3a)

$$
\begin{array}{r l}
 & x^2 + 4x + 1 \\
x - 1 & \overline{\big)\ \cancel{x^3} + 3x^2 - 3x - 2} \\
 & -\ \cancel{x^3} - x^2 \\
 & \overline{\quad \cancel{4x^2} - 3x} \\
 & -\ \cancel{4x^2} - 4x \\
 & \overline{\quad \cancel{x} - 2} \\
 & -\ \cancel{x} - 1 \\
 & \overline{\quad -1 \ R}
\end{array}
$$

f)

$$
\begin{array}{r l}
 & 2y^3 \\
y - 3 & \overline{\big)\ \cancel{2y^4} - 3y^2 + 1} \\
 & -\ \cancel{2y^4} - 6y^3 \\
 & \overline{\quad 6y^3 - 3y^2}
\end{array}
$$

$\ast$ Be careful when one of the descending degrees are missing

3f)

$$
\begin{array}{r|l}
 & 2y^3+6y^2+15y+45 \\
\hline
y-3 & 2y^4+0y^3-3y^2+0y+1 \\
 & -\ \underline{2y^4-6y^3} \\
 & \quad 6y^3-3y^2 \\
 & -\ \underline{6y^3-18y^2} \\
 & \qquad 15y^2+0y \\
 & \qquad \underline{15y^2-45y} \\
 & \qquad\quad 45y+1 \\
 & \qquad\quad \underline{45y-135} \\
 & \qquad\qquad 136\ R.
\end{array}
$$

Using Synthetic Division;

$$
\begin{array}{r|rrrrr}
3 & 2 & 0 & -3 & 0 & 1 \\
+ & \downarrow & 6 & +18 & 45 & 135 \\
\hline
 & 2 & +6 & 15 & 45 & 136\ R
\end{array}
$$

$2y^3+6y^2+15y+45$ Quotient

Synthetic Division

↳ dividing polynomials but easier than long division

* Dividing by $(x-a)$, then you are testing 'a' as a root.

ex. Divide $2x^3+3x^2-4x+15$ by $(x+3)$.

$$\begin{array}{r|rrrr} -3 & 2 & 3 & -4 & 15 \\ & \downarrow & -6 & 9 & -15 \\ \hline & 2 & -3 & 5 & \varnothing \end{array}$$

* -3 is a root

Quotient: $2x^2-3x+5$

$2x^3+3x^2-4x+15$
divided by $x+3$

-3	2	3	-4	15
+	$\downarrow$	-6	9	-15
	2	-3	5	∅ R

Quotient $2x^2-3x+5$

* Because we have ∅ Remainder, -3 is an x-intercept of the cubic.

If we want to find the other two, we can solve the quadratic.

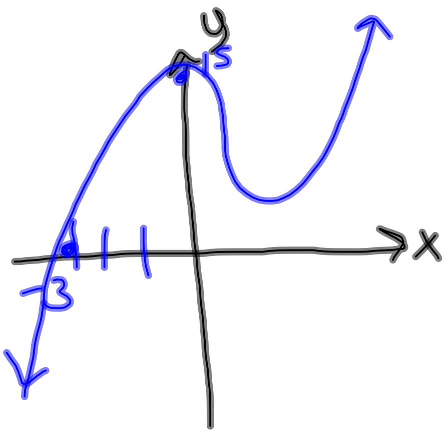
$$2x^2-3x+5=0$$

add -3
mult 10
not possible

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

$$=\frac{3\pm\sqrt{9-4(2)(5)}}{2(2)}$$

$$=\frac{3\pm\sqrt{-31}}{4}$$ * imaginary



Remainder Theorem pg. 123

When a polynomial $P(x)$ is divided by binomial of the form $x-a$, the remainder is $P(a)$.

example: Determine the remainder when $P(x) = x^3 - 10x + 6$ is divided by $(x+4)$.

$$P(-4) = (-4)^3 - 10(-4) + 6$$
$$= -64 + 40 + 6$$
$$= -18$$

Check by Synthetic Division

$$\begin{array}{r|rrrr} -4 & 1 & 0 & -10 & 6 \\ & \downarrow & -4 & 16 & -24 \\ \hline & 1 & -4 & 6 & -18 \end{array} \; R$$

Practice pg. 124

#4, 6a #8a)