HOW TO WIN A SNOWBALL FIGHT With Maths (On the Moon)

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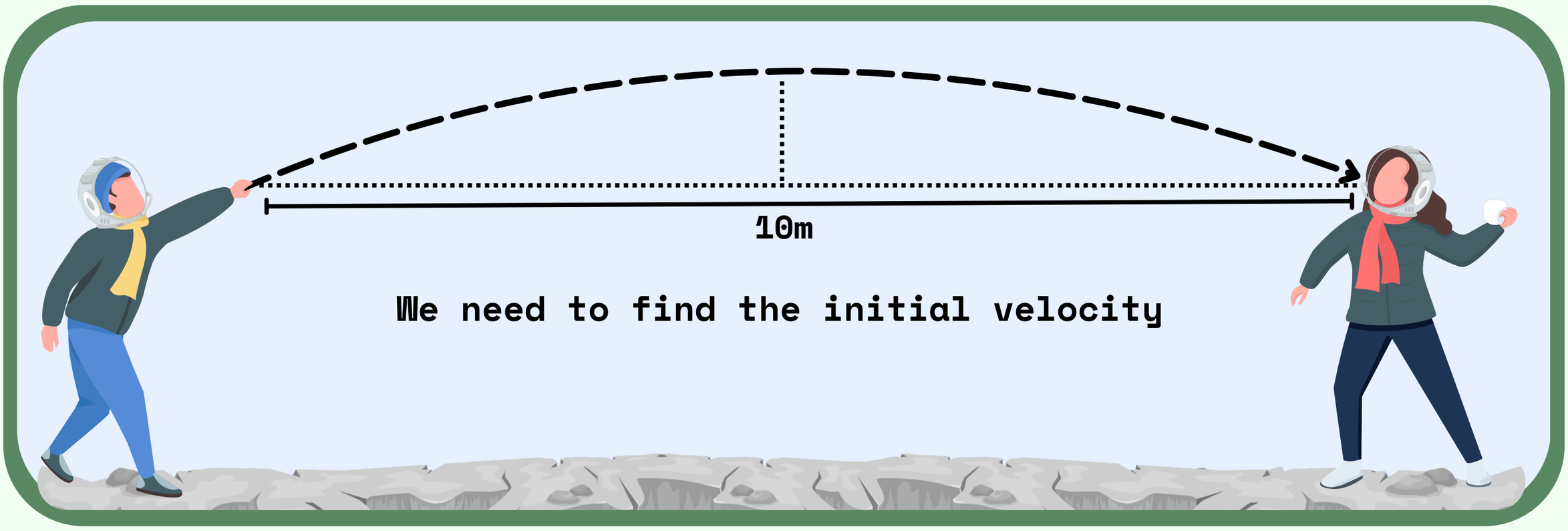
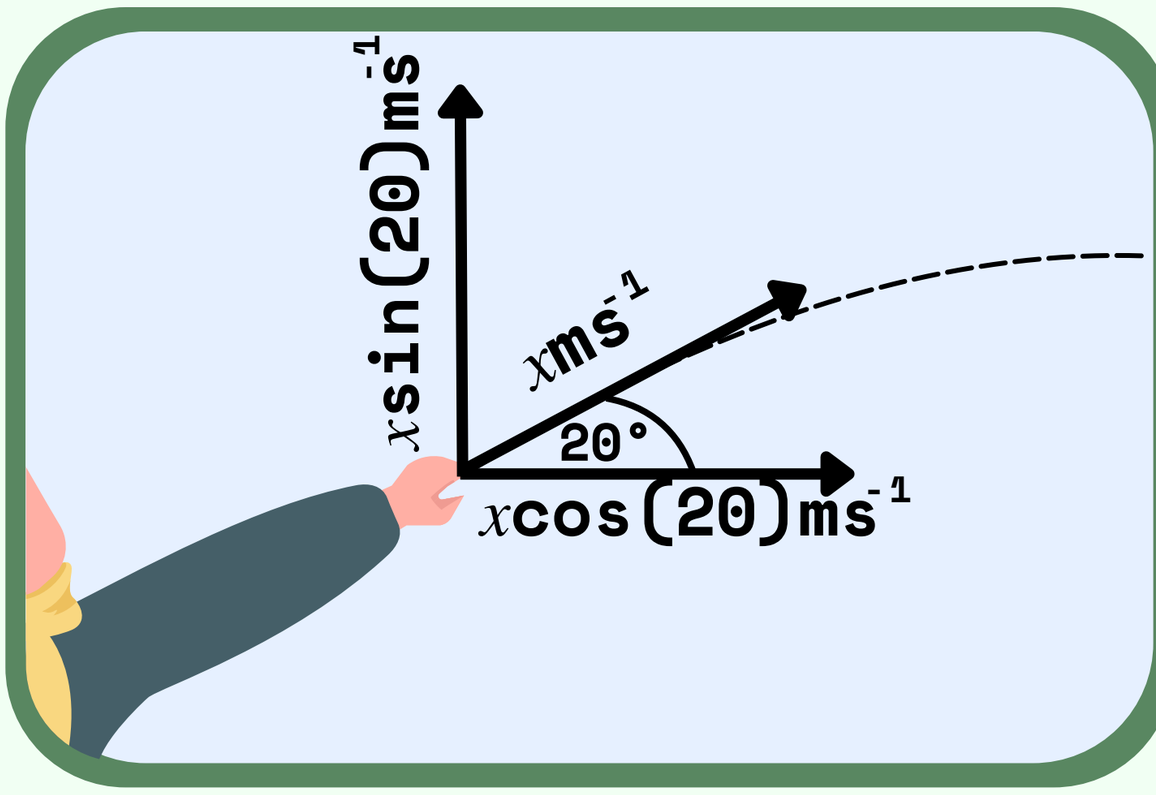
Steve throws a snowball at Jenna, at an angle of 20°. She is 10m away. How fast does Steve have to throw it to hit Jenna?



First we have to resolve it into its vertical and horizontal vectors

Next we use two SUVAT equations. As we don't know the time it takes we will have to use t in both equations and then put them equal to each other to remove time.



Horizontal	Vertical
$s=1/2(u+v)t$	$s=ut+1/2at^2$
as the horizontal velocity is constant this will simplify to...	As the displacement vertically is 0m, s=0.
$s=(u)t$	$0=x\sin20t-1/2x1.6t^2$
$10=(x\cos20)t$	Divide by t to simplify. This is ok as t can't equal 0
$t=10/(x\cos20)$	$0=x\sin20-1/2x1.6t$
	$t=2x\sin20/1.6$

(a on the moon is roughly $1.6ms^{-2}$)

Now we put the two equations equal to eachother

$$10/(x\cos20)=2x\sin20/1.6$$

Finally put it equal to x

$$2x^2\sin20x\cos20-16=0$$

$$x^2=16/2(\sin20x\cos20)$$

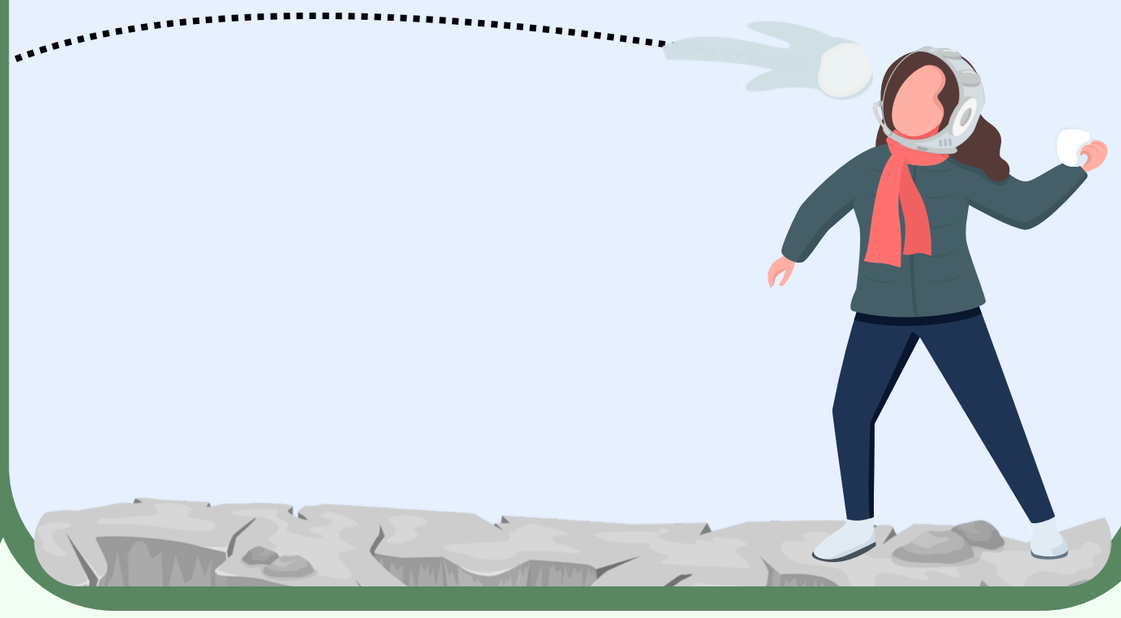
$$x^2=16/2(\sin20x\cos20)$$

$$x=\sqrt{16/2(\sin20x\cos20)}$$

$$x=4.9891...$$

$$\underline{x=4.99ms^{-1}}$$

With this initial speed Steve will hit Jenna with the snowball.



References

- SUVAT equations made by Cédric Gaspard Suvat
- Projectile motion (lumen learning)
- Acceleration due to gravity on the moon (NASA)