1. D $x^3 - 2x^2 - 11x - 20 = 0$ then $(x^2 + 3x + 4)(x - 5) = 0$. Using $b^2 - 4ac = 9 - 16 = -7$, Thus the roots are imaginary and the only real solution to the equation is 5. So, the answer is D.

2. D $(x - y)^2 = 36 = x^2 + y^2 - 2xy$ Thus $x^2 + y^2 - 2xy = 22 - 2xy = 36$ and $-2xy = 14, xy = -7$ then $\frac{1}{x} - \frac{1}{y} = \frac{y-x}{xy} = -\frac{6}{-7} = \frac{6}{7}$. So, the answer is D.

3. A $3(3x)^2 - 10(3^x) + 3 = 0$, let $y = 3^x$. $3y^2 - 10y + 3 = 0$ and factoring the quadratic $(3y - 1)(y - 3) = 0$ Thus the roots are $y = \frac{1}{3}, 3$. So $3^x = \frac{1}{3}, 3$. Therefore, $x = -1, 1$ and the sum $= 0$. So, the answer is A.

4. D First, we factor the numerator and denominator $g(x) = \frac{(x+1)(x+3)(x-2)}{(x+3)(x+2)(x-3)} = \frac{(x+1)(x-2)}{(x+2)(x-3)}$ Thus, there are two vertical asymptotes at $x = -2, 3$. Also, because the numerator and denominator have equal degrees, the horizontal asymptote is the ratio of the leading coefficients. Thus, $y = 1$ is the third asymptote. So, the answer is D.

5. A Multiply $x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1 = 0$ by x-1 to get x^{11}-1 = 0. All the roots to powers of 11 are equivalent to 1, and there are 10. So, the answer is A.

6. C x=$\sqrt{4 + 3x}$, x^2 - 3x - 4=0, (x-4) (x+1) = 0. 4, -1 are the roots. However, -1 is extraneous because a square root cannot be negative, 4 is the only solution. So, the answer is C.

7. D After completing the square, you end up with $9(x - 7)^2 + 4(y + 4)^2 = 0$. This is the graph of the point (7, -4). So, the answer is D.

8. A Using the remainder theorem, the remainder of this division is found by plugging in 3, $3^5 - 4 * 3^4 + 3^2 + 1 = -71$. So, the answer is A.

9. B Factoring the numerator gets (x-6) (x-4) (x-3) / (x-3) =3, canceling the x-3 gets $x^2 - 10x + 24 = 3$, subtracting 3, we get $x^2 - 10x + 21 = 0$. Factoring (x-7) (x-3) = 0, roots are 7 and 3. However 3 is extraneous because the denominator is 0. The only solution is 7. So, the answer is B.

10. A Using power of a point CB*CA=CD*CE, (x+3) * (2x+4) = 2x*(x+8). Expanding we get $2x^2$+10x+12=$2x^2$+16x. Then x=2. So, the answer is A.

11. B To find the shortest distance, you can reflect (-9, 8) across y=2 to get (-9, -4) and then do the distance formula from (-9, -4) to (6, 4). $15^2 + 8^2 = 17^2$. So, the answer is B.

12. D Factoring, we get $\frac{(x+1)^2(x-4)}{x-5} \geq 0$. Drawing a number line, out special numbers are -1, 4, -5. -5 is open and 4, -1 are closed. Everything greater or equal to 4, less than -5, and -1 works. So, the answer is D

13. B Completing the square, we get $4(x - 3)^2 + 9(y - 8)^2 = 36$ and dividing by 36 gets $\frac{(x-3)^2}{9} + \frac{(y-8)^2}{4}$, a=3, b=2 the length of the latus rectum is $\frac{2b^2}{a}$ = 8/3. So, the answer is B.

14. C The intersection points of the lines y=x, y=3x+2, and y=-2x+12 are (-1, -1), (4, 4), (2, 8). The region created by the inequalities is just the area of the triangle with

vertices (-1, -1), (4, 4), (2, 8), you can find this area with the shoelace theorem, getting 15. So, the answer is C.

15. A This is a system of equations. If x is the number of cows and y is the number of chickens then x + y=37 and 8x + 5y = 245. So, 5x + 5y = 185 and 3x = 60, meaning x = 20. So, the answer is A.

16. B X has to be divisible by 13 because 13y and 286 are divisible by 13. So, the only cases that work are (52, 2), (39, 7), (26, 12) and (13,17). So, the answer is B.

17. D Writing out the first few terms $\log_{10}\frac{2}{1} + \log_{10}\frac{3}{2} + \log_{10}\frac{4}{3}$, we realize that many things cancel except for the 1000 and 1, leaving $\log_{10}1000$, which is 3. So, the answer is D.

18. B Using finite differences, we get 193. So, the answer is B.

19. C $(X + \frac{1}{x})^2 = 9$. $x^2 + \frac{1}{x^2} = 7$. Then $x^3 + \frac{1}{x^3} = (X + \frac{1}{x})(x^2 + \frac{1}{x^2} - 1)$. So, $x^3 + \frac{1}{x^3} = 18$. $18 * 18 = x^6 + \frac{1}{x^6} + 2$, then $322 = x^6 + \frac{1}{x^6}$. So, the answer is C.

20. E Completing the square gets $-3(x+2)^2 + 24$. To minimize $(x+2)^2$ as small as possible, this happens when x+2=0. So, the maximum value is 24. The answer is E.

21. B Completing the square gets $25(x-3)^2 - 36(y+1)^2 = 900$. Dividing by 900 gets $\frac{(x-3)^2}{36} - \frac{(y+1)^2}{25} = 1$. So, $a^2 = 36, b^2 = 25, a^2 + b^2 = c^2$, $c^2 = 61$, $c = \sqrt{61}$, 2c is the distance between foci. So, the answer is B.

22. D Using the sum of infinite geometric sequences formula, we get $\frac{3a}{1-r} = \frac{a}{1-2r}$. Cross multiplying and cancelling the a gets 3 - 6r = 1 – r, or 2 = 5r. r=2/5. So, the answer is D.

23. C Using Descartes rule of signs, we can find 3 sign changes, the maximum is 3. So, the answer is C.

24. A A is multiplied by $\frac{2^2}{3^2}$ and $\frac{3}{2}$. $6 * \frac{4}{9} * \frac{3}{2} = 4$. So, the answer is A.

25. B Using partial fraction decomposition, we get $\frac{1}{n^2+3n+2} = \frac{1}{n+1} - \frac{1}{n+2}$. After finding the first few terms, we realize that many terms will cancel. $\frac{1}{2} - \frac{1}{3} + \frac{1}{3} - \frac{1}{4} + \frac{1}{4} - \frac{1}{5} + \cdots + \frac{1}{101} - \frac{1}{102}$, leaving us with $\frac{51}{102} - \frac{1}{102}$ or $\frac{25}{51}$. So, the answer is B.

26. D The area of a cyclic quadrilateral using Brahmagupta's formula is $\sqrt{(s-a)(s-b)(s-c)(s-d)}$ where $s=\frac{a+b+c+d}{2}$ and a, b, c, d are the sides, a + b + c + d = 16 because of Vieta's sum of roots, so s = 8. However, the polynomial in question can be factored to (x-a) * (x-b) * (x-c) * (x-d), and we are looking for (8-a) * (8-b) * (8-c) * (8-d). So, we can just plug in 8 for x to find (8-a) * (8-b) * (8-c) * (8-d). Then f (8) =180, and we square root that to find the area. So, the answer is D.

27. E For x to be the third side of an acute triangle, we must have

$$108^2 - 90^2 < x^2 < 108^2 + 90^2$$

Note that 90 and 108 are $18 \cdot 5$ and $18 \cdot 6$, so $18\sqrt{11} < x < 18\sqrt{61}$.
Also note that $54 = 18 \cdot 3 < 18\sqrt{11}$ and $144 = 18 \cdot 8 > 18\sqrt{61}$, so none of the given answer choices form an acute triangle.

28. E 75% of 12 is 9, meaning that he will have 9 liters of chlorine in his final mixture. $9 = \frac{1}{5}x$, so x = 45 liters. 45-12=33. So, the answer is E.

29. B We can set w, x, y, z to 1 to find the sum of the coefficients, 2+3-1-3=1, and $1^{12} = 1$. So, the answer is B.

30. C Completing the square gets $4(x-6)^2 + 9(y-7)^2$=36. Dividing by 36 gets $\frac{(x-6)^2}{9} + \frac{(y-7)^2}{4} = 1$. So, the conic is an ellipse with a = 3 and b = 2. The area of an ellipse is abπ or 6π. So, the answer is C.