**Equations of Physics for ISP 209**

**Mechanics**

⊙ Newton's second law

force = mass x acceleration

$F = ma$ or $a = F/m$

The unit of force is the Newton (N).

⊙ Mass and Weight

weight = mass x acceleration due to gravity

$W = mg$

Weight is a force (the force due to gravity) so the unit of weight is the Newton (N).

⊙ Velocity of an object experiencing constant acceleration

present velocity = initial velocity + acceleration x time

$v = v_0 + at$

The unit of velocity is m/s.
The unit of acceleration is $m/s^2$.

⊙ Position (or, coordinate) of an object experiencing constant acceleration

present position = initial position + initial velocity x time + 0.5 acceleration x time squared

$x = x_0 + v_{t0} + \frac{1}{2}at^2$

The unit of distance is the meter (m).

⊙ Definition of Work

work = force x distance

$W = F(\Delta x)$

The unit of work is the joule (J); 1 J = 1 N m.

⊙ Gravitational potential energy

gravitational potential energy = mass x acceleration due to gravity x height

$U = mgh$

The unit of energy is the joule (J).

⊙ Linear momentum

momentum = mass x velocity

$p = mv$

⊙ Kinetic energy

kinetic energy = 0.5 mass x speed squared

$K = \frac{1}{2}mv^2$

⊙ Hooke's law for the force of a spring or elastic body,

restoring force = - spring constant x displacement from equilibrium

$F = -kx$

⊙ Centripetal acceleration, the acceleration of an object in uniform circular motion,

acceleration = $speed^2$/radius

$a = \frac{v^2}{r}$, directed toward the center

⊙ The ideal gas law

$p = nkT$ where $k$ = Boltzmann constant

⊙ Bernoulli's equation. Along a streamline of fluid flow,

$p + \frac{1}{2}\rho v^2 + \rho gh =$ a constant

For an incompressible fluid in equilibrium, $p+\rho gh$ is constant throughout the fluid.

⊙ Newton's Theory of Universal Gravitation. The gravitational forces for two masses $m_1$ and $m_2$ are equal but opposite attractive forces with magnitude

$F = \frac{Gm_1m_2}{r^2}$, where $G = 6.67 \times 10^{-11}$ $m^3$ $s^{-2}$ $kg^{-1}$.

⊙ Power is energy per unit time,

$P = \frac{\Delta E}{\Delta t}$.

The unit of power is the watt (W); 1 W = 1 J/s.

⊙ Pressure is force per unit area $p = \frac{F}{A}$.