3. We can immediately see that *a* is the graph of the acceleration function, since at the points where *a* has a horizontal tangent, neither *c* nor *b* is equal to 0. Next, we note that $a=0$ at the point where *b* has a horizontal tangent, so *b* must be the graph of the velocity function, and hence, $b'=a$. We conclude that *c* is the graph of the position function.

5. $f(x)=x^5+6x^2-7x \Rightarrow f'(x)=5x^4+12x-7 \Rightarrow f''(x)=20x^3+12$

8. $y=\theta\sin\theta \Rightarrow y'=\theta\cos\theta+\sin\theta \Rightarrow y''=\theta(-\sin\theta)+\cos\theta\cdot 1+\cos\theta=2\cos\theta-\theta\sin\theta$

9. $F(t)=(1-7t)^6 \Rightarrow F'(t)=6(1-7t)^5(-7)=-42(1-7t)^5 \Rightarrow F''(t)=-42\cdot 5(1-7t)^4(-7)=1470(1-7t)^4$

13. $h(x)=\sqrt{x^2+1} \Rightarrow h'(x)=\frac{1}{2}(x^2+1)^{-1/2}(2x)=\frac{x}{\sqrt{x^2+1}} \Rightarrow$

$$h''(x)=\frac{\sqrt{x^2+1}\cdot 1-x\left[\frac{1}{2}(x^2+1)^{-1/2}(2x)\right]}{\left(\sqrt{x^2+1}\right)^2}=\frac{(x^2+1)^{-1/2}[(x^2+1)-x^2]}{(x^2+1)^1}=\frac{1}{(x^2+1)^{3/2}}$$

27. $f(\theta)=\cot\theta \Rightarrow f'(\theta)=-\csc^2\theta \Rightarrow f''(\theta)=-2\csc\theta(-\csc\theta\cdot\cot\theta)=2\csc^2\theta\cdot\cot\theta \Rightarrow$
$f'''(\theta)=2(-2\csc^2\theta\cdot\cot\theta)\cot\theta+2\csc^2\theta(-\csc^2\theta)=-2\csc^2\theta(2\cot^2\theta+\csc^2\theta) \Rightarrow$
$f'''\left(\frac{\pi}{6}\right)=-2(2)^2[2(\sqrt{3})^2+(2)^2]=-80$

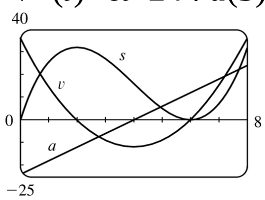
29. $9x^2+y^2=9 \Rightarrow 18x+2yy'=0 \Rightarrow 2yy'=-18x \Rightarrow y'=-9x/y \Rightarrow$
$y''=-9\left(\frac{y\cdot 1-x\cdot y'}{y^2}\right)=-9\left(\frac{y-x(-9x/y)}{y^2}\right)=-9\cdot\frac{y^2+9x^2}{y^3}=-9\cdot\frac{9}{y^3}$ [since *x* and *y* must satisfy the original equation, $9x^2+y^2=9$] . Thus, $y''=-81/y^3$.

35. $f(x)=(1+x)^{-1} \Rightarrow f'(x)=-1(1+x)^{-2}$, $f''(x)=1\cdot 2(1+x)^{-3}$, $f^{(3)}(x)=-1\cdot 2\cdot 3(1+x)^{-4}$,
$f^{(4)}(x)=1\cdot 2\cdot 3\cdot 4(1+x)^{-5}$, … , $f^{(n)}(x)=(-1)^n n!(1+x)^{-(n+1)}$

39. Let $f(x)=\cos x$. Then $Df(2x)=2f'(2x)$, $D^2 f(2x)=2^2 f''(2x)$, $D^3 f(2x)=2^3 f'''(2x)$, $\ldots$, $D^{(n)} f(2x)=2^n f^{(n)}(2x)$. Since the derivatives of cos x occur in a cycle of four, and since $103=4(25)+3$, we have $f^{(103)}(x)=f^{(3)}(x)=\sin x$ and $D^{103}\cos 2x=2^{103} f^{(103)}(2x)=2^{103}\sin 2x$.

49. **(a)** $s=f(t)=t^3-12t^2+36t$, $t\geq 0\Rightarrow v(t)=f'(t)=3t^2-24t+36$.
$a(t)=v'(t)=6t-24$. $a(3)=6(3)-24=-6\,(\text{m/s})\,/\,\text{s or m}\,/\,\text{s}^2$.

(b)



(c) The particle is speeding up when v and a have the same sign. This occurs when $2<t<4$ and when $t>6$. It is slowing down when v and a have opposite signs; that is, when $0\leq t<2$ and when $4<t<6$.

53. Let $P(x)=ax^2+bx+c$. Then $P'(x)=2ax+b$ and $P''(x)=2a$. $P''(2)=2\Rightarrow 2a=2\Rightarrow a=1$.
$P'(2)=3\Rightarrow 2(1)(2)+b=3\Rightarrow 4+b=3\Rightarrow b=-1$.
$P(2)=5\Rightarrow 1(2)^2+(-1)(2)+c=5\Rightarrow 2+c=5\Rightarrow c=3$. So $P(x)=x^2-x+3$.

54. Let $Q(x)=ax^3+bx^2+cx+d$. Then $Q'(x)=3ax^2+2bx+c$, $Q''(x)=6ax+2b$ and $Q'''(x)=6a$. Thus, $Q(1)=a+b+c+d=1$, $Q'(1)=3a+2b+c=3$, $Q''(1)=6a+2b=6$ and $Q'''(1)=6a=12$. Solving these four equations in four unknowns a, b, c and d we get $a=2$, $b=-3$, $c=3$ and $d=-1$, so $Q(x)=2x^3-3x^2+3x-1$.

59.

$$f(x)=g(\sqrt{x})\Rightarrow f'(x)=g'(\sqrt{x})\cdot\frac{1}{2}x^{-1/2}=\frac{g'(\sqrt{x})}{2\sqrt{x}}\Rightarrow$$

$$f''(x)=\frac{2\sqrt{x}\cdot g''(\sqrt{x})\cdot\frac{1}{2}x^{-1/2}-g'(\sqrt{x})\cdot 2\cdot\frac{1}{2}x^{-1/2}}{(2\sqrt{x})^2}=\frac{x^{-1/2}[\sqrt{x}\,g''(\sqrt{x})-g'(\sqrt{x})]}{4x}$$

$$=\frac{\sqrt{x}\,g''(\sqrt{x})-g'(\sqrt{x})}{4x\sqrt{x}}$$