Section 14.1

20. II
22. I
24. III

Section 14.3

48. At $(0,0): x^2+(y-1)^2=1$, At $(1,1/2): (x+1)^2+(y-5/2)^2=8$

Section 14.4

40.

$$\begin{aligned} L(t)=mr(t)\times v(t)\Rightarrow L'(t) &= m[r'(t)\times v(t)+r(t)\times v'(t)] \\ &= m[v(t)\times v(t)+r(t)\times v'(t)] \\ &= m[0+r(t)\times a(t)] \\ &= \tau(t) \end{aligned}$$

Section 15.1

26. a circular paraboloid with vertex at $(0,0,3)$
30. (a) VI (b) V (c) I (d) IV (e) II (f) III
32. I. paraboloid II. cone

Section 15.2

44. (a) Consider the path $y=mx^a, 0<a<4$. If $mx^a\le 0$ then $f(x,mx^a)=0$. If $mx^a>0$, then $mx^a=|mx^a|=|m||x^a|$ and $mx^a\ge x^4\Leftrightarrow |m||x^a|\ge x^4\Leftrightarrow x^4/|x^a|\le |m|\Leftrightarrow |x|^{4-a}\le |m|$ whenever x^a is defined. Then $mx^a\ge x^4\Leftrightarrow |x|\le |m|^{1/(4-a)}$ so $f(x,mx^a)=0$ for $|x|\le |m|^{1/(4-a)}$ and $f(x,y)\to 0$ as $(x,y)\to(0,0)$ along this path.

(b) If we approach $(0,0)$ along the path $y=x^5, x>0$, then we have $f(x,x^5)=1$ for $0<x<1$ because $0<x^5<x^4$ there. Thus $f(x,y)\to 1$ as $(x,y)\to(0,0)$ along this path, but in part (a) we found a limit of 0 along other paths. So $\lim_{(x,y)\to(0,0)} f(x,y)$ does not exist and f is discontinuous at $(0,0)$.

Section 15.3

10. $f_x(2,1)\approx 2.8$, $f_y(2,1)\approx -2.1$

Section 15.5

24.

$$\begin{aligned}
\frac{\partial M}{\partial u} &= \frac{\partial M}{\partial x}\frac{\partial x}{\partial u} + \frac{\partial M}{\partial y}\frac{\partial y}{\partial u} + \frac{\partial M}{\partial z}\frac{\partial z}{\partial u} \\
&= e^{y-z^2}(2v) + xe^{y-z^2}(1) + x(-2z)e^{y-z^2}(1) \\
&= e^{y-z^2}(2v + x - 2xz)
\end{aligned}$$

$$\begin{aligned}
\frac{\partial M}{\partial v} &= \frac{\partial M}{\partial x}\frac{\partial x}{\partial v} + \frac{\partial M}{\partial y}\frac{\partial y}{\partial v} + \frac{\partial M}{\partial z}\frac{\partial z}{\partial v} \\
&= e^{y-z^2}(2u) + xe^{y-z^2}(-1) + x(-2z)e^{y-z^2}(1) \\
&= e^{y-z^2}(2u - x - 2xz)
\end{aligned}$$

When $u = 3, v = -1$, we have $x = -6, y = 4$, and $z = 2$, so $\partial M/\partial u = 16$ and $\partial M/\partial v = 36$.

Section 15.6

34. (a) ascend at a rate of 0.8
(b) descend at a rate of 0.14
(c) the direction of largest slope : $\triangledown f(60, 40) = < -0.6, -0.8 >$
rate of ascent in that direction : $|\triangledown f(60, 40)| = 1$
The angle above the horizontal in which the path begins is given by $\tan\theta = 1 \Rightarrow \theta = 45°$.

Section 15.7

46. $10cm, 10cm, 10cm$