1. **B.** Choice A is odd; choices C and D are even. Choice B is neither as replacing *x* with –*x* does not give the original function or the negative of the original function.

2. **B.** $12=\sqrt{(x-6)^2+(9+1)^2}=\sqrt{x^2-12x+136}\rightarrow 144=x^2-12x+136\rightarrow x^2-12x-8=0\Rightarrow x=6\pm 2\sqrt{11}$.

3. **C.** A sketch of each graph shows that they will intersect two times.

4. **A.** Using the first equation, $f(-1)=-1+3=2$. Now, find where the second function will have a value of 2: $2(-1)-c=2\Rightarrow c=-4$.

5. **B.** When reflected over (4, 1), the new center will be at (8, 2), yielding the new equation $(x-8)^2+(y-2)^2=25$, which is $x^2+y^2-16x-4y+43=0$. The ordered quadruple is $(1,-16,-4,43)$, the sum of whose elements is 24.

6. **B.** Since the negative *r*-value directs the ray in the opposite direction, $\frac{5\pi}{6}$ is a correct angle.

7. **E.** $2^x=2^{2x}-12\rightarrow 2^{2x}-2^x-12=0\rightarrow\left(2^x-4\right)\left(2^x+3\right)=0\rightarrow 2^x=4,\ 2^x=-3\Rightarrow x=2$. When $x=2$, $y=4$, so the sum is 6.

8. **C.** An *x*-axis reflection changes $f(x)$ to $-f(x)$, and the shift right 7 units changes the latter function to $-f(x-7)$.

9. **A.** The *x*-intercept is found by $0=\sqrt{x+9}-5\rightarrow 25=x+9\rightarrow x=16$; the *y*-intercept is found by $y=\sqrt{0+9}-5=-2$. Their product is –32.

10. **D.** The slopes of inverse linear functions are reciprocals of one another. The slope of the given line segment is $\frac{1}{3}$, so the inverse function has slope 3.

11. **A.** To obtain the top part of the ellipse, solve for *y* and take only the positive square root: $\frac{(y-3)^2}{9}=1-\frac{(x+2)^2}{4}\rightarrow\frac{(y-3)}{3}=\sqrt{\frac{4-(x+2)^2}{4}}\Rightarrow y=\frac{3}{2}\sqrt{-x^2-4x}+3$.

12. **C.** The asymptotes are found by using the "parenthetical" part of the equation and the square root of the denominators: $(y+2)=\pm\frac{\sqrt{4}}{\sqrt{2}}(x-1)\Rightarrow(y+2)=\pm\sqrt{2}(x-1)$.

13. **C.** The first equation has slope $-\frac{1}{3}$ and *y*-intercept $\frac{2}{3}$. The second equation has slope $\frac{-2}{a^2+2}$ and *y*-intercept $\frac{a+2}{a^2+2}$. To be parallel, the slopes must be equal but the *y*-intercepts cannot be equal. Using the slopes and solving for *a*: $-\frac{1}{3}=\frac{-2}{a^2+2}\rightarrow a^2=4\rightarrow a=\pm 2$. Using the *y*-intercepts and solving for *a*, $\frac{2}{3}=\frac{a+2}{a^2+2}\rightarrow$ $2a^2-3a-2=0\rightarrow(2a+1)(a-2)=0\rightarrow a=-\frac{1}{2},\ 2$. To be parallel, *a* must be –2, and to be the same line, *a* must be 2. Their sum is 0.

14. **A.** Multiply the second equation by –2 and use elimination. This yields $\frac{19}{y} = -2 \rightarrow y = -\frac{19}{2}$. Substituting to find *x*, we get $\frac{4}{x} - \frac{14}{19} = 10 \rightarrow \frac{4}{x} = \frac{204}{19} \rightarrow x = \frac{19}{51}$. The sum is $\frac{38}{102} - \frac{969}{102} = -\frac{931}{102}$.

15. **E.** The slope of the radius from the center to the point of tangency is $-\frac{3}{4}$ so the slope of the tangent line is $\frac{4}{3}$. Using point-slope form we have $y - 3 = \frac{4}{3}(x+4) \rightarrow 3y - 9 = 4x + 16 \Rightarrow 4x - 3y = -25$.

16. **D.** If the *y*-intercept is (0, *h*), then the area of the triangle is $T = \frac{1}{2}ah$, so $h = \frac{2T}{a}$. The slope of the line is $\frac{h}{a}$, and $\frac{h}{a} = \frac{2T}{a^2}$. The slope-intercept form of the line is $y = \frac{2T}{a^2}x + \frac{2T}{a} \rightarrow 2Tx - a^2y + 2aT = 0$.

17. **A.** Substituting the given points for (*x*, *y*), we obtain $\begin{cases} P + Q = -4 \\ P - Q = 2 \end{cases}$. By elimination we have $2P = -2 \rightarrow P = -1$. By substitution we have $-1 + Q = -4 \rightarrow Q = -3$. $P + Q = -1 + (-3) = -4$.

18. **C.** Take the determinant of the matrix formed by the ordered triples:
By the diagonal method, $\begin{vmatrix} 3 & 2 & 1 \\ -1 & 3 & 0 \\ 2 & 2 & 5 \end{vmatrix} = (45 + 0 - 2) - (6 + 0 - 10) = 47$.

19. **A.** $f(x) = \frac{x^3 + 7x^2 + 16x + 12}{x^2 + 6x + 8} = \frac{(x+2)^2(x+3)}{(x+2)(x+4)}$. There is one vertical asymptote at $x = -4$. Since an $(x+2)$ factor cancels out, there is a hole in the graph at $(-2, 0)$. The highest power of *x* is in the numerator so there is no horizontal asymptote.

20. **C.** For the *x*-coordinate, $|12 - 4| = 8$. Five-sixths of 8 is $\frac{20}{3}$. $\frac{20}{3} + 4 = \frac{32}{3}$. For the *y*-coordinate, $|-6 - 18| = 24$. Five-sixths of 24 is 20. $18 - 20 = -2$. (The *y*-coordinate becomes more negative so we have to subtract the 20.)

21. **D.** Notice the capital S, signifying the use of principal values.

22. **E.** Using elimination we have $x^2 - x = 0 \rightarrow x(x-1) = 0 \Rightarrow (0, 10), (1, 9)$. The distance between the points is $\sqrt{(1-0)^2 + (9-10)^2} = \sqrt{2}$.

23. **B.** Any point on the angle bisector is equidistant from the rays (lines) that form the angle. Using the distance from a point to a line formula gives us $\frac{3x - 4y + 2}{5} = \pm\frac{5x + 12y - 3}{13}$. From here we have two equations:
$39x - 52y + 26 = 25x + 60y - 15 \Rightarrow 14x - 112y + 41 = 0$ and $-39x + 52y - 26 = 25x + 60y - 15 \Rightarrow$
$64x + 8y + 11 = 0$.

24. **D.** *S* has polar coordinates $(4, 0°)$; *U* has coordinates (r, θ), $r \geq 0$. We need $d(0, U) + d(U, S) = 6 \rightarrow$

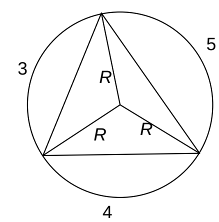
$$r+\sqrt{4^2+r^2-2(4)r\cos(0-\theta)}=6\rightarrow 16+r^2-8r\cos\theta=36-12r+r^2\rightarrow 3r-2r\cos\theta=5\Rightarrow r=\frac{5}{3-2\cos\theta}.$$

25. **B.** Using (1, 2, 4) as our "first" point, we must subtract the first point's coordinates from the second point's coordinates to get the distance: $(4-1,\ 2-2,\ -1-4)=(3,\ 0,\ -5)$. Although we could switch the first and second points, only one correct answer is given: $\mathbf{r} = (1 + 3t)\mathbf{i} + 2\mathbf{j} + (4 - 5t)\mathbf{k}$. The other answer would have been $\mathbf{r} = (4 - 3t)\mathbf{i} + 2\mathbf{j} + (-1 + 5t)\mathbf{k}$

26. **D.** Each of the ten central angles has measure $36°$, and each isosceles triangle has area $\frac{1}{2}(4)^2\sin 36°$. Since there are ten triangles that form the hexagon, the area is $10\left(\frac{1}{2}(4)^2\sin 36°\right)=80\sin 36°$.

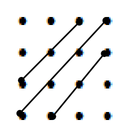
27. **C.** To eliminate the *xy* term, the angle can be found by $\frac{1}{2}\arctan\frac{B}{A-C}\rightarrow\frac{1}{2}\arctan\frac{\sqrt{3}}{2-3}\rightarrow\frac{1}{2}(120°)\Rightarrow 60°$.

28. **E.** If R is the radius of the circle, then the circumference is $2\pi R=3+4+5=12$, so $R=\frac{6}{\pi}$. The arcs make up $\frac{1}{4},\frac{1}{3},$ and $\frac{5}{12}$ of the circle, so their respective central angles are $\frac{\pi}{2},\frac{2\pi}{3},$ and $\frac{5\pi}{6}$ radians. Since the triangles are all isosceles, we can use the formula $\frac{1}{2}R^2\sin\theta$ for the area of each triangle:



$$\frac{1}{2}\left(\frac{6}{\pi}\right)^2\left(\sin\frac{\pi}{2}+\sin\frac{2\pi}{3}+\sin\frac{5\pi}{6}\right)=\frac{18}{\pi^2}\left(1+\frac{\sqrt{3}}{2}+\frac{1}{2}\right)=\frac{9}{\pi^2}\left(3+\sqrt{3}\right).$$

29. **D.** There are 16 lattice points in the given region, and there are ${}_{16}C_3=560$ sets of three points. There are four vertical line segments containing four lattice points and four horizontal line segments containing four lattice points, so there are $8\binom{4}{3}=32$ sets of collinear points that must be subtracted. There are also oblique line segments to consider. Three of them have slope 1 and three have slope –1. For each slope there are $\binom{3}{3}+\binom{4}{3}+\binom{3}{3}=6$ sets of collinear points. Therefore, there are $560-32-12=516$ triangles that satisfy the given condition.



30. **C.** $f(x)=\sqrt{8x-x^2}-\sqrt{14x-x^2-48}=\sqrt{16-(x-4)^2}-\sqrt{1-(x-7)^2}$.
The first radical is the formula for the *y*-coordinate of the upper half of a circle with center at (4, 0) and radius 4; the second radical is the formula for the *y*-coordinate of the upper half of a circle with center (7, 0) and radius 1. $f(x)$ is the difference in the heights of the two semicircles. Graphing these two semicircles shows that the function has domain $[6,\ 8]$ and that the greatest difference must occur at $x=6$.
$f(6)=\sqrt{16-(6-4)^2}=\sqrt{12}=2\sqrt{3}$.