

Applications of Integration: math test solutions, College – download the PDF

Test solutions with the detailed point scale. Add up your points and spot what to review.

Suggested time: 45 minutes. Out of 20 points. Calculator allowed only when the problem says so.

1 Area between a parabola and a line

/ 4 pts

(a) $x^2 = 2x$ gives $x = 0$ or $x = 2$, so the points are $(0, 0)$ and $(2, 4)$. (1 pt)

(b) At $x = 1$: $2 > 1$, so $y = 2x$ is on top. (1 pt)

(c) $A = \int_0^2 (2x - x^2) dx = \left[x^2 - \frac{x^3}{3} \right]_0^2 = 4 - \frac{8}{3} = \frac{4}{3}$. (2 pts)

2 Volume with disks

/ 4 pts

(a) $V = \pi \int_0^1 (e^x)^2 dx = \pi \int_0^1 e^{2x} dx$. (2 pts)

(b) $V = \pi \left[\frac{e^{2x}}{2} \right]_0^1 = \frac{\pi(e^2 - 1)}{2}$. (1 pt)

(c) $V \approx 10.04$ cubic units. (1 pt)

3 Volume with shells

/ 4 pts

Radius x , height $3x - x^2$. (1 pt) $V = 2\pi \int_0^3 x(3x - x^2) dx$. (1 pt)

$$= 2\pi \left[x^3 - \frac{x^4}{4} \right]_0^3 = 2\pi \left(27 - \frac{81}{4} \right). \text{ (1 pt)}$$

$$= \frac{27\pi}{2} \approx 42.41 \text{ cubic units. (1 pt)}$$

4 Arc length

/ 3 pts

$$y' = x^2 - \frac{1}{4x^2}, \text{ so } 1 + (y')^2 = \left(x^2 + \frac{1}{4x^2} \right)^2. \text{ (1 pt)}$$

$$L = \int_1^2 \left(x^2 + \frac{1}{4x^2} \right) dx = \left[\frac{x^3}{3} - \frac{1}{4x} \right]_1^2. \text{ (1 pt)}$$

$$= \left(\frac{8}{3} - \frac{1}{8} \right) - \left(\frac{1}{3} - \frac{1}{4} \right) = \frac{59}{24} \approx 2.46. \text{ (1 pt)}$$

5 Average value and work

/ 3 pts

$$\text{(a) } \frac{1}{\pi} \int_0^\pi \sin x dx = \frac{2}{\pi} \approx 0.637. \text{ (1 pt)}$$

$$\text{(b) } k = 6/0.15 = 40 \text{ N/m. (1 pt) } W = \frac{1}{2}(40)(0.3)^2 = 1.8 \text{ J. (1 pt)}$$

6 Separable equation

/ 2 pts

$$\text{Separate: } \frac{dy}{y} = 2x dx, \text{ so } \ln |y| = x^2 + C. \text{ (1 pt)}$$

$$y(0) = 1 \text{ gives } C = 0, \text{ so } y = e^{x^2}. \text{ (1 pt)}$$



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