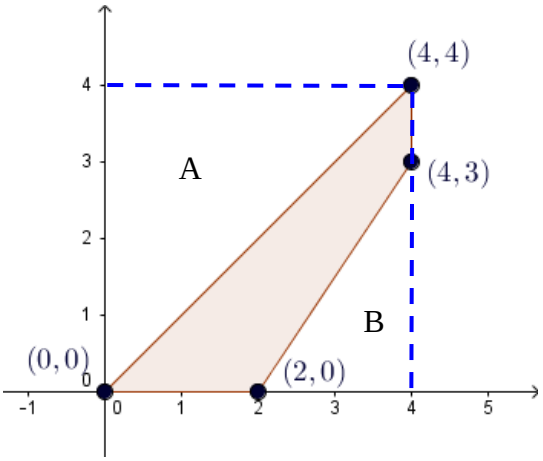
Section 1: Solving problems

Solutions to Exercise level 2

1. The first graph shows the one who took the lift, as there was a wait of 3 minutes before starting, and after that the journey was faster.

   The assumptions made include
   - that the lift moves at constant speed (whereas in fact it will accelerate when starting and then slow down before stopping)
   - that the person who walked was moving at a constant speed
   - that the stairs were continuous with no landings, except perhaps one (the horizontal part could be a landing, or it could be where the person stopped)

2. 

   Area of the square $= 4 \times 4 = 16$
   Area of triangle A $= \frac{1}{2} \times 4 \times 4 = 8$
   Area of triangle B $= \frac{1}{2} \times 2 \times 3 = 3$
   Area of shaded shape $= 16 - 8 - 3 = 5$ square units

3. Each row ends in a multiple of 15
   The nth row ends in $15n$
   $2020 \div 15 = 134.666\ldots$
   The 134^{th} row ends in $134 \times 15 = 2010$
   The 135^{th} row ends in $135 \times 15 = 2025$
   so the number 2020 is in the 135^{th} row.

4. Current job: 7 hours at £4 per hour = £28

New job: 6 hours at £6 per hour = £36
Subtract £3 for lunch give £33

So without taking account of the train fare, the new job income is £5 more than the old one.

So the train fare must be less than £5 if the income from the new job after expenses is greater.

Factors such as enjoyment of the job would also be taken into account.
Also the new job is fewer hours but the train journey might mean that it takes up more time overall.

5. Let the distance between each number be d.

So $w + d = x$ (1)

$x + d = y$ (2)

$y + d = z$ (3)

(i) (2) gives $d = y - x$

(3) gives $z = y + d$

$= y + (y - x)$

$= 2y - x$

(ii) (2) gives $y = x + d$

(3) gives $z = y + d$

$= (x + d) + d$

$= x + 2d$

so $2d = z - x$

(1) gives $x = w + d$

$2x = 2w + 2d$

$2x = 2w + z - x$

$3x = 2w + z$

$x = \frac{1}{3}(2w + z)$

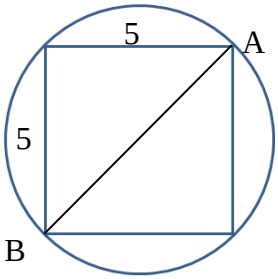
6. Jake is not taking into account the time outside school, during the years he has been going to school, such as school holidays.

Mel has excluded school holidays but has not taken into account weekends and time out of school on weekdays.

The estimates could be improved by thinking about the amount of time spent in school each week.

For example, if you are in school from 8.30 until 3.30 you are in school for 7 hours per day for 5 days a week, so 35 hours. School is open for 39 weeks a year so that is 39 × 35 hours = 1365 hours. Over 10 years this is 13650 hours.
In 15 years, the total number of hours is $15 \times 365 \times 24 = 131400$
So the percentage of time in school is approximately $\frac{13650}{131400} \times 100$ which is about 10%.

7. The perimeter of the square is 20 cm, so the length of each side is 5 cm.



Using Pythagoras' theorem, $AB^2 = 5^2 + 5^2 = 25 + 25 = 50$
so $AB = \sqrt{50}$
AB is the diameter of the circle, so the radius of the circle is given by
$r = \frac{1}{2} \times AB = \frac{1}{2}\sqrt{50}$
Area of circle $= \pi r^2$

$$= \pi \times \tfrac{1}{2}\sqrt{50} \times \tfrac{1}{2}\sqrt{50}$$
$$= \pi \times \tfrac{1}{4} \times 50$$
$$= 12.5\pi$$

8. Let there be n numbers in the list to begin with.
Total of numbers at first $= 18n$.
When 23 is added, the total is $18n + 23$

The new list has $n + 1$ numbers and its average is 19.
Total of new list is $19(n + 1)$.

So $18n + 23 = 19(n + 1)$
$18n + 23 = 19n + 19$
$n = 4$
There were 4 numbers in the list to begin with.

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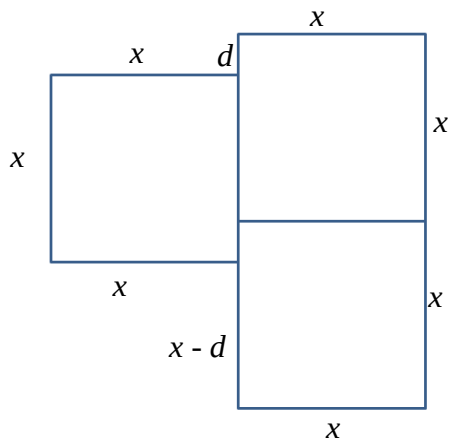
9. Let the length of the sides of the squares be x cm.



From the diagram, the total perimeter $= 7x + d + x - d$

$= 8x$

The perimeter is 32 cm, so $8x = 32$

$x = 4$

The area of each square $= 4 \times 4 = 16$ cm²