

**EXAMPLE 5** Use special product patterns

- a.  $(3t + 4)(3t - 4) = (3t)^2 - 4^2$  Sum and difference  
 $= 9t^2 - 16$
- b.  $(8x - 3)^2 = (8x)^2 - 2(8x)(3) + 3^2$  Square of a binomial  
 $= 64x^2 - 48x + 9$
- c.  $(pq + 5)^3 = (pq)^3 + 3(pq)^2(5) + 3(pq)(5)^2 + 5^3$  Cube of a binomial  
 $= p^3q^3 + 15p^2q^2 + 75pq + 125$

**GUIDED PRACTICE** for Examples 3, 4, and 5

Find the product.

3.  $(x + 2)(3x^2 - x - 5)$       4.  $(a - 5)(a + 2)(a + 6)$       5.  $(xy - 4)^3$

**EXAMPLE 6** Use polynomial models

**PETROLEUM** Since 1980, the number  $W$  (in thousands) of United States wells producing crude oil and the average daily oil output per well  $O$  (in barrels) can be modeled by

$$W = -0.575t^2 + 10.9t + 548 \quad \text{and} \quad O = -0.249t + 15.4$$

where  $t$  is the number of years since 1980. Write a model for the average *total* amount  $T$  of crude oil produced per day. What was the average total amount of crude oil produced per day in 2000?



Oil refinery in Long Beach, California

**Solution**To find a model for  $T$ , multiply the two given models.

$$\begin{array}{r} -0.575t^2 + 10.9t + 548 \\ \times \qquad \qquad - 0.249t + 15.4 \\ \hline - 8.855t^2 + 167.86t + 8439.2 \\ 0.143175t^3 - 2.7141t^2 - 136.452t \\ \hline 0.143175t^3 - 11.5691t^2 + 31.408t + 8439.2 \end{array}$$

- Total daily oil output can be modeled by  $T = 0.143t^3 - 11.6t^2 + 31.4t + 8440$  where  $T$  is measured in thousands of barrels. By substituting  $t = 20$  into the model, you can estimate that the average total amount of crude oil produced per day in 2000 was about 5570 thousand barrels, or 5,570,000 barrels.

**DETERMINE SIGNIFICANT DIGITS**

When multiplying models, round your result so that its terms have the same number of significant digits as the model with the fewest number of significant digits.

**GUIDED PRACTICE** for Example 6

6. **INDUSTRY** The models below give the average depth  $D$  (in feet) of new wells drilled and the average cost per foot  $C$  (in dollars) of drilling a new well. In both models,  $t$  represents the number of years since 1980. Write a model for the average *total* cost  $T$  of drilling a new well.

$$D = 109t + 4010 \quad \text{and} \quad C = 0.542t^2 - 7.16t + 79.4$$