$$r = |k| \dot{E}^a \rho^b t^c$$

scale ~~antagsis~~ analysis

$$L = \left(\frac{ML^2}{T^2}\right)^a \left(\frac{M}{L^3}\right)^b \left(T\right)^c$$

M's cancel $\Rightarrow a = -b$

T's cancel $\Rightarrow c = 2a$

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$$L = \left(\frac{ML^2}{T^2}\right)^a \left(\frac{M}{L^3}\right)^{-a} \left(T\right)^{2a}$$

$$= L^{2a-(-3a)} = L^{5a}$$

$5a = 1 \quad a = \frac{1}{5}$

$b = -1/5$

$c = 2/5$

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Units of pressure P

force per unit area m^2

Newton, $1\,N = 1 \frac{kg\,m}{s^2}$

$1 \frac{N}{m^2} = 1\,Pa$ (Pascal)

At sea level, $P = 15 \frac{lb}{in^2}$

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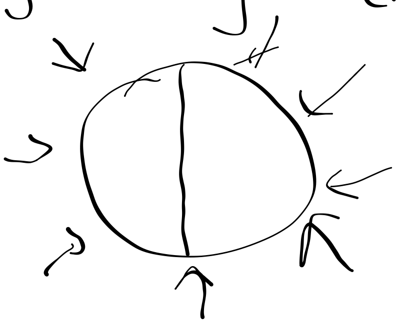
Convert to SI units.

$\Longrightarrow 15 \frac{lb}{in^2} = 1 \times 10^5\,Pa$

Due to the mass of air above our heads.

Magdeburg Hemispheres



pressure is uniform around outside of sphere. If we pump air out, then $p(\text{inside}) = 0$

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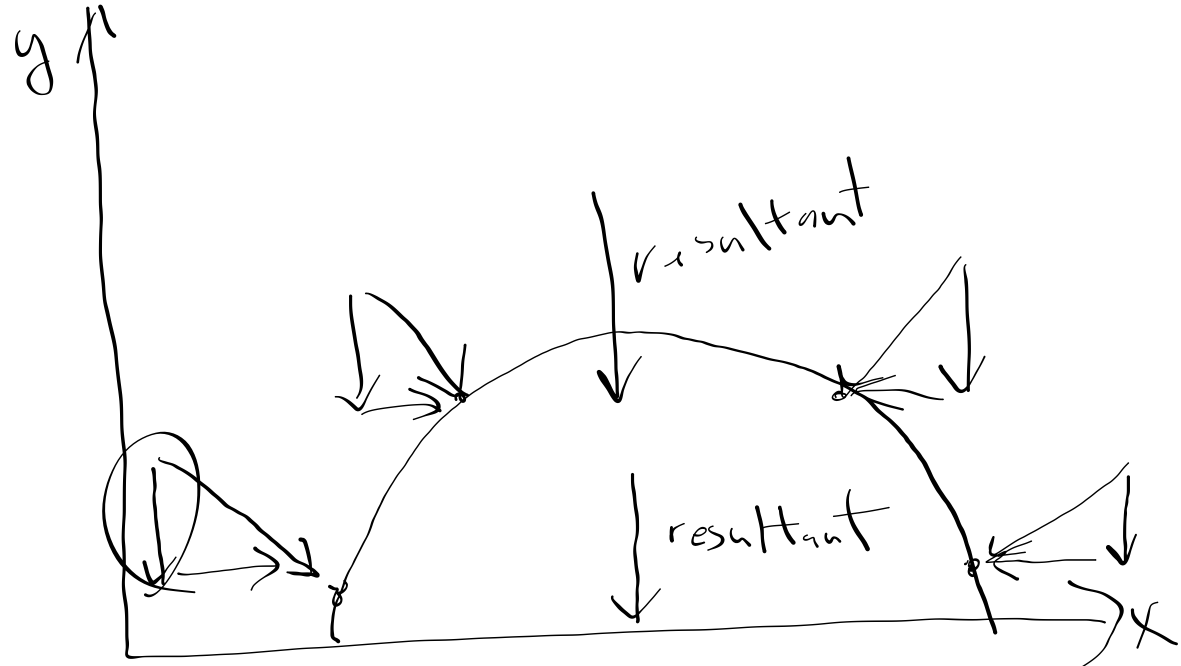

The only forces acting on hemisphere are in the y-direction

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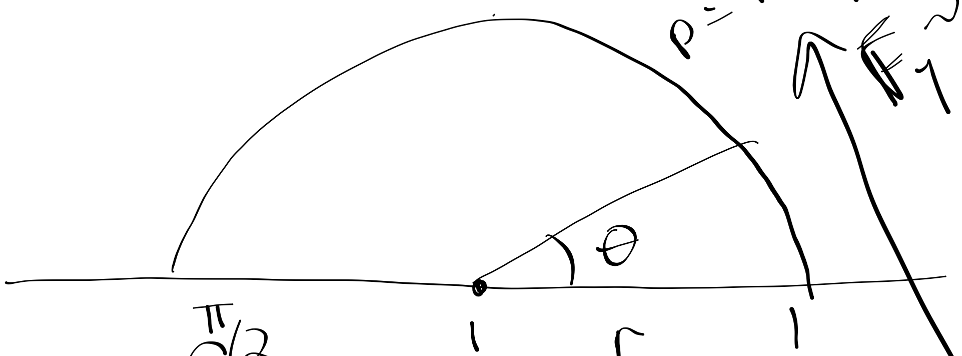
Magnitude of net force?

in our case,
$r = 2\,in$
$p = 15\ \frac{lb}{in^2}$

$F_y \sim 180\,lb$



$$F_y = \int_0^{\pi/2} p \sin\theta \, 2\pi r \, (r\cos\theta \, d\theta)$$
$$= \pi r^2 p$$

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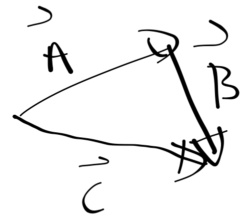
Adding vectors

$\vec{A} + \vec{B} = \vec{C}$

2 ways:

I graphically "head-to-tail"



II components: we add x-components
" " y-components

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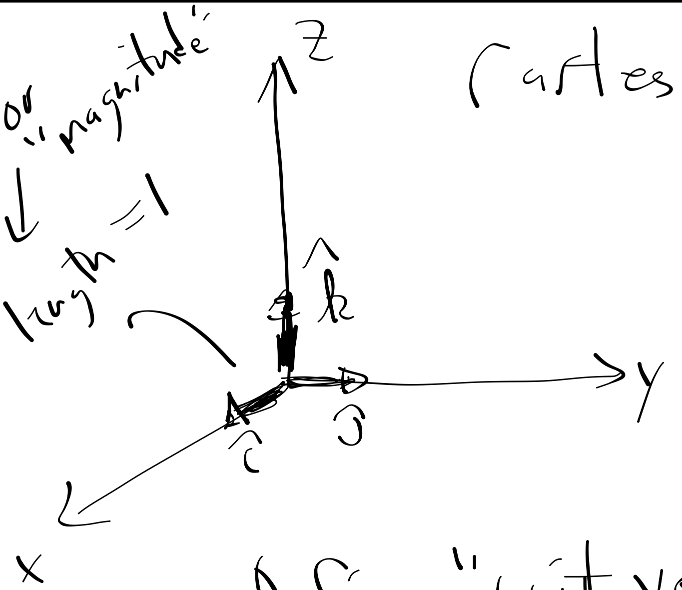
Cartesian

or "magnitude"
length = 1



Define "unit vectors"

$\hat{i}$ = unit vector in x direction
$\hat{j}$ = " " " y "
$\hat{k}$ = " " " z direction

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We can express any vector in terms of unit vectors

$$\vec{A} = A_x\hat{i} + A_y\hat{j} + A_z\hat{k}$$

where A_x, A_y, A_z are the magnitude of the components of $\vec{A}$

$$\vec{B} = B_x\hat{i} + B_y\hat{j} + B_z\hat{k}$$

$$\vec{C} = (A_x+B_x)\hat{i} + (A_y+B_y)\hat{j} + (A_z+B_z)\hat{k}$$

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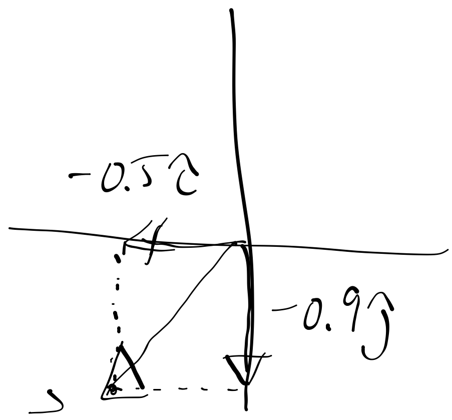
Clicker



$$\vec{D} = -0.5\hat{i} - 0.9\hat{j}$$

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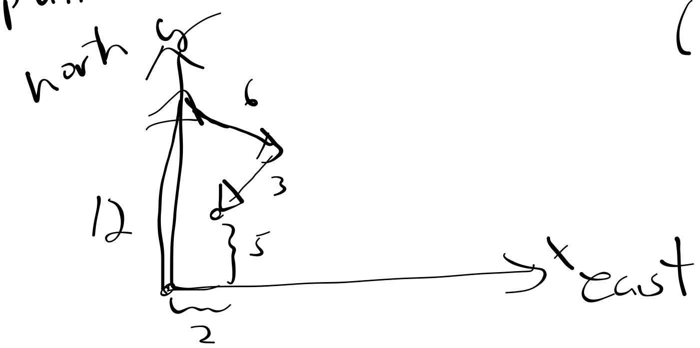
Example

Golfer 3 putts

putt 1: 12 ft north ($\vec{A}$)

putt 2: 6 ft south~~west~~east ($\vec{B}$)

putt 3: 3 ft southwest (in the hole) ($\vec{C}$)



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$$\vec{A} = 12\hat{j}$$

$$\vec{B} = 6(\cos 45^\circ)\hat{i} - 6(\sin 45^\circ)\hat{j}$$

$$\vec{C} = -3(\cos 45^\circ)\hat{i} - 3(\sin 45^\circ)\hat{j}$$

$$\vec{A} + \vec{B} + \vec{C} = 2.1\hat{i} + 5.6\hat{j}$$

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