1. (3 pts each) Use the diagram on the right (showing areas) to find the following integrals. The diagram shows the graph of the function $f(x)$.

(a) $\int_{2}^{4} 2f(x)\,dx = \underline{\phantom{000000000000000}}$

(b) $\int_{1}^{2} f(x)\,dx = \underline{\phantom{000000000000000}}$

(c) $\int_{0}^{4} f(x)\,dx = \underline{\phantom{000000000000000}}$

(d) $\int_{0}^{4} |f(x)|\,dx = \underline{\phantom{000000000000000}}$

2. A particle moves along a horizontal straight line. At any time $t > 0$ its acceleration is given by $a(t) = 8t$ meters/minute. Initial velocity and location are given by $v(0) = -4$ and $s(0) = 1$.

(a) (8 pts) Find the formulas for the velocity $v(t)$ at any time $t > 0$ and the location $s(t)$ at any time $t > 0$.

(b) (2 pts) At what time $t$ does the particle reverse direction?

(c) (5 pts) What is the total distance traveled in the first two minutes?

3. Let $R$ be the region under the graph of $f(x) = x^3$ for $0 \leq x \leq 2$ and let $A$ be the area of $R$.

(a) (8 pts) Form the Riemann sum approximation of $A$, using 4 subintervals of equal length and right endpoints (see Figure). [Leave your answer in the form of an unevaluated sum.]

(b) (7 pts) Now find the exact area using the fundamental theorem of calculus.

4. (15 pts) Solve the initial value problem $\frac{dy}{dx} = 2\pi x \cos(\pi x^2)$; $y(1) = 0$

5. (14 pts each) Use substitution to evaluate the following.
(a) \[ \int_{0}^{2} \cos(x)e^{\sin(x)} \, dx \]

(b) \[ \int \frac{\ln(x)^6}{x} \, dx \]

6. (15 pts) Find the area of the region bounded by the curves \( y = x^2 \), \( y = 2 - x \) (see figure)