Conservation Laws:

Law	Quantity conserved
Conservation of momentum	Momentum
Conservation of energy	Energy
Kirchoff's current law	Charge
Kirchoff's voltage law	Energy
Lenz's law	Energy
Strangeness, baryon number, charge	Strangeness, baryon number, charge

Chapter 2 and 6

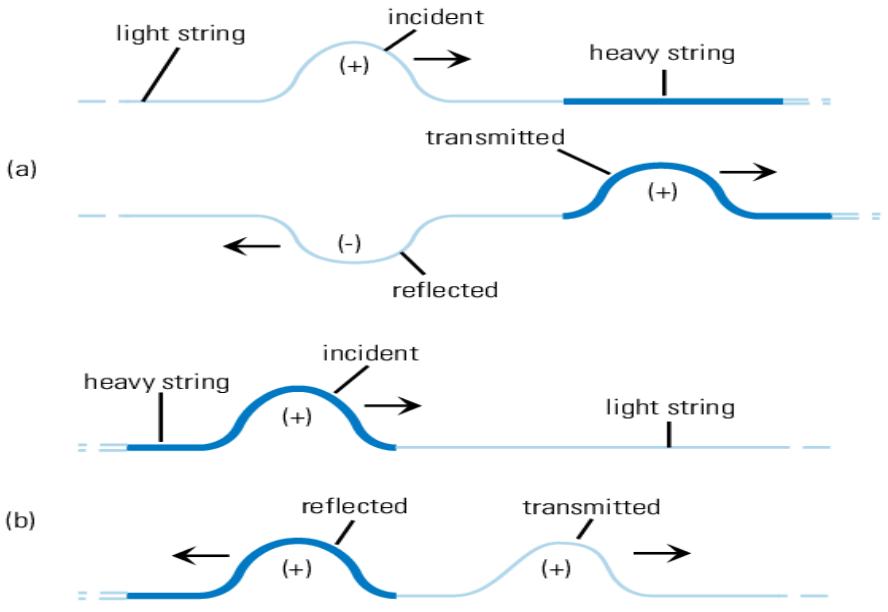
1. Pendulum in a train
2. Elevator Questions
3. Sliding down
4. Spring questions
5. Blocks in contact (Horizontal and Vertical)
6. Tension is minimal at the top of vertical circular motion
7. Area under a-t graph gives change in velocity
8. MOMENTUM IS ALWAYS CONSERVED [Inelastic and elastic is with respect to conservation of energy]

Chapter 3

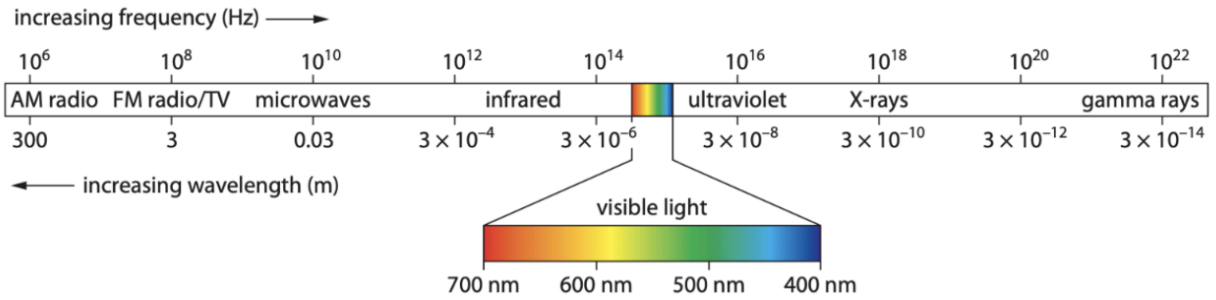
- One atomic mass unit is one twelfth of the mass of one Carbon-12 atom
- Area under P-V graph gives work done on the gas

Chapter 4 and 9

- N (refractive index) is inversely proportional to wavelength
- Fixed End → Pulse inverts, Free End → Pulse reflects

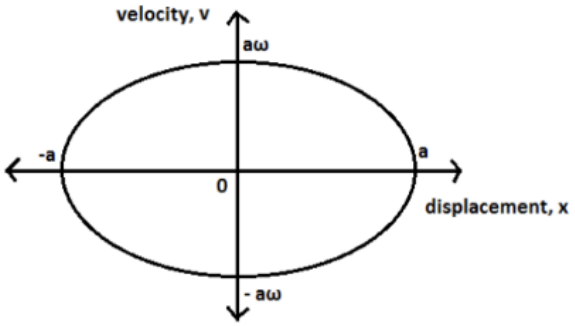


- Orders of magnitude for wavelength (MEMORIZE)



- Two waves are said to be coherent if the phase difference between sources remains constant as time goes on (frequency is constant)
- In the case of standing waves, only two phase differences are possible. Either the phase difference between two particles can be zero or it can be pi.
- Longitudinal waves including sound waves, the point in the middle of the compression is called the antinode, the point in the middle of the rarefactions is called the node.
- Longitudinal waves on the displacement/distance graph:
    - Crossing + to − is a compression,
    - Crossing − to + is a rarefaction.

- Number of slits increases - narrower, sharper, brighter (central maxima)
- Slit width increases - diffraction pattern becomes narrower, intensity increases (brighter central maxima)
- Distance between slits increases - width of fringes decreases,
- Distance between slit and screen increases - diffraction pattern expands (distance between fringes increases), intensity of maxima decreases (LIKE A PROJECTOR AND A SCREEN)
- To increase likelihood of resolution (Rayleigh's criterion must decrease)
    - Reduce wavelength of light or increase diameter of resolving instrument
- V-x graph for simple harmonic motion



    - Purpose of thin-film interference: Reduces reflection of light, more energy transferred to sensors, cameras, optical system for a given thickness of coating or for a given wavelength
    - Circular Doppler Effect → Frequency is maximum/minimum when the velocity (tangent to the circle) is directly facing the observer

Chapter 5, 10 and 11

- Linking more flux from the primary to the secondary energy core reduces energy loss in a transformer
- Using a laminated core reduces eddy currents
- Why are transformers not ideal?
    - Eddy current heating
    - Flux leakage
    - Joule heating

    - Magnetic hysteresis
- How does an AC generator work:
    - Coil cuts magnetic field lines between magnet
    - As coil rotates, there is a changing magnetic flux through the coil as the number of field lines through the coil changes
    - This induces a sinusoidal EMF in the coil (direction opposes the changing flux to account for energy conservation: Lenz' law)
- Capacitor Circuit Questions - Label each plate as a number and figure out which other plate it is connected to to simplify the circuit diagram
- For parallel circuits:
    - Voltage constant
    - Current splits
    - Charge on capacitor different
- For series circuits:
    - Voltage splits
    - Current constant
    - Charge on capacitor same
- Time constant definition: Time needed for the charge on a capacitor to decrease to 37% of its original value during discharge
- Gravitational Potential Energy questions - Work done is negative of change in potential energy

Chapter 7 and 12

- GWES (Gravity < Weak < Electromagnetic < Strong)
- Radioactive decay is **random** (cannot predict which nucleus will decay) and **spontaneous** (cannot affect rate of decay)
- Long half lives → only mass of sample is required to deduce half life
- Strangeness can be violated in weak nuclear interactions
- Higher temperatures - Emission spectrum; Lower temperature - Absorption Spectrum
- Rutherford Scattering - High energy alpha particles and nucleus with low atomic number
- Neutron number vs Proton number -> Short-range nature of the strong nuclear force
- Decay constant - the probability per unit time that a given nucleus will decay
- Gamma Decay → Proof for Energy levels in an atom
- Photoelectric Effect → Wave theory of light
    - Intensity → increases number of electrons emitted (energy stays constant)
    - Frequency → increases the energy of electrons (number decreases)
- Electric current decreases as light frequency increases provided INTENSITY IS CONSTANT (the kinetic energy of electrons increases). Electric current increases with light amplitude (intensity)
- Wavelength is inversely proportional to square root of Voltage/Kinetic energy
- Electron Diffraction → Matter waves
- Beta and neutrino → continuous spectrum, Alpha and gamma → Discrete
- Beta minus decay - antineutrino
- Electron Capture Feynman Diagram
- Whenever energy releases, binding energy per nucleon increases
- Quark Confinement → Quarks cannot be isolated because energy given to nucleon creates other particles than freeing quarks
- **Discuss the reasons why physicists developed a theory that involved quarks.**
    - quark theory is simpler OR Occam's razor example OR simple model explains complex observations
    - quotes experiment that led to quark theory, eg deep inelastic scattering or electron scattering
    - model incorporates strong/weak interactions/forces between protons and neutrons
    - model incorporates conservation rules
    - model explains differences between neutrons and protons OR explains decay of neutron to proton

- Reason Rutherford's model was wrong: Electrons accelerate and radiate energy -> expected to collapse to the nucleus -> Bohr's quantised angular momentum shows that at a given energy level electrons don't radiate
- **Pair production: Photon produces particle anti-particle pair with a nearby nucleus**
    - **Particle and anti-particle move in opposite directions to conserve momentum**
    - **Minimum energy of photon is the total rest-mass energy of particle and anti-particle**
- **Pair annihilation: When a particle and anti-particle collide to form two photons**
    - **Photons move in opposite direction to conserve momentum**
    - **Minimum energy of a photon is equal to the energy of one of the interacting particles**

Chapter 8

- Definition of solar constant - Intensity of the sun's radiation at a distance of 1 AU: the average distance between the earth and sun
- $I_{av} = \frac{(1-\alpha)\,S}{4}$
- Why should an average value be used for solar constant?
    - The Sun's output varies during its 11 year cycle
    - The Earth is in elliptical orbit around the sun
- Albedo is only concerned with SOLAR Radiation - Re-radiated values can be ignored
- **Function of moderator: Absorb neutrons and slow them down (increases probability of fission)**
    - **Moderator heats up during collision so a heat exchanger is required**
- **Function of control rod: Increases or decreases number of neutrons**
    - **If there are too many neutrons energy released will be too high**
    - **If there are too few neutrons, the fission reaction won't start**
- **Global warming/Greenhouse effect: When a greenhouse gas absorbs infra-red radiation radiated from the earth and re-radiates it in all directions (even to the earth)**
    - **The nuclear energy gap is equal to that of the energy of an infra-red photon so when the nucleus returns from excited to the ground state, an infra-red photon is emitted**

Astrophysics

Parallax angle → the angle at which the star subtends 1AU (any question related to this, draw diagram)
CMBR → Black-body radiation at temperature 2.67K, filling the universe, isotropic, radiation released during the Big Bang
Cosmic Scale Factor (R) → parameter that describes the expansion of the universe
Neutron capture → elements with higher mass numbers, series of beta decays to increase atomic number
IF ASKED FOR A COMPARISON BETWEEN TWO QUANTITIES, FIND THE RATIO (Do not waste time calculating them individually)