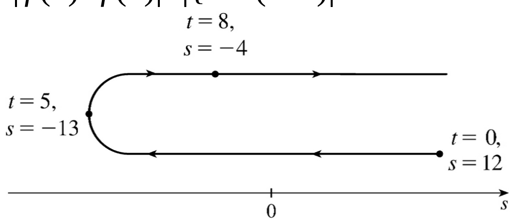
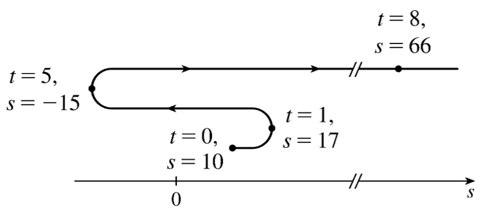
1. **(a)** $s=f(t)=t^2-10t+12 \Rightarrow v(t)=f'(t)=2t-10$
(b) $v(3)=2(3)-10=-4$ ft / s
(c) The particle is at rest when $v(t)=0 \Leftrightarrow 2t-10=0 \Leftrightarrow t=5$ s.
(d) The particle is moving in the positive direction when $v(t)>0 \Leftrightarrow 2t-10>0 \Leftrightarrow 2t>10 \Leftrightarrow t>5$.
(e) Since the particle is moving in the positive direction and in the negative direction, we need to calculate the distance traveled in the intervals [0,5] and [5,8] separately. $|f(5)-f(0)|=|-13-12|=25$ ft and $|f(8)-f(5)|=|\{-4-(-13)|=9$ ft. The total distance traveled during the first 8 s is $25+9=34$ ft.

(f) 

2. **(a)** $s=f(t)=t^3-9t^2+15t+10 \Rightarrow v(t)=f'(t)=3t^2-18t+15=3(t-1)(t-5)$

(b) $v(3)=3(2)(-2)=-12$ ft / s
(c) $v(t)=0 \Leftrightarrow t=1$ s or 5 s
(d) $v(t)>0 \Leftrightarrow 0 \le t<1$ or $t>5$
(e) $|f(1)-f(0)|=|17-10|=7$, $|f(5)-f(1)|=|-15-17|=32$, and $|f(8)-f(5)|=|66-(-15)|=81$. Total distance $=7+32+81=120$ ft.

(f) 

10. **(a)** At maximum height the velocity of the ball is 0 ft / s. $v(t)=s'(t)=80-32t=0 \Leftrightarrow 32t=80 \Leftrightarrow t=\frac{5}{2}$.

So the maximum height is $s\left(\frac{5}{2}\right)=80\left(\frac{5}{2}\right)-16\left(\frac{5}{2}\right)^2=200-100=100$ ft.

(b) $s(t)=80t-16t^2=96 \Leftrightarrow 16t^2-80t+96=0 \Leftrightarrow 16(t^2-5t+6)=0 \Leftrightarrow 16(t-3)(t-2)=0$.
So the ball has a height of 96 ft on the way up at $t=2$ and on the way down at $t=3$. At these times the velocities are $v(2)=80-32(2)=16$ ft / s and $v(3)=80-32(3)=-16$ ft / s, respectively.

21. **(a)** To find the rate of change of volume with respect to pressure, we first solve for V in terms of P.

$PV=C \Rightarrow V=\frac{C}{P} \Rightarrow \frac{dV}{dP}=-\frac{C}{P^2}$.

(b) From the formula for dV/dP in part (a), we see that as P increases, the absolute value of dV/dP decreases. Thus, the volume is decreasing more rapidly at the beginning.

(c) $\beta=-\frac{1}{V}\frac{dV}{dP}=-\frac{1}{V}\left(-\frac{C}{P^2}\right)=\frac{C}{(PV)P}=\frac{C}{CP}=\frac{1}{P}$

31. **(a)** $A(x)=\frac{p(x)}{x} \Rightarrow A'(x)=\frac{xp'(x)-p(x)\cdot 1}{x^2}=\frac{xp'(x)-p(x)}{x^2}$. $A'(x)>0 \Rightarrow A(x)$ is increasing; that is, the average productivity increases as the size of the workforce increases.

(b) $p'(x)$ is greater than the average productivity $\Rightarrow p'(x)>A(x) \Rightarrow p'(x)>\frac{p(x)}{x} \Rightarrow$

$xp'(x)>p(x) \Rightarrow xp'(x)-p(x)>0 \Rightarrow \frac{xp'(x)-p(x)}{x^2}>0 \Rightarrow A'(x)>0.$