16.2

3\. Let $F = \langle y^2, x^2 \rangle$ and let C be the curve $y = x^{-1}$ for $1 \le x \le 2$ oriented from left to right

a) $x = t$ $y = t^{-1}$ $y = \ln F = \langle y^2, x^2 \rangle$ $F(c(t)) = \langle (t^{-1})^2, t^2 \rangle = \langle t^{-2}, t^2 \rangle$

$c(t) = \frac{d}{dt}(t, t^{-1}) = \langle 1, -t^{-2} \rangle$ $ds = (1, -t^{-2})\,dt$

b) dot product: $F(c(t)) \cdot c'(t) = (t^{-2}, t^2)(1, -t^2) = \boxed{t^{-2} - 1}$

9\. $f(x,y) = \sqrt{1 + 9xy}$, $y = x^3$ for $0 \le x \le 1$ $\int_0^1 \sqrt{1 + 9x^4}\,dx = 14/5$

11\. $f(x,y,z) = z^2$ $r(t) = \langle 2t, 3t, 4t \rangle$, $0 \le t \le 2$ $r'(t) = \langle 2, 3, 4 \rangle$

$|r'(t)| = \sqrt{2^2 + 3^2 + 4^2} = \sqrt{29}$ $f(r(t)) = 16t^2$ $\int_0^2 (16t^2)(\sqrt{29})\,dt = \frac{128\sqrt{29}}{3}$

13\. $f(x,y,z) = xe^{z^2}$ $(0,0,1) \to (0,2,0) \to (1,1,1)$ $\int_C f(x,y,z)\,ds = \frac{\sqrt{3}}{2}(e$

17\. $\int_C 1\,ds$ $r(t) = \langle 4t, -3t, 12t \rangle$ $2 \le t \le 5$ $r'(t) = \langle 4, -3, 12 \rangle \to |r'(t)| = \sqrt{16 + 9 + 144}$

$\int_2^5 (1)(13)\,dt = 39$

27\. $\int_C y\,dx - x\,dy$, $y = x^2$, $0 \le x \le 2$ $dy = 2x\,dx$ $\int_0^2 x^2\,dx - (x)(2x)\,dx = -8/3$

29\. $\int_C (x-y)\,dx + (y-z)\,dy + z\,dz$ from $(0,0,0)$ to $(1,4,4)$

$r(t) = \langle t, 4t, 4t \rangle$ $r'(t) = \langle 1, 4, 4 \rangle \to |r'(t)| = \sqrt{33}$ $F(c(t)) =$

$\int_0^1 13t\,dt = 13/2$ $\langle t - 4t, 4t - 4t, 4t \rangle$

31\. $\int_C \frac{-y\,dx + x\,dy}{x^2 + y^2}$ $(1,0)$ to $(0,1)$ $= \pi/2$

35\. $\boxed{2 - 1/e + e}$

16.3

1. $f(x,y,z) = xy\sin(yz)$ $\quad \nabla f = \langle y\sin(yz), x(\sin(yz) + yz\cos(yz))\ xy^2\cos(yz) \rangle$
   $F = y\sin(yz)\,i + x(\sin(yz) + yz\cos(yz))\,j + xy^2\cos(yz)\,k$
   start: $f(0,0,0) = 0$ $\quad$ end: $f(1,1,\pi) = 0$ $\quad \int_C F \cdot dr = 0$

3. $F(x,y) = \langle 3, 6y \rangle$, $f(x,y) = 3x + 3y^2$, $r(t) = \langle t, 2t^{-1} \rangle$, $1 \le t \le 4$ $\quad r'(t) = \langle 1, -2t^{-2} \rangle$
   $= -9/4$

5. $F(x,y,z) = ye^z i + xe^z j + xye^z k$, $f(x,y,z) = xye^z$, $f(x,y,z) = xye^z$

   $\int 6t^3 e + 6t^2 e + 6t^2 e\,dt = \int 18t^2 e\,dt = \frac{135e}{2}$

9. $F = y^2 i + (2xy + e^z) j + ye^z k$ $\quad \text{curl}(F) = \langle 0,0,0 \rangle$ F is conservative
   $f = xy^2 + ye^z$

13. $F = \langle z\sec^2 x, z, y + \tan x \rangle$ $\qquad f = z\tan x + yz$

15. $F = \langle 2xy + 3, x^2 - 4z, -4y \rangle$ $\quad f_x = 2xy + 5$, $f_y = x^2 - 4z$, $f_z = -4y$
   $\boxed{f = x^2 - 4yz}$

17. $\int_C 2xyz\,dx + x^2z\,dy + x^2y\,dz$ $\quad$, $r(t) = \langle t^2, \sin(\pi t/4), e^{t^2-2t} \rangle$
   $r'(t) = \langle 2t, \frac{\pi\cos(\frac{\pi t}{4})}{4}, (2t-2)e^{t^2-2t} \rangle$
   $\int_0^2 F(r(t)) \cdot r'(t)\,dt = \boxed{16}$