1. $P=7y \quad Q=3x$

$\frac{dQ}{dx}-\frac{dP}{dy}=3-7=-4$

$-4\times\pi\times100=-400\pi$

because is clockwise so it is in the negative direction.

So, $-400\pi\times(-1)=400\pi$

2. $z=x^2+3xy+y^2$

$\frac{dz}{dx}=2x+3y=2\times1+3\times1=5$

$\frac{dz}{dy}=3x+2y=3\times1+2\times1=5$

$z-5=5(x-1)+5(y-1)$

$z=5x-5+5y\cancel{-5+5}$

$z=5x+5y-5$

3. $f(x,y)=x^2y \quad (0,0)$

$f_x=2xy \quad f(0,0)=0$

$f_y=x^2 \quad 0\le x\le1 \quad 0\le y\le1-x$

$\cancel{f_{xx}=2y} \quad x=0 \quad 0\le y\le1-x$

$\cancel{f_{yy}=2x} \quad f(0,y)=0y=0$

$\cancel{f_{yy}=2x}$

absolute minimum and absolute maximum is 0.

$\cancel{2xy}$ $2xy=0 \quad x^2=0$

$x=0 \quad y=0$

$\cancel{0\le x\le1 \quad 0\le y\le1-x}$

$\cancel{f_{xx}=0 \quad f_{xy}=0} \quad f_{yy}=0$

4. $\frac{d^4}{dx^2dydz}$

$=\frac{d^2}{dx^2}\cdot\cancel{\frac{d}{dx}}\cdot\frac{d}{dy}\cdot\frac{d}{dz}$

$=\cancel{\sin}$

$(-\sin(x^2+y+z)4x^2+2\cos(x^2+y+z))\cdot$

$\cos(x^2+y+z)\cdot\cos(x^2+y+z)$

5.

$xy+xz+yz+x^2y^2z^2=4$

$x+xz'+z+yz'+x^2(2yz^2+2zy^2z')=0$

$xz'+yz'+2zx^2y^2z'=-x-z-2x^2yz^2$

$z'(x+y+2zx^2y^2)=-x-z-2x^2yz^2$

$z'=\frac{-x-z-2x^2yz^2}{x+y+2zx^2y^2}$

plug in $(1,1,1)$

$z'=\frac{-1-1-2}{1+1+2}=\frac{-4}{4}=-1$

6

~~$x-1=t \quad y-2=t$~~ $z-3=t$

~~$-x=t \quad y-1=t \quad z-2=t$~~

$L_1=\langle1,2,3\rangle+t\langle1,1,1\rangle$

$L_2=\langle0,1,2\rangle+t\langle-1,1,1\rangle$

$t=0: (1,2,3), (0,1,2)$

$i \quad j \quad k$

$1 \quad 1 \quad 1$

$-1 \quad 1 \quad 1$

$0-j(2)+2k=\langle0,-2,2\rangle$

$0(x-1)-2(y-2)+2(z-3)=0.$

$-2y+4+2z-6=0.$

7.

$a(t) = \langle -4\sin 2t, -4\cos 2t, 9e^{3t} \rangle$

$v(t) = \langle 2\cos 2t + c, -2\sin 2t + c, 3e^{3t} + c \rangle$

$t=0$ $2+c=2$ $0+c=0$ $3+c=3$

$c=0$.

$v(t) = \langle 2\cos 2t, -2\sin 2t, 3e^{3t} \rangle$

$p(t) = \langle \sin 2t + c, \cos 2t + c, e^{3t} + c \rangle$

$t=0$ $0+c=0$ $1+c=1$ $1+c=1$

$c=0$.

$p(t) = \langle \sin 2t, \cos 2t, e^{3t} \rangle$ $t = \frac{\pi}{4}$

$= \langle 1, 0, e^{\frac{3\pi}{4}} \rangle$

8. $r(t) = \langle t, 2t, 2t \rangle$

$x=t$ $y=2t$ $z=2t$

$0 \le t \le 1$

$\int_0^1 \cancel{t + 2t + 4t}\, dt$

$= x'(t) = 1$

$y'(t) = 2$ $z'(t) = 2$

$\sqrt{1+4+4} = 3$.

$\int_c x + y + 2z\, ds$

$= \int_0^1 (t + 2t + 4t) \cdot 3\,dt$

$= \int_0^1 21t\, dt$

$= \frac{21}{2}$

9.

$\lim_{(x,y,z) \to (1,1,1)} \sin\left(\frac{\pi}{3} x_1\right) \cos\left(\frac{\pi}{4} x_2\right)$.

$= \lim_{(x,y,z) \to (1,1,1)} \sin\frac{\pi}{3} \cos\frac{\pi}{2}$

$= 0$

10.

$P = x^2 + \sin(y+z)$

$Q = y^2 + xz$

$R = z^2 + e^{xy}$

$z = 1$

11. $\int_c 2e^{2x+3y+4z}\,dx + 3e^{2x+3y+4z}\,dy + 4e^{2x+3y+4z}\,dz$

$x=t$ $y=2t$ $z=t^2$ $0 \le t \le 1$

$\int_0^1 2e^{2t+6t+4t^2}\,dt + 6e^{8t+4t^2}\,dt + 8te^{8t+4t^2}\,dt$

$= \int_0^1 8e^{2t+6t+4t^2} + 8te^{8t+4t^2}\,dt$

$= 162753.79$

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12.

$x=t^2 \quad y=t \quad z=t^2$

$0\le t\le 1$

$\int_0^1 5t\cdot 2t\,dt + 5t^2\,dt + 6t^2\cdot 2t\,dt$

$=\int_0^1 10t^2 + 5t^2 + 12t^3\,dt$

$= 8$

13.

$x^2+y^2+z^2\le 100 \quad z<0.$

$z=\sqrt{100-x^2-y^2}$

$\iiint \frac{1}{\sqrt{(r\cos\theta)^2+(r\sin\theta)^2+z^2}}\,dV.$

$0\le r\le 10. \quad 0\le\theta\le 2\pi.$

14. $\int_0^1\int_0^w\int_0^z\int_0^y 360\,x\,dx\,dy\,dz\,dw$

$=3.$

15. $\begin{vmatrix} \frac{dx}{du} & \frac{dx}{dv} \\ \frac{dy}{du} & \frac{dy}{dv} \end{vmatrix} = \begin{vmatrix} 6\cos(2u+v) & 3\cos(2u+v) \\ 1-\sin(u+v) & 1-\sin(u+v) \end{vmatrix}$

$= \begin{vmatrix} 6\cos(0) & 3\cos(0) \\ 1-\sin(0) & 1-\sin(0) \end{vmatrix}$

$= \begin{vmatrix} 6 & 3 \\ 1 & 1 \end{vmatrix} = 6-3=3$

16.

$f_x = 3x^2-6y$

$f_y = 2y-6x$

$f_{xx} = 6x^2$

$f_{xy} = -6$

$f_{yy} = 2$

$3x^2-6y=0 \quad 2y-6x=0$

$(x_1,y_1)=(6,18)$

$(x_2,y_2)=(0,0).$

$f_{xx}f_{yy}-f_{xy}^2 = 216\times 2-36$

$=396$

$D>0 \quad f_{xx}>0$ so

$(6,18)$ is a local minimum.

$f_{xx}f_{yy}-f_{xy}^2 = 0\times 2-36$

$= -36$

$D<0$ so $(0,0)$ is a saddle point.

17.

$\mathrm{div}F = \frac{d}{dx} x+y + \frac{d}{dy} y+z + \frac{d}{dz} x+z$

$= 1 + 1 + 1 = 3$

$3 \times \pi r^2 = 3 \times \pi \times 10^2$

$= 300\pi$