Sine or Cosine? - Which Do You Use?

In Physics some quantities are at angles and require the use of sine or cosine to solve. For some situations the choice is obvious. For others (objects on ramps, for tetherballs, for cars going around a tilted corner) the choice can be very difficult. Geometry will always show you the right answer, but the geometry, too, may not obvious. By using the idea of minimums and maximums at the extremes of the situation, you can easily decide which trigonometric function to utilize.

Trigonometry Basics

You must MEMORIZE these:

With your calculator, verify these identities:
Sin 0º = 0 Cos 0º = 1
Sin 90º = 1 Cos 90º = 0

Therefore:
Cos is a minimum at 90º
Sin is a minimum at 0º
Cos is a maximum at 0º
Sin is a maximum at 90º

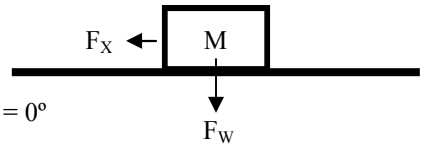
Applying the Logic

As the surface tilts from 0º to 90º, the amount of F_W that moves the object increases until it is at a maximum at 90º. You know this because at 0º gravity doesn't make the object slid at all.

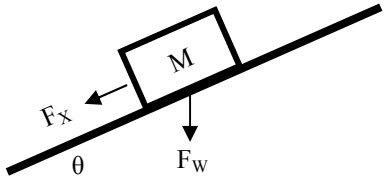
Which function is a maximum at 90º?
Sin 90º = 1, therefore:

$$F_X = F_W(\sin\theta)$$

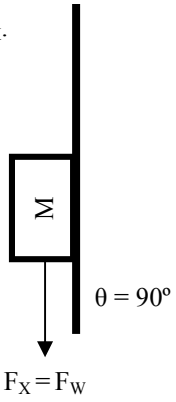
A. $F_X = 0$ (Minimum) NONE of F_W in direction of F_X.



B.

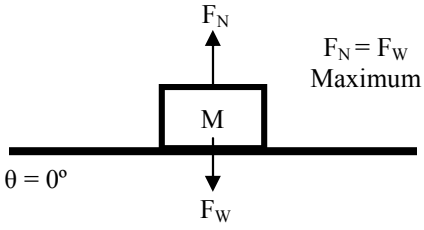


C.



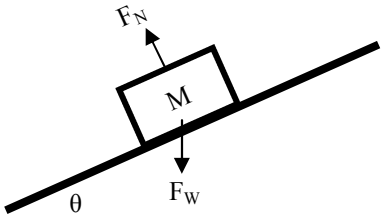
F_X is increasing.

A.



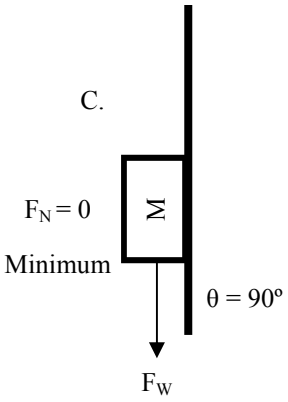
$F_N = F_W$
Maximum

B.



F_N is decreasing.

C.

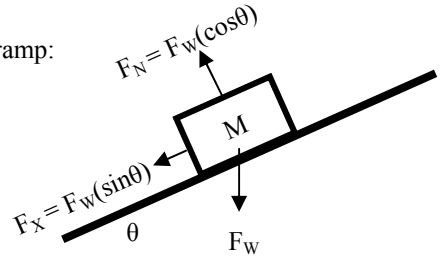


As the surface tilts from 0º to 90º, the amount of F_N decreases. At 0º $F_N = F_W$. At 90º the object falls off the surface, with no friction or F_N at all.

Which function is a maximum at 0º?
Cos 0º = 1, therefore:

$$F_N = F_W(\cos\theta)$$

For an object on a ramp:



Though here the only problem solved is an object moving on a ramp, this same process is effective on other situations as well. Figure out where the forces are at maximums and minimums, then you will know whether to use sine or cosine for the x and y directions.