

UNIT 4 PROBLEMS* VECTORS**

Questions:

1. What is a resultant vector? Can it replace the originals?
2. What does an Equilibrant do when added to a system?
3. What terms are vectors?
4. Can an object in equilibrium be moving? Why/why not?
5. What is the sum of three vectors that form a triangle?
6. What two components do we break weight into?
7. What are the maximum and minimum possible sums of the forces 8N and 12N? What angles correspond with these sums?
8. How do we draw vectors? How do we add them together?
9. The sum of all forces in equilibrium is:
10. When two vectors act on one thing, does one vector change the other?
11. In what order do we add vectors?

Problems A: Mathematical vectors: (Solve these problems using Pythagorean's theorem and/or trig.)

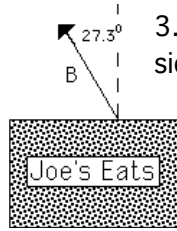
1. Omar and Oscar are fighting over who walks the dog. Omar pulls a leash North with a force of 150 N, Oscar pulls South with 125 N. What is the resultant force on the poor dog?
2. Layla's airplane flies West at 125 m/s, while a wind blow from the North at 25 m/s. What is the resultant velocity of the plane?
3. Three teams play tug of war on a circular rope. Team A pulls East at 500.0 N, team B North with a 250.0 N force, and team C due West with 750.0 N. What is the resultant? Who is winning?
4. Vivian's boat travels West at 32.5 m/s across a river that is flowing South at 15.5 m/s. What is the resultant velocity of the boat?
5. How long did it take the boat in #4 to go across the river if it was 190 m wide? How far downstream was it at that time?
6. A rocket shoots straight up at 149.9 m/s. If a wind blows due West at 15 m/s, what is the resultant velocity of the rocket?

B: Equilibrium/equilibrant

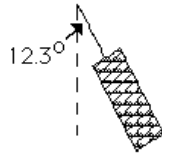
1. What force would bring a 35.8 N force at 39.7° into equilibrium?
2. If two forces act concurrently on a point, what

third force will bring equilibrium? Force #1 is 34.9 N at 29° , force #2 is 47.1 N at 119° .

3. Two ropes hold up a sign. Rope A pulls straight sideways with a 69.5 N force. Rope B pulls at a 27.3° angle from the vertical. What is the weight of the sign?



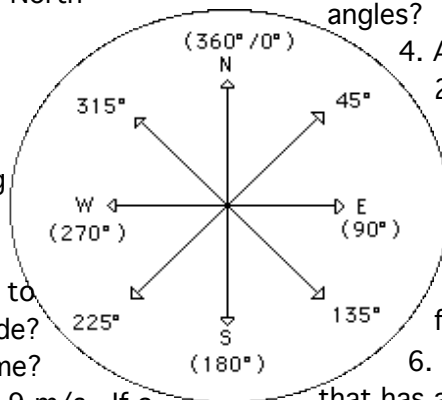
4. A 75 N sign is suspended by a cable. If a strong wind blows the sign so it forms a 12.3° angle with the vertical, how much force is the wind exerting on the sign?



5. Three teams play tug of war on a circular rope. Team A pulls East at 500.0 N, team B North with a 250.0 N force, and team C due West with 750.0 N. What force (with angle) would a 4th team need to pull with to bring the system into equilibrium?

C: Vector resolution/weight inclined

1. If you are traveling at 105.3 m/s at 37.3° , how fast are you moving North? East?
2. Kari pulls a box across a floor with a 720 N force. If he is pulling the rope at a 17.8° angle with the horizontal, what force is actually overcoming friction? If the coefficient of friction is .18 and the box is not accelerating, how heavy is the box?
3. You can only apply a 329 N force on your lawnmower. The angle of the mower is adjustable at 30° , 45° and 60° angles. What is the horizontal component of your applied force at those three angles? What does this tell you about pushing at angles?
4. A water skier pulls on a rope with 249 N when directly behind the boat. What is the tension in the rope when the skier cuts out 39.5° ?
5. A 1205N box is on a ramp inclined to 47.3° . What force wants to pull it down the ramp? What is the normal force?
6. Christina is sliding down a 30° slide that has a coefficient of friction of .237. She has a mass of 12.3 kg. How big is the force pulling her down? How big is the friction force? Will she slide?



7. A 68.9 kg box is on a ramp with a coefficient of friction of .45. The ramp is inclined to 43.8° . How hard do you have to push on the box to get it to move at constant speed up the ramp?

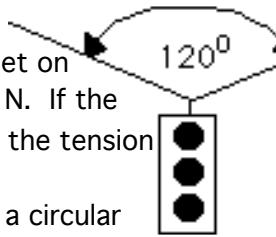
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D: Law of sines/cosines - vector resolution

1. Two girls with no taste are fighting over Mr P. One grabs his right arm and pulls at a 32.8° angle with a 325 N force, while the other pulls his left arm at 248° , with a 320 N force. What is the resultant force on Mr P?

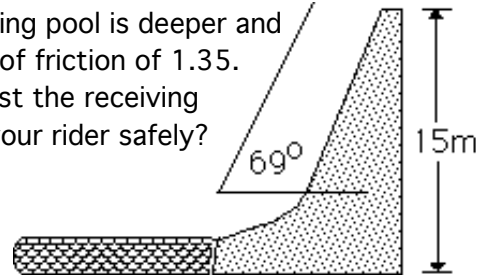
2. A traffic light is held over a street on a cable. The sign's weight is 45.3 N. If the cable makes a 120° angle, what is the tension in the cable?

3. Three teams play tug of war on a circular rope. Team A pulls East at 500.0 N, team B at 193° with a 250.0 N force, and team C at 285° with 750.0 N. What force (with angle) would a 4th team need to pull with to bring the system into equilibrium?



3. Laszlo designed a water slide for speed. The slide starts 15m above the ground and forms a 69° angle with the ground. The average rider has a mass of 62.5 kg and the coefficient of friction on the slide is .013. The receiving pool is deeper and has a coefficient of friction of 1.35.

How long must the receiving pool be to stop your rider safely?



4. Alyssa is trying to move her massive dowry trunk. It has a mass of 312 kg and is on a smooth level floor with a coefficient of friction of .287. She can only pull with a force of 875 N. Can she move the trunk with a straight pull? If she pushes down at a 30° angle? If she pulls upward at a 30° angle?



E: Thinking Problems!

1. Saul is riding a vehicle that can only make 90° turns. He starts off north and travels 349m, then goes 286m W, then 19m S, then 129m W, then 197m N, then 348m E. What is his total displacement?

2. If a 62.8 kg box is on a ramp inclined 32.8° , and the coefficient of friction is .327, what is the final speed of the box if the ramp is 15.9m long?

Probs D:
1) 2.0×10^2 N (195N) @ 322°
2) 45.3 N each
3) 285 N @ 80.0°
Probs E:
1) 530 m @ 353°
2) 9.12 m/s
3) 11 m
4) a. no
b. no
c. yes

Probs C:
1) $N = 83.8$ m/s, $E = 63.8$ m/s
2) 690N, 3800N
3) 285N, 233N, 165N, as the angle increases, the horizontal component decreases.
4) 323N
5) 886N, 817N
6) 60N, 25N, yes, $F_{fr} > F$
7) 690N

Probs B:
1) 35.8N, 219.7° (220°)
2) 58.6N, 262°
3) 135N
4) 16N
5) 353.6N, 135°
6) 150m/s, 6° west of up
or 84° up, to the west
7) 36.0m/s, 245°
8) 5.9 sec, 91 m
9) 353.6N, 315°
10) 130m/s, 259°
11) 25N, North
12) 25N, North

