

“YOUR PSII “FINAL” STUDY GUIDE”

aka FUNDAMENTAL /CRITICAL RELATIONSHIPS / CONCEPTS OF INTRODUCTORY PHYSICS

This document is a recommended Final Exam Study **Guide**. This recommendation notwithstanding, there may be problems on the final exam, 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, Newtons, Joules, Watts, Volts, Amps, Ohms, Hertz = 1 Cycle/Sec.
4. Average Speed (or *Velocity if direction is constant and distance equals displacement*) = $V_{AVG} = [\text{Total Distance}] / [\text{Total Time}] = [\Delta d / \Delta t]$ {*Not generally the average of the speeds or velocities.*}
5. Velocity = Speed with a specific direction = Rate of change of displacement = $V = [\Delta d / \Delta t]$
6. Acceleration = \mathbf{a} = Rate of change of Velocity = $\Delta V / \Delta t = (V_f - V_i) / \Delta t$ (*From this one can rearrange to get $V_f = V_i + \mathbf{a}(\Delta t)$ or when $V_i = 0$ then $V_f = \mathbf{a}(\Delta t)$ assuming \mathbf{a} is constant.*)
7. When acceleration is constant, average Velocity = $V_{AVG} = [V_f + V_i] / 2$
8. Force = (mass) x (acceleration), especially $\Sigma F = (m)(\mathbf{a})$ – a.k.a. 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.
9. Weight Force = (mass) x (acceleration of gravity) = $(m)(g) = (m)(9.81 \text{ meters/s}^2)$
10. Coefficient of Friction (*unit-less*) = μ (*mu*) = F_f / F_N = Friction Force divided by the Normal Force which is generally less than “1”.
11. Hooke’s Law or Force due to a Spring: $F_s = -(k)(x)$, where “ F_s ” is the force due to the spring due to its tension (*stretch*) or compression, “ k ” is the Spring characteristic in Newtons per Meter and “ x ” is the displacement (*stretch or compression*) of the Spring.
12. 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. Newton’s Three Laws of Motion are:
 - (1) All bodies will stay in motion (*at constant velocity*) or at rest, unless acted upon by an outside force - a.k.a the Law of Inertia.
 - (2) The acceleration of an object is directly proportional to the Force applied and inversely proportional to its Mass - a.k.a. $F = ma$.
 - (3) For every action force there is an equal and opposite reaction force – a.k.a a force pair. Each of these forces, of the force pair, acts on a different object.

13. Momentum = $P = (m)(V)$ = mass times velocity. In the absence of external forces momentum of a system is conserved, e.g. P_i (*Initial Momentum before a collision*) = P_f (*Final Momentum after a collision*).
14. Impulse, Change in Momentum: $(\text{Force})(\Delta t) = m(\Delta V) = \Delta P$.
15. Work = Force_{||} x Displacement = $[F_{||}] [\Delta d]$ (*Where the Force is in parallel with the direction of the displacement.*)
16. Conservation of Energy: Energy output of any given process cannot exceed the energy input to that process. Efficiency (η) of any machine or process = $(\text{Work Out})/(\text{Work In}) \times 100\% = (\text{Energy Out})/(\text{Energy In}) \times 100\%$, and is always less than “1” unless an ideal machine or process is involved.
17. Energy is the ability to do Work. The units of Energy & Work are Joules.
18. Potential Energy due to height = $(m)(g)(h)$. Kinetic Energy due to velocity = $\frac{1}{2}(m)(V^2)$.
19. Power = $[\text{Work} / \Delta t] = [\text{Energy} / \Delta t]$. Units of Power are Joules per Second or Watts. Alternatively Power times time equals Energy.
20. Mechanical Advantage of a simple machine = F_o/F_i = Output Force divided by the Input Force.
21. Lever Torque: $(F_i)(L_i) = (F_o)(L_o)$. Input Force times Input Lever Length = Output Force times Output Lever Length, where both forces are perpendicular to their respective lever arms. As such, the Mechanical Advantage of a Lever = $(L_i)/(L_o)$. The point about which a lever rotates is called the fulcrum.
22. Fundamental Characteristic of Electric Charges: Like Charges Repel & Unlike Charges Attract.
23. Ohm’s Law: $V = (I)(R)$. Voltage = Current x Resistance. Voltage (*in Volts*) is an amount of Joules of Energy needed to move 1 Coulomb of charge through an electrical load. Current is an amount of Coulombs per Second (*a.k.a. Amperes*) traveling in a conductor. Conductors are those materials (*such as metals – Copper, Aluminum, Iron Alloys, etc.*) which carry current with little difficulty. Insulators are those materials (*such as dry wood, glass, rubber & plastics*) that greatly resist the conduction of current. Mechanical (fluid system) analogies are: Voltage => Pressure & Current = Fluid Flow. The student should be able to identify (*or sketch*) schematic representations of batteries, ammeters, voltmeters, wires & AC voltage sources - *and* - parallel or series circuits consisting of same.
24. KVL: Kirchoff’s Voltage Law => The Sum of the Voltage Increases minus the Sum of the Voltage Drops around any single circuit loop equals zero. Series circuits are those circuits where circuit elements (*such as resistors*) are “in series” with the voltage source (*e.g. batteries*).
25. KCL: Kirchoff’s Current Law => The Sum of the Current Inputs to any given current node (*junction*) is equivalent to the Sum of the Current Outputs of that node. Parallel circuits are those circuits where circuit elements (*such as resistors*) are “in parallel” with the voltage source (*e.g. batteries*). All household circuits are wired in parallel with the utility voltage source.
26. Electrical Power, $P = (V)(I)$: Power in Watts = (Voltage) x (Current).

27. Fundamental Characteristic of Magnets: Like Poles Repel & Unlike Poles Attract. Changing the poles, from North to South, or vice-versa, can be changed in Electro-Magnets, by changing the current direction in the Electro-Magnet. In electric motors this is done via the commutator.
28. Turns Ratio of a Transformer and therefore the Step-Up or Step-Down Voltage Ratio of that Transformer = V_s/V_p = AC Voltage of Secondary Side of Transformer divided by the AC Voltage of the Primary Side of the Transformer.
29. Period of Harmonic Motion = T in Seconds per Cycle. Frequency of Harmonic Motion = $f = [1/T]$ in Cycles per Second. One Cycle per Second = One Hertz (hz).
30. Speed of a Wave (v), for either a *Transverse* or *Longitudinal* wave, which is considered constant for a given medium, equals the Wavelength λ times the Frequency (f) of the wave. $v = \lambda f$
31. Speed of electromagnetic waves in space = c, the speed of light = 3×10^8 M/Sec. The speed of light is believed to be the maximum speed attainable by anything and is additionally believed to be constant for all frames of reference.
32. The waves of the electromagnetic wave spectrum, from ***Low Energy, Low Frequency, High Wavelength*** to ***High Energy, High Frequency, Low Wavelength*** are ***Radio, Microwave, Infrared, Visible, Uv, X-ray & Gamma***.
33. The waves of the visible portion of the electromagnetic wave spectrum, from ***Low Energy Low Frequency, High Wavelength*** to ***High Energy, High Frequency, Low Wavelength***, are ***Red, Orange, Yellow, Green, Blue & Violet***.
34. It is believed (*by many scientists*) that the main cause of “Global Warming” is excess production of CO₂ due to combustion of “Fossil Fuels” – which tends to cause a “Green-House” affect. All things “organic” will eventually decompose to CO₂ – via the combustion reaction $CH_x + O_2 \Rightarrow CO_2 + H_2O$ - the problem is that stores of ancient organics (*Fossil Fuels – oil, gas, & coal*) are now being added to the atmospheric mix.
35. The “Ozone Layer”, in the upper atmosphere, protects Earth life from certain harmful energies of the Sun. The “Ozone Layer” can be damaged by a chemical reaction with Chlorofluorocarbons (*CFC's*), which for many years were used as refrigerants and spray can propellants. Existing damage to the Ozone Layer has come to be known as the “Ozone-Hole”.
35. Transverse waves are those waves wherein the physical motion of the involved physical material is perpendicular to the direction of the energy flow.
36. Longitudinal waves involve the movement of both the energy and the physical material (*partially/temporarily*) in the same direction.
37. The student should be able to define/sketch the Amplitude, Wavelength, Crests, and Troughs of a transverse wave and the Wavelength, Compressions & Rarefactions of a Longitudinal Wave.
38. The student should be able understand when waves are “In Phase” or “Out of Phase” and the concepts of Constructive and Destructive interference between waves.

39. Sound Waves are Longitudinal. Also, because of the relationship between the subjective sensation of **Loudness** and the physically measurable quantity **Intensity** (*Power per unit area*), physicists specify sound **Loudness** levels on a logarithmic scale. The unit on this scale is a Bel (*after Alexander Graham Bell*) or more commonly a Decibel ($dB = 0.1 \text{ Bel}$). The **Loudness** level β (*in dB*) of any sound is defined in terms of its (*Power/Area*) **Intensity I**, as follows:

$$\beta \text{ (in dB)} = 10 \log [I/I_0]$$

Where I_0 is the **Intensity** of a reference level usually the taken to be the threshold of hearing which is $1 \times 10^{-12} \text{ W/M}^2$.

40. For any given vibratory activity, the student should be able to define “Natural Frequency”, “Resonance” & “Harmonics”. Further, given a “Harmonic” frequency, or any integer multiple thereof, the student should be able identify/calculate any other desired harmonic.