BC AP Integral Applications Practice   name ______________________________

1. The approximate value of $y=\sqrt{4+\sin x}$ at $x=0.12$, obtained from the tangent to the graph at $x = 0$, is

(A) 2.00   (B) 2.03   (C) 2.06

(D) 2.12   (E) 2.24

2. The number of bacteria in a culture is growing at a rate of $3000e^{2t/5}$ per unit of time t. At $t = 0$, the number of bacteria present was 7,500. Find the number present at $t = 5$.

(A) $1,200e^2$ (B) $3,000e^2$ (C) $7,500e^2$

(D) $7,500e^5$ (E) $\frac{15,000}{7}e^7$

3 The acceleration of a particle moving along the x-axis at time t is given by $a(t)=6t-2$. If the velocity is 25 when $t = 3$ and the position is 10 when $t = 1$, then the position $x(t)=$

(A) $9t^2+1$ (B) $3t^2-2t+4$ (C) t^3-t^2+4t+6

(D) $t^3-t^2+9t-20$ (E) $36t^3-4t^2-77t+55$

*4. A puppy weighs 2.0 pounds at birth and 3.5 pounds two months later. If the weight of the puppy during its first 6 months is increasing at a rate proportional to its weight, then how much will the puppy weigh when it is 3 months old?

(A) 4.2 pounds   (B) 4.6 pounds   (C) 4.8 pounds

(D) 5.6 pounds   (E) 6.5 pounds

*5. Let f be a differentiable function such that $f(3)=2$ and $f'(3)=5$. If the tangent line to the graph of f at $x = 3$ is used to find an approximation to a zero of f, that approximation is

(A) 0.4   (B) 0.5   (C) 2.6

(D) 3.4   (E) 5.5

*6. At time $t \geq 0$, the acceleration of a particle moving on the x-axis is $a(t) = t + \sin t$. At t = 0, the velocity of the particle is –2. For what value of t will the velocity of the particle be zero?

(A) 1.02 (B) 1.48 (C) 1.85

(D) 2.81 (E) 3.14

*7. Population y grows according to the equation $\frac{dy}{dt} = ky$, where k is a constant and t is measured in years. If the population doubles every 10 years, then the value of k is

(A) 0.069 (B) 0.200 (C) 0.301

(D) 3.322 (E) 5.000

*8. Let $F(x)$ be an antiderivative of $\frac{(\ln x)^3}{x}$. If $F(1) = 0$, then $F(9) =$

(A) 0.048 (B) 0.144 (C) 5.827

(D) 23.308 (E) 1,640.250

*9. A pizza, heated to a temperature of 350 degrees Fahrenheit (°F), is taken out of an oven and placed in a 75°F room at time $t = 0$ minutes. The temperature of the pizza is changing at a rate of $-110e^{-0.4t}$ degrees Fahrenheit per minute. To the nearest degree, what is the temperature of the pizza at time $t = 5$ minutes?

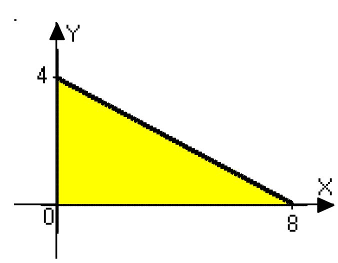
(A) $112°F$ (B) $119°F$ (C) $147°F$

(D) $238°F$ (E) $335°F$

*10. The base of a solid is a region in the first quadrant bounded by the x-axis, the y-axis, and the line $x + 2y = 8$, as shown in the figure below. If cross sections of the solid perpendicular to the x-axis are semicircles, what is the volume of the solid?

(A) 12.566 (B) 14.661 (C) 16.755

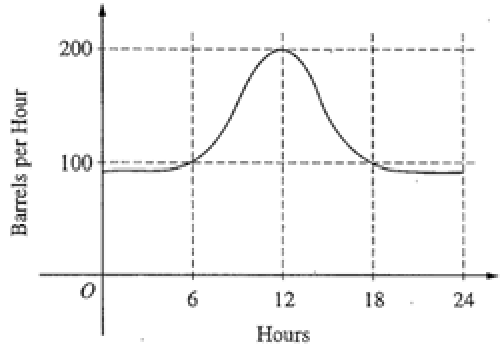
(D) 67.021 (E) 134.041



11. The flow of oil, in barrels per hour, through a pipeline on July 9 is given by the graph shown below. Of the following, which best approximates the total number of barrels of oil that passed through the pipeline that day?

(A) 500 (B)600 (C) 2,400

(D) 3,000 (E) 4,800



12. What is the area of the region between the graphs of $y = x^2$ and $y = -x$ from $x = 0$ to $x = 2$?

(A) $\frac{2}{3}$ (B) $\frac{8}{3}$ (C) 4

(D) $\frac{14}{3}$ (E) $\frac{16}{3}$

*13. If $0 \le k < \frac{\pi}{2}$ and the area under the curve $y = \cos x$ from $x = k$ to $x = \frac{\pi}{2}$ is 0.1, then $k =$

(A) 1.471 (B) 1.414 (C) 1.277

(D) 1.120 (E) 0.436

14. The rate of change of the volume, V, of water in a tank with respect to time, t, is directly proportional to the square root of the volume. Which of the following is a differential equation that describes this relationship?

(A) $V(t) = k\sqrt{t}$ (B) $V(t) = k\sqrt{V}$ (C) $\frac{dV}{dt} = k\sqrt{t}$

(D) $\frac{dV}{dt} = \frac{k}{\sqrt{V}}$ (E) $\frac{dV}{dt} = k\sqrt{V}$

*15. The base of a solid is the region in the first quadrant bounded by the *y*-axis, the graph of $y = \tan^{-1} x$, the horizontal line $y = 3$, and the vertical line $x = 1$. For this solid, each cross section perpendicular to the *x*-axis is a square. What is the volume of the solid?

(A) 2.561 (B) 6.612 (C) 8.046

(D) 8.755 (E) 20.773

Try to do these without a calculator.

1979 AB 5 and BC 5

Let *R* be the region bounded by the graph of $y = \frac{1}{x} \ln x$, the *x*-axis, and the line $x = e$.

(a) Find the area of the region *R*.

1990 AB 3

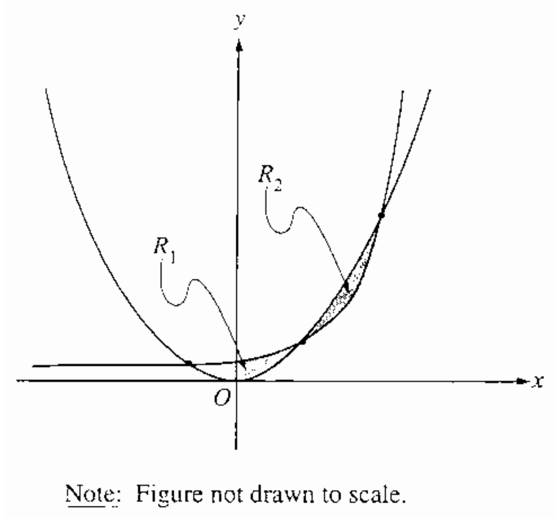
Let *R* be the region enclosed by the graphs of $y = e^x$, $y = (x-1)^2$, and the line $x = 1$.

(a) Find the area of *R*.

(b) Find the volume of the solid generated when *R* is revolved about the <u>*x*-axis</u>.

(c) Set up, but <u>do not integrate</u>, an integral expression in terms of a single variable for the volume of the solid generated when *R* is revolved about the <u>*y*-axis</u>.

1995 AB 4 and BC 2 (Calculator)

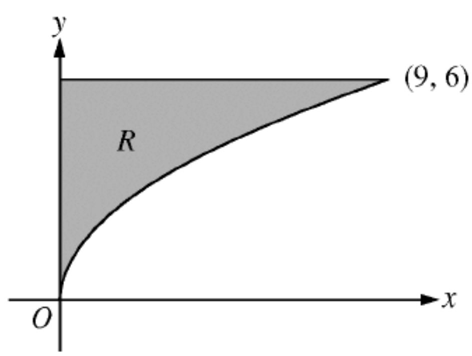


The shaded regions R_1 and R_2 shown above are enclosed by the graphs of $f(x) = x^2$ and $g(x) = 2^x$.

(a) Find the *x*- and *y*-coordinates of the three points of intersection of the graphs of *f* and *g*.

(b) Without using absolute value, set up an expression involving one or more integrals that gives the total area enclosed by the graphs of *f* and *g*. Do not evaluate.

(c) Without using absolute value, set up an expression involving one or more integrals that gives the volume of the solid generated by revolving the region R_1 about the line $y = 5$. Do not evaluate.



4. Let R be the region in the first quadrant bounded by the graph of $y = 2\sqrt{x}$, the horizontal line $y = 6$, and the y-axis, 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 $y = 7$.

(c) Region R is the base of a solid. For each y, where $0 \le y \le 6$, the cross section of the solid taken perpendicular to the y-axis is a rectangle whose height is 3 times the length of its base in region R. Write, but do not evaluate, an integral expression that gives the volume of the solid.

(d) Set up an integral expression to find the perimeter of Region R.

Question 5

At the beginning of 2010, a landfill contained 1400 tons of solid waste. The increasing function W models the total amount of solid waste stored at the landfill. Planners estimate that W will satisfy the differential equation $\frac{dW}{dt} = \frac{1}{25}(W - 300)$ for the next 20 years. W is measured in tons, and t is measured in years from the start of 2010.

(a) Use the line tangent to the graph of W at $t = 0$ to approximate the amount of solid waste that the landfill contains at the end of the first 3 months of 2010 (time $t = \frac{1}{4}$).

(b) Find $\frac{d^2W}{dt^2}$ in terms of W. Use $\frac{d^2W}{dt^2}$ to determine whether your answer in part (a) is an underestimate or an overestimate of the amount of solid waste that the landfill contains at time $t = \frac{1}{4}$.

(c) Find the particular solution $W = W(t)$ to the differential equation $\frac{dW}{dt} = \frac{1}{25}(W - 300)$ with initial condition $W(0) = 1400$.