2. (a) $g(x) = \int_0^x f(t)\,dt$, so $g(0) = \int_0^0 f(t)\,dt = 0$.

$g(1) = \int_0^1 f(t)\,dt = \frac{1}{2} \cdot 1 \cdot 1$ [area of triangle] $= \frac{1}{2}$.

$g(2) = \int_0^2 f(t)\,dt = \int_0^1 f(t)\,dt + \int_1^2 f(t)\,dt$ [below the x-axis]

$= \frac{1}{2} - \frac{1}{2} \cdot 1 \cdot 1 = 0$.

$g(3) = g(2) + \int_2^3 f(t)\,dt = 0 - \frac{1}{2} \cdot 1 \cdot 1 = -\frac{1}{2}$.

$g(4) = g(3) + \int_3^4 f(t)\,dt = -\frac{1}{2} + \frac{1}{2} \cdot 1 \cdot 1 = 0$.

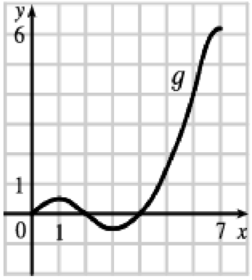
$g(5) = g(4) + \int_4^5 f(t)\,dt = 0 + 1.5 = 1.5$.

$g(6) = g(5) + \int_5^6 f(t)\,dt = 1.5 + 2.5 = 4$.

(b) $g(7) = g(6) + \int_6^7 f(t)\,dt \approx 4 + 2.2$ [estimate from the graph] $= 6.2$.

(c) The answers from part (a) and part (b) indicate that g has a minimum at $x = 3$ and a maximum at $x = 7$. This makes sense from the graph of f since we are subtracting area on $1 < x < 3$ and adding area on $3 < x < 7$.

(d)



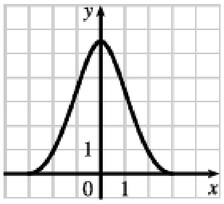
4. (a) $g(-3) = \int_{-3}^{-3} f(t)\,dt = 0$, $g(3) = \int_{-3}^{3} f(t)\,dt = \int_{-3}^{0} f(t)\,dt + \int_0^3 f(t)\,dt = 0$ by symmetry, since the area above the x-axis is the same as the area below the axis.

(b) From the graph, it appears that to the nearest $\frac{1}{2}$, $g(-2) = \int_{-3}^{-2} f(t)\,dt \approx 1$, $g(-1) = \int_{-3}^{-1} f(t)\,dt \approx 3\frac{1}{2}$, and $g(0) = \int_{-3}^{0} f(t)\,dt \approx 5\frac{1}{2}$.

(c) g is increasing on $(-3, 0)$ because as x increases from -3 to 0, we keep adding more area.

(d) g has a maximum value when we start subtracting area; that is, at $x = 0$.

(e)



(f) The graph of $g'(x)$ is the same as that of $f(x)$, as indicated by FTC1.

8. $f(t) = e^{t^2 - t}$ and $g(x) = \int_3^x e^{t^2 - t}\,dt$, so by FTC1, $g'(x) = f(x) = e^{x^2 - x}$.

10. $f(x) = \sqrt{x^2 + 4}$ and $g(r) = \int_0^r \sqrt{x^2 + 4}\,dx$, so by FTC1, $g'(r) = f(r) = \sqrt{r^2 + 4}$.

24. $\int_1^8 \sqrt[3]{x}\,dx = \int_1^8 x^{1/3}\,dx = \left[\frac{3}{4}x^{4/3}\right]_1^8 = \frac{3}{4}(8^{4/3} - 1^{4/3}) = \frac{3}{4}(2^4 - 1) = \frac{3}{4}(16 - 1) = \frac{3}{4}(15) = \frac{45}{4}$

32. $\int_0^{\pi/4} \sec\theta\,\tan\theta\,d\theta = [\sec\theta]_0^{\pi/4} = \sec\frac{\pi}{4} - \sec 0 = \sqrt{2} - 1$

2. $\frac{d}{dx}[x\sin x + \cos x + C] = x\cos x + (\sin x) \cdot 1 - \sin x + 0 = x\cos x$

4. $\frac{d}{dx}\left[\frac{2}{3b^2}(bx-2a)\sqrt{a+bx}+C\right]=\frac{d}{dx}\left[\frac{2}{3b^2}(bx-2a)(a+bx)^{1/2}+C\right]$

$$=\frac{2}{3b^2}\left[(bx-2a)\cdot\tfrac{1}{2}(a+bx)^{-1/2}(b)+(a+bx)^{1/2}(b)\right]+0$$

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

12. $\int\left(x^2+1+\frac{1}{x^2+1}\right)dx=\frac{x^3}{3}+x+\tan^{-1}x+C$

16. $\int\sec t\,(\sec t+\tan t)\,dt=\int(\sec^2 t+\sec t\,\tan t)\,dt=\tan t+\sec t+C$

26. $\int_0^4(2v+5)(3v-1)\,dv=\int_0^4(6v^2+13v-5)\,dv=\left[6\cdot\tfrac{1}{3}v^3+13\cdot\tfrac{1}{2}v^2-5v\right]_0^4=\left[2v^3+\tfrac{13}{2}v^2-5v\right]_0^4$

$$=(128+104-20)-0=212$$

34. $\int_1^9\frac{3x-2}{\sqrt{x}}\,dx=\int_1^9(3x^{1/2}-2x^{-1/2})\,dx=\left[3\cdot\tfrac{2}{3}x^{3/2}-2\cdot 2x^{1/2}\right]_1^9=\left[2x^{3/2}-4x^{1/2}\right]_1^9$

$$=(54-12)-(2-4)=44$$

52. By the Net Change Theorem, $\int_0^{15}n'(t)\,dt=n(15)-n(0)=n(15)-100$ represents the increase in the bee population in 15 weeks. So $100+\int_0^{15}n'(t)\,dt=n(15)$ represents the total bee population after 15 weeks.

56. The units for $a(x)$ are pounds per foot and the units for x are feet, so the units for da/dx are pounds per foot per foot, denoted (lb/ft)/ft. The unit of measurement for $\int_2^8 a(x)\,dx$ is the product of pounds per foot and feet; that is, pounds.

2. Let $u=2+x^4$. Then $du=4x^3\,dx$ and $x^3\,dx=\frac{1}{4}\,du$,

so $\int x^3(2+x^4)^5\,dx=\int u^5\left(\tfrac{1}{4}\,du\right)=\frac{1}{4}\frac{u^6}{6}+C=\frac{1}{24}(2+x^4)^6+C.$

6. Let $u=1/x$. Then $du=-1/x^2\,dx$ and $1/x^2\,dx=-du$, so

$$\int\frac{\sec^2(1/x)}{x^2}\,dx=\int\sec^2 u\,(-du)=-\tan u+C=-\tan(1/x)+C.$$

14. Let $u=e^x$. Then $du=e^x\,dx$, so $\int e^x\sin(e^x)\,dx=\int\sin u\,du=-\cos u+C=-\cos(e^x)+C.$

26. Let $u=\cos t$. Then $du=-\sin t\,dt$ and $\sin t\,dt=-du$, so $\int e^{\cos t}\sin t\,dt=\int e^u\,(-du)=-e^u+C=-e^{\cos t}+C.$

28. Let $u=\tan^{-1}x$. Then $du=\frac{dx}{1+x^2}$, so $\int\frac{\tan^{-1}x}{1+x^2}\,dx=\int u\,du=\frac{u^2}{2}+C=\frac{(\tan^{-1}x)^2}{2}+C.$

30. Let $u=\ln x$. Then $du=(1/x)\,dx$, so $\int\frac{\sin(\ln x)}{x}\,dx=\int\sin u\,du=-\cos u+C=-\cos(\ln x)+C.$