sqrt{6} - \sqrt{2}) : (\sqrt{6} + \sqrt{2}) : 4$$

1.26 22,5° – 67,5° – 90° Üçgeni

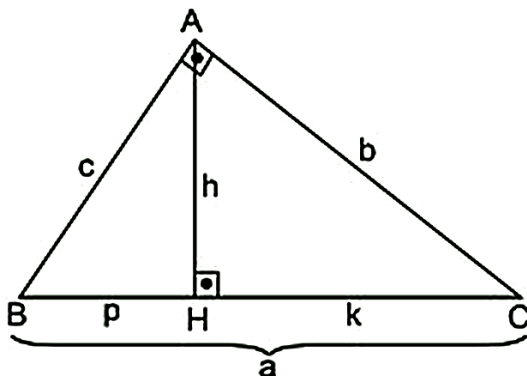


$$|BC| = 2\sqrt{2} \cdot h$$

$$|AB| = (\sqrt{2} + 1) \cdot |AC|$$

$$|AC| : |AB| : |BC| = 1 : (\sqrt{2} + 1) : \sqrt{4 + 2\sqrt{2}}$$

1.27 Öklid Bağıntıları



$$1. \quad h^2 = p \cdot k$$

$$2. \quad a \cdot h = b \cdot c$$

$$3. \quad b^2 = k \cdot a$$

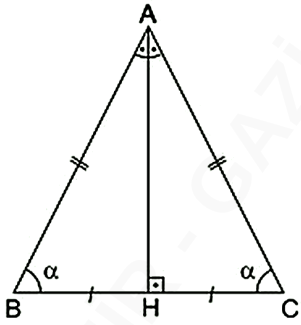
$$4. \quad c^2 = p \cdot a$$



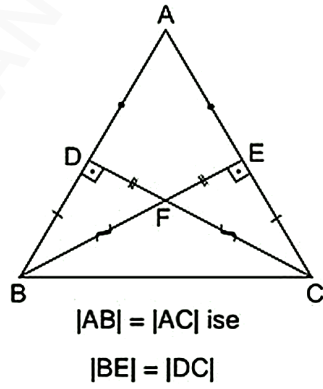
İkizkenar Üçgen

1.28 – 1.37

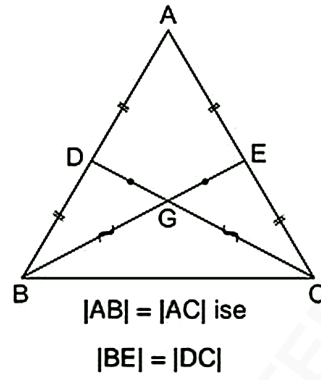
1.28 YAK-İ



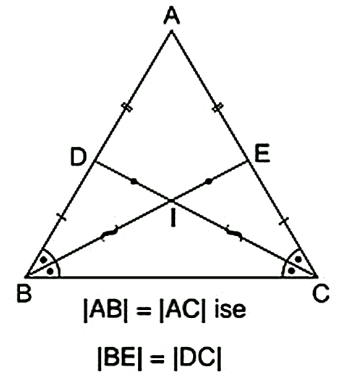
1.29



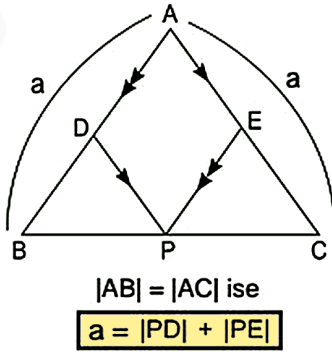
1.30



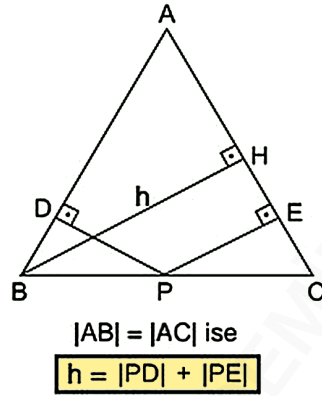
1.31



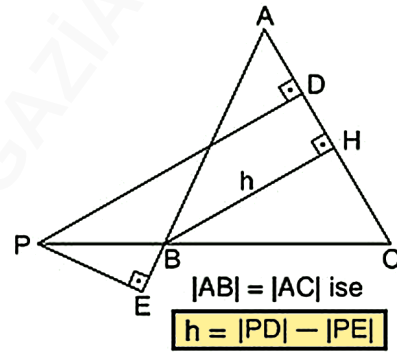
1.32



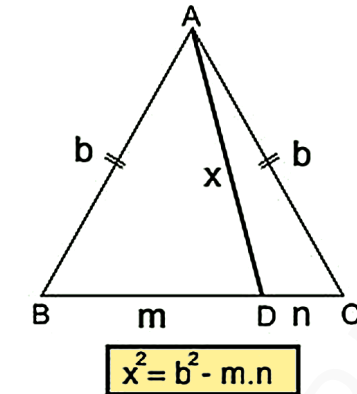
1.33



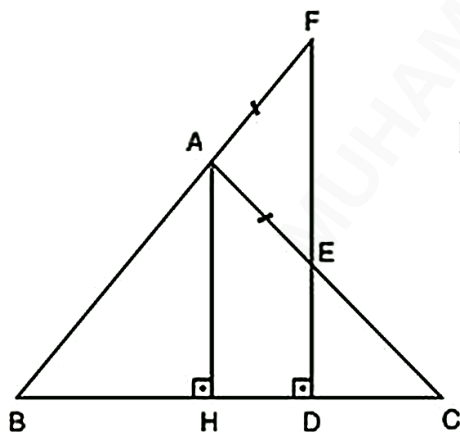
1.34



1.35



1.36



$|AB| = |AC|$ ise
 $|AF| = |AE|$



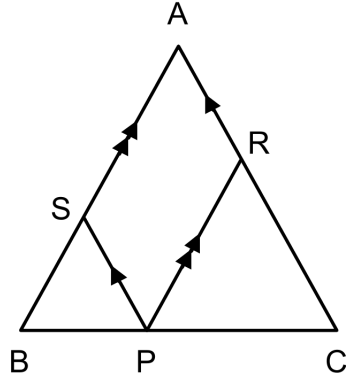
İkizkenar Üçgen (devam)

1.28 – 1.37

1.37 Paralel Doğrular

P herhangi bir nokta

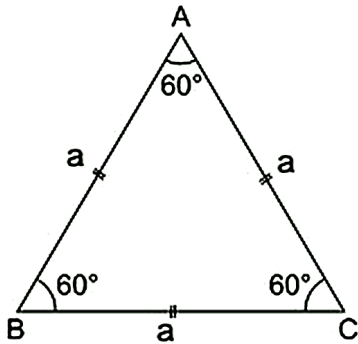
$[PR] \parallel [AB]$, $[PS] \parallel [AC]$ ve $|AB| = |AC|$ olmak üzere $|PR| + |PS| = |AB| = |AC|$



Eşkenar Üçgen

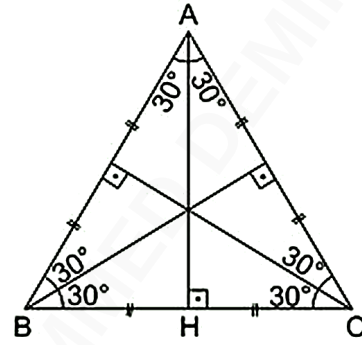
1.38 – 1.42

1.38

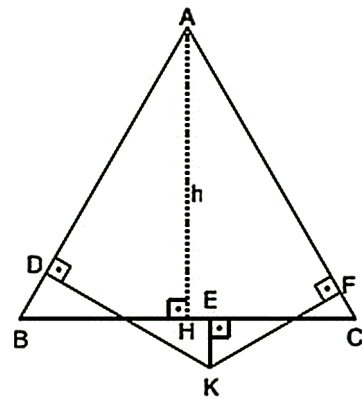


$$\text{Alan}(\widehat{ABC}) = \frac{a^2\sqrt{3}}{4}$$

1.39

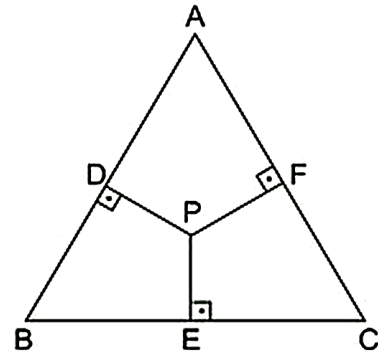


1.41



$$|KD| + |KF| - |KE| = h$$

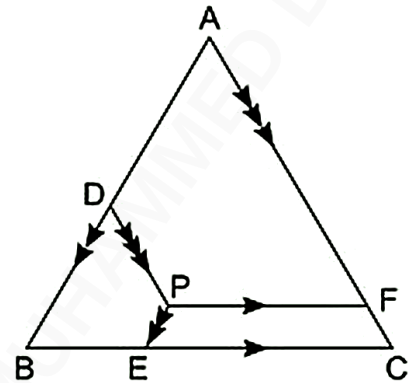
1.40



ABC eşkenar üçgen

$$h = |PD| + |PE| + |PF|$$

1.42



ABC eşkenar üçgen

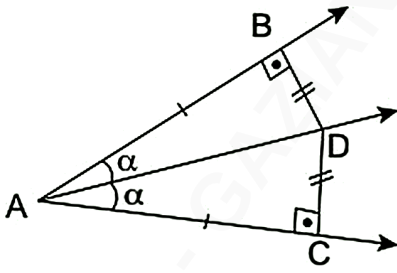
$$|AB| = |PD| + |PE| + |PF|$$



Üçgende Açkırtay

1.43 – 1.47

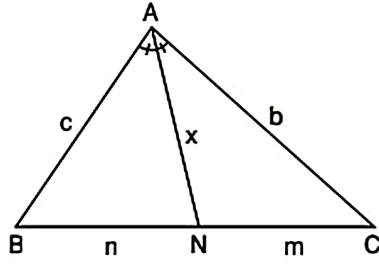
1.43



$$|BD| = |DC|$$

$$|AB| = |AC|$$

1.44



$$\frac{b}{c} = \frac{m}{n}$$

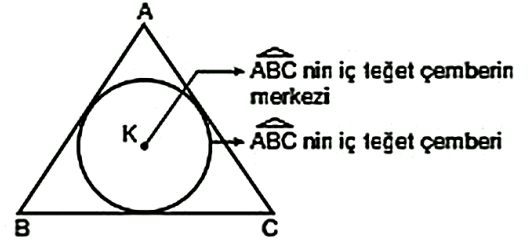
veya

$$\frac{c}{n} = \frac{b}{m}$$

$$x^2 = b \cdot c - m \cdot n$$

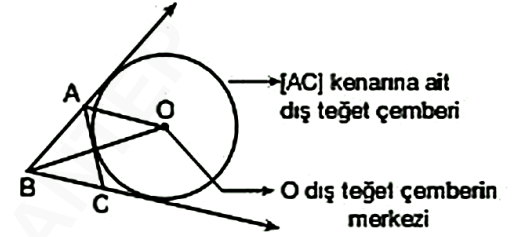
1.46

İç ve Dış Teğet Çember



ABC'nin iç teğet çemberin merkezi

ABC'nin iç teğet çemberi

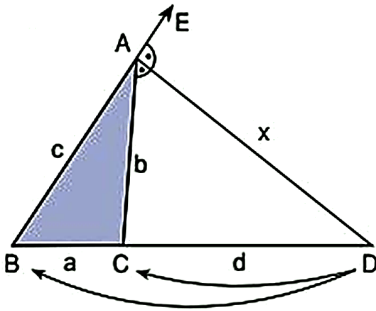


[AC] kenarına ait dış teğet çemberi

O dış teğet çemberin merkezi

1.45

Dış Açkırtay Teoremi



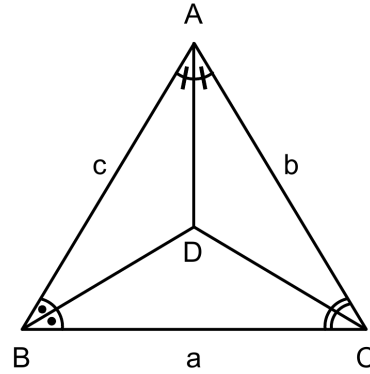
$$\frac{b}{d} = \frac{c}{a+d}$$

$$x^2 = d \cdot (d + a) - b \cdot c$$

1.47

D, ABC üçgeninin iç teğet çemberinin merkezi ise,

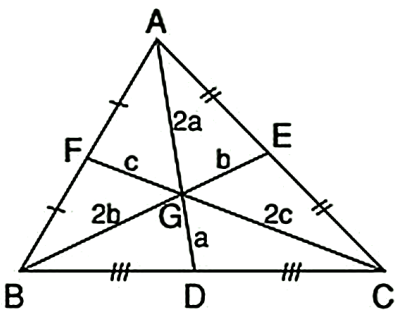
$$\frac{A(\widehat{CDB})}{a} = \frac{A(\widehat{ADC})}{b} = \frac{A(\widehat{ABD})}{c} \text{ dir.}$$



Üçgende Kenarortay

1.48 – 1.54

1.48

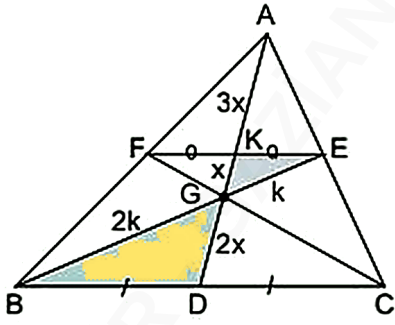




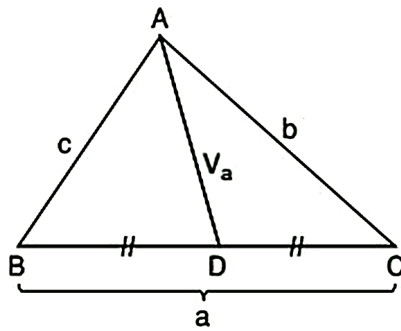
Üçgende Kenarortay (devam)

1.48 – 1.54

1.49

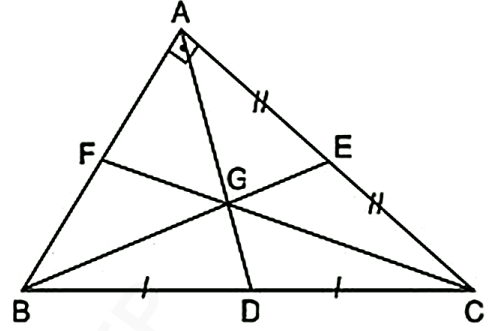


1.50 Kenarortay Teoremi



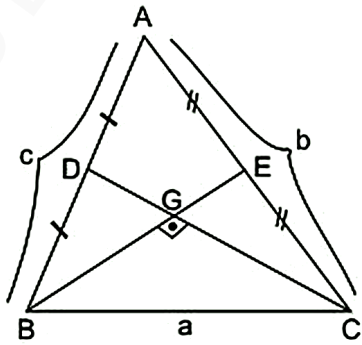
$$2V_a^2 = b^2 + c^2 - \frac{a^2}{2}$$

1.51



$$5V_a^2 = V_b^2 + V_c^2$$

1.52

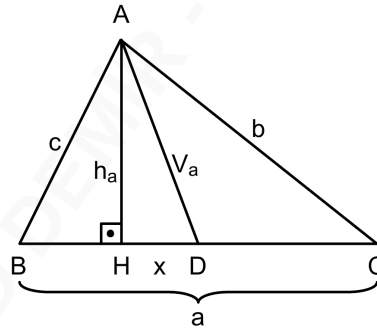


$$5a^2 = b^2 + c^2$$

1.53

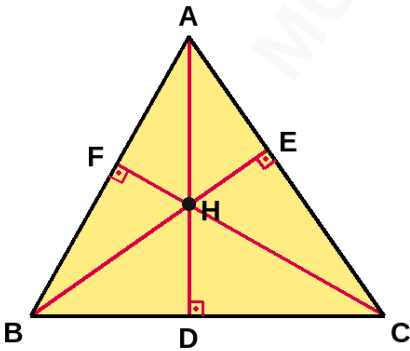
[AD] kenarortay, [AH] yükseklik,

|HD| = x ise, $2 \cdot a \cdot x = |b^2 - c^2|$ dir.

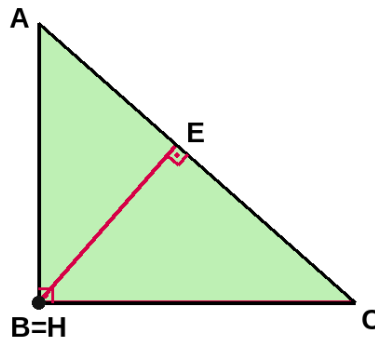


1.54 Yükseklik (Diklik Merkezi)

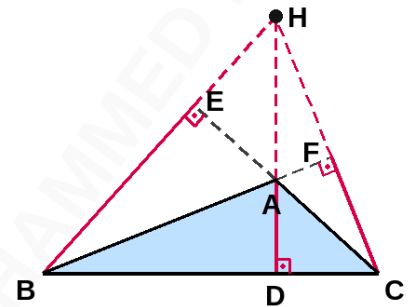
- Bir üçgenin üç yüksekliği bir noktada kesişir. Bu noktaya üçgenin diklik merkezi (H) denir.



Dar açılı üçgende H iç bölgededir.



Dik üçgende H, dik açının köşesidir.



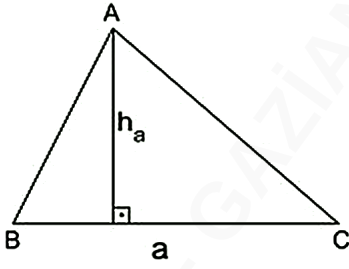
Geniş açılı üçgende H dış bölgededir.



Üçgende Alan

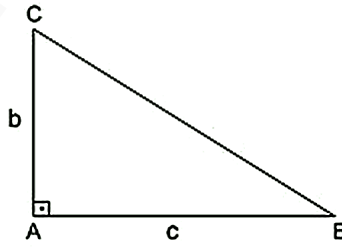
1.55 – 1.70

1.55



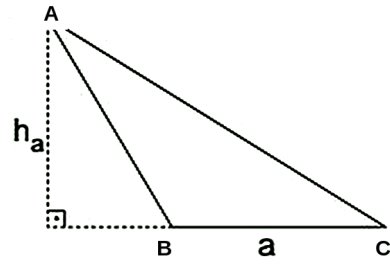
$$\text{Alan}(\widehat{ABC}) = \frac{a \cdot h_a}{2}$$

1.56



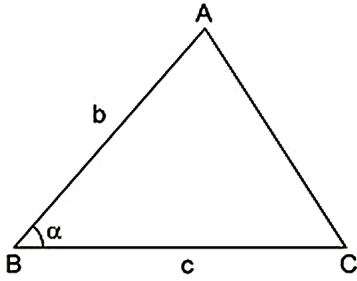
$$\text{Alan}(\widehat{ABC}) = \frac{b \cdot c}{2}$$

1.57



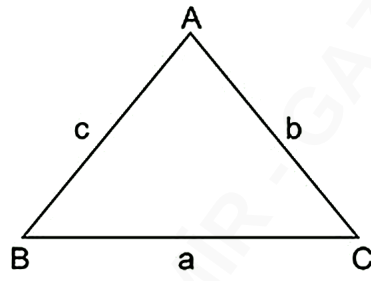
$$\text{Alan}(\widehat{ABC}) = \frac{a \cdot h_a}{2}$$

1.58



$$\text{Alan}(\widehat{ABC}) = \frac{1}{2} \cdot b \cdot c \cdot \sin \alpha$$

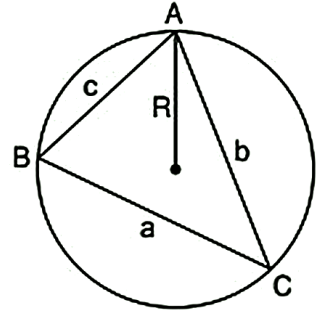
1.59 Heron Formülü



$$u = \frac{a + b + c}{2} \text{ olmak üzere,}$$

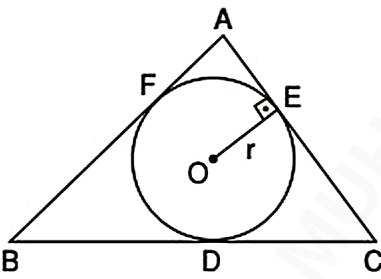
$$A(\widehat{ABC}) = \sqrt{u \cdot (u - a) \cdot (u - b) \cdot (u - c)}$$

1.61



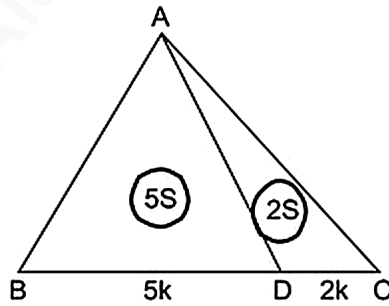
$$A(\widehat{ABC}) = \frac{a \cdot b \cdot c}{4R}$$

1.60

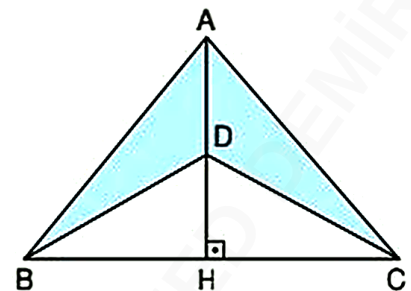


$$A(\widehat{ABC}) = u \cdot r$$

1.62

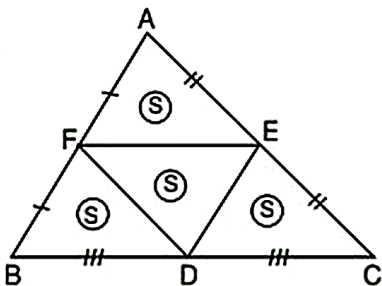


1.63



$$A(\widehat{ABDC}) = \frac{|AD| \cdot |BC|}{2}$$

1.64

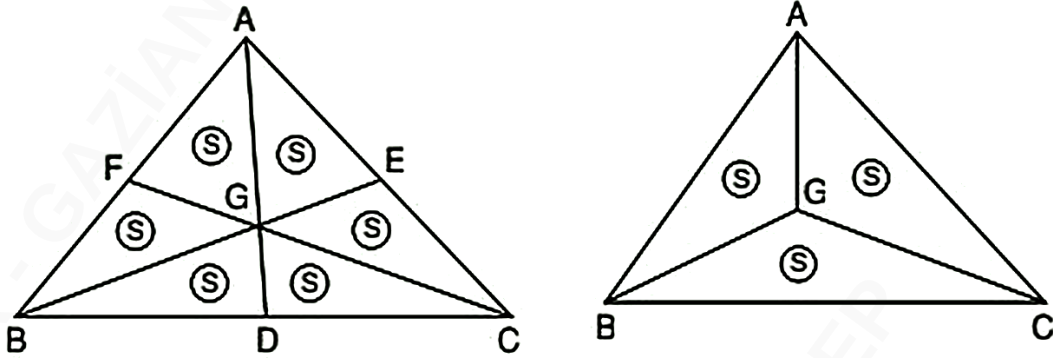




Üçgende Alan (devam)

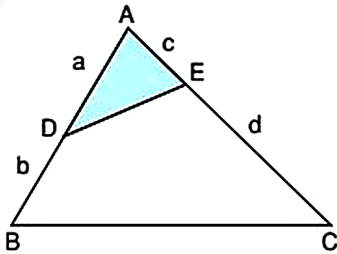
1.55 – 1.70

1.65 Ağırlık Merkezi ve Alan



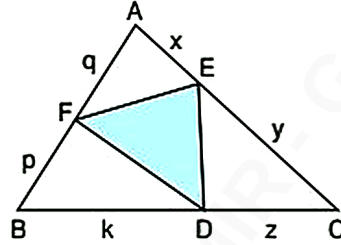
ABC üçgeninde G, ağırlık merkezi ise,

1.66



$$\frac{A(\widehat{ADE})}{A(\widehat{ABC})} = \frac{a}{a+b} \cdot \frac{c}{c+d}$$

1.67



$$\frac{A(\widehat{FDE})}{A(\widehat{ABC})} = \frac{q \cdot k \cdot y + p \cdot z \cdot x}{(p+q) \cdot (k+z) \cdot (x+y)}$$

1.68 Yükseklikleri Eşit Üçgenler

Yükseklikleri eşit olan üçgenlerin alanları oranı ile tabanları oranı eşittir.

$d_1 \parallel d_2$ ise h, ABC ve DEF üçgenlerinin ortak yüksekliğidir.

$$\frac{A(\widehat{ABC})}{A(\widehat{DEF})} = \frac{\frac{a \cdot h}{2}}{\frac{d \cdot h}{2}} = \frac{a}{d}$$

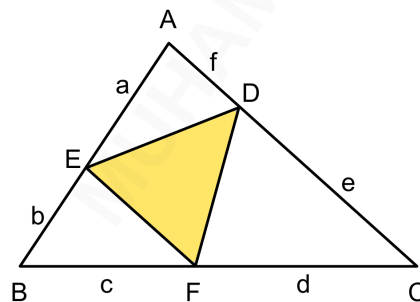
1.69 Tabanları Eşit Üçgenler

Taban uzunlukları eşit olan üçgenlerin alanları oranı, (eşit olan tabanlara ait) yüksekliklerinin oranına eşittir.

$$a = d \text{ ise } \frac{A(\widehat{ABC})}{A(\widehat{DEF})} = \frac{\frac{a \cdot h_a}{2}}{\frac{d \cdot h_d}{2}} = \frac{h_a}{h_d} \text{ olur.}$$

1.70

$$\frac{A(\widehat{ABC})}{A(\widehat{DEF})} = \frac{|AB| \cdot |AC| \cdot |BC|}{a \cdot c \cdot e + b \cdot d \cdot f} \text{ şeklindedir.}$$

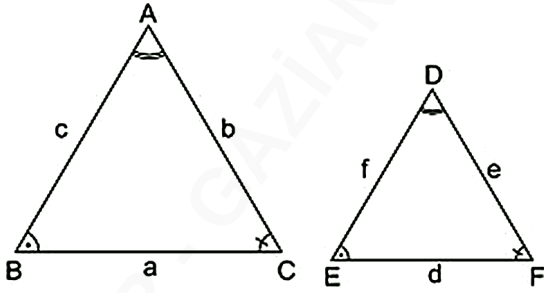




Benzerlik ve Özel Teoremler

1.71 – 1.81

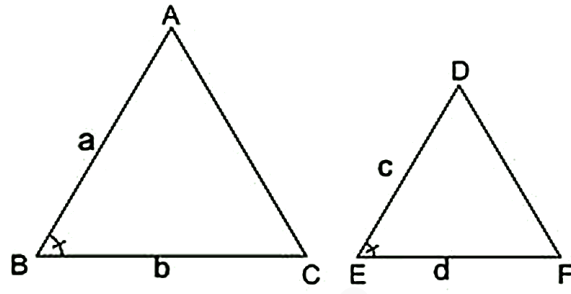
1.71 Açı – Açı (A.A.) Benzerliği



$$\widehat{ABC} \sim \widehat{DEF}$$

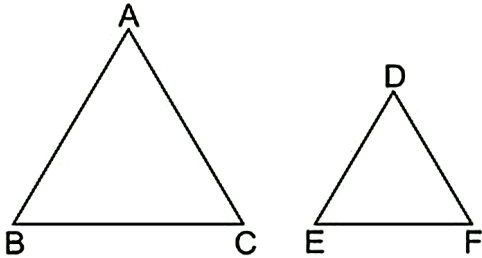
$$\frac{a}{d} = \frac{b}{e} = \frac{c}{f}$$

1.72 Kenar – Açı – Kenar Benzerliği



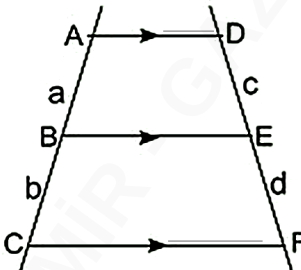
$$\frac{a}{c} = \frac{b}{d} \text{ ve } m(\widehat{B}) = m(\widehat{E}) \text{ ise, } \widehat{ABC} \sim \widehat{DEF}$$

1.73 Kenar – Kenar – Kenar Benzerliği



$$\frac{|AB|}{|DE|} = \frac{|BC|}{|EF|} = \frac{|AC|}{|DF|} \text{ ise, } \widehat{ABC} \sim \widehat{DEF}$$

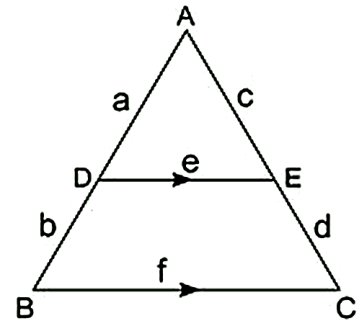
1.74 Thales Teoremi



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

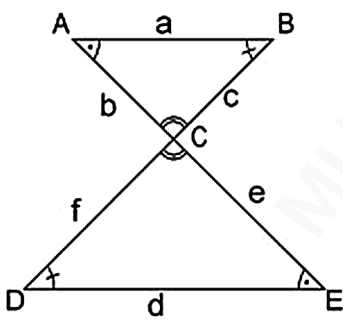
$$\frac{a}{c} = \frac{b}{d}$$

1.75 Temel Orantı Teoremi



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

1.76 Kelebek Benzerliği



$$\frac{a}{d} = \frac{b}{e} = \frac{c}{f}$$

1.77 Benzer Üçgenlerin Özellikleri

- Benzer üçgenlerin, eşit açılarının karşısındaki kenarları, yardımcı elemanları ve çevreleri orantılıdır.

$$\frac{a}{d} = \frac{b}{e} = \frac{c}{f} = k \text{ (benzerlik oranı)}$$

$$\frac{h_a}{h_d} = \frac{n_A}{n_D} = \frac{V_a}{V_d} = k \quad \frac{\text{Çevre}(\widehat{ABC})}{\text{Çevre}(\widehat{DEF})} = k$$

- Benzer üçgenlerin alanlarının oranı benzerlik oranının karesine eşittir.

$$\frac{\text{Alan}(\widehat{ABC})}{\text{Alan}(\widehat{DEF})} = k^2$$

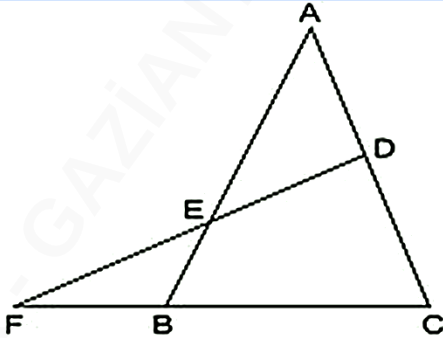
- Benzerlik oranı $k = 1$ olan üçgenler eşittir.



Benzerlik ve Özel Teoremler (devam)

1.71 – 1.81

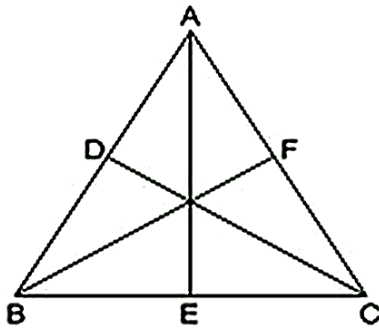
1.78 Menelaus Teoremi (meraklısına)



$$\frac{|FB|}{|FC|} \cdot \frac{|CD|}{|DA|} \cdot \frac{|AE|}{|EB|} = 1$$

$$\frac{|AD|}{|AC|} \cdot \frac{|CB|}{|BF|} \cdot \frac{|FE|}{|ED|} = 1$$

1.79 Seva Teoremi (meraklısına)

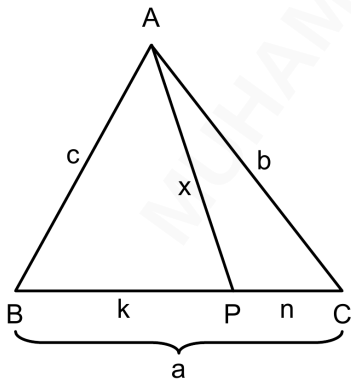


$$\frac{|AD|}{|DB|} \cdot \frac{|BE|}{|EC|} \cdot \frac{|CF|}{|FA|} = 1$$

1.80 Stewart Teoremi (meraklısına)

Şekildeki ABC üçgeninde a, b ve c kenar uzunlukları P, [BC] nın üzerinden alınan herhangi bir nokta olmak üzere,

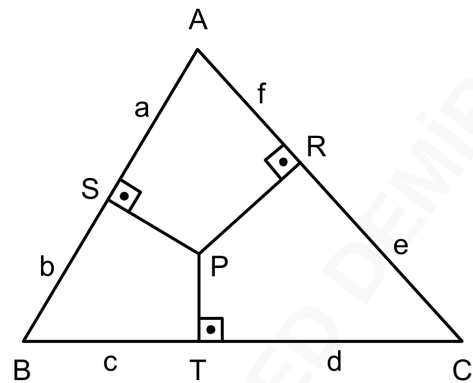
$$x^2 = \frac{b^2 \cdot m + c^2 \cdot n}{a} - m \cdot n \text{ şeklindedir.}$$



1.81 Carnot Teoremi (meraklısına)

P, herhangi bir nokta olmak üzere;

$$a^2 + c^2 + e^2 = b^2 + d^2 + f^2 \text{ şeklindedir.}$$



2. DÖRTGENLER



Dörtgenler

2.1 – 2.12

2.1

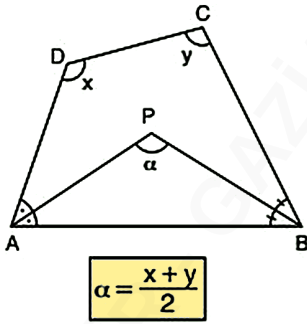
Dörtgenin iç açılarının ölçüleri toplamı 360° dir. Dış açılarının ölçüleri toplamı da 360° dir.



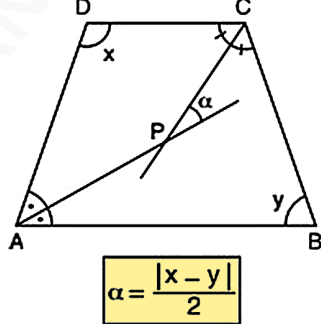
Dörtgenler (devam)

2.1 – 2.12

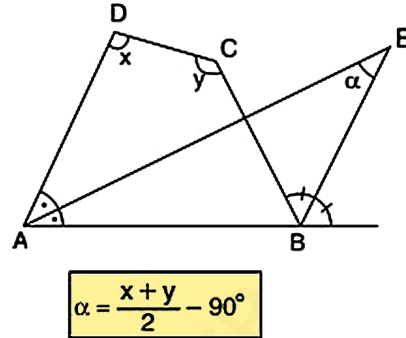
2.2



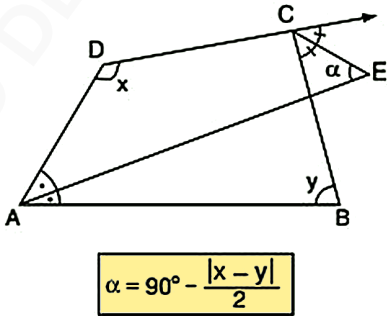
2.3



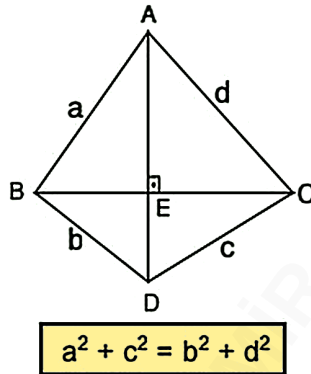
2.4



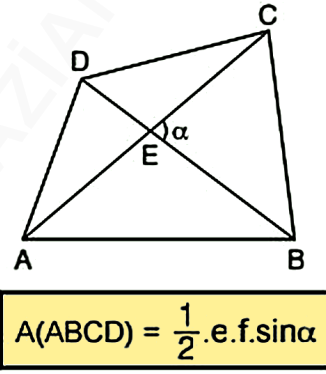
2.5



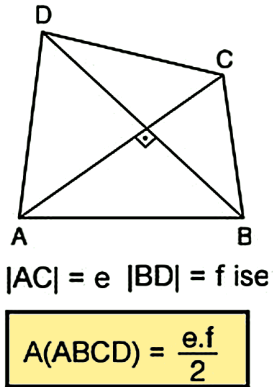
2.6



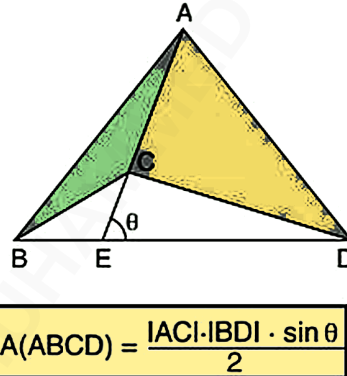
2.7



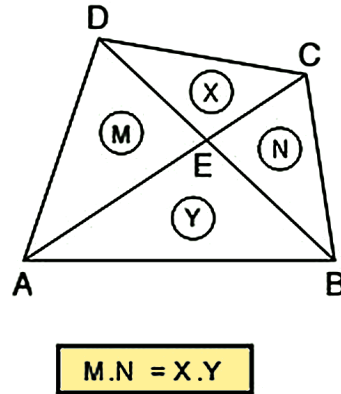
2.8



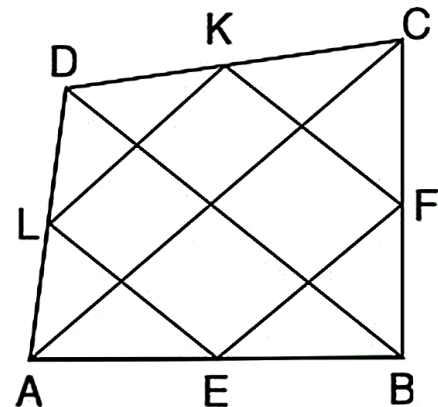
2.9



2.10



2.11



L, E, F ve K kenar orta noktaları ise

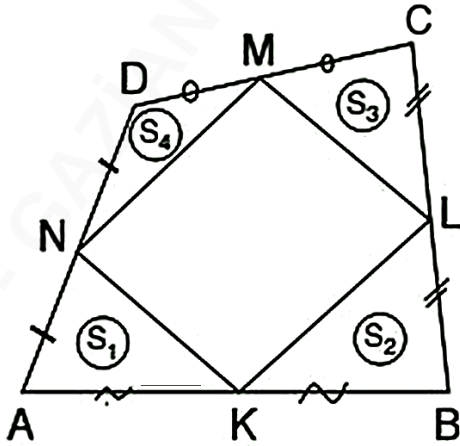
- * EFKL paralelkenardır.
- * Çevre(EFKL) = |AC| + |BD|
- * $[DB] \perp [AC] \Rightarrow$ EFKL dikdörtgendir.
- * $|DB| = |AC| \Rightarrow$ EFKL eşkenar dörtgendir.
- * $|DB| = |AC|$ ve $[DB] \perp [AC] \Rightarrow$ EFKL karedir.



Dörtgenler (devam)

2.1 – 2.12

2.12



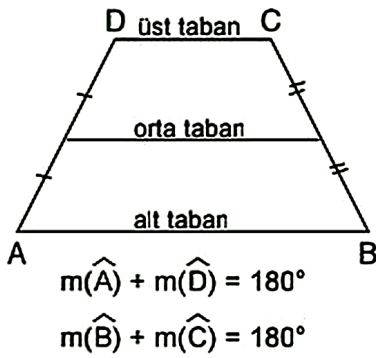
$$S_1 + S_3 = S_2 + S_4$$

$$A(KLMN) = \frac{A(ABCD)}{2}$$

Yamuk

2.13 – 2.18

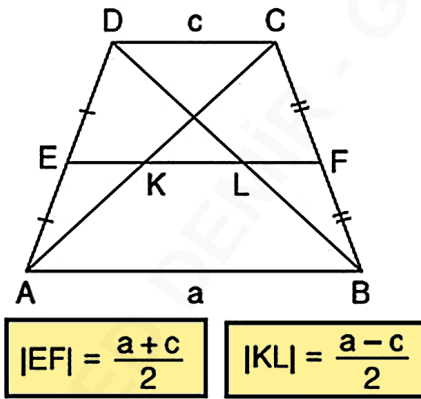
2.13



$$m(\hat{A}) + m(\hat{D}) = 180^\circ$$

$$m(\hat{B}) + m(\hat{C}) = 180^\circ$$

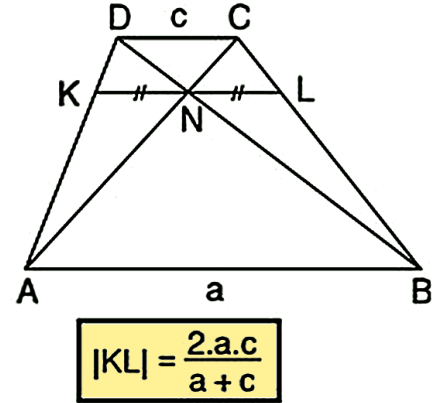
2.14



$$|EF| = \frac{a+c}{2}$$

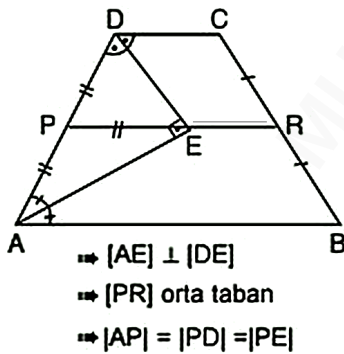
$$|KL| = \frac{a-c}{2}$$

2.15



$$|KL| = \frac{2 \cdot a \cdot c}{a+c}$$

2.16

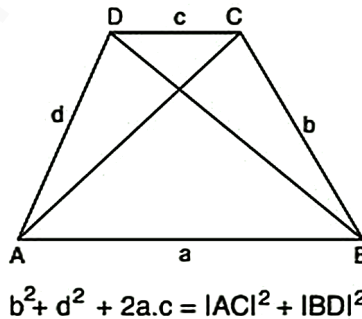


$$\Rightarrow [AE] \perp [DE]$$

$$\Rightarrow [PR] \text{ orta taban}$$

$$\Rightarrow |AP| = |PD| = |PE|$$

2.17

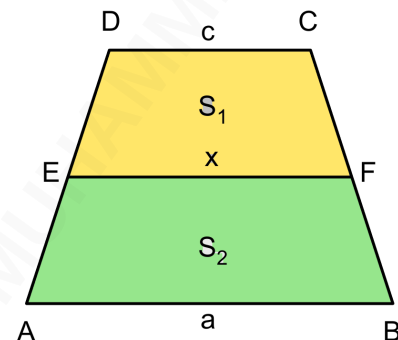


$$b^2 + d^2 + 2a \cdot c = |AC|^2 + |BD|^2$$

2.18 Alanı Eşit İkiye Bölen Paralel

ABCD yamuk, $[EF] \parallel [AB]$, $|EF| = x$, $A(EDCF) = S_1$, $A(AEFB) = S_2$ ve

$$S_1 = S_2 \text{ ise } x = \sqrt{\frac{a^2 + c^2}{2}} \text{ dir.}$$

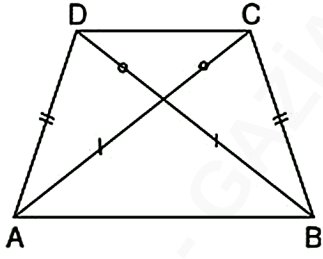




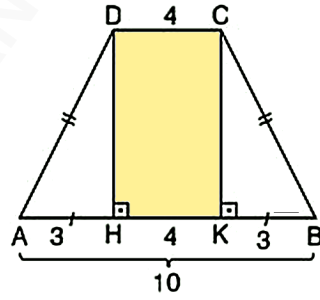
İkizkenar Yamuk ve Dik Yamuk

2.19 – 2.23

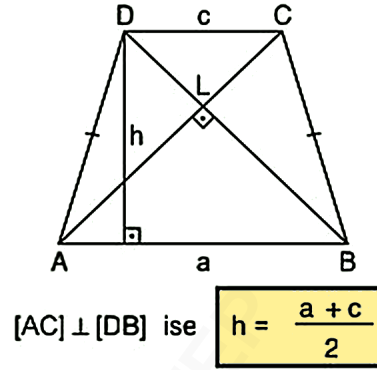
2.19 İkizkenar Yamuk



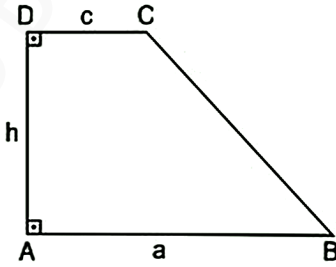
2.20 İkizkenar Yamuk



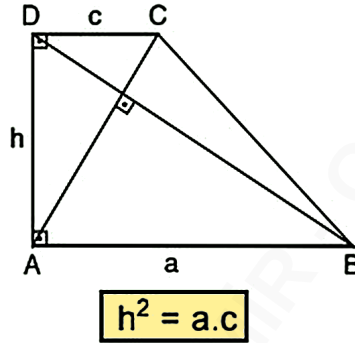
2.21 İkizkenar Yamuk



2.22 Dik Yamuk



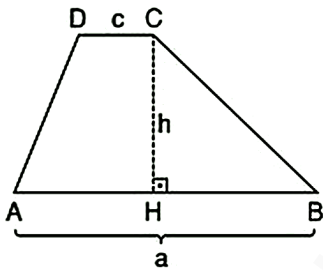
2.23 Dik Yamuk



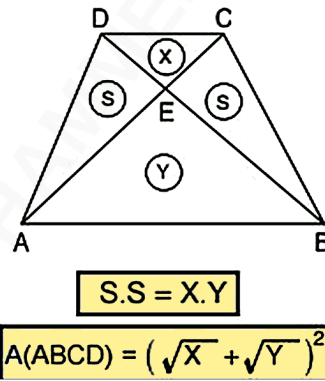
Yamuksal Bölgenin Alanı

2.24 – 2.28

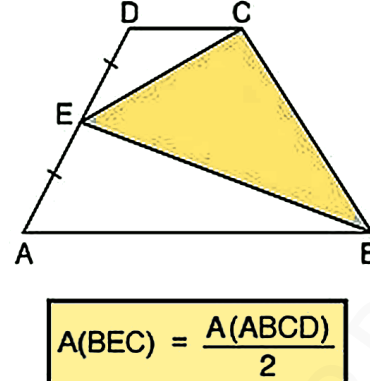
2.24



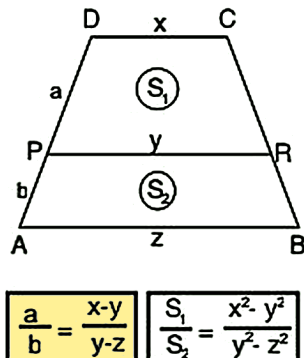
2.25



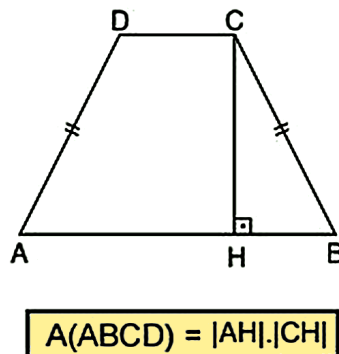
2.26



2.27



2.28

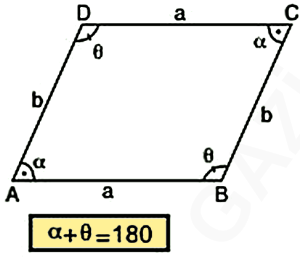




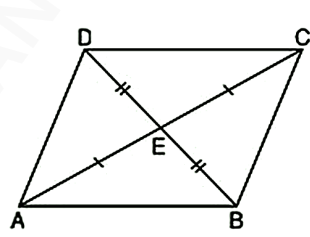
Paralelkenar

2.29 – 2.46

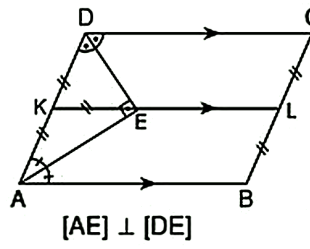
2.29



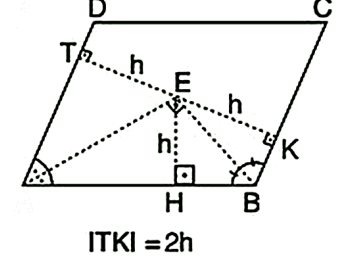
2.30



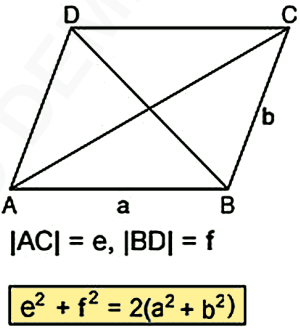
2.31



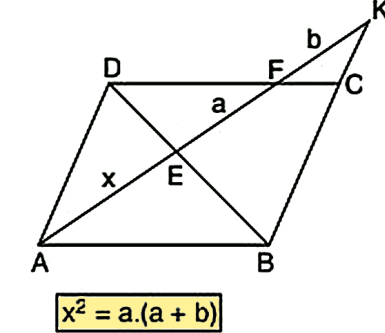
2.32



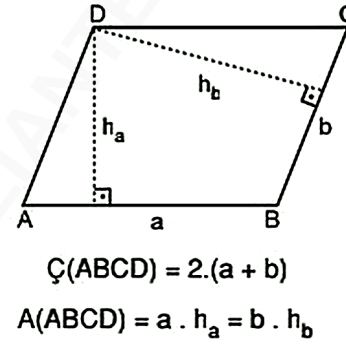
2.33



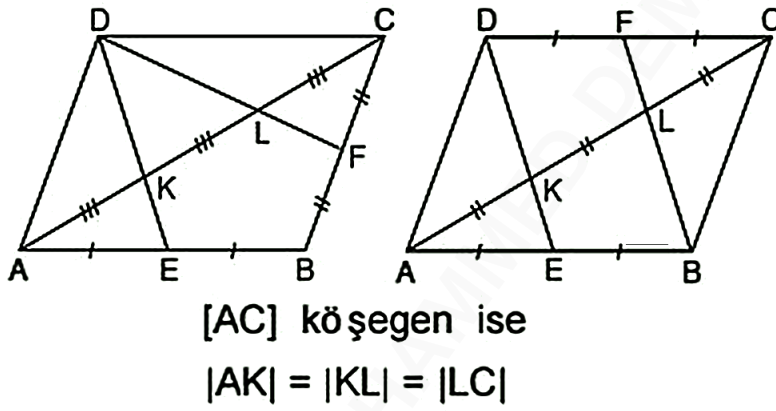
2.34



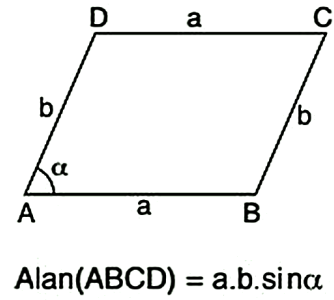
2.36



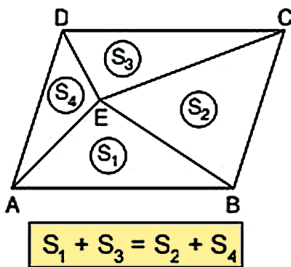
2.35



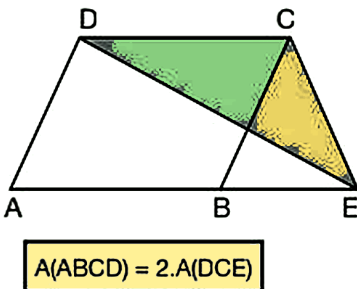
2.37



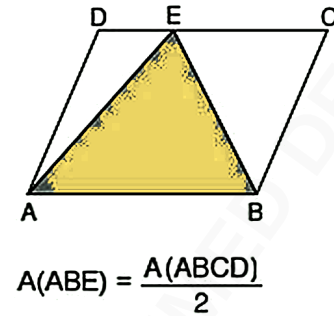
2.39



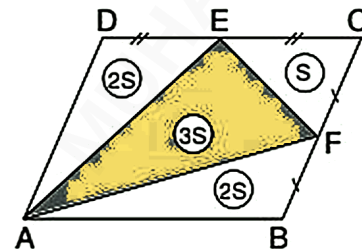
2.40



2.38



2.41

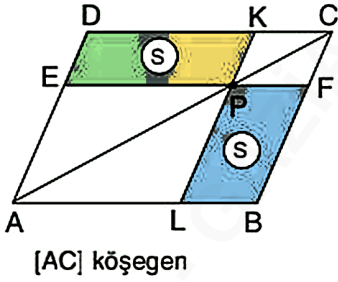




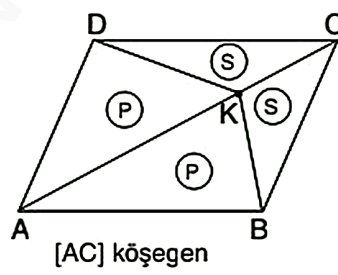
Paralelkenar (devam)

2.29 – 2.46

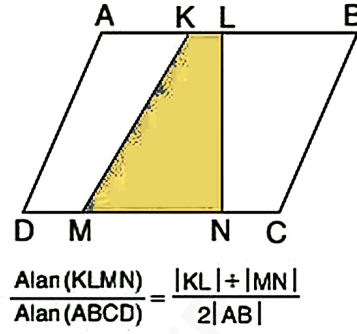
2.42



2.43

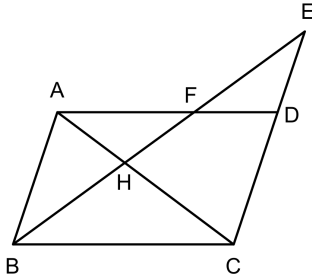


2.44



2.45

B, H, F, E noktaları ve E, D, C noktaları
doğrusal ise $|BH|^2 = |HF| \cdot |HE|$

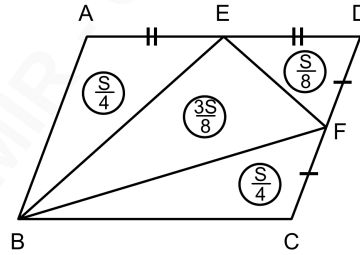


2.46

$$A(ABCD) = S \text{ ise } A(\widehat{BEF}) = \frac{3}{8} \cdot S$$

$$A(\widehat{ABE}) = A(\widehat{BCF}) = \frac{1}{4} \cdot S$$

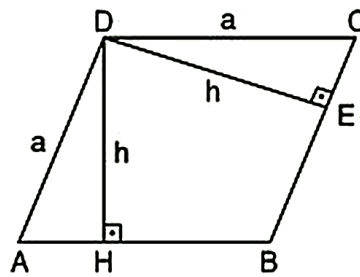
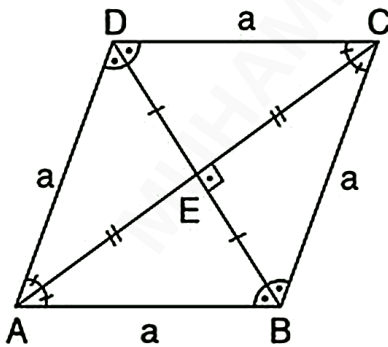
$$A(\widehat{DEF}) = \frac{1}{8} \cdot S \text{ olur.}$$



Eşkenar Dörtgen ve Deltoid

2.47 – 2.48

2.47 Eşkenar Dörtgen



- ⇒ Paralelkenarın tüm özelliklerini taşır.
- ⇒ Köşegenler açıortay ve birbirine diktir.
- ⇒ Yükseklikleri eşittir.
- ⇒ $|BD| = e$, $|AC| = f$, $|AB| = a$ ise

$$e^2 + f^2 = 4a^2$$

$$A(ABCD) = a \cdot h$$

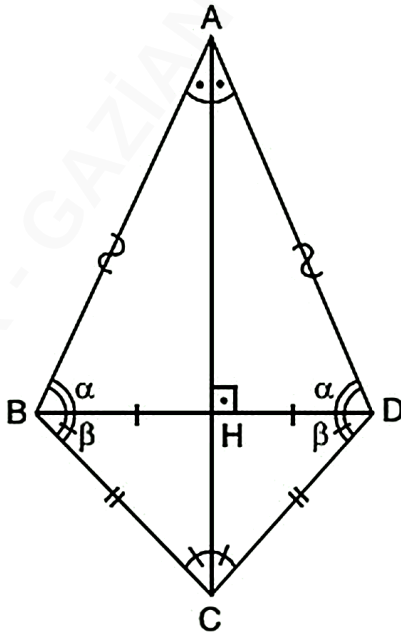
$$A(ABCD) = \frac{e \cdot f}{2}$$



Eşkenar Dörtgen ve Deltoid (devam)

2.47 – 2.48

2.48 Deltoid

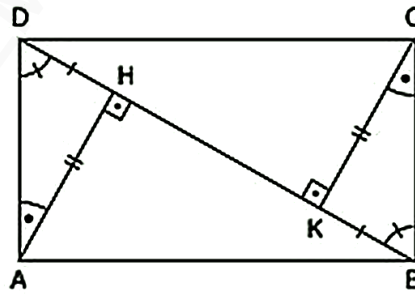
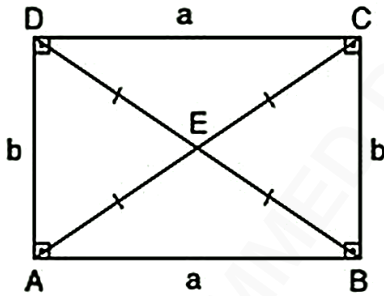


- ⇒ $|AB| = |AD|$
- ⇒ $|BC| = |CD|$
- ⇒ $m(\widehat{ABC}) = m(\widehat{ADC})$
- ⇒ $[AC]$ açıortay köşegeni
- ⇒ $[AC] \perp [BD]$
- ⇒ $|BH| = |HD|$
- ⇒ $\text{Alan}(ABCD) = \frac{|AC| \cdot |BD|}{2}$

Dikdörtgen ve Kare

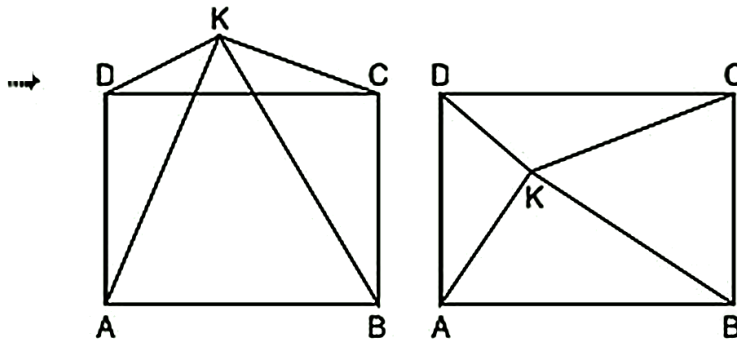
2.49 – 2.52

2.49 Dikdörtgen



- ⇒ Dikdörtgen, paralelkenarın tüm özelliklerini taşır.
- ⇒ Köşegen uzunlukları eşit olup birbirini ortalar.
- ⇒ $A(ABCD) = a.b$

2.50 Dikdörtgen



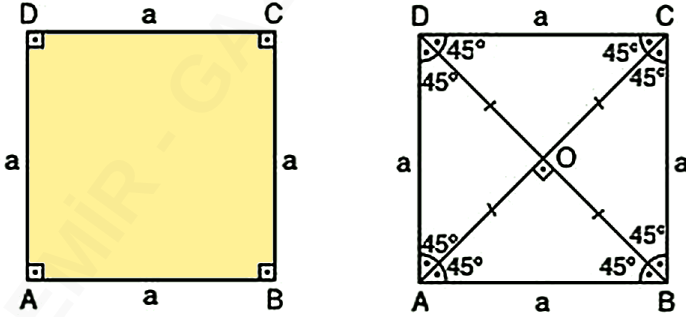
$$|KD|^2 + |KB|^2 = |KA|^2 + |KC|^2$$



Dikdörtgen ve Kare (devam)

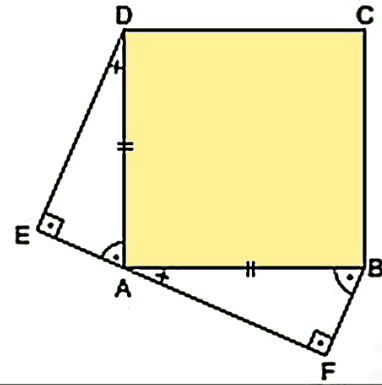
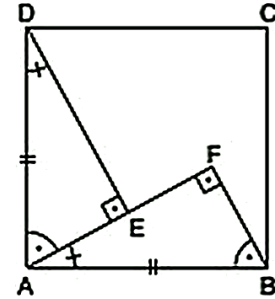
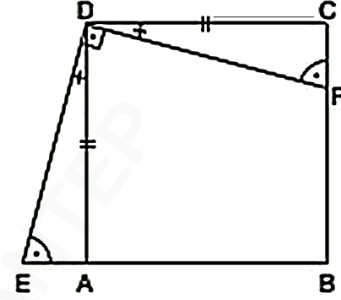
2.49 – 2.52

2.51 Kare



- ⇒ Kare, paralelkenarın tüm özelliklerini taşı^r.
- ⇒ Köşegen uzunlukları birbirine eşittir.
- ⇒ Köşegenler birbirini ortalar.
- ⇒ Köşegenler birbirine diktir.
- ⇒ Köşegenler açıortaydır.
- ⇒ $A(ABCD) = a^2$

2.52 Kareden Eş Üçgenler





3. ÇOKGENLER



Konveks Çokgenler

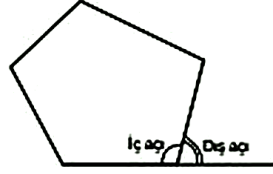
3.1 – 3.6

3.1

İç açılarının ölçüleri toplamı = $(n - 2) \cdot 180^\circ$ dir.

3.2

Dış açılarının ölçüleri toplamı = 360° dir.



3.3

Köşegen sayısı = $\frac{n \cdot (n - 3)}{2}$ dir.

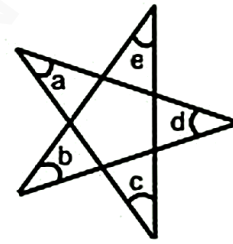
3.4

Bir köşeden en fazla $(n - 3)$ tane köşegen çizilebilir.
Çizilen bu köşegenlerle $(n - 2)$ tane üçgen oluşur.

3.5

n kenarlı bir çokgenin çizilebilmesi için en az $2n - 3$ eleman verilmelidir.
Bunlardan en az $n - 2$ tanesi uzunluk olmalıdır.

3.6



$$a + b + c + d + e = 180^\circ$$

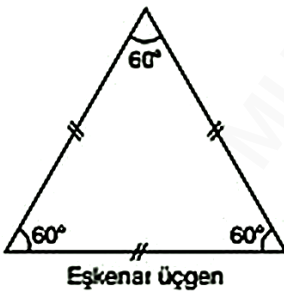
$$a + b + c + d + e + \dots = (n - 4) \cdot 180^\circ$$

Düzgün Çokgenler

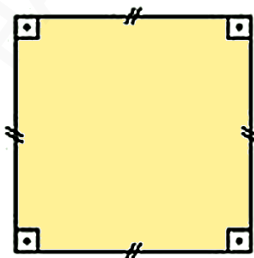
3.7 – 3.18

3.7 Düzgün Konveks Çokgen

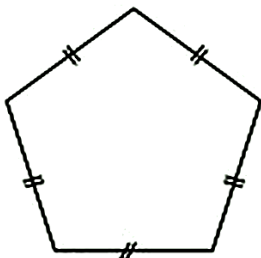
Tüm kenar uzunlukları ve iç açılarının ölçüleri eşit olan çokgenlere **düzgün çokgen** denir.



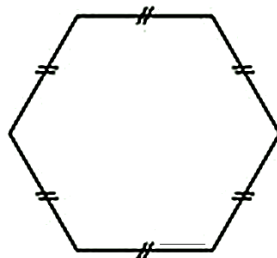
Eşkenar üçgen



Kare



Düzgün beşgen



Düzgün altıgen

3.8

Bir dış açısının ölçüsü = $\frac{360^\circ}{n}$ dir.

3.9

Bütün iç açılarının ölçüleri birbirine eşittir.
Bütün dış açılarının ölçüleri birbirine eşittir.

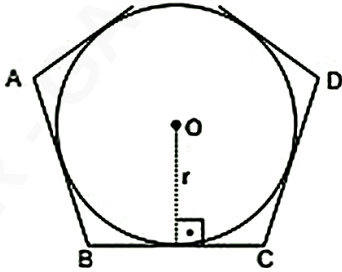


Düzgün Çokgenler (devam)

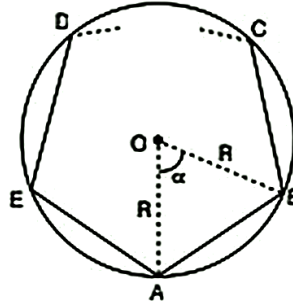
3.7 – 3.18

3.10

Düzgün konveks çokgenlerin iç teğet çemberi ve çevrel çemberi vardır. Çevrel çemberin merkezi, iç teğet çemberinin merkezi ve ağırlık merkezi ortaktır.



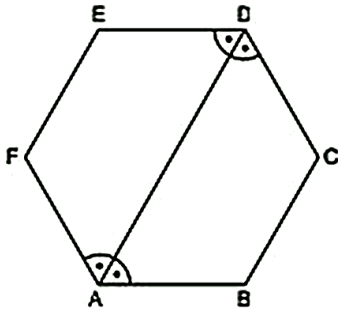
$$A(ABCD...) = n \cdot \frac{a \cdot r}{2}$$



$$A(...DEABC...) = n \cdot \frac{1}{2} \cdot R^2 \cdot \sin \alpha$$

3.11

Düzgün çokgenlerde kenar sayısı çift sayı ise karşılıklı kenarlar paraleldir. Karşılıklı iki köşeyi birleştiren köşegen açıortaydır.



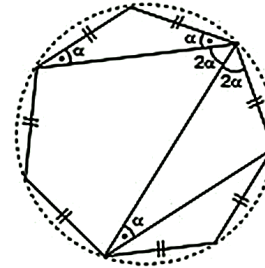
$$[ED] \parallel [AB]$$

$$[EF] \parallel [BC]$$

$$[AF] \parallel [CD]$$

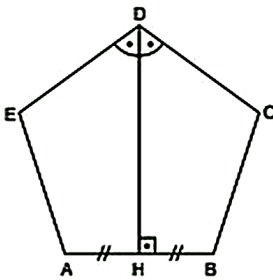
3.13

Düzgün çokgenlerde eşit uzunlukta veya eşit sayıda kirisleri gören çevre açıların ölçüleri birbirine eşittir.



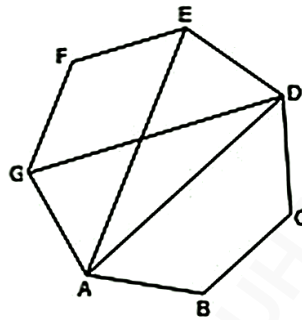
3.12

Düzgün çokgenlerde kenar sayısı tek sayı ise bir köşeden karşı kenara çizilen dikme hem kenarortay hem de açıortaydır. (Simetri eksenini)



3.14

Düzgün çokgenlerde aynı sayıda köşeleri birleştiren köşegenlerin uzunlukları eşittir.



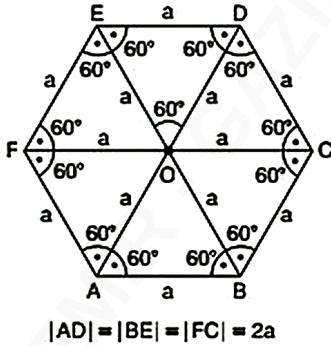
$$|GD| = |AE| = |AD|$$



Düzgün Çokgenler (devam)

3.7 – 3.18

3.15 Düzgün Altıgen



3.16 Düzgün Altıgen

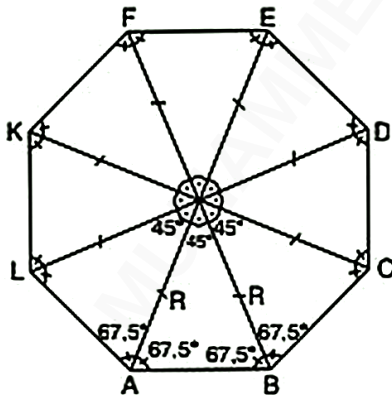
Karşılıklı köşeleri birleştiren köşegenler çizildiğinde;
[AD], [BE], [FC]

- * Bu köşegenler açıortay olur ve uzunlukları birbirine eşittir.
- * Bu köşegenlerin her biri düzgün altıgeni iki tane eş ikizkenar yamuğa ayırır.
- * 6 adet eşkenar üçgen oluşur.

$$A(ABCDEF) = 6 \cdot \frac{a^2 \sqrt{3}}{4}$$

- * Düzgün altıgenin bir iç açısı 120° ve bir dış açısı 60° dir.
- * Düzgün altıgenin kenar sayısı çift sayı olduğundan karşılıklı kenarlar paraleldir.
- * O noktası; düzgün altıgenin iç teğet çemberinin merkezi, çevrel çemberinin merkezi ve aynı zamanda ağırlık merkezidir.

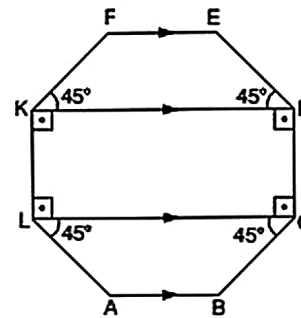
3.17 Düzgün Sekizgen



- * Karşılıklı kenarlar paraleldir.
- * Karşılıklı köşeleri birleştiren köşegenler, açıortaydır ve uzunlukları birbirine eşittir.
- * Bu köşegenler düzgün sekizgenin merkezinden geçer ve düzgün sekizgeni 8 adet eş üçgene ayırır.

Oluşan her bir üçgenin alanı $\frac{1}{2} R.R.\sin 45^\circ$ dir.

3.18 Düzgün Sekizgen



LCDK dikdörtgen
ABCL ve KDEF
İkizkenar yamuk olur.



4. ÇEMBER VE DAİRE



Temel Kavramlar

4.1

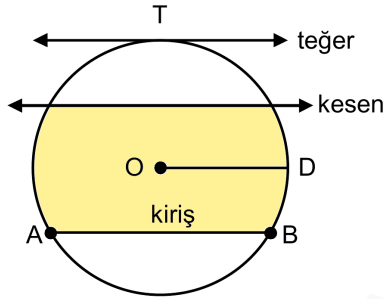
4.1 Teğet, Kesen, Kiriş, Yay

Teğet : Çember ile bir ortak noktası olan doğruya **teğet** denir.

Kesen : Çember ile iki ortak noktası olan doğruya **kesen** denir.

Kiriş : İki ucu da çember üzerinde olan doğru parçasına **kiriş** denir. Merkezden geçen kirişe **çap** denir. En büyük kiriş çaptır.

Yay : Çember üzerindeki iki nokta arasında kalan parçaya **yay** denir.



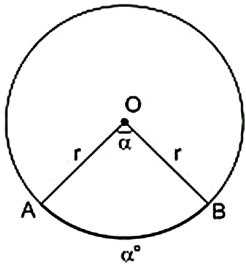
AB yayı, $\widehat{AB}$ şeklinde gösterilir.

AB yayının ölçüsü ise $m(\widehat{AB})$ şeklinde gösterilir.

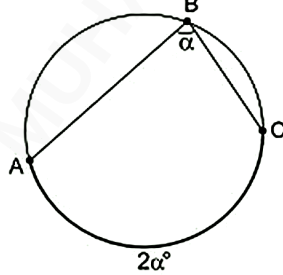
Çemberde Açılar

4.2 – 4.19

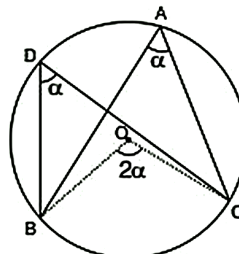
4.2 Merkez Açı



4.3 Çevre Açısı

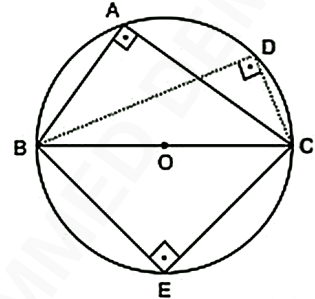


4.4



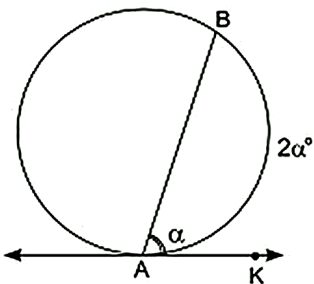
Aynı yayları gören çevre açılarının ölçüleri birbirine eşittir.

4.5



Çapı gören çevre açısı 90° dir.

4.6 Teğet – Kiriş Açısı

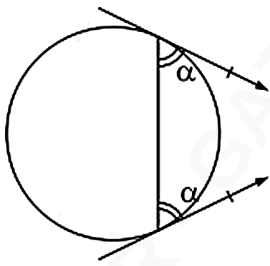




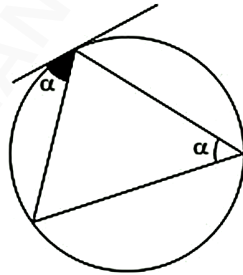
Çemberde Açılar (devam)

4.2 – 4.19

4.7

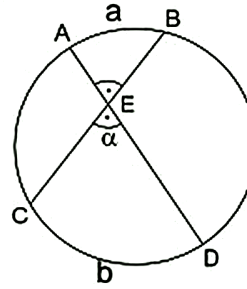


4.8



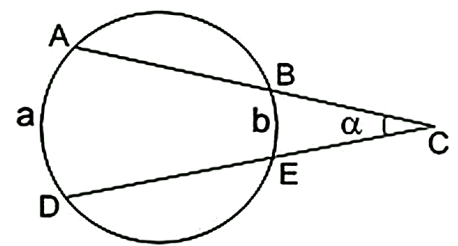
Aynı yayı gören çevre açısı ile teğet - kiriş açısının ölçüsü birbirine eşittir.

4.9 İç Açısı



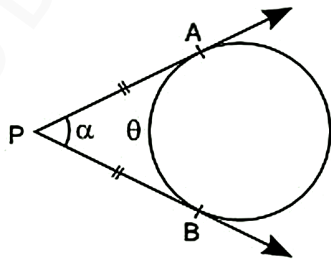
$$\alpha = \frac{a + b}{2}$$

4.10 Dış Açısı



$$\alpha = \frac{a - b}{2}$$

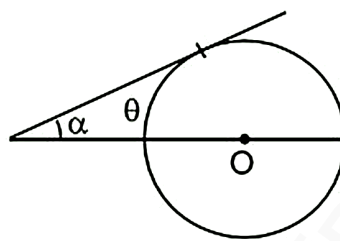
4.11 Dış Açısı



$$\alpha + \theta = 180^\circ$$

$$|PA| = |PB|$$

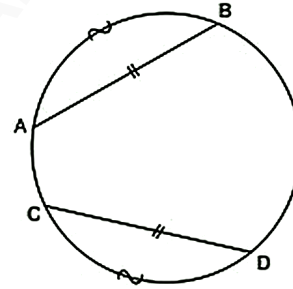
4.12 Dış Açısı



$$\alpha + \theta = 90^\circ$$

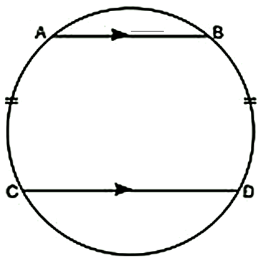
4.13

Eşit uzunluktaki kırıřler çemberden eş yayları ayırır.

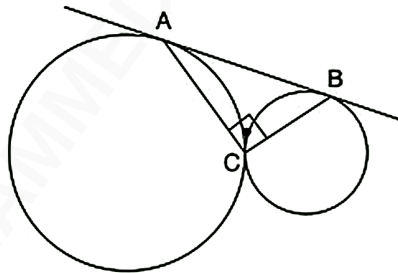


4.14

Paralel iki kırıř arasında kalan yayların ölçüleri birbirine eşittir.

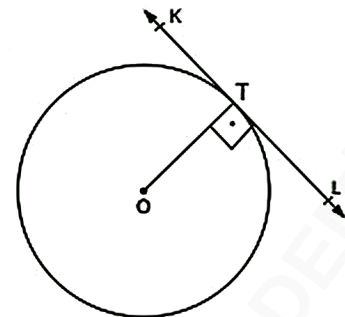


4.15



$$m(\widehat{ACB}) = 90^\circ$$

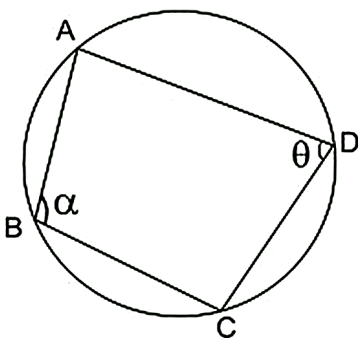
4.16



O merkez

$$[OT] \perp KL$$

4.17 Kiriřler Dörtgeni



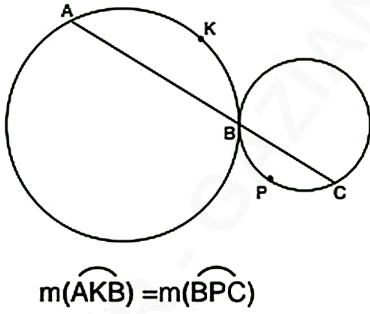
$$\alpha + \theta = 180^\circ$$



Çemberde Açılar (devam)

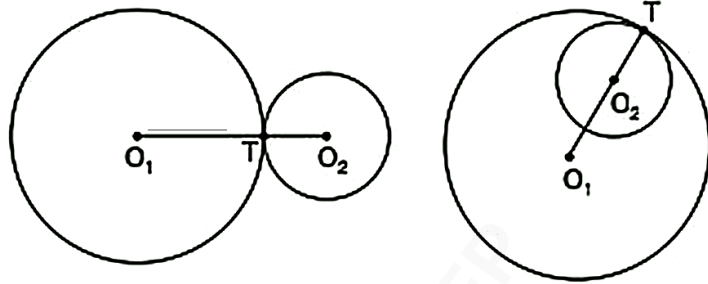
4.2 – 4.19

4.18



4.19

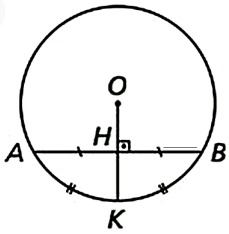
Çemberlerin merkezleri ve teget noktalar doğrusaldır.



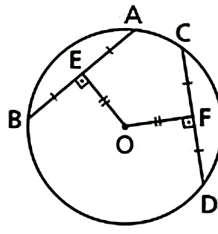
Çemberde Uzunluk

4.20 – 4.30

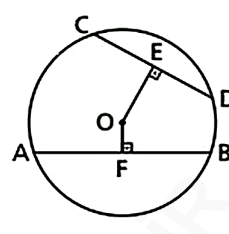
4.20



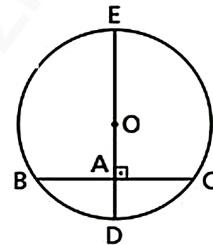
4.21



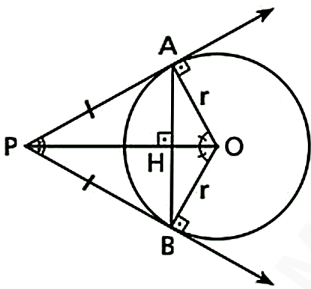
4.22



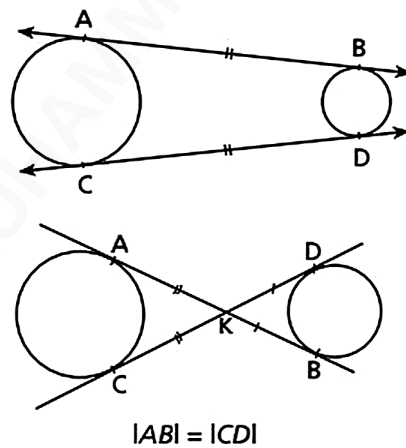
4.23



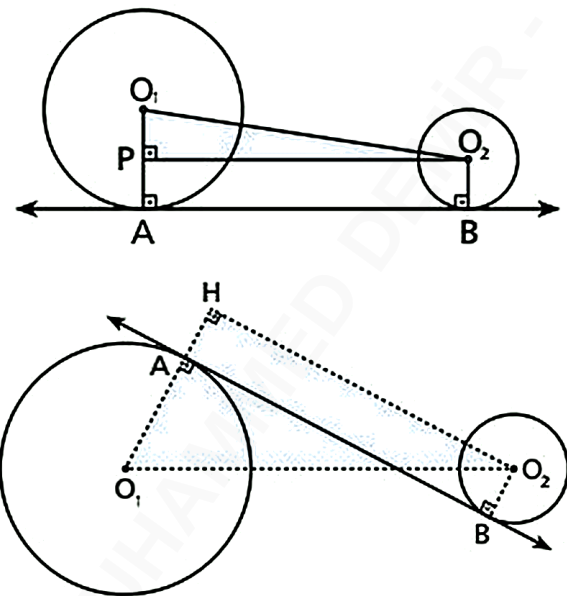
4.24



4.25



4.26

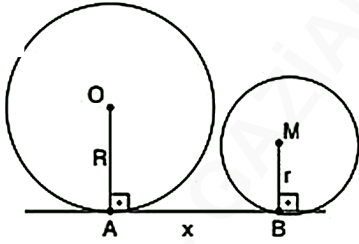




Çemberde Uzunluk (devam)

4.20 – 4.30

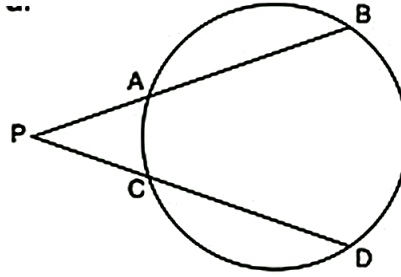
4.27



$$|AB| = x = 2\sqrt{R \cdot r}$$

4.28

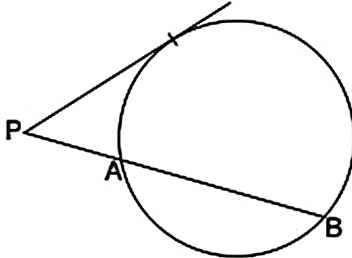
Bir Noktanın Çembere Göre Kuvveti



$$|PA| \cdot |PB| = |PC| \cdot |PD|$$

4.29

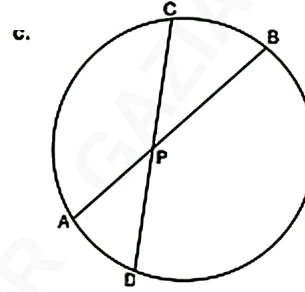
Bir Noktanın Çembere Göre Kuvveti



$$|PT|^2 = |PA| \cdot |PB|$$

4.30

Bir Noktanın Çembere Göre Kuvveti

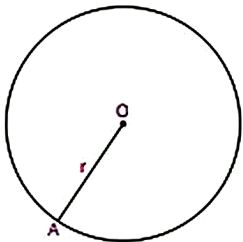


$$|PA| \cdot |PB| = |PC| \cdot |PD|$$

Dairede Alan

4.31 – 4.41

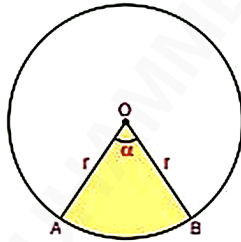
4.31



$$\text{Dairenin Alanı} = \pi r^2$$

$$\text{Dairenin Çevresi} = 2\pi r$$

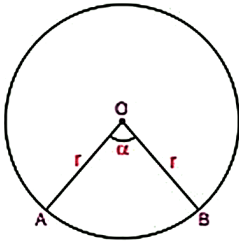
4.32



$$\text{Taralı Alan} = \frac{\pi r^2 \cdot \alpha}{360^\circ}$$

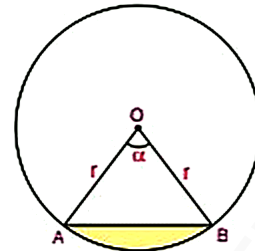
$$\text{Taralı Alan} = \frac{r \cdot |\widehat{AB}|}{2}$$

4.33



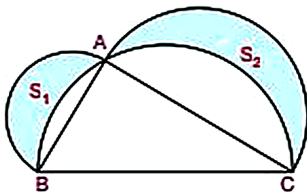
$$|\widehat{AB}| = \frac{2\pi r \cdot \alpha}{360^\circ}$$

4.34



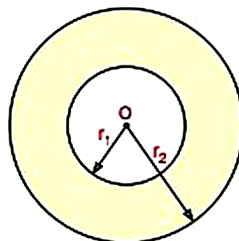
$$\text{Taralı Alan} = \frac{\pi r^2 \cdot \alpha}{360^\circ} - \frac{r^2}{2} \cdot \sin \alpha$$

4.37



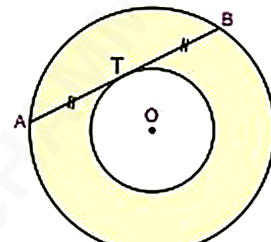
$$A(ABC) = S_1 + S_2$$

4.35



$$\text{Taralı Alan} = \pi r_2^2 - \pi r_1^2$$

4.36



$$|AT| = |BT|$$

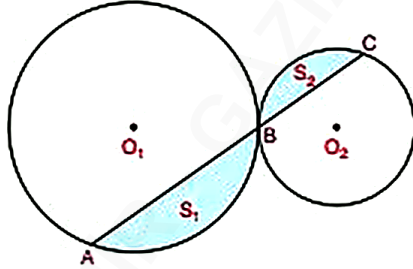
$$\text{Taralı Alan} = \pi \cdot |AT|^2$$



Dairede Alan (devam)

4.31 – 4.41

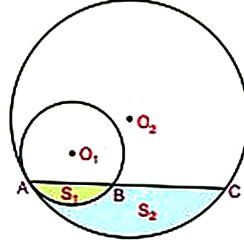
4.38



$$\text{Benzerlik oranı} = \frac{r_1}{r_2} = \frac{|AB|}{|BC|} = \frac{|\widehat{AB}|}{|\widehat{BC}|} \text{ dir.}$$

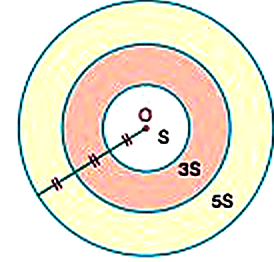
Alan oranı ise benzerlik oranının karesine eşittir.

4.39

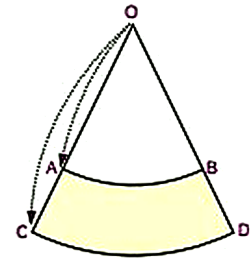


$$\text{Benzerlik oranı} = \frac{r_1}{r_2} = \frac{|AB|}{|AC|} = \frac{|\widehat{AB}|}{|\widehat{AC}|}$$

4.40



4.41



$$\frac{|OA|}{|OC|} = \frac{|OB|}{|OD|} = \frac{|\widehat{AB}|}{|\widehat{CD}|}$$

$$\text{Taralı Alan} = \frac{(|\widehat{AB}| + |\widehat{CD}|) \cdot |BD|}{2}$$

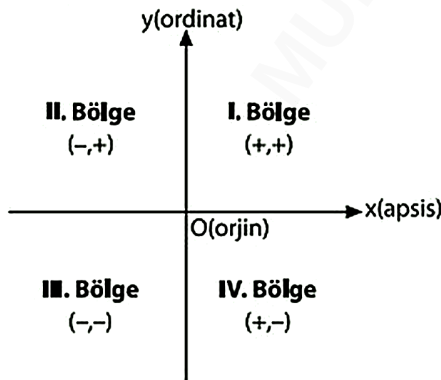
5. ANALİTİK GEOMETRİ



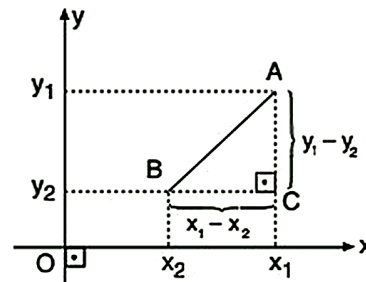
Doğrunun Analitik İncelenmesi

5.1 – 5.18

5.1 Koordinat Düzlemi

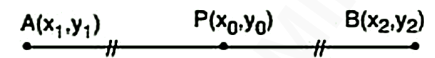


5.2 İki Nokta Arası Uzaklık



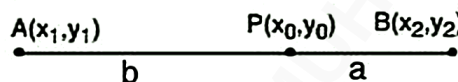
$$|AB| = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

5.3 Doğru Parçasının Orta Noktası



$$x_0 = \frac{x_1 + x_2}{2} \quad y_0 = \frac{y_1 + y_2}{2}$$

5.4 Doğru Parçasını Belli Oranda Bölme



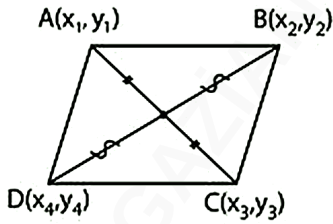
$$\frac{a}{b} = \frac{x_2 - x_0}{x_0 - x_1} \quad \frac{a}{b} = \frac{y_2 - y_0}{y_0 - y_1}$$



Doğrunun Analitik İncelenmesi (devam)

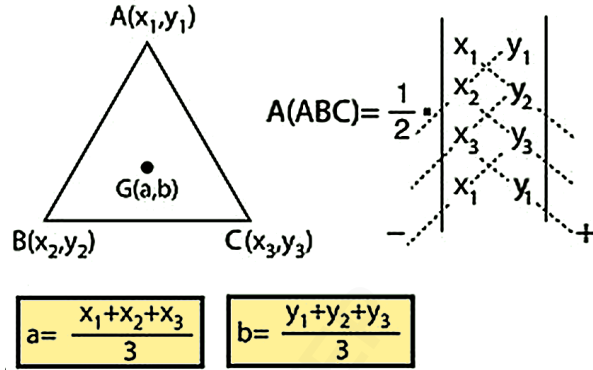
5.1 – 5.18

5.5 Köşegenleri Birbirini Ortalayan Dörtgen



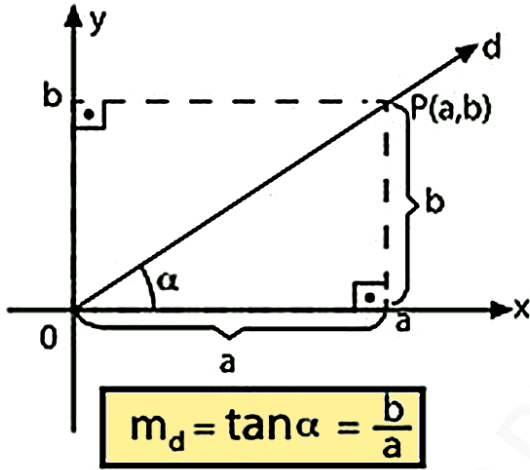
$$x_1 + x_3 = x_2 + x_4 \quad y_1 + y_3 = y_2 + y_4$$

5.6 Üçgenin Ağırlık Merkezi ve Alanı (meraklısına)



$$a = \frac{x_1 + x_2 + x_3}{3} \quad b = \frac{y_1 + y_2 + y_3}{3}$$

5.7 Doğrunun Eğimi

Eğim açısı α olan bir doğruda,

- $0^\circ < \alpha < 90^\circ$ ise eğim m pozitifdir.
- $90^\circ < \alpha < 180^\circ$ ise eğim m negatiftir.

5.8 Eğim ile İlgili Notlar

NOT :

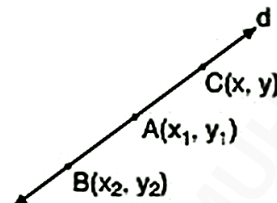
- iki noktası bilinen doğrunun eğimi: $m = \frac{y_2 - y_1}{x_2 - x_1}$
- $y = ax + b$ doğrusunun eğimi m dir.
- $ax + by + c = 0$ doğrusunun eğimi $m = -\frac{a}{b}$
- İki doğru paralel ise eğimleri eşittir.
- iki doğru dik ise eğimlerini çarpımı -1 dir.
- x eksenine paralel doğruların eğimi sıfırdır.
- y eksenine paralel doğruların eğimi tanımsızdır.

5.9 Eğimi ve Bir Noktası Bilinen Doğru

Eğimi m olan ve $A(x_1, y_1)$ noktasından geçen doğrunun denklemi:

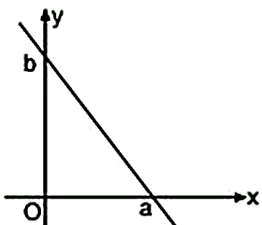
$$y - y_1 = m(x - x_1)$$

5.10 İki Noktası Bilinen Doğru



$$\frac{y - y_1}{y_1 - y_2} = \frac{x - x_1}{x_1 - x_2}$$

5.11 Eksenleri Kesen Doğru



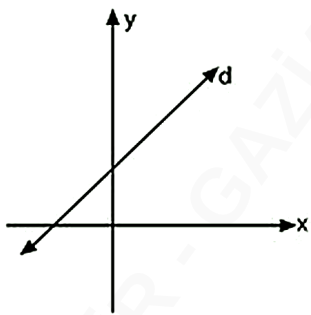
$$\frac{x}{a} + \frac{y}{b} = 1$$



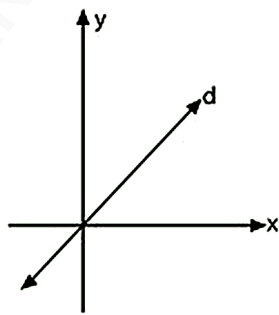
Doğrunun Analitik İncelenmesi (devam)

5.1 – 5.18

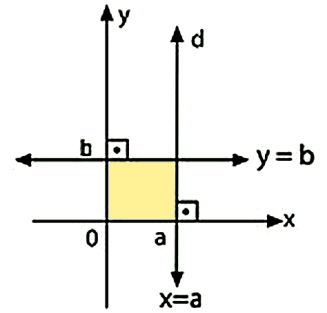
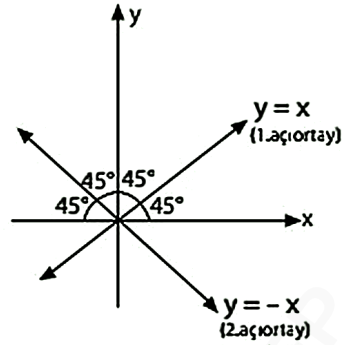
5.12 Özel Doğrular



d doğrusunun denklemi,
 $ax + by + c = 0$ şeklindedir.



d doğrusunun denklemi,
 $ax + by = 0$ şeklindedir.



5.13 İki Doğrunun Birbirine Göre Durumları

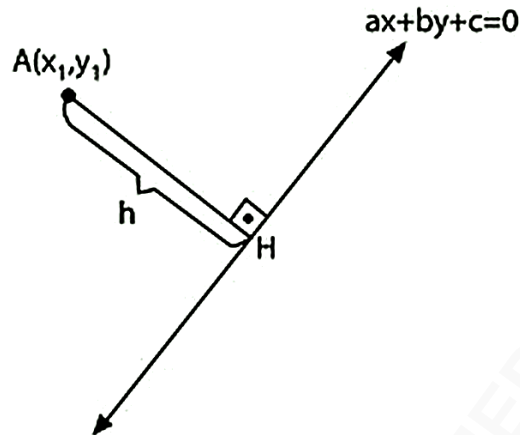
$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

1. $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ ise doğrular paraleldir.
2. $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ ise doğrular çakışiktır.
3. $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ ise doğrular bir noktada kesişir.

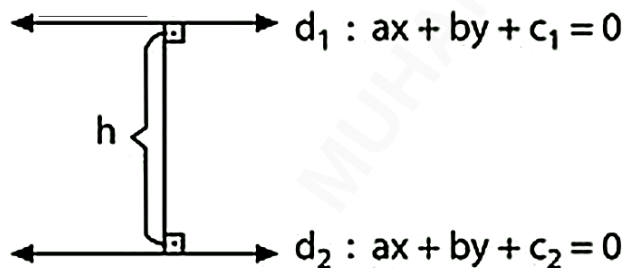
5.14 Noktanın Doğruya Uzaklığı

$$h = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$



5.15 Paralel İki Doğru Arası Uzaklık

$$h = \frac{|c_1 - c_2|}{\sqrt{a^2 + b^2}}$$





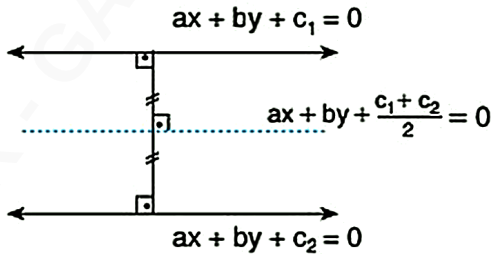
Doğrunun Analitik İncelenmesi (devam)

5.1 – 5.18

5.16 Paralel Doğrulara Eşit Uzaklıktaki Noktalar

NOT :

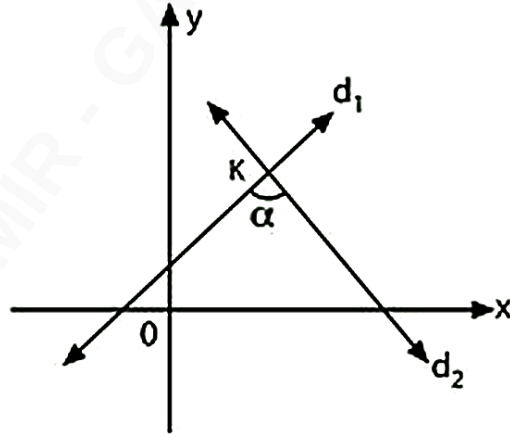
Paralel doğrulara eşit uzaklıktaki noktaların geometrik yeri,



5.17 İki Doğru Arasındaki Açının Tanjantı

$$\tan \alpha = \left| \frac{m_1 - m_2}{1 + m_1 \cdot m_2} \right|$$

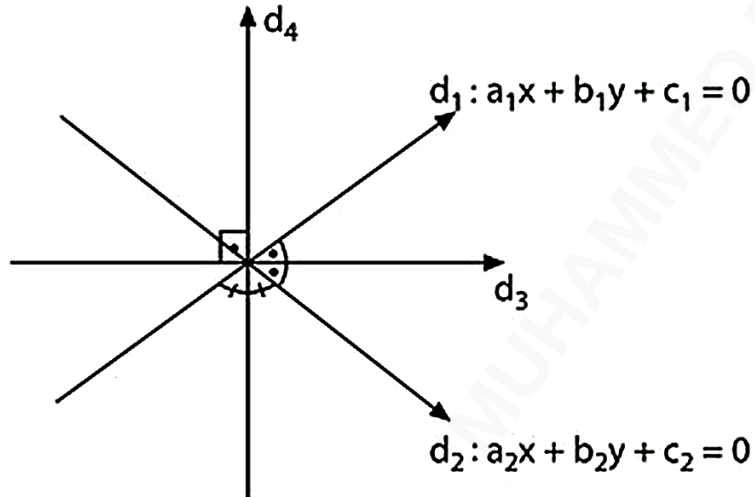
(Formüldeki α iki doğru arasındaki dar açıdır.)



5.18 Açıortay Denklemleri

$$d_3, d_4: \frac{|a_1x + b_1y + c_1|}{\sqrt{a_1^2 + b_1^2}} = \frac{|a_2x + b_2y + c_2|}{\sqrt{a_2^2 + b_2^2}}$$

(d_1 ve d_2 doğrularının açıortayları d_3 ve d_4 tür.)





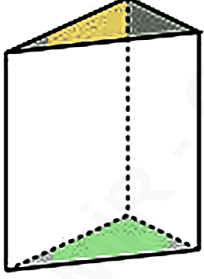
6. KATI CİSİMLER



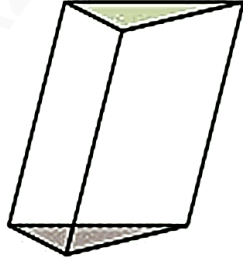
Prizmalar

6.1 – 6.5

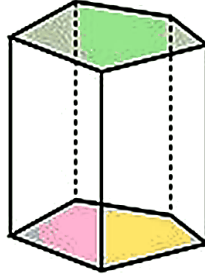
6.1 Prizma Çeşitleri



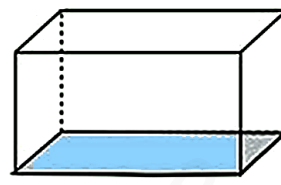
Üçgen dik
prizma



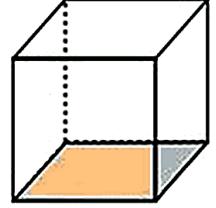
Üçgen eğik
prizma



Düzgün beşgen
prizma



Dikdörtgenler
Prizması



Küp

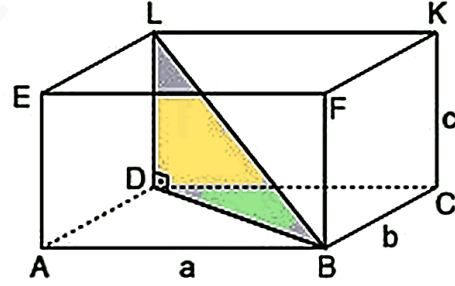
6.2 Prizmanın Alanı ve Hacmi

Yanal alan = Taban çevresi x yükseklik

Bütün alan = Yanal alan + 2.Taban alanı

Hacim = Taban alanı x Yükseklik

6.3 Dikdörtgenler Prizması



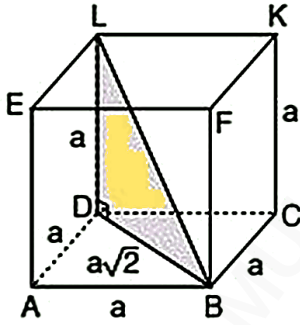
Cisim köşegeni $|LB| = \sqrt{a^2 + b^2 + c^2}$

Yanal alan = $2(a + b) \cdot c$

Bütün alan = $2(ab + ac + bc)$

$V = a \cdot b \cdot c$

6.4 Küp



Yüzey köşegeni = $a\sqrt{2}$

Cisim köşegeni = $a\sqrt{3}$

$A = 6 \cdot a^2$

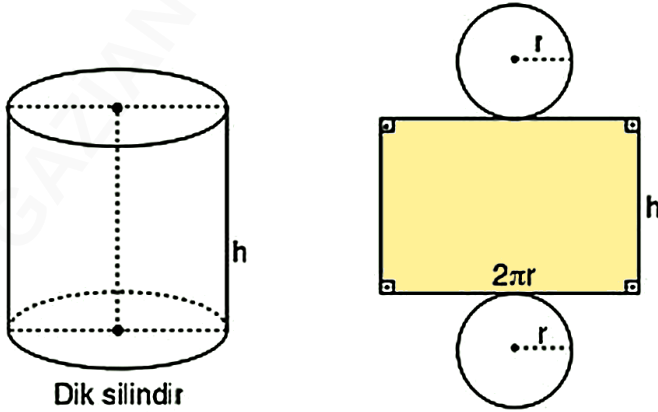
$V = a^2 \cdot a = a^3$



Prizmalar (devam)

6.1 – 6.5

6.5 Silindir



$$\text{Yanal Alan} = \text{Taban çevresi} \times \text{Yükseklik} = 2\pi r h$$

$$\text{Alan} = \text{Yanal alan} + 2 \cdot \text{Taban alanı}$$

$$S = 2\pi r h + 2 \cdot \pi r^2 = 2\pi r (h + r)$$

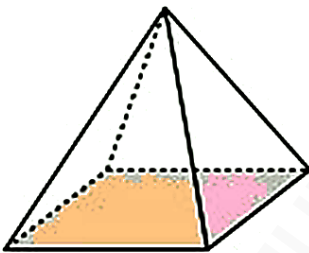
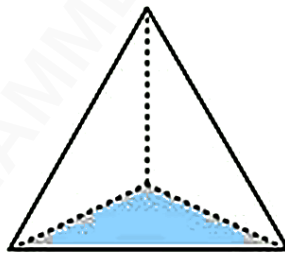
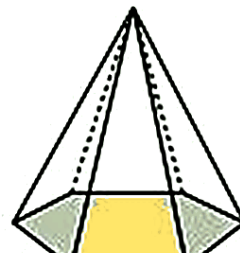
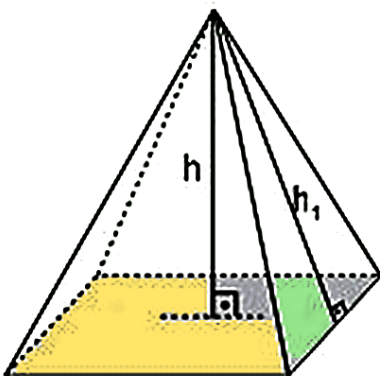
$$\text{Hacim} = \text{Taban alanı} \times \text{Yükseklik}$$

$$V = \pi r^2 h$$

Piramit, Koni ve Küre

6.6 – 6.9

6.6 Düzgün Piramit

Kare
piramitEşkenar
üçgen piramitDüzgün
altıgen piramit

$$Y.A = \frac{\text{Taban çevresi} \times \text{Yan yüz yüksekliği}}{2}$$

$$\text{Bütün alan} = \text{Yanal alan} + \text{Taban alanı}$$

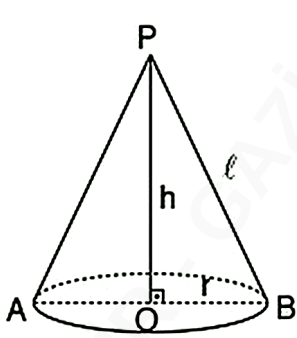
$$V = \frac{1}{3} \text{ Taban Alanı} \times \text{Yükseklik}$$



Piramit, Koni ve Küre (devam)

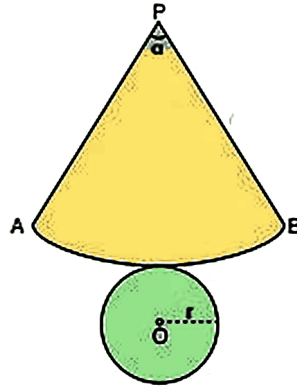
6.6 – 6.9

6.7 Koni



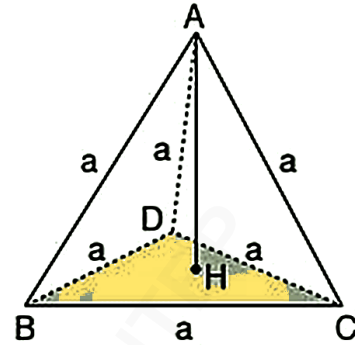
$$\text{Alan} = \pi r \ell + \pi r^2$$

$$V = \frac{1}{3} \pi r^2 h$$



$$\frac{r}{\ell} = \frac{\alpha}{360^\circ}$$

6.8 Düzgün Dörtüzlü

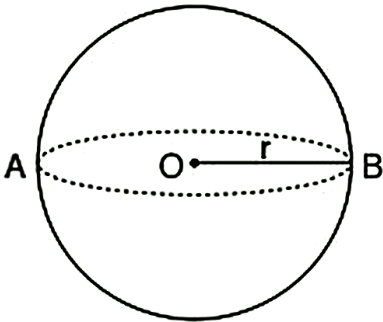


$$|AH| = \frac{a\sqrt{6}}{3}$$

$$\text{Alan} = a^2 \sqrt{3}$$

$$V = \frac{a^3 \sqrt{2}}{12}$$

6.9 Küre



$$A = 4\pi r^2$$

$$V = \frac{4}{3} \pi r^3$$