Chapter 12

Section 12.1

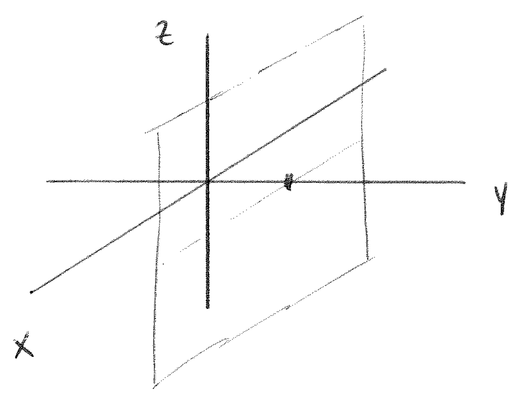
2. A closest to yz plane.
   B on xz plane
   C farthest away from xy

4. (1, -1, 1)

6. $\sqrt{6}$

8. $(x-1)^2 + (y-2)^2 + (x-3)^2 = 25$

10.



plane parallel to xz plane and passing thru (0, 1, 0)

22. (a.) $C = f(d, m) = 40d + 0.15m$

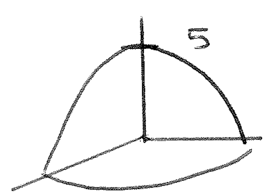
    (b) $f(5, 300) = 40(5) + 0.15(300) = \$245$

Section 12.2

2. (a) I (b) V (c) IV (d) II (e) III

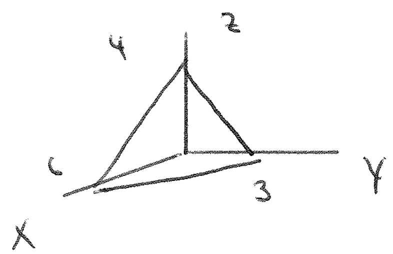
4. sphere with $r = 3$, centered at origin

6.

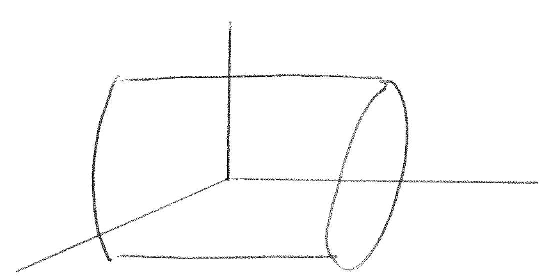


paraboloid opening ↓ with vertex at $z = 5$

8.



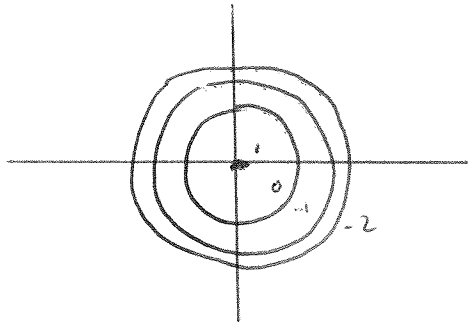
10.



Chapter 12

Section 12.3

(4.)



circles become more closely packed as $c \downarrow$

(20) (a) \$ 137 (b) $\sim$ \$6250

(c)

3	5	7	9	11	13	15
7.5	7.1	6.9	6.5	6.25	6	5.75

Section 12.4

(4) Linear $\frac{\Delta y}{\Delta z} = 3$ $\frac{\Delta x}{\Delta z} = -4$

(6) Linear $\frac{\Delta y}{\Delta z} = 5$ $\frac{\Delta x}{\Delta z} = 2$

(12) Non linear (14) Linear

Section 12.5

(16) $-x^2 + y^2 - z^2 = 0 \Rightarrow$ cone

(18) $x^2 + y^2 = 1 \Rightarrow$ cylindrical surface

Chapter 13

Section 13.3

(2) -38

(8) 238

Section 13.4

(2) $\hat{j} - \hat{k}$

(8) $\hat{i} - \hat{j}$

(10) $-2\hat{k}$

(12) $-2\hat{i} - 7\hat{j} - 13\hat{k}$

(14) $-x + y + z = 3$

(16) $\tan\theta = \dfrac{\sqrt{38}}{3}$

Chapter 14

Section 14.1

4 (a) $f_p < 0$

(b) $f_a(8, 12) = 150$

Change in unit sales with ad spending ↑ by 150 when price is 8 and spending = 12.

Section 14.2

6 $\frac{\partial V}{\partial r} = \frac{2}{3}\pi r h$

8 $\frac{\partial}{\partial T}\left(\frac{2\pi r}{T}\right) = -\frac{2\pi r}{T^2}$

14 $\frac{1}{2}v^2$

16 $\frac{2\pi}{v}$

26 $(15x^2y - 3y^2)\cdot\cos(5x^3y - 3xy^2)$

34 13.6

Chapter 14.

Section 14-3

(8) $dh = e^{-3t}\cos(x+5t)\,dx$ +

$(5e^{-3t}\cos(x+5t) - 3\sin(x+5t)\cdot e^{-3t})\,dt$

(10) $dF = 0.01\,G\,dm - 0.2\,G\,dr$

(14) $z = 12x - 6y - 7$

(16) $df = \frac{1}{3}dx + 2\,dy$

$\Delta f \cong 2.973$

Section 14.4

(30) $\nabla f(5,2) = 50\hat{i} + 96\hat{j}$

(52) (a) $\frac{2}{\sqrt{13}}$ (b) $\frac{1}{\sqrt{17}}$

Section 14-5

(2) $\vec{\nabla}_f = -\sin(x+y)\,\hat{i} + (-\sin(x+y) + \cos(y+z))\,\hat{j}$

$+ \cos(y+z)\,\hat{k}$

Chapter 14

Section 14.6

(2) $$\frac{dz}{dt} = \frac{t^3-2}{t^4+t}$$

(16) $$\frac{\partial w}{\partial t} = \frac{\partial w}{\partial x}\frac{dx}{dt} + \frac{\partial w}{\partial y}\frac{dy}{dt} + \frac{\partial w}{\partial t}\frac{dz}{dt}$$

(20) $$\frac{\partial p}{\partial t} = -\frac{5\ Pa}{hr}$$

Section 14.7

(4) $f_x = e^y$ $\quad$ $f_y = xe^y$

$f_{xx} = 0$ $\quad$ $f_{yy} = xe^y$

$f_{xy} = e^y$ $\quad$ $f_{yx} = e^y$

(6) $f_x = e^y$ $\quad$ $f_y = xe^y + ye^y + e^y$

$f_{xx} = 0$ $\quad$ $f_{yy} = xe^y + ye^y + 2e^y$

$f_{xy} = e^y$ $\quad$ $f_{yx} = e^y$

(10) $f_x = 6\cos 2x \cos 5y$ $\quad$ $f_y = -15\sin 2x \sin 5y$

$f_{xx} = -12\sin 2x \cos 5y$ $\quad$ $f_{yy} = -75\sin 2x \cos 5y$

$f_{xy} = -30\cos 2x \sin 5y$ $\quad$ $f_{yx} = -30\cos 2x \sin 5y$

(14) $Q(x,y) = 1 - 2x + y + 4x^2 - 4xy + y^2$

(16) $Q(x,y) = 1 - \frac{1}{2}x^2 - 3xy - 9y^2$

(18) $Q(x,y) = 1 + 2x - \frac{1}{2}y^2$

Chapter 14

Section 14-7

(26) $f_x < 0$ $\qquad f_{xx} = f_{yy} = f_{xy} = 0$

$f_y < 0$

(30) $f(x,y) = (x+2y)^{1/2}$

Chapter 15

Section 15.1

(2) CP @ $(2,2)$

$D = 8$, $f_{xx} > 0$ } local min

Section 15.3

(2) CP's at $(6,-2)$ ⇒ Local max

$(-6,2)$ ⇒ Local min

(10) CP at $(1,11,2)$ ⇒ max

(14) CP's $(0,1)$ $(0,-1)$ $(1,0)$, $(-1,0)$, $\left(-\frac{2}{3}, \pm\frac{\sqrt{5}}{3}\right)$

max / min values are $1, -1$.

Inside circle cp $= (0,0)$ and is a saddle pt.

(18) Cp at $q_1 = 50$ $q_2 = 150$ and is a min value.

(22) (a) 25,219

(b) $\lambda = 11.348$

Chapter 16

Section 16.1

4 (a) Avg = 3702

(b) 77.125

10 function is always (+), so $\int$ is (+).

20 cos y (+) on interval so $\int$ ~~is~~ (+)

Section 16.2

4 $2/3$

6 $\int_0^4 \int_{3x}^{12} f(x,y)\,dy\,dx$ or $\int_0^{12} \int_0^{\frac{y}{3}} f(x,y)\,dx\,dy$

10 $\int_1^4 \int_{\frac{x-1}{3}}^{2} f(x,y)\,dy\,dx$

14 656.1

18 2.38

28 0.23

36 $\int_{-3}^{3} \int_{-\sqrt{9-y^2}}^{\sqrt{9-y^2}} (9-x^2-y^2)\,dx\,dy$

38 4

Chapter 16

Section 16.3

(30) integral is positive

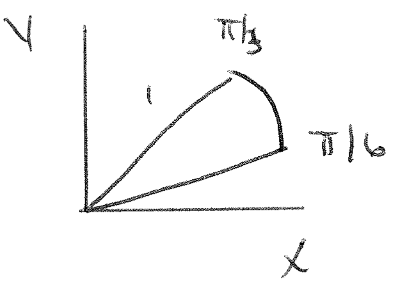
(32) $\int_W y \, dV = 0$

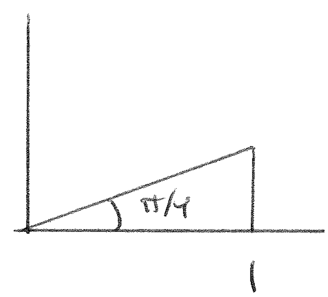
(34) $\int_W xy \, dV = 0$

(36) $\int (z-2) \, dV < 0$

Section 16.4

(4) $\int_R f \, dA = \int_{\pi/4}^{3\pi/4} \int_0^2 f \, r \, dr \, d\theta$

(8) 

(10) 

(14) $\frac{38\pi}{3}$

(20) $\frac{32\pi(\sqrt{2}-1)}{3}$

Note break problem into 2 parts

Total = ∇ + ⌓

Chapter 16

Section 16.5

(2) $V = \frac{200\pi}{3}$

(4) $\int_0^5 \int_0^{2\pi} \int_{\pi/2}^{\pi} \rho \sin\phi \, d\phi \, d\theta \, d\rho = 25\pi$

(6) $\int_0^5 \int_0^3 \int_0^1 f \, dx \, dy \, dz$

(10) $\int_0^{2\pi} \int_0^{\pi/6} \int_0^3 f \, \rho^2 \sin\phi \, d\rho \, d\phi \, d\theta$

(14) a) $V = \int_0^{2\pi} \int_{\pi/4}^{\pi/2} \int_0^{3/\sin\phi} \rho^2 \sin\phi \, d\rho \, d\phi \, d\theta$

b) 18π

(22) 2π

(28) Cylindrical $V = \int_0^{2\pi} \int_0^{\sqrt{2}} \int_r^{\sqrt{4-r^2}} r \, dz \, dr \, d\theta$

Spherical $V = \int_0^{\pi/4} \int_0^{2\pi} \int_0^2 \rho^2 \sin\phi \, d\rho \, d\theta \, d\phi$

Chapter 17

Section 17.1

(12) Lines don't intersect

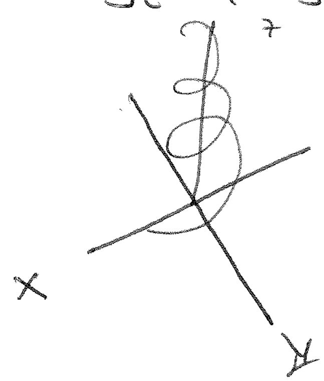
(32) $t_1 = -2 \quad t_2 = 1$

$x = -7 \quad y = 7 \quad z = -4$

(36) upper arc $\quad 5\hat{i} + 5(-\cos t\,\hat{i} + \sin t\,\hat{j})$

lower arc $\quad 5\hat{i} + 5(\cos t\,\hat{i} + \sin t\,\hat{j})$

(54) helix



Section 17.2

(2) $\vec{v} = 3\hat{i} + \hat{j} - \hat{k}$

$\hat{a} = x''\hat{i} + y''\hat{j} + z''\hat{k} = \bar{0}$

(8) $\bar{v} = 6\sin t\cos t\,\bar{i} - \sin t\,\bar{j} + 2t\,\bar{k}$

$\|\bar{v}\| = \sqrt{36\sin^2 t\cos^2 t + \sin^2 t + 4t^2}$

particle at rest when $t = 0$

Chapter 17

Section 17-2

(12) $\bar{v} = -6\pi \sin(2\pi t)\hat{i} + 6\pi \cos(2\pi t)\hat{j}$

$\hat{a} = 12\pi^2 \cos(2\pi t)\hat{i} - 12\pi^2 \sin(2\pi t)\hat{j}$

$\bar{v} \cdot \bar{a} = 0 \qquad \|\bar{v}\| = 6\pi \qquad \|\bar{a}\| = 12\pi^2$

(14) $\bar{v} = 2t(i - 2\hat{j} - \hat{k})$

$\bar{a} = 2(i - 2\bar{j} - k)$

$\|\bar{v}\| = 2\sqrt{6}\,|t|$

(30) a) vertical velocity $= 2$

(b) $r_z = 2t = 10 \quad \boxed{t = 5}$

(c) $v(5) = -\sin(5)\hat{i} + \cos(5)\hat{j} + 2\hat{k}$

remember to use radians.

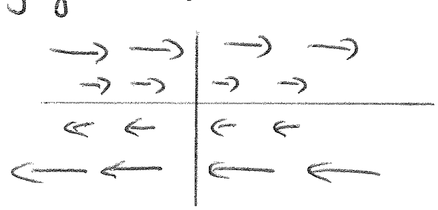
(d) $r(t) = 0.284\hat{i} - 0.959\hat{j} + 10\hat{k} + (t-5)(0.959\hat{i} + 0.284\hat{j} + 2\hat{k})$

Section 17.3

(2) $\vec{F} = cy\,\hat{i} \qquad c < 1$

(4) $\vec{F} = -c_1 x\hat{i} + c_2 y\hat{j} \quad c_1, c_2 > 0$

(6) $\dfrac{r}{\|r\|}$

(8) 

(16) (a) IV (b) III (c) I (d) II

Chapter 18

Section 18.1

(2) Negative

(4) Zero

(6) $\int \vec{F} \cdot d\vec{r} = 0$

(8) 28

(10) 16

(12) 32

Section 18.2

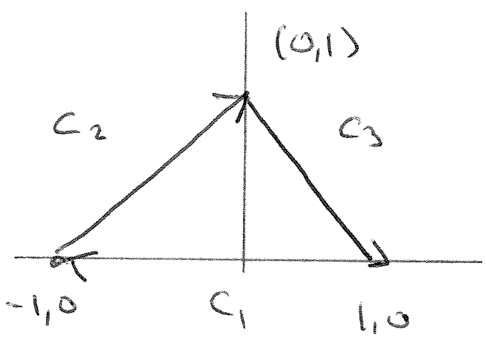
(4) $\frac{82}{3}$

(6) -1.6646

(8) -2π

(14) 21

(12)



$\int_{C_1} = 0 \quad \int_{C_2} = -\frac{7}{6} \quad \int_{C_3} = 1/6$

total = 1

Chapter 18

Section 18.3

2 a) 1 b) 1 c) 1

4 vector field is gradient field

8 path independent

10 path dependent

12 -7 16 0

28 -0.3

Section 18.4

4 $f = \frac{x^3}{3} + xy^2 + C$

6 $f = \ln k(xyz)$ where $k > 0$

10 $1/2$ 20 $-\frac{3\pi}{2}$

Chapter 19

Section 19-1

16 Flux $= 0$

22 $$\frac{81\pi}{2}$$

Chapter 20

Section 20.2

(2) Flux $= 3 \cdot 2 \cdot 2 \cdot 2 = 24$

(14) 36π

Section 20.3

(4) Flow diverging but not rotating

(14) Curl $\vec{F} = z\hat{j} + x\hat{k}$

a) at $(0,-1,0)$ Curl $\vec{F} = 0$

b) Field rotational since curl $\vec{F} \neq 0$ everywhere.

Section 20.4

(28) a) Flux $= -2\pi a^2$

b) Flux $= 2\pi a^2$

c) difference is due to circulation specified in opposite directions.