

1 SIGNIFICANT FIGURES

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Revision7th November**1 SIGNIFICANT FIGURES**

Number	1 sf	2 sf	3 sf
457			
78229			
256137		-----	
2.6789			
0.00007824		-----	
29.007		-----	

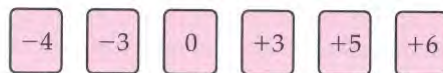
Revision7th November**1 SIGNIFICANT FIGURES**

Number	1 sf	2 sf	3 sf
457	500	460	457
78229	80000	78000	78200
256137	300000	260000	256000
2.6789	3	2.7	2.68
0.00007824	0.00008	0.000078	0.0000782
29.007	30	29	29.0

## Exercise 9D

## 2 NEGATIVE NUMBERS

1 Look at these numbers.



- a Which two numbers have a difference of 7?  
 b Which two numbers sum to  $-1$ ?  
 c Which three numbers have a total of  $-1$ ? Give all possible answers.

2 Work out

- a  $2 \times (-3)$     b  $3 \times (-3)$     c  $(-2) \times (+5)$     d  $(-4) \times (+3)$     e  $(-2) \times (-4)$

3 Work out

- a  $10 \div (-2)$     b  $12 \div (-4)$     c  $(-9) \div 3$     d  $(-24) \div 6$     e  $(-16) \div (-4)$

4 Work out the product of  $-8$  and  $2$ .

5 Work out

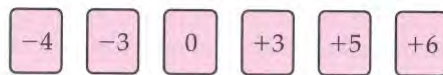
- a  $(-36) \div 6$     b  $-36 \div (-6)$   
 c  $\frac{-18}{2}$     d  $\frac{-18}{-3}$

$\frac{-18}{2}$  means  $-18 \div 2$ .

Exercise 9D

2 NEGATIVE NUMBERS

1 Look at these numbers.



- a Which two numbers have a difference of 7? -4 and 3
- b Which two numbers sum to -1? +3 + -4 = -1
- c Which three numbers have a total of -1? Give all possible answers. 0 + +3 + -4 = -1  
+6 + -4 + -3 = -1

2 Work out

- a  $2 \times (-3) = -6$
- b  $3 \times (-3) = -9$
- c  $(-2) \times (+5) = -10$
- d  $(-4) \times (+3) = -12$
- e  $(-2) \times (-4) = 8$

3 Work out

- a  $10 \div (-2) = -5$
- b  $12 \div (-4) = -3$
- c  $(-9) \div 3 = -3$
- d  $(-24) \div 6 = -4$
- e  $(-16) \div (-4) = 4$

4 Work out the product of -8 and 2.

$-8 \times 2 = -16$

5 Work out

- a  $(-36) \div 6 = -6$
- b  $-36 \div (-6) = 6$

c  $\frac{-18}{2} = -9$

d  $\frac{-18}{-3} = 6$

$\frac{-18}{2}$  means  $-18 \div 2$ .

Exercise 9D

- 1 a -4 and 3    b -4 and 3    c -4, 3, 0 and -4, -3, 6
- 2 a -6    b -9    c -10    d -12    e 8
- 3 a -5    b -3    c -3    d -4    e 4
- 4 -16
- 5 a -6    b 6    c -9    d 6

## 2 NEGATIVE NUMBERS

6 Copy and complete these calculations.

a  $6 \times \square = -18$

b  $24 \div \square = -3$

c  $\square \times (-7) = 21$

d  $-40 \div \square = -10$

e  $\square \div (-5) = -9$

f  $\frac{-30}{\square} = 6$

7 What number gives an answer of 24 when multiplied by  $-4$ ?

8 Here is a sequence of numbers.

1,  $-2$ , 4,  $-8$ , ...

Work out the next three numbers in this sequence.

9 Find two different pairs of numbers that have a difference of 7 and a product of  $-12$ .

10 The sum of two numbers is 8.  
When they are divided, the answer is  $-3$ .  
What are the two numbers?

The first question to ask yourself is, 'Which two numbers when divided give an answer of  $-3$ ?'  
The ' $-$ ' sign tells you that one number is positive and the other is negative.

11 Work out

6 a  $-3$                       b  $-8$                       c  $-3$                       d 10

e 45                      f  $-5$

7  $-6$

8 16,  $-32$ , 64

9 3 and  $-4$  or  $-3$  and 4

10 12 and  $-4$

**6** Copy and complete these calculations.

**a**  $6 \times \boxed{-3} = -18$

**b**  $24 \div \boxed{-8} = -3$

**c**  $\boxed{-3} \times (-7) = 21$

**d**  $-40 \div \boxed{4} = -10$

**e**  $\boxed{45} \div (-5) = -9$

**f**  $\frac{-30}{\boxed{-5}} = 6$

## 2 NEGATIVE NUMBERS

**7** What number gives an answer of 24 when multiplied by  $-4$ ?

$$-6 \times -4 = 24$$

**8** Here is a sequence of numbers.

1, -2, 4, -8, ...

16, -32, 64

Work out the next three numbers in this sequence.

**9** Find two different pairs of numbers that have a difference of 7 and a product of  $-12$ .

$$-3 \times 4 = -12 \quad 4 - -3 = 7 \quad -4 \times 3 = -12 \quad 3 - -4 = 7$$

**10** The sum of two numbers is 8.

When they are divided, the answer is  $-3$ .

What are the two numbers?

The first question to ask yourself is, 'Which two numbers when divided give an answer of  $-3$ ?'  
The ' $-$ ' sign tells you that one number is positive and the other is negative.

**11** Work out  $12 + -4 = 8$       $12 \div -4 = -3$

**6** **a**  $-3$      **b**  $-8$      **c**  $-3$      **d**  $10$

**e**  $45$      **f**  $-5$

**7**  $-6$

**8**  $16, -32, 64$

**9**  $3$  and  $-4$  or  $-3$  and  $4$

**10**  $12$  and  $-4$

**11** Work out

**2 NEGATIVE NUMBERS**

**a**  $(-2) \times (-3) \times 3$

**b**  $3 \times (-4) \times (-2)$

**c**  $(-5) \times (-2) \times (-3)$

**d**  $6 \div (-2) \div 1$

**e**  $(-8) \div 4 \div (-2)$

**f**  $(-12) \div (-1) \div (-3)$

**12** Copy and complete these calculations.

**a**  $(-3) \times (-4) \div 6 = \square$

**b**  $(-16) \div 8 \times (-3) = \square$

**c**  $(-4) \times \square \div (-2) = 12$

**d**  $\square \div (-4) \times (-3) = -12$

**13** You are given that

$$a + b + c = 1$$

$$a \times b \times c = 36$$

$$c \div b = -3$$

$$c \div a = -2$$

$a$  is a negative number.

What are the values of  $a$ ,  $b$  and  $c$ ?

- 11** **a** 18      **b** 24      **c** -30      **d** -3  
**e** 1      **f** -4
- 12** **a** 2      **b** 6      **c** 6      **d** -16
- 13**  $a = -3, b = -2, c = 6$



**11** Work out**2 NEGATIVE NUMBERS**

**a**  $(-2) \times (-3) \times 3 = 18$

**b**  $3 \times (-4) \times (-2) = 24$

**c**  $(-5) \times (-2) \times (-3) = -30$

**d**  $6 \div (-2) \div 1 = -3$

**e**  $(-8) \div 4 \div (-2) = 1$

**f**  $(-12) \div (-1) \div (-3) = -4$

**12** Copy and complete these calculations.

**a**  $(-3) \times (-4) \div 6 = \boxed{2}$

**b**  $(-16) \div 8 \times (-3) = \boxed{6}$

**c**  $(-4) \times \boxed{6} \div (-2) = 12$

**d**  $\boxed{-16} \div (-4) \times (-3) = -12$

**13** You are given that

$a + b + c = 1$

$a \times b \times c = 36$

$c \div b = -3$

$c \div a = -2$

 $a$  is a negative number.

$a = -3$

$b = -2$

$c = 6$

What are the values of  $a$ ,  $b$  and  $c$ ?

- 11** **a** 18      **b** 24      **c** -30      **d** -3  
**e** 1      **f** -4
- 12** **a** 2      **b** 6      **c** 6      **d** -16
- 13**  $a = -3, b = -2, c = 6$

## Estimating

**Estimating** the answer to a calculation gives you an **approximate** answer.

You can use estimation to check that an answer is about right.

To estimate

- **round** all the numbers to one **significant figure**
- do the calculation using these approximations.

### 3 ESTIMATING

#### Example 1

Use approximation to estimate the answer to each of these calculations.

a  $\frac{119 \times 5.4}{46}$

b  $\frac{5.3 \times 19.8}{6.2 - 1.7}$

c  $\frac{560 \times 5.45}{0.534}$

a	$\frac{119 \times 5.4}{46} \approx \frac{100 \times 5}{50} = \frac{500}{50} = 10$
b	$\frac{5.3 \times 19.8}{6.2 - 1.7} \approx \frac{5 \times 20}{6 - 2} = \frac{100}{4} = 25$
c	$\frac{560 \times 5.45}{0.534} \approx \frac{600 \times 5}{0.5} = \frac{3000}{0.5} = 6000$

119 rounded to 1 s.f. is 100.  
5.4 rounded to 1 s.f. is 5.  
46 rounded to 1 s.f. is 50.

' $\approx$ ' means 'is approximately equal to'.

**1** Estimate the answer to each of these calculations.

**a**  $\frac{436 + 394}{109}$

**b**  $\frac{27 \times 105}{55}$

**c**  $\frac{40.26 \times 8.49}{16.4}$

**d**  $\frac{324 \times 7.63}{75.9}$

### 3 ESTIMATING

**2** Estimate the answer to each of these calculations.

**a**  $\frac{5.4 \times 19.8}{4.3 - 2.2}$

**b**  $\frac{17.32 + 14.29}{4.08 - 1.79}$

**c**  $\frac{584 + 829}{749 - 485}$

**d**  $\frac{294 + 149}{842 - 385}$

**7** Use approximation to estimate the value of each of these calculations.

**a**  $\frac{325 \times 4.34}{0.237}$

**b**  $\frac{26.79}{3.51 \times 0.48}$

**c**  $\frac{5.62 \times 478}{64.5 \times 0.527}$

**8** Which is the better approximation for this calculation?

$$\frac{7.25^2}{1.86 \times 12.42}$$

**A**  $\frac{7^2}{2 \times 12}$

**B**  $\frac{7^2}{2 \times 10}$

Give a reason for your answer.

## 3 ESTIMATING

1 Estimate the answer to each of these calculations.

a	$\frac{436 + 394}{109}$	b	$\frac{27 \times 105}{55}$	c	$\frac{40.26 \times 8.49}{16.4}$	d	$\frac{324 \times 7.63}{75.9}$
$\approx$	$\frac{400 + 400}{100}$	$\approx$	$\frac{30 \times 100}{60}$	$\approx$	$\frac{40 \times 8}{20}$	$\approx$	$\frac{300 \times 8}{80}$
=	$\frac{800}{100}$	=	$\frac{3000}{60}$	=	$\frac{320}{20}$	=	$\frac{2400}{80}$
=	8	=	50	=	16	=	30

2 Estimate the answer to each of these calculations.

a	$\frac{5.4 \times 19.8}{4.3 - 2.2}$	b	$\frac{17.32 + 14.29}{4.08 - 1.79}$	c	$\frac{584 + 829}{749 - 485}$	d	$\frac{294 + 149}{842 - 385}$
$\approx$	$\frac{5 \times 20}{4 - 2}$	$\approx$	$\frac{20 + 10}{4 - 2}$	$\approx$	$\frac{600 + 800}{700 - 500}$	$\approx$	$\frac{300 + 100}{800 - 400}$
=	$\frac{100}{2}$	=	$\frac{30}{2}$	=	$\frac{1400}{200}$	=	$\frac{400}{400}$
=	50	=	15	=	7	=	1

7 Use approximation to estimate the value of each of these calculations.

a	$\frac{325 \times 4.34}{0.237}$	b	$\frac{26.79}{3.51 \times 0.48}$	c	$\frac{5.62 \times 478}{64.5 \times 0.527}$
$\approx$	$\frac{300 \times 4}{0.2}$	$\approx$	$\frac{30}{4 \times 0.5}$	$\approx$	$\frac{6 \times 500}{60 \times 0.5}$
=	$\frac{1200}{0.2}$	=	$\frac{30}{2}$	=	$\frac{3000}{30}$
=	6000	=	15	=	100

8 Which is the better approximation for this calculation?

$$\frac{7.25^2}{1.86 \times 12.42}$$

A  $\frac{7^2}{2 \times 12}$       B  $\frac{7^2}{2 \times 10}$

Give a reason for your answer.

B because 12.42 rounds to 10 to 1sf

## Multiplying decimals

### 4 MULTIPLYING DECIMALS

You can multiply decimals in the same way as whole numbers.

Here is a useful rule for multiplying decimals.

$$1.25 \times 7.3$$



**1** Ignore the decimal points and just multiply the numbers.

$$125 \times 73 = 9125$$



**2** Count the decimal places in the calculation.

$$1.25 \times 7.3$$

↑      ↑  
2 places + 1 place



**3** Put this number of decimal places in the answer.

$$9.125$$

= 3 places

**1** Work out

**a**  $3.6 \times 7$

**b**  $2.13 \times 9$

**c**  $4.02 \times 11$

**d**  $5.87 \times 40$

**e**  $6.5 \times 6.5$

**f**  $1.25 \times 0.6$

**g**  $3.14 \times 0.05$

**h**  $0.035 \times 6.4$

**2** Work out

**a**  $2.65 \times 0.08$

**b**  $26.5 \times 0.008$

What do you notice?

Write down two more multiplication calculations that have the same answer.

**3** Henna is making curtains.

She has chosen a material that costs £7.95 per metre. She buys 3.4 metres.

How much will this cost?

**4** Mrs Jones is buying a class set of maths text books for her class of 27 students. They cost £13.99 each.

What is the total cost of buying one for each student, plus one for herself?

**5** Eighteen coins are placed in a pile. Each coin is 1.23 mm thick.

What is the height of the pile of coins?



## 4 MULTIPLYING DECIMALS

e  $6.5 \times 6.5$

×	60	5							
60	3600	300							
5	300	25							
<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 0 5px;">3600</td> <td style="padding: 0 5px;">300</td> </tr> <tr> <td style="padding: 0 5px;">+ 300</td> <td style="padding: 0 5px;">25</td> </tr> <tr> <td style="border-top: 1px solid black; padding: 0 5px;">4225</td> <td></td> </tr> </table>				3600	300	+ 300	25	4225	
3600	300								
+ 300	25								
4225									

there were two digits after the decimal point in our two original numbers, so there are two decimal points in our answer

$$42.25$$

f  $1.25 \times 0.6$

×	100	20	5									
6	600	120	30									
<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 0 5px;">600</td> <td style="padding: 0 5px;">120</td> <td style="padding: 0 5px;">30</td> </tr> <tr> <td style="padding: 0 5px;">+ 30</td> <td></td> <td></td> </tr> <tr> <td style="border-top: 1px solid black; padding: 0 5px;">750</td> <td></td> <td></td> </tr> </table>				600	120	30	+ 30			750		
600	120	30										
+ 30												
750												

there were three digits after the decimal point in our two original numbers, so there are three decimal points in our answer

$$0.750$$

g  $3.14 \times 0.05$

×	300	10	4									
5	1500	50	20									
<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 0 5px;">1500</td> <td style="padding: 0 5px;">50</td> <td style="padding: 0 5px;">20</td> </tr> <tr> <td style="padding: 0 5px;">+ 50</td> <td></td> <td></td> </tr> <tr> <td style="border-top: 1px solid black; padding: 0 5px;">1570</td> <td></td> <td></td> </tr> </table>				1500	50	20	+ 50			1570		
1500	50	20										
+ 50												
1570												

there were four digits after the decimal point in our two original numbers, so there are four decimal points in our answer

$$0.1570$$

h  $0.035 \times 6.4$

×	30	5							
60	1800	300							
4	120	20							
<table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 0 5px;">1800</td> <td style="padding: 0 5px;">300</td> </tr> <tr> <td style="padding: 0 5px;">+ 120</td> <td style="padding: 0 5px;">20</td> </tr> <tr> <td style="border-top: 1px solid black; padding: 0 5px;">2240</td> <td></td> </tr> </table>				1800	300	+ 120	20	2240	
1800	300								
+ 120	20								
2240									

there were four digits after the decimal point in our two original numbers, so there are four decimal points in our answer

$$0.2240$$



**2** Work out

**a**  $2.65 \times 0.08$       **b**  $26.5 \times 0.008$

What do you notice?

Write down two more multiplications that have the same answer.

**4 MULTIPLYING DECIMALS**

**3** Henna is making curtains.

She has chosen a material that costs £7.95 per metre. She buys 3.4 metres.

How much will this cost?

**4** Mrs Jones is buying a class set of maths text books for her class of 27 students.

They cost £13.99 each.

What is the total cost of buying one for each student, plus one for herself?

**5** Eighteen coins are placed in a pile. Each coin is 1.23 mm thick.

What is the height of the pile of coins?

**2** **a** 0.212      **b** 0.212      They are the same.

**3** £27.03

**4** £391.72

**5** 22.14 mm

## 5 MEAN MEDIAN MODE AND RANGE

**1** Darren counted the people in each checkout queue at a supermarket.

Number of people in queue	Frequency	Number of people $\times$ frequency
0	4	
1	6	
2	13	
3	2	$3 \times 2 = 6$
4	0	
<b>Total</b>		

- Work out the range and mode of this data.
- Work out the median number of people in a queue.
- Copy and complete the table.  
Use it to calculate the mean number of people in a queue.

## 5 MEAN MEDIAN MODE AND RANGE

- 1 Darren counted the people in each checkout queue at a supermarket.

Number of people in queue	Frequency	Number of people $\times$ frequency
0	4	
1	6	
2	13	
3	2	$3 \times 2 = 6$
4	0	
<b>Total</b>	25	

- a Work out the range and mode of this data.

The table shows there are no checkouts with 4 people at them. The largest number of people at a checkout is 3 and the smallest number is 0.

$$\text{RANGE} = \text{BIGGEST} - \text{SMALLEST} = 3 - 0 = 3$$

The biggest value in the frequency column is 13. There are 13 checkouts with 2 people at them.

$$\text{MODE} = \text{MOST COMMON} = 2 \text{ people in a queue}$$

## 5 MEAN MEDIAN MODE AND RANGE

- 1 Darren counted the people in each checkout queue at a supermarket.

Number of people in queue	Frequency	Number of people $\times$ frequency	cumulative frequency
0	4		4
1	6		10
2	13		23
3	2	$3 \times 2 = 6$	25
4	0		25
<b>Total</b>	25		

- b Work out the median number of people in a queue.

To do this use CUMULATIVE FREQUENCY, add a column.

First, calculate the MEDIAN POSITION

$$\text{MEDIAN POSITION} = \frac{n+1}{2} = \frac{26}{2} = 13^{\text{th}}$$

If we wrote out all of the numbers in our table we would have:

0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 2, 2, ②, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 3, 3

1<sup>st</sup> .....13<sup>th</sup>.....25<sup>th</sup>

The thirteenth value is 2.

However, it is quicker to use the cumulative frequency column. The '1' row goes UP TO the 10<sup>th</sup> value, so the '2' row starts at the 11<sup>th</sup> value and GOES UP TO the 25<sup>th</sup>. As the 13<sup>th</sup> value is between the 11<sup>th</sup> and 25<sup>th</sup>, the median is 2.

$$\text{MEDIAN} = 2$$

## 5 MEAN MEDIAN MODE AND RANGE

1 Darren counted the people in each checkout queue at a supermarket.

Number of people in queue	Frequency	Number of people $\times$ frequency
0	4	$0 \times 4 = 0$
1	6	$1 \times 6 = 6$
2	13	$2 \times 13 = 26$
3	2	$3 \times 2 = 6$
4	0	$4 \times 0 = 0$
<b>Total</b>	25	38

c Copy and complete the table.

Use it to calculate the mean number of people in a queue.

1. Complete the number  $\times$  frequency column
2. Add up all the values in the number  $\times$  frequency column
3. Add up the values in the frequency column to find its total
4. Divide total of number  $\times$  frequency by total of frequency

$$\text{mean} = \frac{\text{total of number} \times \text{frequency}}{\text{total of frequency}} = \frac{38}{25} = 1.52$$

**6 MEAN FROM A GROUPED FREQUENCY TABLE**

**1** This frequency table shows the times taken by members of a class to solve a puzzle.

Time taken, $t$ (minutes)	Frequency	Mid-point	Mid-point $\times$ frequency
$0 \leq t < 5$	3		
$5 \leq t < 10$	15		
$10 \leq t < 15$	8		
$15 \leq t < 20$	2		
$20 \leq t < 25$	5		
<b>Total</b>			

- Copy and complete the table to work out an estimate for the total time taken by the whole class.
- Calculate an estimate for the mean time taken, correct to one decimal place.

## 6 MEAN FROM A GROUPED FREQUENCY TABLE

- 1 This frequency table shows the times taken by members of a class to solve a puzzle.

Time taken, $t$ (minutes)	Frequency	Mid-point	Mid-point $\times$ frequency
$0 \leq t < 5$	3	2.5	$3 \times 2.5 = 7.5$
$5 \leq t < 10$	15	7.5	$15 \times 7.5 = 112.5$
$10 \leq t < 15$	8	12.5	$8 \times 12.5 = 100$
$15 \leq t < 20$	2	17.5	$2 \times 17.5 = 35$
$20 \leq t < 25$	5	22.5	$5 \times 22.5 = 112.5$
<b>Total</b>	33		367.5

- a Copy and complete the table to work out an estimate for the total time taken by the whole class. 367.5 minutes
- b Calculate an estimate for the mean time taken, correct to one decimal place.

$$\text{estimate of mean} \approx \frac{367.5}{33} = 11.1 \text{ (1dp)}$$



this is an estimate because we approximate the average value for each row in the table by using the midpoint in our calculation

## 7 CUMULATIVE FREQUENCY

- 1** The times spent by a group of students using their mobile phones in one day are shown in the table.

Time, $t$ (minutes)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 40$	$40 < t \leq 50$	$50 < t \leq 60$
Frequency	6	10	21	46	11	6

- a** Draw a cumulative frequency diagram to illustrate this data.
- b** Use the cumulative frequency diagram to estimate
  - i** the median time
  - ii** the lower and upper quartiles
  - iii** the inter-quartile range.
- c** How many students used their mobile for 16 minutes or less?
- d** How many students used their mobile for more than 48 minutes?
- e** How many students used their mobile for between 27 and 36 minutes?
- f** Draw a box plot to represent this data



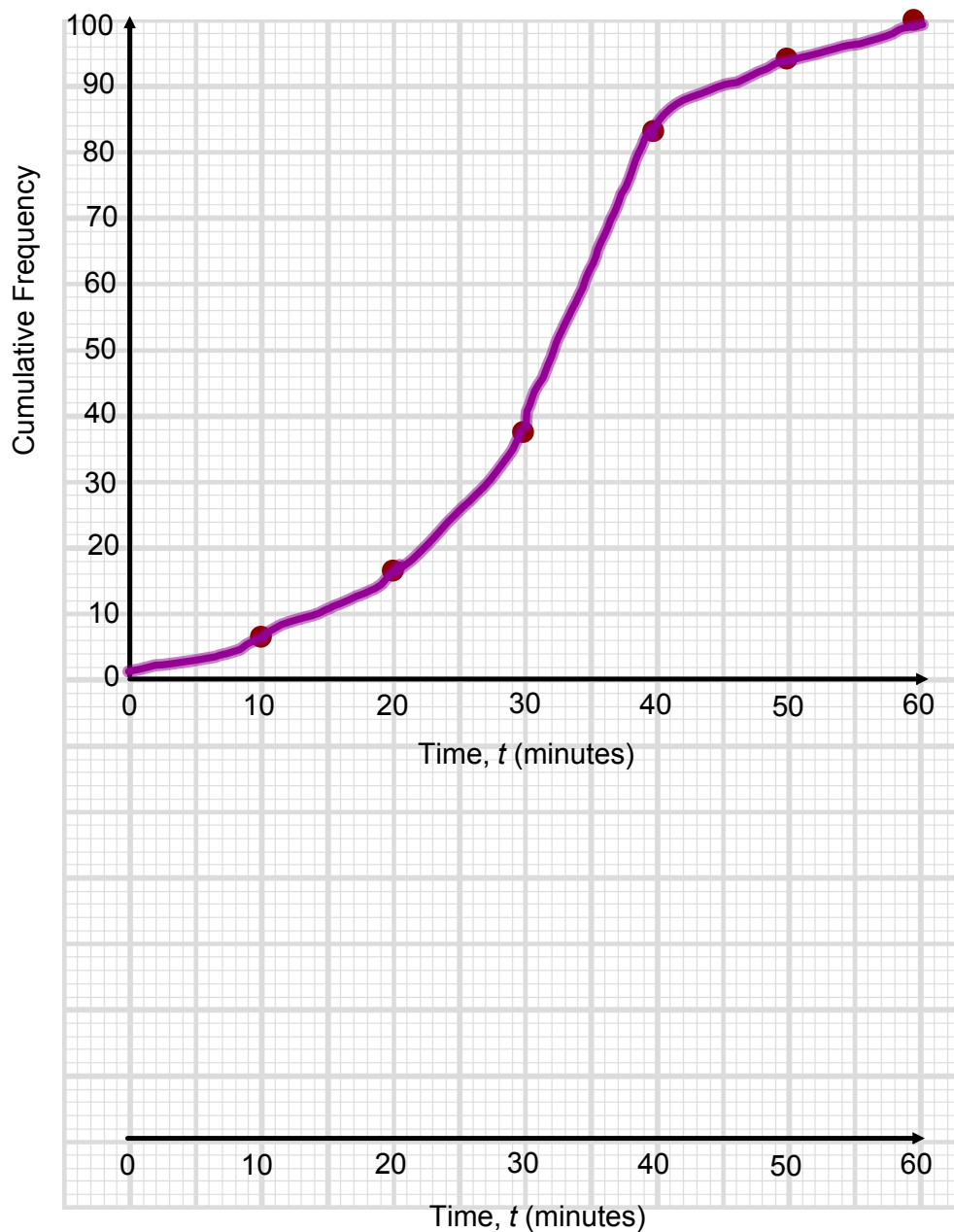
## 7 CUMULATIVE FREQUENCY

- 1 The times spent by a group of students using their mobile phones in one day are shown in the table.

Time, $t$ (minutes)	$0 < t \leq 10$	$10 < t \leq 20$	$20 < t \leq 30$	$30 < t \leq 40$	$40 < t \leq 50$	$50 < t \leq 60$
Frequency	6	10	21	46	11	6
cumulative frequency	6	16	37	83	94	100

- a Draw a cumulative frequency diagram to illustrate this data.

REMEMBER: plot the **GROUP END POINTS** against **CUMULATIVE FREQUENCY**

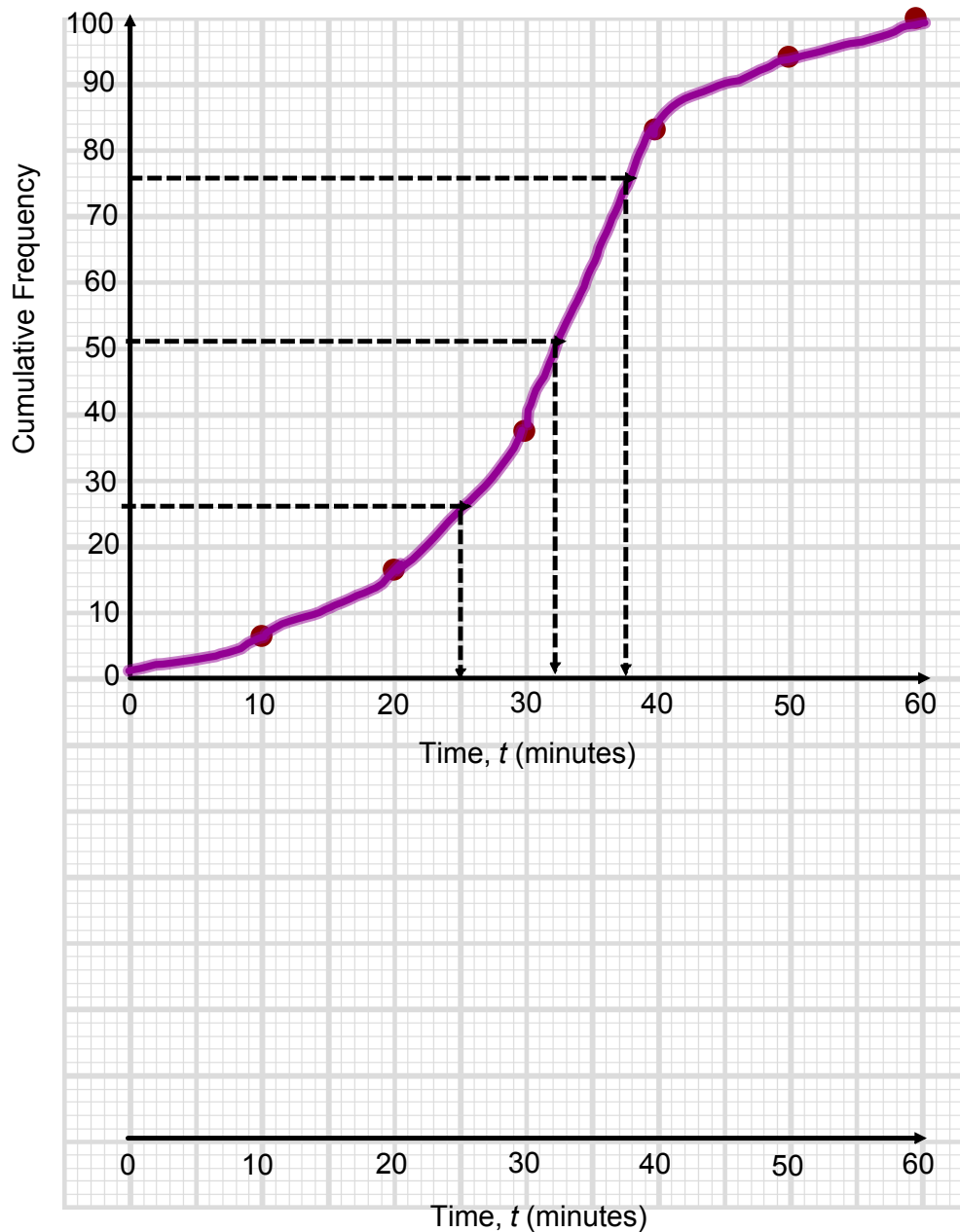


## 7 CUMULATIVE FREQUENCY

**1** The times spent by a group of students using their mobile phones in one day are shown in the table.

**b** Use the cumulative frequency diagram to estimate

- i** the median time median  $\approx 32$
- ii** the lower and upper quartiles LQ  $\approx 25$    UQ  $\approx 38$
- iii** the inter-quartile range. IQR = UQ - LQ = 38 - 25 = 13

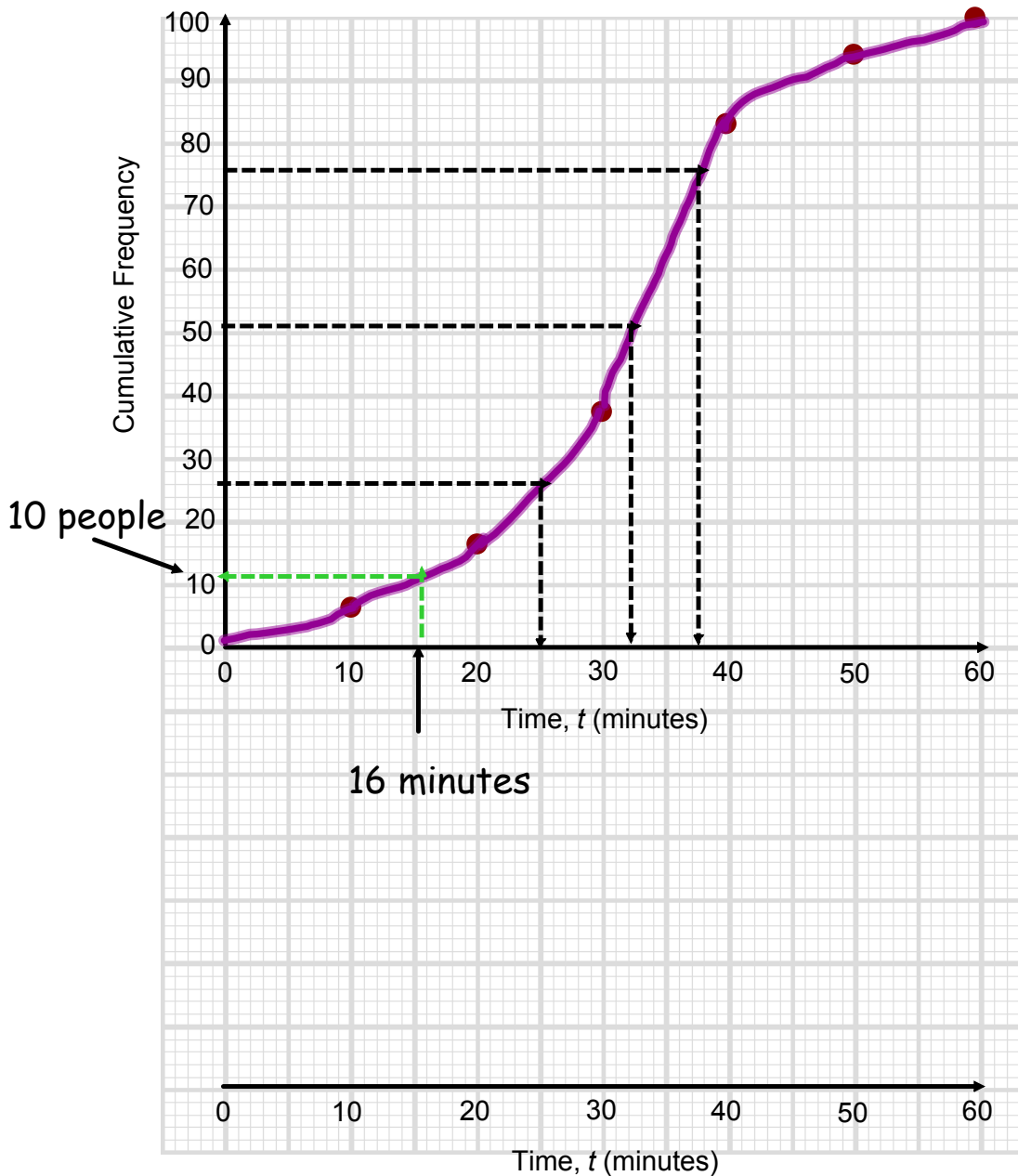


**7 CUMULATIVE FREQUENCY**

**1** The times spent by a group of students using their mobile phones in one day are shown in the table.

**c** How many students used their mobile for 16 minutes or less?

10 people



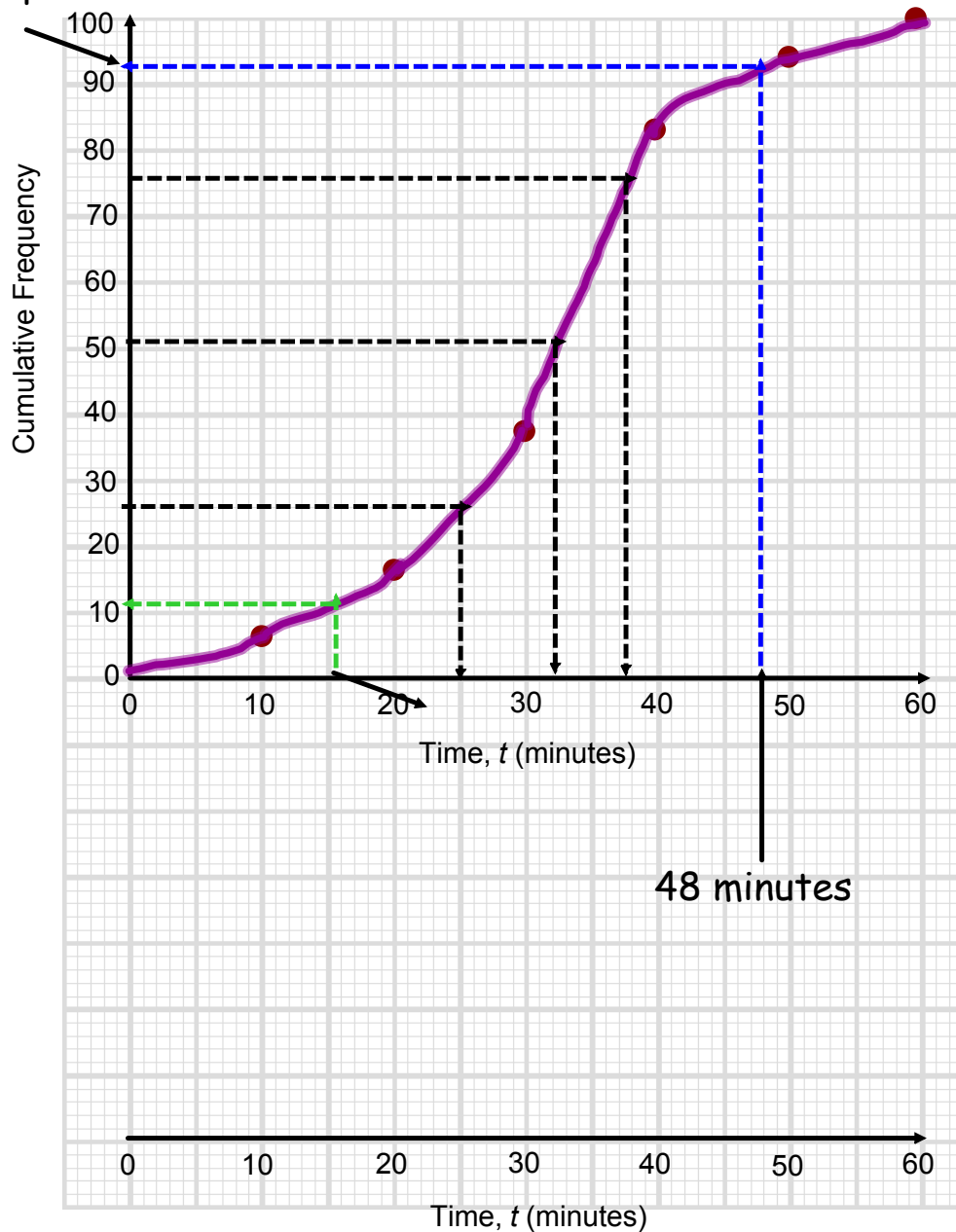
## 7 CUMULATIVE FREQUENCY

1 The times spent by a group of students using their mobile phones in one day are shown in the table.

d How many students used their mobile for more than 48 minutes? 8 people

92 people use their mobile for LESS THAN 48 minutes, so  $100 - 92 = 8$  people use their mobile for MORE THAN 48 minutes

92 people



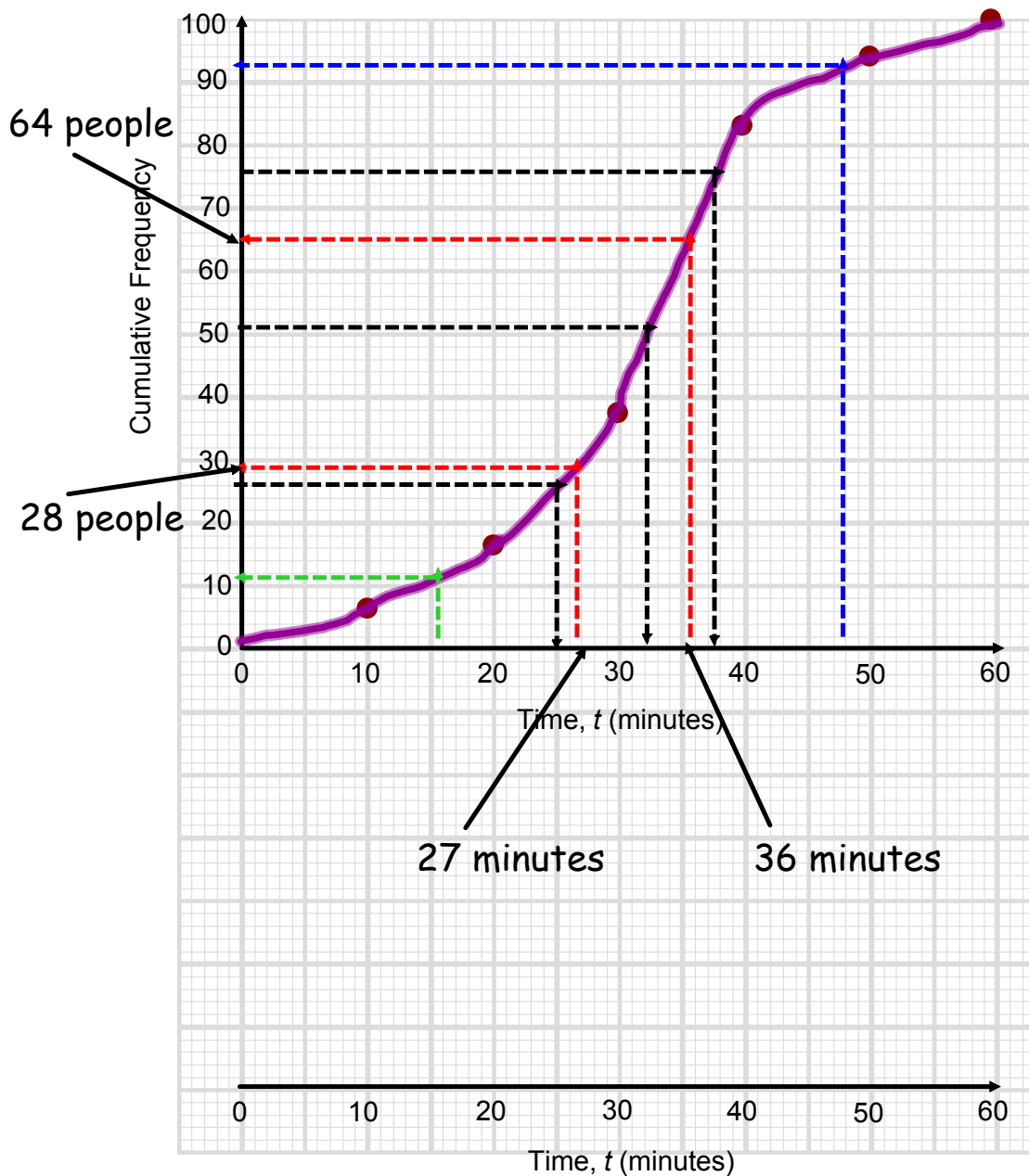
## 7 CUMULATIVE FREQUENCY

**1** The times spent by a group of students using their mobile phones in one day are shown in the table.

**e** How many students used their mobile for between 27 and 36 minutes? 36 people

64 people use their mobile for LESS THAN 36 minutes, 28 people use their mobile for less than 27 minutes.

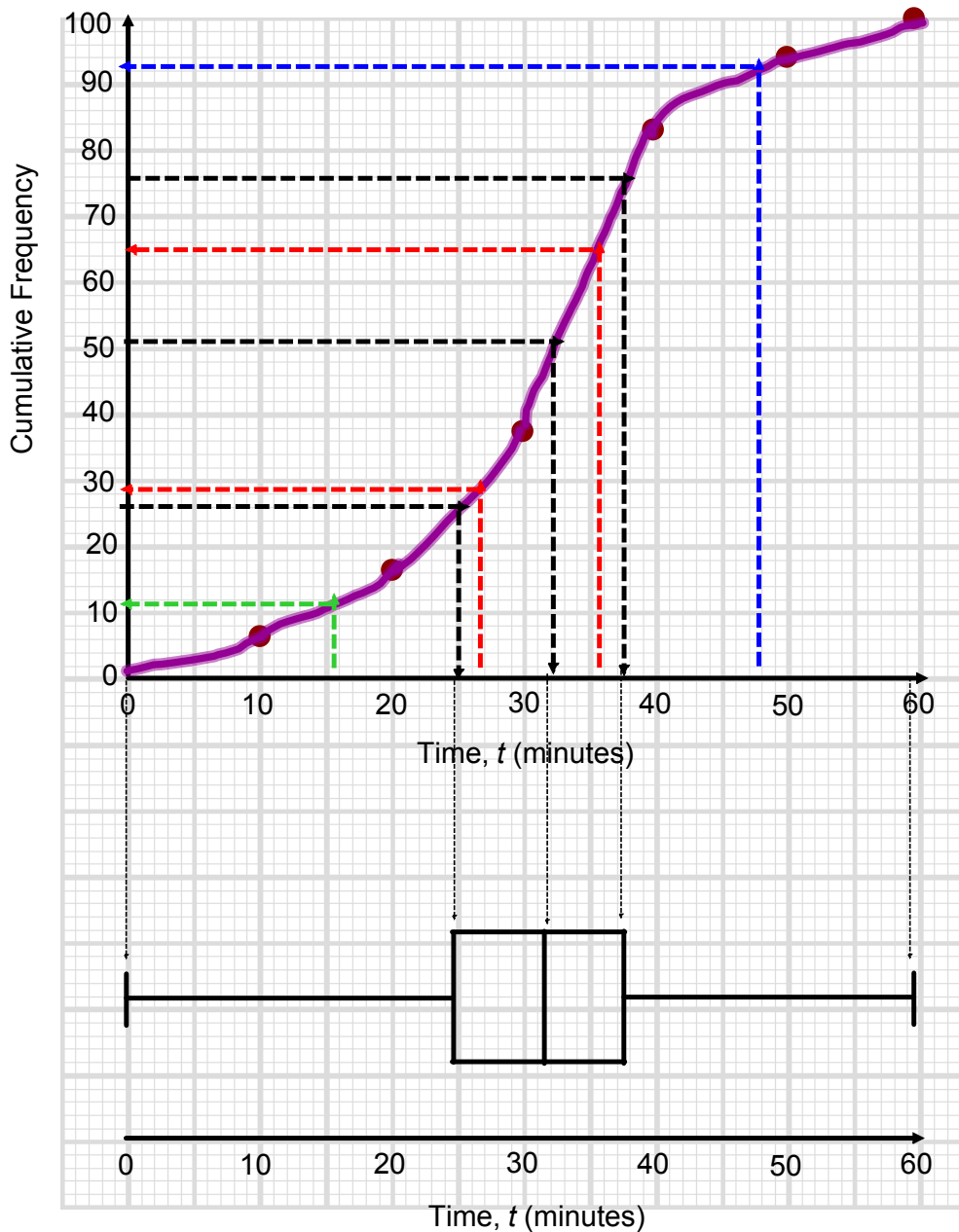
64 people - 28 people = **36 people** use their mobile for between 27 and 36 minutes



**7 CUMULATIVE FREQUENCY**

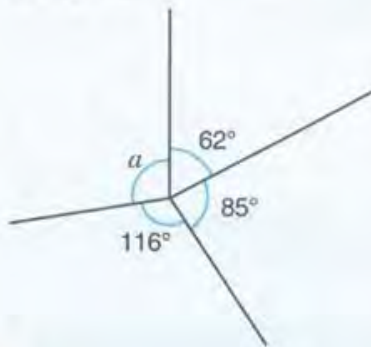
- 1** The times spent by a group of students using their mobile phones in one day are shown in the table.
- f** Draw a box plot to represent this data

see BOX PLOT underneath CUMULATIVE FREQUENCY graph



## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 1 In the diagram, all angles are measured to the nearest degree. Find the maximum possible size of angle  $a$ .

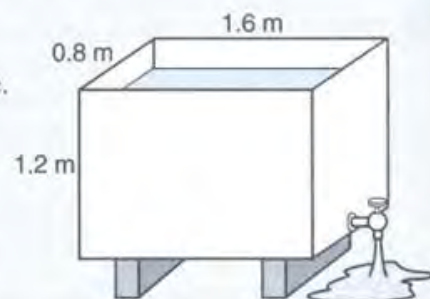


- 2 Fiona measures a corridor as being 126 paces in length. The length of her pace is 90 cm, to the nearest 10 cm. What is the difference between the maximum and minimum possible lengths of the corridor?

- 5 A bag of potatoes weighs 5.0 kg to the nearest 100g.  
 (a) Find the upper bound of the weight of 100 bags of potatoes.  
 1.5 kg of potatoes to the nearest 100 g are taken from a bag.  
 (b) What is the lower bound of the weight of potatoes left in the bag?

- 7 Books are packed into boxes for delivery. The total weight of a box should **not exceed** 30 kg. A book weighs 2.7 kg, to the nearest 0.1 kg. What is the maximum number of books that can be packed in a box?

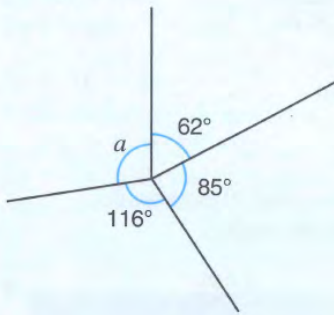
- 8 A water tank, in the shape of a cuboid, is full of water. Water is drained from the tank at a rate of 8 litres per minute. The dimensions of the tank are given to the nearest 10 cm. The rate at which the water is drained from the tank is given to the nearest 0.5 litres per minute.  
 (a) Calculate the smallest possible time to drain the tank.  
 (b) Calculate the greatest possible time to drain the tank.



- 3 Hasim travels for 4 hours at an average speed of 50 miles per hour. The time is given to the nearest hour. The speed is given to the nearest 10 miles per hour.  
 (a) What is the maximum possible distance Hasim travels?  
 (b) What is the minimum possible distance Hasim travels?
- 4 There are people queuing at two entrances,  $A$  and  $B$ , of a concert hall. The number of people queuing at entrance  $A$  is 150 to the nearest 10. The number of people queuing at entrance  $B$  is 300 to the nearest 100.  
 (a) Calculate the largest possible total of the number of people queuing at entrances  $A$  and  $B$ .  
 (b) Calculate the smallest possible difference between the number of people queuing at entrances  $A$  and  $B$ .

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

1 In the diagram, all angles are measured to the nearest degree. Find the maximum possible size of angle  $a$ .



$$\text{accuracy} = 1$$

$$\text{tolerance} = 1 \div 2 = 0.5$$

LOWER BOUNDS

$$\text{lower bound} = 62 - 0.5 = 61.5 \quad \text{etc...}$$

lower bound of sum of given angles

$$= 61.5 + 84.5 + 115.5 = 261.5$$

$$\text{UB of } a = 360 - 261.5 = \underline{\underline{98.5^\circ}}$$



**8 CALCULATING WITH UPPER AND LOWER BOUNDS**

- 2 Fiona measures a corridor as being 126 paces in length. The length of her pace is 90 cm, to the nearest 10 cm. What is the difference between the maximum and minimum possible lengths of the corridor?

$$\text{accuracy} = 10\text{cm}$$

$$\text{tolerance} = 10\text{cm} \div 2 = 5\text{cm}$$

$$\text{UB of pace} = 90 + 5 = 95\text{cm}$$

$$\text{LB of pace} = 90 - 5 = 85\text{cm}$$

$$\text{UB of length} = 95\text{cm} \times 126 = 11970\text{cm}$$

$$\text{LB of length} = 85\text{cm} \times 126 = 10710\text{cm}$$

$$\text{difference} = 11970 - 10710 = 1260\text{cm}$$

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 3 Hasim travels for 4 hours at an average speed of 50 miles per hour.  
The time is given to the nearest hour.  
The speed is given to the nearest 10 miles per hour.
- (a) What is the maximum possible distance Hasim travels?  
(b) What is the minimum possible distance Hasim travels?

	UB	LB
time	4.5	<del>3.5</del>
speed	55	45

$$\text{max distance} = 4.5 \times 55 = 247.5 \text{ miles}$$

$$\text{min distance} = 3.5 \times 45 = 157.5 \text{ miles}$$

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 4 There are people queuing at two entrances,  $A$  and  $B$ , of a concert hall.  
The number of people queuing at entrance  $A$  is 150 to the nearest 10.  
The number of people queuing at entrance  $B$  is 300 to the nearest 100.
- (a) Calculate the largest possible total of the number of people queuing at entrances  $A$  and  $B$ .
- (b) Calculate the smallest possible difference between the number of people queuing at entrances  $A$  and  $B$ .

	UB	LB
A	155	145
B	350	250

$$\text{largest total} = 155 + 350 = 505$$

$$\text{smallest difference} = 250 - 155 = 95$$

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 5 A bag of potatoes weighs 5.0 kg to the nearest 100g.
- (a) Find the upper bound of the weight of 100 bags of potatoes.  
1.5 kg of potatoes to the nearest 100 g are taken from a bag.
- (b) What is the lower bound of the weight of potatoes left in the bag?

$$\text{UB of weight} = 5.0 \text{ kg} + 0.05\text{kg} = 5.05\text{kg}$$

$$5.05 \times 100 = \underline{505 \text{ kg}}$$

(b)

$$\text{LB of weight} = 5.0 \text{ kg} - 0.05\text{kg} = 4.95\text{kg}$$

$$\text{UB of weight of potatoes removed} = 1.5 + 0.05 = 1.55$$

LB of weight

$$= \text{LB of starting weight} - \text{UB of weight of potatoes removed}$$

$$= 4.95 - 1.55 = \underline{3.4 \text{ kg}}$$

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 7 Books are packed into boxes for delivery. 5.2 cr  
The total weight of a box should **not exceed 30 kg**.  
A book weighs **2.7 kg**, to the nearest 0.1 kg.  
What is the maximum number of books that can be packed in a box?

$$\text{UB of weight of a book} = 2.7 + 0.05 = 2.75\text{kg}$$

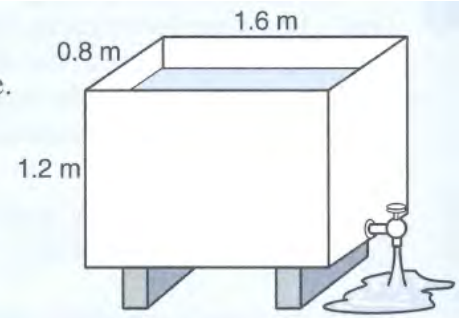
$$30 \div 2.75 = \underline{10 \text{ books}} \text{ (nearest whole book)}$$

*(10 × 2.75kg = 27.5kg, definitely less than 30kg,*

*11 × 2.75kg = 30.25kg, 11 books COULD weigh more than 30kg)*

## 8 CALCULATING WITH UPPER AND LOWER BOUNDS

- 8 A water tank, in the shape of a cuboid, is full of water. Water is drained from the tank at a rate of 8 litres per minute. The dimensions of the tank are given to the nearest 10 cm. The rate at which the water is drained from the tank is given to the nearest 0.5 litres per minute.



- (a) Calculate the smallest possible time to drain the tank.  
 (b) Calculate the greatest possible time to drain the tank.

$1\text{m}^3 = 1000$  litres

	UB	LB
volume ( $\text{m}^3$ )	$1.25 \times 0.85 \times 1.65$ $= 1.753125 \text{ m}^3$	$1.15 \times 0.75 \times 1.55$ $= 1.336875 \text{ m}^3$
capacity (litres)	<b>1753.125</b>	<b>1336.875</b>
rate	<b>8.5</b>	<b>7.5</b>

$$(a) \text{ smallest possible time} = \frac{\text{LB of capacity}}{\text{UB of rate}} = 157.2794111 \text{ minutes}$$

$$(b) \text{ greatest possible time} = \frac{\text{UB of capacity}}{\text{LB of rate}} = 233.75 \text{ minutes}$$