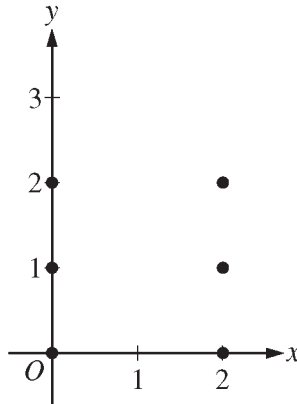


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4. Consider the differential equation  $\frac{dy}{dx} = \frac{y^2}{x-1}$ .

(a) On the axes provided, sketch a slope field for the given differential equation at the six points indicated.

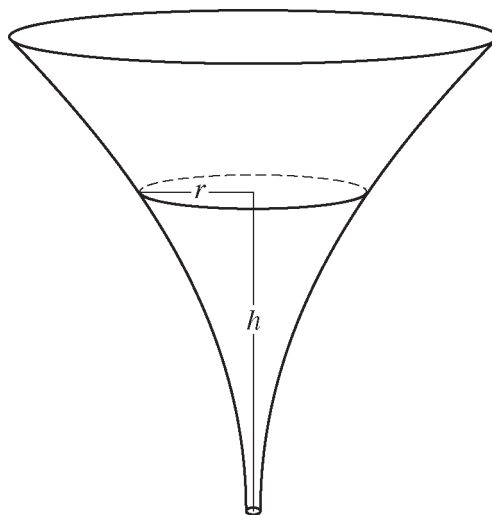


(b) Let  $y = f(x)$  be the particular solution to the given differential equation with the initial condition  $f(2) = 3$ . Write an equation for the line tangent to the graph of  $y = f(x)$  at  $x = 2$ . Use your equation to approximate  $f(2.1)$ .

(c) Find the particular solution  $y = f(x)$  to the given differential equation with the initial condition  $f(2) = 3$ .

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5. The inside of a funnel of height 10 inches has circular cross sections, as shown in the figure above. At height  $h$ , the radius of the funnel is given by  $r = \frac{1}{20}(3 + h^2)$ , where  $0 \leq h \leq 10$ . The units of  $r$  and  $h$  are inches.
- (a) Find the average value of the radius of the funnel.
- (b) Find the volume of the funnel.
- (c) The funnel contains liquid that is draining from the bottom. At the instant when the height of the liquid is  $h = 3$  inches, the radius of the surface of the liquid is decreasing at a rate of  $\frac{1}{5}$  inch per second. At this instant, what is the rate of change of the height of the liquid with respect to time?
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$x$	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	-6	3	2	8
2	2	-2	-3	0
3	8	7	6	2
6	4	5	3	-1

6. The functions  $f$  and  $g$  have continuous second derivatives. The table above gives values of the functions and their derivatives at selected values of  $x$ .

(a) Let  $k(x) = f(g(x))$ . Write an equation for the line tangent to the graph of  $k$  at  $x = 3$ .

(b) Let  $h(x) = \frac{g(x)}{f(x)}$ . Find  $h'(1)$ .

(c) Evaluate  $\int_1^3 f''(2x) dx$ .

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**STOP**

**END OF EXAM**