Advice for Solving Calculation Questions

Know your unit prefixes:

$T=10^{12}$, $G=10^{9}$, $M=10^{6}$, $k=10^{3}$, $c=10^{-2}$, $m=10^{-3}$, $\mu=10^{-6}$, $n=10^{-9}$, $p=10^{-12}$, $f=10^{-15}$

Examples: 1.5 GHz=1.5×10^{9} Hz 30 μm=30×10^{-6}m 0.5 ms=0.5×10^{-3} s

With a calculation problem:

1. Try to find an applicable equation in the Equations Sheet.
2. If it is there, carefully transcribe it to your answer sheet.
3. Rearrange the equation as needed.
4. Replace the symbols in the equation with the numbers **and units** given in the problem.
5. Add any unit conversions needed. These should be equivalent to multiplying by 1.
6. Write an equal sign and the numeric answer with 4 significant digits.
7. Write the units for the answer. These units should follow from the units in your equation.

Example Problem: A rocket accelerates in a straight line from 0 km/h to 1800 km/h in 25 s, what is its average acceleration in m/s^2 ?

1. An equation that gives the average acceleration in terms of velocity and time is $\bar{a}=\frac{\Delta v}{\Delta t}$.

(Here the capital greek letter delta (Δ) means "change in". So the average acceleration is the change in velocity divided by the change in time.)

2. $\bar{a}=\frac{\Delta v}{\Delta t}$

3. No rearrangement is needed.

4. $\bar{a}=\frac{\Delta v}{\Delta t}=\frac{(1800\,\text{km/h}-0\,\text{km/h})}{(25\,\text{s}-0\,\text{s})}=\frac{1800\,\text{km/h}}{25\,\text{s}}$

5. Adding unit conversions. $1000\,\text{m}=1\,\text{km}$ so $1=\left(\frac{1000\,\text{m}}{1\,\text{km}}\right)$ and $3600\,\text{s}=1\,\text{h}$ so $1=\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$

$$\bar{a}=\frac{\Delta v}{\Delta t}=\frac{(1800\,\text{km/h}-0\,\text{km/h})}{(25\,\text{s}-0\,\text{s})}=\frac{1800\,\text{km/h}}{25\,\text{s}}\cdot\left(\frac{1000\,\text{m}}{1\,\text{km}}\right)\cdot\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$$

(Note: A shortcut for km is simply to replace "km" with "10^3 m". You then don't need the $\left(\frac{1000\,\text{m}}{1\,\text{km}}\right)$ factor.)

6 & 7. Finish with equal sign, underline and final units.

$$\bar{a}=\frac{\Delta v}{\Delta t}=\frac{(1800\,\text{km/h}-0\,\text{km/h})}{(25\,\text{s}-0\,\text{s})}=\frac{1800\,\text{km/h}}{25\,\text{s}}\cdot\left(\frac{1000\,\text{m}}{1\,\text{km}}\right)\cdot\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)=\_\_\_\_\_\,\text{m/s}^2$$

(Notice how the final units follow from the units in the equation.)

Check your work:

Did you read the problem correctly?
Did you find an equation the gives you the needed answer in terms of the given parameters?
Did you transcribe the equation correctly from the equation sheet?
Did you pay attention to any "cubes" and squares" in the equation? Remember, any conversions for parameters that are squared or cubed also need to be squared or cubed.
Do your units actually give the correct units for the required answer?