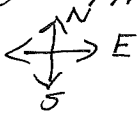
Name KEY Period 1&3

SPASH PHYSICS

UNIT 3 REVIEW (NEWTONS 3rd LAW AND VECTORS)

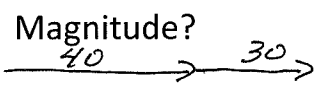
Part 1 VECTORS

1. A boat has a velocity vector due East at 40 KM/HR.
   a. What is the magnitude of the vector with units? 40 KM/HR
   b. What is the direction of the vector? due East



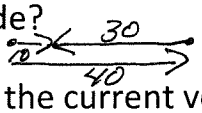
What if a current also travels due East at 30 KM/HR.

c. What is the resultant velocity of the boat taking the current vector into account?
   Magnitude? 70 KM/HR Direction? due East



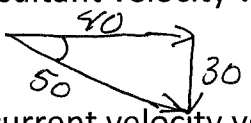
Now let us change the current velocity vector to due West at 30 KM/HR.

d. What is the resultant velocity vector of the boat's velocity and the currents velocity?
   Magnitude? 10 KM/HR Direction? due East



Now let us change the current velocity vector to due South at 30 KM/HR.

e. What is the resultant velocity vector of the boat's velocity and the currents velocity?
   Magnitude? 50 KM/HR Direction? $\theta = \tan^{-1}\left(\frac{30}{40}\right) = 36.9°$ S of E

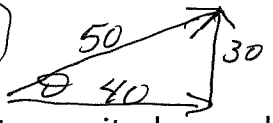


$C = \sqrt{30^2 + 40^2} = 50$

Now let us change the current velocity vector to due North at 30 KM/HR.

f. What is the resultant velocity vector of the boat's velocity and the currents velocity?
   Magnitude? 50 KM/HR Direction? 36.9° N of E

Same as e



Same as e only

g. Can the resultant magnitude ever be 75 KM/HR for this problem if the boat always has a velocity with magnitude 40 KM/HR and the current always has a velocity with magnitude 30 KM/HR; noting both vectors can be any direction you wish?

NO, The resultant magnitude has to be between the sum and the difference inclusively $10 \le x \le 70$ in this case

2. Graphically, what is the rule for adding two or more vectors together?

Keeping there magnitudes and directions the same, hook them all tail to head. The resultant is from the tail of the 1st to the head of the last.

Mathematically, what is the rule for adding two or more vectors together? (Two ways) Precalc only

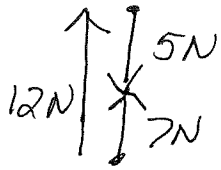
with only two vectors you can use law of cosines to obtain the magnitude. The easiest way though with two or more vectors is to ① change all their directions to the math + x axis (over)

(2. cont.) as zero degrees and go counter clockwise. ② Then add up all the magnitudes times the SIN of the angles and the magnitudes times the COS of the angles ③ Use the resultants of these two with Pythagorean Thm for magnitude and inverse TAN for direction.

3. If you are pulling with 12 N vector force due north and a friend is pushing the same object with a vector force of 5 N due north, what is the resultant vectors force and direction?

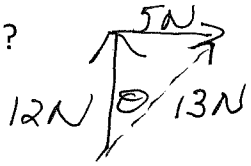
magnitude 17N
direction due North

4. If you are pulling with vector force of 12 N due north and a friend is pulling with a vector force of 5 N due south, what is the resultant vector force's magnitude and direction?



magnitude 7N
direction due North

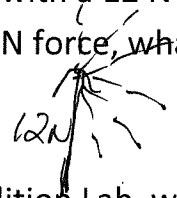
5. If you are pulling with vector force of 12 N due north and a friend is pulling with a vector force of 5 N due East, what is the resultant vector force's magnitude and direction?



$c = \sqrt{5^2 + 12^2} = 13N$

$\theta = \tan^{-1}\left(\frac{5}{12}\right) = 22.6^\circ$ E of N

6. If you are pulling with a 12 N force due north and a friend is pushing any direction possible with a 5 N force, what are all the possibilities for the final magnitude of the resultant force?



$12N - 5N \le x \le 12N + 5N$

so $7N \le x \le 17N$

7. In the Vector Addition Lab, when you added any two of the three vector forces, how was the resultant vector related to the 3rd force's vector? Magnitude and direction

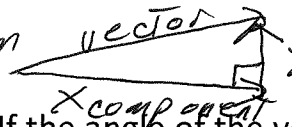
The resultant was the equilibrant of the 3rd vector thus same magnitude but opposite direction

8. In the Where Am I Lab, what was the easiest way to find the resultant card given the 19 cards each with a vector or a scalar on the index card? Seperate the vectors from the scalars, adding the N/S, E/W, up/down together then going each of the three remaining directions to the resultant.

9. What was the point of drawing a right triangle with the Etch-a-Sketch? To draw the hypotenuse you turned each knob the same as drawing the legs.

10. How do you resolve a vector into its components? Essentially make a right triangle with the vector being the hypotenuse.

Note diagram

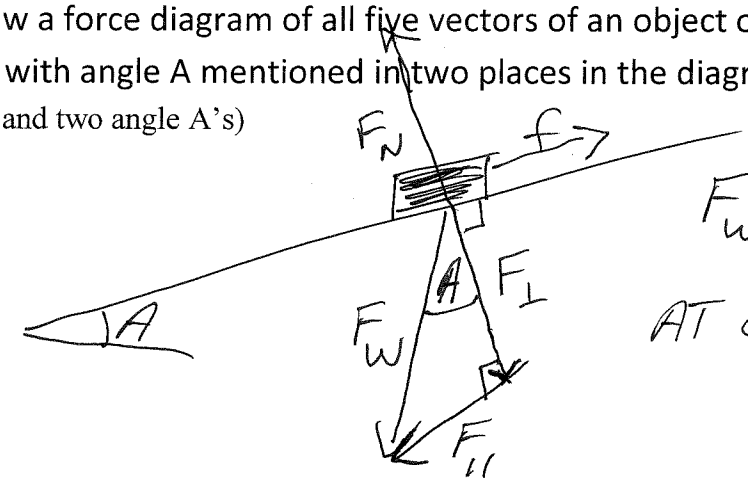


11. If the angle of the vector is A degrees and the vector has a magnitude of F N, what is the formula for the vertical component's magnitude? $(F)(\sin A)$

What is the formula for the horizontal component's magnitude?

$(F)(\cos A)$

12. Draw a force diagram of all five vectors of an object of weight F_w on an incline plane of angle A with angle A mentioned in two places in the diagram. (Vectors F and F and F_N and F_W and f and two angle A's)



$F_W = F_\perp + F_{\parallel}$

AT Constant Speed

$F_{\parallel} = -f$

$F_\perp = -F_N$

13. A. What is the equilibrant of 13 N due South?

13 N due North

B. What is the bearing of the direction 13° S of E? 90° 13° 103°

C. What is the bearing of the direction 13° N or W? 270 13° 283°

D. What is the heading of the direction 13° W or N? 13° 360 −13 347 347°

Precalc only

E. What is the trigonometric way (with the +x axis zero degrees and going counterclockwise around the quadrants) of an angle for each of the above:

A. 270° B. 347° C. 180 −13 167°

S

What is the advantage of doing it this way?

The signs (±) of the four quadrants are done automatically.

Part 2 Newtons 3RD Law

1. What is Newton's 1st Law?

An object in motion will remain in motion in a straight line and an object at rest will stay at rest UNLESS acted upon by a net non-zero force.

2. What is Newton's 2nd Law?

If an object IS acted upon by a NET NON-ZERO force, the object will be accelerated directly related to that force and inversely related to the mass.

3. What is Newton's 3rd Law including magnitude's and direction's?

Forces come in pairs equal in magnitude but opposite in direction.

Newton's 3rd Law continued from other side

4. Orally name at least three places you see Newton's 3rd law taking place while observing them, to someone nearest to you? Legs of chair pushing down on floor with floor pushing up on legs of chair equally. Posterior pushing down on seat and seat pushing up on posterior equally. Elbow on desk pushing down and desk pushing up on Elbow. (CONTACT POINTS)

5. Who wins at a tug of war? whoever the ground and the rope can push back on the most

6. What is the reaction force of a car taking a curve? The friction of the Tires on the road surface pushing back.

7. What is the reaction force of pulling back and letting go of all five spheres on a Newton's Cradle? The friction between the legs of the Newton's Cradle and the surface its sitting on. Think contact points

8. On an incline plane, what is the reaction force to the normal force?

$F_{\perp}$

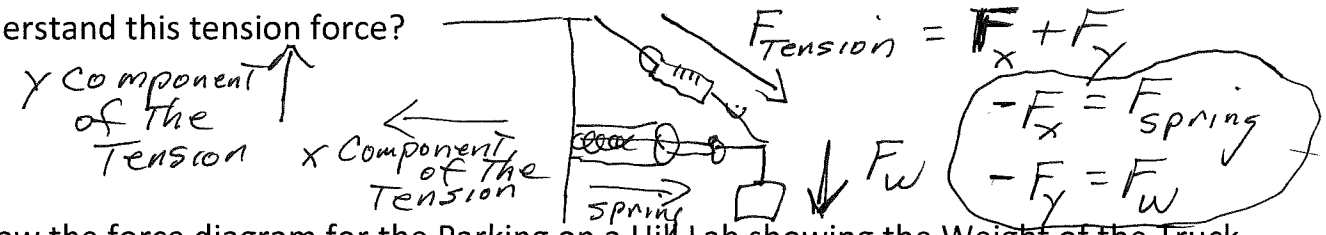
9. On an incline plane, what is the reaction force to the friction force if the object is sliding down the incline plane at a constant speed?

$F_{\parallel}$

10. On an incline plane, what is the reaction force to the weight force sitting on the incline plane?

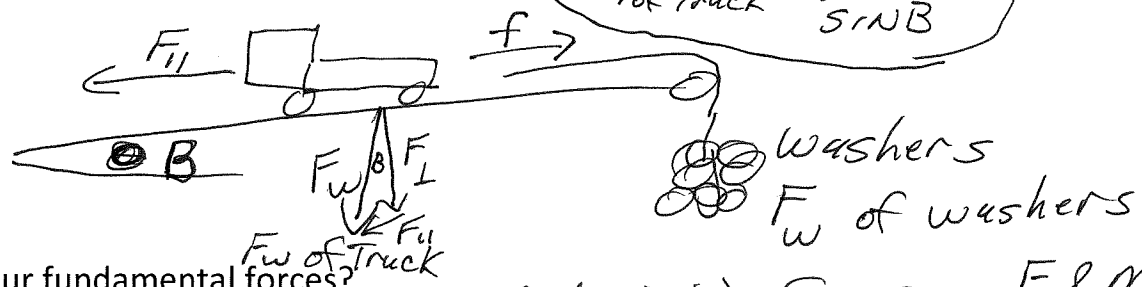
$F_N + f$

11. Draw the force diagram for the Boom Lab showing the Boom force of the spring pushing out, the hanging weight force down, and the resolution of the tension in the cable both pushing in and pulling up. How does the etch a sketch activity help you understand this tension force?



12. Draw the force diagram for the Parking on a Hill Lab showing the Weight of the Truck vector, the parallel vector force, the perpendicular vector force, and the angle of the incline B at two places. Which component was equal to the weight of the washers? $F_{\parallel}$
How did we calculate the weight of the truck? $F_{weight\ of\ truck} = \frac{F_{\parallel}}{\sin B}$

$-F_{w\ of\ washers} = F_{\parallel}$



13. Name the four fundamental forces?
Strong (holding nucleus together); Weak (radioactivity); Gravity (weakest); E&M (electricity magnetism)