Gr 9 Maths: Content Area 3 & 4
Geometry & Measurement (2D)
QUESTIONS

Mostly past ANA exam content

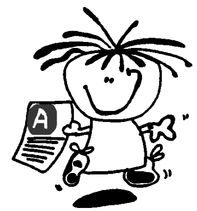
- Geometry of Straight Lines
- Triangles: Basic facts
- Congruent Δ^s
- Similar Δ^s
- Quadrilaterals
- Polygons

Theorem of Pythagoras

Area and Perimeter of 2D shapes

All questions have been graded to facilitate concept development.

GOOD LUCK!



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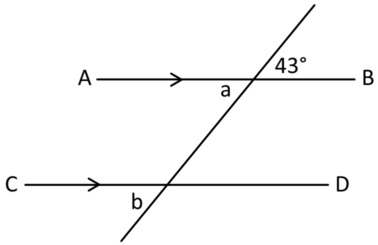
GEOMETRY OF STRAIGHT LINES

(Solutions on page A1)

Refer to page Q13 for details on parallel lines & angles.

1. Calculate the sizes of the angles marked a to d.
Give reasons for your answers.

1.1



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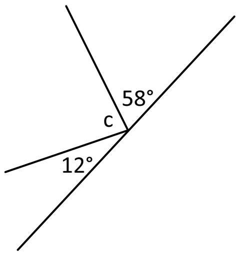
1.2



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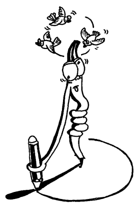
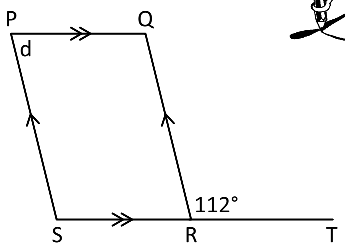


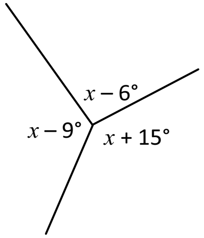
1.3



(3)

2. Calculate the size of the largest angle.

Show all your steps with reasons.



(4)

3. Complete the following :

3.1 Angles which add up to 90° are called .... angles. (1)

3.2 Angles around a point add up to .... (1)

4. Complete each of the following statements:

4.1 $\hat{D}$ and $\hat{F}$ are complementary angles if ________________________________. (1)

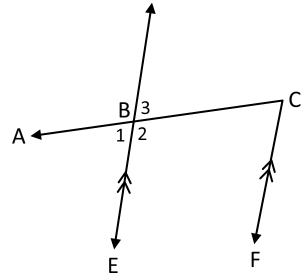
4.2 The sum of the interior angles of a triangle is equal to ______________________. (1)

4.3 The sum of the exterior angles of any polygon is equal to ____________________. (1)

4.4 A trapezium is a quadrilateral with one pair of ________________ sides. (1)

4.5 The diagonals of a rectangle are ________ in length. (1)

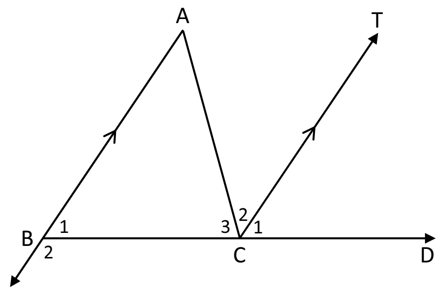
5. In the figure, $\hat{B}_3 = 35°$ and BE || CF.
Determine the size of $\hat{B}_1$ and $B\hat{C}F$.



Statement	Reason
$\hat{B}_1$ =	
$B\hat{C}F$ =	

(3)

6.



In the figure above, AB || TC, $\hat{C}_1 = 65°$ and $\hat{C}_2 = 43°$.

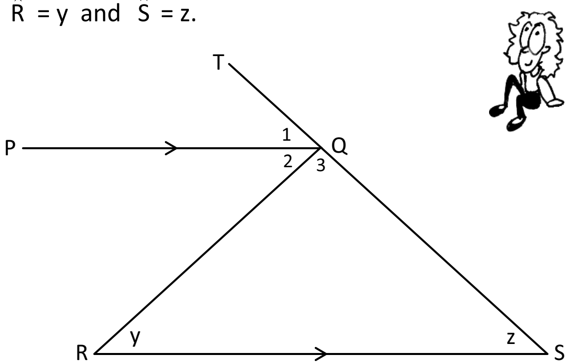
Calculate the size of $\hat{A}$, $\hat{B}_1$ and $\hat{B}_2$.

Statement	Reason

(4)

7. Give reasons for each of your statements in the questions below.

In the figure PQ || RS, $\hat{Q}_1$, $\hat{Q}_2$ and $\hat{Q}_3$ are equal to $2x$, $3x$ and $4x$ respectively. $\hat{R}$ = y and $\hat{S}$ = z.

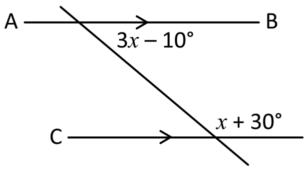


7.1 Calculate the value of x. (3)

7.2 Calculate the value of y. (3)

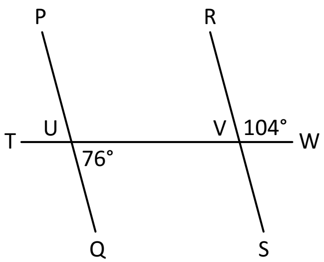
7.3 Calculate the value of z. (3)

8. Calculate, with reasons, the value of x.



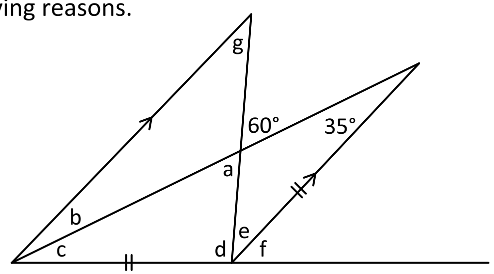
(4)

9. State, giving reasons, whether PQ || RS.



(4)

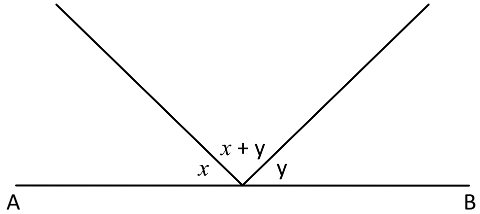
10. Find the size of angles a to g (in that order), giving reasons.



(7)

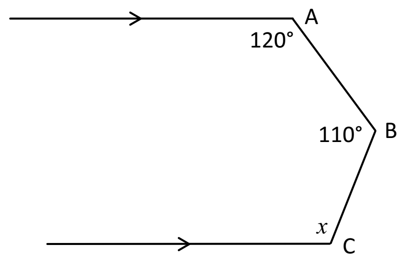
11. In the sketch, AB is a straight line.

Determine the value of x + y.



(4)

12. Calculate, with reasons, the value of x.



(4)

Hint: Draw a third line, through B, parallel to the given parallel lines.

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.32

STRAIGHT LINE GEOMETRY

Important Vocabulary

An **acute** angle is one that lies **between 0º and 90º**.

An **obtuse** angle is one that lies **between 90º and 180º**.

A **reflex** angle is one that lies between **180º and 360º**.

A **right** angle = **90º**

A **straight** angle = **180º**

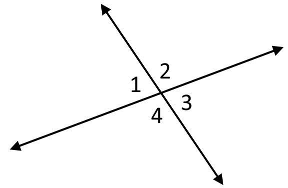
A **revolution** = **360º**

When the **sum** of 2 angles = **90º**, we say the angles are **complementary**.

When the **sum** of 2 angles = **180º**, we say the angles are **supplementary**.

When 2 lines intersect, 4 angles are formed:

$\hat{1}$, $\hat{2}$, $\hat{3}$, $\hat{4}$



Adjacent angles have a common vertex and a common arm, e.g. $\hat{1}$ and $\hat{2}$, $\hat{2}$ and $\hat{3}$, $\hat{3}$ and $\hat{4}$ or $\hat{1}$ and $\hat{4}$.

Vertically opposite angles lie opposite each other, e.g. $\hat{1}$ and $\hat{3}$ or $\hat{2}$ and $\hat{4}$.

The FACTS

When 2 lines intersect:

- **adjacent** angles are **supplementary**
- **vertically** opposite angles are **equal**.

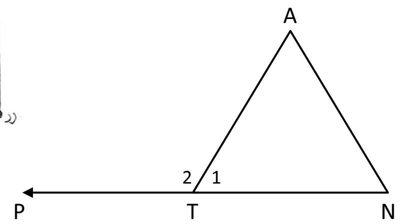
See the end of the questions for more on straight lines.

TRIANGLES: BASIC FACTS

(Solutions on page A3)

Reasons must be provided for all Geometry statements.

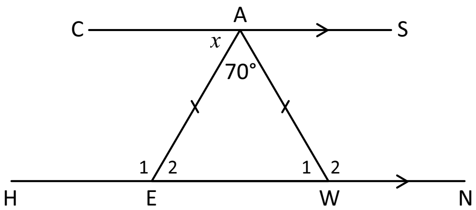
1. In the figure below, ΔANT is an equilateral triangle. Calculate the size of $\hat{T}_1$ and $\hat{T}_2$.



(4)

2. In the figure below, CS || HN, $E\hat{A}W = 70^o$; AE = AW and $C\hat{A}E = x$.

   Determine the value of x.



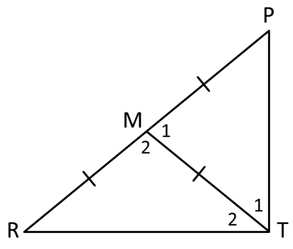
(3)

3. In ΔPRT alongside, M is the midpoint of PR and MR = MT.

   If $\hat{P} = 25^o$, calculate with reasons:

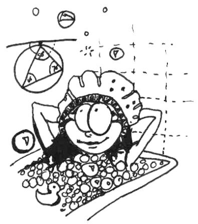
   3.1 The size of $\hat{T}_1$ (1)

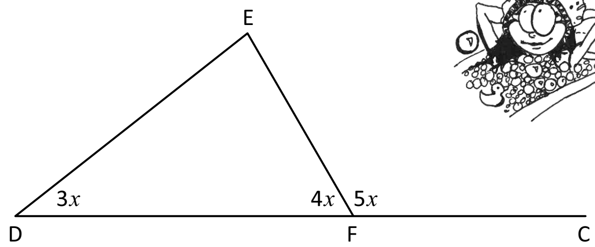
   3.2 The size of $\hat{M}_2$ (1)



4. In ΔEDF, DF is produced to C.

   The size of $\hat{E}$ is . . . ?

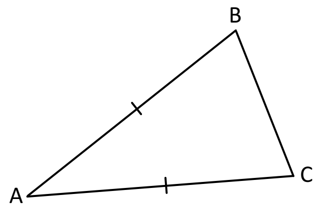




   A 40^o B 60^o

   C 140^o D 20^o (1) [10]

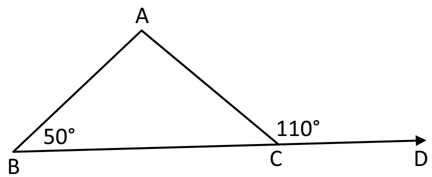
5.



   In ΔABC, AB = AC and $\hat{C} = x$.

   Determine the size of $\hat{A}$ in terms of x. (3)

6.



   In the figure above, $\hat{B} = 50^o$ and $A\hat{C}D = 110^o$.

   The size of $\hat{A}$ is . . . . . .

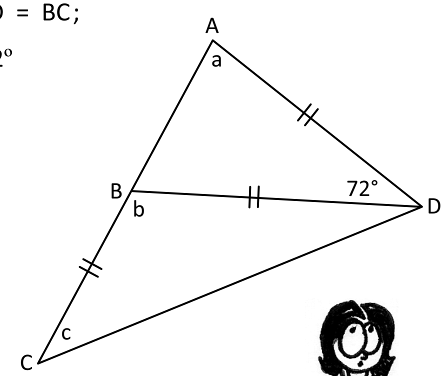
   A 50^o B 60^o

   C 110^o D 160^o

7. Using the figure below, calculate the size of the angles a, b and c (in this order).

   AD = BD = BC;

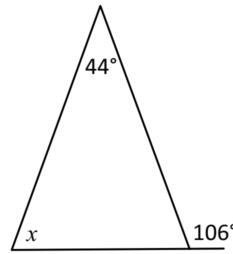
   $A\hat{D}B = 72^o$



(6)

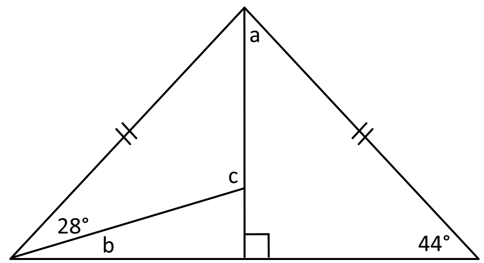
8. Determine the values of x, a, b and c in the figures below.

   8.1



(2)

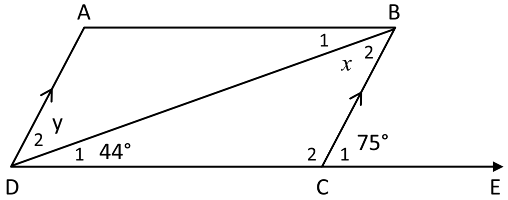
   8.2



(6)

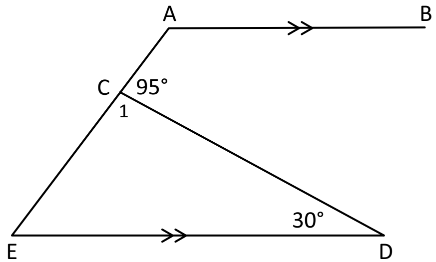
9. Calculate the values of x and y if

$\hat{B}_2 = x$, $\hat{D}_2 = y$, $\hat{D}_1 = 44°$, $\hat{C}_1 = 75°$ and AD || BC.



(3)

10.



In the above figure AB || ED, $A\hat{C}D = 95°$ and $\hat{D} = 30°$.

Determine the size of $\hat{E}$ and $\hat{A}$. (3)

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.24

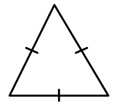
TRIANGLES: Study the following very carefully

CLASSIFICATION OF TRIANGLES . . .

Triangles are classified according to their sides or their angles (or both).

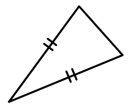
- **Sides**

equilateral Δ



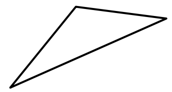
3 sides equal

isosceles Δ



2 sides equal

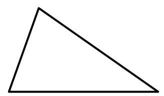
scalene Δ



no sides equal

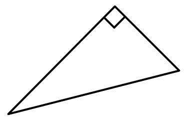
- **Angles**

acute-angled Δ



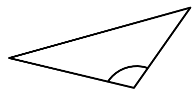
3 acute angles

right-angled Δ



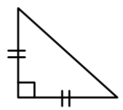
1 right angle (90°)

obtuse-angled Δ

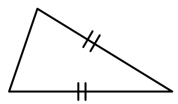


1 obtuse angle

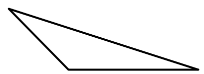
- **Sides and Angles**



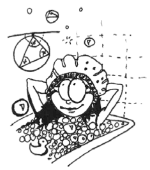
This is an isosceles, right-angled triangle



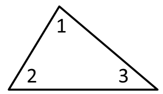
This is an isosceles, acute-angled triangle



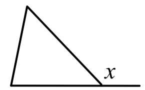
This is a scalene, obtuse-angled triangle.

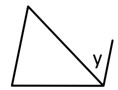


INTERIOR AND EXTERIOR ANGLES . . .



$\hat{1}$, $\hat{2}$ and $\hat{3}$ are **interior** angles of the triangle





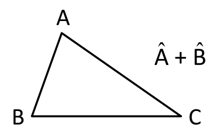
$\hat{x}$ is an **exterior** ∠
$\hat{y}$ is **not** an **exterior** ∠

An **exterior angle** is formed between one side of a triangle and the produced (extension) of another.

4 BASIC FACTS

- **FACT 1**

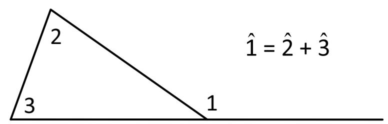
The sum of the interior angles of a triangle = 180°



$\hat{A} + \hat{B} + \hat{C} = 180°$

- **FACT 2:**

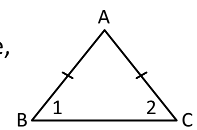
The exterior angle of a triangle equals the sum of the interior opposite angles.



$\hat{1} = \hat{2} + \hat{3}$

- **FACT 3**

In an isosceles triangle, the base angles are equal.



If AB = AC, then $\hat{1} = \hat{2}$

Converse:

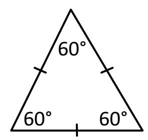
If $\hat{1} = \hat{2}$, then AB = AC

The converse states:

If 2 angles of a triangle are equal, then the sides opposite them are equal.

- **FACT 4**

The angles of an equilateral triangle all equal 60°.

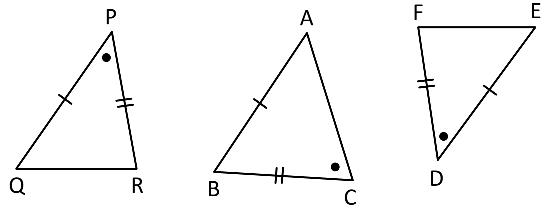


CONGRUENT Δ^s

(Solutions on page A4)

See the notes on Congruency and Similarity on page A5

1.

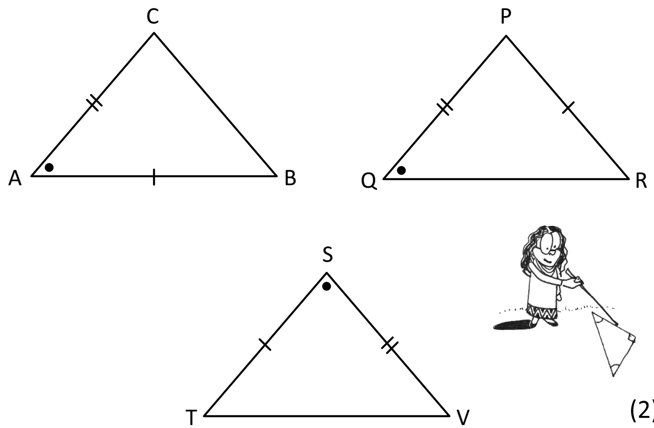


Which triangle is congruent to ΔPQR?

Statement	Reason

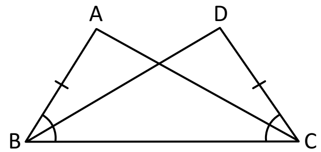
(2)

2. State which triangle is congruent to ΔABC.



(2)

3. Why is ΔABC ≡ ΔDCB?



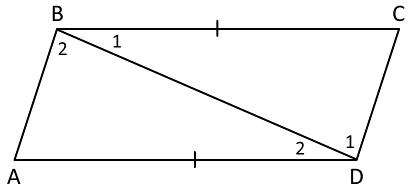
A S, S, S

B 90°, Hyp, S (RHS)

C S, ∠, S

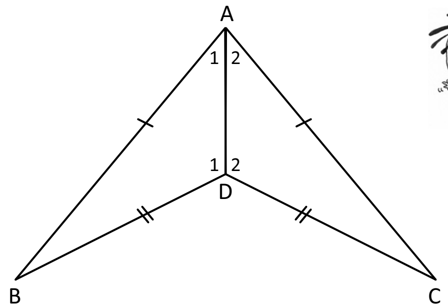
D ∠, ∠, S

4. In the figure below $\hat{D}_1 = \hat{B}_2 = 90^\circ$ and AD = BC.



Prove that ΔABD ≡ ΔCDB.

5. In the figure below, AB = AC and BD = CD.



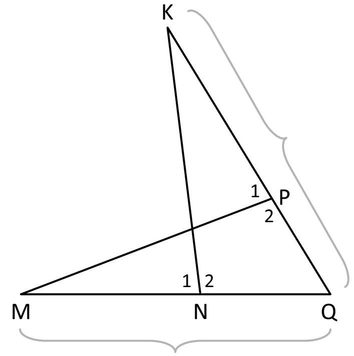
5.1 Prove that ΔABD ≡ ΔACD. (4)

5.2 Prove that DA bisects $B\hat{A}C$ (2)

6. In the figure below ΔKNQ and ΔMPQ have a common vertex Q.

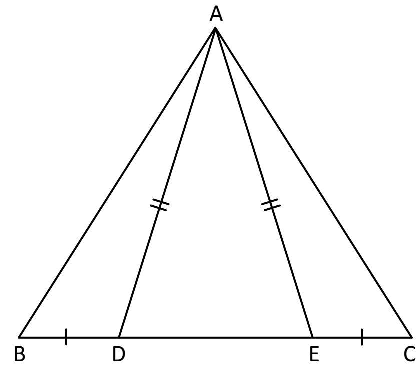
P is a point on KQ and N is a point on MQ.

KQ = MQ and PQ = QN.



Prove with reasons that ΔKNQ ≡ ΔMPQ. (4)

7. ΔABC, D and E are points on BC such that BD = EC and AD = AE.

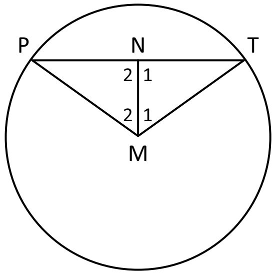


7.1 Why is BE = CD? (1)

7.2 Which triangle is congruent to ΔABE? (1)

8. In the given figure, P and T are points on a circle with centre M.

N is a point on a chord PT such that $MN \perp PT$.

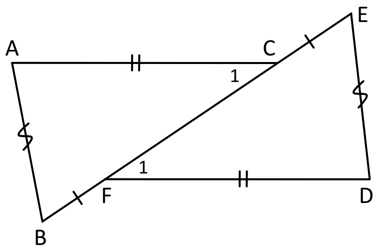


Prove that PN = NT.

Statement	Reason

(8)

9.



In the above diagram, AC = DF, AB = DE and BF = CE.

9.1 Prove that BC = EF.

Statement	Reason

(2)

9.2 Prove that $\Delta ABC \equiv \Delta DEF$.

Statement	Reason

(5)

9.3 Why is $\hat{B} = \hat{E}$?

Statement	Reason
$\hat{B} = \hat{E}$	

(1)

9.4 Use your answer in Question 9.3 to derive a further relationship between AB and ED.

Note: It has (already) been given that AB = ED.

Statement	Reason

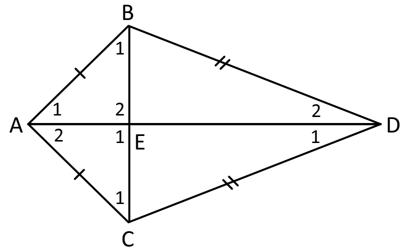
(2)

10. In the figure alongside

AB = AC

and

BD = CD



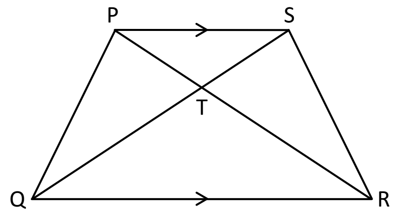
10.1 Prove that $\Delta ABD \equiv \Delta ACD$. (4)

10.2 Prove that $\Delta ABE \equiv \Delta ACE$. (4)

10.3 Prove that $\hat{E}_1 = \hat{E}_2 = 90^\circ$. (3)

10.4 Hence, state the relationship between AE and BC. (1)

11. In the figure below, PS || QR. Which ONE of the following statements is true for this figure?



A $\Delta PTS \equiv \Delta PQT$

B $\Delta PTS \equiv \Delta RTQ$

C $\Delta PTS\ |||\ \Delta SRT$

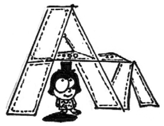
D $\Delta PTS\ |||\ \Delta RTQ$ (1)

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.28

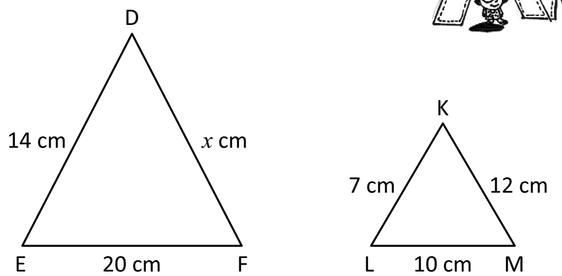
SIMILAR Δ^s

(Solutions on page A6)

See the notes on Congruency and Similarity on page A5



1. Examine ΔDEF and ΔKLM.



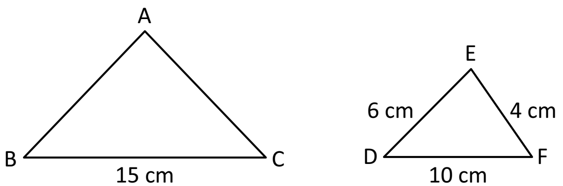
Complete the following calculations if ΔDEF ||| ΔKLM.

$\frac{DE}{KL} = \frac{EF}{LM} = \frac{DF}{\quad}$ (proportional sides of similar triangles)

➨ $\frac{14}{7} = \frac{x}{\quad}$

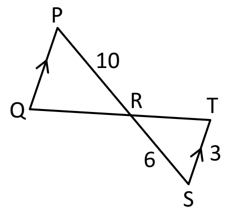
➨ $x =$ ________ (3)

2. Calculate the length of AB if ΔABC ||| ΔEDF :



(4)

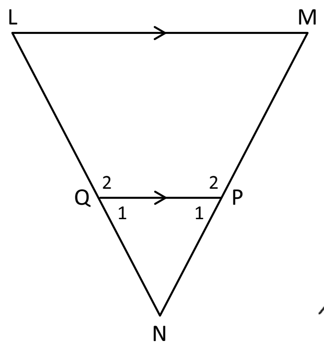
3. In ΔPQR and ΔSTR in the figure alongside, PQ || ST, PR = 10 cm, ST = 3 cm and SR = 6 cm.



3.1 Prove that ΔPQR ||| ΔSTR (4)

3.2 Calculate the length of PQ. (3)

4. In ΔNML below, P and Q are points on the sides MN and LN respectively such that QP || LM. MN = 16 cm, QP = 3 cm and LM = 8 cm.



4.1 Complete the following (give reasons for the statements):

Prove with reasons that ΔQPN ||| ΔLMN.

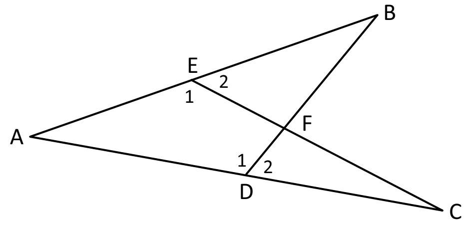
In ΔQPN and ΔLMN

1. $\hat{N}$ ....
2. $\hat{P}_1$ = ...
3. $\hat{Q}_1$ = ...

∴ ΔQPN ||| Δ .... (4)

4.2 Hence, calculate the length of PN. (3)

5.



In the figure,

$\hat{B} = \hat{C}$, AD = 9 cm, AE = 7 cm and CE = 21 cm.

5.1 Prove that ΔABD ||| ΔACE.

Statement	Reason

(6)

5.2 Calculate the length of BD.

Statement	Reason

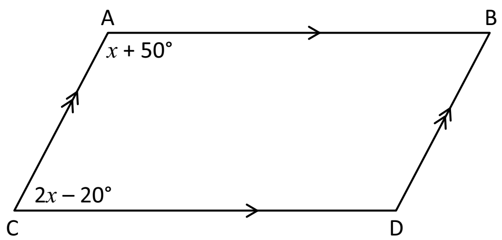
(5)

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.28

QUADRILATERALS

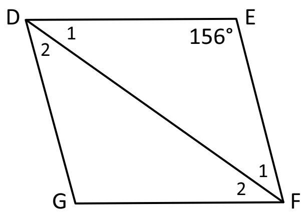
(Solutions on page A7)

1. ABCD is a parallelogram. Calculate the size of $\hat{B}$.



(4)

2. In the figure below, DEFG is a rhombus and $\hat{E}$ = 156°.



Calculate the size of:

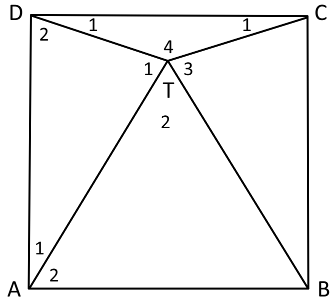
2.1 $E\hat{F}G$

2.2 $\hat{F}_2$

2.3 $\hat{G}$

	Statement	Reason	
2.1	$E\hat{F}G$ =		(2)
2.2	$\hat{F}_2$ =		(2)
2.3	$\hat{G}$ =		(2)

3. In the figure below, ABCD is a square and ATB is an equilateral triangle.

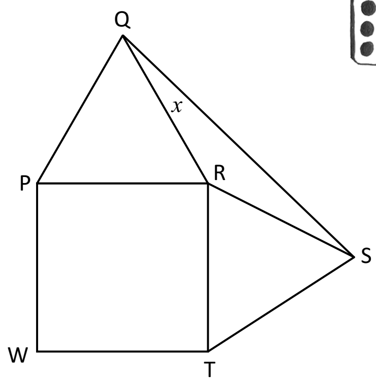


3.1 Name two isosceles triangles. (2)

3.2 Calculate the size of $\hat{D}_2$. (3)

3.3 Calculate the size of $\hat{T}_4$. (2)

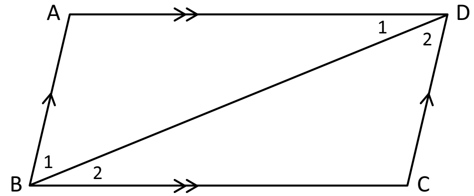
4. PRTW is a square. ΔPQR and ΔRTS are equilateral.
Calculate x $(R\hat{Q}S)$



(7)

NB: Study 'Quadrilaterals' on page Q12 very carefully.

5.



Look at parallelogram ABCD above and complete the table.

Statement	Reason
In ΔADB and ΔCBD	
$\hat{D}_1$ = ______	Alternate ∠'s and AD || BC
$\hat{B}_1$ = ______	Alternate ∠'s and AB || DC
BD = BD	Common side
∴ ΔADB ≡ Δ______	____________
∴ AD = ______ and AB = ______	Corresponding sides of congruent Δ^s

(4)

6. A parallelogram with at least one angle equal to 90° is called a __________

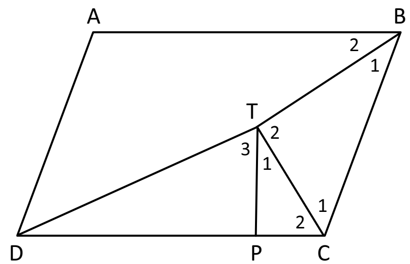
A kite.

B rhombus.

C trapezium.

D rectangle. (1)

7.



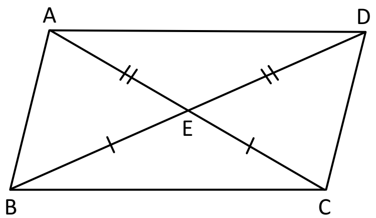
The bisectors of $\hat{B}$ and $\hat{C}$ of parallelogram ABCD intersect at T. Points B, T and D do not lie on a straight line. P is a point on DC such that $T\hat{P}D = 90^\circ$.

7.1 Prove that $\hat{T}_2 = 90^\circ$. (5)

7.2 Which triangle is similar to ΔBCT? (2)

7.3 If BC = 2TC and TP = 4 cm, calculate the length of BT. (3)

8. In the given quadrilateral AE = ED and BE = EC, therefore:



A $\Delta AEB \,|||\, \Delta CED$

B $\Delta AED \,|||\, \Delta BEC$

C $\Delta AEB \equiv \Delta DEC$

D $\Delta AED \equiv \Delta BEC$ (2)

POLYGONS

9. What is the size of each angle in a regular pentagon?

A 90°

B 120°

C 100°

D 108° (1)

10. What is the size of each angle in a regular hexagon?

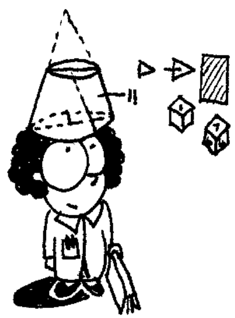
A 90°

B 120°

C 100°

D 108° (1)

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.26



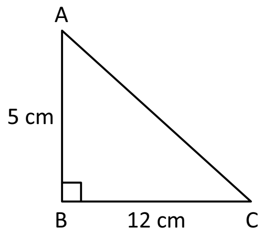
NOTES

THEOREM OF PYTHAGORAS

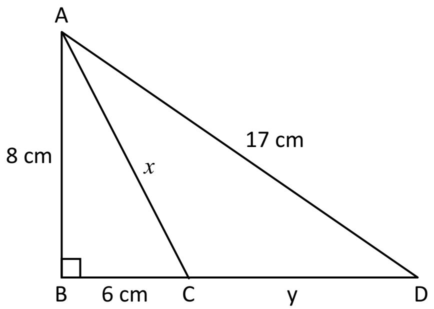
(Solutions on page A9)

1. In ΔABC, $AB \perp BC$.

   Determine the length of AC if AB = 5 cm and BC = 12 cm. (4)



2.1



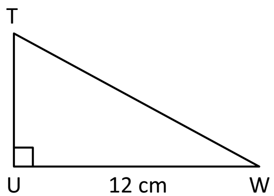
2.1 Calculate x. (3)

2.2 Calculate y. (3)

Give reasons.

3. The area of $\Delta TUW = 30\ cm^2$ and UW = 12 cm.

   Calculate:



3.1 TU (2)

3.2 the perimeter of ΔTUW (3)

4. A ladder is standing against the wall. If the ladder reaches a height of 12 m up the wall and has its foot 5 m away from it, calculate the length of the ladder. (3)

5. In rectangle ABCD, AB = 8 cm and diagonal AC = 10 cm.

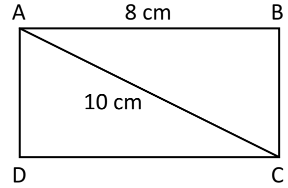
   Calculate the length of AD.

   A 2 cm

   B 6 cm

   C 12,8 cm

   D 14 cm (2)



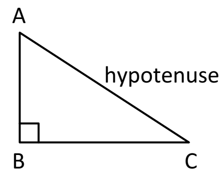
6. In ΔABC: AB = 9 cm, BC = 12 cm and AC = 15 cm.

   Show that $\hat{B} = 90°$.

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.33

A Right-angled triangle

A **right-angled triangle** has one angle of **90°**. Here, $\hat{B} = 90°$.
The side opposite the right angle (90°) is called the **hypotenuse**.
Here, AC is the hypotenuse.



The Theorem of Pythagoras

This theorem states:

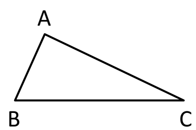
> In a right-angled triangle . . .
> the square of the hypotenuse equals
> the sum of the squares on the other two sides.

i.e. In ΔABC, $\hat{B} = 90°$

So: $AC^2 = AB^2 + BC^2$

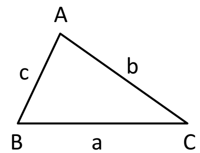
The **converse** theorem states the reverse:

If in **any** ΔABC,
$AC^2 = AB^2 + BC^2$,
then $\hat{B} = 90°$.

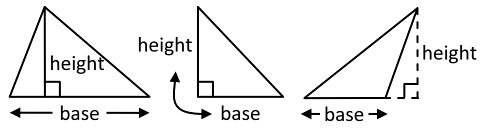


PERIMETER AND AREA FORMULAE

Triangle

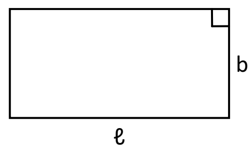


The **perimeter** of this triangle = (a + b + c) units.



The **area** of a triangle = $\dfrac{\textbf{base} \times \textbf{height}}{\textbf{2}}$

Rectangle

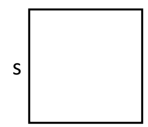


ℓ : length
b : breadth

The **perimeter** of a rectangle
= ℓ + b + ℓ + b
= 2ℓ + 2b
= **2(ℓ + b)**

The **area** of a rectangle
= ℓ × b = **ℓb**

Square

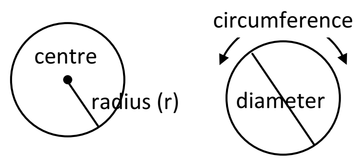


The **perimeter** of a square
= 4 × s = **4s**

The **area** of a square
= s × s = $\mathbf{s^2}$

See the Quadrilaterals on page Q12 for the areas of all other quadrilaterals.

Circle



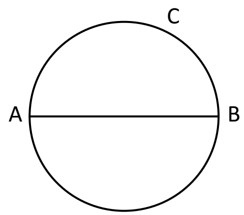
The **circumference** of a circle:
= πd = π(2r) = **2πr**

The **area** of a circle:
= $\pi \mathbf{r^2}$

MEASUREMENT: 2D

(Solutions on page A10)

1. AB, the diameter of the given circle, is 12 cm. Use π = 3,14 to answer the following questions, correct to two decimal places.

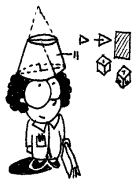


1.1 Calculate the area of the circle. (4)

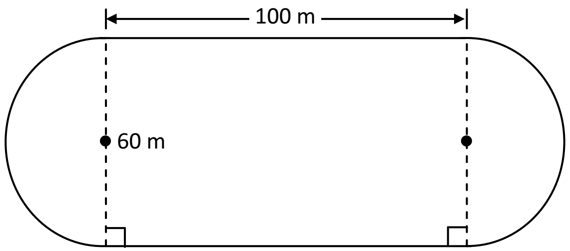
1.2 Calculate the perimeter of the semi–circle ACB. (3)

2. If the length of the side of a square is 0,12 cm then the area =

A $0,24\ cm^2$
B $0,144\ cm^2$
C $1,44\ cm^2$
D $0,0144\ cm^2$ (2)



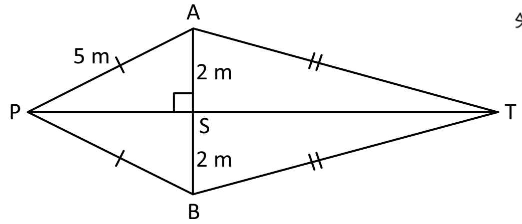
3. Peter runs around the field with the following dimensions:



3.1 How many times must he run around the field in order to run a distance of at least 4 km?
Use π = 3,14. (4)

3.2 Calculate the area of this field, correct to two decimal places. (4)

4. In the figure below, AP = 5 m, AS = SB = 2 m and PS $\perp$ AB.



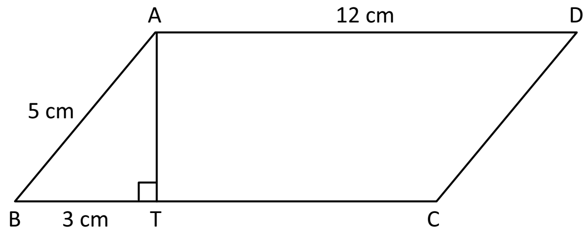
4.1 Calculate the length of PS correct to 2 decimal places. (3)

4.2 Calculate the length of PT if PT = 3 $\times$ AB. (1)

4.3 What kind of quadrilateral is APBT? (2)

4.4 Calculate the area of the figure correct to 2 decimal places. (2)

5.



In parallelogram ABCD, AB = 5 cm, AD = 12 cm, BT = 3 cm and AT $\perp$ BC.

5.1 Calculate the length of AT. (3)

5.2 Determine the area of the parallelogram. (3)

5.3 Calculate

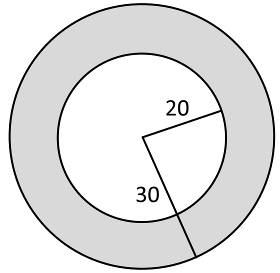
5.3.1 the perimeter of trapezium ADCT. (1)

5.3.2 the area of trapezium ADCT. (3)

6. The length of a rectangle is doubled.
Write down the value of k if the area of the enlarged rectangle = k $\times$ the area of the original rectangle. (1)

7. The circumference of a circle is 52 cm. Calculate the area of the circle correct to 2 decimal places. (4)

8. Two circles have the same centre.
The smaller circle has a radius of 20 cm.
The larger circle has a radius of 30 cm.

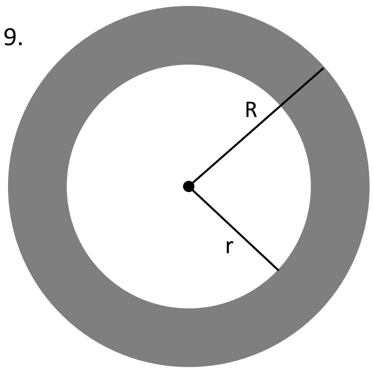


Calculate:

8.1 the circumference of the smaller circle. (2)

8.2 The area of the shaded section. (3)

9.



9.1 Show that the area of the shaded ring is equal to $\pi(R^2 - r^2)$. (2)

9.2 Determine the area of the shaded ring in terms of π if R = 14 cm and r = 8 cm. (2)

For further practice in this topic – see The Answer Series Gr 9 Mathematics 2 in 1 on p. 1.26

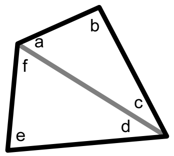
QUADRILATERALS

Pathways of **definitions** and **properties**

Quadrilaterals play a prominent role right through to Grade 12!

The arrows indicate various 'ROUTES' from 'any' quadrilateral to the square, the 'ultimate quadrilateral'.

'Any' Quadrilateral

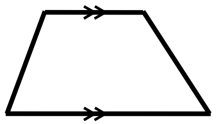


Sum of the $\angle^s$ of ***any*** quadrilateral = 360°

*See how the **properties accumulate** as you move from left to right.*

i.e. the first quad has no special properties and each successive quadrilateral has all preceding properties.

A Trapezium



Definition of a trapezium

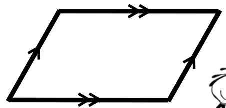
A quadrilateral with 1 pair of opposite sides parallel

Properties of a trapezium

The Sides

- 1 pair of opposite sides parallel

A Parallelogram



Definition of a parallelogram

A quadrilateral with 2 pairs of opposite sides parallel

Properties of a parallelogram

The Sides

- 2 pairs of opposite sides parallel
- 2 pairs of opposite sides equal

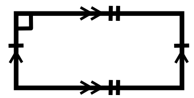
The Angles

- 2 pairs of opposite angles equal

The Diagonals . . .

- bisect each other

A Rectangle



Definition of a rectangle

A parallelogram with one right angle

Properties of a rectangle

The Sides

- 2 pairs of opposite sides parallel
- 2 pairs of opposite sides equal

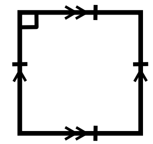
The Angles

- all 4 angles equal 90º

The Diagonals . . .

- bisect each other equally (the diagonals are equal to each other!)

The Square



Definition of a square

A rectangle with one pair of adjacent sides equal

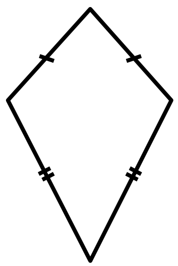
OR

A rhombus with one angle of 90º

Properties of a square

A square contains ALL the accumulated properties of sides, angles and diagonals!!!

A Kite



Definition of a kite

A quadrilateral with 2 pairs of adjacent sides equal

Properties of a kite

The Sides

- 2 pairs of adjacent sides equal

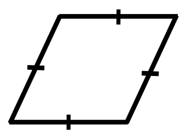
The Angles

- the following pair of angles will be equal because of isosceles triangles as a result of adjacent sides equal

The Diagonals . . .

- cut perpendicularly
- the LONG DIAGONAL bisects the short diagonal and the opposite angles

A Rhombus



Definition of a rhombus

A parallelogram with one pair of adjacent sides equal

OR

A kite with 2 pairs of opposite sides parallel

Properties of a rhombus

The Sides

- all 4 sides equal

The Angles

- 2 pairs of opposite angles equal

The Diagonals . . .

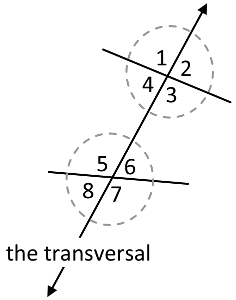
- cut perpendicularly
- bisect each other
- bisect the opposite angles

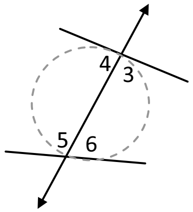
MORE STRAIGHT LINE GEOMETRY

Important Vocabulary

When 2 lines are cut
by another line (a transversal),
two **families** of angles are formed:

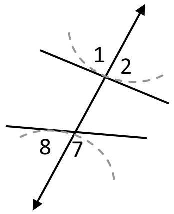
$\hat{1}$, $\hat{2}$, $\hat{3}$, $\hat{4}$ and $\hat{5}$, $\hat{6}$, $\hat{7}$, $\hat{8}$

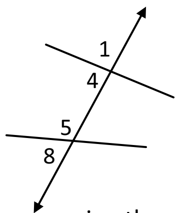




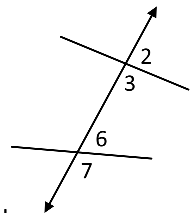
These are **interior** angles.

These are **exterior** angles.

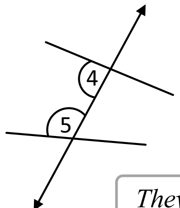




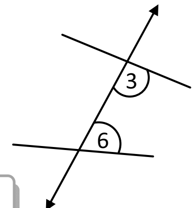
Each of these groups are **'co-'** angles



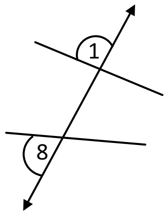
i.e. they are on the same side of the transversal



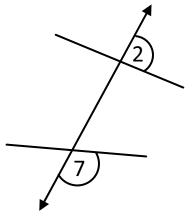
These are pairs of **co-interior** angles.



They are NOT necessarily supplementary.

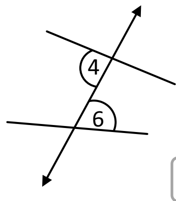


These are pairs of **co-exterior** angles.

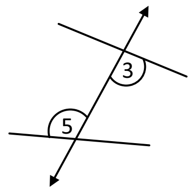


Not usually used.

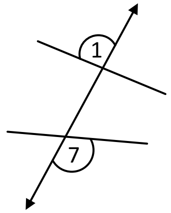
Angles that 'alternate' are on opposite sides of the transversal.



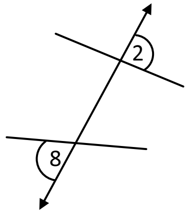
These are pairs of **interior 'alternate'** angles.



They are NOT necessarily equal.

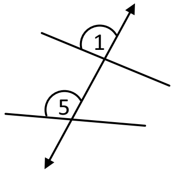


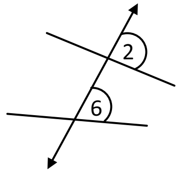
These are pairs of **exterior 'alternate'** angles.

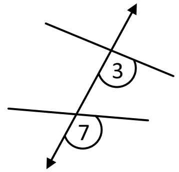


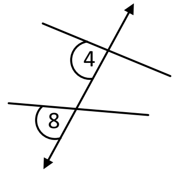
Not usually used.

These pairs of angles **correspond**.





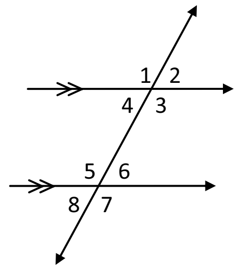




Note: *They are NOT necessarily equal.*

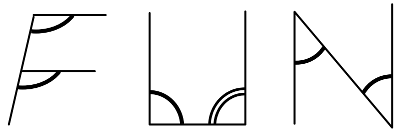
The FACTS

When 2 **PARALLEL** lines are cut by a transversal, then
the **corresponding angles** are **equal**,
the (interior) **alternate angles** are **equal**, and
the **co-interior** angles are **supplementary**.



& conversely:

If the **corresponding angles** are **equal**, or if
the (interior) **alternate angles** are **equal**, or if
the **co-interior** angles are **supplementary**, then the lines are **parallel**.



Recognise these angles in unfamiliar situations.