

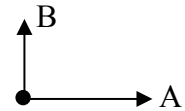
Problem Solving, Units and Numerical Accuracy

Problem Solution Method:

1. Inputs
 Outputs
 “Critical Path” \Rightarrow $\left. \begin{array}{l} \underline{\text{GIVEN:}} \\ \underline{\text{FIND:}} \\ \underline{\text{SOLUTION}} \end{array} \right\} \text{ on graph paper}$
 2. Draw simple diagram of body/bodies & forces acting on it/them.
 3. Choose a reference system for the forces.
 4. Identify key geometry and constraints.
 5. Write the basic equations for force components.
 6. Count the equations & unknowns.
 7. SOLVE
 8. “Feel” the validity of the answer. (Use common sense. Check units...)
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Example: Two forces, A & B, act on a particle. What is the resultant?

1. GIVEN: Two forces on a particle and a diagram with size and orientation



FIND: The “resultant” of the two forces

SOLUTION:

2. Draw what you know (the diagram, any other numbers in the problem statement that could be put on the drawing....)
3. Choose a reference system. What would be the easiest? Cartesian, radian?
4. Key geometry: the location of the particle as the origin of all the forces
Key constraints: the particle is “free” in space
5. Write equations: $\text{sizeof } A^2 + \text{sizeof } B^2 = \text{sizeof resultant}$
 $\sin\alpha = \frac{\text{sizeof } B}{\text{sizeof } A + B}$
6. Count: Unknowns: 2, magnitude and direction \leq Equations: 2 \therefore can solve
7. Solve: graphically or with equations
8. “Feel”: Is the result bigger than A and bigger than B? Is it in the right direction?
(like A & B)

Units

Units	Mass	Length	Time	Force
SI	kg	m	s	$N = \frac{kg \cdot m}{s^2}$
Absolute English	lb	ft	s	$Poundal = \frac{lb \cdot ft}{s^2}$
Technical English	$slug = \frac{lb_f \cdot s^2}{ft}$	ft	s	lb _{force}
Engineering English	lb	ft	s	lb _{force}
	$lb_{force} = lb_{(mass)} \times 32.17 \frac{ft}{s^2}$			
gravitational constant	$g_c = 32.17 \frac{ft}{s^2}$	(US Customary)		
	$g_c = 9.81 \frac{m}{s^2}$	(SI)		
conversions (pg. vii)	$1 in = 25.4 mm$			
	$1 lb = 4.448 N$			

Numerical Accuracy

Depends on 1) accuracy of data you are given
2) accuracy of the calculations performed

The solution CANNOT be more accurate than the less accurate of #1 and #2 above!

DEFINITIONS: *precision* the number of significant digits
accuracy the possible error

Relative error measures the degree of accuracy:

$$\frac{\text{relative error}}{\text{measurement}} \times 100 = \text{degree of accuracy} (\%)$$

For engineering problems, accuracy *rarely* is less than 0.2%.