P11 - Formula Sheet

MKS Units - Meters/Kilograms/Seconds

$\Delta = final - initial$

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

$v_{av} = \frac{(v_f + v_i)}{2}$; $if\ continuous\ acceleration$; $in\ one\ direction$

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

$v_f = v_i + at$

SOH CAH TOA

$\sin\theta = \frac{opp}{hyp}$ $\quad o = hsin\theta$ $\quad \theta = \sin^{-1}(\frac{opp}{hyp})$

$\cos\theta = \frac{adj}{hyp}$ $\quad a = hcos\theta$ $\quad \theta = cos^{-1}(\frac{adj}{hyp})$

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

$d = vt$

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

$v_f^2 = v_i^2 + 2ad$ $\quad ; v_f = 0$ @ max $height$

$F = \frac{mv}{t}$

$g = \frac{Gm}{r^2}$; Planet Surface

$F_g = mg$ $\quad F = ma$ $\quad F_a - F_f = ma$ $\quad F_f = \mu F_n$ $\quad F_N = mg$; $a = 0$

$F_g = \frac{Gm_1 m_2}{r^2}$

$p = mv$ $\quad p_i = p_f$ $\quad I = \Delta p = F_{net}t = m\Delta v$

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

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

$W = Fd$ $\quad E_i = E_f$ $\quad E_k = \frac{1}{2}mv^2$ $\quad E_p = mgh$

$W = \Delta E$ $\quad E_{ki} + E_{pi} = E_{kf} + E_{pf}$ $\quad E_t = E_k + E_p$

$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$

$P = \frac{W}{t}$ $\quad P = Fv$; $a = 0$ $\quad E_{ff} = \frac{Power\ Out}{Power\ In}$

$v = \lambda f$ $\quad v = \frac{\lambda}{T}$ $\quad T = \frac{1}{f}$ $\quad f = \frac{1}{T}$

$n_1 sin\theta = n_2 sin\theta$ $\quad n = \frac{C}{v}$ $\quad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$ $\quad \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$n_1 sin\theta = n_2 sin\theta$ $\quad$ $n = \frac{C}{v}$ $\quad$ $m = \frac{n_i}{h_o} = -\frac{a_i}{d_o}$ $\quad$ $\frac{\perp}{d_o} + \frac{\perp}{d_i} = \frac{\perp}{f}$

MKS Units - Meters/Kilograms/Seconds

P11 - Variables/Unit Definitions

$v: velocity\ \left(\frac{m}{s}\right)$ $d: distance\ (m)$ $a: acceleratiom\ \left(\frac{m}{s^2}\right)$ $t: time\ (s)$

$v_i: initial\ velocity\ \left(\frac{m}{s}\right)$ $v_f: final\ velocity\ \left(\frac{m}{s}\right)$ $\Delta: change\ in\ (final\ minus\ initial)$

$F: Force\ (N)\ Newtons$ $m: Mass\ (kg)$ $F_f: Force\ of\ Friction\ (N)$

$F_N: Normal\ Force, (N) = Weight$

µ: Coeffcient of Fiction

$F_g: Gravitational\ Force\ (N)$ $G: Gravitational\ Constant, G = 6.67 \times 10^{-11}\ N$

$p: Momentum\ \left(\frac{kgm}{s}\right)$ $Impulse: Change\ in\ Momentum$

$W: Work, (Nm) Newton\ Meters = (J) Joules = Change\ in\ Energy$

$P: Power, (W)\ Watts$ $\frac{J}{s} = W$

$\lambda: Wavelenght$ $f: frequency\ (Hz) = Cycles\ Per\ Second = (s^{-1})$ $T: Period\ (s)$

$n: Index\ of\ Refaction$

$n: Vacuum = 1$
$n: Air = 1.0003$
$n: Water = 1.33$
$n: Ethanol = 1.36$
$n: Crown\ Glass = 1.52$
$n: Quartz = 1.54$
$n: Flint\ Glass = 1.61$
$n: Diamomd = 2.42$

$C: Speed\ of\ Light = 6.00 \times 10^8 \frac{m}{s}$

$m: Magnification$ $h_o: Height\ of\ the\ Object$ $d_o: Distance\ to\ Object$

$h_i: Height\ of\ Image$ $d_i: Distance\ to\ Image$

$f: Focal\ Lenght$

$+ve: Concave$

$-ve: Convex$

P11 - Isolating variables $a + b = c, v = v_0 + at$ $Notes$

$\boxed{a + b = c}$

$Solve\ for\ "a"$

$$a + b = c$$
$$-b \quad -b$$
$$a = c - b$$

$Subtract\ "b"\ from\ both\ sides$

$$a + b = c$$
$$a + \cancel{b} = c - b$$
$$\boxed{a = c - b}$$

$Bring\ "b"\ over, change\ sign$

$Solve\ for\ "b"$

$$\cancel{a} + b = c$$
$$\boxed{b = c - a}$$

$\boxed{v = v_0 + at}$

$Solve\ for\ v_0$

$$v = v_0 + at$$
$$-at \qquad -at$$
$$v - at = v_0$$
$$v_0 = v - at$$

$Subtract\ "at"\ from\ bot\ sides$

$Mirror$

$$v = v_0 + at$$
$$v = v_0 + \cancel{at}$$
$$v - at = v_0$$
$$v_0 = v - at$$

$Bring\ "at"\ over, change\ sign$

$Solve\ for\ "t"$

$\boxed{Brackets!}$

$$v = v_0 + at$$
$$v - v_0 = at$$
$$\frac{(v - v_0)}{a} = t$$
$$t = \frac{v - v_0}{a}$$

$Bring\ "v_0"\ over$

$Bring\ "a"\ down$

$Solve\ for\ "a"$

$$v = v_0 + at$$
$$v - v_0 = at$$
$$\frac{(v - v_0)}{t} = a$$
$$a = \frac{v - v_0}{t}$$

P11 - Isolating variables $v = \frac{d}{t}, \frac{a}{b} = \frac{c}{d}$ Notes

$$\boxed{v = \frac{d}{t}}$$

Solve for d

$v = \frac{d}{t}$

$t \times v = \frac{d}{t} \times t$ — *Multiply both sides by "t"*

$t \times v = \cancel{\frac{d}{t} \times t}$ — *Simplify*

$tv = d$

$d = vt$ — *Mirror*

$v = \frac{d}{t}$

$tv = d$ — *Bring t up*

$\boxed{d = vt}$ — *Mirror*

Solve for t

$v = \frac{d}{t}$

$t \times v = \frac{d}{t} \times t$ — *Multiply both sides by "t"*

$tv = d$

$\frac{tv}{v} = \frac{d}{v}$ — *Divide both sides by "v"*

$\frac{t\cancel{v}}{\cancel{v}} = \frac{d}{v}$ — *Simplify*

$t = \frac{d}{v}$

$d = vt$

$\frac{d}{v} = t$

Bring "v" down

$v = \frac{d}{t}$

$\boxed{t = \frac{d}{v}}$ — *Switch v and t*

$$\boxed{\frac{a}{b} = \frac{c}{d}}$$

Solve for "a"

$\frac{a}{b} = \frac{c}{d}$

$\boxed{a = \frac{cb}{d}}$ — *Bring "b" up*

Solve for "c"

$\frac{a}{b} = \frac{c}{d}$

$\frac{ad}{b} = c$ — *Bring "d" up*

$\boxed{c = \frac{ad}{b}}$ — *Mirror*

Solve for "b"

$\frac{a}{b} = \frac{c}{d}$

$a = \frac{cb}{d}$ — *Bring "b" up*

$ad = cb$

$\frac{ad}{c} = b$ — *Bring "c" down*

$\boxed{b = \frac{ad}{c}}$

Solve for "d"

$\frac{a}{b} = \frac{c}{d}$

$\frac{ad}{b} = c$ — *Bring "d" up*

$ad = cb$

$\boxed{d = \frac{cb}{a}}$ — *Bring "a" down*

P11 - Isolating variables $a^2 + b^2 = c^2, v_f^2$ $Notes$

$\boxed{a^2 + b^2 = c^2}$

Solve for "c"

$$a^2+b^2 = c^2$$

$$\sqrt{a^2 + b^2} = \sqrt{c^2}$$ *Square root both sides*

$$\sqrt{a^2 + b^2} = c$$

$$c = \sqrt{a^2 + b^2}$$ *Mirror*

Solve for "a"

$$a^2 + b^2 = c^2$$

$$a^2 = c^2 - b^2$$ *Bring b^2 over*

$$\sqrt{a^2} = \sqrt{c^2 - b^2}$$ *Square root both sides*

$$a = \sqrt{c^2 - b^2}$$

Solve for "v_f"

$\boxed{v_f^2 = v_i^2 + 2ad}$

$$v_f^2 = v_i^2 + 2ad$$

$$\sqrt{v_f^2} = \sqrt{v_i^2 + 2ad}$$ *Square root both sides*

$$v_f = \sqrt{v_i^2 + 2ad}$$

Solve for "v_i"

$$v_f^2 = v_i^2 + 2ad$$

$$v_f^2 = v_i^2 + 2ad$$

$$v_f^2 - 2ad = v_i^2$$

P11 - Significant Figures

Accuracy

Precision

Natural Numbers

Natural Numbers (1,2,3...) are Significant

123	3 sig figs
12	2 sig figs
9876	4 sig figs

Zero's

Leading Zeros aren't significant

0.4	1 sig fig
0.044	2 sig figs

Middle zeros are Significant

505	3 sig figs

Trailing Zeros

After Decimals are significant

0.40	2 sig figs

If No Decimal, trailing zeros aren't significant

10	1 sig fig
100	1 sig fig

Adding/Subtracting
Round answer to least # decimal place

5.5 + 5 = 10.5 = 11

Multiplication/Division
Round answer to least # sig figs

11 × 8 = 88 = 90

10.	1.0×10^1	2 sig figs
100.	1.00×10^2	3 sig figs

P11 - Sci Not Sig and Ex Figs

Write in Scientific Notation, with 3 sig figs

$4567 = 4.57 \times 10^3$

Round to two sig figs

$4000 = 4.00 \times 10^3$

AKA: 4570

Write in Scientific Notation, with 2 sig figs

$4521 = 4.5 \times 10^3$

$= 4500$

$4000 = 4.0 \times 10^3$

Write in Scientific Notation, with 1 sig figs

$4213 = 4 \times 10^3$

$= 4000$

$\mathit{Find\ velocity\ if\ distance} = 2000m\ \mathit{and\ time} = 25s$

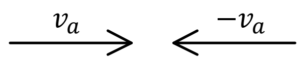
2000	25
1 sf	2 sf
Round to 1 sf	

$$v = \frac{d}{t}$$
$$v = \frac{2000}{25}$$
$$v = 80\ \frac{m}{s}$$

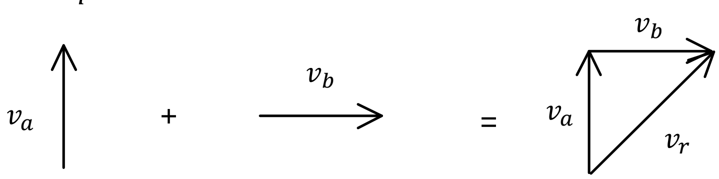
$$v = 8 \times 10^1\ \frac{m}{s}$$

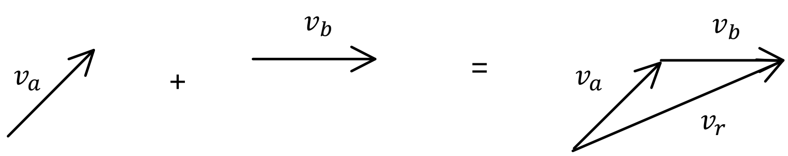
P11 - Resultant Vector Notes

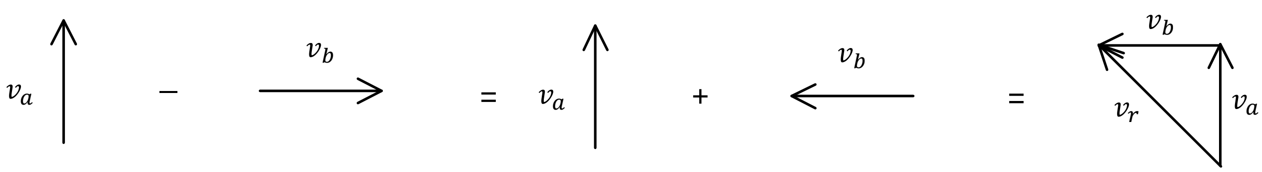
Properties

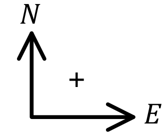


Tip to Tail



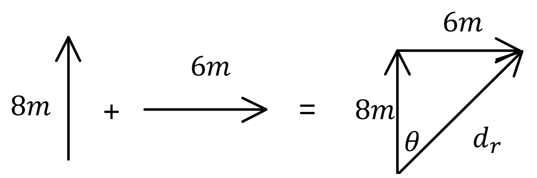






P11 - Pythag Displacement Vector Notes

If you walk 8 *meters North*, *then* 6 *meters east*, *what is your displacement*?

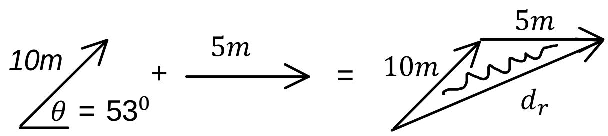


$$a^2 + b^2 = c^2$$
$$8^2 + 6^2 = c^2$$
$$100 = c^2$$
$$c = 10$$
$$d_r = 10m$$

$$tan\theta = \frac{opp}{adj}$$
$$tan\theta = \frac{6}{8}$$
$$\theta = \tan^{-1}(0.75)$$
$$\theta = 36.9^0 \quad [EoN]$$

$\boxed{[EoN]\ Towards\ East\ From\ North}$

If you walk 10 *meters* 53^0 $[NoE]$, *then* 5 *meters east*, *what is your displacement*?



$$sin\theta = \frac{o}{h}$$
$$sin37 = \frac{o}{10}$$
$$10sin37 = o$$
$$o = 6.02m$$

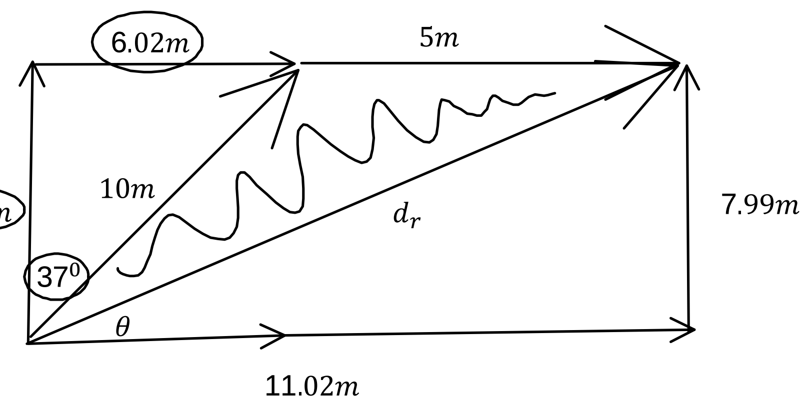
$\boxed{hsin\theta = a}$

$$cos\theta = \frac{a}{h}$$
$$cos37 = \frac{a}{10}$$
$$10cos37 = a$$
$$a = 7.99m$$

7.99m

$90^0 - 53^0 = 37^0$

$\boxed{hcos\theta = a}$



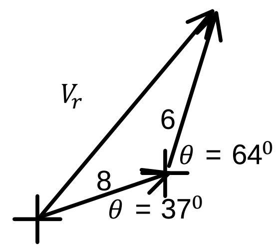
$$a^2 + b^2 = c^2$$
$$11.02^2 + 7.99^2 = c^2$$
$$185.2 = c^2$$
$$c = 13.6$$
$$d_r = 13.6m$$

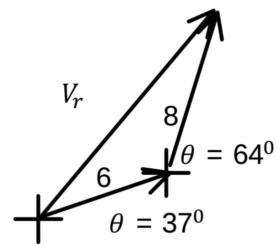
$$tan\theta = \frac{opp}{adj}$$
$$tan\theta = \frac{7.99}{11.02}$$
$$\theta = \tan^{-1}(0.725)$$
$$\theta = 35.9^0 \quad [NoE]$$

P12 - Comp Displacement Vector Notes

N $+$ E

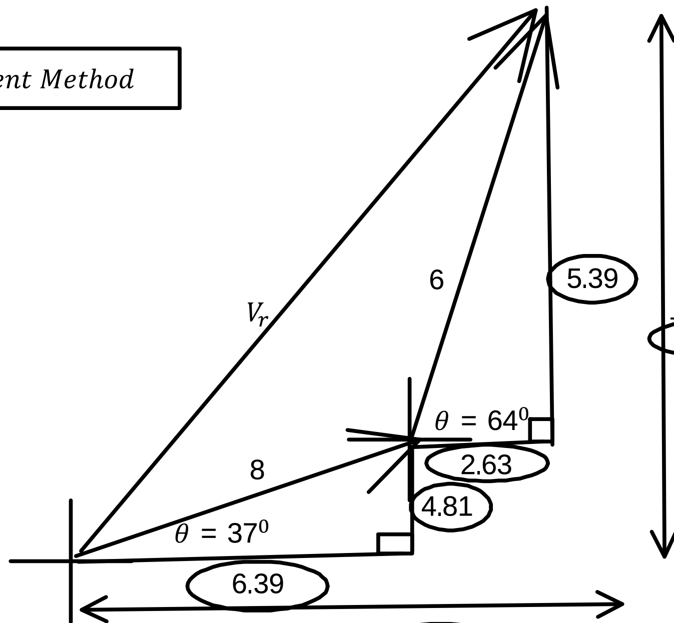
If you walk 8 *meters* 37^0 $[NoE]$, *then* 6 *meters* 64^0 $[EoN]$, *what is your displacement*?





Cosine Law M11

Component Method



$$\begin{array}{r} 4.81 \\ \underline{+5.39} \\ 10.2 \end{array}$$

$sin\theta = \frac{y}{h}$

$y = hsin\theta$

$y = 6sin64$

$y = 5.39$

$cos\theta = \frac{x}{h}$

$x = hcos\theta$

$x = 6cos64$

$x = 2.63$

$6.39 + 2.63 = 9.02$

$cos\theta = \frac{x}{h}$

$x = hcos\theta$

$x = 8cos37$

$x = 6.39$

$sin\theta = \frac{y}{h}$

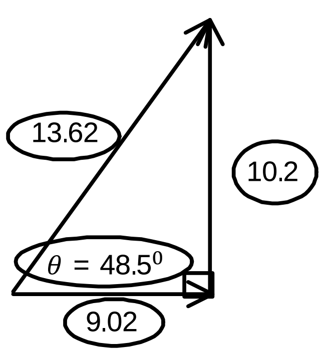
$y = hsin\theta$

$y = 8sin37$

$y = 4.81$

Pythagoras

x	y
6.39	4.81
2.63	5.39



$a^2 + b^2 = c^2$

$9.02^2 + 10.2^2 = c^2$

$c = 13.62$

$tan\theta = \frac{x}{y}$

$\theta = \tan^{-1}\left(\frac{10.2}{9.02}\right)$

$\theta = 48.5^0$

Resultant Vector $= 13.62\,m\ 48.5^0\ [NoE]$