C 1. Using synthetic division, find roots are 3, $\frac{1}{2}, -2$. Largest root is 3.

A 2. Factoring gives $4\sqrt{1+x^2} - 3\sqrt{1+x^2}$ which is $\sqrt{1+x^2}$.

C 3. When roots are equal, the discriminant = 0. $p^2 - 4 \bullet 1 \bullet 2p = 0$, $p^2 - 8p = 0, p = 0, 8$. There are 2 distinct values for n.

C 4. Find the vertex by completing the square: $y = -2(x^2 - 6x + 9) - 24 + 18$. The vertex is $(3, -6)$. Since this parabola opens down, the range would be $(-\infty, -6]$.

A 5. $f(0+1) = f(0)\,f(1) = -2;$
$f(0) = 1;\ f(1+1) = f(1)\,f(1) = 4;$
$f(2) = 4;\ f(1+2) = f(1)\,f(2) = -2 \bullet 4;$
$f(3) = -8$

B 6. $\frac{1}{x+2} - \frac{3}{x-1} + \frac{1}{x^2+x-2}$, factor $x^2 + x - 2$ to find it is the common denominator.
$\frac{x-1-3x-6+1}{x^2+x-2} = \frac{-2x-6}{x^2+x-2}$

A 7. $f(x) = -x^2 + 1, g(x, y) = x(1+y)$
To find, $g(f(2), 3)$; $f(2) = -3$;
$g(-3, 3) = -3(4) = -12$

B 8. Since a is negative $1-a$ is positive so use $(x-1)^2, (1-a-1)^2 = (-a)^2 = a^2$.

D 9. To find what must be done to make $\frac{1}{x+3} = x$, we must find the inverse of $\frac{1}{x+3}$ then substitute this into $\frac{1}{2-5x}$. So
$x = \frac{1}{y+3}, x(y+3) = 1, y+3 = \frac{1}{x},\ y = \frac{1}{x} - 3$.

This gives $\frac{1}{2-5\left(\frac{1}{x}-3\right)} = \frac{1}{2-\frac{5}{x}+15} =$
$\frac{1}{17-\frac{5}{x}} = \frac{1}{\frac{17x-5}{x}} = \frac{x}{17x-5}$.

A 10. Find the vertex of the parabola: $y = -2(x^2 - 2x + 1) - 1 + 2$, $y = -2(x-1)^2 + 1$ making the vertex $(1,1)$. Since the line passes through the origin $(0,0)$ the slope of the line is 1, which makes the equation of the line $x = y$.

B 11. $\frac{\frac{1}{a}+\frac{1}{b}}{\frac{1}{a+b}} = \frac{\frac{a+b}{ab}}{\frac{1}{a+b}} = \frac{(a+b)^2}{ab}$.

C 12. $\sqrt{x+1} + \sqrt{x-1} = 3\left(\sqrt{x+1} - \sqrt{x-1}\right)$,
$\sqrt{x+1} + \sqrt{x-1} = 3\sqrt{x+1} - 3\sqrt{x-1}$,
$4\sqrt{x-1} = 2\sqrt{x+1}$,
$16x - 16 = 4x + 4, 12x = 20, x = \frac{5}{3}$.

D 13. We need to find the values for p and q. $\frac{p}{q} = \frac{\pm1, \pm3, \pm5, \pm15}{\pm1, \pm2} =$
$\pm1, \pm3, \pm5, \pm15, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm\frac{5}{2}, \pm\frac{15}{2}$ which is 16 POSSIBLE roots.

E 14. The line has a slope of 4 so the line perpendicular to this would have a slope of $-\frac{1}{4}$ and containing $(-1, 3)$. The equation would be $x + 4y = 11$.

A 15. Find the possible integer roots which would be $\pm1, \pm3$. Using synthetic or substitution none of these satisfy the equation.

C 16. Set the denominator equal to zero.

B 17. Completing the square on the left hand sides gives $\left(x^2-3x+\frac{9}{4}\right)+2-\frac{9}{4}=\left(x-\frac{3}{2}\right)^2-\frac{1}{4}$ so the value of p is $-\frac{1}{4}$.

C 18. Doing synthetic division with -3 gives the new equation as $2x^3-9x^2+14x-5=0$. The new possible roots are now $\pm1,\pm5,\pm\frac{1}{2},\pm\frac{5}{2}$. Trying synthetic division gives ½ as a root. From the original equation, the sum of the roots is $\frac{3}{2}$. The sum of the real roots is $-3+\frac{1}{2}=-\frac{5}{2}$. So subtracting that from the sum of the roots gives the sum of the imaginary roots as 4.

E 19. If 5 is a root, $x-5$ is a factor. Doing division with this makes the remainder 0.

A 20. $f(x)$ must be positive. Factoring the expression under the root gives $\sqrt{x(x-1)(x+1)}$. The critical values for x are 0, $1,-1$. Put these on a number line and test the zones. This gives $[-1,0]\cup[1,\infty)$.

D 21. Switch x and y and solve for y.

$x=\frac{1}{y+3},x(y+3)=1,\quad y+3=\frac{1}{x},y=\frac{1}{x}-3$

B 22. The remainder when $y^2+2y+4s$ is divided by $y-1$ is $4s-2$. The remainder when $y^2+sy+2s^2$ is divided by $y-1$ is $2s^2+s+1$. Set these two remainders equal and solve for s. $2s^2+s+1=4s-2$. $2s^2-3s+3=0$. The sum of the roots is $\frac{-b}{a}=\frac{3}{2}$ which is $1\frac{1}{2}$.

B 23. $f(g(x))=2^{\log_2 x}$ which equals x.

C 24. $(x-4)(x-5)=x^2-9x+20, A=-9, B=20$

$(x-2)(x-9)=x^2-11x+18, C=-11, D=18$

$x^2-9x+18=(x-6)(x-3)$ so the roots are 6 or 3.

C 25. $g(2)=-1, f(-1)=4.$

C 26. Using the information in the problem, the points on the graph are $(-2,0),(1,0),(0,0)$. Substituting, we get three equations:

$\begin{cases}0=-8+4a-2b+c\\0=1+a+b+c\\0=0+0+0+c\end{cases}$ making $c=0$.

Substitute this into the first two equations to get $\begin{cases}4a-2b=8\\a+b=-1\end{cases}$. Solve this system to get $a=1,b=-2$. So the original equation should now be $P(x)=x^3+x^2-2x, P(-1)=2$/

C 27. $8^{-\frac{2}{3}}=\frac{1}{4}$

B 28. Let $g(x)=y$. Substituting y into $f(x)$, we get $y-3$. Since this is $(f\circ g)(x)$, $y-3=x^2+1, y=x^2+4$ which is $g(x)$.

D 29. Square both sides and put in standard form gives a hyperbola. $1=\frac{y^2}{4}-\frac{x^2}{16}$ .Graphing by hand shows that it is the lower half.

D 30. Complete the square to find the vertex. The maximum value would be the y-coordinate of the vertex. $y=-\left(x^2+5x+\frac{25}{4}\right)+2+\frac{25}{4}$.

$2+\frac{25}{4}=\frac{33}{4}$.