**Formulas**

**Fall time:**



Where *H* represents the fall height and *g* = 9.81 m/s2

**Horizontal speed required** to travel a certain horizontal distance for a time T:

**Force*(F)*to accelerate a mass object (m):**

Where

*Vend* - final speed that will have to be worth *Vhor*, (Launch speed)

*Vini* - initial speed if the body is moving before the application of force

and *t* time of application of this force.

**ANGULAR MOTION**

**Newton 2** (translation, linear motion)

F = m ˑ a

**Rotational analog:** (torqueΤ - external, net torque)

Τ = I ˑ α

Where Τ = F ˑ LA (LA : lever arm, often r or l)

I = m ˑ r²

α : angular acceleration

**Angular speed** ω [rad/s]

ω = α ˑ Δt

**Angular acceleration** α [rad/s²]

α = Τ / I

which gives : α = F ˑ LA / I

**Parallel axis theorem**

I = I0 + m d²

where I is the new moment of inertia, about an axis parallel to the axis crossing CM

I0 the initial I around an axis passing throuhg the CM,

m mass of rotating object

and d is the distance between CM and the application point of the force

**Moment of inertia (I) of a solid rectangular parallelepiped about an axis through CM**

Ileft/right axis = 1/12 m (a² + b²)

Where m is the mass of the object

a the ant/post diameter (if an idealised rigid human body is considered)

and b the height

**Moments of inertia of the human body around axes through CM (**mean values, McConville, 1980, see also Klein & Sommerfeld, 2004**):**

Around ant/post axis: 13.5 ± 3.4 kgm²

Around left/ right axis: 12.6 ± 3.1 kgm²

Around long axis: 1.4 ± 0.4 kgm²

Comment: Notice that the energy needed to rotate around the cranio-caudal axis is nearly ten times less than around the other two axes. From an evolution point of view this feature is of great importance, namely when the animal or the human has to look backwards. Advantage is given to bipedalism.