VECTORS

Scaler; the quantity (mph, etc.)

Direction; how the scaler is going to be affected

there are things that aren't affected by direction, such as temperature and age, they don't need north, south, east or west to make sense.

Velocity; a vector quantity that contains both the quantity and the direction

Distance; the scaler, how far you go
Displacement; how far you end up from the starting point

~there are different ways to go a certain distance. You can take all of the steps forward, or you can take some forward and some backwards, or some forward and some sideways, etc. The distance will always be the same (for example, 7 steps) but the displacement can always change depending on how you take the steps.

Composition of vectors; the resultant of the combination of more than one vector

Newtons; a unit of push and pull, measurement of force

Q; What is the resultant of 5 newtons east and 6 newtons east?
A; 11 newtons east

Q; What is the resultant of 5 newtons east and 6 newtons west?
A; 1 newton west

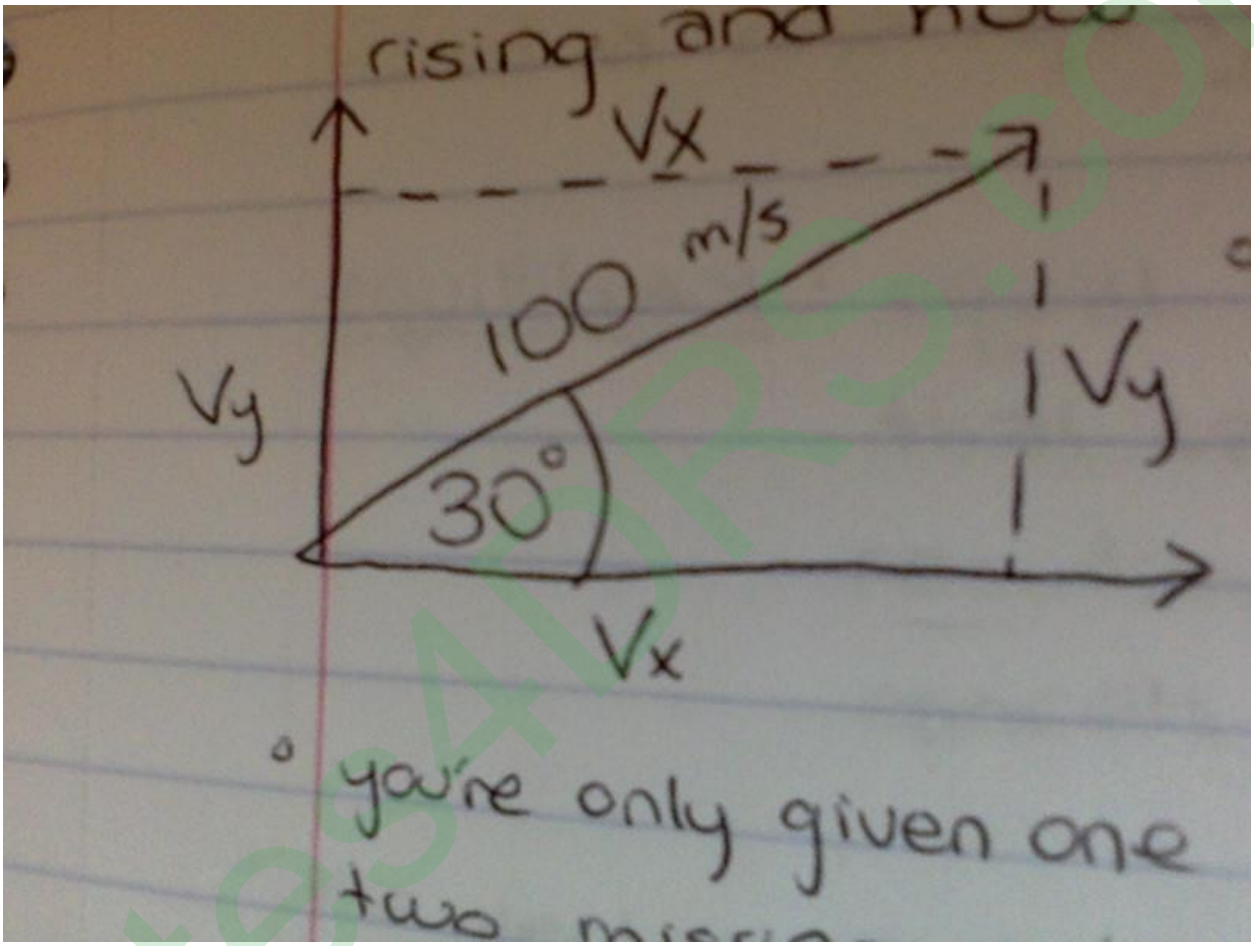
Q; What is the magnitude of the resultant of 9 newtons east and 12 newtons north?
A; 15 newtons

You make a chart, going up 12 and going east 9. Draw a diagonal in between them and do the pythagorean theorem to solve for the missing side, the hypotenuse. If you wanted to solve for the angle, you would use SohCahToa. When debating which one to use, use the one that doesn't include the hypotenuse because that's the side that you solved for, and if you made an error in solving for it, then both of your answers will be wrong.

Q; What is the resultant of 6 newtons east and 8 newtons north?
A; missing side: 10 newtons
angle: 53 degrees

Resolution of Vectors

An airplane is travelling at a velocity of 100 meters per second at an angle of elevation at 30 degrees. How fast is it rising and how fast is it moving forward?



~If a diagonal is made from a horizontal and vertical line, then you can make a horizontal and vertical line from any diagonal.

~In this problem you're only given one side and an angle, so using those two, you solve for the missing side.

~Use SIN or cosine because you were only given the hypotenuse.

USING SIN

$\frac{\sin(30)}{1} = \frac{Vy}{100}$ then you cross multiply sin(30) with 100

USING COSINE

$\frac{\cos(30)}{1} = \frac{Vx}{100}$ same thing, you cross multiply cos(30) with 100

Velocity; it's a vector that includes speed, the number, magnitude and direction.

Q; 15 newtons north, 10 newtons east and 5 newtons south?

- The first thing you do is the 5 newtons south from the 15 newtons north because they're opposites so you can't go *both* ways
- You're left with 10 newtons north and 10 newtons east
- This makes it a square because both sides in the chart (not shown) are equal.
- It's a right angle, so the angle you're solving for is 45 degrees.

KINEMATICS

Laws of Motion

Acceleration; the rate of change in velocity
Uniform acceleration - changing at same amount (car changing velocity from 40 to 45 to 50 every second, but at a constant rate of 5 so it's uniform)

$V = (Vi + Vf)/2$
If you go from 0 mph to 60 mph then average is 30 mph

Gravity makes everything accelerate with same mass at same rate

If one is making a circle with their arm at a constant speed, there is a change in acceleration. You would think that there isn't, but since when the arm is turning, it changes direction. Direction is part of velocity, and that means there is a change in velocity.

Equilibrant; equal and opposite to the resultant. It's a vector that cancels out the resultant. The resultant cancels out the two forces that were combined to form the resultant, the equilibrant cancels out the entire thing.

- The vectors cancel each other out
- The middle (the ring for example) is at equilibrium because it's being pulled on a lot of sides, but it isn't moving.
- Each pull is the equilibrant of the other two
- Each resultant is the equilibrant of the other two

Inertia; an object at rest tends to remain at rest. An object in motion will continue to stay in motion unless acted upon by an outside force. Like if something is pushed in space it will continue to float through space forever if nothing blocks its path.

For example, if you take a ball and you roll it, technically, it should just continue rolling.

Friction; creation of heat by the rubbing of surface on surface

On earth, we can't truly observe what the true nature of an object is. This is because there are opposing forces that slow things down. One of these forces is friction. Friction is basically heat, energy. But we know that energy isn't created, it's simply taken from something else. The heat created by the friction is taken from the kinetic energy of the moving object, which slows down the object.

Minimizing friction; using air hockey as an example; the air that's being jetted onto the table, under the puck isn't pushing the puck to move. It's creating a small layer of air that cushions the puck so that the friction is minimized between the puck and the table. Therefore, the puck can move freely and won't stop until the air is turned off.

- Objects have resistance to change

ACCELERATION FORMULA; $\alpha = \frac{\Delta}{t}$ or $\alpha = \frac{Vf - Vi}{t}$

Positive acceleration; speeding up
Zero acceleration; speed is at a constant rate
Negative acceleration; slowing down

TWO FORMULAS: **Vi+at= Vf** **and** **d= Vit + ½ at∧ *2***

A car is travelling at 30 meters per second. It accelerates at the rate of 3 meters per second∧ *2*. (this means that each second it goes up by three, not by one) for 5 seconds. What is the new velocity?

(Use the first formula above) 30 + (5)(3) = Vf ⇒ **Vf = 45**
How far did it travel during those 5 seconds?

(use the second formula)

d= 30(5) + ½ 3(5)∧ *2* d= 187.5 meters;

A car is travelling at 30 meters per second. It accelerates uniformly at the rate of 4 meters per second∧ *2*. (this means that each second it goes up by three, not by one) for 5 seconds. What is the new velocity?

(Use the first formula above) 30 + (5)(4) = Vf ⇒ **Vf = 50**
How far did it travel during those 5 seconds?

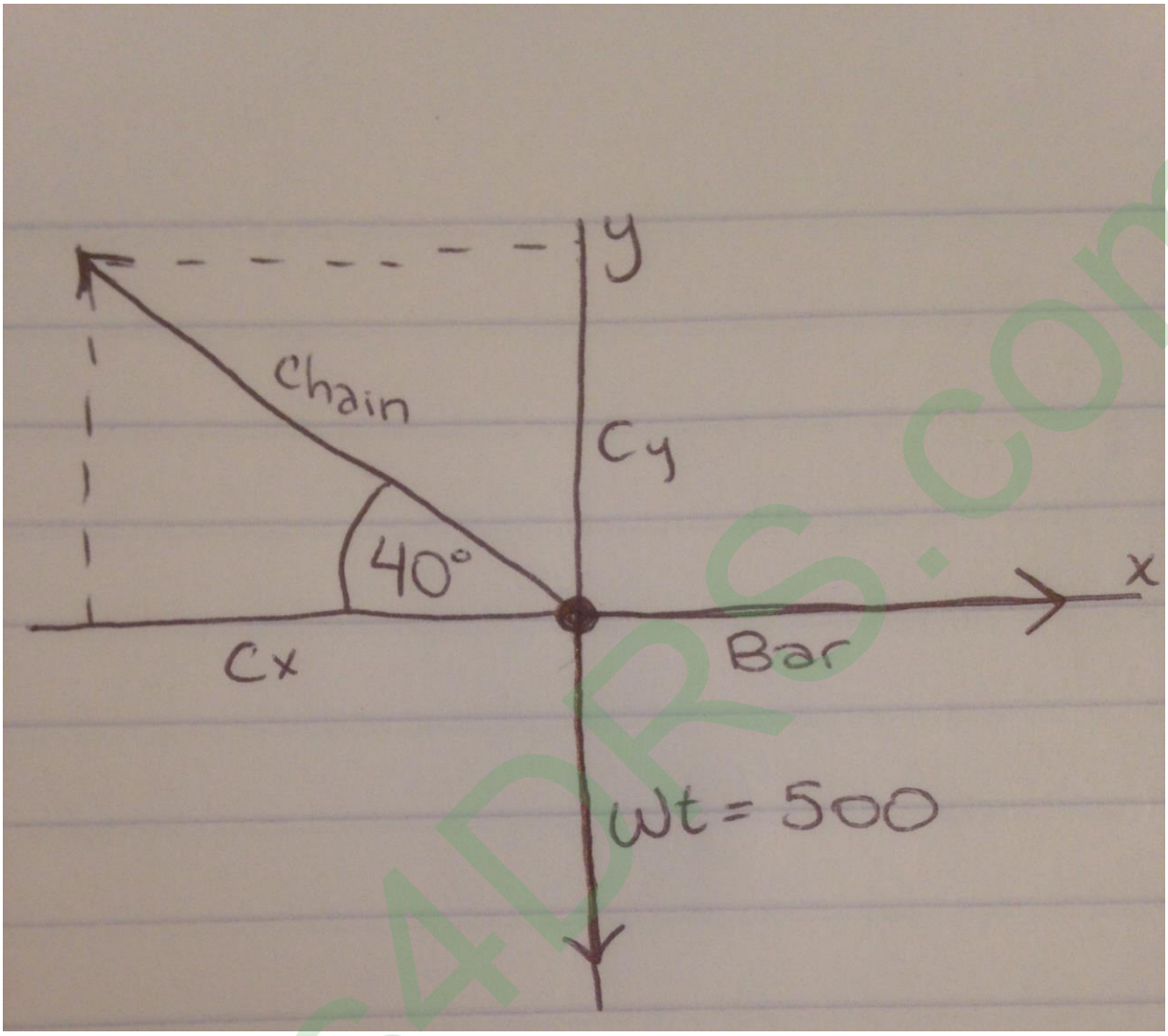
(use the second formula)

d= 30(5) + ½ 4(5)∧ *2* d= 200 meters

LAB #2

**diagram of the store with the sign

- the chain is physically holding up the sign. The bar is pushing out the chain because otherwise the chain would be hanging limply at the side of the store, and nobody would see it.
- the point of equilibrium is the point where all three vectors (chain, sign and bar) meet.



- when these three forces are equal, the whole system is at equilibrium
- we know it's at equilibrium because the sign is being pulled by two forces, the bar and the chain, and it's still not moving. The system is at rest
- □□ = *0*

□□□ = *0*	□□□ = *0*
left = right	up = down
□□ = □	□□ = *500*

❑ because we know that that every diagonal comes from a horizontal and vertical line, drop two perpendiculars from the C so that you have an x axis C and a y axis C

- when you cross multiply, it doesn't matter if you switch two of the things being multiplied because multiplication is commutative.