1. $\displaystyle\int_{\pi/4}^{\pi/2} \sin^3 \alpha \cos \alpha \; d\alpha =$

A) $\frac{3}{16}$

B) $\frac{1}{8}$

C) $-\frac{1}{8}$

D) $-\frac{3}{16}$

E) $\frac{3}{4}$

---

2. If the distance of a particle from the origin on a line is given by $x(t) = 3 + (t-2)^4$, then the number of times the particle reverses direction is

A) 0

B) 1

C) 2

D) 3

E) None of these

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3. $\displaystyle\int \tan x \; dx =$

A) $-\ln|\sec x| + C$

B) $\sec^2 x + C$

C) $\ln|\sin x| + C$

D) $\sec x + C$

E) $-\ln|\cos x| + C$

4. Solve the differential equation $\frac{dy}{dx} = y$ with the initial condition that $y(0) = 1$. From your solution, find the value of $y(e)$.

A) e^e

B) e

C) $e - 1$

D) $e^e - e$

E) e^2

---

5. The average value of $p(x) = \frac{1}{x}$ from $x = 1$ to $x = e$ is

A) $\frac{1}{e+1}$

B) $\frac{1}{1-e}$

C) $e - 1$

D) $1 - \frac{1}{e}$

E) $\frac{1}{e-1}$

---

6. The volume of a solid generated by revolving the region enclosed by the curve $y = 3x^2$ and the line $y = 6x$ about the x-axis is represented by

A) $\pi \int_0^3 (6x - 3x^2)^2 \, dx$

B) $\pi \int_0^2 (6x - 3x^2)^2 \, dx$

C) $\pi \int_0^2 (9x^4 - 36x^2) \, dx$

D) $\pi \int_0^2 (36x^2 - 9x^4) \, dx$

E) $\pi \int_0^2 (6x - 3x^2) \, dx$

7. A region in the plane is bounded by $y = \dfrac{1}{\sqrt{x}}$, the x-axis, the line $x = m$, and the line $x = 2m$, where $m > 0$. A solid is formed by revolving the region about the x-axis. The volume of this solid

A) is independent of m.

B) increases as m increases.

C) decreases as m decreases.

D) increases until $m = \frac{1}{2}$, then decreases.

E) cannot be found with the information given.

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8. If the graph of $y = f(x)$ contains the point $(0, 1)$, and if $\dfrac{dy}{dx} = \dfrac{x \sin(x^2)}{y}$, then $f(x) =$

A) $\sqrt{2 - \cos(x^2)}$

B) $\sqrt{2} - \cos(x^2)$

C) $2 - \cos(x^2)$

D) $\cos(x^2)$

E) $\sqrt{2 - \cos x}$

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9. $\lim\limits_{h \to 0} \left(\dfrac{\tan(x + h) - \tan x}{h} \right) =$

A) $\sec x$

B) $-\sec x$

C) $\sec^2 x$

D) $-\sec^2 x$

E) does not exist

10. Given the differential equation $\frac{dy}{dx} = x + y$ with initial condition $y(0) = 2$, approximate $y(1)$ using Euler's method with a step size of 0.5.

A) 3

B) $\frac{7}{2}$

C) $\frac{15}{4}$

D) $\frac{19}{4}$

E) $\frac{21}{4}$

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11. The base of a solid is a right triangle whose perpendicular sides have lengths 6 and 4. Each plane section of the solid perpendicular to the side of length 6 is a semicircle whose diameter lies in the plane of the triangle. The volume of the solid is

A) 2π units^3.

B) 4π units^3.

C) 8π units^3.

D) 16π units^3.

E) 24π units^3.

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12. Which of the following expressions represents the length of the curve $y = e^{-x^2}$ for x from 0 to 2 ?

A) $\displaystyle\int_0^2 \sqrt{1 + e^{-2x^2}}\, dx$

B) $\displaystyle\int_0^2 \sqrt{1 + 4x^2 e^{-2x^2}}\, dx$

C) $\displaystyle\int_0^2 \sqrt{1 - e^{-2x^2}}\, dx$

D) $\displaystyle\int_0^2 \sqrt{1 + 2xe^{-2x^2}}\, dx$

E) $\pi \displaystyle\int_0^2 e^{-2x^2}\, dx$

13. If $f(x) = \displaystyle\int_2^{\sin x} \sqrt{1+t^2}\, dt$, then $f'(x) =$

A) $(1+x^2)^{3/2}$

B) $(\cos x)\sqrt{1+\sin x}$

C) $\sqrt{1+\sin^2 x}$

D) $(\cos x)\sqrt{1+\sin^2 x}$

E) $(\cos x)(1+\sin^2 x)^{3/2}$

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14. For what value of x is the line tangent to $y = x^2$ parallel to the line tangent to $y = \sqrt{x}$?

A) 0

B) $\dfrac{1}{4\sqrt[3]{4}}$

C) $\dfrac{1}{2}$

D) $\dfrac{1}{2\sqrt[3]{2}}$

E) 1

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15. An antiderivative of $(x^2+1)^2$ is

A) $\frac{1}{3}(x^2+1)^3 + C$

B) $\frac{1}{5}x^5 + x + C$

C) $\frac{1}{5}x^5 + \frac{2}{3}x^3 + x + C$

D) $\frac{1}{6x}(x^2+1) + C$

E) $4x(x^2+1) + C$