#1. Answer
9

#2. Answer
7

#3. Answer
3

#4. Answer
2

#5. Answer
36

#6. Answer
2

#7. Answer
3

#8. Answer
4

#9. Answer
2

#10. Answer
9

#11. Answer
34

#12. Answer
4

#1. Solution:

$\Rightarrow \int_0^k (2x)dx = \left[x^2\right]_0^k = k^2 - 0$. Given $k = 3$, we have $k^2 = 3^2 = 9$.

#2. Solution:

$\lim_{x\to 1} \frac{(2x+k)(\sqrt{x}-1)}{(2x-1)(x-1)} = \lim_{x\to 1} \frac{(2x+k)(\sqrt{x}-1)}{(2x-1)(\sqrt{x}+1)(\sqrt{x}-1)} = \lim_{x\to 1} \frac{2x+k}{(2x-1)(\sqrt{x}+1)} = \frac{2+k}{2}$ Given $k = 7$, then $\frac{2+7}{2} = \frac{9}{2}$. And so $9 - 2 = 7$.

#3. Solution:

The vertices of the triangle are $\pm\sqrt{\frac{j}{a}}$ and $(0, -j)$. To be equilateral, $2 \cdot \sqrt{\frac{j}{a}} = \sqrt{\frac{j}{a} + j^2}$ Since $k = 10$ then $j = 1 \Rightarrow \frac{2}{\sqrt{a}} = \sqrt{1 + \frac{1}{a}}$ So $\frac{4}{a} = 1 + \frac{1}{a} \Rightarrow a = 3$.

#4. Solution:

Multiplying by 8 and 3 respectively, we have $8\ln\left(x^2y^3\right) = 8 \cdot 1 \Rightarrow \ln\left(x^{16}y^{24}\right) = 8$ and $3\ln\left(x^5y^7\right) = 3 \cdot k \Rightarrow \ln\left(x^{15}y^{21}\right) = 3k.$ And so we can get $\ln\left(xy^3\right)$ from $\ln\left(\frac{x^{16}y^{24}}{x^{15}y^{21}}\right) = \ln\left(x^{16}y^{24}\right) - \ln\left(x^{15}y^{21}\right) = 8 - 3k$. Given $k = 2$ we have $8 - 6 = 2$.

#5. Solution:

Using Heron's formula, we have $A = \sqrt{s(s-10)(s-17)(s-k)}$, where $s = \frac{10+17+k}{2} = \frac{27+k}{2}.$ Since $k = 9$, then $s = \frac{10+17+9}{2} = 18$. And so $A = \sqrt{18 \cdot 8 \cdot 1 \cdot 9} = \sqrt{9 \cdot 2 \cdot 8 \cdot 9} = 3 \cdot 4 \cdot 3 = 36$.

#6. Solution:

$5 \times 343 + 6 \times 49 + 7y + x = 512k + 7 \times 64 + 5 \times 8. \Rightarrow 2009 + 7y + x = 512k + 488. \Rightarrow 7y + x = 512k - 1521.$ Since $k = 3$, we have $7y + x = 15$. From the bases we know that $0 \le x \le 6$ and $0 \le y \le 6$, but it is easy to see $y = 2$ and $x = 1$.

#7. Solution:

Square both sides to get $j + x = x^2$. Since $k = 7$, we have $j = 6$. $6 + x = x^2$. $x^2 - x - 6 = 0$ $(x-3)(x+2) = 0$ $x = 3$

#8. Solution:

$f'(x) = \frac{\left(x^2+j\right)(1) - (x+1)(2x)}{\left(x^2+j\right)^2} = 0$. $x^2 + j - 2x^2 - 2x = 0$. $x^2 + 2x - j = 0$. $x^2 + 2x - 3 = 0$ $(x-3)(x+1) = 0.$ $x = 3$ and $x = -1$. The max is at $x = 3$, so $a = 3$. The min is at $x = -1$, so $b = -1$. $a - b = 3 + 1 = 4.$

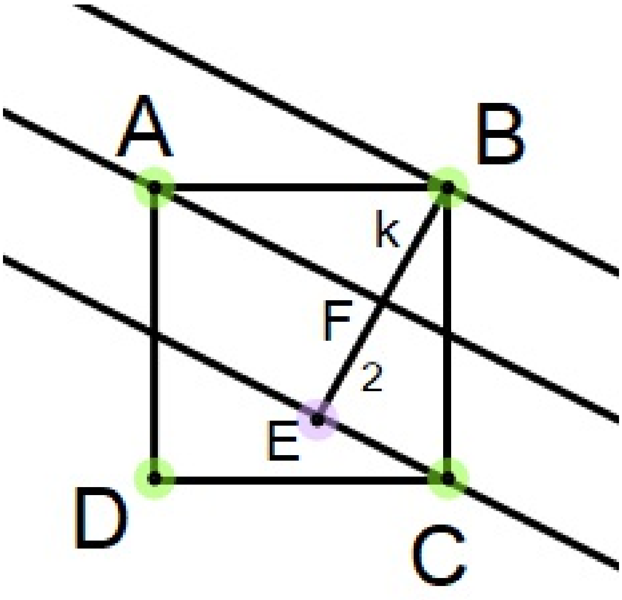
#9. Solution:

$2(3x - 2y)(3 - 2y') + 2(x - y)(1 - y') = 0.$ $2[(3(k+2) - 2(k+3)](3 - 2y') + 2(k + 2 - (k+3))(1 - y') = 0.$ $2(k)(3 - 2y') - 2(1 - y') = 0$. Given $k = 1$, $2(3 - 2y') - 2 + 2y' = 0.$ $6 - 4y' - 2 + 2y' = 0$ $y' = 2.$

#10. Solution:

$A = \int_0^{\frac{\pi}{2}} \frac{1}{2}r^2 d\theta = \frac{1}{2} \cdot j^2 \cdot \int_0^{\frac{\pi}{2}} \sin^2(2\theta)d\theta = \frac{j^2}{2} \cdot \int_0^{\frac{\pi}{2}} \frac{1}{2}(1 - \cos(4\theta))d\theta = \frac{j^2}{4} \cdot \left[\theta - \frac{1}{4}\sin(4\theta)\right]_0^{\frac{\pi}{2}}$ $= \frac{j^2}{4}\left[\frac{\pi}{2} - \frac{1}{4}\sin(2\pi)\right] = \frac{j^2}{4} \cdot \frac{\pi}{2}$ Given $k = 2$, then $j = 6$. $\Rightarrow \frac{9\pi}{2}$.

#11. Solution:



$\triangle ABF \cong \triangle BCE$, so $EC = k$ and $EB = k + 2.$ $(k+2)^2 + k^2 = BC^2$ Given $k = 3$, we have $5^2 + 3^2 = BC^2 = 25 + 9 = 34$. The area is 34.

#12. Solution:

Let $A = \arctan\left(\frac{1}{2}\right)$, and $B = \arctan\left(\frac{1}{k}\right)$. So $\tan(A) = \frac{1}{2}$ and $\tan(B) = \frac{1}{k}$. $\tan(A+B) = \frac{\tan(A) + \tan(B)}{1 - \tan(A)\tan(B)}$ $= \frac{\frac{1}{2} + \frac{1}{k}}{1 - \frac{1}{2} \cdot \frac{1}{k}}$ Given $k = 3$, we have $= \frac{\frac{1}{2} + \frac{1}{3}}{1 - \frac{1}{6}} = \frac{\frac{5}{6}}{\frac{5}{6}} = 1$. Since $\tan(A+B) = 1$, then $A + B = \frac{\pi}{4}$. So $N = 4$.