The following were changed at the resolution center at the convention: 23 A

1. ***A*** $x^2+y^2=200\to y=\sqrt{200-x^2}$ $P(x)=x\cdot\sqrt{200-x^2}\to P'(x)=\sqrt{200-x^2}-\dfrac{x^2}{\sqrt{200-x^2}}=0$ Solving for x= 10 and y= 10. So product is 100.

2. ***B*** $C=2\pi r\to dC/dt=2\pi\, dr/dt\to 3\pi=2\pi\, dr/dt\ \therefore\ dr/dt=3/2$ $A=\pi r^2\to dA/dt=2\pi r\, dr/dt=2\pi\cdot 3\cdot 3/2=9\pi$

3. ***E*** The graph is given by the function $x(t)=2\cos\left(\pi/2\, t\right),\ v(t)=x'(t)=-\pi\sin\left(\pi/2\, t\right)$

4. ***D -*** $h/r=20/5\to r=h/4$ $V=\dfrac{\pi r^2h}{3}=\dfrac{\pi h^3}{48}\to\dfrac{dV}{dt}=\dfrac{\pi h^2}{16}\cdot\dfrac{dh}{dt}\to 15=\dfrac{64\pi}{16}\dfrac{dh}{dt}\ \therefore\ \dfrac{dh}{dt}=\dfrac{15}{4\pi}$

5. C $P=Ce^{kt}\to 20=Ce^0\to C=20$ $\quad 1620=20e^{4k}\to e^{4k}=81\to 4k=\ln 81\to k=\frac{\ln 81}{4}=\ln 3$
$P=20e^{6\ln 3}=20\cdot e^{\ln 729}=20\cdot 729=14580$

6. B speed decreases when acc is positive and vel is negative or when acc is negative and vel is positive. Velocity is positive and acceleration is negative on the interval $\dfrac{\pi}{2}<t<\dfrac{7\pi}{6}$ and vel is negative and acc is positive on $\dfrac{3\pi}{2}<t<\dfrac{11\pi}{6}$

7. C in the diagram, the diameter of the circle is equal to the side of the square so:
$C=\pi s\to\frac{dC}{dt}=\pi\frac{ds}{dt}\to 6=\pi\cdot\frac{ds}{dt}\to\frac{ds}{dt}=\frac{6}{\pi}$ since P = 4s the rate at which the perimeter is changing is $4\cdot\frac{6}{\pi}=\frac{24}{\pi}$

8. D Area of circle is 25π, r=5, s = 10 $Area=s^2-\pi r^2\to\frac{dA}{dt}=2s\frac{ds}{dt}-2\pi r\frac{dr}{dt}=2\cdot 10\cdot\frac{6}{\pi}-2\pi\cdot 5\cdot\frac{3}{\pi}=\frac{120}{\pi}-30$

9. C Solving for x, gives us $x=\frac{2}{3}y^{3/2}$, $\dfrac{dx}{dy}=\sqrt{y}$ $L=\int_0^3\sqrt{1+\left(\sqrt{y}\right)^2}\,dy=\dfrac{2}{3}(1+y)^{\frac{3}{2}}\Big|_0^3=\dfrac{14}{3}$

10. B Solving for y we have $y=\dfrac{\sqrt{36-4x^2}}{3}$ that equation represents half of the diagonal of the hexagon which is equal to one side of the hexagon. The formula for the area of a hexagon is $A=\dfrac{3s^2\sqrt{3}}{2}$. The volume of the solid can be found by $V=\dfrac{3\sqrt{3}}{2}\int_{-3}^{3}\left(\dfrac{\sqrt{36-4x^2}}{3}\right)^2dx=24\sqrt{3}$

11. B MVT for derivatives - $f'(c)=\dfrac{f(2)-f(0)}{2-0}\to 6c^2=\dfrac{20-4}{2}=8\to c=\sqrt{\dfrac{4}{3}}$

12. C Use Pappus. Equation of circle in standard form $(x-4)^2+(y+7)^2=9$ so the center is (4,-7) and r =3. The area of the circle is 9π and the radius of the rotation is 7 so the volume of the solid is 9π × 14π = $126\pi^2$

13. B since x, y and z make a right triangle, they can be related by $x^2+y^2=z^2$ so when x = 4 and y = 3, z=5.
$\not{2}x\frac{dx}{dt}+\not{2}y\frac{dy}{dt}=\not{2}z\frac{dz}{dt}$ and since $\frac{dx}{dt}=3\frac{dy}{dt}$ then $4\cdot 3\frac{dy}{dt}+3\frac{dy}{dt}=5\cdot 1\to\frac{dy}{dt}=\frac{1}{3}$ $\frac{dx}{dt}=3\frac{dy}{dt}=3\cdot\left(\frac{1}{3}\right)=1$

14. D Find the time when the particle changes direction, $x'(t)=3t^2-6t-9=0\to t=3$ then find distance from t =0 to t = 3, and then also from t = 3 to t = 5. $x(3)-x(0)=-27$ so the particle traveled 27 units from t = 0 to t = 3 and $x(5)-x(3)=32$ so the particle traveled 32 units from t = 3 to t = 5. Total is 59.

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15. A To find total leaked $\int_0^{\sqrt{3}/2} \frac{12}{9+4t^2}dt = 2\tan^{-1}\left(\frac{2t}{3}\right)\Big|_0^{\sqrt{3}/2} = 2\tan^{-1}\left(\frac{\sqrt{3}}{3}\right) - 0 = \frac{\pi}{3}$

16. A slope = $\frac{dy}{dx} = \frac{4e^{4t}}{3/2\cos\left(3t/2\right)}\Bigg|_0 = \frac{8}{3}$ when t = 0, x = 6 and y = 1. Line equation $y - 1 = \frac{8}{3}(x-6)$

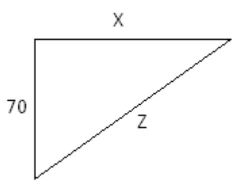
17. C trap sum = $\frac{L+R}{2}$ $L = 10\cdot3+30\cdot2+40\cdot1 = 130, R = 30\cdot3+40\cdot2+20\cdot1 = 190$ $\frac{L+R}{2} = \frac{130+190}{2} = 160$

18. B Since the region is symmetrical about the y-axis, the center of mass is at x=0. To find y- value use:
$\bar{y} = \frac{1}{2A}\int_a^b \left[\left(f(x)\right)^2 - \left(g(x)\right)^2\right]dx$ Area of region = $\int_{-2}^{2}\left(4-x^2\right)dx = \frac{32}{3}$ $\bar{y} = \frac{3}{64}\int_{-2}^{2}\left[\left(4-x^2\right)^2 - 0^2\right]dx = \frac{8}{5}$

19. B Use shell , curves intersect at x= 0 and x= 2 $V = 2\pi\int_0^2 x\left[5-\left(x^2-1\right)\right]dx = 2\pi\int_0^2\left(4x-x^3\right)dx = 8\pi$

20. D The number of bushels is equal to the number of trees times the number of bushels per tree. The number of trees can be expressed as T(t)=200+15t and the number of bushels per tree is expressed as B(t)=15+1.2t. The total number of bushels can be expressed as the product of the two functions $B_{Total}(t) = (200+15t)(15+1.2t) = 3000+465t9+18t^2$
The rate of increase at t = 3 will be $B'_{Total}(3) = 465+36(3) = 573$

21. A $x^2 + 70^2 = z^2 \rightarrow 2x\frac{dx}{dt} = 2z\frac{dz}{dt} \rightarrow \not{2}\cdot240\cdot60 = \not{2}\cdot250\frac{dz}{dt} \rightarrow \frac{dz}{dt} = \frac{288}{5} = 57.6$



Solve for x, x= 240

22. D $\frac{dy}{dx} = xy^2 \rightarrow \frac{dy}{y^2} = xdx \rightarrow \int\frac{dy}{y} = \int xdx \rightarrow -\frac{1}{y} = \frac{x^2}{2} + C$ sub in x =3 and y = 2 $-\frac{1}{2} = \frac{9}{2} + C \rightarrow C = -5$ Solve for y $y = \frac{2}{10-x^2}$

23. C Average value can be found by $\frac{\int_0^2 x^2\sqrt{x^3+1}dx}{2-0}$ $x^3+1 = u \rightarrow x^2dx = \frac{du}{3} \rightarrow \int_1^9 \sqrt{u}du = \frac{2}{3}\left[u^{3/2}\right]_1^9 = \frac{52}{3}$

$\frac{52/3}{2} = \frac{26}{3}$

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24. B r = 0 at $\theta = -\pi/4, \pi/4$. Polar area =

$$\frac{1}{2}\int_{\alpha}^{\beta} r^2 \to \frac{1}{2}\int_{-\pi/4}^{\pi/4}\left(4\cos(2\theta)\right)^2 d\theta = 8\int_{-\pi/4}^{\pi/4}\cos^2(2\theta)\,d\theta = \frac{8}{2}\int_{-\pi/4}^{\pi/4}\left[1+\cos(4\theta)\right]d\theta =$$

$$4\left[\theta + \frac{\sin(4\theta)}{4}\right]_{-\pi/4}^{\pi/4} = 4\left(\pi/4 - \left(-\pi/4\right)\right) = 2\pi$$

25. C $F = kx^2 \to 40 = k\cdot 2^2 \to k = 10\ W = \int_3^6 10x^2dx = \frac{10}{3}x^3\Big|_3^6 = 630$

26. E find p.o.i. $y'' = 6x - 6 = 0 \to x = 1, y = -2$ $y'(1) = -3$ slope NORMAL to the curve = $1/3$ so $y + 2 = \frac{1}{3}(x-1)$

27. C $2x\frac{dx}{dt} + 8y\frac{dy}{dt} = 0$ x =2, y=2, dx/dt=4 $\to 2\cdot 2\cdot 4 + 8\cdot 2\cdot\frac{dy}{dt} = 0 \to = \frac{dy}{dt} = -1$

28. C total gallons = $\int_0^4 3\sqrt{t}\,dt + 40 = \left[2\cdot t^{3/2}\right]_0^4 + 40 = 16 + 40 = 56$

29. A horizontal sections = x, vertical sections = y.

$3x + 2y = 240 \to 2y = 240 - 3x\ \ Area = x\cdot 2y = x(240-3x) = 240x - 3x^2$ $A'(x) = 240 - 6x = 0 \to x = 40$ plug in 40 and find y = 60 the length of the pen was 2y so the dimensions of the pen are 40 x 120.

30. A $R(P) = P\cdot Q = P\cdot 100e^{-.01P}$ $R'(P) = 100e^{-.01P} - Pe^{-.01P} = 0 \to e^{-.01P}(100 - P) = 0 \to P = 100$ cents or \$1.00