kinematics equations

UNIT 2 and 3 CP EQUATIONS

Var	Given value	Units	Description
Δx		m	displacement
x_f		m	final position
x_i		m	initial position
$speed_{ave}$		$\frac{m}{s}$	average speed
d		m	distance
t		s	time
v_{ave}		$\frac{m}{s}$	average velocity
Δv		$\frac{m}{s}$	change in velocity
v_f		$\frac{m}{s}$	final velocity
v_i		$\frac{m}{s}$	initial velocity
a		$\frac{m}{s^2}$	acceleration

$$\Delta x = x_f - x_i$$

$$speed_{ave} = \frac{d}{t}$$

$$v_{ave} = \frac{\Delta x}{t}$$

$$\Delta v = v_f - v_i$$

kinematics equations (continued)

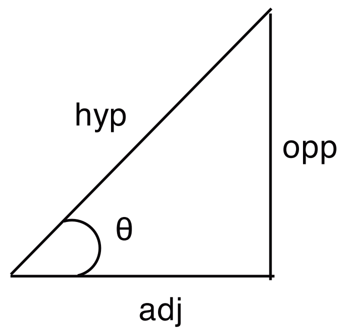
$$a = \frac{\Delta v}{t}$$

$$v_f = v_i + at$$

$$\Delta x = \frac{1}{2} a t^2$$

dynamics equations

UNIT 4 and 5 CP EQUATIONS



Remember! SOH CAH TOA

Var	Given value	Units	Description
θ		°	angle in degrees
opp			side opposite of angle
hyp			longest side of a right triangle
adj			side adjacent to angle

$$\sin\theta = \frac{opp}{hyp}$$

$$\cos\theta = \frac{adj}{hyp}$$

$$\tan\theta = \frac{opp}{adj}$$

dynamics equations (continued)

Var	Given value	Units	Description
$weight$		N	force of gravity on object
m		kg	mass
g	10	$\frac{m}{s^2}$	acceleration due to gravity
F_{NET}		N	net or total force
a		$\frac{m}{s^2}$	acceleration
f		N	force of friction
μ			coefficient of friction
N		N	normal force

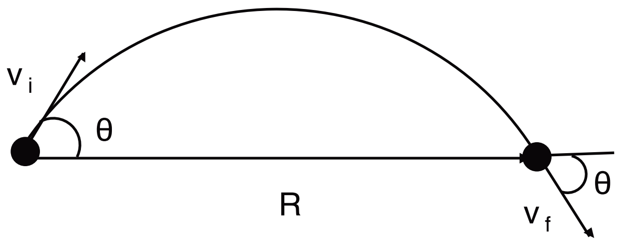
$$weight = m\,g$$

$$F_{NET} = m\,a$$

$$f = \mu\,N$$

projectile and circular motion equations

UNIT 6 and 8 CP EQUATIONS



Var	Given value	Units	Description
R		m	range of a projectile
v_i		$\frac{m}{s}$	launch velocity of a projectile
v_f		$\frac{m}{s}$	impact velocity of a projectile
g	10	$\frac{m}{s^2}$	acceleration due to gravity
θ		°	launch angle with respect to the horizontal

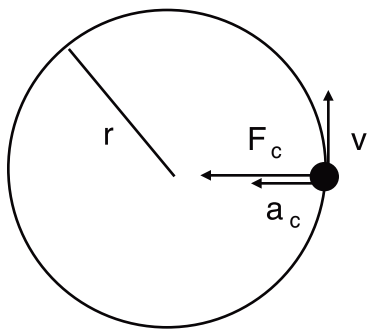
$$v_i = v_f$$

$$time_{up} = time_{down}$$

$$R = \left(\frac{v_i^{\,2}}{g}\right)\sin(2\,\theta)$$

projectile and circular motion equations (continued)

Var	Given value	Units	Description
v		$\frac{m}{s}$	tangential velocity or linear speed
r		m	radius of circular path
T		s	period – time to go around circle once
a_c		$\frac{m}{s^2}$	centripetal acceleration
F_c		N	centripetal force – net force towards the center of the circle
m		kg	mass



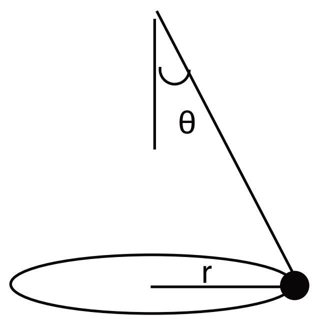
$$v = \frac{2\pi r}{T}$$

$$a_c = \frac{v^2}{R}$$

$$F_c = m a_c$$

projectile and circular motion equations (continued)

This formula is for a conical pendulum aka the Flying Pig!



Var	Given value	Units	Description
θ		°	angle string makes with the vertical

$$\tan\theta = \frac{v^2}{r\,g}$$

work and energy equations

UNIT 7 CP EQUATIONS

Var	Given value	Units	Description
$work$		J	work
F		N	force in the direction of Δx
Δx		m	displacement
ΔE		J	change in energy of a system
E_g		J	gravitational potential energy
m		kg	mass
g	10	$\frac{m}{s^2}$	acceleration due to gravity
h		m	height above reference point
E_k		J	kinetic energy
E_{el}		J	elastic potential energy
k		$\frac{N}{m}$	spring constant
Δx_s		m	amount spring is stretched
F_s		N	force required to stretch a spring
$power$		W	power, the rate at which work is done
t		t	time
v		$\frac{m}{s}$	velocity

$$work = \Delta E$$

$$work = \text{area under } F \text{ vs } \Delta x \text{ curve}$$

work and energy equations (continued)

$$work = F\Delta x$$

$$E_g = m g h$$

$$E_k = \frac{1}{2} m v^2$$

$$E_{el} = \frac{1}{2} k \Delta x_s{}^2$$

$$F_s = k \Delta x_s$$

$$power = \frac{work}{t}$$

$$power = F v$$

momentum equations

Var	Given value	Units	Description
p		$\frac{kg\ m}{s}$	momentum
m		kg	mass
v		$\frac{m}{s}$	velocity
$impulse$		Ns	impuse
F		N	applied force
t		s	time
Δp		$\frac{kgm}{s}$	change in momentum
v_f		$\frac{m}{s}$	final velocity
v_i		$\frac{m}{s}$	initial velocity

$$p = m v$$

$$impulse = F t$$

$$impulse = \Delta p$$

$$\Delta p = m (v_f - v_i)$$

momentum equations (continued)

conservation of momentum for a system of two objects (sum of initial momenta = sum of final momenta)

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

For an elastic collision, kinetic energy is also conserved.

$$\textit{sum of } E_{ki} = \textit{sum of } E_{kf}$$

For a completely inelastic collision where objects stick together after collision:

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

conservation of momentum for an explosion (like firing a gun) where the system was initially at rest:

$$0 = m_1 v_{1f} + m_2 v_{2f}$$