PHYSICS 151 EQUATION SHEET

Prof. Doney 3/9/17

CONSTANTS/CONVERSIONS

1 mi = 1.609 km = 5280 ft

1 in. = 2.54 cm   1 m = 3.28 ft

1 liter = 1000 mL = 1000 cm^3 = 1×10^{-3} m^3

1 kg = 2.2 lb   1 hp = 746 watt

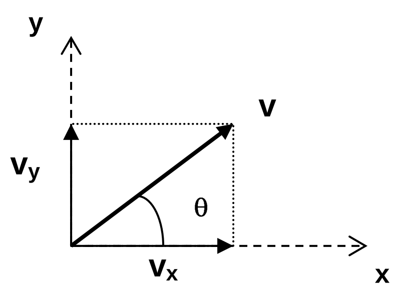
1 Watt = 1 J/s   Newton = (kg)(m/s^2)

MISCELLANEOUS

$A_{circle} = \pi r^2$ $A_{\Delta} = ½\ b\ h$ $A_{rectangle} = b\ h$

$V_{box} = l\ w\ h$ $V_{cylinder} = \pi r^2 h$ $V_{sphere} = 4/3\ \pi r^3$

VECTORS (2-D)

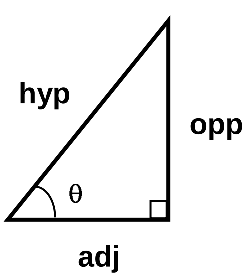


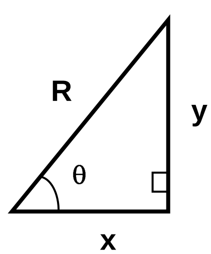
x-direction: $v_x = v \cos\theta$

y-direction: $v_y = v \sin\theta$

GEOMETRY & RIGHT TRIANGLES

Note: right (90°) angle is required





"SOH CAH TOA"

$\sin\theta = \dfrac{opp}{hyp}$ $\cos\theta = \dfrac{adj}{hyp}$ $\tan\theta = \dfrac{opp}{adj} = \dfrac{\sin\theta}{\cos\theta}$

$\theta = \tan^{-1}\left(\dfrac{opp}{adj}\right)$

$hyp^2 = adj^2 + opp^2$ *or* $x^2 + y^2 = R^2$

$hyp = \sqrt{adj^2 + opp^2}$ *or* $R = \sqrt{x^2 + y^2}$

Simple Harmonic Motion (SHM)

$f = \left(\dfrac{1}{T}\right)$ $F_{restore}$ ~ - displacement $F = -k\,x$ *Hooke's law*

Total Energy = $PE_{spring} + KE + PE_{gravity}$

$= ½\,k\,x^2 + ½\,m\,v^2 + m\,g\,h$

$v_{ptx} = v_{max}\sqrt{1-\dfrac{x^2}{A^2}}$ F = m a

SPRINGS

$T = 2\pi\sqrt{\dfrac{m}{k}}$ $f = \dfrac{1}{2\pi}\sqrt{\dfrac{k}{m}}$

PENDULUMS

$T = 2\pi\sqrt{\dfrac{L}{g}}$ $f = \dfrac{1}{2\pi}\sqrt{\dfrac{g}{L}}$ $F = -m\,g\sin\theta$

WAVES

$v_{string} = \sqrt{\dfrac{F_T}{\left(\dfrac{m}{L}\right)}}$ $v = \lambda f$ $d = v\ t$ $I = \left(\dfrac{Power}{Area}\right) = \dfrac{P}{4\pi r^4}$

SOUND

$I \sim P \sim A^2$ $f_{beat} = \Delta f$ $v_{sound\ in\ air} = (331 + 0.6T)$ m/s

$v_{in\ air\ 20°} = 343$ m/s $v_{in\ water} = 1440$ m/s $v_{in\ sea\ water} = 1560$ m/s

$\beta = 10\log\left(\dfrac{I}{I_o}\right)$ $I_o = 10^{-12}$ $I \sim 1/r^2$ $A = \left(\dfrac{1}{\pi f}\right)\sqrt{\dfrac{1}{2\rho v}}$

$f_{harmonic} = n\,f_o$ *where n = 1, 2, 3, …*

DOPPLER Effect

$f' = f\left(\dfrac{v \pm v_o}{v \mp v_s}\right)$

signs

toward = "upper"

away = "lower"

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ELECTRIC FORCE / COULOMB's LAW

$\boldsymbol{F} = k \dfrac{q_1 q_2}{r^2}$ *where:* $k = 9.0x10^9$

$q^{e-} = -1.602 \times 10^{-19}\, C$ $q^{+} = +1.602 \times 10^{-19}\, C$

ELECTRIC FIELD

$\boldsymbol{E} = \dfrac{\vec{F}}{q} = k \dfrac{q}{r^2} = \dfrac{V}{d}$

W = F d = (q E) d

ELECTRIC POTENTIAL

$V = \frac{PE}{q} = k \dfrac{q}{r}$

$\boldsymbol{PE} = k \dfrac{q_1 q_2}{r}$

PARALLEL PLATE CAPACITANCE

$Q = C V$

where: $C = \epsilon_0 \dfrac{A}{d}$ $\epsilon_o = 8.85x10^{-12}$

For Dielectric: $C = k \; \epsilon_0 \dfrac{A}{d}$

$PE = ½ Q V = ½ C V^2 = ½ \dfrac{Q}{C}$

ELECTRIC (DC) CURRENT

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

$V = I R$ *where:* $R = \rho \dfrac{l}{A}$

$P = I V = I^2 R$

Series: $R_{eq} = R_1 + R_2 + \ldots.$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} \ldots$$

Parallel: $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2} \ldots$

$$C_{eq} = C_1 + C_2 + \ldots.$$

ELECTRIC (AC) CURRENT

$V = V_o \sin 2\pi f t = V_o \sin \omega t$

RC CIRCUIT

$V_{CAP} = V\,(1 - e^{-t/RC})$

$\tau = R\,C$