# Physics 11 Cheat Sheet*

## Kinematics

$$v = \frac{\Delta d}{\Delta t}$$
$$a = \frac{\Delta v}{\Delta t}$$
$$v_{\text{av}} = \tfrac{1}{2}(v_{\text{i}} + v_{\text{f}})$$
$$v_{\text{f}} = v_{\text{i}} + at$$
$$d = \tfrac{1}{2}(v_{\text{f}} + v_{\text{i}})t$$
$$d = v_{\text{i}}t + \tfrac{1}{2}at^2$$
$$v_{\text{f}}^2 = v_{\text{i}}^2 + 2ad$$

## Forces

$$F_{\text{g}} = mg$$
$$\frac{F_2}{F_1} = \left(\frac{d_1}{d_2}\right)^2 = \frac{g_2}{g_1}$$
$$F_{\text{g}} = \frac{Gm_1m_2}{d^2}$$
$$g = \frac{Gm_2}{d^2}$$
$$F_{\text{s}} = kx$$
$$F_{\text{f}} = \mu F_{\text{N}}$$

## Newton's laws

1. Inertia
2. $\vec{F}_{\text{net}} = m\vec{a}$
3. Action-reaction

## Momentum

$$\vec{p} = m\vec{v}$$
$$\Delta\vec{p} = \vec{p}_2 - \vec{p}_1 = (m\vec{v})_2 - (m\vec{v})_1$$
$$\Delta\vec{p} = \vec{F}\Delta t = m\Delta\vec{v}$$
$$(m\vec{v})_{\text{A1}} + (m\vec{v})_{\text{B1}} = (m\vec{v})_{\text{A2}} + (m\vec{v})_{\text{B2}}$$
$$(m\vec{v})_{\text{A1}} + (m\vec{v})_{\text{B1}} = (m_{\text{A}} + m_{\text{B}})\,\vec{v}_2$$

## Energy

$$W = \vec{F}d$$
$$P = \frac{W}{t}$$
$$E = Pt$$
$$E_{\text{pg}} = mgh$$
$$E_{\text{k}} = \tfrac{1}{2}mv^2$$
$$E_{\text{ps}} = \tfrac{1}{2}kx^2$$
$$E_{\text{H}} = mc\,\Delta T$$
$$P = mc\,\frac{\Delta T}{\Delta t}$$

## Light

$$m = \frac{h_{\text{i}}}{h_{\text{o}}} = \frac{d_{\text{i}}}{d_{\text{o}}} \text{ (pinhole)}$$
$$m = \frac{h_{\text{i}}}{h_{\text{o}}} = -\frac{d_{\text{i}}}{d_{\text{o}}}$$
$$\frac{1}{d_{\text{o}}} + \frac{1}{d_{\text{i}}} = \frac{1}{f}$$
$$d_{\text{o}} = -d_{\text{i}} \text{ (plane mirror)}$$
$$f = \tfrac{1}{2}R \text{ (concave mirror)}$$
$$f = -\tfrac{1}{2}R \text{ (convex mirror)}$$
$$n = \frac{c}{v_{\text{medium}}}$$
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$
$$\sin\theta_{\text{c}} = \frac{n_2}{n_1}$$

| | if positive | if negative |
|---|---|---|
| $d_{\text{i}}$ | real | virtual |
| $f$ | converging | diverging |
| $m$ | upright | inverted |

## Waves

$$f = \frac{1}{T}$$
$$v = f\lambda$$
$$\frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2}$$
$$L = \frac{n}{2}\lambda_n$$
$$f_n = \frac{nv}{2L} = nf_1$$
$$d = \frac{vt}{2} \text{ (sonar)}$$

## Nuclear energy

$$E = mc^2$$
$${}^{\text{A}}_{\text{Z}}\text{X} \rightarrow {}^{\text{A}-4}_{\text{Z}-2}\text{Y} + {}^{4}_{2}\alpha$$
$${}^{\text{A}}_{\text{Z}}\text{X} \rightarrow {}^{\text{A}}_{\text{Z}+1}\text{Y} + {}^{0}_{-1}\beta$$
$${}^{\text{A}}_{\text{Z}}\text{X}^* \rightarrow {}^{\text{A}}_{\text{Z}}\text{X} + {}^{0}_{0}\gamma$$
$$A = A_0\left(\frac{1}{2}\right)^{\frac{t}{h}}$$

## Constants

$g = -9.8\,\text{m/s}^2 = 9.8\,\text{N/kg}$
$G = 6.67 \times 10^{-11}\,\text{N m}^2/\text{kg}^2$
$m_{\text{earth}} = 5.97 \times 10^{24}\,\text{kg}$
radius of earth $= 6.37 \times 10^{6}\,\text{m}$
$c = 3.00 \times 10^{8}\,\text{m/s}$
speed of sound $= 330\,\text{m/s}$

## Units

$\text{N} = \text{kg m/s}^2$
$\text{J} = \text{N m} = \text{kg m}^2/\text{s}^2$
$\text{W} = \text{J/s} = \text{kg m}^2/\text{s}^3$
$\text{Hz} = \text{s}^{-1}$

## Variables

$A$: amount remaining
$a$: acceleration
$c$: specific heat capacity, speed of light
$d$: displacement, distance
$d_{\text{i}}$: distance of image
$d_{\text{o}}$: distance of object
$E$: energy
$E_{\text{H}}$: heat energy
$E_{\text{k}}$: kinetic energy
$E_{\text{pg}}$: gravitational potential energy
$E_{\text{ps}}$: spring potential energy
$F$: force
$f$: focal point, frequency
$F_{\text{f}}$: force of friction
$F_{\text{g}}$: force of gravity
$F_{\text{N}}$: normal force
$F_{\text{s}}$: force of spring
$G$: universal gravitational constant
$g$: gravitational field strength
$h$: half-life
$h_{\text{i}}$: height of image
$h_{\text{o}}$: height of object
$k$: spring constant
$L$: length
$m$: mass, magnification
$n$: index of refraction
$P$: power
$p$: momentum
$R$: radius
$T$: temperature, period
$t$: time
$v$: velocity, speed
$W$: work
$\lambda$: wavelength
$\mu$: coefficient of friction
$\theta_{\text{c}}$: critical angle