Solution Tips

Your assignments will be graded by CAPA. However, each week, you will also have to **copy** one CAPA solution on a quiz. You will only have five minutes to do this, so you'll need to make sure that your work is in an easy-to-copy format before you come to class each Thursday. Here are some guidelines to writing good homework solutions. Partial credit on quizzes will be based on following these steps. An example is provided on the next sheet, and an example quiz after that.

1) Draw a *large* **diagram** when necessary.
2) **Read** the problem. As you read, pause whenever you encounter a numeric value, and assign a unique symbol to it. Also, create a symbol for the requested quantity.
3) Indicate your **coordinate system** both in words and on your sketch.
4) **List/convert** all relevant quantities with respect to your coordinate system.
5) Indicate which **equation(s)** you will use.
6) Work **symbolically**. Examples of symbols include: m, g, π, v_0, 0, 1, and ½. Note that every symbol stands for a *sign*, a *number*, and its *units*. For example, $g = +9.8$ m/s^2. So, if you discover that $a = 2g$, then writing $a = (2g \text{ m/s}^2)$ is not just bad, it is **wrong**, because it really says $a = 19.6$ m^2/s^4. You can't include the units twice!

   Good symbolic answers: $a_1 = \dfrac{g(m_1 + m_2)}{m_1}$

   $\mu_{\max} = \dfrac{\pi}{4}$

7) It is smart to use subscripts when there is more than one similar item in a problem. For example, a_1 refers to the acceleration of mass 1, and x_2 refers to the position of mass 2, etc. Subscripts can also refer to different moments in time. You can also use letters as subscripts for different objects: x_A, x_B, and x_C.
8) You don't need to show all of your algebra… just the first step or two, and the last step or two.
9) Check that your answers have sensible **units**. For example, if $m = 10$ kg, then it is logically impossible for your answer to algebraically include $(m + 1)$ anywhere, since "1" doesn't have units of mass, and therefore can't be added to a mass.
10) **Box** the final answer.

Example of a good problem solution

Here's the problem as it might appear on the CAPA assignment:

4. A bolt comes loose from the bottom of an elevator that is moving upward at a speed of 5 m/s. The bolt reaches the bottom of the elevator shaft in time 3 seconds. How high up *H* was the elevator when the bolt came loose?

Here's what your solution should look like:

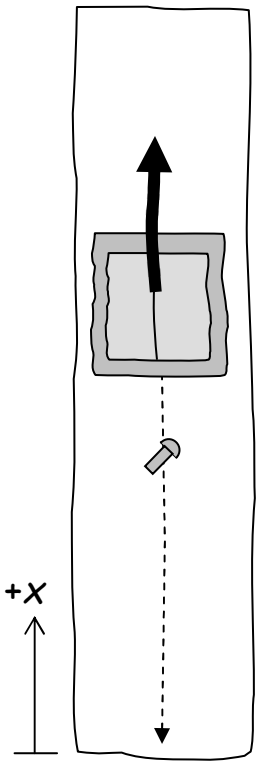
Reading: $v_0 = 5$ m/s, $t = 3$s. Looking for height "*H*".

Coordinate system: +*x* is upwards from the bottom of the shaft (as shown in my sketch).

Variables Used: In this coordinate system, we have:

$x_0 = H =$?	(our eventual answer)
$x = 0$	(the bolt stops at the *bottom* of the shaft)
$v_0 = 5$ m/s	(the starting velocity is known)
$v =$?	(the ending velocity is unknown!)
$a = -g = -9.8$ m/s^2	(acceleration for free fall)
$t = 3$ s	(ending time is given)

My Sketch



Fundamental Equation:

$$x = x_0 + v_0 t + \tfrac{1}{2}at^2 \qquad \text{[equation 2.8]}$$

Substitution of symbols (not values) from variable list:

$$0 = H + v_0 t + \tfrac{1}{2}(-g)t^2$$

After algebra:

$$\boxed{H = \tfrac{1}{2}gt^2 - v_0 t}$$ ← my ***real*** *final answer!*

Units Check:

$$H = (\text{none})\left(\frac{\text{m}}{\text{s}^2}\right)(\text{s}^2) \text{ and } \left(\frac{\text{m}}{\text{s}}\right)(\text{s}) = \text{m and } \text{m} = \text{m} \ \checkmark$$

Numeric Substitution:

$$H = (0.5)(9.8 \text{ m/s}^2)(3 \text{ s})^2 - (5 \text{ m/s})(3 \text{ s}) = 29.1 \text{ m}$$

my CAPA final answer → $\boxed{H = 29.1 \text{ m}}$

The same example as it would appear on a quiz.

On a quiz, all numeric values will be already be removed from the text and replaced with proper symbols for you. Their numeric values will be listed in a separate box. They will be different than the numbers you actually used on your CAPA assignment. Your answer will be incorrect if it includes additional symbols that you create.

As a quiz, this same problem will look like this:

4. A bolt comes loose from the bottom of an elevator that is moving upward at a speed v_0. The bolt reaches the bottom of the elevator shaft in time t. How high up h was the elevator when the bolt came loose?

$v_0 = 6$ m/s
$t = 5$ s

Your symbolic answer:

$h =$

Your numeric answer:

$h =$

The symbolic answer is worth 7 points, and the numeric answer is worth only 3 points. To create a symbolic answer, you may not substitute the actual numbers given in the box!

Note that the numbers you get on the quiz will almost always be <u>different</u> than the numbers you were given on the homework problem.

Best possible symbolic answer: $\frac{1}{2}gt^2 - v_0t$

Best possible numeric answer: **92.5 m**

Incorrect symbolic answers:

$4.9t^2 - 30$	error: used value for givens, such as g.
$\frac{1}{2}gT^2 - v_0T$	error: T and t are not equivalent.
92.5 m	error: not symbolic at all
$\frac{1}{2}gt^2 - v_0$ (m/s)t (s)	error: includes units

Incorrect numeric answers:

92.50	error: forgot units
92 m	error: not enough sig-figs.

Remember: you are NOT supposed to actually do any physics during a quiz… you are merely supposed to copy work that you already did.