

Lecture U2 Mud: Units & Vectors Review

(51 respondents)

1. *What good is dimensional analysis?* (1 student)

With dimensional analysis you can determine many useful things about a physical problem or situation before you even "solve it". Some examples:

- What units must the result have
- What is the minimum number of variables you need to describe the situation (the fewer the better!)
- What must be known to make the result applicable to other similar problems

2. *What were the F and L entered into the equation when we did the dimensional analysis?* (1 student)

F is a generic term used for any force unit (N, lb, dyne, ...). L is a generic term used for any length unit (m, ft, cm, ...). Other symbols commonly used are T for a time unit, and M for a mass unit.

3. *What is the physical meaning of the \sqrt{m} unit?* (1 student)

Non-integer units are extremely rare, and I've seen them only in fracture mechanics. I'll punt this one to fracture-guy Prof. Spearing.

4. *What are intrinsic coordinates used for?* (1 student)

Some equations of motion, such as those for an airplane or fluid particle, become conceptually clearer when expressed in intrinsic coordinates. But they are often awkward for computation because their orientation depends on the trajectory itself, which is usually unknown at the outset.

5. *Didn't cover conversion between coordinate systems.* (3 students)

Prof. Spearing will cover this in more depth on Thursday.

6. *Confused with notation for unit vectors versus coordinate axes.* (1 student)

Coordinate axes declare your chosen coordinate directions (e.g. x horizontal, y sideways, z vertical). A unit vector is a conceptual and practical way to specify a more arbitrary direction, and is denoted by 3 numbers which are its components along the chosen axes. For example, $(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0)$ points up at 45° in the x - y plane.

The unit vectors $(1,0,0)$, $(0,1,0)$, and $(0,0,1)$ are special in that they just happen to lie along the chosen coordinate axes. Sometimes these are called basis vectors of the coordinate system.

7. *Why is $u \cdot \tilde{v} = 1.1 + 0.0 = 1$, and why is $u \cdot v < 1$?* (1 student)

For the example I gave, $u = (1, 0)$ and $\tilde{v} = (1, 0)$, since both were basis vectors. So the first dot-product computation just happens to produce a numerical result of 1. But this is not a meaningful result, since the two vectors are defined in different axes. When dotting two non-parallel unit vectors, the result must clearly be in the range $-1 < u \cdot v < 1$, just from a geometry argument. To get the correct result, the dot product must be done in a common coordinate system.

8. *Will we be using non-perpendicular (non-orthogonal) coordinate systems?* (1 student)
Not in the Fluid Mechanics part of Unified. I don't know about the other parts. Non-orthogonal axes are quite a bit more complicated to deal with than orthogonal axes.
9. *Difference between moment and moment arm.* (1 student)
In the notes, the moment arm is denoted by the r vector, and has the dimensions of length. A force F , acting via a moment arm r , results in a moment M (all are vectors). The computation is done via the cross product $M = r \times F$.
10. *Cross product represents moment? What does dot product physically represent?* (1 student)
The cross product is a mathematical operation which can be used to define or compute a moment, and a vast number of other things. The dot product is another type of operation used for many things, and conceptually represents taking the component of vector 1 in the direction of vector 2, and also scaling it by the magnitude of vector 2. Or vice versa, for the same result.
11. *Didn't understand "moment of inertia".* (1 student)
This concept didn't come up.
12. *Review of moments was very brief.* (6 students)
Prof. Spearing will discuss moments in more detail on Thursday.
13. *Diagrams were hard to read.* (3 students)
We'll try to make them bigger.
14. *Good review of 8.01 stuff.* (3 students)
That's the intent.
15. *We've seen all this before. Pace much too slow.* (2 students)
It's a review.
16. *No mud.* (24 students)
Kewl.