Objective: Model Real World Situations with Polynomials

Ex) The data from the U.S. Census Bureau for 2005-2009 shows that the number of male students (in thousands) enrolled in high school in the United States can be modeled by the function $M(x) = -10.4x^3 + 74x^2 - 3.4x + 8320.2$, where x is the number of years after 2005. The number of female students (in thousands) enrolled in high school in the United States can be modeled by the function $F(x) = -13.8x^3 + 55.3x^2 + 141x + 7880$, where x is the number of years after 2005.

a) Write a new function, $T(x)$, that models the total number of students in thousands after 2005. $T(x) = M(x) + F(x)$

$$M(x) = -10.4x^3 + 74x^2 - 3.4x + 8320.2$$
$$+\ F(x) = -13.8x^3 + 55.3x^2 + 141x + 7880$$
$$\boxed{T(x) = -24.2x^3 + 129.3x^2 + 137.6x + 16{,}200.2}$$

b) Estimate the total number of students enrolled in high school in the United States in 2009. $x = 2009 - 2005$

$x = 4$

$$T(4) = -24.2(4)^3 + 129.3(4)^2 + 137.6(4) + 16{,}200.2$$
$$\times 1000$$
$$= 17{,}270{,}600$$

conclusion

In 2009 there were about 17,270,600 students enrolled in high school in the United States.

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Ex) From 1995 through 2010, the yearly gross revenue (in millions) for a candy company can be modeled by the function $R(t) = 0.01t^3 - 0.2677t^2 + 1.7779t + 2.1805$ and the yearly cost (in millions) can be modeled by the function $C(t) = 0.0008t^3 - 0.0096t^2 + 0.0288t + 2.4$ where t is the number of years since 1995.

a. Write a new function, $P(t)$, that models the yearly profit after 1995.

profit = revenue − costs

$P(t) = R(t) - C(t)$

$P(t) = (0.01t^3 - 0.2677t^2 + 1.7779t + 2.1805) + (-0.0008t^3 + 0.0096t^2 - 0.0288t - 2.4)$

$$\boxed{P(t) = 0.0092t^3 - 0.2581t^2 + 1.7491t - 0.2195}$$

b. What was the total profit the candy company had in 2007?

$t = 2007 - 1995$
$= 12$

$P(12) = 0.0092(12)^3 - 0.2581(12)^2 + 1.7491(12) - 0.2195$

$\times 1{,}000{,}000$

$= \$-499{,}100$ (loss of \$499,100)

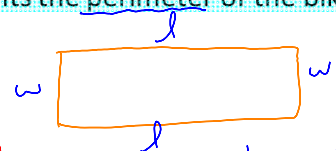
conclusion

In 2007 the candy company had a loss of \$499,100.

Objective: Model Real World Situations with Polynomials

Ex) A straight section of a biking path has a width, in feet, modeled by the function $W(x) = 2x + 7$ and a length, in feet, modeled by the function $L(x) = x^3 + 4x^2 + 5x - 6$.

a) Write a new function, $P(x)$, that represents the perimeter of the bike path section.



perimeter $= 2l + 2w$

$P(x) = 2 \cdot L(x) + 2 \cdot W(x)$

$= 2(x^3 + 4x^2 + 5x - 6) + 2(2x + 7)$

$= 2x^3 + 8x^2 + 10x - 12 + 4x + 14$

$\boxed{P(x) = 2x^3 + 8x^2 + 14x + 2}$

b) Find the perimeter of the described section of the biking path if the width is 17 feet.

① width $W(x) = 2x + 7$

$17 = 2x + 7$

$-7 \qquad -7$

$\frac{10}{2} = \frac{2x}{2}$

$x = 5$

② $P(5) = 2(5)^3 + 8(5)^2 + 14(5) + 2$

$= 522$ feet

③ The section of the biking path has a perimeter of 522 feet.

Objective: Model Real World Situations with Polynomials

Ex) A farmer has a field he needs to mow before he can plant wheat. The length of the field can be modeled by $L(x) = 5x^3 + 2x^2 + 7$ feet and the width of the field can be modeled by $W(x) = 3x^2 - 4x + 2$ feet.

a) Write a function, $A(x)$, that models the area of the field.

$A(x) = L(x) \cdot W(x)$

field, l, w

area $= l \cdot w$

$A(x) = (5x^3 + 2x^2 + 7)(3x^2 - 4x + 2)$

$= 5x^3(3x^2 - 4x + 2) + 2x^2(3x^2 - 4x + 2) + 7(3x^2 - 4x + 2)$

$= 15x^5 - 20x^4 + 10x^3 + 6x^4 - 8x^3 + 4x^2 + 21x^2 - 28x + 14$

$\boxed{A(x) = 15x^5 - 14x^4 + 2x^3 + 25x^2 - 28x + 14}$

b) The farmer can mow the field at a rate of 1000 square feet per minute. If the value of x is 8, how long, to the nearest hour, will it take the farmer to mow the field?

$x = 8$

① $A(8) = 15(8)^5 - 14(8)^4 + 2(8)^3 + 25(8)^2 - 28(8) + 14$

$= 436{,}590 \text{ ft}^2$

② $\frac{436{,}590 \cancel{\text{ft}^2}}{1} \cdot \frac{1 \cancel{\text{min}}}{1000 \cancel{\text{ft}^2}} \cdot \frac{1 \text{ hr}}{60 \cancel{\text{min}}}$

≈ 7 hours

③ It will take the farmer about 7 hours to mow the field.