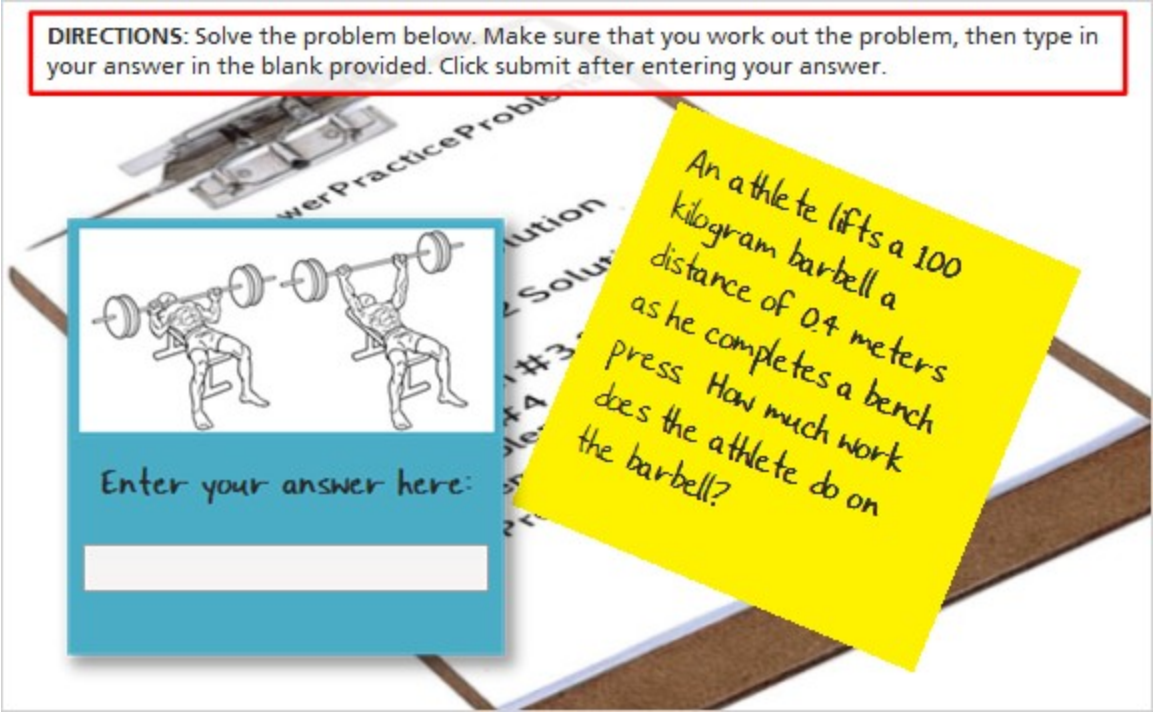
Module 4: Energy
Topic 1 Content: Work and Power Practice Solutions

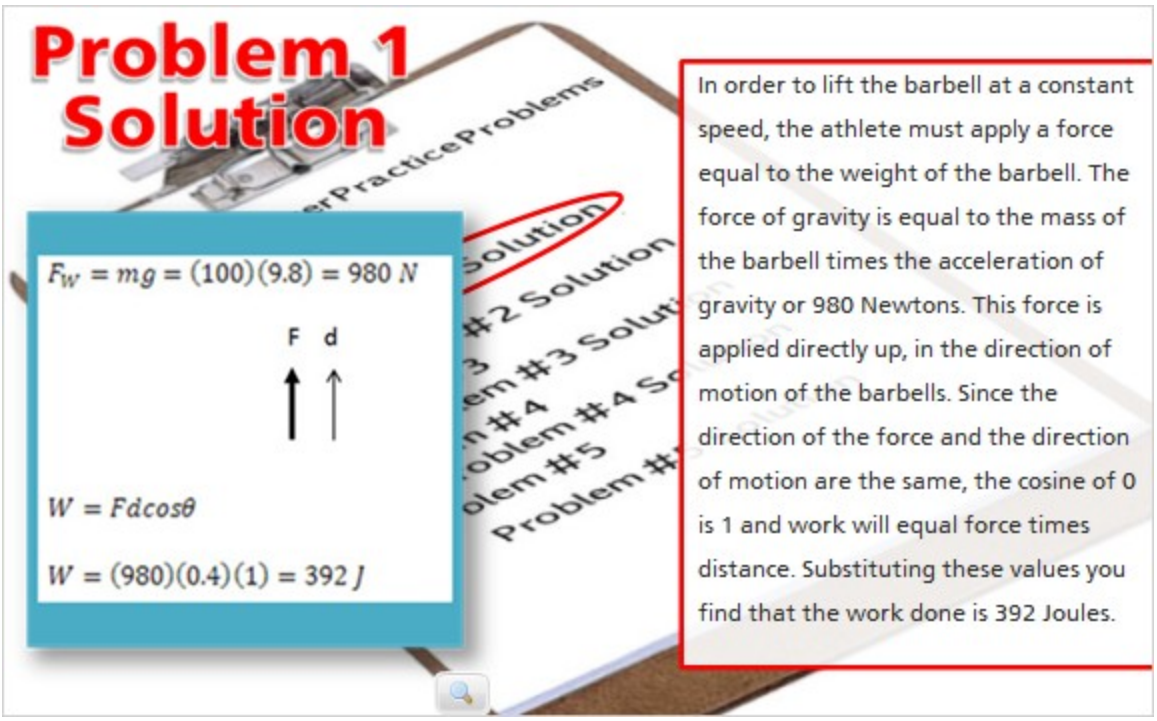
Introduction

Remember tips



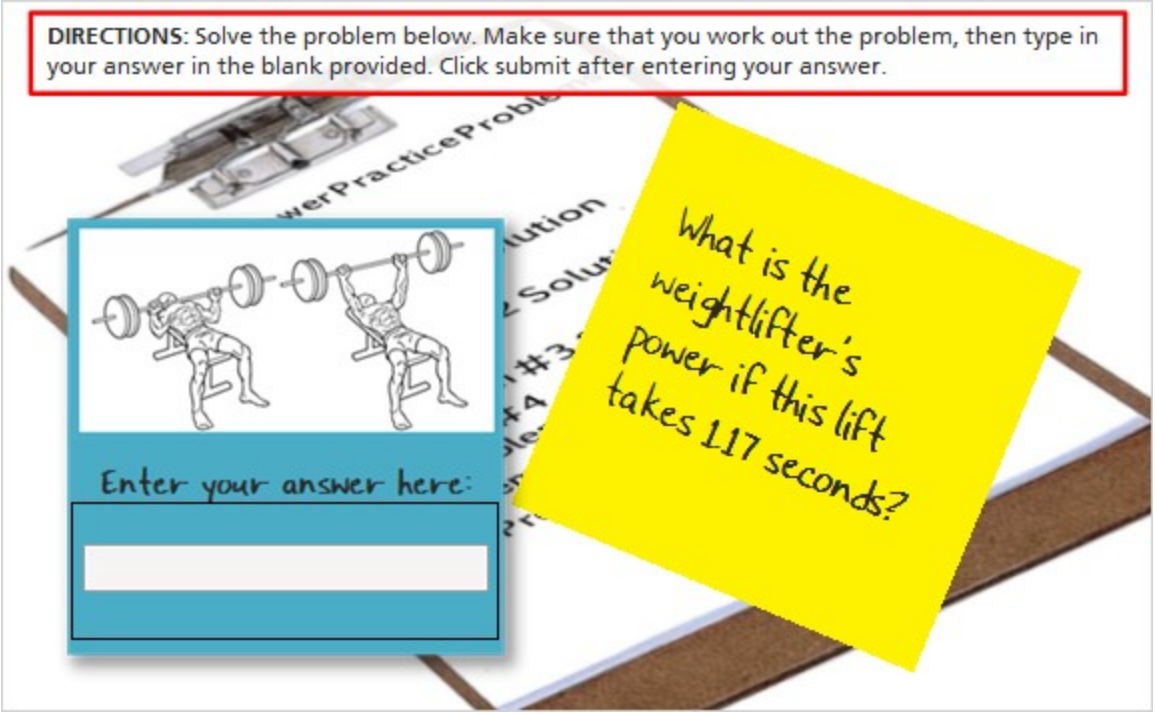
Problem 1

In a practice exercise, a navy ship fires one of its large guns towards a target in the distance. The shell is launched with an initial velocity of four hundred fifty meters per second at an angle of thirty five degrees above the horizon and precisely hits its target. How long is the projectile in the air?



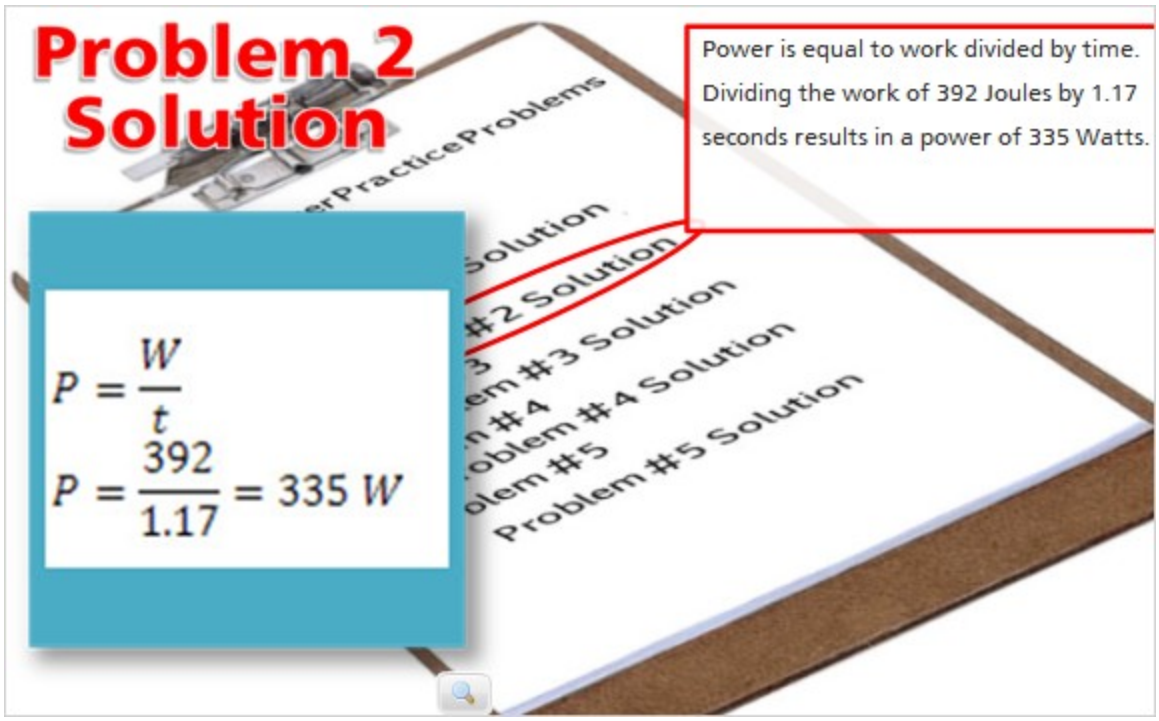
Problem 1 Solution

In order to lift the barbell at a constant speed, the athlete must apply a force equal to the weight of the barbell. The force of gravity is equal to the mass of the barbell times the acceleration of gravity or nine hundred eighty Newtons. This force is applied directly up, in the direction of motion of the barbells. Since the direction of the force and the direction of motion are the same, the cosine of zero is one and work will equal force times distance. Substituting these values you find that the work done is three hundred ninety two Joules.



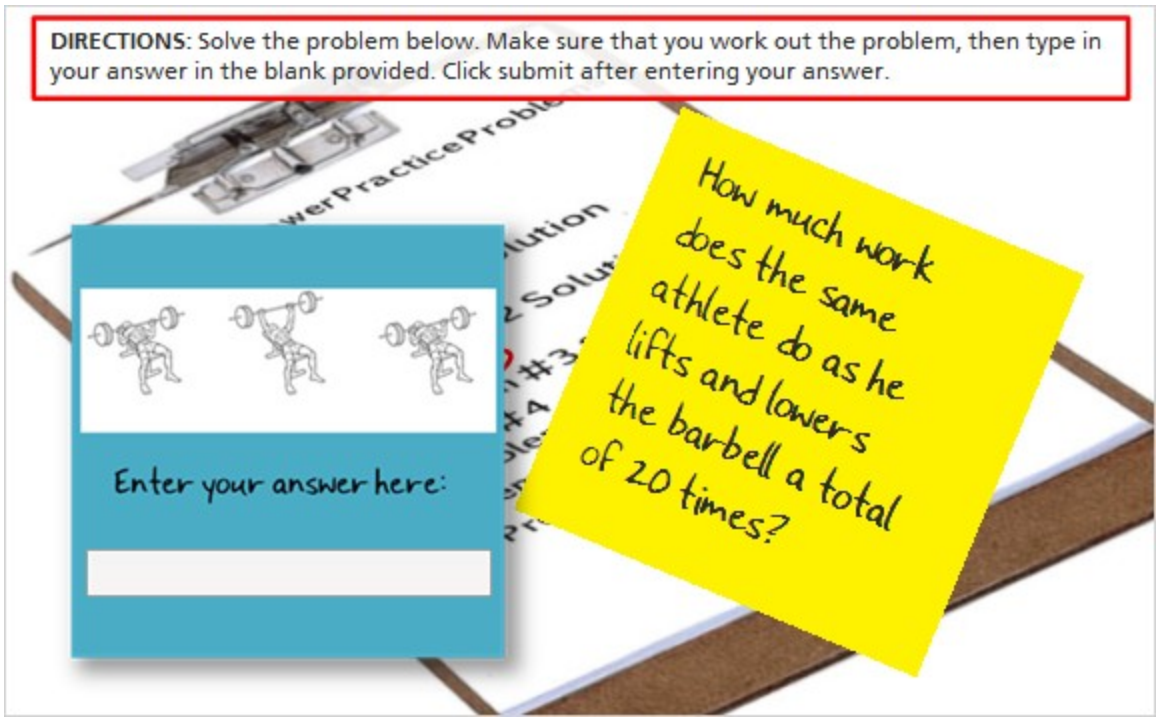
Problem 2

In a practice exercise, a navy ship fires one of its large guns towards a target in the distance. The shell is launched with an initial velocity of four hundred fifty meters per second at an angle of thirty five degrees above the horizon and precisely hits its target. How long is the projectile in the air?



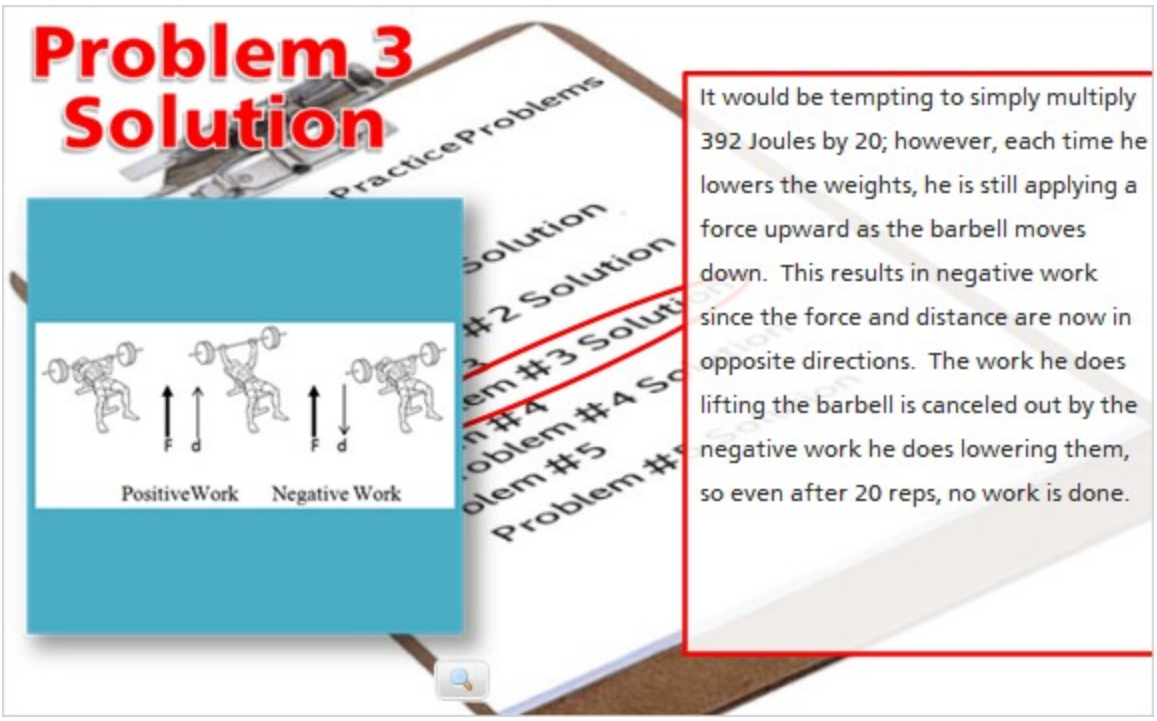
Problem 2 Solution

Power is equal to work divided by time. Dividing the work of three hundred ninety two joules by one point one seven seconds results in a power of three hundred thirty five Watts.



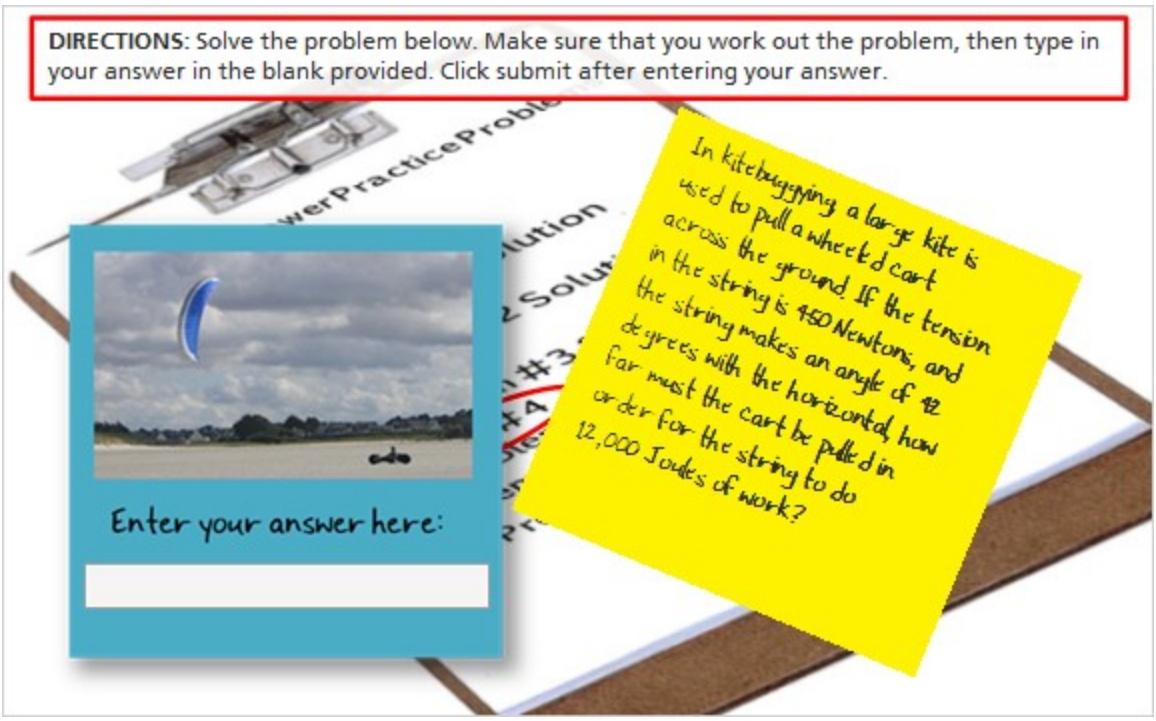
Problem 3

How much work does the same athlete do as he lifts and lowers the barbell a total of 20 times?



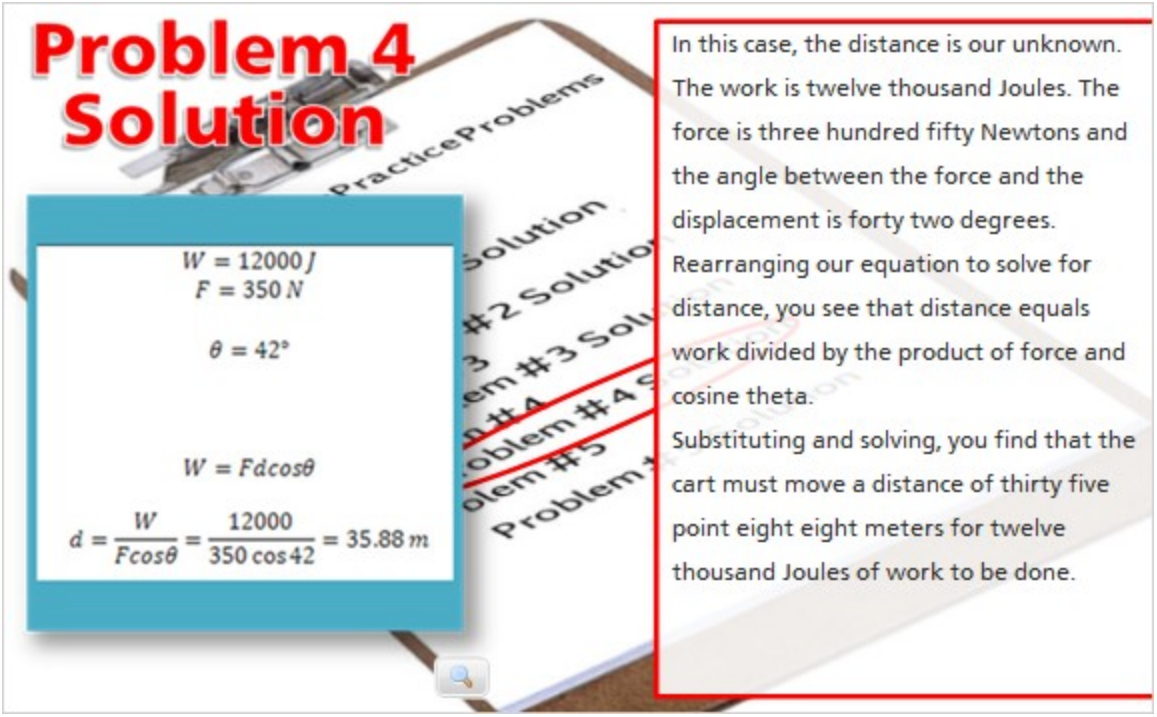
Problem 3 Solution

It would be tempting to simply multiply three hundred ninety two Joules by twenty; however, each time he lowers the weights, he is still applying a force upward as the barbell moves down. This results in negative work since the force and distance are now in opposite directions. The work he does lifting the barbell is canceled out by the negative work he does lowering them, so even after twenty reps, no work is done.



Problem 4

In kitebuggying, a large kite is used to pull a wheeled cart across the ground. If the tension in the string is 450 Newtons, and the string makes an angle of 42 degrees with the horizontal, how far must the cart be pulled in order for the string to do 12,000 Joules of work?

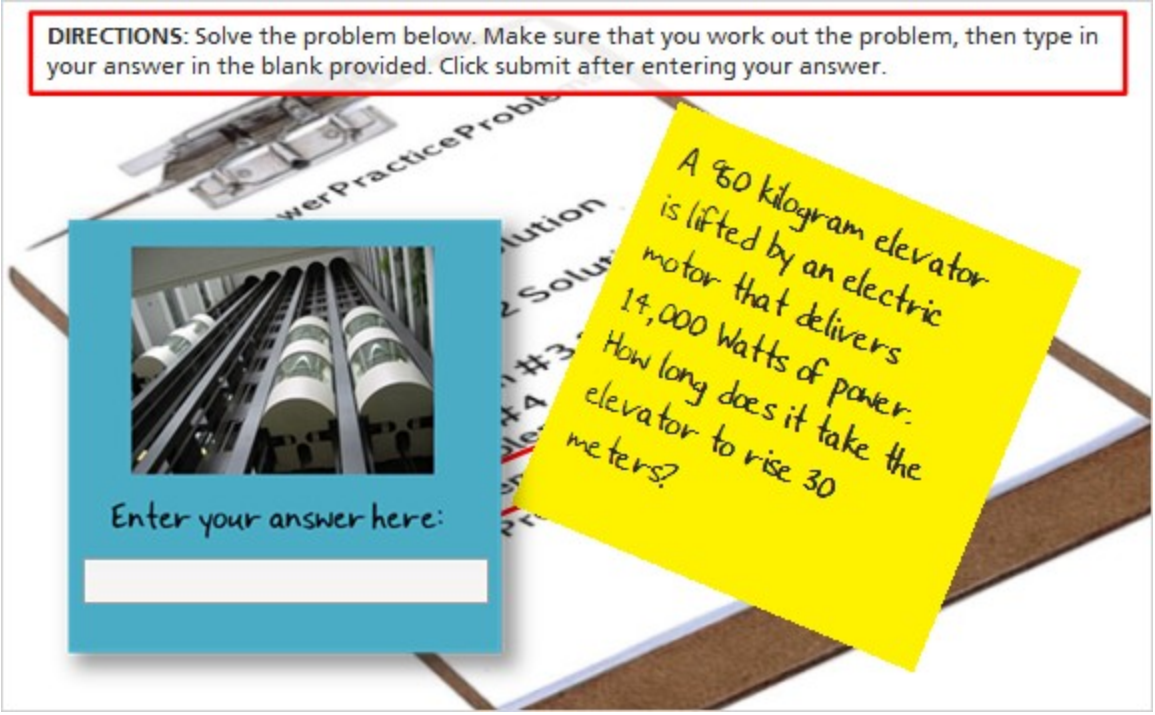


Problem 4 Solution

In this case, the distance is our unknown. The work is twelve thousand Joules. The force is three hundred fifty Newtons and the angle between the force and the displacement is forty two degrees.

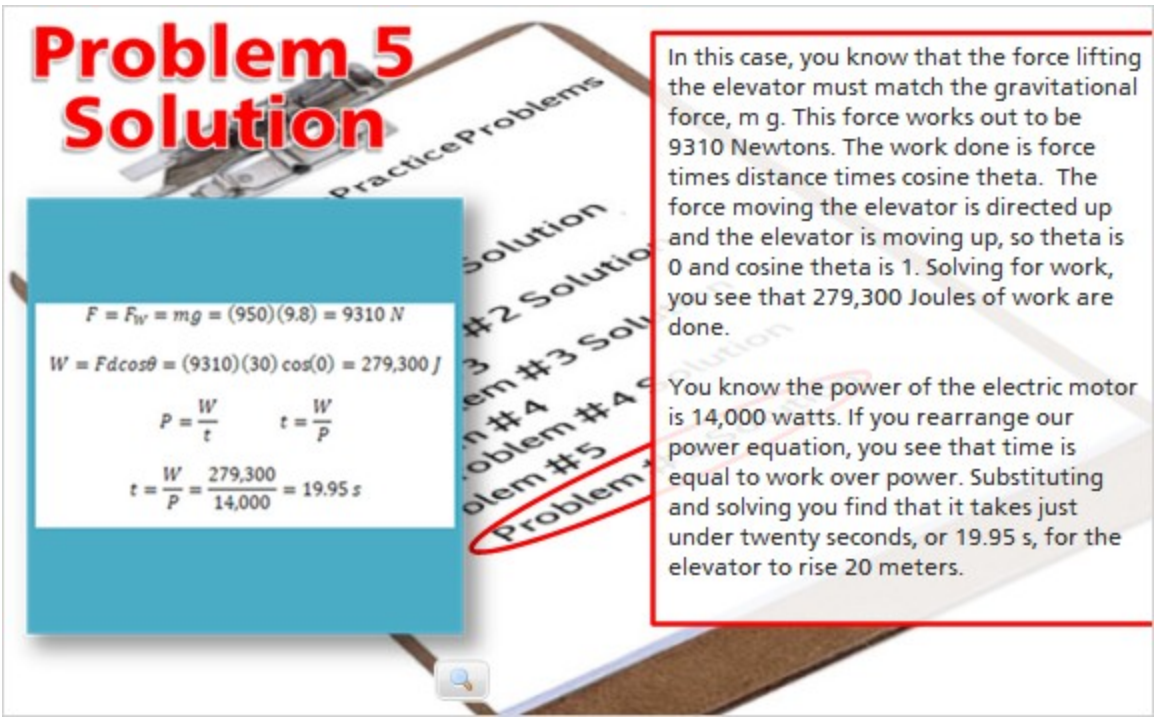
Rearranging our equation to solve for distance, you see that distance equals work divided by the product of force and cosine theta.

Substituting and solving, you find that the cart must move a distance of thirty five point eight eight meters for twelve thousand Joules of work to be done.



Problem 5

A 950 kilogram elevator is lifted by an electric motor that delivers 14,000 Watts of power. How long does it take the elevator to rise 30 meters?



Problem 5 Solution

In this case, you know that the force lifting the elevator must match the gravitational force, m g. This force works out to be ninety thousand three hundred ten Newtons. The work done is force times distance times cosine theta. The force moving the elevator is directed up and the elevator is moving up, so theta is zero and cosine theta is one. Solving for work, you see that two hundred seventy nine thousand three hundred Joules of work are done.

You know the power of the electric motor is fourteen thousand watts. If you rearrange our power equation, you see that time is equal to work over power. Substituting and solving you find that it takes just under twenty seconds for the elevator to rise twenty meters.