Name_____
KUID_____
Instructor_____

Part 1: Multiple Choice. Show your work in the space provided. Circle the correct answer. Partial credit will be given only if work is shown. Each question is worth 10 points.

1. Solve the system of equations $\begin{cases} x + 2y = 7 \\ 3x - y = 1 \end{cases}$

   (a) $(1, 2)$
   (b) $(1, 3)$
   (c) $(\frac{9}{7}, \frac{20}{7})$
   (d) $(\frac{7}{9}, \frac{4}{3})$

2. Write the equation of a line through the point $(-2, 7)$ which is parallel to the line $y = 3x$.

   (a) $x - 3y = -23$
   (b) $-3x + y = -13$
   (c) $x + 3y = 19$
   (d) $3x - y = -13$

3. Find the inverse of the function $g(x) = 2 + \sqrt{x + 5}$; $x \geq -5$ and specify its domain.

   (a) $g^{-1}(x) = -2 + \sqrt{x - 5}$; $x \geq 5$
   (b) $g^{-1}(x) = -5 + (x - 2)^2$; $x \geq 2$
   (c) $g^{-1}(x) = 2 + (x - 5)^2$; $x \geq -5$
   (d) $g^{-1}(x) = -5 + (x + 2)^2$; $x \geq -2$

4. Evaluate the difference quotient $\dfrac{f(x + h) - f(x)}{h}$ for the function $f(x) = 4x^2 - x$

   (a) $8x + 4h - 1$
   (b) $4x + 4h + 1$
   (c) $8x + h - 1$
   (d) 1

5. What are the asymptotes of the function $R(x) = \dfrac{(x-3)(x+3)}{x(x+4)(x-3)}$?

   (a) VA: $x = -4$, $x = 0$; HA: $y = 0$

   (b) VA: $x = -3$, $x = 3$; HA: $y = 1$

   (c) VA: $x = -4$, $x = 0$, $x = 3$; HA: $y = 0$

   (d) VA: $x = -4$, $x = 0$; HA: none

6. If you borrow \$2,000 from a credit card company charging 20.99% interest compounded continuously and you make no payments, how long will it be until you owe \$3,000? (Round to the nearest year.)

   (a) 2 years

   (b) 4 years

   (c) 6 years

   (d) 8 years

7. What are the sine and cosine of the angle $\theta = \dfrac{7\pi}{6}$ radians?

   (a) $\sin(\theta) = -\frac{1}{2}$, $\cos(\theta) = -\frac{\sqrt{3}}{2}$

   (b) $\sin(\theta) = -\frac{\sqrt{3}}{2}$, $\cos(\theta) = -\frac{1}{2}$

   (c) $\sin(\theta) = \frac{1}{2}$, $\cos(\theta) = -\frac{\sqrt{3}}{2}$

   (d) $\sin(\theta) = -\frac{\sqrt{3}}{2}$, $\cos(\theta) = \frac{1}{2}$

8. If $\sin(\alpha) = \frac{2}{5}$ and α is in quadrant II, find $\tan(\alpha)$

   (a) $\tan(\alpha) = -\frac{2}{\sqrt{23}}$

   (b) $\tan(\alpha) = \frac{\sqrt{23}}{2}$

   (c) $\tan(\alpha) = -\frac{2}{\sqrt{21}}$

   (d) $\tan(\alpha) = \frac{\sqrt{21}}{2}$

9. What is the period of the function $s(x) = 3\sin(\frac{x}{2} + \frac{\pi}{2})$?

   (a) 3

   (b) 2π

   (c) 4π

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

10. Find all solutions to the equation $\sin(x) + \sin(x)\tan(x) = 0$ in the interval $[0, 2\pi)$.

    (a) $x = 0, \pi, \frac{5\pi}{4}, \frac{7\pi}{4}$

    (b) $x = \frac{\pi}{2}, \frac{5\pi}{4}, \frac{\pi}{2}, \frac{7\pi}{2}$

    (c) $x = -1, 0$

    (d) $x = 0, \frac{3\pi}{4}, \pi, \frac{7\pi}{4}$

11. Which of the following is **not** equivalent to $\csc(x)$?

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

    (b) $\sec(x)\cot(x)$

    (c) $\dfrac{1}{\sin(x)}$

    (d) $\dfrac{\sin^2(x) + \cos^2(x)}{\sin(x)}$

12. If you walk 2 km north and then turn 45^o to the east and walk another 2 km, how far are you from your starting point? (Hint: use the law of cosines)

    (a) 1.5 km

    (b) 2.3 km

    (c) 3.3 km

    (d) 3.7 km

13. Find the angle A in the triangle shown to the nearest degree (hint: use the law of sines).

    (a) 46^o

    (b) 44^o

    (c) 46^o or 134^o

    (d) 72^o or 108^o

14. Find the properties of the parabola $(y+4)^2 = -4(x-2)$

    (a) Vertex: $(-4, 2)$, Focus: $(-5, 2)$, Directrix: $x = -3$

    (b) Vertex: $(2, -4)$, Focus: $(1, -4)$, Directrix: $x = 3$

    (c) Vertex: $(2, -4)$, Focus: $(-2, -4)$, Directrix: $x = 6$

    (d) Vertex: $(-4, 2)$, Focus: $(0, 2)$, Directrix: $x = -8$

15. Where are the foci of the ellipse $\dfrac{(x+1)^2}{9} + \dfrac{(y-3)^2}{16} = 1$?

    (a) $(-1, 3 \pm \sqrt{7})$

    (b) $(-1 \pm \sqrt{7}, 3)$

    (c) $(-1, 7)$ and $(-1, -1)$

    (d) $(-4, 3)$ and $(2, 3)$

16. Which of the following hyperbolas has asymptotes $y = 2x - 10$ and $y = -2x + 6$?

    (a) $\dfrac{(x-4)^2}{1} - \dfrac{(y+2)^2}{4} = 1$

    (b) $\dfrac{(y+2)^2}{1} - \dfrac{(x-4)^2}{4} = 1$

    (c) $\dfrac{(x-2)^2}{1} - \dfrac{(y+5)^2}{4} = 1$

    (d) $\dfrac{(y-2)^2}{2} - \dfrac{(x+4)^2}{1} = 1$

17. Convert the point $(r, \theta) = (-4, \frac{\pi}{3})$ to rectangular coordinates.

    (a) $(x, y) = (2, 2\sqrt{3})$
    (b) $(x, y) = (-2, 2\sqrt{3})$
    (c) $(x, y) = (-2\sqrt{3}, -2)$
    (d) $(x, y) = (-2, -2\sqrt{3})$

18. Which of the following polar points is **not** equivalent to the rectangular point $(x, y) = (-5, 5)$?

    (a) $(r, \theta) = (-5, -\frac{\pi}{4})$
    (b) $(r, \theta) = (5, \frac{3\pi}{4})$
    (c) $(r, \theta) = (-5, \frac{5\pi}{4})$
    (d) $(r, \theta) = (5, -\frac{5\pi}{4})$

19. The graph of the parametric equations $\begin{cases} x = 2 + 3\cos(t) \\ y = -1 + 5\sin(t) \\ \pi \leq t \leq 2\pi \end{cases}$ where t is in radians looks like:

    (a) The top half of an ellipse
    (b) A line
    (c) A point
    (d) The bottom half of an ellipse

20. Which of the following is a parametrization of the function $g(x) = \dfrac{6}{\sqrt{3x - 5}}$?

    (a) $\begin{cases} x = \dfrac{5 + t}{3} \\ y = \dfrac{6}{\sqrt{t}} \end{cases}$
    (b) $\begin{cases} x = 3t - 5 \\ y = \dfrac{6}{\sqrt{t}} \end{cases}$
    (c) $\begin{cases} x = \dfrac{(5 + t)^2}{9} \\ y = \dfrac{6}{t} \end{cases}$
    (d) $\begin{cases} x = t \\ y = \dfrac{6}{t - 5} \end{cases}$

Part 2: Short Answer. Show your work in the space provided. Algebraic support must be shown to receive credit. Each question is worth 25 points.

21. Answer the following questions about the functions $f(x) = \log_3(x+5)$ and $g(x) = \sqrt{x+4}$.

    (a) What are the domains of f and g?

    (b) What is the vertical asymptote of f?

    (c) Evaluate $(f \circ g)(12)$

    (d) Evaluate $(g \circ f)(-4)$

22. Find all zeros of the polynomial $x^4 + 6x^3 + 2x^2 + 54x - 63$ and use the zeros to write f in completely factored form.

23. Prove any **two** of the following trigonometric identities.

(a) $\csc(\theta)\sec(\theta) - \cot(\theta) = \tan(\theta)$

(b) $\sec(\theta) - \tan(\theta)\cos(\theta) = \cos(\theta)$

(c) $\sec^2(\theta) + \csc^2(\theta) = \sec^2(\theta)\csc^2(\theta)$

(d) $\sin^4(\theta) - \cos^4(\theta) = \sin^2(\theta) - \cos^2(\theta)$

24. Mercury's orbit around the sun is elliptical, with the sun at one focus. The equation of this orbit is

$$\frac{x^2}{3364} + \frac{y^2}{3220} = 1$$

with distances in millions of kilometers. Answer the following questions:

(a) How far is the sun from the center of the orbit?

(b) How far is the sun from the other focus of the orbit?

(c) What are the maximum and minimum distances from mercury to the sun? (These are when mercury is at either end of the major axis).