MAXIMUM PROBLEMS in Realistic Contexts.

1. A cinema manager finds that when the price of a ticket is \$12, she gets an audience of 100 people (on average) but for every \$1 increase the number of people goes down by 10.
   Use calculus to find what ticket price produces the most profit.
   If x represents the ticket price and y represents the amount of money collected then $\boldsymbol{y = x(320 - 10x)}$

$y = 320x - 10x^2$

$y' = 320 - 20x = 0$ *for max value*

$x = \dfrac{320}{20} = 16$ *ie \$16 per ticket and y = \$2560 collected*

2. When the cost of a bag of potatoes is \$5 a supermarket sells 40 bags a day. For every \$1 increase in price they sell 4 bags a day less.
   Use calculus to find what price per bag produces the most money collected.
   If $\boldsymbol{x}$ represents the price per bag and $\boldsymbol{y}$ represents the amount of money collected then $\boldsymbol{y = x(60 - 4x)}$

$y = 60x - 4x^2$

$y' = 60 - 8x = 0$ *for max value*

$x = \dfrac{60}{8} = 7.5$ *ie \$7.50 per bag and y = \$225 collected*

3. When the cost of a bag of kumara is \$5 a supermarket sells 30 bags a day. For every \$1 increase in price they sell 4 bags a day less.
   Use calculus to find what price per bag produces the most money collected.
   If $\boldsymbol{x}$ represents the price per bag and $\boldsymbol{y}$ represents the amount of money collected then $\boldsymbol{y = x(50 - 4x)}$

$y = 50x - 4x^2$

$y' = 50 - 8x = 0$ *for max value*

$x = \dfrac{50}{8} = 6.25$ *ie \$6.25 per bag and y = \$156.25 collected*

4. A dairy farmer notices that the average amount of milk per cow is 14 litres a day when he puts 30 cows in his paddock, however, for every 5 cows added, the average amount of milk goes down by 1 litre a day.
   Use calculus to find how many cows he should put in the paddock to get the most milk and find the maximum amount of milk he could get.
   If x represents the number of cows and y represents the total amount of milk produced in litres then $\boldsymbol{y = x\left(20 - \frac{x}{5}\right)}$

$y = 20x - \dfrac{x^2}{5}$

$y' = 20 - \dfrac{2x}{5} = 0$ *for max value*

$20 = \dfrac{2x}{5}$ *so x = 50 cows/paddock so y = 500 L/day*