① $f(x) = (x+2)(x-5)(x-(3-2i))(x-(3+2i))$

(Recall that since $3-2i$ is a root, its complex conjugate $3+2i$ is also a root)

Now $(x-(3-2i))(x-(3+2i)) = (x-3+2i)(x-3-2i) =$

$x^2 - 3x - \cancel{2ix} - 3x + 9 + \cancel{6i} + \cancel{2ix} - \cancel{6i} - 4i^2 = x^2 - 6x + 9 - 4(-1) = x^2 - 6x + 9 + 4 =$

$x^2 - 6x + 13$, which has real coefficients.

So $\boxed{f(x) = (x+2)(x-5)(x^2-6x+13)}$

② $f(x) = d\,x(x-1)(x-3)$ $\boxed{f(x) = -5x(x-1)(x-3)}$

we need to find d using $f(2) = 10$

$10 = d\,2(2-1)(2-3)$

$10 = -2d \quad d = -5$

③ $f(x) = \dfrac{x-2}{x^2+x+1}$

domain: Solve $x^2+x+1=0$ $x = \dfrac{-1 \pm \sqrt{1-4}}{2} = \dfrac{-1 \pm \sqrt{-3}}{2}$ no real solutions.

The denominator is never 0, so domain is $\boxed{(-\infty,\infty)}$

x-intercept $x-2=0$ $x=2$ $\boxed{(2,0)}$

y-intercept $f(0) = -2$ $\boxed{(0,-2)}$

Horizontal asymptote $\boxed{y=0}$ (because the degree of the numerator (1) is less than the degree of the denominator (2)).

Vertical asymptote $\boxed{\text{None}}$ (because the denominator is never zero)

④ $f(x) = \dfrac{3x-9}{2-x}$

a) domain $2-x \neq 0$ $x \neq 2$ $\boxed{(-\infty,2)\cup(2,\infty)}$

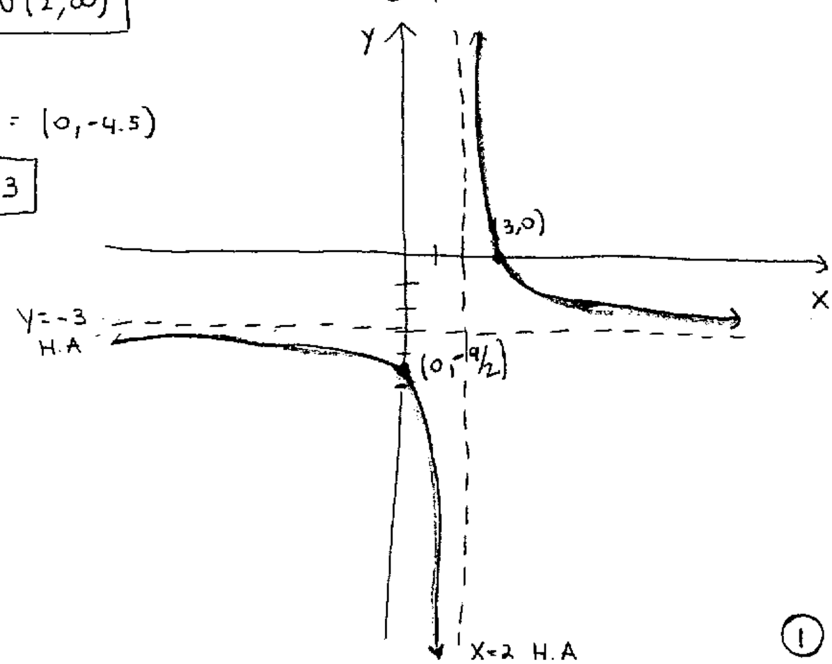
x-intercept $3x-9=0$ $x=3$ $\boxed{(3,0)}$

y-intercept $f(0) = -9/2$ $\boxed{(0,-9/2)} = (0,-4.5)$

Horizontal asymptote $y = \frac{3}{-1}$ $\boxed{y=-3}$

Vertical asymptote $\boxed{x=2}$

b) Graphing paper will be provided



c) Identity roots and V.A : $x=2$, $x=3$. Test a point in each interval.

NEGATIVE	POSITIVE	NEGATIVE
$x=1$	$x=2.5$	$x=4$
$\frac{3(1)-9}{2-1}=-6<0$	$\frac{3(2.5)-9}{2-2.5}=3>0$	$\frac{3(4)-9}{2-4}=-\frac{3}{2}<0$

(The sign chart's division points are 2 and 3.)

$\boxed{\text{Answer } (2,3]}$

(Notice that $x=2$ is not included since it is not in the domain)

(5) $25-9x^2<0$

Identity roots: $25=9x^2$ $\quad x^2=\frac{25}{9}$ $\quad x=\pm\frac{5}{3}$ $\quad$ Test a point in each interval

NEGATIVE	POSITIVE	NEGATIVE
$x=-2$	$x=0$	$x=2$
$25-9(-2)^2=-11<0$	$25>0$	$25-9(2)^2=-11<0$

(The sign chart's division points are $-5/3$ and $5/3$.)

$\boxed{\text{Answer } \left(-\infty,-\frac{5}{3}\right)\cup\left(\frac{5}{3},\infty\right)}$

(6)

$$
\begin{array}{r|l}
 & 2x^2+3x+6 \\
\hline
x-1 & 2x^3+x^2+3x+5 \\
 & -2x^3+2x^2 \\
\hline
 & \quad 3x^2+3x+5 \\
 & \quad -3x^2+3x \\
\hline
 & \qquad 6x+5 \\
 & \qquad -6x+6 \\
\hline
 & \qquad\quad 11
\end{array}
$$

$\boxed{\text{Answer } 2x^2+3x+6+\frac{11}{x-1}}$

or: Quotient $=2x^2+3x+6$

Remainder $=11$

(7) From the graph of $f(x)$ (or a table) we "guess" that $x=-1$ is a root.

We check that $f(-1)=0$: $f(-1)=(-1)^3+7(-1)^2+13(-1)+7=-1+7-13+7=0$. So $x=-1$ is a root.

The other roots are not exact, so we use algebra.

Since $x=-1$ is a root, $x+1$ is a factor of $f(x)$,

$f(x)=(x+1)\,g(x)$. To find $g(x)$ we divide $f(x)$ by $x+1$ (notice that remainder must be zero)

$$
\begin{array}{r|l}
 & x^2+6x+7 \\
\hline
x+1 & x^3+7x^2+13x+7 \\
 & -x^3-x^2 \\
\hline
 & \quad 6x^2+13x+7 \\
 & \quad -6x^2-6x \\
\hline
 & \qquad 7x+7 \\
 & \qquad -7x-7 \\
\hline
 & \qquad\quad 0
\end{array}
$$

$f(x)=(x+1)(x^2+6x+7)$

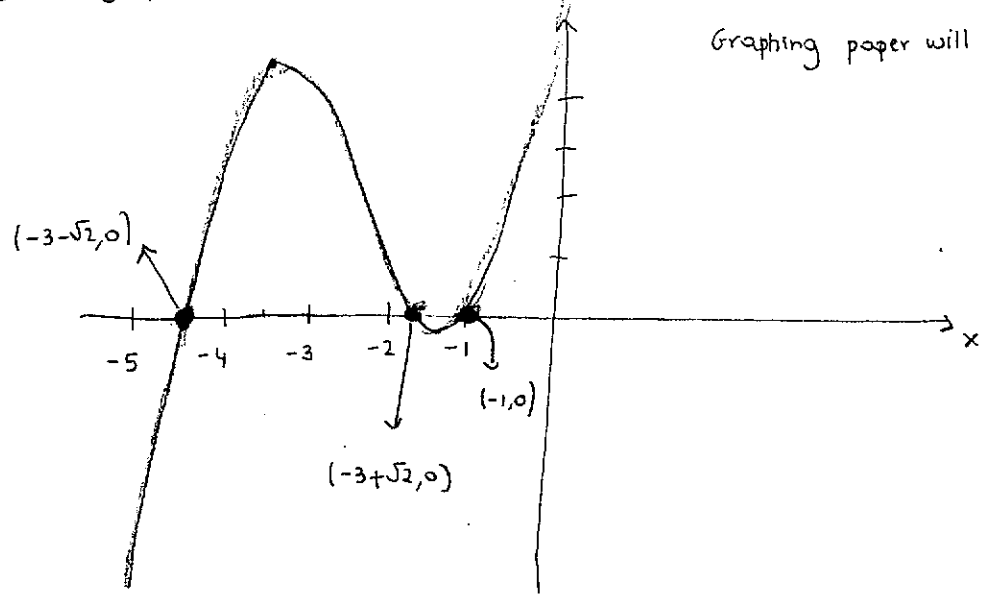
To find the other roots we solve $x^2+6x+7=0$ using the quadratic formula

$x^2 + 6x + 7 = 0 \qquad x = \dfrac{-6 \pm \sqrt{36 - 28}}{2} = \dfrac{-6 \pm \sqrt{8}}{2} = \dfrac{-6 \pm 2\sqrt{2}}{2} = -3 \pm \sqrt{2}$

So the 3 roots of $f(x)$ are: $\boxed{x = -1, \; x = -3-\sqrt{2}, \; x = -3+\sqrt{2}}$

For graphing purposes notice that $-3-\sqrt{2} \approx -4.4$ and $-3+\sqrt{2} \approx -1.6$

Graphing paper will be provided



⑧ $f(x) = \dfrac{x^2-36}{x-6}$

domain $\boxed{(-\infty, 6) \cup (6, \infty)}$

y-intercept $\boxed{(0,6)}$

x-intercepts $x^2-36=0 \quad x = \pm 6$ but $x=6$ is not in the domain, so the only x-intercept is $\boxed{(-6,0)}$

Since $\dfrac{(x-6)(x+6)}{(x-6)} = x+6$ $f(x)$ is the line $y = x+6$ with a hole at $x=6$

There are $\boxed{\text{no horizontal or vertical asymptotes.}}$