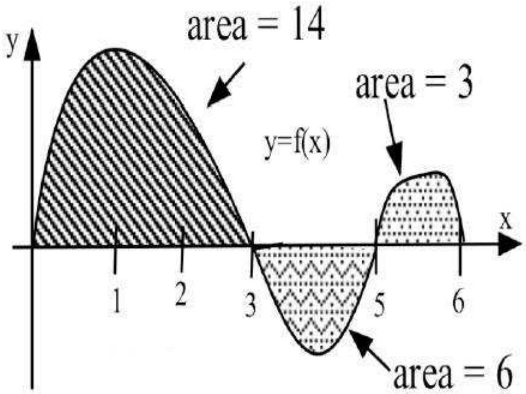
4. (8 points) Let $f(x) = \cos(x^2)$. Find the average value of $f'(x)$ on $[0, \sqrt{\pi}]$.

3. (8 total points) Use the area information given on this graph of $f(x)$ to evaluate the integrals below.



(a) (2 points) $\int_3^6 |f(x)|\,dx$

(b) (2 points) $\int_0^5 2+f(x)\,dx$

(c) (2 points) $\int_6^5 2f(x)\,dx$

(d) (2 points) $\int_0^3 6x-f(x)\,dx$

4. (8 total points) Determine if the following are **TRUE** or **FALSE**. You need not explain your answers. Each correct answer is $+2$ points, each wrong answer is -1 points, each blank answer is 0 points, but your total for this whole problem will not be less than 0 points. Put your **ANSWERS** in the **BOXES**.

   (a) (2 points) The function $f(x) = \dfrac{e^x}{x}$ is a solution of the differential equation $x^2y' + xy = xe^x$.

   Answer (T or F or leave blank):

   (b) (2 points) $\dfrac{d}{dx}\displaystyle\int_2^{x^2+1} \ln(t)\,dt = \ln(x^2+1)$.

   Answer (T or F or leave blank):

   (c) (2 points) The arc length of the curve $y = \tan x$ for $0 \le x \le \dfrac{\pi}{4}$ is $\displaystyle\int_0^{\pi/4} \sqrt{1+\sec^2 x}\,dx$.

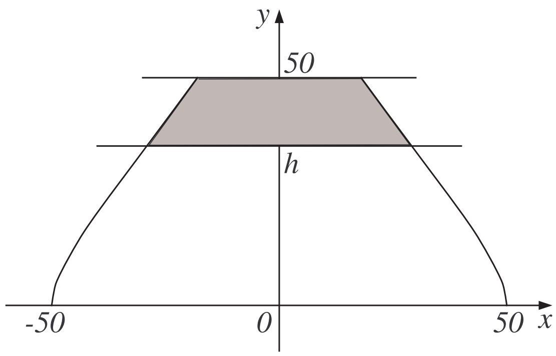
   Answer (T or F or leave blank):

   (d) (2 points) If f and f' are continuous on $[3,7]$, then $\displaystyle\int_3^7 f'(u)\,du = f(7) - f(3)$.

   Answer (T or F or leave blank):

4. (12 total points) A shape S is bounded by the x-axis, the line $y = 50$, the curve $x = 50e^{-(y/50)^2}$, and the curve $x = -50e^{-(y/50)^2}$. A barrier comes down and covers the shape S between height h and height 50.

(a) (3 points) Express the area not covered by the barrier (the unshaded area) in terms of an integral.



(b) (4 points) Suppose that the horizontal line $y = h$ at the bottom of the barrier starts at the top with zero velocity at time $t = 0$ and descends with acceleration $a(t) = -6t$. Find a formula for h in terms of t.

(c) (5 points) If the barrier descends as in part b), find a formula in terms of t for the rate of change of the area not covered by the barrier.