

Applied Trigonometry

Note that vector quantities are represented by bold symbols, like force \mathbf{F} , whereas scalar quantities are represented by italic symbols, like energy E .

Problems

1. A team of Egyptians building a pyramid pulls a 2000 kg stone block up a (happily frictionless) ramp which is at 15° to the horizontal, for 500 m along the slope. How much work do they do?
2. A bead having mass 0.5 kg is threaded a long horizontal wire, along which it is free to move without friction. It is acted on by a constant force of 2 N at 28° to the horizontal. What is its acceleration?
3. A buoy which has loosed its mooring is at the mercy of wind and tide. If the wind imparts a velocity of 2 knots along a bearing of 038° , and the tide adds a velocity of 1.5 knots along a bearing of 074° , what is the overall velocity?
4. A child slides down a frictionless water slide, which starts a horizontal distance of 30 m from an outdoor swimming pool, and has an angle of 40° . How fast are they going when they make a splash?
5. Two electron guns are positioned 5 cm vertical distance apart. If the lower of the two emits a steady horizontal beam of electrons, at what angle should the other beam be directed in order to make the beams intersect at a horizontal distance of 34 cm away from the sources?
6. A falling object having a mass of 8 kg is acted on by its weight, and a force from a horizontal wind of 20 N. What is the magnitude and direction of the resultant force on the object?
7. A beam of monochromatic light ($\lambda = 598 \text{ nm}$) is normally incident on a diffraction grating, which is at a distance of 50 cm from a screen. If the zeroth order beam strikes the screen normally, at what distance would you expect to see the second order maximum, deflected by an angle of 37° ?
8. The steering of a narrow boat imparts a force of 200 N perpendicular away from the bank. If a horse can provide a force of 850 N, what direction should it pull in to keep the barge going directly along the canal? If we were to replace this arrangement with a single motor, providing a forward force, what would be the force of the motor?
9. A cricket ball is thrown (with neither spin nor drag) at 34° to the horizontal, at a speed of 22 m s^{-1} . How long will it take to reach the batsman. NB The distance between the stumps is $22 \text{ yd} = 20.12 \text{ m}$.