1. Using the graph of $f(x)$ shown below, compute the exact value of $\int_{-2}^{3} f(x) \, dx$.

![Graph of f(x)](image)

2. Using the graph of $f(x)$ shown below, determine which one of the following choices could possibly be the value of the definite integral $\int_{-2}^{3} f(x) \, dx$.

(a) 15    (b) 10    (c) 5    (d) 0    (e) -5

3. The graphs of $f(x) = x + 3$ and $g(x) = 5 - x^2$ are sketched below and the area between the two curves is shaded in.

![Graphs of f(x) and g(x)](image)

(a) Find the points of intersection of these two graphs.
(b) Set up, but do not evaluate, the definite integral (or integrals) which represent the exact area between these two graphs.
(c) Use the built-in features of your calculator to get a very good approximation of this area.

4. The graphs of \( f(x) = x + 4 \) and \( g(x) = x^2 - 2 \) are sketched below and the area between the two curves is shaded in. Find the exact area of this shaded region. Your final answer must be a number.

5. At noon, the number of bacteria in Gordon’s sink was 500 and was growing very rapidly. In fact, the number of bacteria was growing at a rate of \( r(t) = 200(1.6)^t \) bacteria per hour, where \( t \) represents the number of hours since noon.

(a) Set up, but do not evaluate, the definite integral needed to compute the total change in the bacteria population between noon and 3:00 PM.

(b) Use the built-in integrator on your calculator to get a good approximation to the value of the definite integral used in part (a).

(c) How many bacteria were there in Gordon’s sink at 3:00 PM?

6. Sharon had a lot of quizzes to grade but didn’t begin until midnight. She was grading at a rate of \( 100e^{-2t} \) quizzes per hour where \( t \) denotes the number of hours since midnight. How many quizzes did she grade between 1:00 AM and 2:00 AM?

7. Suppose that a town had a population of 5000 people in 1970. If the population was growing at a rate of \( r(t) = 16t \) people per year, where \( t \) represents the number of years since 1970, then what was the population of the town in 1980?

8. The marginal cost of a product, in dollars per item, is \( C'(q) = q^2 - 50q + 700 \). If fixed costs are $500, find the total cost to produce 50 items.
9. Evaluate the following definite integrals \textbf{without the use of a calculator}. Then check your answer with a calculator to make sure that your answers are the same.

(a) \( \int_1^2 4x^3 \, dx \)

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

(c) \( \int_1^5 3 \, dx \)

(d) \( \int_0^2 e^x \, dx \)

(e) \( \int_1^3 \frac{1}{x} \, dx \)

(f) \( \int_0^1 e^{2x} \, dx \)

(g) \( \int_0^2 xe^{x^2} \, dx \)
10. Which one of the following most clearly states the Fundamental Theorem of Calculus?

(a) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_{a}^{b} \) (total change in that quantity) \( dt \)

(b) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_{b}^{a} \) (total change in that quantity) \( dt \)

(c) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_{a}^{b} \) (rate of change of that quantity) \( dt \)

(d) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_{b}^{a} \) (rate of change of that quantity) \( dt \)

(e) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_{a}^{b} \) (rate of change of that quantity) \( dt \)

(f) Rate of change of a quantity from \( t = a \) to \( t = b \) equals \( \int_{b}^{a} \) (rate of change of that quantity) \( dt \)

(g) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_{b}^{a} \) (total change in that quantity) \( dt \)

(h) Total change in a quantity from \( t = a \) to \( t = b \) equals \( \int_{a}^{b} \) (total change in that quantity) \( dt \)

11. Which one of the following most clearly states the Fundamental Theorem of Calculus?

(a) \( \int_{a}^{b} F'(t) \, dt = F'(b) - F'(a) \)

(b) \( \int_{a}^{b} F'(t) \, dt = F'(a) - F'(b) \)

(c) \( \int_{a}^{b} F'(t) \, dt = F(b) - F(a) \)

(d) \( \int_{a}^{b} F'(t) \, dt = F(a) - F(b) \)

(e) \( \int_{a}^{b} F(t) \, dt = F'(b) - F'(a) \)

(f) \( \int_{a}^{b} F(t) \, dt = F'(a) - F'(b) \)

(g) \( \int_{a}^{b} F(t) \, dt = F(b) - F(a) \)

(h) \( \int_{a}^{b} F(t) \, dt = F(a) - F(b) \)