1. First find the midpoint: it is (1,0). The slope of the segment = -5/2, the perpendicular segment has m = 2/5. It just so happens that the x-intercept of the perpendicular bisector is the point (1,0); today is your lucky day! The answer is **1**. **D**
2. We know that imaginary roots occur in conjugate pairs, as roots of the quadratic factor. Using the sum and product of roots, we get that $1+i$ and $1-i$ are the roots of x^2-2x+2. Multiplying $(x^2-2x+2)(x+2)$ gives us $\mathbf{x^3-2x+4=0}$ **A**
3. $P(-2)=(-2)^2+2=6$; $P(6)=\frac{6-1}{6+3}=\mathbf{\frac{5}{9}}$ **C**
4. Using the "log of a product" property, we get $\ln(10x^2)=3$; so $e^3=10x^2$. Solving for *x*, and rationalizing the denominator, we get $\mathbf{\frac{e\sqrt{10e}}{10}}$; **B**
5. Sum and product of roots, the sequel! Find the sum and product of the conjugate pair $\frac{-3\pm i\sqrt{2}}{2}$. The sum = $\frac{-12}{4}=-\frac{b}{a}$; the product = $\frac{11}{4}=\frac{c}{a}$. The equation is $4x^2+12x+11=0$; the coefficient of the linear term is **12. A**
6. The key to success is to get a common base; which in this case is $\frac{2}{3}$. Our equation can be written as $\left(\frac{2}{3}\right)^{2(x-5)}=\left(\frac{2}{3}\right)^{-3(2x+1)}$. The exponents are equal, so 2(x-5) = -3(2x+1). Solving leads us to $x=\mathbf{\frac{7}{8}}$. **D.**
7. The center of the circle must lie on the line $y=2$, and the radius = 4. Since the center is in quadrant II, it must be (-4, 2). The equation is $\mathbf{(x+4)^2+(y-2)^2=16}$; **B.**
8. The axis of symmetry is horizontal; $p=3$. The equation in "vertex" form is $(y-2)^2=12(x-1)$; this can also be written as $\mathbf{y^2-4y-12x+16=0}$. **B**
9. The quickest way to find this determinant is expansion by minors. Using the top row, we get: $-x(3-4x)+1(0+4)=14$ which becomes $4x^2-3x-10=0$. This factors into $(4x+5)(x-2)=0$. Solving we get ***x* = 2, and -5/4**; neither of which is listed, so **E.**
10. Use the shortcut: $h=-b/2a$. This gives us $h=2$. The maximum value of the function is *k*, which is $f(h)=2(2)^2-8(2)+5=$ **-3. D**
11. First, use the factoring pattern for difference of two cubes: $(x^3-y^3)=(x-y)(x^2+xy+y^2)$. Substituting the given information, we get $45=3(x^2+xy+y^2)$, so $15=(x^2+xy+y^2)$. Now go back to the fact that $(x-y)=3$, and square both sides of this equation. That gives us $x^2-2xy+y^2=9$. We can combine these two equations and solve for *xy*; we get *xy* = **2. E.**
12. One way to solve this is to multiply the matrices on the left side of the equation. Doing so results in the system of equations: $-2x+3y=11$ and $-x+4y=2$. Solving we get $x=-8/5$ and $y=13/5$; the sum is **1. B**
13. Factor the polynomials by using the remainder theorem and synthetic division. Factored form is $\frac{(x+1)(x-2)(x+3)}{(x-2)(x-2)(x+3)}\ge 0$; before reducing, note the restrictions: *x* cannot equal 2 or -3 . After reducing, we have $\frac{(x+1)}{(x-2)}\ge 0$. Using -1 and 2 as critical points on the number line, we conclude that $x\le -1$ *or* $x>2$. Since $x\ne -3$, our solution is $\mathbf{(-\infty,-3)\cup(-3,-1]\cup(2,\infty)}$ **C**

14. *Let* $a = 2^x$ and $b = 3^x$; our equation can be written $2a^2 + ab - b^2 = 0$, which when factored into $(2a - b)(a+b) = 0$, so $2a = b$ and $a = -b$. Referring back to the original substitution, we get $2 \cdot 2^x = 3^x$ and $2^x = -3^x$. The second equation has no solution, so we only need to solve $2 \cdot 2^x = 3^x$. Dividing gives us $2 = \left(\frac{3}{2}\right)^x$; this leads us to $x = \log_{3/2} 2$ so $h =$ **2. D**

15. The function can be written in factored form: $f(x) = \frac{(3x-2)(x+3)}{(2x-1)(x+3)}$, which reduces to $f(x) = \frac{(3x-2)}{(2x-1)}$. This tells us the vertical asymptote is $x = \frac{1}{2}$, and the horizontal asymptote is $y = \frac{3}{2}$; the sum is **2. D**

16. $x = 27^{\log_3 4}$ becomes $x = 3^{\log_c 4}$, which gives us $x = 3^{\log_3 4^3}$, so $x = 64$. Similarly, the second equation becomes $y = 2^{\log_2 17^{-1}}$, so $y = 17^{-1}$, and $y^{-1}=17$. Substituting into the expression $\frac{x}{y^{-1} - 1}$ gives us **4. B**

17. The equation graphs into a square with vertices at (3,0), (-3,0), (0,3), and (0, -3). The area can be done in several ways; viewing the square as 2 triangles, each with base = 6 and height = 3, gives us a total area of **18. A**

18. To simplify the process, ignore the whole number for the time being. Let N = 0.3272727….; then 100N = 32.72727…… Subtracting 100N- N gives us 99N = 32.4, so N = 324/990. We can reduce by dividing by 9 and then by 2, so N = 18/55. Now, returning to the original decimal, we need to add the whole number 1. The mixed number $1\frac{18}{55} = \frac{73}{55}$, so the sum of the numerator and denominator is **128. C**

19. Start by cubing both sides of the equation; that gives us $2x^2 - 11x + 14 = -x^3 + 6x^2 - 12x + 8$, which transforms to $x^3 - 4x^2 + x + 6 = 0$. Using the factor theorem and synthetic division, we can find the roots of the equation: -1, 2, and 3, which are a, b, and c, respectively. $(-1)^5 \cdot (2)^5 \cdot (3)^2 =$ **-288. C**

20. Multiplying each term by the LCD $(x - 3)(x + 2)$ gives us $x + 7 = Ax + 2A + Bx - 3B$. We can separate the terms into two equations: $x = Ax + Bx$, or 1 = A + B; and 7 = 2A – 3B. Solving this system leads us to B = -1 and A = 2, so 4B + 2A = **0. B**

21. The constant term is the 4th term, we can deduce this by knowing that the degree of the constant term is 0, so both the first term and the second term have equal exponents of 3. The expression for the 4th term is $\frac{6!}{3!3!}\left(\frac{2}{x}\right)^3(-3x)^3$. This "boils down" to (20)(8)(-27) which = **-4,320 C**

22. The domain of the inverse is the same as the range of the original function, which is all real numbers: $(-\infty,\infty)$. **D.**

23. By dividing the numerator by the denominator, we get the equation for the slant asymptote: $y = \frac{1}{2}x + 1$; the y-intercept is **1. A.**

24. It may help to do a quick sketch of the graph of the 4 lines. That enables us to identify the pairs of lines that intersect and the corresponding systems to solve to find the points of intersection. Let *a* be the line $x = -2$, *b* be the line $y = -3x - 5$, *c* : $x - y = 5$, and *d*: $3x + y = 3$. We are looking for the intersections of the following pairs of lines: *ad, ab, bc,* and *cd.*. Solving the corresponding systems, we get the following points of intersection, in the same order as previously listed: **(-2, 9), (-2, 1), (0, -5), and (2, -3). C**

25. Expressing the numerator and denominator as products, we have $\log_7 \frac{9\cdot 8\cdot 7\cdot 6\cdot 5\cdot 4\cdot 3\cdot 2}{5\cdot 7\cdot 7\cdot 7}$.
Using the properties of logarithms, we can rewrite this as
$\log_7 9+\log_7 8+\log_7 7+\log_7 6+\log_7 5+\log_7 4+\log_7 3+\log_7 2-3\log_7 7-\log_7 5$, and further simplifying we get:
$2\log_7 3+3\log_7 2+\log_7 7+\log_7 2+\log_7 3+\log_7 5+2\log_7 2+\log_7 3+\log_7 2-3\log_7 7-\log_7 5$
which now can be rewritten in terms of a, b, and c: 2b +3a + 1 + a + b + c + 2a + b + a – 3 – c; combining terms gives us **7*a* + 4*b* -2. B**

26. It will help to transform the equation into "vertex" form by completing the square. Doing so gives us $(y+1)^2=4(x-8)$. The vertex is (8, -1) and p = 1. So the axis of symmetry is the horizontal line y = -1, and the directrix is the vertical line x = 7. They intersect at **(7, -1). A**

27. $A=\left(\log_{125}64\cdot\log_{128}\frac{1}{5}\right)-\left(\log_{1024}\frac{1}{49}\cdot\log_{49}32\right)$. We can simplify this into

$\frac{\log 64}{\log 125}\cdot\frac{\log\frac{1}{5}}{\log 128}-\frac{\log\frac{1}{49}}{\log 1024}\cdot\frac{\log 32}{\log 49}$, and again into $\frac{6\log 2}{3\log 5}\cdot\frac{-1\log 5}{7\log 2}-\frac{-1\log 49}{10\log 2}\cdot\frac{5\log 2}{\log 49}$. This allows us to reduce the expression down to $-\frac{2}{7}+\frac{1}{2}$, which equals $\mathbf{\frac{3}{14}}$. **D**

28. One way to look at this is to list the first few terms: $i^0+i^1+i^2+i^3+i^4+\ldots$, and their values 1 + i + -1 + -i + 1 + … We have blocks of 4 consecutive terms that each have a sum of 0. The last complete block of 4 such terms ends with i^{2011}, so the sum of the series equals the sum of the final three terms, $i^{2012}+i^{2013}$ i^{2014} which equal 1 + i + -1 = ***i*. C**

29. We can start with $4\Diamond 2=\frac{3\cdot 4+2\cdot 2}{2\cdot 4-3\cdot 2}$ which equals 8. So $x\Diamond 8=8$, which means $\frac{3x+16}{2x-24}=8$.
Cross multiplying and solving gives us x = **16**. **D**

30. Multiplying the first equation by 2 and then subtracting the second equation from it gives us $\frac{15}{y}=5$, so , y = 3. We can quickly solve for x by substituting 3 for y in either equation; we obtain x = **2**. **C**