Phys 161: Notes

These notes are not complete! Use them in conjunction with the textbook, the lectures, discussion sections, study groups and the website.

Lecture 8: Radians vs Degrees

“Ever since you studied calculus, you have been expected to measure angles in radians and not degrees. Do you know why? You have learned that \( \frac{d}{dx}(\sin x) = \cos x \). This formula is not correct – unless \( x \) is in radians. (Look up the derivation in your calculus book!) Many of the formulas you now know and use are correct only if you use radian measure; consequently, that is what you are usually advised to do. However, it is sometimes simpler to do calculations using degrees (especially when you must use a calculator, as often happens in practical work). Thus it is important to know when you can and when you cannot use degrees. You can use degrees to measure an angle and to add and subtract angles as long as the final step is to find the sine, cosine, or tangent of the resulting angle (with your calculator in degree mode) or to use tables with entries in degrees. For example, we can, if we like, say that \( \theta = 60^\circ \) instead of \( \theta = \pi/3 \). If we want to find \( \sin(\pi/3 - \pi/4) = \sin(\pi/12) = 0.2588 \) (calculator in radian mode), we can instead find \( \sin(60^\circ - 45^\circ) = \sin(15^\circ) = 0.2588 \) (calculator in degree mode). Note carefully that an angle is in radians unless the degree symbol is used; for example, in \( \sin 2 \), the 2 is 2 radians or about 115°.

In formulas, however, use radians. For example, in using infinite series, we say that \( \sin \theta \sim \theta \) for very small \( \theta \). Try this on your calculator; you will find that it is true in radian mode but not in degree mode. As another example, consider \( \int_0^1 \frac{dx}{1 + x^2} = \arctan 1 = \pi/4 = 0.785 \). Here \( \arctan 1 \) is not an angle; it is the numerical value of the integral, so the answer 45 (obtained from the calculator in degree mode) is wrong! Do not use degree mode in reading an arctan (or arcsin or arccos) unless you are finding an angle.”


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