

A2-2 Collecting Terms

- collecting terms to solve equations

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Summary

Some equations, like $6a + 5 + 2a = 29$, contain the unknown more than once. To solve these, we first have to collect the terms containing the unknown together. In the example here, we can write $6a + 2a$ as $8a$ to get $8a + 5 = 29$. We can then solve the equation as normal.

Learn

You should now be able to solve equations like these by undoing the operations which were done to the unknown:

$$2x + 7 = 19 \qquad \frac{4(h-3)+1}{5} \times 2 + 17 = 113$$

But that method won't work on this one:

$$4a + 2 + a = 27$$

Not without an extra little trick anyway. Try it and see what happens.

The problem is that the unknown appears in the equation twice. In all the equations you have solved so far (except maybe one or two in the problem sets), it has only been there once.

Now let's have a look at that trick. The trick is called 'collecting terms' and this is how it works.

Think about what the $4a$ means. It means $4 \times a$, which is 4 lots of a or $a + a + a + a$. (This is just the same as $4 \times 7 = 7 + 7 + 7 + 7$.)

Knowing this lets us re-write the equation:

$$4a + 2 + a = 27$$

as $a + a + a + a + 2 + a = 27$

We can now see that the left side of the equation is the sum of 5 lots of a and 2. If we want to see this more clearly, we can change the order of the numbers on the left side to

$$a + a + a + a + a + 2 = 27$$

[You know that when you add numbers, it doesn't matter what order you add them in – the sum is always the same: $8 + 3 = 11$ and $3 + 8 = 11$.]

We know that $a + a + a + a + a$ is the same as $a \times 5$ or $5a$. So we can re-write the left side again as

$$5a + 2$$

And then we can solve the equation.

Just to recap, the whole solution without the explanations will look like this

$$\begin{aligned} 4a + 2 + a &= 27 \\ a + a + a + a + 2 + a &= 27 \\ a + a + a + a + a + 2 &= 27 \\ 5a + 2 &= 27 \\ -2 \quad -2 & \\ 5a &= 25 \\ \div 5 \quad \div 5 & \\ a &= 5 \end{aligned}$$

Read through this till you feel comfortable with it and feel that you could do the same with a different equation. Then try these.

Practice

Q1 Solve these equations:

(a) $3a + 5 + a = 17$

(b) $5r + r + 11 = 29$

(c) $3p + 6 + 2p = 21$

(d) $2d + 3 + 7d = 30$

Once you get the hang of this you will probably leave out some of the working steps. You might write this for Q1 (d):

$$\begin{aligned} 2d + 3 + 7d &= 30 \\ 9d + 3 &= 30 \\ -3 \quad -3 & \\ 9d &= 27 \\ \div 9 \quad \div 9 & \\ d &= 3 \end{aligned}$$

But of course, don't leave out steps unless you are comfortable with doing so – the main thing is to get it right!

Now we've only had pluses in these equations so far – no minuses. How would we go with

$$5w + 3 - 2w = 18$$

We might rearrange to

$$5w - 2w + 3 = 18$$

Then what we have is 5 lots of our unknown number take away 2 lots of our unknown number. This will leave 3 lots of our unknown number. So the whole solution might look like this:

$$5w + 3 - 2w = 18$$

$$5w - 2w + 3 = 18$$

$$3w + 6 = 18$$

$$\begin{array}{r} -6 \quad -6 \\ 3w + 6 = 18 \\ \hline 3w = 15 \end{array}$$

$$3w = 15$$

$$\begin{array}{r} \div 3 \quad \div 3 \\ 3w = 15 \\ \hline w = 4 \end{array}$$

$$w = 4$$

Practice

Q2 Solve these

(a) $6a + 5 - 2a = 21$

(b) $7k - 3k + 3 = 23$

(c) $5f - 2f - 11 = 16$

(d) $3d - d + 5 = 17$

(e) $6b + 9 - 5b = 16$

(f) $2x + 7 + x + 8 - 5 = 34$

In Q2 (f) you might have undone the +7, the +8 and the -5 in three separate steps like this:

$$2x + 7 + x + 8 - 5 = 34$$

$$3x + 7 + 8 - 5 = 34$$

$$\begin{array}{r} +5 \quad +5 \\ 3x + 7 + 8 - 5 = 34 \\ \hline 3x + 7 + 8 = 39 \end{array}$$

$$3x + 7 + 8 = 39$$

$$\begin{array}{r} -8 \quad -8 \\ 3x + 7 + 8 = 39 \\ \hline 3x + 7 = 31 \end{array}$$

$$3x + 7 = 31$$

$$\begin{array}{r} -7 \quad -7 \\ 3x + 7 = 31 \\ \hline 3x = 24 \end{array}$$

$$3x = 24$$

$$\begin{array}{r} \div 3 \quad \div 3 \\ 3x = 24 \\ \hline x = 8 \end{array}$$

$$x = 8$$

Alternatively, you might have realised that adding 7, adding 8 and subtracting 5 is the same as just adding 10, and done it this way:

$$\begin{aligned}2x + 7 + x + 8 - 5 &= 34 \\3x + 10 &= 34 \\-10 \quad -10 & \\3x &= 24 \\\div 3 \quad \div 3 & \\x &= 8\end{aligned}$$

This is more efficient. What we have done in using this shorter method is to collect all the x 's to make $3x$ ($2x + x = 3x$) and collect all the known numbers to make 10 ($7 + 8 - 5 = 10$).

This is called *collecting terms*, or sometimes *collecting like terms*. This is because the unknowns (the x 's) are alike and the known numbers (the 7, the 8 and the 5) are alike. But the unknowns are not like the knowns and you can't collect knowns and unknowns together. For example, you can't write $2d + 5$ as 7 of anything.

Terms are the things which are added and subtracted in an equation.

So far we have only collected two unknown terms, but do you think you can handle this?

$$4n + 2n + 5n - 3n + 7 = 23$$

Give it a try.

Not too hard, eh? We just add and subtract all the lots of n . $4n + 2n + 5n - 3n$ is the same as $8n$.

Practice

Q3 Solve these

- (a) $2n + 3 + 5n - n = 33$
- (b) $3a - 13 - a + 5a + 2 - 2a = 34$
- (c) $v + 2v + 3v + 4v + 5 - 3 - 8 + 1 = 25$
- (d) $u + 14 + 4u - 5 - u = 38$
- (e) $f + 16 - 3f + 4f = 25$

Q4 Solve the following by writing and solving an equation. Don't forget to start each with *Let...*

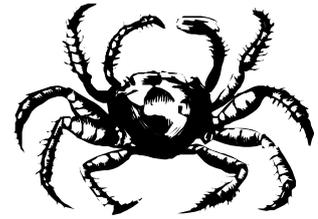
- (a) Albert thought of a number, added 6, then added the number he first thought of. This gave him 22. What number did he first think of?
- (b) Bazza thought of a number, multiplied it by 3, then subtracted 12, then added twice the number he first thought of. If he ended up with 18, what number did he start with?

- (c) Cecilia picked a number, multiplied it by 3, then added the number she started with, then subtracted 6. This gave her 20. What number did she start with?
- (d) Drongo thought of a number, multiplied it by 5, added 7, then added the number he started with. This gave him 49. What number did he start with?
- (e) Ethel thought of a number, multiplied it by 4, added 15, then subtracted the number she started with to leave 54. What number did she start with?
- (f) Frankenstein picked a number, multiplied it by 7, subtracted 10, then subtracted 3 times the number he started with, then added 6. If he ended up with 36, what number did he start with?
- (g) Grogan had some marks on his bedroom wall. He doubled the number of marks, then made another 11, then added the same number of marks that he started with, then rubbed 4 off. Then he had 40. How many did he start with?
- (h) Hariot bought 3 boxes of pencils to add to the 9 pencils she already had. She then gave 17 pencils away and bought another box. This gave her 40 pencils. How many pencils in a box?
- (i) Jasmine got 3 hours pay plus a \$15 tip and a \$9 tip. She then spent 1 hour's pay plus \$40. Then she mugged an old lady and got another \$27. She then counted her money and found she had \$51. How much did she get paid per hour? [She did 2 years for the mugging.]

Q5 Solve the following by writing and solving an equation.

- (a) Haggar the Horrible had 5 packets of sugar cubes. He lost 2 packets, gave 1 packet away, then ate 15 cubes. He then bought 4 more packets and stole 40 sugar cubes from his neighbour. This gave him a total of 385 sugar cubes. How many cubes in a packet?
- (b) Felicity, the fire bug, had 3 boxes of matches. 2 of the boxes were full and the other had 20 missing. Pyro, her friend, had 1 box plus 12 loose matches. They went to the shop, where Felicity bought 4 more boxes and Pyro bought 1 more box. They then counted all the matches and found they had 352 between them. How many matches in a box?
- (c) Clammo bought a packet of used stamps and threw 6 of them away. His brother bought 3 packets and threw 13 stamps away. They then gave 52 stamps to a friend. This left them with only 1 stamp between them. How many stamps in a packet?

- (d) Tiddles thought of a number, multiplied it by 4, then added 12, then added the number she started with, then subtracted 9, then subtracted twice the number she started with leaving herself 24. What number did she start with?
- (e) Uggles thought of a number but died of a heart attack before she could tell anyone.
- (f) Winkin had 2 packs of Life Savers, one of which had 4 missing. Blinkin had 3 packs and 8 loose ones. Nod had twice as many as Blinkin. Between them they had 141. How many in a pack?
- (g) On Monday, Hilda ate some M&Ms. Then on Tuesday, Wednesday, Thursday and Friday, she ate 5 more than on the previous day. In total she ate 110. How many did she eat of Monday?
- (h) Brutus weighs 5kg more than Bronson, who weighs twice as much as Bloogle. If the 3 of them weigh 27.5kg, how much does Bloogle weigh?
- (i) Gonzo is 7 years older than Marie was 4 years before she was half as old as he would have been 8 years after he was 3 times her age. If Marie has been alive for 17 years, how old is she?



Solve

- Q51 On March 1, Obadiah collected 1 foggelopod; on March 2, he collected 2 foggelopods; then he collected 3 on March 3, 4 on March 4; 5 on March 5 and so on. He stopped collecting them after he had collected his 10 on March 10. Then he pulled all their legs off and put them in a jar. The jar then contained 770 legs. How many legs did each foggelopod have before Odabiah pulled them off?

Revise

Revision Set 1

- Q61 Solve $a + 4 + 5a - 3 - 2a = 25$
- Q62 Bazza got 6 hours pay plus a \$10 tip. He then spent 2 hours pay and \$26, leaving him with \$22. How much did he get paid per hour?

Q63 Monolith had a packet of Minties with 5 missing. Clatterbones had two packets (the same as Monolith's packets) plus 114 loose ones. They had 166 Minties between them. How many Minties in a packet?

Answers

Q1 (a) 3 (b) 3 (c) 3 (d) 3

Q2 (a) 4 (b) 5 (c) 9 (d) 6 (e) 7 (f) 8

Q3 (a) 5 (b) 9 (c) 3 (d) 7.25 (e) 4.5

Q4 (a) 8 (b) 6 (c) 6.5 (d) 7 (e) 13 (f) 10 (g) 11 (h) 12 (i) \$20

Q5 (a) 60 (b) 40 (c) 18 (d) 7 (e) - (f) 11 (g) 12 (h) 4.5 kg (i) 17

Q51 14

Q61 6

Q72 \$9.50

Q73 19