

## Equations (Continued)

### Energy: Work

$$W = F \cdot d$$

W = work  
F = force  
d = distance

### Power

$$P = \frac{E}{t} = \frac{W}{t}$$

$$P = \frac{\tau \cdot \text{rpm}}{5252}$$

P = power  
E = energy  
W = work  
t = time  
 $\tau$  = torque  
rpm = revolutions per minute

### Efficiency

$$\text{Efficiency (\%)} = \frac{P_{\text{out}}}{P_{\text{in}}} \cdot 100\%$$

$P_{\text{out}}$  = useful power output  
 $P_{\text{in}}$  = total power input

### Energy: Potential

$$U = mgh$$

U = potential energy  
m = mass  
g = acceleration due to gravity  
h = height

### Energy: Kinetic

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

K = kinetic energy  
m = mass  
v = velocity

### Energy: Thermal

$$Q = mc\Delta T$$

Q = thermal energy  
m = mass  
c = specific heat  
 $\Delta T$  = change in temperature

### Fluid Mechanics

$$P = \frac{F}{A}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} \quad (\text{Charles' Law})$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} \quad (\text{Gay-Lussac's Law})$$

$$P_1V_1 = P_2V_2 \quad (\text{Boyle's Law})$$

$$Q = Av$$

$$A_1v_1 = A_2v_2$$

$$\text{Horsepower} = \frac{QP}{1714}$$

absolute pressure = gauge pressure  
+ atmospheric pressure

P = absolute pressure  
F = Force  
A = Area  
V = volume  
T = absolute temperature  
Q = flow rate  
v = flow velocity

### Mechanics

$$s = \frac{d}{t} \quad (\text{where acceleration} = 0)$$

$$v = \frac{d}{t} \quad (\text{where acceleration} = 0)$$

$$a = \frac{v - v_0}{t}$$

$$X = \frac{v_0 \sin(2\theta)}{-g}$$

$$v = v_0 + at$$

$$d = d_0 + v_0t + \frac{1}{2}at^2$$

$$v^2 = v_0^2 + 2a(d - d_0)$$

$$\tau = dF \sin \theta$$

s = speed  
v = velocity  
a = acceleration  
X = range  
t = time  
d = distance  
g = acceleration due to gravity  
d = distance  
 $\theta$  = angle  
 $\tau$  = torque  
F = force

### Electricity

Ohm's Law  
 $V = IR$

$$P = IV$$

$$R_T \text{ (series)} = R_1 + R_2 + \dots + R_n$$

$$R_T \text{ (parallel)} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \dots + \frac{1}{R_n}}$$

### Kirchoff's Current Law

$$I_T = I_1 + I_2 + \dots + I_n$$

or  $I_T = \sum_{n=1}^n I_n$

### Kirchoff's Voltage Law

$$V_T = V_1 + V_2 + \dots + V_n$$

or  $V_T = \sum_{n=1}^n V_n$

V = voltage  
 $V_T$  = total voltage  
I = current  
 $I_T$  = total current  
R = resistance  
 $R_T$  = total resistance  
P = power

### Thermodynamics

$$P = Q' = AU\Delta T$$

$$P = \frac{Q}{\Delta t}$$

$$U = \frac{k}{R} = \frac{k}{L}$$

$$P = \frac{kA\Delta T}{L}$$

$$A_1v_1 = A_2v_2$$

$$P_{\text{net}} = cAe(T_2^4 - T_1^4)$$

P = rate of heat transfer  
Q = thermal energy  
A = Area of thermal conductivity  
U = coefficient of heat conductivity  
(U-factor)  
 $\Delta T$  = change in temperature  
 $\Delta t$  = change in time  
R = resistance to heat flow (R-value)  
k = thermal conductivity  
v = velocity  
 $P_{\text{net}}$  = net power radiated  
 $c = 5.6696 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \text{K}^4}$   
e = emissivity constant

# Essential Engineering Equations

**J Elliott**



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