King Fahd University of Petroleum and Minerals
Department of Mathematics and Statistics

**Math 101**
**Final Exam**
**Term 171**
**Thursday 04/01/2018**
**Net Time Allowed: 180 minutes**

# MASTER VERSION

| Q | MM | V1 | V2 | V3 | V4 |
|---|---|---|---|---|---|
| 1 | a | a | c | d | d |
| 2 | a | a | e | b | c |
| 3 | a | b | e | a | a |
| 4 | a | a | e | b | d |
| 5 | a | c | c | b | a |
| 6 | a | e | a | d | a |
| 7 | a | d | a | d | c |
| 8 | a | a | e | a | b |
| 9 | a | e | e | c | b |
| 10 | a | e | a | b | c |
| 11 | a | c | e | b | e |
| 12 | a | b | d | b | a |
| 13 | a | c | b | a | b |
| 14 | a | a | b | b | e |
| 15 | a | a | e | e | d |
| 16 | a | b | b | c | e |
| 17 | a | e | c | c | a |
| 18 | a | e | e | c | e |
| 19 | a | a | d | b | a |
| 20 | a | a | e | d | c |
| 21 | a | d | e | e | c |
| 22 | a | b | d | e | c |
| 23 | a | a | a | a | a |
| 24 | a | d | e | b | b |
| 25 | a | a | b | a | b |
| 26 | a | c | c | c | b |
| 27 | a | a | a | e | d |
| 28 | a | e | c | e | b |

1. $\lim\limits_{x \to 1^-} \dfrac{1 - x^2}{|x^2 + 3x - 4|} =$

(a) $\frac{2}{5}$

(b) $-\frac{2}{5}$

(c) $\frac{3}{5}$

(d) $-\frac{3}{5}$

(e) Does not exist

2. If $f(x) = \cosh(\ln x)$, then $f'\left(\frac{1}{5}\right) =$

(a) $-12$

(b) $-10$

(c) $24$

(d) $-26$

(e) $-1$

3. $\lim_{x \to 1^-} (2 - x)^{\tan(\frac{\pi x}{2})} =$

(a) $e^{\frac{2}{\pi}}$

(b) $e^{\pi}$

(c) $0$

(d) $e^{\frac{1}{\pi}}$

(e) $1$

4. The critical numbers of the function $f(x) = (1 + x + x^2)e^{-x}$ are:

(a) 0 and 1

(b) 0 only

(c) 1 only

(d) 0 and $-1$

(e) 1 and $-1$

5. The function $f$ is such that $f(1) = 5$ and $f'(x) \leq 2$ for all values of $x$. The value of $f(3)$ could be equal to:

(a) 9

(b) 10

(c) 12

(d) 13

(e) 11

6. If $f(x) = \dfrac{2x^3 - 3x^2 + 5}{x^2 + x}$, an equation of the oblique (slant) asymptote for the graph of $f$ is:

(a) $y = 2x - 5$

(b) $y = 2x - 3$

(c) $y = x + 3$

(d) $y = 3x + 1$

(e) $y = 3x - 2$

7. The linear approximation of $f(x) = \ln(e + \tan x)$ at $a = 0$ is given by

(a) $L(x) = 1 + \frac{x}{e}$

(b) $L(x) = 1 + ex$

(c) $L(x) = e + \tan x$

(d) $L(x) = 1 - x$

(e) $L(x) = e - \frac{x}{e}$

8. If the graph of $f(x) = \frac{2}{9}x^3 + Ax^2 - \frac{4}{3}x + B + 1$ has a local minimum at the point $(1, 1)$, then $3A + 9B =$:

(a) 8

(b) 0

(c) 2

(d) $-9$

(e) $-1$

9. $\lim_{x\to 0^+}\left(\frac{1}{\ln(x+1)} - \frac{1}{x}\right) =$

(a) $\frac{1}{2}$

(b) $-\frac{1}{3}$

(c) 4

(d) 0

(e) $\infty$

10. The sum of the absolute maximum and the absolute minimum values of the function $f(x) = 2\sin(x) + \cos(2x)$ on the interval $\left[0; \frac{\pi}{2}\right]$ is:

(a) $\frac{5}{2}$

(b) $\frac{3}{2}$

(c) 2

(d) 1

(e) 0

11. The slope of the normal line to the curve described by $\dfrac{2x+y^4}{y} = 5\ln y + 3x^2$ at the point $(1,1)$ is:

(a) 1

(b) $-1$

(c) 2

(d) $-2$

(e) 0

12. The equation $f(x) + f''(x) = 1$ is valid for all values of $x$. If $F(x)$ is an antiderivative of $f(x)$ such that $F(0) = -1$ and $F(1) = 2$, and $f'(0) = 2$, then $f'(1)$ is equal to:

(a) 0

(b) $-1$

(c) 1

(d) 2

(e) $-2$

13. $\lim_{x\to 0} \frac{e^x - x - 1}{x^2} =$

(a) $\frac{1}{2}$

(b) $-\frac{1}{2}$

(c) $0$

(d) $1$

(e) Does not exist

14. If $f(x) = \frac{\sqrt{x+1}}{x}$, then $f'(x) =$

(a) $-\frac{x+2}{2x^2\sqrt{x+1}}$

(b) $\frac{3x+1}{x^2\sqrt{x+1}}$

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

(d) $\frac{1-x}{x^2\sqrt{x+1}}$

(e) $\frac{2x}{2x^2\sqrt{x+1}}$

15. $\lim_{x \to -\infty} \dfrac{\sqrt{x^2+3}}{\sqrt{4+2x^2}} =$

(a) $\dfrac{1}{\sqrt{2}}$

(b) $-\dfrac{1}{\sqrt{2}}$

(c) $\dfrac{1}{2}$

(d) $-\dfrac{1}{2}$

(e) 1

16. The function $f(x) = x^3 - x^2 - x$ is

(a) decreasing on $\left(-\dfrac{1}{3}, 1\right)$

(b) decreasing on $\left(-\infty, -\dfrac{1}{3}\right)$

(c) decreasing on $(1, \infty)$

(d) decreasing on $(-\infty, \infty)$

(e) increasing on $(-\infty, \infty)$

17. The function $f(x) = e^x - x^2$ is

(a) concave-down on $(-\infty, 0]$

(b) concave-up on $(-\infty, 0]$

(c) concave-down on $[0, \infty)$

(d) concave-up on $[0, \infty)$

(e) concave-down on $(-\infty, \infty)$

18. If $f(x) = \begin{cases} x^2 & \text{if} \quad x \leq 2 \\ mx + b & \text{if} \quad x > 2 \end{cases}$

is differentiable everywhere, then $m - b =$

(a) 8

(b) 4

(c) 6

(d) 0

(e) $-6$

19. The function $f(x) = (2x - 7)\sqrt{x^2 - 1}$ has a:

(a) local minimum at $x = 2$.

(b) local minimum at $x = 2$ and a local maximum at $x = -\frac{1}{4}$.

(c) local maximum at $x = 2$.

(d) local maximum at $x = 2$ and a local minimum at $x = -\frac{1}{4}$.

(e) local maximum at $x = 2$ and a local minimum at $x = 1$.

20. If $x^2 + xy + y^3 = 1$, the value of $y''$ at the point where $x = 1$ is equal to

(a) 2

(b) 1

(c) 0

(d) 3

(e) 4

21. If $4x + 3y = 7$ is the tangent line to the graph of $x^2y + ay^2 = b$ at the point $(1, 1)$, then $a + b =$

(a) $\frac{3}{2}$

(b) $\frac{2}{3}$

(c) $\frac{5}{2}$

(d) $\frac{2}{5}$

(e) $0$

22. The area of an equivalent triangle is expanding with time. When the side is 4 inches long, the area increases at a rate of $\sqrt{3}\ in^2/sec$. The side's length at that moment is increasing at the rate:

(a) $\frac{1}{2}\ in/sec$

(b) $1\ in/sec$

(c) $\sqrt{3}\ in/sec$

(d) $\frac{1}{\sqrt{3}}\ in/sec$

(e) $\frac{1}{4}\ in/sec$

23. If $f(x) = (2x+1)(3x+2)^2(4x+3)^3(5x+4)^4$, then $f'(-1) =$

(a) $-40$

(b) $-28$

(c) 38

(d) 1

(e) 0

24. Using Newton's Method to estimate the value of $\sqrt[3]{7}$, starting with $x_0 = 1$, $x_1 =$

(a) 3

(b) 2

(c) $\frac{3}{2}$

(d) $\frac{2}{3}$

(e) $\frac{7}{3}$

25. If $f(x) = \begin{cases} [\,|x|\,] + 3, & -2 \le x < -1 \\ \dfrac{A}{2+x} + x^2, & -1 \le x < 2 \end{cases}$

is continuous at $x = -1$, then the value of $A$ is:

($[\,|x|\,]$ : **greatest integer of** $x$)

(a) 0

(b) 1

(c) 2

(d) 3

(e) 4

26. The antiderivative $F(x)$ of the function $f(x) = \dfrac{3 + 10x^2}{10\sqrt{x}} + e^x$ such that $F(1) = e$ is:

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

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

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

(d) $\frac{1}{5}\sqrt{x} + \frac{4}{5}\sqrt{x^5} + e^x - 1$

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

27. The area (in units$^2$) of the largest rectangle that could be inscribed in a semicircle of radius 1 is

(a) $1$

(b) $2$

(c) $\sqrt{2}$

(d) $\frac{1}{2}$

(e) $2\sqrt{2}$

28. A particle is moving along a quarter circle of equation $x^2 + y^2 = 4$; $x \geq 0; y \geq 0$. How fast is the particle's $y$-coordinate changing at the point $(1, \sqrt{3})$ if its $x$-coordinate is increasing at the rate of 2 unit/sec.

(a) $-\frac{2}{\sqrt{3}}$ unit/sec

(b) $-2\sqrt{3}$ unit/sec

(c) $\frac{2}{\sqrt{3}}$ unit/sec

(d) $2\sqrt{3}$ unit/sec

(e) $2 + \sqrt{3}$ unit/sec