

## MCAT Physics Study List

### Mechanics: Translational Motion, Force, Momentum, Work and Energy

#### A. Translational Motion

1. Vector arithmetic
2. Speed, velocity, acceleration
3. Projectile motion

#### B. Force

1. Mass and weight
2. Center of mass
3. Newton's three laws
4. Concept of a field
5. Law of gravitation ( $F = Gm_1m_2/r^2$ )
6. Centripetal force and circular motion ( $F=mv^2/r$ )
7. Torques
8. Friction, static and kinetic
9. Analysis of pulley systems
10. Equilibrium

#### C. Momentum

1. Momentum =  $mv$
2. Impulse =  $Ft$
3. Conservation of linear momentum
4. Elastic and inelastic collisions

#### D. Work and Energy

1. Work
2. Kinetic energy:  $KE = 1/2 mv^2$ ; units
3. Potential energy
  - a.  $PE = mgh$  (gravitational, local)
  - b.  $PE = 1/2 kx^2$  (spring)
  - c.  $PE = -GmM/r$  (gravitational, general)
4. Conservation of energy
5. Conservative and non-conservative forces
6. Power

### Waves and Periodic Motion

1. Wave characteristics – transverse vs. longitudinal, wavelength, frequency, velocity in different media, amplitude, intensity (log scale), phase
2. Supposition of waves, interference
3. Hooke's law, force  $F = -kx$
4. Simple harmonic motion

5. Resonance
6. Standing waves, nodes, harmonics
7. Beat frequencies
8. Refraction and diffraction
9. Doppler effect

### **Fluids and Solids**

#### *A. Fluids*

1. Density, specific gravity
2. Buoyancy, Archimedes' principle
3. Hydrostatic pressure
4. Ideal and non-ideal fluids
5. Continuity equation ( $A \cdot v = \text{constant}$ )
6. Concept of turbulence at high velocities
7. Surface tension
8. Bernoulli's equation

#### *B. Solids*

1. Density
2. Elastic properties (elementary properties)
3. Thermal expansion coefficient
4. Shear
5. Compression

### **Electricity and Magnetism**

#### *A. Electrostatics*

1. Charge, charge conservation
2. Coulomb's law:  $F = kq_1q_2/r^2$
3. Electric field and electric potential
4. Electric dipole: aligns with applied electric field, has potential  $U = -pE \cos \theta$

#### *B. Magnetism*

1. Force on individual charged particles moving in magnetic field
2. Force on a current in magnetic field
3. General concepts of sources of the magnetic field
4. Nature of solenoid
5. Magnetic field induced by current in straight wire and other simple configurations
6. Relationship between E and B

#### *C. Electronic Circuits*

1. Current  $I = dQ/dt$ , sign conventions, units
2. Battery, electromotive force, voltage
3. Terminal potential, internal resistance of battery

4. Resistivity and resistance, series and parallel
5. Capacitors
6. Power
7. Alternating currents

### **Light and Geometrical Optics**

#### *A. Light*

1. Light as an electromagnetic radiation
2. Concept of interference; Young double slit experiment
3. Thin films, diffraction grating, single slit diffraction
4. Polarization of light

#### *B. Geometrical Optics*

1. Reflection, refraction, dispersion
2. Spherical mirrors
  - a. Center of curvature
  - b. Focal length
  - c. Real and virtual images
3. Thin lenses
  - a. Converging and diverging lenses
  - b. Use of formula  $1/d_o + 1/d_i = 1/f$ , with sign conventions
  - c. Lens strength, diopters
4. Combination of lenses and mirrors
5. Ray tracing

### **Atomic and Nuclear Structure**

1. Quantized electron energy levels and the corresponding atomic emission spectra
2. Atomic number, atomic weight
3. Neutrons, protons, isotopes
4. Binding energy
5. Nuclear forces
6. Radioactive decay:  $\alpha$ ,  $\beta$ ,  $\gamma$ , half-life, exponential decay, semi-log plots
7. General nature of fission
8. General nature of fusion
9. Mass deficit, energy liberated