

Venn diagrams with 3 sets - applications

Example 1

50 people were asked what they had for breakfast this morning.

27 people had eggs

24 had cheese

14 had bacon

13 had bacon and eggs

7 had eggs and cheese

3 had bacon and cheese

5 had none of the three products.

Example 1

50 people were asked what they had for breakfast this morning.

27 people had eggs

24 had cheese

14 had bacon

13 had bacon and eggs

7 had eggs and cheese

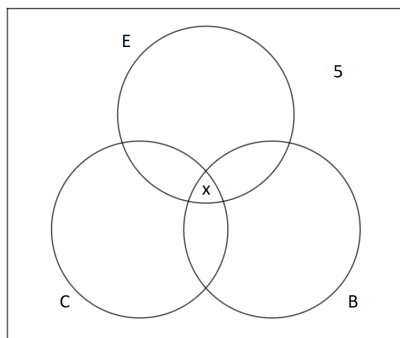
3 had bacon and cheese

5 had none of the three products.

Find the number of people who had (i) all three products (ii) exactly one of the three for breakfast.

Example 1

We start by putting 5 outside of the regions and x in the intersection of all 3.

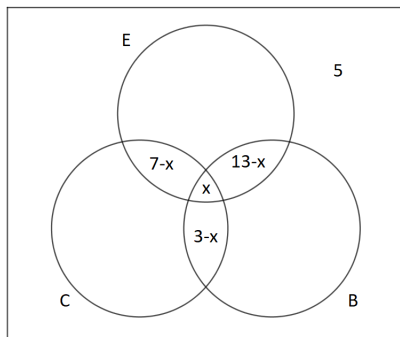


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Now we can put $13 - x$, $7 - x$ and $3 - x$ in appropriate regions:

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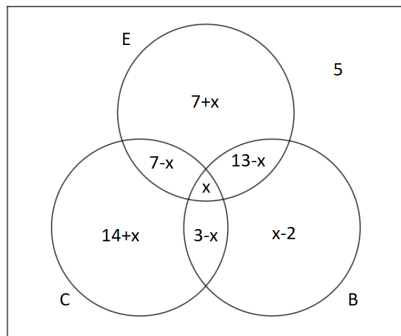
$27 - (13 - x) - x - (7 - x) = 7 + x$. Similarly for those who are cheese

only we have $24 - (7 - x) - x - (3 - x) = 14 + x$, and for bacon

$14 - (13 - x) - x - (3 - x) = x - 2$.

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Now the number of those who ate eggs only is $27 - (13 - x) - x - (7 - x) = 7 + x$. Similarly for those who are cheese only we have $24 - (7 - x) - x - (3 - x) = 14 + x$, and for bacon $14 - (13 - x) - x - (3 - x) = x - 2$. So we can represent this on the diagram:



Example 1

We can now form an equation, since the total number of people surveyed was 50, we have:

$$50 = x + (7 - x) + (3 - x) + (13 - x) + (7 + x) + (14 + x) + (x - 2) + 5$$

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which gives:

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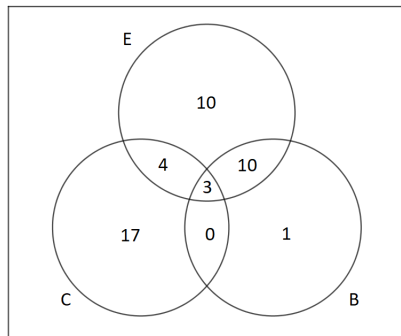
which gives:

$$50 = x + 47$$

$$\text{So } x = 3$$

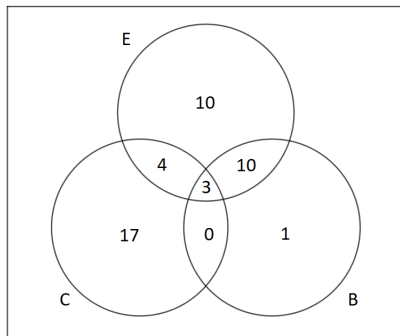
Example 1

We can now update the diagram:



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So 3 people had all three products and $17 + 10 + 1 = 28$ had exactly one of the 3 products.

Example 2

100 people were asked what they had for breakfast this morning.

60 people had eggs

51 had cheese

32 had bacon

31 had bacon and eggs

19 had eggs and cheese

11 had bacon and cheese

8 had none of the three products.

Example 2

100 people were asked what they had for breakfast this morning.

60 people had eggs

51 had cheese

32 had bacon

31 had bacon and eggs

19 had eggs and cheese

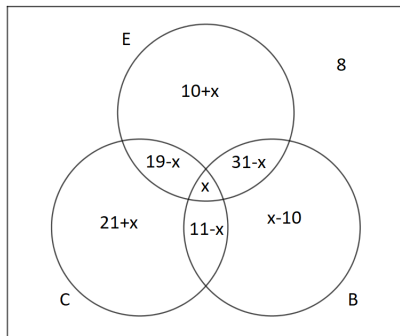
11 had bacon and cheese

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Find the number of people who had (i) all three products (ii) exactly one of the three for breakfast.

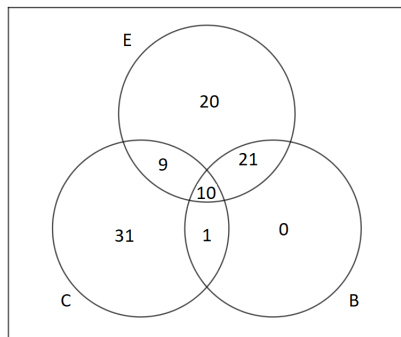
Example 2

The diagram with x as the variable representing the number of people who had all three products:



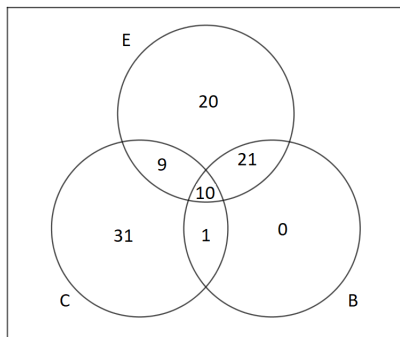
Example 2

We solve for x and find out the $x = 10$, so the diagram becomes:



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10 people had all three products and 51 had exactly one of the 3 products.