

8

Rate

This photocopier can print 50 copies per minute.

I can type about 80 words in 1 minute.

How many copies can the printer print in 5 minutes?

Finding Rate

Let's Learn



- 1 A printer prints 50 pages every minute.
This means the printer prints at a **rate** of 50 pages per minute.

The word “per” means “every”.
So “50 pages *per* minute” means
“50 pages *every* minute”.



- 2 A photocopier takes 5 minutes to print 300 pages.
How many pages does it print per minute?

$\div 5$	5 min	300 pages	$\div 5$
	1 min	? pages	

$$300 \div 5 = 60$$

The photocopier prints **60** pages per minute.

Since we divide
5 minute by 5 to get
1 minute, we also divide
300 pages by 5 to find
the number of pages
printed in 1 minute.

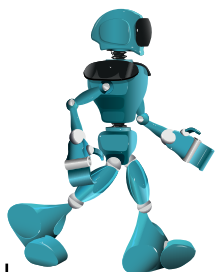


We can also use the **unitary method** to
find the value that represents one unit.

$$\begin{aligned} 5 \text{ min} &\rightarrow 300 \text{ pages} \\ 1 \text{ min} &\rightarrow 300 \text{ pages} \div 5 \\ &= 60 \text{ pages} \end{aligned}$$



- 3 A robot walks 20 m for 4 minutes.
How far does it walk in 1 minute?



20 m

$\div 4$	4 min	20 m	$\div 4$
	1 min	? m	

$$20 \text{ m} \div 4 = 5 \text{ m}$$

It walks **5 m** in 1 minute.

Let's **divide proportionately** to find the answer.



- 4 Jenny is paid \$75 for working 5 hours.
What is the rate of her pay per hour?



$$5 \text{ h} \rightarrow \$75$$

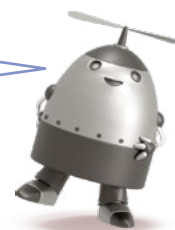
$$1 \text{ h} \rightarrow \$75 \div 5 \\ = \$15$$

The rate of her pay is **\$15** per hour.

Let's use the **unitary method** to find the answer.



Which method do you prefer?



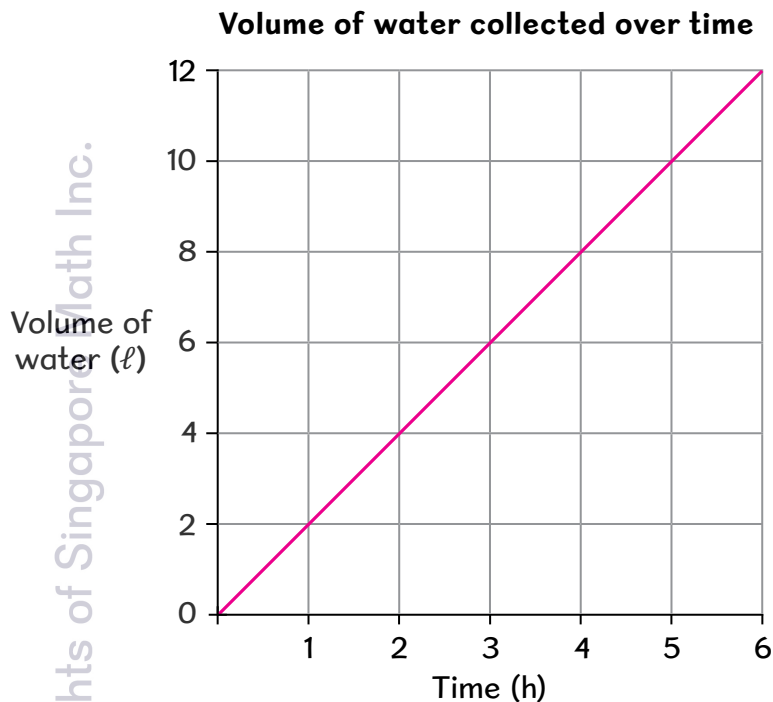
- 5 12 ℓ of water was collected from a dripping tap in 6 hours.
How much water was collected per hour?

÷6	6 h	12 ℓ	÷6
	1 h	? ℓ	

$$12 \ell \div 6 = 2 \ell$$

2 ℓ of water was collected per hour.

The line graph represents the rate of water collected from a dripping tap.



The line graph shows that for every 1 hour, 2 ℓ of water was collected.



Let's Practise



- 1 A printer prints 36 pages in 4 minutes.
At this rate, how many pages does it print per minute?
- 2 A machine packs 9600 bottles into boxes in 5 hours.
At this rate, how many bottles does it pack into boxes per hour?
- 3 A motorcyclist travelled 140 km in 4 hours.
He travelled the same distance every hour.
How far did he travel in 1 hour?



Word Problems II

Let's Learn

- 1 Gopal types 50 words per minute.
How many minutes does he take to type 150 words?

×3	50 words	1 min	×3
	150 words	? min	

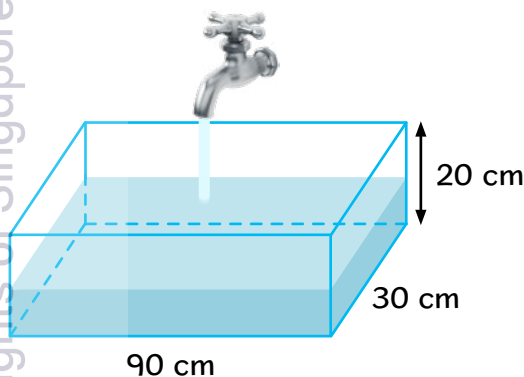
$$1 \text{ min} \times 3 = 3 \text{ min}$$

Gopal takes **3 minutes** to type 150 words.

$$\begin{aligned} 50 \text{ words} &\rightarrow 1 \text{ min} \\ 1 \text{ word} &\rightarrow \frac{1}{50} \text{ min} \\ 150 \text{ words} &\rightarrow 150 \times \frac{1}{50} \text{ min} \\ &= 3 \text{ min} \end{aligned}$$



- 2 Water flows from a tap into an empty tank at a rate of 6 litres per minute.
The tank measures 90 cm by 30 cm by 20 cm.
How long does it take to fill the tank to the brim?



$$\begin{aligned} \text{Capacity of tank} &= 90 \text{ cm} \times 30 \text{ cm} \times 20 \text{ cm} \\ &= 54\,000 \text{ cm}^3 \end{aligned}$$

$$54\,000 \text{ cm}^3 = 54 \ell$$

×9	6 ℓ	1 min	×9
	54 ℓ	? min	

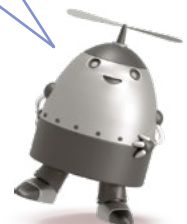
$$1 \text{ min} \times 9 = 9 \text{ min}$$

It takes **9 minutes** to fill the tank to the brim.

$$\begin{aligned} 6 \ell &\rightarrow 1 \text{ min} \\ 1 \ell &\rightarrow \frac{1}{6} \text{ min} \\ 54 \ell &\rightarrow 54 \times \frac{1}{6} \text{ min} \\ &= 9 \text{ min} \end{aligned}$$



Why do we need to
convert $54\,000 \text{ cm}^3$
to 54ℓ ?



- 3 A scanner scans 15 pages in 3 minutes.
How many minutes does it take to scan 60 pages?

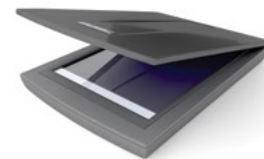
$\div 3$	15 pages	3 min	$\div 3$
$\times 12$	5 pages	1 min	$\times 12$
	60 pages	? min	

$$15 \div 3 = 5$$

It takes 1 minute to scan 5 pages.

$$1 \text{ min} \times 12 = 12 \text{ min}$$

It takes **12 minutes** to scan 60 pages.



Can you think of another way to solve this question?



- 4 A car travels 98 km on 7 litres of petrol. Each litre of petrol costs \$1.30 .
(a) How far can the car travel on 12 litres of petrol?
(b) How much does the amount of petrol cost when the car travels 126 km?

(a) $7 \ell \rightarrow 98 \text{ km}$

$$1 \ell \rightarrow 98 \text{ km} \div 7 \\ = 14 \text{ km}$$

$$12 \ell \rightarrow 12 \times 14 \text{ km} \\ = 168 \text{ km}$$

The car can travel **168 km** on 12 litres of petrol.

(b) $98 \text{ km} \rightarrow 7 \ell$

$$1 \text{ km} \rightarrow \frac{7}{98} \ell$$

$$126 \text{ km} \rightarrow 126 \times \frac{7}{98} \ell \\ = 9 \ell$$

The car requires 9 ℓ of petrol to travel 126 km.

$$9 \times \$1.30 = \$11.70$$

The amount of petrol costs **\$11.70** when the car travels 126 km.



- 5 At a supermarket, a brand of washing powder is sold in two different pack sizes. Pack A contains 3 kg of washing powder and costs \$6.90. Pack B contains 5 kg of washing powder and costs \$9.00. Which pack is cheaper per kilogram of washing powder?



Should my mum
buy Pack A
or Pack B?



Pack A
3 kg → \$6.90
1 kg → $\$6.90 \div 3$ = \$2.30

Pack B
5 kg → \$9.00
1 kg → $\$9.00 \div 5$ = \$1.80

For Pack A, the washing powder costs \$2.30 per kg.
For Pack B, it costs \$1.80 per kg.

Pack B is cheaper than Pack A for every kilogram of washing powder.



Let's Practise



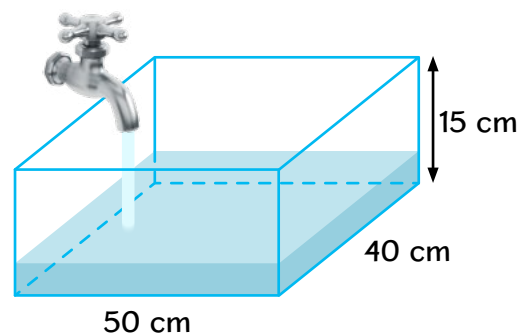
- 1 A bakery bakes 48 muffins in 4 hours.
At this rate, how long does it take to bake 108 muffins?

- 2 Every 4 minutes, a robot vacuum cleans an area of 20 m^2 .
How many minutes does it take to clean an area of 150 m^2 ?



- 3 A rectangular tank measuring 40 cm by 30 cm by 25 cm is filled with water to the brim. A hole is made at the bottom of the tank and water flows out at a rate of 5 litres per minutes.
How long will it take to empty the tank?

- 4 A tap was turned on to fill an empty rectangular tank measuring 50 cm by 40 cm by 15 cm. Water flowed from the tap at a rate of 6 litres per minute.
After 3 minutes, the tap was turned off.
How much more water is needed to fill the tank completely? Give your answer in litres.



- 5 Mdm Tay is looking for a part-time job at a restaurant.
For 7 hours of work, Restaurant A will pay her \$45.50.
For 6 hours of work, Restaurant B will pay her \$40.80.
She wants to work for 5 hours. Which restaurant do you think Mdm Tay should work for? Explain your answer.

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Vertically Opposite Angles

Hands-on Activity



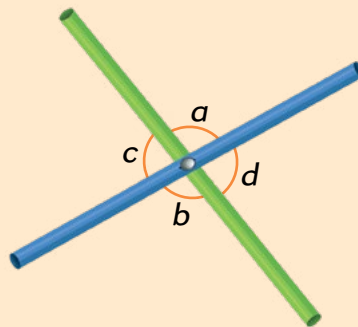
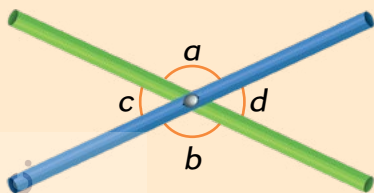
Work in groups.

Take two straws and attach them at the centre using a fastener.

Use a protractor to measure the pairs of opposite angles.

Move the straws to change the size of the angles.

Then measure the pairs of opposite angles again.



What do you notice? Discuss and explain.

(a) Is $\angle a = \angle b$? Is $\angle c = \angle d$?

(b) Is $\angle a + \angle c = \angle b + \angle d$?

(c) Is $\angle a + \angle d = \angle b + \angle c$?

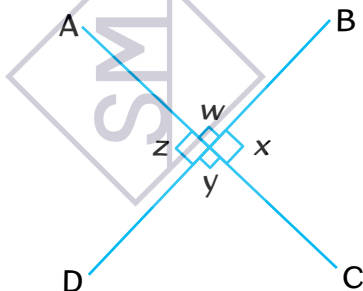
Let's Learn



- 1 In the figure, AC is **perpendicular** to BD.
These two straight lines **intersect** each other.

$\angle w$ and $\angle y$ are a pair of **vertically opposite angles**.

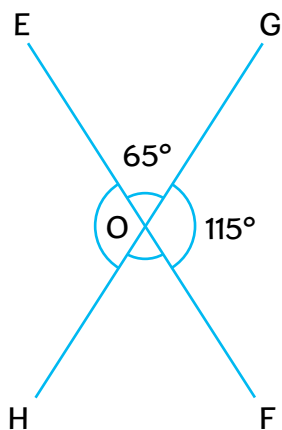
$\angle x$ and $\angle z$ are another pair of vertically opposite angles.



$$\angle w = \angle y = 90^\circ$$

$$\angle x = \angle z = 90^\circ$$

- 2 EF and GH are straight lines.



$$\begin{aligned}\angle EOH &= \angle GOF \\ &= 115^\circ\end{aligned}$$

$\angle EOH$ and $\angle GOF$ are a pair of vertically opposite angles.

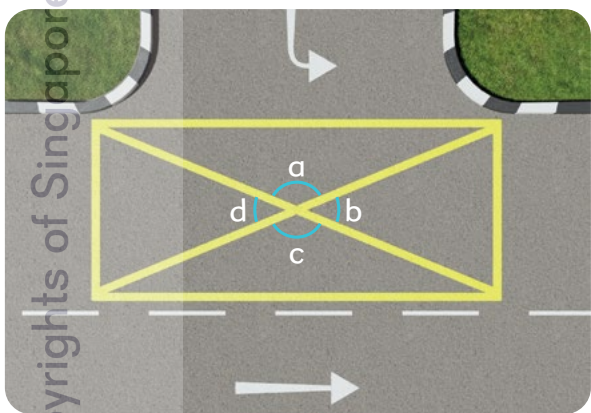
$$\begin{aligned}\angle HOF &= \angle EOG \\ &= 65^\circ\end{aligned}$$

$\angle HOF$ and $\angle EOG$ are another pair of vertically opposite angles.

When two straight lines intersect, they form two pairs of vertically opposite angles.

Vertically opposite angles are equal.

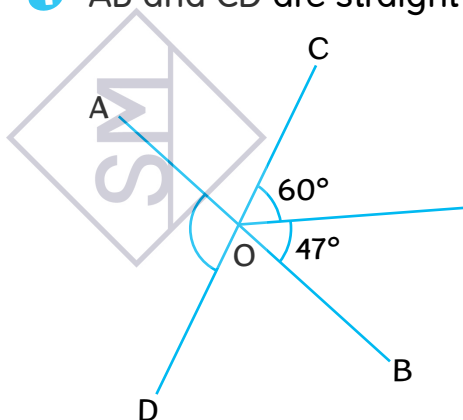
- 3 The yellow box junction is commonly seen on the roads.



Can you identify and name the pairs of vertically opposite angles that are equal?



- 4 AB and CD are straight lines. Find $\angle AOD$.

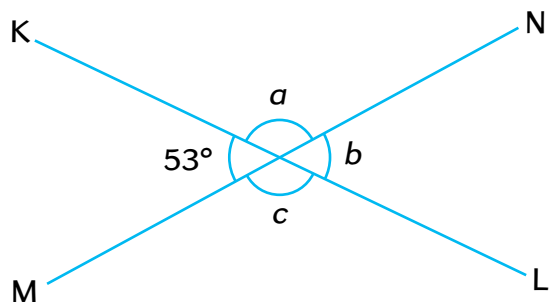


$$\begin{aligned}\angle AOD &= \angle COB \\ &= 60^\circ + 47^\circ \\ &= 107^\circ\end{aligned}$$

$\angle AOD$ and $\angle COB$ are vertically opposite angles.



- 5 KL and MN are straight lines. Find the unknown angles.



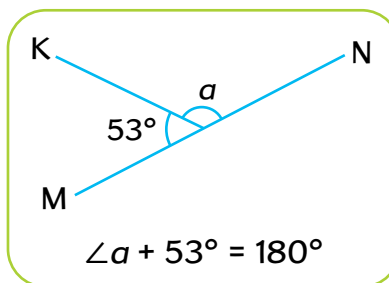
$$\angle a = 180^\circ - 53^\circ$$

$$= 127^\circ$$

$$\angle b = 53^\circ$$

$$\angle c = \angle a$$

$$= 127^\circ$$

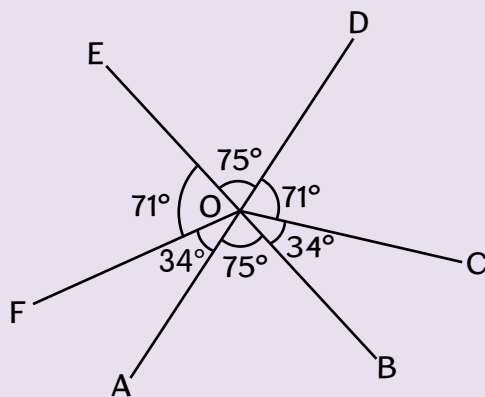


Maths Talk



Discuss with your partner.

AOD and BOE are two straight lines that cross each other.



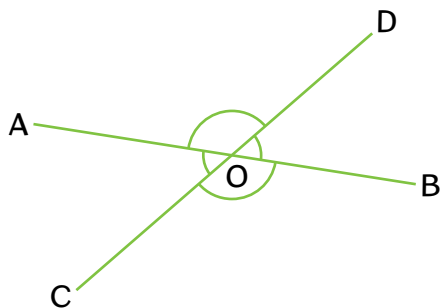
(a) Identify two pairs of vertically opposite angles.

(b) $\angle EOF = \angle DOC$. Are these two angles vertically opposite angles? Explain.

Let's Practise

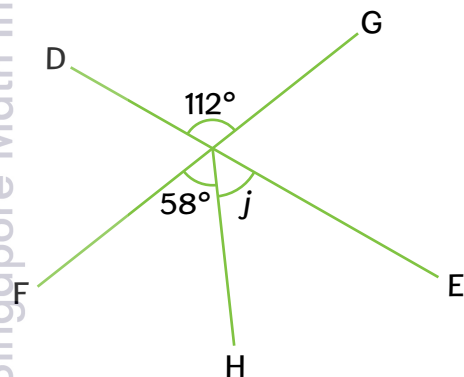


- 1 AB and CD are straight lines.
Which angle is the same as $\angle AOC$?



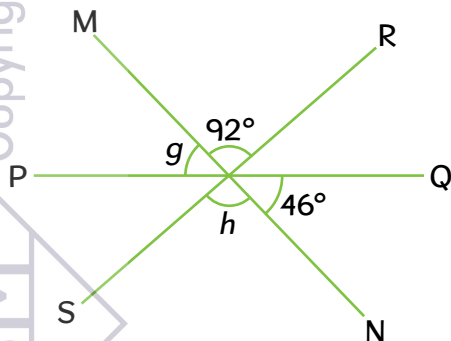
$\angle$

- 2 DE and FG are straight lines.
Find $\angle j$.



$\angle j =$

- 3 MN, PQ and RS are straight lines. Find $\angle g$ and $\angle h$.



$\angle g =$

$\angle h =$

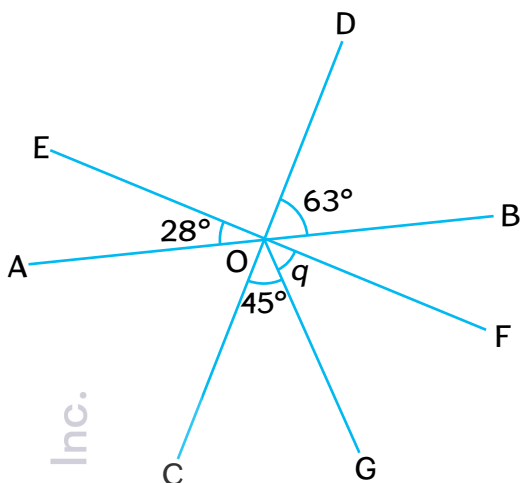


Finding Unknown Angles

Let's Learn



- 1 AOB, COD and EOF are straight lines. Find $\angle q$.



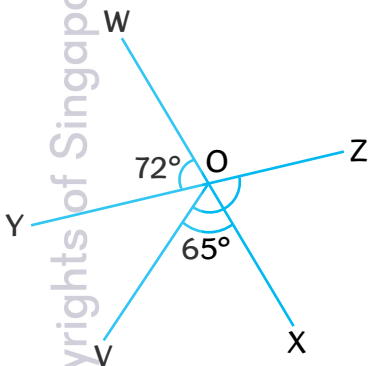
$$\begin{aligned}\angle BOF &= \angle AOE \\ &= 28^\circ\end{aligned}$$

$$\begin{aligned}\angle q &= 180^\circ - 63^\circ - 28^\circ - 45^\circ \\ &= \mathbf{44^\circ}\end{aligned}$$

Can you think of other ways to find $\angle q$?



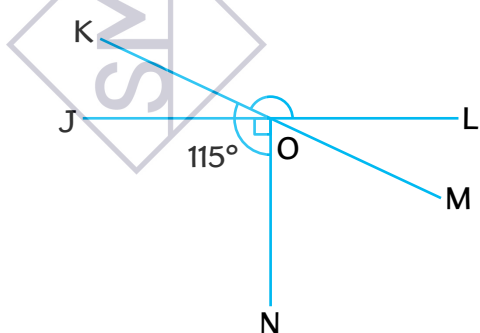
- 2 WX and YZ are straight lines. Find $\angle VOZ$.



$$\begin{aligned}\angle ZOY &= \angle WOY \\ &= 72^\circ\end{aligned}$$

$$\begin{aligned}\angle VOZ &= 65^\circ + 72^\circ \\ &= \mathbf{137^\circ}\end{aligned}$$

- 3 JL and KM are straight lines. $\angle KON = 115^\circ$. Find $\angle KOL$.



Method 1

$$\begin{aligned}\angle NOL &= 180^\circ - 90^\circ \\ &= 90^\circ\end{aligned}$$

$$\begin{aligned}\angle KOL &= 360^\circ - 90^\circ - 115^\circ \\ &= \mathbf{155^\circ}\end{aligned}$$

Method 2

$$\begin{aligned}\angle KOJ &= 115^\circ - 90^\circ \\ &= 25^\circ\end{aligned}$$

$$\begin{aligned}\angle KOL &= 180^\circ - 25^\circ \\ &= \mathbf{155^\circ}\end{aligned}$$

Hands-on Activity

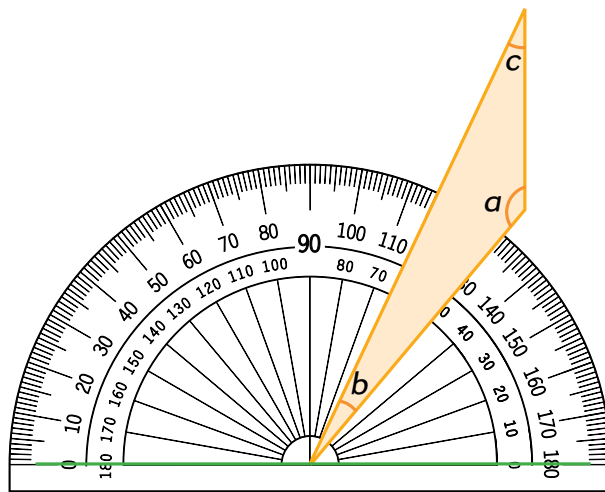


Work in pairs.

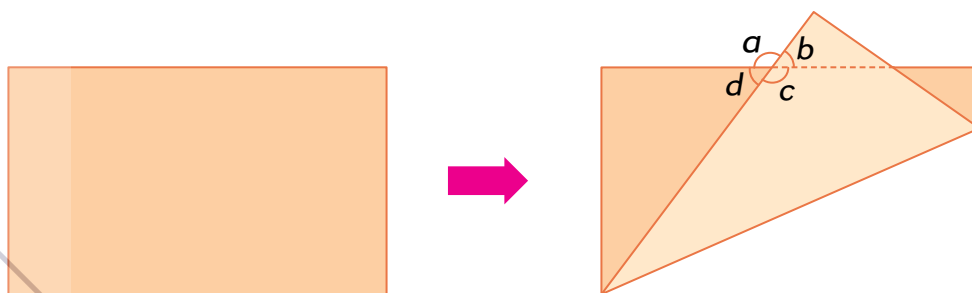
- 1 Cut out a triangle and label the angles as a , b and c .
Place one of the vertices of a shape on a protractor as shown below.
Take turns to find the unknown marked angles using the property **angles on a straight line**.

Example

$$\begin{aligned}\angle b &= 180^\circ - 50^\circ - 115^\circ \\ &= 15^\circ\end{aligned}$$



- 2 Fold a piece of A4 paper as shown below.



Use a protractor to measure $\angle a$ formed by the sides of the folded paper. Then find $\angle b$, $\angle c$ and $\angle d$ without using the protractor. Discuss the method with your partner.

Maths Talk

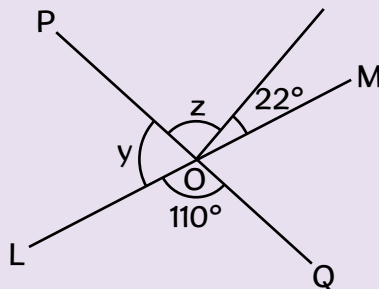


In the figure below, POQ and LOM are straight lines. Hairul and Cheryl are trying to find the values of $\angle y$ and $\angle z$.

I can find $\angle z$ by finding $\angle y$ first.



Hairul



I can find $\angle y$ by finding $\angle z$ first.



Cheryl

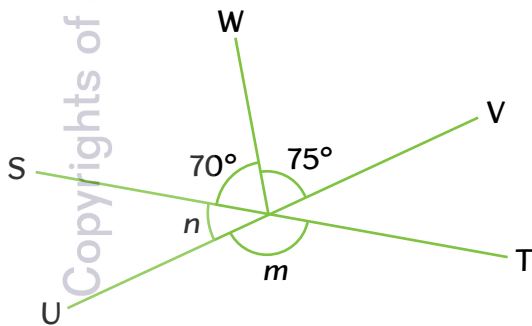
Are the children correct?

Let's Practise



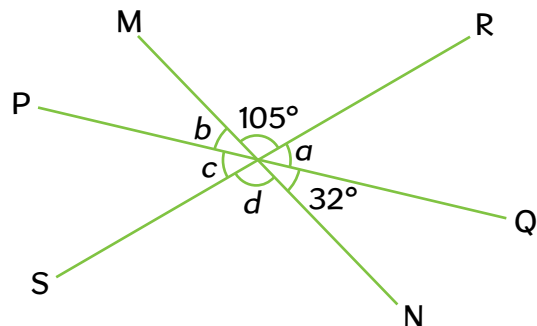
Find the unknown angles.

(a) ST and UV are straight lines.



$\angle m = \boxed{}$, $\angle n = \boxed{}$

(b) MN, PQ and RS are straight lines.



$\angle a = \boxed{}$, $\angle b = \boxed{}$

$\angle c = \boxed{}$, $\angle d = \boxed{}$

