STUDY GUIDE SECOND QUARTER QUIZ *(Date = 12-15-06)*

aka **FUNDAMENTAL /CRITICAL RELATIONSHIPS / CONCEPTS OF INTRODUCTORY PHYSICS (*to date*)**

Prior to utilizing this document the student should be fluent in all POD's & WOD's assigned to date. This recommendation notwithstanding, there may be problems on the quiz/test, which cover salient points of PSII, not directly highlighted herein.

1. **Scalar Quantities** – Those requiring only magnitude for sufficient description.

2. **Vector Quantities** – Those requiring magnitude and direction for sufficient description.

3. **Basic SI (*System International*) Units** are **Meters, Kilograms, Seconds** and fluency with the **Factor Label Method** of units conversion and solution arrangement. See reference links page for further information.

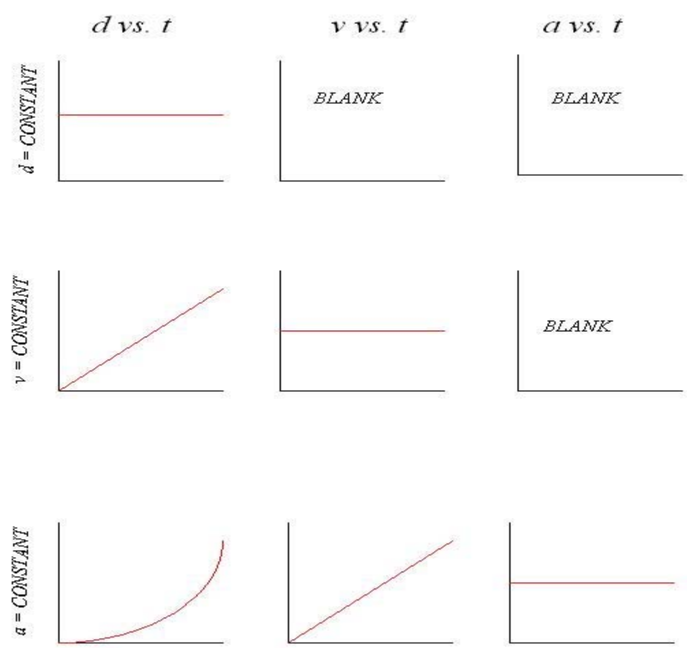
4. **Average Speed** (*or Velocity if direction is constant and distance equals displacement*) = $\mathbf{V_{AVG}}$ **= [Total Distance] / [Total Time]** = [Δd / Δt] {***Not generally the average of the speeds or velocities.***}

5. **Velocity** = Speed with a specific direction = Rate of change of displacement = V = [Δd / Δt]. **Note also that the slope of a displacement versus time graph is equivalent to the associated velocity for the involved object.**

6. **Acceleration** = a = Rate of change of Velocity = $\Delta V/\Delta t = (V_f - V_i) / \Delta t$ (*From this one can rearrange to get* $V_f = V_i + a(\Delta t)$ *or when* $V_i = 0$ *then* $V_f = a(\Delta t)$ *assuming* a *is constant.*) **Note also that the slope of a velocity versus time graph is equivalent to the associated acceleration for the involved object.**

7. When **acceleration is constant**, average Velocity = $\mathbf{V_{AVG} = [V_f + V_i] / 2}$

8. Position/Displacement, Velocity & Acceleration Graphs as follows:



9. The area under a velocity versus time graph is equivalent to the displacement of the object.

10. Newton's Three Laws of Motion are:

    I. All bodies will stay in motion (*at constant velocity*) or at rest, unless acted upon by an outside force - *aka* the **Law of Inertia**.
    II. The acceleration of an object is directly proportional to the Force applied and inversely proportional to its Mass - *aka* F = ma.
    III. For every action force there is an equal and opposite reaction force – ***aka* a force pair**. Each of these forces, of the force pair, acts on a different object.

11. **F**orce = (mass) x (acceleration), especially **$\Sigma F = (m)(a)$** => *aka* Newton's Second Law of Motion. It says that the sum of the forces on any object (*i.e. the net force*) is equal to the mass times the acceleration of the object (in Newtons) – where *one* Newton = an acceleration of *one* [Meter / s^2] times a mass of *one* [Kilogram].

12. **W**eight Force = (mass) x (acceleration of gravity) = (m) (g) = (m) $\left|(-9.81 \text{ meters/s}^2)\right|$ in Newtons.

13. **Newton's Law of Gravitation**: Force between two objects is proportional to the product of their masses and inversely proportional to the square of the distance between them.

14. **Kinematics** (*a.k.a. Equations of Motion -for Constant **a***) **Summary** - The following equations, for motion of an object (*that has an initial velocity of zero*) in *one direction* are provided below; where "**V**" represents velocity, "**a**" represents a constant acceleration, "**delta D**" represents the total displacement, "**delta t**" represents the change in time, subscript "**i**" represents the associated initial parameter, "**f**" represents the associated final parameter, subscript "**AVG**" means average – all in that *one direction*.

$$V_{AVG} = [\text{Total Distance / Total Time}]$$

$$V_{AVG} = [V_f + V_i]/2 \ (\textit{for constant } \text{"}\mathbf{a}\text{"})$$

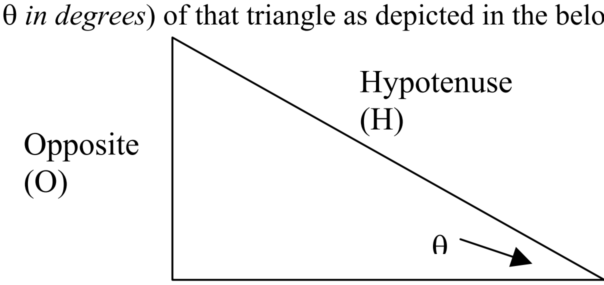
$$\mathbf{a} = [\Delta V / \Delta t] = (V_f - V_i) / \Delta t$$

$$V_f = V_i + (\mathbf{a})(\Delta t)$$

$$\Delta D = V_i(\Delta t) + (1/2)(\mathbf{a})(\Delta t)^2$$

15. **Right Triangle Trigonometry for "<u>Vector</u>" Analysis** (*i.e. for the below pictured Right "Vector" Triangle*) the following information applies:

    OPPOSITE, ADJACENT, HYPOTENUSE – Sides of a right triangle in relationship to one of the acute angles (*e.g.* θ *in degrees*) of that triangle as depicted in the below figure;



Adjacent (A)

In this regard the following information applies: $\text{Sin}(\theta) = O/H$, $\text{Cos}(\theta) = A/H$, $\text{Tan}(\theta) = O/A$ & $\text{Sin}^{-1}(O/H) = \theta$, $\text{Cos}^{-1}(A/H) = \theta$, $\text{Tan}^{-1}(O/A) = \theta$.

16. **Work** = $\text{Force}_{\parallel}$ x Displacement = [$F_{\parallel}$] [Δd] (*Where the Force is in parallel with the direction of the displacement*.)

17. **Energy is the ability to do Work**. The units of Energy & Work are **Joules**.

18. **Potential Energy** due to height = $(m)(g)(\Delta h)$. **Kinetic Energy** due to velocity = $\frac{1}{2}(m)(V^2)$.

19. **Power** = [Work / Δt] = [Energy / Δt]. **Units of Power** are Joules per Second or **Watts**. Alternatively Power times time equals Energy.

21. **Conservation of Energy**: Energy output of any given process cannot exceed the energy input to that process. Efficiency (η) of any machine or process = (Work Out)/(Work In) x 100% = (Energy Out)/(Energy In) x 100%, and is always less than "1" unless an ideal machine or process is involved.