Chapter 1 - Units, Measurements and Vectors

Physics 206

For any problems where you are given a variable/symbol and a value for that variable, make sure to solve the problem symbolically first. Your final answer should then only contain the variables that you are given values for in the problem, constants that appear on the equation sheet and numbers like 2 or π.

Problem 1 – Understanding LO's Below is a chart showing an example of a student's performance for 10 LO's across the three midterms and the comprehensive exams. How many of the LO's did they pass?

	Exam 1		Exam 2		Exam 3		Comprehensive	
LO #	Passed	Tested	Passed	Tested	Passed	Tested	Passed	Tested
1	3	5	1	3	3	4	1	3
2	0	6	3	4	2	3	3	3
3	3	4	0	5	1	2	0	0
4			4	5	5	5	1	1
5			5	7	1	2	1	3
6			1	4	5	5	2	2
7					1	6	2	4
8					5	7	2	4
9					3	6	3	3
10							2	3

Problem 2 – Understanding how to calculate your grade Below is a chart showing the earned and maximum score for an example student. Assuming that this student achieved an 82.0% for their iClicker score and their exam score was a 72%, what is the students overall grade? We are looking for the numeric score here, not the letter grade.

	Homework		Concept Quiz		Recitation		Prelecture	
Assignment #	Score	Max	Score	Max	Score	Max	Score	Max
1	8.5	10	9	10	2	2	2	4
2	11.2	12	10	10	2	2	2	3
3	9.8	10	10	10	0	2	3	3
4	11	11	8	10	Excused	2	1	2
5	11.5	12	10	10	2	2	3	3

Charts of common variables from this class and constants from this class and other physics courses and their units are below. These will be used for problems 3-6. Some SI units are derived units that have a special name. A chart of their equivalents is also below.

Common variables

Symbol	Unit
x, y, h, d	m
t	s
m	kg
v	m/s
a	$\mathrm{m/s^2}$
F	N
U, K, W	J
P	W
p	$\frac{\mathrm{kg\cdot m}}{\mathrm{s}}$
I	$\mathrm{kg\cdot m^2}$

Universal Constants

Symbol	Unit
g	$\frac{\mathrm{m}}{\mathrm{s^2}}$
G	$\frac{\mathrm{N\cdot m^2}}{\mathrm{kg^2}}$
c	$\frac{\mathrm{m}}{\mathrm{s}}$
$\hbar$	J·s

Named units

Named Unit	Equivalent
N	$\frac{\mathrm{kg\cdot m}}{\mathrm{s^2}}$
J	$\frac{\mathrm{kg\cdot m^2}}{\mathrm{s^2}}$
W	$\frac{\mathrm{kg\cdot m^2}}{\mathrm{s^3}}$

Problem 3 Show whether or not the following formulae are dimensionally consistent?

(a) $h = \dfrac{g(gt^2 - 2vt)^2}{8(v - gt)^2}$

(b) $t = \dfrac{y}{v} - \dfrac{gt^2}{2v} - \dfrac{g^2 t}{2va}$

(c) $t = \dfrac{v \sin\theta + \sqrt{v^2 \sin^2\theta + 2gy}}{g}$

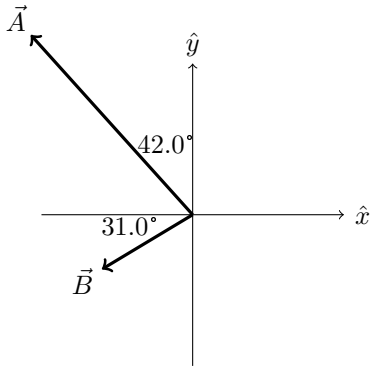
(d) $K = (k\Delta x - mg\Delta x \sin\alpha)\cos^2\alpha$ where k has units of $\dfrac{\text{N}}{\text{m}}$

Problem 4 You are told that a variable α has the same units as I, β has the same units as p, γ has the same units as a and κ is dimensionless. You also know that $\kappa\alpha^m\beta^n\gamma^p$ has units of volume (m^3). What do m, n and p have to be?

Problem 5 Repeat the previous problem except that $\kappa\alpha^m\beta^n\gamma^p$ has units of velocity (m/s).

Problem 6 If you were told that $\kappa G^m c^n \hbar^p$ has units of length (m), what are m, n and p.

Problem 7 Vectors $\vec{A}$ and $\vec{B}$ have magnitudes of 16.0 and 7.00 units respectively and their directions are shown in the diagram below. Vector $\vec{C} = 3\vec{B} - \vec{A}$.
(a) What is $\vec{C}$?
(b) What is the magnitude of $\vec{C}$ and at what angle is it pointing as measured counterclockwise from the $+x$-axis?



Problem 8 The scalar product of vectors $\vec{A}$ and $\vec{B}$ is +48.0 m^2. $\vec{A}$ has a magnitude of 9.00 m and is pointing 28 degrees west of south. $\vec{B}$ has a direction of 39 degrees south of east. What is the magnitude of $\vec{B}$?

Problem 9 There are two vectors, $\vec{A}$ with a magnitude of 4 and $\vec{B}$ with a magnitude of 3. (Treat each of these parts as completely unrelated to the others. Each part is a completely different situation except the magnitudes of $\vec{A}$ and $\vec{B}$.)
(a) The dot product between these two vectors is -11.0. What is the magnitude of the cross product between them?
(b) The vector product is $\vec{A} \times \vec{B} = -3.00\hat{\jmath} + 4.00\hat{k}$. What is the angle between the two vectors?
(c) The magnitude of the cross product between these two vectors is 8.92. What is the dot product between them?

Problem 10 The dot product between two vectors is -14.5 and the magnitude of the cross product between those two vectors is 22.2. What is the angle between these two vectors?

Problem 11 On the left below are four vectors. On the right are a series of scalar and vector products to calculate.

$\vec{A} = 4.00\hat{\imath} + 7.00\hat{\jmath}$
$\vec{B} = 5.00\hat{\jmath} - 2.00\hat{k}$
$\vec{C} = -1.00\hat{\imath} - 3.00\hat{\jmath} + 6.00\hat{k}$
$\vec{D} = 3.00\vec{A} - 4.00\vec{B}$

(a) $\vec{A} \cdot \vec{B}$ and $\vec{A} \times \vec{B}$
(b) $\vec{C} \cdot \vec{A}$ and $\vec{C} \times \vec{A}$
(c) $\vec{D} \cdot \vec{B}$ and $\vec{D} \times \vec{B}$
(d) $\vec{C} \cdot \vec{D}$ and $\vec{C} \times \vec{D}$