

Record your answers to the multiple choice problems by placing an \times through one letter for each problem on this page. There are 8 multiple choice questions worth 6 points each and 4 partial credit problems worth 10 points each. You start with 12 points. On the partial credit problems try to simplify your answer and indicate your final answer clearly. *You must show your work and all important steps to receive credit.*

You may not use a calculator.

1. a b c d

2. a b c d e

3. a b c d

4. a b c d

5. a b c d e

6. a b c d e

7. a b c d e

8. a b c d e

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1. Evaluate $\int_0^{\pi/8} \cos^2(x) \sin^2(x) dx$

- (a) $(\pi - 1)/64$ (b) $(\pi + 1)/64$ (c) $(\pi + 2)/64$ (d) $(\pi + 4)/64$ (e) $(\pi - 2)/64$

2. Let $f(x) = x^3 + 2x - 1$. Find $(f^{-1})'(2)$.

- (a) $1/5$ (b) $1/3$ (c) $1/7$ (d) $1/14$ (e) $1/2$

3. Find the derivative of x^{a^x} where a is a positive constant.

- (a) $x^{a^x} a^x \left(\ln(ax) + \frac{1}{x} \right)$ (b) $x^{a^x} a^x \ln(a)$ (c) $a^x \left(\ln(x) \ln(a) + \frac{1}{x} \right)$
(d) $a^x x^{a^x - 1}$ (e) $x^{a^x} a^x \left(\ln(a) \ln(x) + \frac{1}{x} \right)$

4. Solve for x in the equation $2^x = 3^{1-x}$.

- (a) $\sqrt{3/2}$ (b) $\sqrt{2/3}$ (c) $\ln(2)/\ln(3)$.
(d) $\ln(3)/\ln(2)$. (e) $\ln(3)/\ln(6)$.

5. Evaluate $\int \frac{6}{9 - x^2} dx$.

- (a) $\frac{2}{3} \sinh^{-1} \left(\frac{x}{3} \right) + C$ (b) $\frac{2}{3} \tan^{-1}(x) + C$ (c) $2 \tanh^{-1} \left(\frac{x}{3} \right) + C$
(d) $6 \sin^{-1}(x) + C$ (e) $-3 \ln(9 - x^2) + C$

6. Evaluate $\int_0^{1/\sqrt{2}} \frac{\sin^{-1}(x)}{\sqrt{1-x^2}} dx$.

- (a) $-\ln(\sqrt{2})$ (b) $\pi/4$ (c) $1 - \pi^2/16$ (d) $\pi^2/32$ (e) $\frac{1}{4}$

7. Use L'Hospital's Rule to evaluate $\lim_{x \rightarrow \pi} \frac{\sin(x)}{\ln(\pi/x)}$.

- (a) 0 (b) 1 (c) π^2 (d) π (e) ∞

8. Use a trigonometric substitution to evaluate $\int_1^2 \frac{1}{x^2\sqrt{4x^2-1}} dx$.

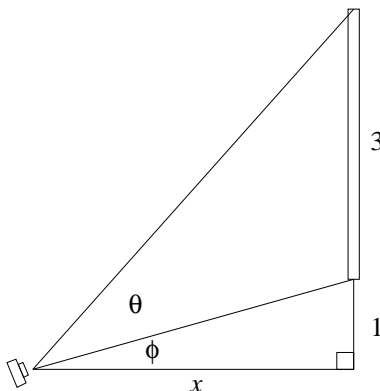
- (a) $\frac{2}{\sqrt{5}} - \frac{4}{\sqrt{3}}$ (b) $3\sqrt{5} - \frac{\sqrt{3}}{2}$ (c) $\sqrt{5} - \sqrt{3}$ (d) $\frac{\sqrt{15}}{2} - \sqrt{3}$ (e) $\frac{1}{\sqrt{15}} - \frac{1}{\sqrt{3}}$

9. Let $f(x) = \frac{1 - e^{2x}}{1 + e^{2x}}$.

- a) Find the domain and range of $f(x)$.
- b) Show that $f(x)$ is one-to-one in its domain.
- c) Find $f^{-1}(x)$ and determine its domain and range.

10. A photographer is taking a picture of a three-foot tall painting hung on a wall in an art gallery. The camera is one foot below the lower edge of the painting, as shown in the figure below. Determine the distance x the camera should be from the wall to maximize the angle θ subtended by the camera lens.

Hint: Let ϕ be the angle to the bottom of the picture as shown in the figure. Find the tangent of $\theta + \phi$ and the tangent of ϕ , then use inverse functions to solve for θ as a function of x . Be sure to explain why your answer maximizes θ and does not minimize it.



11. Compute the limit $\lim_{x \rightarrow \infty} \left(1 + \frac{2}{x-1}\right)^{3x}$.

12. Use integration by parts to evaluate $\int_0^3 x^2 e^{x/3} dx$.