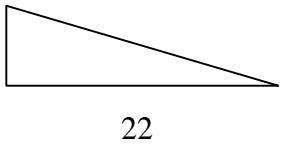
Slope Applications:

Draw a diagram, label the diagram and do the appropriate calculations.

1. Shaun wants to build a skateboard ramp. He knows that the slope he would like is 0.32 and the space that he has to work in allows for a total run of 22 feet.
   a) What would be the height of his ramp?
   b) What angle does the ramp make with the ground?
   c) What is the length of the ramp?



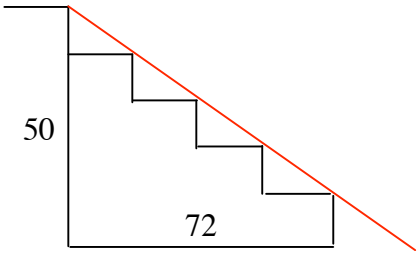
$m = 0.32 \Rightarrow \frac{32}{100}$

$a)\ \frac{32}{100} = \frac{\text{height of ramp}}{\text{length of ramp}} = \frac{x}{22} \Rightarrow \frac{32 \cdot 22}{100} = x \Rightarrow \frac{704}{100} \Rightarrow x = 7.04\,ft$

$b)\ \tan\theta = \frac{rise}{run} \Rightarrow \tan\theta = \frac{7.04}{22} \Rightarrow \tan\theta = 0.32 \Rightarrow \theta = 17.7°$

$c)\ c^2 = a^2 + b^2 \Rightarrow c^2 = 7.04^2 + 22^2 \Rightarrow c^2 = 533.56 \Rightarrow c = 23.09\,ft$

2. Sam has to build a 4-step staircase from his back deck to the yard. The deck is 50 inches off the ground and the run of the stairs is to be 72 inches.
   a) What is the slope of the staircase?
   b) What is the rise and run of each step?
   c) What is the slope of each step?



$a)\ m = \frac{50}{72} = 0.6944$

$b)\ \text{rise of step} = 10, \text{run of step} = 14.4$

$c)\ m = \frac{\text{rise of step}}{\text{run of step}} = \frac{10}{14.4} = 0.6944$

Note: to avoid confusion number of risers equals number of step

3. The safety standard for using a ladder is defined as the 1/4 rule. Translated this means that for every four feet the ladder reaches up a wall, the base should be a foot away from the wall.
   a) If the base of a ladder is placed a distance of 3.5 feet from the wall, at what height would the top of the ladder safely touch the wall?

$\frac{4}{1} = \frac{x}{3.5} \Rightarrow 4 \cdot 3.5 = x \Rightarrow x = 14\,ft$

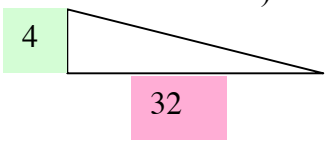
   b) If a ladder touches the wall at a height of 12.5 meters, where should the base of the ladder be placed in relation to the wall? How long a ladder should be used if we take into account that this extension ladder should have a safety overlap of 1 meter?

$$\frac{4}{1}=\frac{12.5}{x}\Rightarrow x=\frac{12.5}{3}\Rightarrow x=4.16 \text{ meters}$$

$$c^2=a^2+b^2\Rightarrow c^2=12.5^2+4.16^2\Rightarrow c^2=173.5556\Rightarrow c=13.17$$

taking into account safety the ladder should be at least 13.17 + 1= 14.17 meters

4. George has been hired to build a wheel chair ramp. The building code calls for a rise of 1 inch for every 12 inches.
   a) What would be the run of a ramp if the required rise is 4 feet?
   b) How high would a ramp reach if the run of the ramp was 32 feet?
      i) What angle does the ramp make with the ground?
      ii) How long would the ramp be?



$$a)\ \frac{1}{12}=\frac{4}{x}\Rightarrow x=12\cdot 4\Rightarrow x=48\,ft$$

$$b)\ \frac{1}{12}=\frac{x}{32}\Rightarrow \frac{32}{12}=x\Rightarrow x=2.667\,ft$$

$$i)\ \tan\theta=\frac{opp}{adj}=\frac{2.667}{32}\Rightarrow \tan\theta=0.0833\Rightarrow\theta=4.76^\circ$$

$$ii)\ c^2=a^2+b^2\Rightarrow c^2=2.667^2+32^2\Rightarrow c^2=1031.11\Rightarrow c=32.11\,ft$$

5. A group of friends are hiking at Jasper National Park. They have hiked up a trail that has a run of 5 km with a calculated slope of 0.54.
   a) If we assume they start at an elevation of 2000m, at what elevation would they be after completing their hike?
   b) What would the average angle of their climb?
   c) What distance have they covered in their climb?

$$m=0.54\Rightarrow\frac{54}{100}$$

$$a)\ \frac{54}{100}=\frac{x}{5}\Rightarrow x=\frac{54\cdot 5}{100}\Rightarrow x=\frac{270}{100}=2.7km$$

$2.7km=2700m\Rightarrow$ therefore the final elevation would be $2700+2000=4700m$

$$b)\ \tan\theta=\frac{opp}{adj}=\frac{2.7}{5}\Rightarrow\tan\theta=0.54\Rightarrow\theta=28.36^\circ$$

$$c)\ c^2=a^2+b^2\Rightarrow c^2=2.7^2+5^2\Rightarrow c^2=32.29\Rightarrow c=5.68km$$

6. Many roads and highways have signs giving the percentage grade for the road. A 7% grade, for example, means that the altitude changes by 7 feet (meters) for each 100 feet (meters) of horizontal distance.
   a) Suppose an uphill road sign indicates a road grade of 9%. What is the angle of

elevation of the road?

$$9\% \Rightarrow \frac{9}{100}$$

$$\tan\theta = grade \Rightarrow \tan\theta = \frac{9}{100} = .09 \Rightarrow \theta = 5.14°$$

b) If a road has a grade of 4%, what would be the travelers change in elevation in a horizontal distance of 1.6 km?

$$grade = 4\% \Rightarrow \frac{4}{100}$$

$$\frac{4}{100} = \frac{x}{1.6} \Rightarrow \frac{4 \cdot 1.6}{100} = x \Rightarrow x = \frac{6.4}{100} \Rightarrow x = .064 km$$

7. Karin's savings account balance changed from $1240 in January to $1750 in April. Find the average rate of change (slope) per month. Round your answer to the nearest dollar.

create 2 points with coordinates x and y

$$(\text{January},1240) \Rightarrow (1,1240)$$

$$(\text{April},1750) \Rightarrow (4,1750)$$

$$m = \frac{y_2 - y_2}{x_2 - x_1} \Rightarrow m = \frac{1240 - 1750}{1 - 4} = \frac{-510}{-3} = 170 \text{ per month}$$

8. If Glenn bought a house is 1982 for a cost of $94,000 and had an appraisal done in 2010 and found out the value of the house was now $426,000. Find the annual rate of change in the value of the house in dollars per year. (round off to the nearest dollar)

create 2 points with coordinates x and y

$$(1982,94{,}000) \text{ and } (2010,426{,}000)$$

$$m = \frac{y_2 - y_2}{x_2 - x_1} \Rightarrow m = \frac{94000 - 426000}{1982 - 2010} = \frac{-332000}{-28} = \$11{,}857 \text{ per year}$$