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## Number

- 1 **a** 87      **b**  $\frac{5}{12}$       **c**  $33\frac{1}{3}\%$   
**d** Because the parts of the ratio add up to 13, and 310 is not exactly divisible by 13.  
The numbers of men, women and children must be whole numbers.
- 2 **a** 23 cm      **b** 30% increase
- 3 **a** 45 litres      **b** £2.25
- 4 **a**  $48 = 2 \times 2 \times 2 \times 2 \times 3$ ;  $180 = 2 \times 2 \times 3 \times 3 \times 5$ ;  $108 = 2 \times 2 \times 3 \times 3 \times 3$   
**b** HCF = 12      **c** LCM = 6480
- 5  $\frac{607 \times 4.97}{0.214}$  is approximately the same as  $\frac{600 \times 5}{0.2} = \frac{600 \times 5 \times 5}{1} = 15\,000$
- 6 **a**  $6\frac{5}{24}$       **b**  $\frac{2}{5}$
- 7 **a**  $4^8$       **b**  $3^6$       **c**  $t^{12}$       **d**  $m^3$
- 8 **a** £6.40      **b** 6 days
- 9 **a** Any irrational number; examples are  $\sqrt{2}$ ,  $\pi$ ,  $\sqrt{3}$   
**b** Answers may vary; examples are 6,  $5\frac{1}{2}$ ,  $6\frac{1}{4}$   
**c** Answers may vary; examples are  $\sqrt{5}$ ,  $2\sqrt{2}$ ,  $\sqrt{7}$
- 10 **a** ~~0.45~~  $0.4\bar{5}$       **b**  $\frac{7}{18}$        $\frac{2}{35}$
- 11 **a i**  $2.73 \times 10^7$       **ii**  $6 \times 10^{-11}$   
**b i**  $1.175 \times 10^{-8}$       **ii**  $7.4 \times 10^1$
- 12 **a** £28 000      **b** £14 336
- 13 **a** £92.40      **b** £80      **c** £360
- 14 **a**  $P = 375\text{ W}$       **b** 1950 watts
- 15 **a** Upper bound = 8.5 cm      Lower bound = 7.5 cm  
**b** Upper bound = 5.5 cm      Lower bound = 4.5 cm  
**c**  $13\text{ cm}^2$
- 16 0.21
- 17 **a** 1      **b**  $\frac{1}{9}$       **c** 5      **d** 9      **e**  $\frac{1}{25}$
- 18 **a**  $\sqrt{15}$       **b** 15      **c**  $2\sqrt{7}$       **d**  $\frac{3}{2}$       **e**  $3\sqrt{2}$
- 19  $\frac{4}{9}$

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## Statistics

1 Answers may vary. Suggestions are:

10 is too small a sample to get a true analysis of the situation.

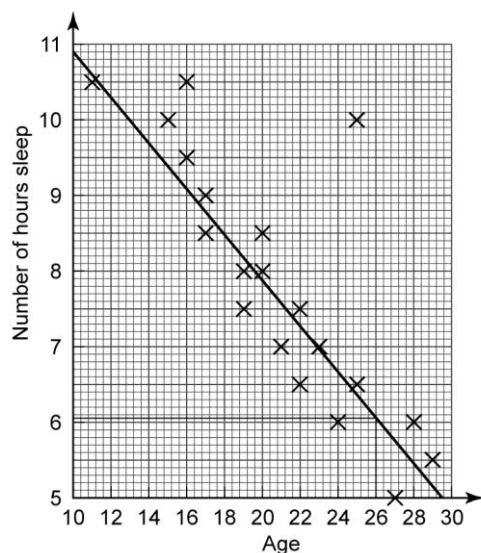
People coming out of a gym are likely to be health conscious anyway, so the sample is biased.

2 a 35                      b 46 cm                      c 42 cm                      d 25.7%

3 a £8500                      b £15 000                      c £13 812.50

d The modal salary is that of the lowest-paid workers. The mean is distorted upwards by the high salaries of the smaller groups of skilled workers, foremen and especially the manager.

4 a



b 6.05 hours (this may vary depending on the position of the line of best fit).

c The graph shows negative correlation. In general, the higher the age of a person, the lower the number of hours sleep that is thought to be needed.

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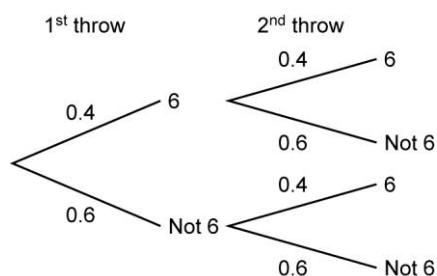
- 5 a** £3300      **b** £1200  
**c**



- d** The range of salaries is much greater in the West Midlands than in either of the other two areas, but the median salary is also higher in the West Midlands.

There is not a lot of difference between the North West and the North East, the range of salaries being similar, but the salaries are on average slightly higher in the North East.

- 6 a**



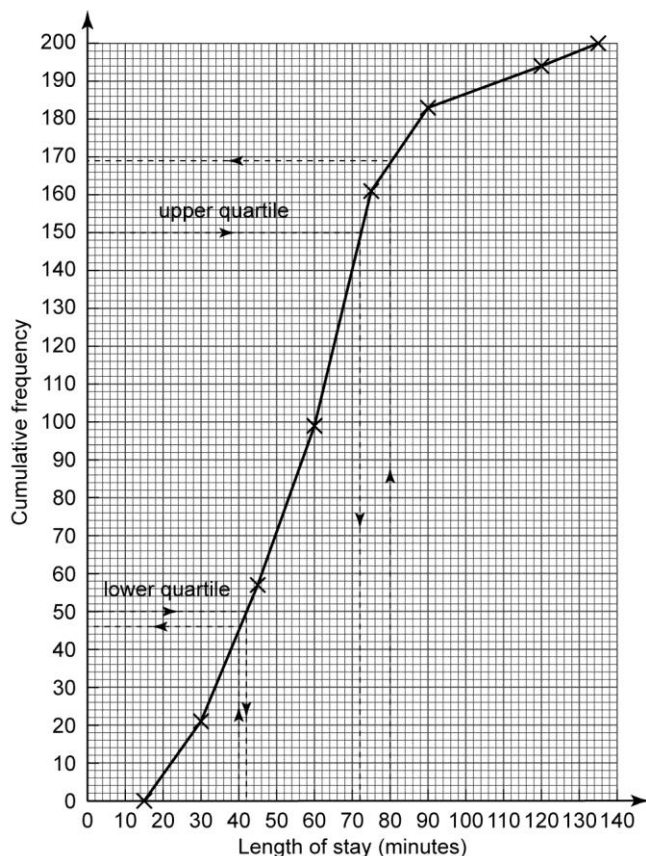
- b** 0.36  
**c** 0.48

- 7 a**

Length of stay (minutes)	Number of cars (frequency)	Cumulative frequency
$0 < t \leq 15$	0	0
$15 < t \leq 30$	21	21
$30 < t \leq 45$	36	57
$45 < t \leq 60$	42	99
$60 < t \leq 75$	62	161
$75 < t \leq 90$	22	183
$90 < t \leq 120$	11	194
$120 < t \leq 135$	6	200

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**b**



**c** Inter-quartile range =  $72 - 42 = 30$

**d** Ewan's results show that the owners were nearly correct.

An estimated 123 cars were left in the car park for between 40 and 80 minutes, and this is 61.5%, which is not much less than 66.66% or  $\frac{2}{3}$ .

**8 a**  $\frac{5}{12} \times \frac{4}{11} = \frac{20}{132}$

**b**  $P(\text{red and blue}) = \frac{4}{12} \times \frac{5}{11} = \frac{20}{132}$

$P(\text{red and yellow}) = \frac{4}{12} \times \frac{3}{11} = \frac{12}{132}$

$P(\text{blue and red}) = \frac{5}{12} \times \frac{4}{11} = \frac{20}{132}$

$P(\text{blue and yellow}) = \frac{5}{12} \times \frac{3}{11} = \frac{15}{132}$

$P(\text{yellow and red}) = \frac{3}{12} \times \frac{4}{11} = \frac{12}{132}$

$P(\text{yellow and blue}) = \frac{3}{12} \times \frac{5}{11} = \frac{15}{132}$

$P(\text{different colours}) = \frac{20 + 12 + 20 + 15 + 12 + 15}{132} = \frac{94}{132} = \frac{47}{66}$

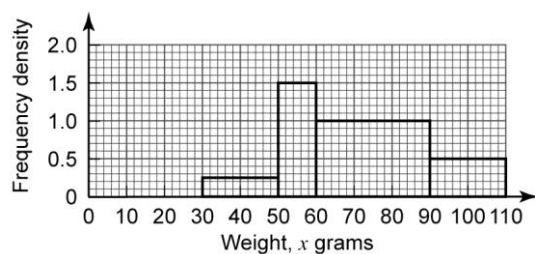
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**9 a 9      b 7      c 85      d 99**

**10 a**

Weight, $x$ grams	Number of eggs, $f$	Frequency density
$30 \leq x < 50$	5	0.25
$50 \leq x < 60$	15	1.5
$60 \leq x < 90$	30	1
$90 \leq x < 110$	10	0.5

**b**



**c 70.9 grams**

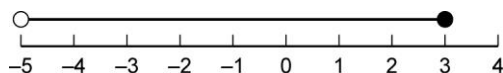
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## Algebra

1 **a**  $4(3a + 2b)$       **b**  $x(y - 2)$       **c**  $2k(k + 3)$       **d**  $3p(q^2 - 4pr)$

2 **a**  $-4, -3, -2, -1, 0, 1, 2, 3$

**b**



3 **a**  $11x + 9y$       **b**  $13m + 3$

4 **a** 33, 39      **b** add 6      **c**  $6n - 3$       **d** 117

5  $y \leq 2.7516$

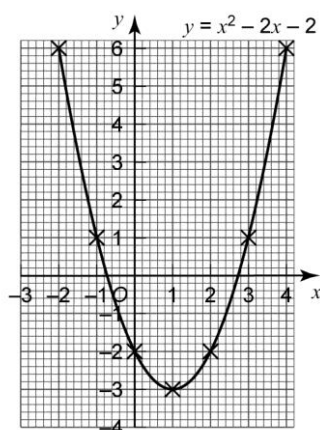
6 **a**  $a = 9$       **b**  $x = -1$

7  $x = 4.3$

8 **a**

$x$	-2	-1	0	1	2	3	4
$y$	6	1	-2	-3	-2	1	6

**b**



**c**  $x = 1$       **d**  $(1, -3)$       **e**  $x = -0.7$  or  $2.7$

9 **a**  $a = \frac{2q - p}{t}$       **b**  $a = \frac{2(v + 5)}{3}$       **c**  $a = \frac{d^2 - c}{3}$       **d**  $a = \frac{m + n}{4 - q}$

10 **a**  $(2, -2)$       **b**  $-\frac{3}{2}$       **c**  $2y + 3x = 2$       **d**  $2y + 3x = 13$

11 **D**  $(6, 3, 5)$

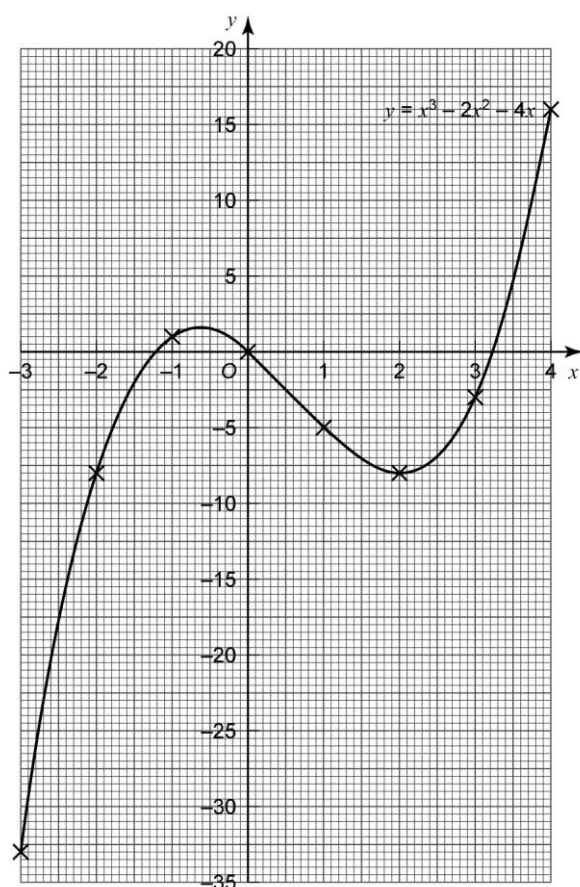
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**12 a**  $x = 5, y = -1\frac{1}{2}$       **b**  $x = 3, y = 4$       **c**  $x = 6, y = -2$       **d**  $x = -6, y = -8$

**13 a**

$x$	-3	-2	-1	0	1	2	3	4
$y$	-33	-8	1	0	-5	-8	-3	16

**b**



**c i**  $x = -1, -0.3$  and  $3.3$       **ii**  $x = -1.7, 1$  and  $2.8$

**14 a i**  $x^2 + 11x + 28$     **ii**  $x^2 - 3x - 18$       **iii**  $x^2 - 25$       **iv**  $15x^2 - 2x - 8$   
**b i**  $(x + 6)(x - 3)$     **ii**  $(x - 5)(x - 4)$       **iii**  $(2x + 1)(x - 3)$       **iv**  $(2x - 5)(3x - 6)$

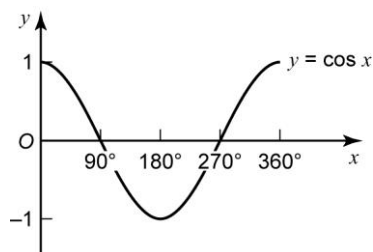
**15 a**  $\frac{x+3}{3}$       **b**  $\frac{x+3}{4}$       **c**  $\frac{x-4}{x+2}$

**16 a**  $x = 4$  and  $-6$       **b**  $x = 0$  and  $-6$       **c**  $x = 8$  and  $-8$       **d**  $x = 1\frac{1}{2}$  and  $-4$

**17 a**  $x = -1.44$  and  $-5.56$       **b**  $x = 2.62$  and  $0.38$       **c**  $x = 0.38$  and  $-5.19$

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**18 a**



**b**  $x = 92.3^\circ$  and  $267.7^\circ$

**19 a**  $x = 7.87$  and  $0.13$

**b**  $x = -0.52$  and  $-3.68$

**c**  $x = 1.24$  and  $-2.62$

**20**

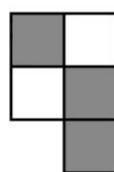
Equation	Graph
$y = x^2 + 2x - 1$	<b>f</b>
$y = x^3 - 3x$	<b>e</b>
$y = 3x - x^3$	<b>b</b>
$y = 4x - x^2$	<b>d</b>
$y = \frac{4}{x}$	<b>a</b>
$y = x^2 - 2$	<b>c</b>



## Geometry and measure

- 4

**c** Plan view



- 

Not drawn accurately

- 9 a**  $PR = 51.48\text{ m}$  (2 d.p.)                      **b**  $PS = 37.75\text{ m}$  (2 d.p.)
- 10 a**  $50^\circ$  The angle subtended by an arc at the centre is twice the angle subtended at the circumference.
- b**  $25^\circ$  Angles subtended by the same arc are equal.
- c**  $90^\circ$  The angle in a semicircle is a right angle.

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**11 a** 5.81 cm

**b** 58.09 cm<sup>3</sup>

**c** 56.1°

**12 a** 10°

**b** 13.96 cm

**c** 558.51 cm<sup>2</sup>

**d** 1.74 m (2 d.p.)

**13 a** 11.57 km

**b** 014°

**14 a**  $PT = b$

**b**  $PR = a + b$

**c**  $RT = -a$

**d**  $SR = \frac{3a}{2}$

**e**  $PS = b - \frac{a}{2}$

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## Essential skills

- 1 a The mean will decrease because the age of the new member is less than the original mean.  
 b The range cannot decrease because the difference between the lowest and highest ages cannot get smaller. It is not possible to tell whether the range will increase or stay the same, because it depends whether the age of the new member is lower than the lowest age already in the club.

- 2 The perimeter of the square = 16 cm

$$\begin{aligned}\text{So } 2 \times \pi \times r &= 16 \\ \pi \times r &= 8 \\ r &= \frac{8}{\pi} = 2.55 \text{ cm (3 s.f.)}\end{aligned}$$

- 3  $3^2 + 2^3 = 9 + 8 = 17$   
 $(3^2)^2 - 4^3 = 9^2 - 64 = 81 - 64 = 17$   
 So  $3^2 + 2^3 = (3^2)^2 - 4^3$

- 4 Let  $6y - 4 = 2(2y + 3)$   
 $6y - 4 = 4y + 6$   
 $6y - 4y = 6 + 4$   
 $2y = 10$   
 $y = 5$

- 5 Let  $p = 3$  and  $q = 4$ , so  $\frac{1}{p} + \frac{1}{q} = \frac{1}{3} + \frac{1}{4}$

The common denominator for 3 and 4 is 12 ( $3 \times 4$  not  $3 + 4$ ).

$$\text{So } \frac{1}{3} + \frac{1}{4} = \frac{4 + 3}{12} = \frac{7}{12} \text{ and } \frac{1}{p} + \frac{1}{q} = \frac{q + p}{pq} \text{ not } \frac{1}{p + q}$$

- 6 1:2

- 7 Let  $x$  represent the number of sheep.  
 Let  $y$  represent the number of hens.  
 Write down two simultaneous equations, and solve for  $x$  and  $y$ .

$$\begin{array}{ll}x + y = 84 & \text{Equation 1} \\ 4x + 2y = 288 & \text{Equation 2}\end{array}$$

$$\begin{array}{ll}2x + 2y = 168 & \text{multiply Equation 1 by 2 to form Equation 3} \\ 2x = 120 & \text{subtract Equation 3 from Equation 2 to eliminate } y \\ x = 60 & \text{solve for } x \\ 4 \times 60 + 2y = 288 & \text{substitute this value for } x \text{ in Equation 2} \\ 2y = 48 & \text{simplify} \\ y = 24 & \text{solve for } y \\ 60 + 24 = 84 \checkmark & \text{check values for } x \text{ and } y \text{ by substitution in Equation 1}\end{array}$$

The farmer has 60 sheep and 24 hens.

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**8**  $(p + q)^2 = (p + q)(p + q) = p^2 + 2pq + q^2$

$(p + q)^2$  could be the same as  $p^2 + q^2$  if  $pq = 0$ , so  $p$  or  $q$  or both would have to be zero.

**9** Angle  $ADC =$  angle  $BAD = 90^\circ$

$BD = AC$

Angle  $ABD =$  angle  $ACD$

an angle in a semi-circle is a right angle

both are diameters of the circle

angles subtended by the same arc are equal

So triangles  $ABD$  and  $DCA$  are congruent.

**10**  $2\frac{1}{2}$  and  $-1\frac{1}{2}$

**11 a** 10.25%      **b** Decreased by 1%      **c** 44%

**12 a** Sum of consecutive numbers  $= 4n + 6$   
 Product of highest and lowest  $= n^2 + 3n$

$$n^2 + 3n = 4n + 6$$

$$n^2 - n - 6 = 0$$

$$(n + 2)(n - 3) = 0$$

$$n = -2 \text{ or } 3$$

So there are only two sets of four consecutive numbers where the sum of the numbers is equal to the product of the highest and the lowest numbers.

**b** -2, -1, 0, 1 and 3, 4, 5, 6

**13** The area of cross-section is  $(3x \times x) + (2x \times y) + (3x \times x)$   
 $= 6x^2 + 2xy$   
 $= 2x(3x + y)$

The volume of the prism is  $12x^3 - 2x^2y - 2xy^2$   
 $= 2x(6x^2 - xy - y^2)$   
 $= 2x(2x - y)(3x + y)$

So the depth of the prism  $= \frac{2x(2x - y)(\cancel{3x + y})}{\cancel{2x(3x + y)}}$   
 $= 2x - y$