21-P-FA-AG-039

Two proto-engineers need to test their new iteration of the mammoth chariot. They have captured a big mammoth and are now pulling it towards the testing area. Right now, the mammoth is stubbornly not moving, but is already exerted to its limit. If $F_1 = A$ Newtons and $F_2 = B$ Newtons, then what direction is the mammoth pulling? Select all that apply.

If both the proto-engineers start pulling *P*% more and the mammoth weighs *W* kg, what will be the magnitude of the mammoth's acceleration?

ANSWER:

There are two correct answers for this question.

$$\tan(\theta) = \frac{opposite}{adjacent} = \frac{A}{B}$$

$$\theta = \tan^{-1}\left(\frac{A}{B}\right), south\ of\ west$$

$$\tan(\theta) = \frac{opposite}{adjacent} = \frac{B}{A}$$

$$\theta = \tan^{-1}\left(\frac{B}{A}\right), west\ of\ south$$

The acceleration can be calculated by first finding the force the mammoth is capable of exerting.

$$F_M = \sqrt{{F_1}^2 + {F_2}^2} = \sqrt{A^2 + B^2}$$

Then, we write the force balance equation and rearrange to solve for acceleration.

$$\sum F = ma = F_M - \sqrt{\left(F_1 \cdot (1+P)\right)^2 + \left(F_2 \cdot (1+P)\right)^2}$$

$$a = \frac{\sqrt{A^2 + B^2} - \sqrt{\left(A \cdot (1+P)\right)^2 + \left(B \cdot (1+P)\right)^2}}{W}$$