



KING EDWARD VI  
HANDSWORTH GRAMMAR  
SCHOOL FOR BOYS



KING EDWARD VI  
ACADEMY TRUST  
BIRMINGHAM

# Year 9

## 2025 Mathematics 2026

### Unit 11 Booklet – Part 1

HGS Maths



Tasks



Dr Frost Course



Name: \_\_\_\_\_

Class: \_\_\_\_\_



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# Year 9

## 2025 Mathematics 2026

### Unit 11 Booklet – Part 2

HGS Maths



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# 1 Fraction Arithmetic

## Extra Notes

## 2 Highest Common Factor and Lowest Common Multiple

### Worked Example

Find the HCF and LCM of

$$2^2 \times 3^2 \times 5^2 \times 11$$

$$2^3 \times 3 \times 5^2 \times 7$$

### Your Turn

Find the HCF and LCM of

$$2 \times 3^3 \times 5 \times 7^2$$

$$2^2 \times 3^2 \times 7^2 \times 11$$

### Worked Example

Find the HCF and LCM of  
123 and 456

### Your Turn

Find the HCF and LCM of  
321 and 654

## Fill in the Gaps

	$a$	$b$	p.p.f. for $a$	p.p.f. for $b$	HCF p.p.f	HCF	LCM p.p.f	LCM
1.	20	8	$2^2 \times 5$	$2^3$	$2^2$	4	$2^3 \times 5$	40
2.	20	16						
3.	200	16						
4.	200				$2 \times 5$		$2^3 \times 5^2$	
5.	21	7						
6.	22	7						
7.	23	7						
8.			$2 \times 5 \times 13$	$2 \times 5^2$				
9.		15				3		405
10.	8				1		$2^3$	
11.	1	100						
12.	16	81						
13.			$2^3 \times 5$	$3^2 \times 11$				
14.						12		180
15.	$x^2y$	$xy^2$	$x^2 \times y$	$x \times y^2$				
16.			$a \times b^2 \times c^3$	$b \times c^2 \times d$				

### Worked Example

Find the HCF and LCM of  
123 and 456 and 789

### Your Turn

Find the HCF and LCM of  
321 and 654 and 987

### **Worked Example**

The HCF of two numbers is 6. The LCM of two numbers is 60.  
Write down two possible numbers.

### **Your Turn**

The HCF of two numbers is 3. The LCM of two numbers is 36.  
Write down two possible numbers.

### **Worked Example**

The HCF of two numbers is 5. The LCM of two numbers is a multiple of 12. Write down two possible numbers.

### **Your Turn**

The HCF of two numbers is 8. The LCM of two numbers is a multiple of 5. Write down two possible numbers.

### Worked Example

The lowest common multiple (LCM) of  $x$  and 72 is 144  
Find the smallest possible value of  $x$

### Your Turn

The lowest common multiple (LCM) of  $x$  and 70 is 210  
Find the smallest possible value of  $x$

### Worked Example

The highest common factor (HCF) of 42 and  $x$  is 14  
The lowest common multiple (LCM) of 42 and  $x$  is 84  
Find the value of  $x$

### Your Turn

The highest common factor (HCF) of 60 and  $x$  is 12  
The lowest common multiple (LCM) of 60 and  $x$  is 240  
Find the value of  $x$

### Worked Example

The lowest common multiple (LCM) of  $a$  and  $b$  is 12  
The lowest common multiple of  $a$  and  $c$  is 500  
Find the least possible value of the lowest common multiple of  $b$  and  $c$

### Your Turn

The lowest common multiple (LCM) of  $a$  and  $b$  is 24  
The lowest common multiple of  $a$  and  $c$  is 75  
Find the least possible value of the lowest common multiple of  $b$  and  $c$

### Worked Example

Two strings of different lengths, 240 cm and 318 cm are to be cut into equal integer lengths. What is the greatest possible length of each piece?

### Your Turn

Two strings of different lengths, 212 cm and 360 cm are to be cut into equal integer lengths. What is the greatest possible length of each piece?

### Worked Example

Two lighthouses flash their lights every 240 s and 318 s respectively. They both flash at the same time. After how many seconds will they next both flash at the same time.

### Your Turn

Two lighthouses flash their lights every 212 s and 360 s respectively. They both flash at the same time. After how many seconds will they next both flash at the same time.

### Worked Example

Mary is organising a charity hot dog sale. There are 312 bread rolls in each packet. There are 276 hot dogs in each packet. Mary buys exactly the same number of bread rolls as hot dogs. What is the smallest number of each packet that Mary can buy?

### Your Turn

Mary is organising a charity hot dog sale. There are 465 bread rolls in each packet. There are 195 hot dogs in each packet. Mary buys exactly the same number of bread rolls as hot dogs. What is the smallest number of each packet that Mary can buy?

## Extra Notes

### 3 Standard Form

Standard form is written in the form of  $a \times 10^n$ , where  $a$  is a number bigger than or equal to 1 and less than 10 (i.e.  $1 \leq a < 10$  or  $-10 < a \leq -1$ ).  $n$  can be any positive or negative whole number.

Note:  $a$  can be any positive or negative number.

In Standard Form	Not in Standard Form
$7.3 \times 10^3$	438,000
$1 \times 10^{-3}$	$54 \times 10^7$
$9.36 \times 10^{18}$	$0.6 \times 10^{-4}$
$4 \times 10^1$	$389 \times 10000$
$5.002 \times 10^{-7}$	$6 \times 10^{1.5}$
$-1.729 \times 10^{211}$	0.000372

Why use standard form?

- It allows us to write really small or really big numbers concisely.
- It allows us to easily compare small and big numbers.

## Intelligent Practice

Decide if the following numbers are in standard form

$3 \times 10^5$

$3 \times -10^5$

$3 \times 10^6$

$3 \times (-10)^5$

$3 \times 10^{67}$

$3 \div 10^5$

$3 \times 10^{6.7}$

$3 + 10^5$

$3 \times 10^{0.67}$

$3 - 10^5$

$3 \times 10^{0.7}$

$4 \times 10^5$

$3 \times 10^7$

$40 \times 10^5$

$3 \times 10^{-7}$

$46 \times 10^5$

$3 \times 10^{-0.7}$

$4.6 \times 10^5$

$3 \times 11^5$

$0.46 \times 10^5$

$3 \times 100^5$

$3.46 \times 10^5$

$3 \times 10.5^5$

$3.46434561 \times 10^5$

$3 \times 10.5^5$

$-3.46434561 \times 10^5$

## Fill in the Gaps

$10^6$	1 000 000	$10 \times 10 \times 10 \times 10 \times 10 \times 10$
$10^5$		
$10^4$		
$10^3$		$10 \times 10 \times 10$
$10^2$		
$10^1$	10	
$10^{-1}$		
		$\frac{1}{10} \times \frac{1}{10}$
	$\frac{1}{1000}$	
$10^{-4}$		

Complete this part first.

Look for patterns in the columns  
to complete the table.

### Worked Example

Write the following numbers in standard form

- a) 70,000
- b) 72,000
- c) 720,000
- d) 722 million

### Your Turn

Write the following numbers in standard form

- a) 63,000
- b) 630,000
- c) 60,000
- d) 633 thousand

### Worked Example

Write the following numbers in standard form

- a) 0.05
- b) 0.005
- c) 0.00572
- d) 572 thousandths

### Your Turn

Write the following numbers in standard form

- a) 0.006
- b) 0.00683
- c) 0.06
- d) 68 hundredths

### Worked Example

Write the following numbers in standard form

- a)  $4367 \times 10^6$
- b)  $0.125 \times 10^{-6}$

### Your Turn

Write the following numbers in standard form

- a)  $0.4367 \times 10^6$
- b)  $125 \times 10^{-6}$

### Worked Example

Write the following as an ordinary number

a)  $3.1 \times 10^6$

b)  $4.1 \times 10^{-6}$

### Your Turn

Write the following as an ordinary number

a)  $3.2 \times 10^7$

b)  $4.2 \times 10^{-7}$

### Worked Example

Put the following numbers in ascending order:

$$5.77 \times 10^6$$

$$8.85 \times 10^6$$

6,350,000

$$2.6 \times 10^5$$

$$3.9 \times 10^5$$

### Your Turn

Put the following numbers in ascending order:

$$1.2 \times 10^6$$

$$8.4 \times 10^7$$

$$8.7 \times 10^6$$

7,000,000

$$3.04 \times 10^7$$

### Worked Example

Put the following numbers in ascending order:

$$3.8 \times 10^{-3}$$

$$5.7 \times 10^{-4}$$

$$1.81 \times 10^{-2}$$

0.000 238

### Your Turn

Put the following numbers in ascending order:

$$3.22 \times 10^{-4}$$

$$7.29 \times 10^{-2}$$

0.003 7

$$1.1 \times 10^{-3}$$

### Worked Example

Put the following numbers in ascending order, starting with the smallest:

500,000

$9.39 \times 10^{-4}$

$7.2 \times 10^{-4}$

0.0024

$1.6 \times 10^4$

### Your Turn

Put the following numbers in ascending order, starting with the smallest:

82,900

9,470,000

$8.16 \times 10^4$

0.00842

$4.59 \times 10^{-2}$

## Worked Example

Work out

a)  $(3 \times 10^5) \times (2 \times 10^4)$

b)  $(3 \times 10^{-5}) \times (2 \times 10^{-4})$

## Your Turn

Work out

a)  $(2 \times 10^3) \times (4 \times 10^5)$

b)  $(2 \times 10^{-4}) \times (4 \times 10^{-5})$

## Worked Example

Work out

- a)  $(3 \times 10^5) \times (6 \times 10^4)$
- b)  $(3 \times 10^{-5}) \times (6 \times 10^{-4})$
- c)  $(3 \times 10^5) \times (6 \times 10^{-4})$

## Your Turn

Work out

- a)  $(6 \times 10^3) \times (4 \times 10^5)$
- b)  $(6 \times 10^{-3}) \times (4 \times 10^{-5})$
- c)  $(6 \times 10^{-3}) \times (4 \times 10^5)$

## Worked Example

Work out

a)  $(4 \times 10^9) \div (2 \times 10^3)$

b)  $(4 \times 10^{-9}) \div (2 \times 10^{-3})$

## Your Turn

Work out

a)  $(8 \times 10^6) \div (2 \times 10^3)$

b)  $(8 \times 10^{-6}) \div (2 \times 10^{-3})$

## Worked Example

Work out

- a)  $(2 \times 10^9) \div (4 \times 10^3)$
- b)  $(2 \times 10^{-9}) \div (4 \times 10^{-3})$
- c)  $(2 \times 10^{-9}) \div (4 \times 10^3)$

## Your Turn

Work out

- a)  $(2 \times 10^6) \div (8 \times 10^3)$
- b)  $(2 \times 10^{-6}) \div (8 \times 10^{-3})$
- c)  $(2 \times 10^6) \div (8 \times 10^{-3})$

## Worked Example

Work out

a)  $(3 \times 10^4) + (4 \times 10^4)$

b)  $(3 \times 10^4) + (8 \times 10^4)$

c)  $(3 \times 10^5) + (8 \times 10^4)$

## Your Turn

Work out

a)  $(3 \times 10^7) + (2 \times 10^7)$

b)  $(3 \times 10^7) + (9 \times 10^7)$

c)  $(3 \times 10^8) + (9 \times 10^7)$

## Worked Example

Work out

- a)  $(7 \times 10^4) - (4 \times 10^4)$
- b)  $(7 \times 10^4) - (0.4 \times 10^4)$
- c)  $(7 \times 10^5) - (0.4 \times 10^4)$

## Your Turn

Work out

- a)  $(6 \times 10^7) - (2 \times 10^7)$
- b)  $(6 \times 10^7) - (0.2 \times 10^7)$
- c)  $(6 \times 10^7) - (0.2 \times 10^8)$

## Worked Example

Work out

a)  $(4 \times 10^{-1}) + (3 \times 10^{-2})$

b)  $(7 \times 10^{-3}) - (2 \times 10^{-4})$

## Your Turn

Work out

a)  $(8 \times 10^{-2}) + (2 \times 10^{-3})$

b)  $(2 \times 10^{-2}) - (5 \times 10^{-3})$

### Worked Example

Calculate

$$\frac{(4.6 \times 10^4) + (1.5 \times 10^3)}{(2 \times 10^2)}$$

### Your Turn

Calculate

$$\frac{(4.5 \times 10^4) + (1.3 \times 10^2)}{(2 \times 10^2)}$$

## Worked Example

- a) Use a calculator to determine  
 $(2.8 \times 10^{41}) \times (8.04 \times 10^{44})$   
Give your answer in standard form.
- b) Use a calculator to work out  
 $(5.13 \times 10^{42}) - (9.98 \times 10^{39})$   
Give your answer in standard form.
- c) Use a calculator to work out  
$$\frac{(2.312 \times 10^{87}) - (4.72 \times 10^{86})}{(1.102 \times 10^{45}) - (8.72 \times 10^{44})}$$
  
Give your answer in standard form.

## Your Turn

- a) Use a calculator to evaluate  
 $(4.752 \times 10^{-68}) \div (6.6 \times 10^{-33})$   
Give your answer in standard form.
- b) Use a calculator to work out  
 $(4.58 \times 10^{-47}) + (1.85 \times 10^{-44})$   
Give your answer in standard form.
- c) Use a calculator to evaluate  
$$\frac{(1.6 \times 10^{60}) - (8.8 \times 10^{59})}{(1.058 \times 10^{29}) - (2.58 \times 10^{28})}$$
  
Give your answer in standard form.

## Fill in the Gaps

$a$	$b$	$a + b$	$a - b$	$a \times b$	$a \div b$	$2a + 5b$
$9 \times 10^8$	$2 \times 10^7$					
$8 \times 10^9$	$4 \times 10^7$					
$2 \times 10^5$		$2.4 \times 10^5$				
$4.8 \times 10^{11}$		$4.82 \times 10^{11}$				
$3.4 \times 10^6$				$5.78 \times 10^{11}$		
	$3 \times 10^{12}$			$1.62 \times 10^{23}$		
$2.25 \times 10^6$	$1.5 \times 10^9$					
	$-3 \times 10^{13}$		$9.3 \times 10^{14}$			
	$4 \times 10^6$				$-2 \times 10^{-1}$	
$-7.2 \times 10^5$	$-1.2 \times 10^8$					
$7 \times 10^{-5}$	$2 \times 10^{-4}$					
$3 \times 10^{-6}$	$5 \times 10^{-7}$					

## Fill in the Gaps

Complete the table using standard form numbers.

### Standard Form: Percentages

100%	1%	5%	10%	20%	50%
$4 \times 10^5$					
$8 \times 10^7$					
			$3 \times 10^2$		
	$1 \times 10^6$				
					$3 \times 10^{-3}$
		$7.5 \times 10^0$			
				$8.6 \times 10^{-6}$	

a) 20% of  $6 \times 10^9$  =

b) 30% of  $9 \times 10^4$  =

c) 90% of  $5 \times 10^7$  =

d) 2% of  $1.7 \times 10^7$  =

e) 75% of  $1 \times 10^{-3}$  =

f) 120% of  $9 \times 10^6$  =

### Worked Example

$$x = m^2 \times 10^{q+4} \text{ where } 4 \leq m^2 < 6$$

Find a simplified expression in standard form for  $x^5$

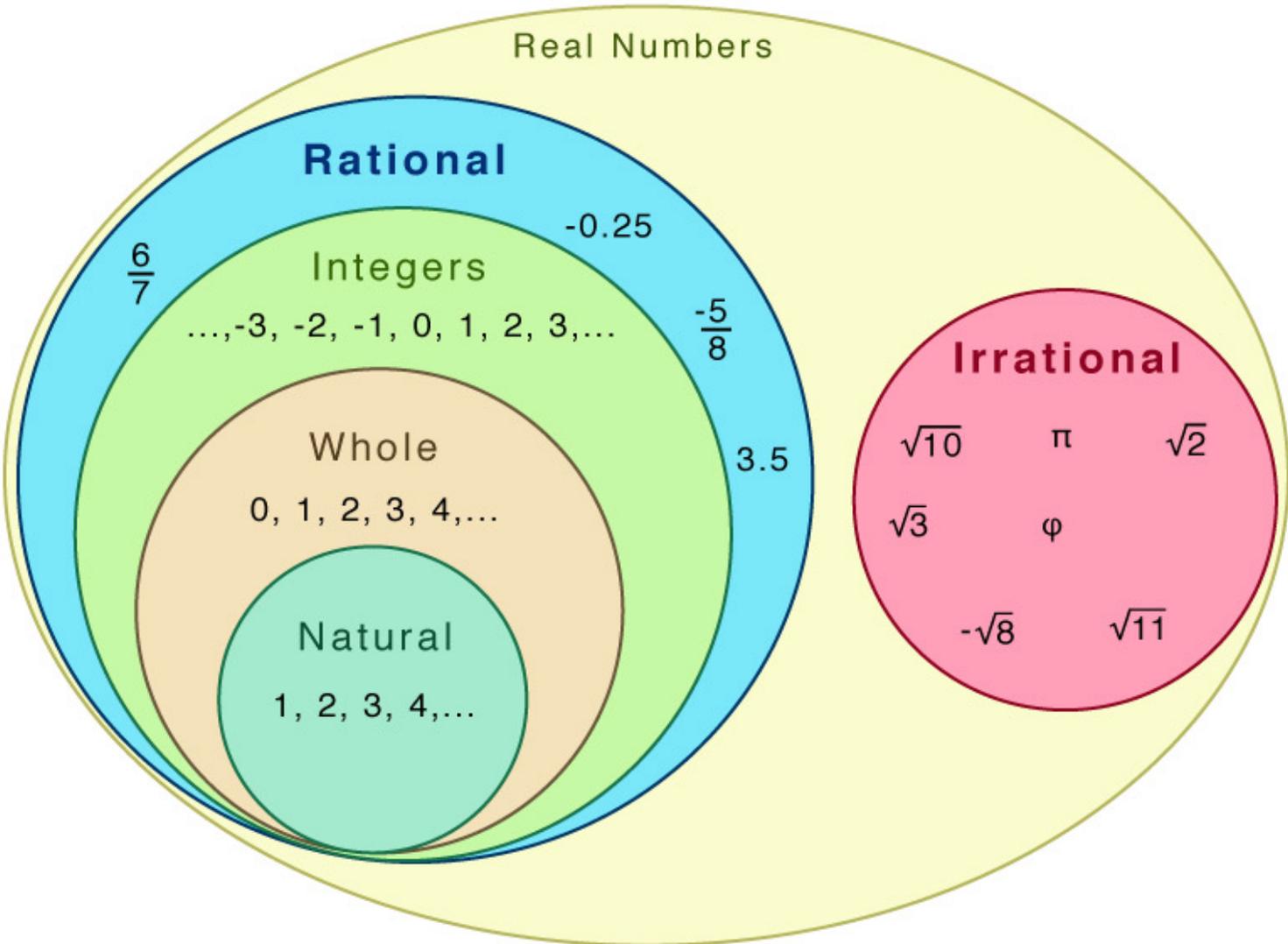
### Your Turn

$$z = a \times 10^{c+2} \text{ where } c \text{ is an integer and } 5 \leq a < 9$$

Find a simplified expression in standard form for  $z^2$

## Extra Notes

# 4 Types of Numbers



# Fluency Practice

Classify each number below as either rational or irrational. If you believe your number is rational, prove your answer by writing it as a fraction. The first one is done for you.

	Rational or Irrational?	Fraction?
1) 0.8	Rational	$\frac{8}{10}$ or $\frac{4}{5}$
2) $-\frac{3}{10}$		
3) $\sqrt{40}$		
4) $\sqrt{81}$		
5) $2\frac{1}{3}$		
6) 0.35		
7) 0.33333 ...		
8) -9		
9) 3.4		
10) $\sqrt{2}$		

**Directions:** For each number shown, classify it as either rational or irrational, then tell whether or not it is terminating or repeating.

- |                    |   |   |
|--------------------|---|---|
| 11) -0.6           | <i>(circle one)</i><br>rational or irrational | <i>(circle one)</i><br>terminating, repeating, or neither |
| 12) $\sqrt{100}$   | rational or irrational                        | terminating, repeating, or neither                        |
| 13) $\frac{2}{5}$  | rational or irrational                        | terminating, repeating, or neither                        |
| 14) $-\frac{2}{3}$ | rational or irrational                        | terminating, repeating, or neither                        |
| 15) 0.35217534 ... | rational or irrational                        | terminating, repeating, or neither                        |

## Fill in the Gaps

Number	Rational or Irrational?	First Eight Digits	Rounded to 1 Decimal Place	Rounded to 2 Decimal Places	Rounded to 1 Significant Figure	Rounded to 3 Significant Figures
$\sqrt{10}$	<i>Irrational</i>	3.1622776..		3.16		3.16
$\frac{\pi}{2}$		1.5707963 ...				1.57
$\sqrt[3]{1200}$					10	
$7\pi$						22.0
$7.\dot{6}$						
$\pi + 15$						
$\frac{7}{90}$						
$125 - \sqrt{3}$						
$\sqrt{\square}$						2.24
$\square \pi$						37.7

## Extra Notes

## 5 Multiplying and Simplifying Surds

A surd is an expression that includes a square root, cube root or other root symbol. Surds are used to write irrational numbers precisely – because the decimals of irrational numbers do not terminate or recur, they cannot be written exactly in decimal form.

Surds	Not Surds
$\sqrt{8}$	8
$\sqrt{10}$	-12.05
$\sqrt{91}$	0.62
$\sqrt[3]{7}$	$\frac{3}{7}$
$\sqrt[3]{16}$	$7\frac{1}{2}$
$\sqrt[4]{73}$	$\sqrt{16}$
$2\sqrt{2}$	$\sqrt{25}$
$2 + \sqrt{5}$	$\sqrt[3]{8}$
$(2 + \sqrt{5})(3 + \sqrt{5})$	$\sqrt{2.25}$
$\frac{1}{5 - \sqrt{17}}$	$\frac{\sqrt{100}}{\sqrt{4}}$

## Intelligent Practice

Decide if the following numbers are surds:

$$\sqrt{1}$$

$$\sqrt{4}$$

$$\sqrt{9}$$

$$\sqrt{36}$$

$$\sqrt{6}$$

$$\sqrt{24}$$

$$\sqrt{3}$$

$$2\sqrt{3}$$

$$3\sqrt{3}$$

$$3\sqrt{4}$$

$$\sqrt{5}$$

$$\sqrt{5^2}$$

$$\frac{1}{(\sqrt{5})^2}$$

$$\frac{\sqrt{1}}{\sqrt{4}}$$

$$\sqrt{\frac{1}{4}}$$

$$\sqrt{\frac{2}{8}}$$

$$\sqrt{\frac{2}{9}}$$

$$\sqrt{\frac{4}{9}}$$

$$\frac{2}{\sqrt{9}}$$

$$\frac{\sqrt{7}}{2}$$

$$\sqrt{0.25}$$

$$\sqrt{0.125}$$

$$\sqrt{0.01}$$

$$(\sqrt{2})^2$$

$$(\sqrt{2})^3$$

$$\sqrt{2}(\sqrt{2} + 3)$$

$$(\sqrt{2} + 3)(\sqrt{2} - 3)$$

$$\frac{2}{\sqrt{2}}\sqrt{2}$$

$$\frac{2}{3 + \sqrt{2}}$$

$$\frac{2}{\frac{3}{\sqrt{2}} + \sqrt{2}}$$

## Purposeful Practice

Surd or Not a Surd?					
Question	As a decimal or whole number	Is it a surd?	Question	As a decimal or whole number	Is it a surd?
$\sqrt{1}$	1	No	$\sqrt{16}$		
$\sqrt{2}$	1.4142135 ...	Yes	$\sqrt{17}$		
$\sqrt{3}$	1.7320508 ...	Yes	$\sqrt{18}$		
$\sqrt{4}$	2	No	$\sqrt{19}$		
$\sqrt{5}$			$\sqrt{20}$		
$\sqrt{6}$			$\sqrt{21}$		
$\sqrt{7}$			$\sqrt{22}$		
$\sqrt{8}$			$\sqrt{23}$		
$\sqrt{9}$			$\sqrt{24}$		
$\sqrt{10}$			$\sqrt{25}$		
$\sqrt{11}$			$\sqrt{26}$		
$\sqrt{12}$			$\sqrt{27}$		
$\sqrt{13}$			$\sqrt{28}$		
$\sqrt{14}$			$\sqrt{29}$		
$\sqrt{15}$			$\sqrt{30}$		

How can you tell if a square root is a surd or not?

Write down the next three square roots which are not surds.

## Worked Example

Simplify:

- a)  $5 \times \sqrt{6}$
- b)  $\sqrt{5} \times \sqrt{6}$
- c)  $2\sqrt{5} \times 3\sqrt{6}$

## Your Turn

Simplify:

- a)  $\sqrt{5} \times \sqrt{7}$
- b)  $\sqrt{7} \times 5$
- c)  $3\sqrt{5} \times 2\sqrt{7}$

## Worked Example

Simplify

a)  $\sqrt{6} \times \sqrt{6}$

b)  $(\sqrt{6})^2$

c)  $(2\sqrt{6})^2$

d)  $2(\sqrt{6})^2$

e)  $2(\sqrt{6})^3$

## Your Turn

Simplify

a)  $\sqrt{7} \times \sqrt{7}$

b)  $(\sqrt{7})^2$

c)  $(2\sqrt{7})^2$

d)  $2(\sqrt{7})^2$

e)  $2(\sqrt{7})^3$

## Worked Example

Simplify

a)  $\sqrt{60}$

b)  $\sqrt{120}$

## Your Turn

Simplify

a)  $\sqrt{50}$

b)  $\sqrt{200}$

## Fill in the Gaps

Square Numbers	1	4	9	16	25	36	49	64	81	100
----------------	---	---	---	----	----	----	----	----	----	-----

Question	Largest Square Number Factor	Split into Two Surds	Rationalise the Square Number	Answer
$\sqrt{27}$	9	$\sqrt{9} \times \sqrt{3}$	$3 \times \sqrt{3}$	$3\sqrt{3}$
$\sqrt{24}$	4	$\sqrt{4} \times \sqrt{6}$		
$\sqrt{50}$	25			
$\sqrt{28}$				
$\sqrt{32}$				
$\sqrt{45}$				
$\sqrt{72}$				
$\sqrt{90}$				
$\sqrt{75}$				
$\sqrt{200}$				
$\sqrt{98}$				
$\sqrt{80}$				
		$\sqrt{9} \times \sqrt{7}$	$3 \times \sqrt{7}$	$3\sqrt{7}$
				$7\sqrt{3}$

## Worked Example

Simplify

a)  $2\sqrt{20}$

b)  $4\sqrt{40}$

## Your Turn

Simplify

a)  $3\sqrt{20}$

b)  $4\sqrt{50}$

## Worked Example

Simplify:

a)  $\sqrt{3} \times \sqrt{6}$

b)  $4\sqrt{3} \times 5\sqrt{6}$

## Your Turn

Simplify:

a)  $\sqrt{3} \times \sqrt{8}$

b)  $7\sqrt{3} \times 2\sqrt{8}$

**Worked Example**Simplify  $\sqrt{504}$ **Your Turn**Simplify  $\sqrt{756}$

## Fill in the Gaps

Question	Surd as a Product of its Prime Factors	Simplify 'Paired' Surds	Answer
$\sqrt{12}$	$\sqrt{2} \times \sqrt{2} \times \sqrt{3}$	$2 \times \sqrt{3}$	$2\sqrt{3}$
$\sqrt{40}$	$\sqrt{2} \times \sqrt{2} \times \sqrt{2} \times \sqrt{5}$	$2 \times \sqrt{2} \times \sqrt{5}$	
$\sqrt{18}$	$\sqrt{2} \times \sqrt{3} \times \sqrt{3}$		
$\sqrt{75}$			
$\sqrt{20}$			
	$\sqrt{3} \times \sqrt{3} \times \sqrt{2} \times \sqrt{5}$		$3\sqrt{10}$
			$3\sqrt{7}$
$\sqrt{48}$	$\sqrt{2} \times \sqrt{2} \times \sqrt{2} \times \sqrt{2} \times \sqrt{3}$	$2 \times 2 \times \sqrt{3}$	$4\sqrt{3}$
$\sqrt{72}$	$\sqrt{2} \times \sqrt{2} \times \sqrt{2} \times \sqrt{3} \times \sqrt{3}$		
$\sqrt{200}$			
$\sqrt{162}$			
$\sqrt{675}$			
		$5 \times \sqrt{2} \times \sqrt{3}$	$5\sqrt{6}$
			$10\sqrt{3}$
			$8\sqrt{7}$

### Worked Example

Write the following as a single root

a)  $2\sqrt{15}$

b)  $2\sqrt{30}$

### Your Turn

Write the following as a single root

a)  $5\sqrt{2}$

b)  $10\sqrt{2}$

## Fluency Practice

**Splitting Surds** All these roots are surds: complete the missing radicands.

a)  $\sqrt{2} \times \sqrt{3} = \sqrt{\quad} \times \sqrt{\quad} = \sqrt{6}$

b)  $\sqrt{3} \times \sqrt{\quad} = \sqrt{\quad} \times \sqrt{5} = \sqrt{\quad}$

c)  $\sqrt{2} \times \sqrt{7} = \sqrt{\quad} = \sqrt{\quad}$

d)  $\sqrt{5} \times \sqrt{6} = \sqrt{\quad} = \sqrt{\quad}$

e)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{3 \times 7} = \sqrt{\quad}$

f)  $\sqrt{6} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{42}$

g)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{55}$

h)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{34}$

i)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = 5$

j)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{77}$

k)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{65}$

l)  $\sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{102}$

m)  $\sqrt{\quad} \times \sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{66}$

n)  $\sqrt{\quad} \times \sqrt{\quad} \times \sqrt{\quad} = \sqrt{\quad} = \sqrt{210}$

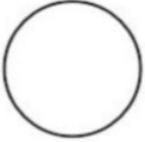
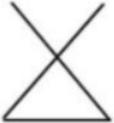
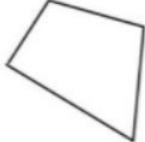
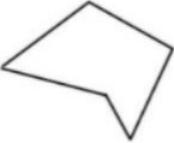
## Extra Notes

## 6 Angles in Polygons

# Fluency Practice

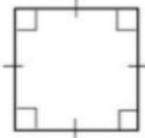
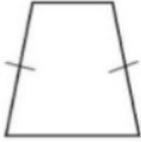
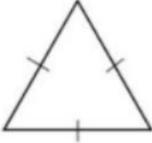
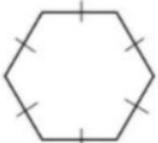
## Polygons – Example or Non-Example

In each of the following diagrams decide whether the shape is a polygon or not. Label them 'Example' or 'Non-example'. For those that ARE polygons, give the name of the polygon.

<b>A</b> 	<b>B</b> 	<b>C</b> 	<b>D</b> 	<b>E</b> 
<b>F</b> 	<b>G</b> 	<b>H</b> 	<b>I</b> 	<b>J</b> 

## Polygons – Regular or Irregular

Which of the following are regular and which are irregular – how do you know?

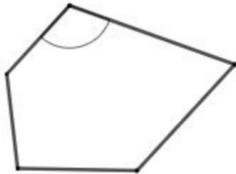
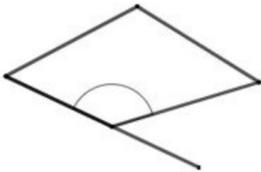
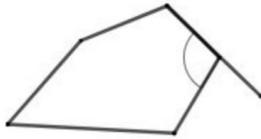
<b>A</b> 	<b>B</b> 	<b>C</b> 	<b>D</b> 	<b>E</b> 	<b>F</b> 
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## Interior and Exterior Angle Formulae

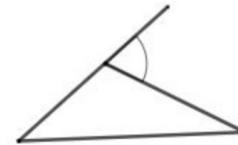
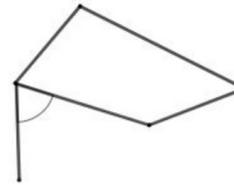
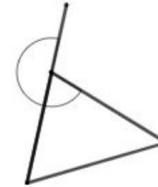
All Polygons	Regular Polygons
Interior Angle + Exterior Angle = $180^\circ$	Each Exterior Angle = $\frac{360^\circ}{n}$
Sum of Interior Angles = $(n - 2) \times 180^\circ$	Each Interior Angle = $180^\circ - \frac{360^\circ}{n}$
Sum of Exterior Angles = $360^\circ$	
where $n$ = number of sides	

# Interior Angles

Examples



Nonexamples



### **Worked Example**

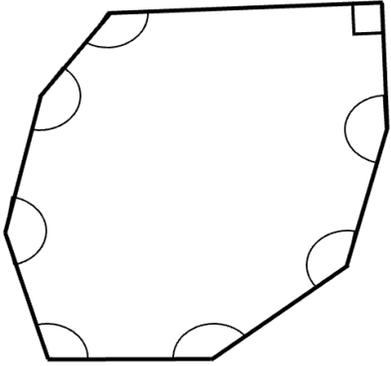
Find the sum of the interior angles of a polygon with 30 sides.

### **Your Turn**

Find the sum of the interior angles of a polygon with 60 sides.

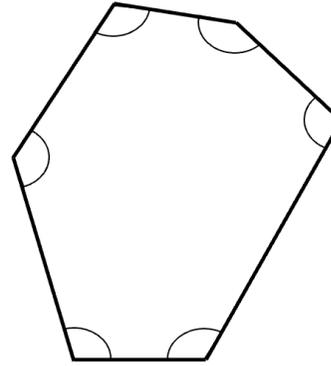
### Worked Example

Find the sum of interior angles of this polygon.



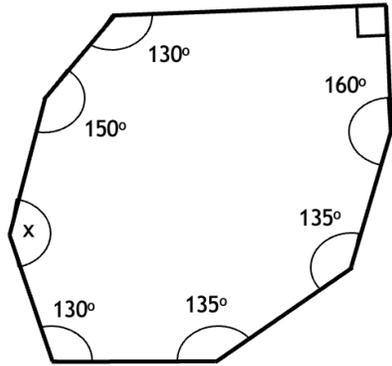
### Your Turn

Find the sum of interior angles of this polygon.



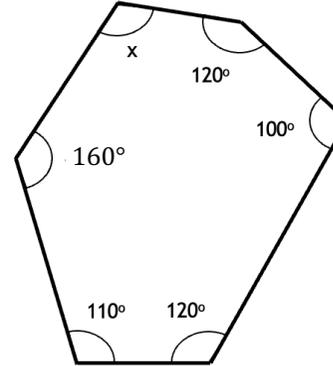
## Worked Example

Find angle  $x$



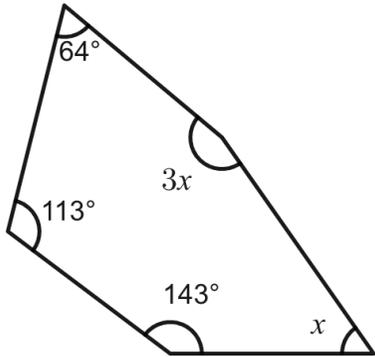
## Your Turn

Find angle  $x$



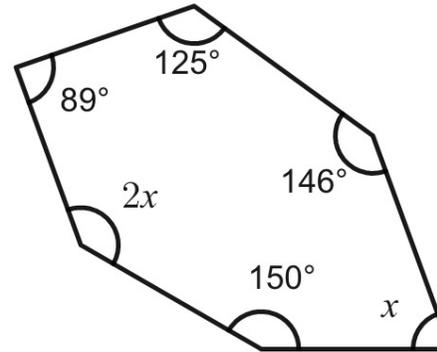
## Worked Example

Find the value of  $x$



## Your Turn

Find the value of  $x$



### Worked Example

The sum of the interior angles of a polygon is  $3240^\circ$ . How many sides does the polygon have?

### Your Turn

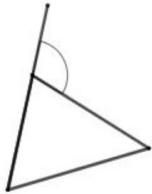
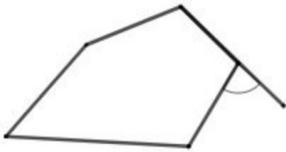
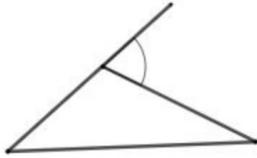
The sum of the interior angles of a polygon is  $6840^\circ$ . How many sides does the polygon have?

## Fill in the Gaps

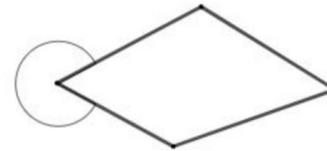
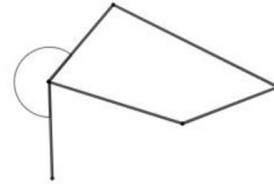
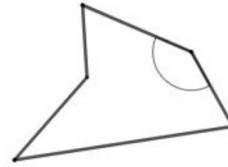
Number of sides	Sum of interior angles	Size of one interior angle in a regular polygon
3	$180^\circ$	
	$360^\circ$	
7		
9		
10		$144^\circ$
	$1800^\circ$	$150^\circ$
13	$1980^\circ$	
14		
	$2700^\circ$	

# Exterior Angles

Examples

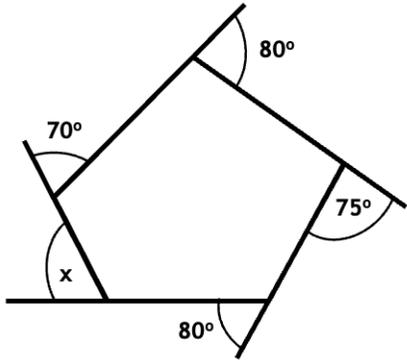


Nonexamples



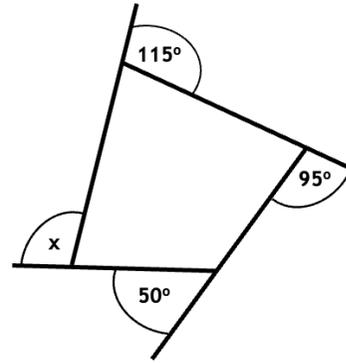
## Worked Example

Find angle  $x$



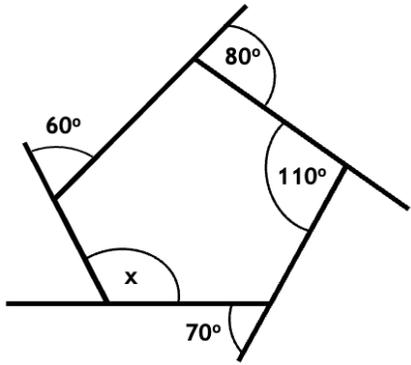
## Your Turn

Find angle  $x$



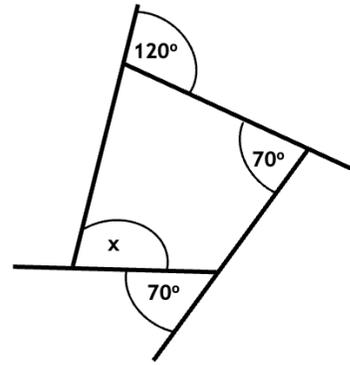
## Worked Example

Find angle  $x$



## Your Turn

Find angle  $x$



### Worked Example

A regular polygon has 12 sides. Find the size of each exterior angle.

### Your Turn

A regular polygon has 48 sides. Find the size of each exterior angle.

### Worked Example

A regular polygon has 12 sides. Find the size of each interior angle.

### Your Turn

A regular polygon has 48 sides. Find the size of each interior angle.

### Worked Example

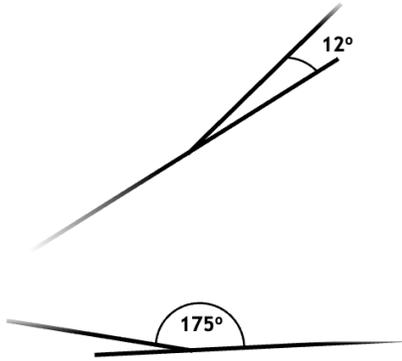
The exterior angle of a regular polygon is  $20^\circ$ . How many sides does the polygon have?

### Your Turn

The exterior angle of a regular polygon is  $40^\circ$ . How many sides does the polygon have?

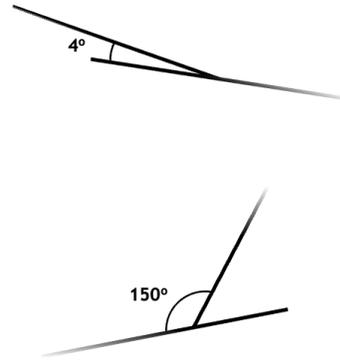
## Worked Example

A section of a two different regular polygons are show below.  
How many sides do they each have?



## Your Turn

A section of a two different regular polygons are show below.  
How many sides do they each have?



### Worked Example

The interior angle of a regular polygon is  $160^\circ$ . How many sides does the polygon have?

### Your Turn

The interior angle of a regular polygon is  $140^\circ$ . How many sides does the polygon have?

## Fill in the Gaps

Number of Sides	Sum of Interior Angles	Size of an Interior Angle	Size of an Exterior Angle
9	$(9 - 2) \times 180 = 1260^\circ$	$\frac{1260}{9} = 140^\circ$	$\frac{360}{9} = 40^\circ$
5	$(5 - 2) \times 180 = 540^\circ$		
12			
8			
15			
36			$60^\circ$
		$144^\circ$	
	$2880^\circ$		
	$900^\circ$		
		$162^\circ$	
			$22.5^\circ$
24		$165^\circ$	
$x$			

## Fill in the Gaps

Name	Number of Angles	Sum of Interior Angles	Size of One Interior Angle in a Regular Polygon	Size of One Exterior Angle in a Regular Polygon
	3			
		360°	90°	
Octagon				45°
Hexadecagon		2520°		
Pentadecagon	15		156°	
				72°
		720°	120°	
	12			
		1620°		$\frac{360^\circ}{11}$

### Worked Example

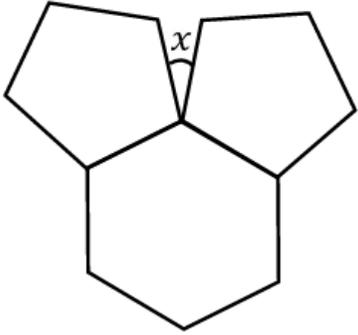
The size of each interior angle of a regular polygon is 9 times the size of each exterior angle. How many sides does the polygon have?

### Your Turn

The size of each interior angle of a regular polygon is 11 times the size of each exterior angle. How many sides does the polygon have?

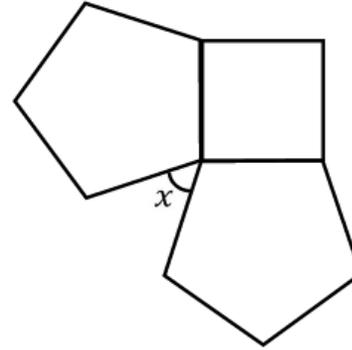
### Worked Example

These are regular polygons. Find  $x$



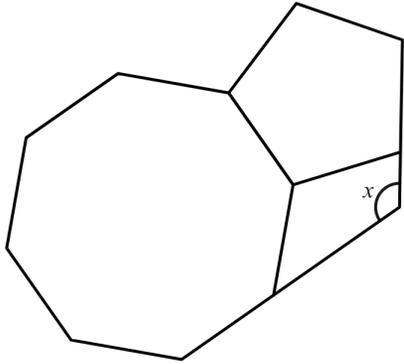
### Your Turn

These are regular polygons. Find  $x$



### Worked Example

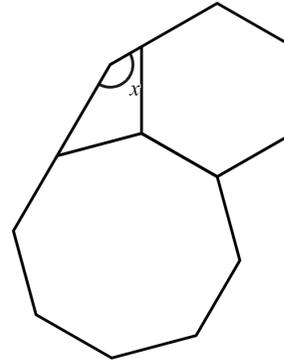
The diagram shows a regular octagon and a regular pentagon. A quadrilateral is formed by extending sides of the two regular polygons.



Find the value of  $x$

### Your Turn

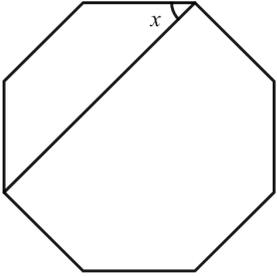
The diagram shows a regular hexagon and a regular octagon. A quadrilateral is formed by extending sides of the two regular polygons.



Find the value of  $x$

## Worked Example

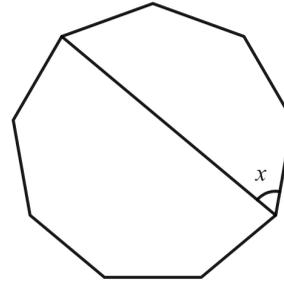
The diagram shows a regular polygon.



Work out the value of  $x$

## Your Turn

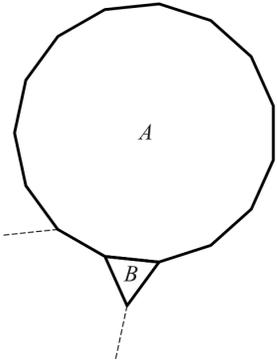
The diagram shows a regular polygon.



Work out the value of  $x$

### Worked Example

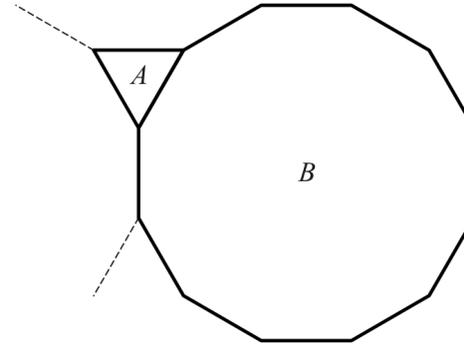
The diagram shows  $A$ , a regular 15-sided polygon,  $B$ , an equilateral triangle, and part of another polygon.



Find the number of sides of the third polygon.

### Your Turn

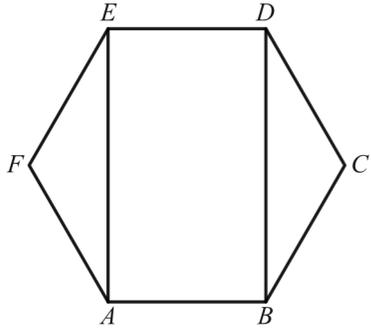
The diagram shows  $A$ , an equilateral triangle,  $B$ , a regular dodecagon, and part of another polygon.



Find the number of sides of the third polygon.

## Worked Example

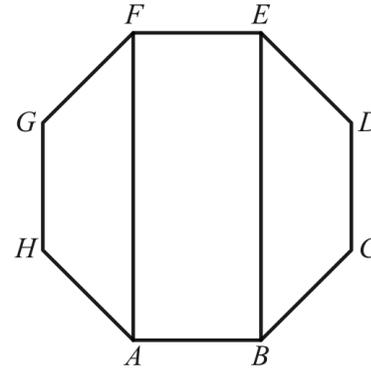
The diagram shows a regular hexagon  $ABCDEF$



Prove that  $ABDE$  is a rectangle.

## Your Turn

The diagram shows a regular octagon  $ABCDEFGH$



Prove that  $ABEF$  is a rectangle.

## Extra Notes