PHYS-1050-01,02 Exam 1 review guide

Chapter 1 - Introduction, measurement, estimating

Unit conversion - be able to convert units, including if units are in numerator (e.g. m) or denominator (e.g. s^{-1}), and if units have a power (e.g. ft^3).
Significant figures - for adding, keep the number of decimal places as the number that has the fewest; for multiplying, keep the number of significant figures as the number that has the fewest.
Percent error - error divided by number times 100%.
Scientific notation - know how to use it (e.g $1.4x10^5$).
Accuracy vs. precision - accuracy is correctness, precision is repeatability.
SI system - know the prefixes, from 10^{-9} to 10^9 (nano, micro, milli, kilo, mega, giga). The important base units for this class are m, kg, and s
Order of magnitude - goal is to provide a rough estimate. This is a useful skill but not one that will be tested.
Dimensional analysis - understand "dimension math" in which dimensions (e.g. m/s and kg, also written as [L/T] and [M], respectively) are manipulated. Rules: dimensions must be equal for adding and subtracting; dimensions are combined for multiplying and dividing; dimensions must be unitless for exponents and logs; dimensions must be angles for sines, cosines, and tangents.

Chapter 2 - Describing motion: kinematics in one dimension

Velocity - change of position with time. Units are m/s. Average velocity: $v_{average} = \Delta x/\Delta t$. Instantaneous velocity is the same thing but in the limit of short time interval. Written in calculus as $v = dx/dt$. Velocity is slope of position-time graph. Position is area (integral) of velocity-time graph.
Speed is magnitude (absolute value) of velocity.
Constant velocity - position changes linearly over time; slope depends on the velocity. Equation for position is $x = x_0 + vt$.
Acceleration - change of velocity with time. Units are m/s^2. Average acceleration: $a_{average} = \Delta v/\Delta t$. Instantaneous acceleration is the same thing but in the limit of short time interval. Written in calculus as $a = dv/dt$. Acceleration is slope of velocity-time graph. Velocity is area (integral) of acceleration-time graph.
Deceleration - is negative acceleration.
Constant acceleration - velocity changes linearly over time; slope depends on the acceleration. Equation for velocity is $v = v_0 + at$. Equation for position is $x = x_0 + v_0t + at^2/2$. Can also relate velocity to position: $v^2 = v_0^2 + 2a(x-x_0)$. The average velocity is $v_{average} = (v_0+v)/2$.
Falling objects - This is constant acceleration with $a = -g = -9.81\ m/s^2$. Acceleration is the same for all objects, independent of their mass.
You should be able to read, sketch, and understand position-time, velocity-time, and acceleration-time graphs.

Chapter 3 - Kinematics in two dimensions; vectors

Vectors - three representations: picture of an arrow, *length* & *angle*, and x & y. Length is also called magnitude and is shown as |**v**|, where **v** is the vector.
Scalar - just a number (i.e. not a vector).
Convert from *length* & *angle* to x & y: $x = length*\cos(angle)$, $y = length*\sin(angle)$.
Convert from x & y to *length* & *angle*: $length = (x^2 + y^2)^{1/2}$, $angle = \text{Atan}(y/x)$; however, you need to add 180° if x is negative. Always draw a picture and make sure that the calculated values are reasonable.
Adding vectors - don't add magnitudes. In picture, add using tail to tip method. In x & y representation, add x components and y components separately. Often you need to convert from *length* & *angle* to x & y, then add, and then convert back.
Multiplying vectors by scalars - if in *length* & *angle*, then multiply *length* by the scalar. If in x & y, then multiply both x and y by the scalar.
Subtracting vectors - easiest to multiply by -1 and then add.
Projectile motion - x and y components of object's motion are independent, but have shared time values. The x component has constant velocity, zero acceleration. The y component has constant downward acceleration from gravity. Often, solve on one axis to get a time value, and then use this time to get the desired solution on the other axis.
Projectile motion equations - same as before but extra notation. On x: $x = x_0 + v_{0x}t$. On y: $y = y_0 + v_{0y}t + a_y t^2/2$.
Relative velocity - total velocity is sum of multiple velocity vectors, e.g. rowing velocity, river velocity, train velocity, etc. Add vectors to find total velocity, or subtract vectors to compute one of the components from the total velocity and other components.

Equations - following are all of the important equations from chapters 1 to 3
You will be given these for the exam (but formatted slightly more nicely).

$v_{average} = \Delta x/\Delta t$
$v = dx/dt$
$x = x_0 + vt$
$a_{average} = \Delta v/\Delta t$
$a = dv/dt$
$v = v_0 + at$
$x = x_0 + v_0 t + at^2/2$
$v^2 = v_0^2 + 2a(x-x_0)$
$v_{average} = (v_0+v)/2$
$x = length*\cos(angle)$
$y = length*\sin(angle)$
$length = (x^2 + y^2)^{1/2}$
$angle = \text{Atan}(y/x)$ (+180°?)
$x = x_0 + v_{0x}t$
$y = y_0 + v_{0y}t + a_y t^2/2$