

When finding approximate solutions, round all answers to the nearest tenth of a unit. Round very small numbers, like 0.06862..., to the nearest thousandth (0.069).

Projectile Motion

1. The path of a toy rocket is modelled by the equation $y = -x^2 + 6x + 2$, where x is the horizontal distance from the launch point, in metres, and y is the height, in metres, of the rocket above the ground.
 - (a) What is the maximum height of the rocket?
 - (b) What is the horizontal distance from the launch point to the maximum?
 - (c) What is the horizontal distance that the rocket has travelled when it hits the ground?
2. The path of a football after it is kicked from a height of 0.3 m above the ground can be modelled by the equation $h = -0.2d^2 + 2d + 0.3$, where h is the height, in metres, above the ground and d is the horizontal distance from the launch point, in metres.
 - (a) How far has the football travelled horizontally when it lands on the ground?
 - (b) Find the horizontal distance when the football is at a height of 1.5 m above the ground.
 - (c) What is the maximum height reached by the football? At what horizontal distance does it reach this height?
3. A baseball is thrown upward at an initial velocity of 9.2 m/s, from a height of 1.6 m above the ground. The height of the baseball, in metres, above the ground after t seconds is modelled by the equation $h = -4.9t^2 + 9.2t + 1.6$.
 - (a) How long does it take the baseball to go up, then fall to the ground?
 - (b) Find the times that the baseball is 4.5 metres above the ground.
 - (c) What is the maximum height of the baseball? At what time does it reach this height?
4. A toy rocket is launched upward at an initial velocity of 51 m/s, from a height of 1.3 metres above the ground. The height of the toy rocket, in metres, after t seconds is modelled by the equation $h = -4.9t^2 + 51t + 1.3$.
 - (a) How long does it take the rocket to fall to the ground?
 - (b) Find the times that the rocket is at a height of 95.7 m above the ground.
 - (c) What is the maximum height of the rocket? At what time does it reach this height?

Revenue

1. As the price of cranberry juice drops at the local food mart, sales increase. On an average day, a 1.89 L bottle of cranberry juice costs \$3.95, and the food mart sells an average of 80 bottles. For each \$0.05 reduction in price, sales increase by 10 bottles per day. If n is the number of \$0.05 price reductions, the price and value of sales can be modelled as follows:

Price per bottle in dollars: $3.95 - 0.05n$

Number of bottles sold: $80 + 10n$

Total revenue or total cost is always (the number of things) \times (the price per thing). In this case, it is the product of the number of bottles sold and the price per bottle.

- (a) How many price reductions will result in revenue of \$450?
 - (b) How many price reductions will result in the maximum value of sales?
 - (c) What is the maximum value of sales?
2. Bryanna is selling t-shirts. Her regular price is \$20 per t-shirt and she usually sells about 15 t-shirts. Anne finds that, for each reduction in price of \$1, Bryanna can sell an additional 2 t-shirts.
 - (a) Create an algebraic model to represent Bryanna's total sales revenue.
 - (b) Determine the maximum revenue and the price at which this maximum will occur.
 3. The captain of a riverboat cruise charges \$36 per person, including lunch. The cruise averages 300 customers a day. The captain is considering increasing the price. A survey of customers indicates that for every \$2 increase, there would be 10 fewer customers.
 - (a) What increase in price would maximize the revenue?
 - (b) Determine the maximum revenue.
 - (c) How many customers would take a cruise if the captain raised the price by \$10?
 4. A sporting goods store sells 90 ski jackets in a season for \$200 each. Each \$10 decrease in price would result in five more jackets being sold.
 - (a) Find the number of jackets sold and the selling price to give revenues of \$17 600 from the sales of ski jackets.
 - (b) What is the lowest price that would produce revenues of at least \$15 600? How many jackets would be sold at this price?

Numbers

1. The product of two consecutive integers is 182. What are the integers?
2. Two times a number is equal to the number squared minus 3. What is the number?
3. The sum of the squares of two consecutive integers is 481. What are the integers?
4. The sum of the squares of two consecutive integers is 685. What are the integers?
5. The sum of the squares of two consecutive even integers is 1060. What are the integers?

Shapes

1. The parabolic cross section of an arch in front of a museum is modelled by the relation $h = -d^2 + 9$, where h is the height, in metres, above the ground and d is the horizontal distance, in metres, from the centre of the arch.
 - (a) Sketch a graph to represent the cross section.
 - (b) How wide and how tall is the arch?
 - (c) How tall is the arch at a distance of 1 m from its point of contact with the ground?
2. The parabolic cross section of a bridge in a park is modelled by the relation $h = -d^2 + 4$, where h is the height, in metres, above the ground and d is the horizontal distance, in metres, from the centre of the bridge.
 - (a) How wide and how tall is the bridge?
 - (b) Sketch a graph to represent the cross section.
 - (c) For what values of d is this relation valid? Explain.
3. The design of a new bridge can be modelled by the equation $h = -0.005d^2 + 25.2$, where h is the height of the bridge, in metres, and d is the distance along the ground below the bridge, in metres.
 - (a) Determine the length of of the bridge.
 - (b) Determine the maximum height of the bridge above the ground.
 - (c) Determine the height of the bridge 42 m from the centre of the bridge.

Measurements

1. A rectangle has dimensions $x + 8$ and $x - 2$. Determine the value of x that gives an area of 24 cm^2 .
2. A rectangle has a perimeter of 28 cm. Its area is 42 cm^2 . Determine the dimensions of the rectangle. Include a diagram in your solution.
3. The length of a rectangle is 5 cm greater than its width. The area is 104 cm^2 . Find the dimensions of the rectangle.
4. The hypotenuse of a right triangle measures 13 cm. One leg is 7 cm shorter than the other leg. What are the lengths of the two perpendicular sides? (The two short sides of a right triangle are sometimes called “legs.”)
5. The length of one leg of a right triangle is 17 cm more than that of the other leg. The length of the hypotenuse is 4 cm more than triple the length of the shorter leg. Find the lengths of each of the three sides.
6. Three sides of a right triangle are consecutive integers. What is the length of each side?
7. The length of the hypotenuse of a right triangle is 3 cm more than twice that of the shorter leg. The length of the longer leg is 2 cm more than twice that of the shorter leg. Find the lengths of the three sides of the triangle.
8. The area of a triangle is 18 cm^2 , and the altitude is 3 cm greater than the base. What is the length of the base?
9. A garden is enclosed on three sides using 60 m of fencing. The remaining side is formed by a house wall. What dimensions enclose 450 m^2 of garden?
10. A rectangular floating dock measures 4 m by 5 m. A new dock is to be made by increasing each side length by the same amount. The area of the new dock is to be 42 m^2 . Find the dimensions of the new floating dock.