1. Applications of Vectors

2. You should be familiar with vectors in both rectangular and polar coordinates, and with adding vectors in rectangular coordinates.

    In this lesson, we will add vectors that are given originally in polar coordinates.

3. Recall the conversions from rectangular coordinates to polar coordinates and back.

4. (a) One application of vectors is to add physical forces acting on an object. We are often given the forces in polar coordinates. In this example, force F_1 is pushing with a strength of 10 Newtons in a direction of 30° and force F_2 is pushing with a strength of 18 Newtons in a direction of 320°. Geometrically, we can determine the total force by drawing the parallelogram,

    (b) but it is hard to tell the exact length of the resultant vector. We know how to add vectors in rectangular coordinates, but how do we add the forces in polar form. If the two forces are pushing in opposite directions, they will cancel each other out, but if they are pushing in the same direction, they will add together. The angle between the two vectors has a large effect on the sum.

5. (a) The answer is, we don't add the vectors in polar form. The best way to find the sum of the forces is to first convert to rectangular coordinates

    (b) then add the coordinates

    (c) then convert back to polar coordinates

    (d) The total force is 23.39 Newtons and is pointed in the direction 343.7°.

6. (a) A second application is in navigation. An airplane is affected by the wind. Likewise, a ship travelling through the water is affected by the current. We will use the same procedure of converting to rectangular coordinates, then adding, then converting back.

    (b) To set up the problem, the polar form of the ship's vector has a length of 15 miles per hour and a direction of 70°. The current's vector has a length of 3 miles per hour, and a direction of 310°. We first convert to rectangular coordinates

    (c) Then add the vectors

    (d) then convert back to polar coordinates

    (e) The current, which is pushing back against the ship slows the ship down to 13.74 miles per hour and changes its course to 59.1°

7. To recap: To add two vectors given in polar coordinates, first, convert them to rectagular coordinates, then add, and finally, convert back to polar coordinates.