FORMULAS

VARIABLES

A - area
a – acceleration
α - angular acceleration
a_t – tangential acceleration
d – distance
F – force
g – acceleration due to gravity
h – height (or depth)
J – impulse
K – kinetic energy (KE)
k – force constant
L – angular momentum
ℓ - length
m – mass
P – power (or pressure)
p – momentum
ρ - density
r – radius
s – arc length
T – period
t – time
τ - torque
U – potential energy (PE)
μ - coefficient of friction
V - volume
v – velocity
v_t – tangential velocity
W – work
ω - angular velocity
x – horizontal position
Δx – displacement
y – vertical position
θ - angle
$\Delta\theta$ - angular displacement

CONSTANTS

$g = -9.81\ \frac{m}{s^2}$

$G = 6.673 \times 10^{-11}\ \frac{Nm^2}{kg^2}$

$M_E = 5.98 \times 10^{24}\ kg$

$R_E = 6.37 \times 10^{6}\ m$

$P_0 = 1.01 \times 10^{5}\ Pa$

$1\ in = 2.54\ cm$

$1\ km = 0.62\ mi$

$1\ kg = 2.2\ lbs$

$1\ hp = 746\ W$

Chapter 2

$$\Delta x = x_f - x_i$$

$$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i}$$

$$a = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$

$$\Delta x = \frac{1}{2}(v_f + v_i)t$$

$$v_f = v_i + at$$

$$\Delta x = v_i t + \frac{1}{2}at^2$$

$${v_f}^2 = {v_i}^2 + 2a(\Delta x)$$

Chapter 3

$$\Delta x = v_x t$$

$$\Delta y = \frac{1}{2}(v_{yf} + v_{yi})t$$

$$v_{yf} = v_{yi} + gt$$

$$\Delta y = v_{yi}t + \frac{1}{2}gt^2$$

$${v_{yf}}^2 = {v_{yi}}^2 + 2g(\Delta y)$$

$$v = \sqrt{{v_x}^2 + {v_y}^2}$$

Chapter 7

$$\Delta\theta = \frac{1}{2}(\omega_f + \omega_i)t$$

$$\omega_f = \omega_i + \alpha t$$

$$\Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$$

$${\omega_f}^2 = {\omega_i}^2 + 2\alpha(\Delta\theta)$$

$$v_t = r\omega$$

$$a_t = r\alpha$$

$$a_c = \frac{{v_t}^2}{r} = r\omega^2$$

$$F_c = m\frac{{v_t}^2}{r} = mr\omega^2$$

$$F_g = G\frac{m_1 \cdot m_2}{r^2}$$

Chapter 4

$$\sum F = ma$$

$$F_N = mg \cdot \cos\theta$$

$$F_s = \mu_s F_N$$

$$F_k = \mu_k F_N$$

Chapter 5

$$W = F \cdot \Delta x \cdot \cos\theta$$

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

$$U_g = mgh$$

$$U_{elastic} = \frac{1}{2}kx^2$$

$$F(\Delta x) = \frac{1}{2}m{v_f}^2 - \frac{1}{2}m{v_i}^2$$

$$P_{avg} = \frac{\Delta W}{\Delta t}$$

$$P = Fv \cdot \cos\theta$$

$$mgh_i + \frac{1}{2}k{x_i}^2 + \frac{1}{2}m{v_i}^2 = mgh_f + \frac{1}{2}k{x_f}^2 + \frac{1}{2}m{v_f}^2$$

Chapter 6

$$p = mv$$

$$J = F\Delta t = mv_f - mv_i$$

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

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

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

$$(m_1 + m_2)v_i = m_1 v_{1f} + m_2 v_{2f}$$

Chapter 8

$$\tau = Fd \cdot \sin\theta$$

$$\sum \tau = I\alpha$$

$$L = I\omega$$

$$K_{rotational} = \frac{1}{2}I\omega^2$$

$$I_{point\ mass} = MR^2$$

$$I_{hoop} = MR^2$$

$$I_{disc} = \frac{1}{2}MR^2$$

Chapter 9

$$\rho = \frac{m}{V}$$

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

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

$$P = P_0 + \rho gh$$

$$\frac{F_{g,object}}{F_B} = \frac{\rho_o}{\rho_f}$$

$$Flow\ rate = Av$$

$$A_1 v_1 = A_2 v_2$$

$$F_B = F_{g,air} - F_{g,fluid}$$

$$F_B = m_{object} \cdot g = \rho_f V_o g$$

$$P_1 + \rho g h_1 + \frac{1}{2}\rho {v_1}^2 = P_2 + \rho g h_2 + \frac{1}{2}\rho {v_2}^2$$

VARIABLES

A – area
a – slit width
α - coefficient of linear expansion
B – magnetic field
β - coefficient of volumetric expansion
C - capacitance
c – speed of light in a vacuum
d – slit separation (or distance)
E – electric field (or energy)
ε – induced emf
eff – efficiency
F – force
f – focal length
ƒ – frequency
g – acceleration due to gravity
h – depth (or height)
h' – image height
I – current (or intensity)
k – force constant
L – latent heat (or length)
ℓ - length
m – order number
N – number of particles (number of coils)
n – number of moles (or harmonic #)
$n_{\#}$ *– index of refraction*
Φ - magnetic flux (or electric flux)
p – object distance
ρ - resistivity
Q – heat (or net charge)
q – image distance (or charge)
R – resistance (or radius of curvature)
r – charge distance
T – period (or temperature)
ΔU – internal energy
V – volume (or voltage)
λ - wavelength
δ - path difference

CONSTANTS

$k_B = 1.38 \text{ x } 10^{-23} \ \frac{J}{K}$

$I_0 = 1.0 \text{ x } 10^{-12} \ \frac{W}{m^2}$

$c = 3.00 \text{ x } 10^{8} \ \frac{m}{s}$

$k_C = 8.99 \ x \ 10^{9} \ \frac{N \cdot m^2}{C^2}$

$\epsilon_0 = 8.85 \text{ x } 10^{-12} \ \frac{C^2}{N \cdot m^2} = \frac{C}{V \cdot m}$

$\mu_0 = 4\pi \text{x } 10^{7} \ \frac{T \cdot m}{A}$

Chapter 10

$$T_F = \frac{9}{5}T_C + 32$$

$$T = T_C + 273$$

$$PV = Nk_BT$$

$$PV = nRT$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$Q = mc(\Delta T)$$

$$\Delta T = T_{HOT} - T_{COLD}$$

$$Q = mL$$

Chapter 11

$$W = P \cdot \Delta V$$

$$\Delta U = Q - W$$

$$W = Q_h - Q_c$$

$$eff = \frac{W}{Q_h} = 1 - \frac{Q_c}{Q_h}$$

$$\Delta L = \alpha L_i \Delta T$$

$$\Delta V = \beta V_i \Delta T$$

Chapter 12

$$F_s = -kx$$

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$$T = 2\pi\sqrt{\frac{m}{k}}$$

$$U_{elastic} = \frac{1}{2}kx^2$$

$$T = \frac{1}{f} \text{ or } f = \frac{1}{T}$$

$$v = f\lambda$$

Chapter 13

$$v_{sound} = \left(331 \ \frac{\text{m}}{\text{s}}\right)\sqrt{1 + \frac{T}{273}}$$

$$I = \frac{P}{A} = \frac{P}{4\pi r^2}$$

$$\frac{I_1}{I_2} = \frac{{r_2}^2}{{r_1}^2}$$

$$\beta = 10 \cdot \log\frac{I}{I_0}$$

$$f_D = f\left(\frac{v \pm v_o}{v \mp v_s}\right)$$

$$f_{n,string} = n\frac{v}{2L}$$

$$f_{n,open} = n\frac{v}{2L}$$

$$f_{n,closed} = n\frac{v}{4L}$$

$$f_n = nf_1$$

$$f_{beats} = |f_1 - f_2|$$

Chapter 14

$$c = f\lambda$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$f = \frac{R}{2}$$

$$M = \frac{h'}{h} = -\frac{q}{p}$$

$$I = \frac{P}{4\pi r^2}$$

Chapter 15

$$n = \frac{c}{v}$$

$$n_1 \cdot \sin\theta_1 = n_2 \cdot \sin\theta_2$$

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$\sin\theta_c = \frac{n_2}{n_1}$$

Chapter 16

$$\delta = d \cdot \sin\theta$$

$$\delta_{bright} = d \cdot \sin\theta = m\lambda$$

$$\delta_{dark} = d \cdot \sin\theta = \left(m + \frac{1}{2}\right)\lambda$$

$$x_m = \frac{m\lambda L}{a}$$

Chapter 17

$$F_E = k_C\frac{q_1q_2}{r^2}$$

$$E = k_C\frac{q}{r^2}$$

$$F = qE$$

$$\Phi_E = EA \cdot \cos\theta$$

Chapter 18

$$U_E = k_C\frac{q_1q_2}{r}$$

$$\Delta U_E = -qEd$$

$$\Delta V = \frac{\Delta U}{q}$$

$$\Delta V = -Ed$$

$$V = k_C\frac{q}{r}$$

$$C = \frac{Q}{\Delta V}$$

$$C = \epsilon_o\frac{A}{d}$$

$$C = \kappa \cdot C_0$$

$$U = \frac{1}{2}QV$$

$$U = \frac{1}{2}CV^2 = \frac{Q^2}{2C}$$

Chapter 19

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

$$V = IR$$

$$R = \rho\frac{L}{A}$$

$$P = IV = I^2R = \frac{V^2}{R}$$

Chapter 20

$$R_s = R_1 + R_2 + \cdots$$

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$$

Chapter 21

$$F_B = qvB \cdot \sin\theta$$

$$r = \frac{mv}{qB}$$

$$F_B = BI\ell \cdot \sin\theta$$

$$B = \frac{\mu_0 I}{2\pi r}$$

Chapter 22

$$\Phi_B = BA \cdot \cos\theta$$

$$\varepsilon = -\frac{\Delta\Phi_B}{\Delta t}$$

$$\varepsilon = B\ell v$$