

Name \_\_\_\_\_ ID # \_\_\_\_\_ Section # \_\_\_\_\_

The examination consists of **20** multiple choice questions. For each problem, please fill in the bubble on the scantron sheet and circle the correct answer on your examination. Each problem is worth five points.

**THE USE OF CALCULATORS IS NOT PERMITTED  
IN THIS EXAMINATION.**

CHECK THE EXAMINATION BOOKLET BEFORE  
YOU START. THERE SHOULD BE **20** PROBLEMS  
ON **11** PAGES (INCLUDING THIS ONE).

1. Let  $f(x) = 2x^3 - 3x^2 - 12x + 5$ . Find the intervals where  $f$  is increasing and intervals where  $f$  is decreasing.

- a)  $f$  is increasing on  $(-1, 2)$ ; decreasing on  $(-\infty, -1)$  and on  $(2, \infty)$ .
- b)  $f$  is increasing on  $(-2, 3)$ ; decreasing on  $(-\infty, -2)$  and on  $(3, \infty)$ .
- c)  $f$  is increasing on  $(-\infty, -3)$ ; decreasing on  $(3, \infty)$ .
- d)  $f$  is increasing on  $(-\infty, -1)$  and on  $(2, \infty)$ ; decreasing on  $(-1, 2)$ .

2. Suppose the first derivative of  $f(x)$  is given by

$$\frac{d}{dx}f(x) = \frac{x(x-1)(x+2)^2}{x^2+1}.$$

Find the relative maxima and relative minima of  $f$ .

- a) relative maximum at  $x = 0$ ; relative minimum at  $x = -1$  and at  $x = -2$ .
- b) no relative maxima or minima.
- c) relative maximum at  $x = 0$ ; relative minimum at  $x = 1$ .
- d) relative maximum at  $x = 1$  and at  $x = -2$ ; relative minimum at  $x = 0$ .

3. Suppose the second derivative of  $f(x)$  is given by

$$\frac{d^2}{dx^2}f(x) = \frac{2x^2 - 10x}{(x^2 + 1)^3}.$$

Determine the intervals of concavity of  $f$ .

- a)  $f$  is concave down on  $(-\infty, 5)$ ; concave up on  $(5, \infty)$ .
- b)  $f$  is concave up on  $(-\infty, 0)$  and on  $(5, \infty)$ ; concave down on  $(0, 5)$ .
- c)  $f$  is concave down on  $(-\infty, 0)$ ; concave up on  $(0, 5)$  and on  $(5, \infty)$ .
- d)  $f$  is concave up on  $(-\infty, -1)$  and on  $(5, \infty)$ ; concave down on  $(-1, 5)$ .

4. Determine all vertical and horizontal asymptotes of the function

$$g(x) = \frac{3x(x - 2)}{x^2 - x - 20}.$$

- a) vertical asymptotes  $x = 5$  and  $x = -4$ ; horizontal asymptotes  $y = 0$  and  $y = 2$ .
- b) vertical asymptotes  $x = 5$  and  $x = -4$ ; horizontal asymptote  $y = 3$ .
- c) vertical asymptotes  $x = 0$  and  $x = 2$ ; no horizontal asymptote.
- d) no vertical asymptote; horizontal asymptote  $y = \frac{3}{10}$ .

5. A company's cost (in dollars) for producing  $x$  units of their product is

$$C(x) = 0.01x^2 + 5x + 49, \quad (0 < x < \infty).$$

Determine the average cost function,  $\overline{C}(x)$ , and determine the value of  $x$  that minimizes  $\overline{C}(x)$ .

- a)  $\overline{C}(x)$  is minimum when  $x = 7$ .
- b)  $\overline{C}(x)$  is minimum when  $x = 250$ .
- c)  $\overline{C}(x)$  is minimum when  $x = 70$ .
- d)  $\overline{C}(x)$  is minimum when  $x = -250$ .

6. Find the absolute maximum and absolute minimum values of the function

$$f(x) = x^4 - 2x^2 + 5 \quad \text{on} \quad [0, 2].$$

- a) absolute maximum is 20; absolute minimum is 5.
- b) absolute maximum is 13; absolute minimum is  $-2$ .
- c) absolute maximum is 5; absolute minimum is 4.
- d) absolute maximum is 13; absolute minimum is 4.

7. What is the maximum possible value of

$$A = (x - 1)(y - 2),$$

if  $x > 0$  and  $xy = 50$ .

a) 25

b)  $\frac{65}{2}$

c) 32

d)  $\frac{95}{3}$

8. A rectangular box with square base and no top must hold 4 cubic feet. What dimensions minimize the total surface area (the base plus the four sides)?

a)  $\frac{3}{4} \times \frac{3}{4} \times \frac{64}{9}$

b)  $1 \times 1 \times 4$

c)  $\frac{3}{2} \times \frac{3}{2} \times \frac{16}{9}$

d)  $2 \times 2 \times 1$

9. Simplify  $A = \log_3 27 + \ln \left( \frac{1}{e^3} \right) - \log_5 1$ .

a)  $A = -2$

b)  $A = 0$

c)  $A = 1$

d)  $A = 5$

10. If  $3^{t-1} = 9^t$ , what is  $t$ ?

a)  $t = 2$

b)  $t = -2$

c)  $t = -1$

d)  $t = 0$

11. Given that  $\ln 2 \approx 0.7$ , and  $\ln 3 \approx 1.1$  what is  $\ln \sqrt{6}$ ?

- a)  $\ln \sqrt{6} \approx 0.9$
- b)  $\ln \sqrt{6} \approx 1.2$
- c)  $\ln \sqrt{6} \approx 0.75$
- d)  $\ln \sqrt{6} \approx 1.1$

12. If \$1000 is invested at 3.6% per year compounded *monthly*, what will be the accumulated amount after 8 years?

- a)  $1000e^{3.6}$  dollars.
- b)  $1000(1.036)^8$  dollars.
- c)  $1000(1.003)^{96}$  dollars.
- d)  $1000(1.036)^{96}$  dollars.

13. What amount must be invested now at 6% per year compounded *continuously* to yield \$10,000 in 5 years?

a)  $\frac{10,000}{e^{0.3}}$  dollars

b)  $10,000e^{-0.06}$  dollars

c)  $10,000e^{0.3}$  dollars

d)  $\frac{10,000}{(1 + e^{0.06})^5}$  dollars

14. What is the present value  $P$  of  $A = \$1000$  two years from now if the interest rate is 12% compounded monthly?

a)  $P = 1000(1.1)^{24}$

b)  $P = 1000(1.01)^{-24}$

c)  $P = \frac{1000}{1.24}$

d)  $P = 1000(1.12)^{-24}$

15. If interest is paid at 6% compounded continuously, what is the effective interest rate  $r_{\text{eff}}$ ?

a)  $r_{\text{eff}} = e^{1.06}$ .

b)  $r_{\text{eff}} = e^{0.06}$ .

c)  $r_{\text{eff}} = e^{0.06} - 1$ .

d)  $r_{\text{eff}} = 1 - e^{1.06}$ .

16. Find  $\frac{d}{dt}((t^2 + 1)e^{3t})$ .

a)  $6t(t^2 + 1)e^{3t-1}$

b)  $2t + 3e^{3t}$

c)  $(3t^2 + 2t)e^{3t}$

d)  $(3t^2 + 2t + 3)e^{3t}$

17. If  $f(x) = \ln(x^2 - 3x + 4)$ , find  $f'(x)$ .

a)  $\ln(2x - 3)$

b)  $\frac{2x - 3}{x^2 - 3x + 4}$

c)  $\frac{1}{x^2 - 3x + 4}$

d)  $\frac{\ln(x^2 - 3x + 4)}{2x - 3}$

18. Find  $\frac{d^2}{dt^2}(te^t)$ .

a)  $(2 + t)e^t$

b)  $1 + te^t$

c)  $3te^{t-1} + t^3e^{t-2}$

d)  $e^t + t^2e^{t-1}$

19. Find  $\frac{d^2}{dx^2}(\ln x)^2$

a)  $\frac{2 - 2 \ln x}{x^2}$

b)  $\frac{2}{x}$

c)  $\frac{2 \ln x}{x}$

d)  $x - \frac{2}{x^2}$

20. Use logarithmic differentiation to find  $\frac{d}{dx} \left( \frac{(x+1)^5}{\sqrt{x^2-1}} \right)$ .

a)  $\frac{(x+1)^5}{\sqrt{x^2-1}} \left[ \frac{5}{x+1} - \frac{x}{x^2-1} \right]$

b)  $5x(x+1)^4 \sqrt{x^2-1}$

c)  $\frac{5(x+1)^4}{\sqrt{x^2-1}} + \frac{(x+1)^5}{(x^2-1)^{\frac{3}{2}}}$

d)  $\frac{(x+1)^5}{\sqrt{x^2-1}} \left[ 5 \ln(x+1) - \frac{1}{2} \ln(x^2-1) \right]$

21. KEY: 1-d, 2-c, 3-b, 4-b, 5-c, 6-d, 7-c, 8-d, 9-b, 10-c, 11-a, 12-c, 13-a, 14-b, 15-c, 16-d, 17-b, 18-a, 19-a, 20-a.