16.2

3.(a) $F(r(t)) = \langle t^{-2}, t^2 \rangle$

$dr = \langle 1, -t^{-2} \rangle dt$.

(b) $\langle t^{-2}, t^2 \rangle \cdot \langle 1, -t^{-2} \rangle$

$= t^{-2} + (t^2 \cdot (-t^{-2}))$

$= t^{-2} - t^0 = t^{-2} - 1$

$\int_1^2 (t^{-1} - 1) dt = -\frac{1}{2}$

9. $f(x,y) = \sqrt{1+9xy}$ $y = x^3$ $0 \le x \le 1$

(x, x^3). (t, t^3) $0 \le t \le 1$

$x' = 1$ $y' = 3t^2$ $\sqrt{1+9t^4}$

$\int_0^1 \sqrt{1+9t^4} \cdot \sqrt{1+9t^4}\, dt$

$= 2.8$

11. $f(x,y,z) = z^2$, $r(t) = (2t, 3t, 4t)$ for $0 \le t \le 2$

$x = 2t$, $y = 3t$ $z = 4t$ $z^2 = 16t^2$

$x' = 2$, $y' = 3$ $z' = 4$

$\sqrt{4+9+16} = \sqrt{29}$.

$\int_0^2 16t^2 \cdot \sqrt{29}\, dt = 229.8$.

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13. $A(0,0,1)$ $B(0,2,0)$, $C(1,1,1)$
$BC = (0,2,0) + t(1,-1,1)$
$= \cancel{0+t}\ (t, 2-t, t)$.
$\cancel{\sqrt{t^2+(2-t)^2+t^2}}$ $x=t$
$x=t$ $y=2-t$ $z=t$
$x'=1$ $y'=-1$ $z'=1$
$\sqrt{1+1+1} = \sqrt{3}$.
$\int_0^1 te^{t^2} \cdot \sqrt{3}\, dt = 1.488$.

17. $x=4t$ $y=-3t$ $z=12t$
$x'=4$ $y'=-3$ $z'=12$
$\sqrt{16+9+144} = 13$.
$\int_2^5 \cancel{1\ 13\,dt} = \int_2^5 13\,dt = 39$.
13 the distance between $(=78,-6,24)$ and $(20,-15,60)$.

21. (x, x^2) $0 \le x \le 2$ (t, t^2) $0 \le t \le 2$
$x=t$ $y=t^2$ $\cancel{x'=1\ y'=2t}$
$dx = 1dt$ $dy = 2tdt$.
$\int_0^2 t^2 dt - \int_0^2 2t^2 dt$
$= \int_0^2 t^2 - 2t^2\, dt = -\frac{8}{3}$

29. $(0,0,0)+t(1,4,4)=(t,4t,4t)$.

~~$x'=1 \quad y'=$~~

$dx=dt \quad dy=4dt \quad dz=4dt$

$\int_0^1 \cancel{4tdt}\ (t-4t)dt+4t(4t-4t)dt+16t\,dt$

$=\frac{13}{2}$

31. $(1,0)+t(-1,1)=(1-t,\ t)$.

$x=1-t \quad y=t$

$dx=-dt \quad dy=dt$.

$\int_0^1 \frac{-t\,dt+(1-t)dt}{(1-t)^2+t^2}=1.5708$

35. $P(0,0,0) \quad a=(-1,1,1)$.

$R\ (0,0,0)+t(-1,1,1)$

$=(0-t,\ 0+t,\ t)$

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

$x'=1 \quad y'=1 \quad z'=1$

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

$\int_0^1 (e^t+e^{-2t}+e^t)\sqrt{3}\,dt$

$=6.701$

16.3

$x\sin(yz) + xyz\cos(yz)$

1. $F = (y\sin(yz),\ \cancel{\sin(yz)}\ ,$ $xy^2\cos(yz)$

$\int_C F\,dr = f(1,1,\pi) - f(0,0,0)$

$= 0.$

3. $(3, 6y)$

$f(x,y) = 3x + 3y^2$

$f_x = 3 \quad f_y = 6y.$

$F(x,y) = (3, 6y) \quad f(x,y) = 3x + 3y^2 \quad r(t) = (t, 2t^{-1})$

$\cancel{r'(t) = (1, -2t^{-2})}$

$\int_C \cancel{F\,dr} = \quad r(1) = (1, 2) \quad r(4) = (4, \frac{1}{2})$

$f(4, \frac{1}{2}) - f(1,2) = -4$

5. $f(x,y,z) = xye^z \quad f_x = ye^z$

$f_y = xe^z \quad f_z = xye^z.$

$r(1) = (1,1,0) \quad r(2) = (4, 8, 1)$

$f(4,8,1) - f(1,1,0) = 85.985$

9. $F = y^2 i + (2xy + e^{z}) j + ye^z k.$

$$\begin{array}{ccc} i & j & k \\ \frac{d}{dx} & \frac{d}{dy} & \frac{d}{dz} \\ y^2 & 2xy + e^z & ye^z \end{array}$$

$f_x = y^2$

$f = \int y^2\,dx$

$= xy^2 + g(y,z)$

$2xy + g_y = 2xy + e^z$

$g_y = e^z$

$= 0$. is conservative. $f_y = 2xy + e^z$

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$g(y,z) = \cancel{(z)}\, h(z) + e^{z}y.$

$f = xy^2 + e^{z}y + h(z)$

$f_z = ye^{z}$

$e^{z}y \cancel{+e^{z}} + h'(z) = ye^{z}$

$h'(z) = 0 \cdot h(z) = 0$

$f = xy^2 + e^{z}y.$

13. $f_x = z\sec^2 x.$

$f = \cancel{z\sec^2 x}\ z\tan x + g(y,z)$

$f_y = z$

$0 + g_y = z$

$g_y = z \quad g(y,z) = h(z) + \cancel{\ }\ zy.$

$f = z\tan x + zy + h(z).$

$f_z = y + \tan x$

$\tan x + y + h'(z) = y + \tan x$

$y \cancel{+h'(z) = y + \tan x}$

$\cancel{h'(z) = \tan x} \quad h(z) = ? \quad h'(z) = 0$

$h(z) = 0$

$f = z\tan x + zy$

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15. is conservative.

$f_x = 2xy + 5$

$f = 2y\frac{x^2}{2} + 5x + g(y,z)$

$= x^2y + 5x + g(y,z)$

$f_y = x^2 - 4z$

$x^2 + g_y = x^2 - 4z$

$g_y = -4z \quad g(y,z) = h(z) + -4zy$.

$f = x^2y + 5x \cancel{+} -4yz + h(z)$.

$f_z = -4y$

$-4y + h'(z) = -4y$

$h'(z) = 0 \quad h(z) = 0$.

$f = x^2y + 5x - 4yz$

17. is conservative.

$f_x = 2xyz \quad f = x^2yz + g(y,z)$.

$f_y = x^2z \quad \cancel{x^2z} \; x^2z + g_y = x^2z$

$g_y = 0$.

$g(y,z) = 0 \quad \cancel{h(z)=0}. \quad (g(y,z) = h(z))$.

$\cancel{f_z} = x^2y, \quad f = x^2yz + h(z)$

$x^2y + h'(z) = x^2y$

$h'(z) = 0 \quad h'(z) = 0$

$f = x^2yz$

$r(t) = (t^2, \sin(\frac{\pi t}{4}), e^{t^2-2t})$

$r(0) = (0, 0, 1)$

$r(2) = (4, 1, 1)$

$f(4,1,1) - f(0,0,1) = 16 - 0 = 16.$

19. is conservative

$r_1 = (t, t, 0)$

$r(0) = (0, 0, 0)$

$r(1) = (1, 1, 0)$

$f(1,1,0) - f(0,0,0) = 1 - 0 = 1.$

$r_2 = (t, t^2, 0)$

$r(0) = (0, 0, 0)$ $r(1) = (1, 1, 0)$

$f(1,1,0) - f(0,0,0) = 1.$