t (minutes)	0	2	5	8	12
$v_A(t)$ (meters/minute)	0	100	40	-120	-150

Train A runs back and forth on an east-west section of railroad track. Train A's velocity in meters per minute, is given by a differentiable function $v_A(t)$, where time t is measured in minutes. Selected values for $v_A(t)$ are given in the table above.

a. Find the average acceleration of train A over the interval $2 \le t \le 8$.

b. Do the data in the table support the conclusion that train A's velocity is -100 meters per minute at some time t with $5 < t < 8$? Give a reason for your answer.

c. At time t = 2, train A's position is 300 meters east of Origin Station, and the train is moving to the east. Write an expression involving an integral that gives the position of train A, in meters from the Origin Station, at time t = 12. Use a trapezoidal sum with three subintervals indicated by the table to approximate the position of the train at time t = 12.

d. A second train, train B, travels north from Origin Station. At time t the velocity of train B is given by $v_B(t) = -5t^2 + 60t + 25$, and at time t = 2 the train is 400 meters north of the station. Find the rate, in meters per minute, at which the distance between train A and train B is changing at time t = 2.

x	-2	-2 < x < -1	-1	-1 < x < 1	1	1 < x < 3	3
f(x)	12	Positive	8	Positive	2	Positive	7
f '(x)	-5	Negative	0	Negative	0	Positive	½
g(x)	-1	Negative	0	Positive	3	Positive	1
g'(x)	2	Positive	3/2	Positive	0	Negative	-2

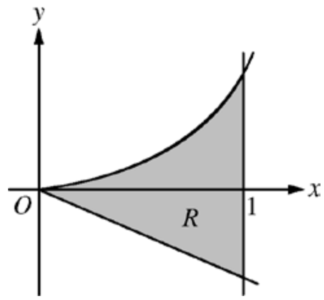
The twice differentiable functions f and g are defined for all real numbers x. Values of f, f ', g, and g' for various values of x are given in the table above.

a. Find the x-coordinate of each relative minimum of f on the interval [-2, 3]. Justify your answers.

b. Explain why there must be a value c, for -1 < c < 1, such that f "(c) = 0.

c. The function h is defined by h(x) = ln(f(x)). Find h'(3). Show the computations that lead to your answer.

d. Evaluate $\int_{-2}^{3} f'(g(x))\,g'(x)\,dx$.



Let R be the shaded region bounded by the graph of $y = xe^{x^2}$, the line $y = -2x$ and the vertical line $x = 1$, as shown in the figure above.

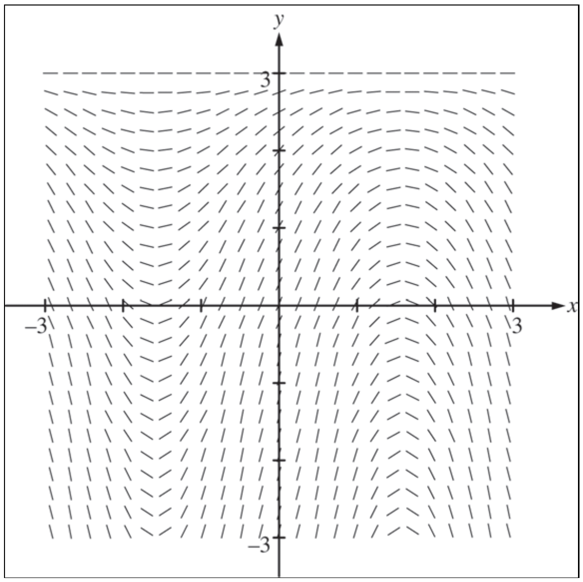
a. Find the area of R.

b. Write, but do not evaluate, an integral expression that gives the volume of the solid generated when R is rotated about the horizontal line $y = -2$.

c. Write, but do not evaluate an expression involving one or more integrals that gives the perimeter of R.

Consider the Differential equation $\frac{dy}{dx} = (3 - y) \cos x$. Let y = f(x) be the particular solution to the differential equation with the initial condition f(0) = 1. The function f is defined for all real numbers.

a. A portion of the slope field of the differential equation is given below. Sketch the solution curve through the point (0, 1).



b. Write an equation for the line tangent to the solution curve in part (a) at the point (0, 1). Use the equation to approximate f(0.2).

c. Find y = f(x), the particular solution to the differential equation with the initial condition f(0) = 1.