More problems for section 3.2 of *Essentials of Precalculus with Calculus Previews* by Zill and Dewar, 5e.

How to make up your own polynomial long division practice problems:

- Pick any two polynomials $Q(x)$ and $D(x)$. Carefully calculate their product.
- Pick any polynomial R(x), but make sure that the degree of $R(x)$ is less than that of $D(x)$. For instance, if $D(x)$ is quadratic, $R(x)$ can be linear or constant. Add $R(x)$ to the product $Q(x)D(x)$. Call the resulting polynomial $P(x)$.
- You've arranged it so that $P(x) = Q(x)D(x) + R(x)$ and $\deg R(x) < \deg D(x)$. If you now divide $P(x)$ by $D(x)$, the quotient should be $Q(x)$ and remainder should be $R(x)$.
- To practice synthetic division, use $D(x)$ of the form $x - c$.

To read about synthetic division, Google the phrase "college algebra tutorial synthetic division"
You should practice writing the results of long division two ways:

$$P(x) = Q(x)D(x) + R(x) \quad \text{and} \quad \frac{P(x)}{D(x)} = Q(x) + \frac{R(x)}{D(x)}.$$

Note that in the second, the improper rational function $\frac{P(x)}{D(x)}$ is written as the polynomial $Q(x)$ plus the proper rational function $\frac{R(x)}{D(x)}$. This is similar to what happens when we use long division on integers to write an improper fraction as a mixed number, that is, an integer plus a proper fraction.

1. Find the quotient and remainder in the following division problems.

a. $(2x^4 + 11x^3 + 10x^2 - 5x - 1) \div (2x + 3)$
b. $(2x^5 + 4x^4 - 15x^3 - 10x^2 + 26x + 3) \div (2x^2 - 5)$
c. $(2x^6 + 3x^5 + 2x^4 + 7x^3 + x^2 + 4x + 2) \div (x^2 + 1)$
d. $(15x^6 - 2x^5 + 21x^4 + 11x^3 + 6x^2 + 2x) \div (5x^2 + x - 1)$
e. $(2x^6 + x^5 + 4x^4 + 4x^2 + x + 3) \div (x^2 + 1)$
f. $(18x^5 - x^4 - x^3 + 21x^2 + 12x + 5) \div (2x^2 - x + 1)$
g. $(4x^5 - 20x^4 + 3x^3 - 6x^2 - 45x + 4) \div (x - 5)$
h. $(4x^5 - 7x^3 - 8x^2 - 11x - 18) \div (x - 2)$
i. $(2x^6 + 7x^5 + 10x^4 + 21x^3 + 5x^2 + 21x + 22) \div (x + 3)$
j. $(x^5 + 3x^4 + x^2 - 4x + 1) \div (x - 1)$
k. $(2x^5 - 4x^4 + 5x^3 - 9x^2 + 5x - 14) \div (x - 2)$
l. $(4x^5 + 16x^4 + 9x^3 - 6x^2 + 7x - 11) \div (x + 3)$
m. $(7x^6 + 31x^5 + 5x^4 - 48x^3 - 78x^2 + 12x + 16) \div (x + 4)$
n. $(8x^4 - 44x^3 + 23x^2 - 8x - 33) \div (x - 5)$
o. $(6x^4 + 9x^3 + 8x - 8) \div (x + 2)$
p. $(x^4 - 2x^2 + 1) \div (x - 1)$
q. $(2x^2 + 6x + 4) \div (x + 1)$
r. $(3x^2 - 7x + 2) \div (x - 2)$

Answers

1a. $Q = x^3+4x^2-x-1$, $R = 2$ 1b. $Q = x^3+2x^2-5x$, $R = x+3$ 1c. $Q = 2x^4+3x^3+4x+1$, $R = 1$ 1d. $Q = 3x^4-x^3+5x^2+x+2$, $R = x+2$ 1e. $Q = 2x^4 + x^3 + 2x^2 - x + 2$, $R = 2x + 1$ 1f. $Q = 9x^3 + 4x^2 - 3x + 7$, $R = 22x - 2$ 1g. $Q = 4x^4 + 3x^2 + 9x$, $R = 4$ 1h. $Q = 4x^4 + 8x^3 + 9x^2 + 10x + 9$, $R = 0$ 1i. $Q = 2x^5 + x^4 + 7x^3 + 5x + 6$, $R = 4$ 1j. $Q = x^4 + 4x^3 + 4x^2 + 5x + 1$, $R = 2$ 1k. $Q = 2x^4 + 5x^2 + x + 7$, $R = 0$ 1l. $Q = 4x^4 + 4x^3 - 3x^2 + 3x - 2$, $R = -5$ 1m. $Q = 7x^5 + 3x^4 - 7x^3 - 20x^2 + 2x + 4$, $R = 0$ 1n. $Q = 8x^3 - 4x^2 + 3x + 7$, $R = 2$ 1o. $Q = 6x^3 - 3x^2 + 6x - 4$, $R = 0$ 1p. $Q = x^3 + x^2 - x - 1$, $R = 0$ 1q. $Q = 2x + 4$, $R = 0$ 1r. $Q = (3x - 1)$, $R = 0$