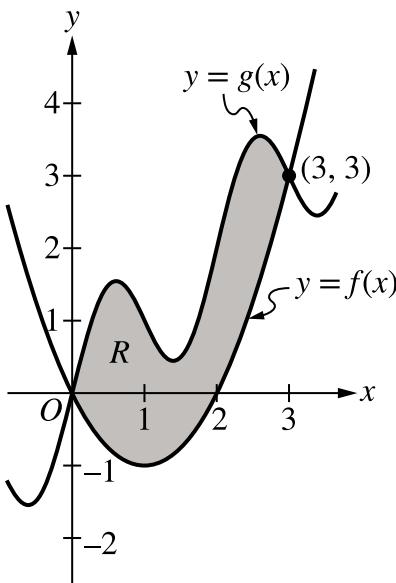


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1. An invasive species of plant appears in a fruit grove at time  $t = 0$  and begins to spread. The function  $C$  defined by  $C(t) = 7.6 \arctan(0.2t)$  models the number of acres in the fruit grove affected by the species  $t$  weeks after the species appears. It can be shown that  $C'(t) = \frac{38}{25 + t^2}$ .

**(Note: Your calculator should be in radian mode.)**

- A. Find the average number of acres affected by the invasive species from time  $t = 0$  to time  $t = 4$  weeks. Show the setup for your calculations.
- B. Find the time  $t$  when the instantaneous rate of change of  $C$  equals the average rate of change of  $C$  over the time interval  $0 \leq t \leq 4$ . Show the setup for your calculations.
- C. Assume that the invasive species continues to spread according to the given model for all times  $t > 0$ . Write a limit expression that describes the end behavior of the rate of change in the number of acres affected by the species. Evaluate this limit expression.
- D. At time  $t = 4$  weeks after the invasive species appears in the fruit grove, measures are taken to counter the spread of the species. The function  $A$ , defined by  $A(t) = C(t) - \int_4^t 0.1 \cdot \ln(x) dx$ , models the number of acres affected by the species over the time interval  $4 \leq t \leq 36$ . At what time  $t$ , for  $4 \leq t \leq 36$ , does  $A$  attain its maximum value? Justify your answer.

2. The shaded region  $R$  is bounded by the graphs of the functions  $f$  and  $g$ , where  $f(x) = x^2 - 2x$  and  $g(x) = x + \sin(\pi x)$ , as shown in the figure.



(Note: Your calculator should be in radian mode.)

- A. Find the area of  $R$ . Show the setup for your calculations.
- B. Region  $R$  is the base of a solid. For this solid, at each  $x$  the cross section perpendicular to the  $x$ -axis is a rectangle with height  $x$  and base in region  $R$ . Find the volume of the solid. Show the setup for your calculations.
- C. Write, but do not evaluate, an integral expression for the volume of the solid generated when the region  $R$  is rotated about the horizontal line  $y = -2$ .
- D. It can be shown that  $g'(x) = 1 + \pi \cos(\pi x)$ . Find the value of  $x$ , for  $0 < x < 1$ , at which the line tangent to the graph of  $f$  is parallel to the line tangent to the graph of  $g$ .

**END OF PART A**

**Part A (AB or BC): Graphing calculator required****Question 1****9 points****General Scoring Notes**

- The model solution is presented using standard mathematical notation.
- Answers (numeric or algebraic) need not be simplified. Answers given as a decimal approximation should be accurate to three places after the decimal point. Within each individual free-response question, at most one point is not earned for inappropriate rounding.

An invasive species of plant appears in a fruit grove at time  $t = 0$  and begins to spread. The function  $C$  defined by  $C(t) = 7.6 \arctan(0.2t)$  models the number of acres in the fruit grove affected by the species  $t$  weeks after the species appears. It can be shown that  $C'(t) = \frac{38}{25 + t^2}$ .

**(Note: Your calculator should be in radian mode.)**

	<b>Model Solution</b>	<b>Scoring</b>
A	<p>Find the average number of acres affected by the invasive species from time <math>t = 0</math> to time <math>t = 4</math> weeks. Show the setup for your calculations.</p> $\frac{1}{4 - 0} \int_0^4 C(t) dt$ $= \frac{1}{4}(11.112896) = 2.778224$	<p>Average value formula</p> <p><b>Point 1 (P1)</b></p>
	<p>From time <math>t = 0</math> to <math>t = 4</math> weeks, the average number of acres affected by the invasive species was 2.778 acres.</p>	<p>Answer</p> <p><b>Point 2 (P2)</b></p>