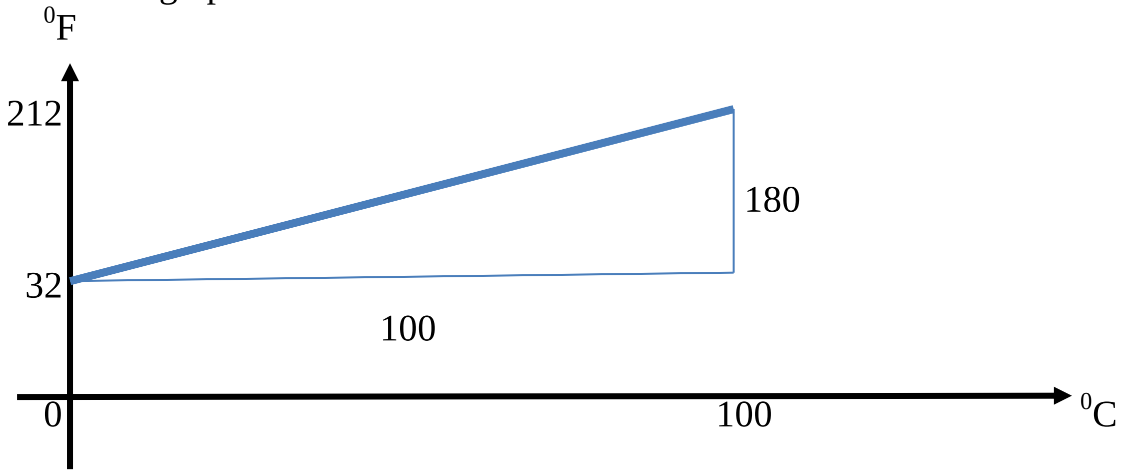
Converting between Fahrenheit and Celsius temperature scales Mentally.

On a recent trip to the USA I found it frustrating mentally converting the temperatures from the **Fahrenheit scale** to the more familiar **Celsius scale**. There is no problem if you have a calculator on hand but the formula can be awkward when trying to work out a quick answer.

Basically, the freezing point of water in Fahrenheit is 32^0F and in Celsius it is 0^0C
The boiling point of water in Fahrenheit is 212^0F and in Celsius it is 100^0C.
The linear graph is as follows:



The gradient of this line is $\frac{180}{100}$ or $\frac{9}{5}$ or 1.8

The "y" intercept is 32

If we want to change from degrees C to degrees F, the most convenient formula is:

$$F = 1.8C + 32 \text{ or } F = \frac{9}{5}C + 32$$

If we want to change from degrees F to degrees C it is more convenient to transpose the formula to the form:

$$C = 5 \times \frac{(F - 32)}{9}$$

On my trip, a typical temperature in Arizona was 35^0C which amounts to
$F = \frac{9}{5}\times 35 + 32 = 95$ in Fahrenheit.

The temperature range was often between 25^0C and 45^0C
which is 77^0F to 113^0F

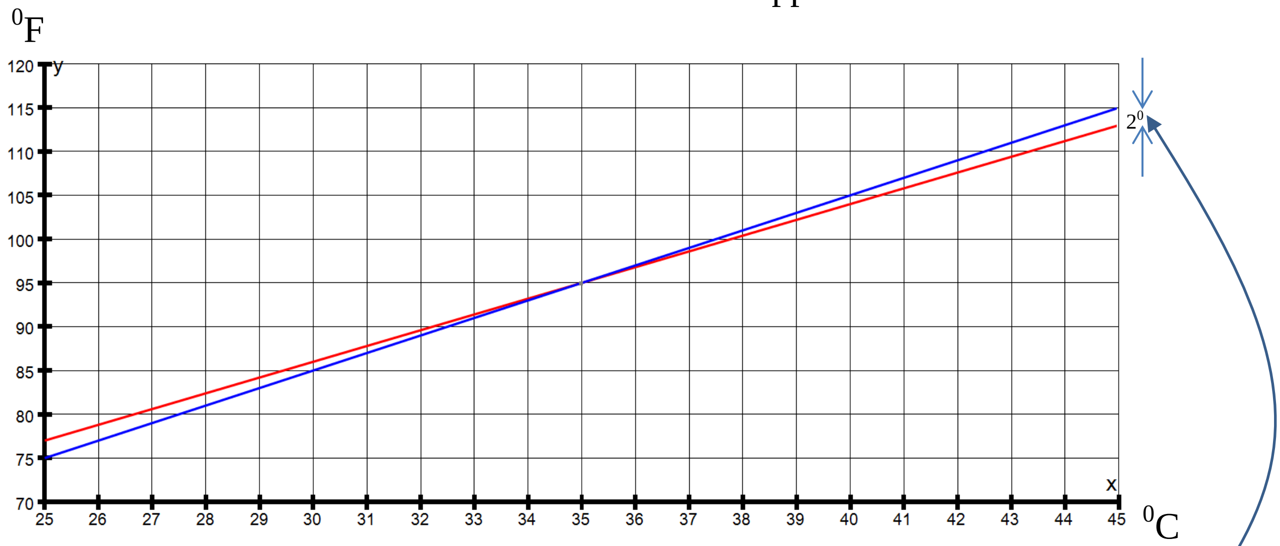
If the temperature were 39^{0}C the calculation would be $\mathbf{\frac{9 \times 39}{5} + 32}$

which is a little awkward to do mentally.
However if we notice the gradient of the graph is close to **2**, the calculation would be much easier to do mentally.

The proper formula is **F = 1.8C + 32**
and if we make the approximation **F = 2C + "something",** we will need to work out a value for the **"something"** which fits the temperature range.
Since we know that 35^{0}C = 95^{0}F we can use this as a guide:

95 = 2 × 35 + "something"
95 = 70 + "something"
So the approximate formula to use is F ≈ 2C + **25**
or transposed, we get $C = \frac{(F - 25)}{2}$

If I draw the two graphs accurately, we see that they fit very closely in the required temperature range. The **RED** line is the exact line.
The **BLUE** line is the approximation.



Considering the 39^{0}C from above we see that the exact number in ^{0}F = **102.2^0**
And our approximate formula gives 2×39 + 25 = **103^0**

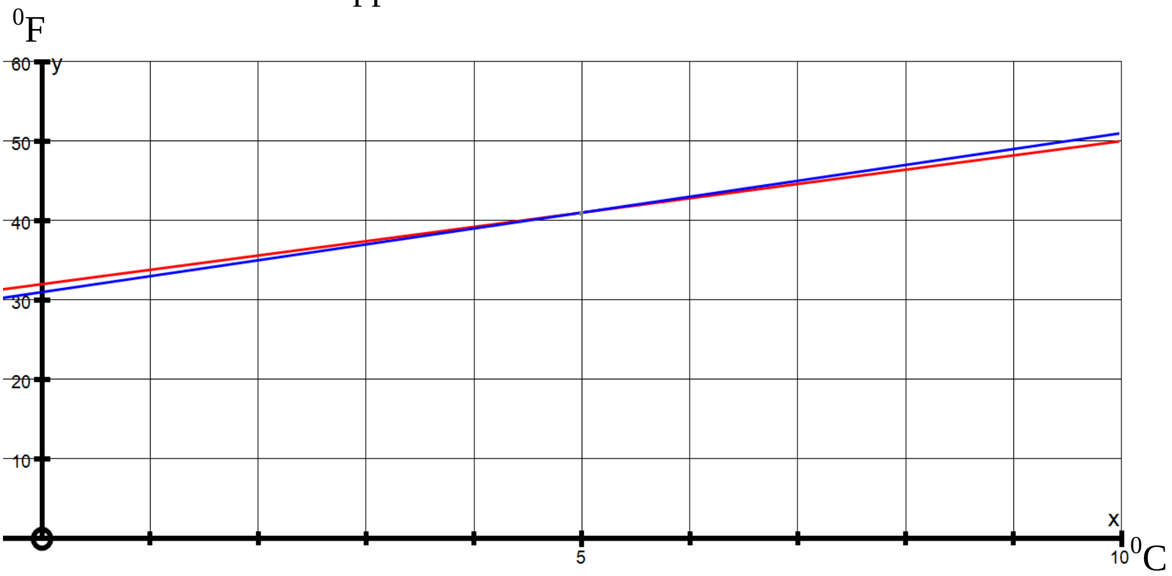
For temperatures close to 35^{0}C the approximations are very close.
At the extreme ends of the range, the approximations are within 2^{0}F

Exact Celsius	Exact Fahrenheit	Approx Fahrenheit
25	77	75
35	95	95
45	113	112

This method will work for any restricted temperature range.
Consider the case of a winter period where the temperature averages 5^0C and varies between 0^0C and 10^0C

Celsius	**Fahrenheit**
0	32
5	41
10	50

Finding an approximate equation, let F = 2C + p
Subs C = 5, F = 41
41 = 10 + p so p = 31
The approximate equation is F = 2C + **31**
As you can see the graphs are very close for this range of temperatures.
The **RED** line is the exact line.
The **BLUE** line is the approximation.



Exact Celsius	Exact Fahrenheit	Approx Fahrenheit
0	32	31
5	41	41
10	50	51

Some interesting points:

There is a temperature which is the **same number** in the Fahrenheit and Celsius scales.

Let T ^{0}C = T ^{0}F

Then $T = \frac{9T}{5} + 32$

So $5T = 9T + 160$

$-160 = 4T$

$T = -40$

This means **-40^0F = -40^0C**

Also we find that **16^0C ≈ 61^0F** (just change the numbers round!)

Also **28^0C ≈ 82^0F**

There are no other pairs which behave like this.
