Complete solutions to Intro\((g)\)

1. (a) The number between 1 and 10 is 1.86. How many places do we need to shift the decimal point?

\[186000 = 1.86 \times 10^5\]

(b) Similarly 1 392 000 = 1.392 \times 10^6.

(c) 136 000 = 1.36 \times 10^5

(d) The number between 1 and 10 is 3.439, we need to shift the decimal point:

\[0.000 000 03439 = 3.439 \times 10^{-8}\]

Negative index because we are moving the decimal point to the right (it's a small number).

(e) Similarly 0.000 000 0951 = 9.51 \times 10^{-8}

(f) 0.009 29 = 9.29 \times 10^{-3}

(g) 0.000 025 8 = 2.58 \times 10^{-5}

(h) 14.96 \times 10^6 is not in standard form, why not? Because 14.96 is not between 1 and 10, remember the first number needs to lie between 1 and 10. How can we rewrite this number?

\[14.96 = 1.496 \times 10\]

Substituting this into the original number gives:

\[14.96 \times 10^6 = 1.496 \times 10 \times 10^6\]

\[= 14.96 \times 10^7\]

(i) 273.15 = 2.7315 \times 10^2

(j) This number is already in standard form.

2. Write them in conventional form means write out the whole number without a power of 10.

(a) \(6.4 \times 10^6 = 6.400000 \times 10^6\), multiplying by \(10^6\) moves the decimal point 6 places to the right:

\[6.4 \times 10^6 = 6400000\]

(b) We can place as many zeros as we want in front of a number without changing the number:

\[3.3 \times 10^{-9} = 0\,000\,000\,003.3 \times 10^{-9}\]

The index, \(-9\), shifts the decimal point 9 places to the left. Hence

\[3.3 \times 10^{-9} = 0.000\,000\,003\,3\]

(c) Similarly:

\[7.292 \times 10^{-5} = 000\,007.292 \times 10^{-5}\]

\[= 0.000\,072\,92\]

(d) Also

\[3 \times 10^8 = 3.000\,000\,00 \times 10^8\]

\[= 300\,000\,000\]
3. (a) Writing the middle numbers in conventional form gives:
\[
12.75 \times 10^2 = 1275
\]
\[
12.75 \times 10^{-3} = 0.01275
\]
We have 12750, 1275, 0.01275 and 12.75. Putting this in order with smallest first gives 0.01275, 12.75, 1275 and 12750. Hence this is:
\[
12.75 \times 10^{-3}, 12.75, 12.75 \times 10^2, 12750
\]
(b) Note that
\[
3.14 \div 10^{-3} = 3.14 \times 10^3
\]
The numbers are
\[
3.14 \times 10^3, 3.14 \times 10^{-3}, 3.14 \times 10^{-2}
\]
which one is smallest?
The more negative an index the smaller the number, so
\[
3.14 \times 10^{-3}, 3.14 \times 10^{-2}
\]
and
\[
3.14 \times 10^3
\]
4. Use your calculator for this question. To enter a number with
\[
10^3
\]
use 
\[
\text{EXP}, \text{EE} \text{ or E button on the calculator.}
\]
(a) To evaluate
\[
1.25 \times 10^3 \times 0.15 \times 348
\]
on a calculator, PRESS;
\[
[(1.25) \times [3] \times [0.15] \times [348] \times ] \quad [+] \quad [(1) \times [15] \times [5] \times ] \quad [=] \quad \text{shows 0.0435 = 0.04 \ (2 \ d.p.).}
\]
(b) Similarly by using our calculator we have
\[
1.58
\]
(c) By using a calculator we have
\[
0.49
\]
5. Need to write each to the power of 10 and which is a multiple of 3:
(a) \(100 \times 10^{-12}\) farads = \(100pF\) because \(p\) is the symbol for \(pico\) = \(10^{-12}\)
(b) \(30000 \Omega = 30 \times 10^{3} \Omega = 30k\Omega\)
(c) \(0.0003 \text{amps}=0.3 \times 10^{-3} A = 0.3mA\)
6. (a) \(8536N = 8.536 \times 10^{3} N = 8.536kN\)
(b) \(75000000W = 75 \times 10^{8} W = 75MW\)
(c) There is no \(10^{12}\) given in TABLE 2 so we use \(10^{9}\), how can we write
\(0.2 \times 10^{12}\) to the power of 9?
\[
0.2 \times 10^{12} = 0.200 \times 10^{12} = 200 \times 10^{-3} \times 10^{12}
\]
Let's examine
\[
10^{-3} \times 10^{12} = \frac{1}{10^3} \times 10^{12}
\]
\[
= \frac{1}{10 \times 10 \times 10} \times (10 \times 10 \times \ldots \times 10)
\]
\[
= (10 \times 10 \times \ldots \times 10) \text{ cancelling } 10 \times 10 \times 10
\]
\[
= 10^9
\]
Substituting this into the Right Hand Side of \((*)\) gives:
\[
200 \times 10^{-3} \times 10^{12} = 200 \times 10^9
\]
Hence \(0.2 \times 10^{12} Pa = 200 \times 10^{9} Pa = 200GPa \ (G \text{ is } giga = 10^{9})\)
7. Use TABLE 2 and TABLE 3 to see what the symbols represent.
(a) \(3000mm = 3000 \text{ millimeters} = 3000 \times 10^{-3} m\), this is now in the units of metres but we can simplify this further by writing 3000 as \(3 \times 10^3\). We have
\[3000 \times 10^{-3} = 3 \times 10^3 \times 10^{-3} = 3 \times 10^3 \times \frac{1}{10^3} = 3 \text{ (cancelling } 10^3)\]

Hence \(3000 \text{ mm} = 3 \text{ m}\).

(b) \(573 \text{kN} = 573 \times 10^3 \text{ N}\)

(c) \(25 \text{ MJ} = 25 \times 10^6 \text{ J}\)

(d) \(12 \text{ ps} = 12 \times 10^{-12} \text{ s}\)

(e) \(25 \text{ MW} = 25 \times 10^{-3} \text{ W}\)

8. (a) The top-heavy fraction \(\frac{22}{7}\) can be written as:
\[\frac{22}{7} \approx \frac{21}{7} = 3\]

(b) We can write \(\frac{333}{106} \approx \frac{300}{100} = 3\), is a close approximation.

(c) \(99 \times 99 \approx 100 \times 100 = 10000\)

(d) Rounding 714 to 700, 0.63 to 0.6 and 14.45 to 14 gives
\[\frac{714 \times 0.63}{14.45} \approx \frac{700 \times 0.6}{14}\]

Now \(700 \times 0.6 = 700 \times \frac{6}{10} = 70 \times 6\). Therefore
\[\frac{700 \times 0.6}{14} = \frac{70 \times 6}{14} = \frac{420}{14} = 30 \text{ (because } 42 \div 14 = 3)\]
\[\frac{714 \times 0.63}{14.45} \approx 30\]