

Math 181 Honors Exam 2 Version A

1. Find the following derivatives.

(i) $\frac{d}{dx} \arctan(3x)$

(ii) $\frac{d}{dx} \sqrt{2 + \sin(14x)}$

(iii) $\frac{d}{dx} (x^2 \sec(14x))$

(iv) $\frac{d^2}{dx^2} \left(\frac{1}{x^2 + 1} \right)$

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2. Find the following indefinite integrals.

(i) $\int x^{100} dx$

(ii) $\int (x^2 + 1)^2 dx$

(iii) $\int x(x + 14)^{3/2} dx$

(iv) $\int x \sin(3x^2 + 4) dx$

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3. Use the δ - ϵ definition of limit to verify that $\lim_{x \rightarrow 9} \frac{1}{\sqrt{x}} = \frac{1}{3}$.

4. Use the definition

$$f'(x) = \lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

to find the derivative of $f(x) = x^2$.

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5. Suppose $f(x) = x^2 + 4x - 8$. The minimum value of $f(x)$ is

- (A) -2
- (B) -8
- (C) -12
- (D) -13
- (E) none of these

6. Compute $\frac{d}{dx}(2 \sin x \cos x)$

- (A) 2
- (B) $2 \cos 2x$
- (C) $-2 \cos x \sin x$
- (D) $\sin^2 x - \cos^2 x$
- (E) none of these

7. Compute $\lim_{x \rightarrow 0} \frac{\sin 2x}{3x}$

- (A) $\frac{2}{3}$
- (B) $\frac{\sin 2}{3}$
- (C) $\frac{2 \cos 2x}{3}$
- (D) $\frac{6x \cos 2x - 3 \sin 2x}{9x^2}$
- (E) none of these

8. Compute $\int 2 \sin^2 x \, dx$

- (A) $\frac{2}{3} \sin^3 x + C$
- (B) $\frac{2}{3} \cos^3 x + C$
- (C) $x + \sin x \cos x + C$
- (D) $x - \sin x \cos x + C$
- (E) none of these

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- 9.** A cylindrical tank without a top is to have a specified volume. If the cost of the material used for the bottom is five times the cost of that used for the curved lateral part, find the ratio of the height to the diameter of the base for which the total cost is least.

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10. [Extra Credit] A light is at the top of a pole 80 ft high. A ball is dropped from the same height from a point 20 ft away from the light. Find how fast the shadow of the ball is moving along the ground 1 second later. Assume that the ball falls $s = 16t^2$ feet in t seconds.