INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **show all work**. A correct answer with incorrect or no supporting work may receive no credit. Books, notes, electronic devices (such as calculator or unauthorized electronic resources) are not permitted. **Give all answers in exact form.**

1. Write the word "agree" as your answer to question 1 to indicate that you will abide by the University honor code for this exam. An honor code violation on the final exam will result in an F in the course.

2. Simplify the following: (24 pts)

   (a) $9y^2 - (2x^2 - 3y)^2$

   (b) $\left(\dfrac{8x^4y^{-5}}{\sqrt[3]{x}y^{-3}}\right)^{-1}$

   (c) $\dfrac{\sqrt{24a^6b^2}}{\sqrt{3a^2b^4}}$

   (d) $-\ln\left(e^{3x}\right) + \log_4(8) + \log_4(2)$

   (e) $\dfrac{\frac{1}{a} - 2a}{\frac{1}{a^2} + a}$

3. Solve the following equations for x: (20 pts)

   (a) $-2 = x(x-5)$

   (b) $\dfrac{5}{6}x - \dfrac{1}{2} = -\dfrac{\sqrt{3}}{12}x + \dfrac{5}{6}$

   (c) $27 = 3^{3x-2}$

   (d) $\ln(x) = \ln(28) - \ln(x+3)$

4. Consider the function $f(x) = \dfrac{x^3 - 2x^2 - 8x}{2x^2 - 8}$. Answer the following: (12 pts)

   (a) Find x, y-coordinates of any hole(s). If there are none write NONE.

   (b) Find all x and y-intercepts. If there are none write NONE.

   (c) Find any horizontal/slant asymptotes. If there are none write NONE.

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5. Sketch the graph of the following functions. Label all intercepts and asymptotes as appropriate. (14 pts)

   (a) $q(x) = \begin{cases} \sqrt[3]{x} & \text{if } x \leq 1 \\ 3x - 2 & \text{if } x > 1 \end{cases}$

   (b) $h(x) = \sin x$ on the restricted domain $[0, 2\pi]$

   (c) $k(x) = \csc x$ on the restricted domain $[0, 2\pi]$. Graph on the same axes as $h(x)$ and label any asymptotes.

6. A certain city has a constant elevation of 120 feet above sea level throughout the city. In the city, a building stands 225 ft away from you. You measure the angle from your feet to the top of the building to be 77.11^o. How high is the top of the building above **sea level**? Leave your answer in exact form, do not attempt to approximate your answer. (6 pts)

7. Given $f(x) = e^x + e^{-x}$ and $g(x) = \ln(x - 2)$ answer the following. (14 pts)

   (a) Find $g(3)$.

   (b) Sketch a graph of $g(x)$. Label all intercepts and asymptote(s).

   (c) Find $h(x) = (f \circ g)(x)$ and state the domain. Give the domain in interval notation.

8. Find the exact value: (18 pts)

   (a) $\sin\left(\dfrac{3\pi}{4}\right)$

   (b) $\cos\left(-\dfrac{7\pi}{6}\right)$

   (c) $\tan^{-1}\left(-\sqrt{3}\right)$

   (d) $\cos\left(\arcsin\left(\dfrac{\sqrt{3}}{2}\right)\right)$

   (e) $\sin^{-1}\left(\sin\left(\dfrac{3\pi}{2}\right)\right)$

9. Verify the identity: $\sec\theta \csc\theta = \tan\theta + \cos\theta \csc\theta$ (6 pts)

10. Find all solutions to the following equations: (12 pts)

    (a) $\cos\theta \tan\theta - 2\tan\theta = 0$

    (b) $\sin(3\theta) = \dfrac{1}{2}$

11. The following are unrelated (12 pts)

    (a) Simplify as much as possible: $\dfrac{\cos(2\theta) - \cos^2\theta}{\sin\theta}$

    (b) Find the exact value: $\sin\left(-\dfrac{\pi}{12}\right)$

12. For $y = 2\cos(3x)$ (12 pts)

    (a) Identify the amplitude.

    (b) Identify the period.

    (c) Identify the phase shift.

    (d) Sketch two cycles of the curve. Label x and y-values to receive full credit.

End of Exam

Formula sheet on next page.

Formulas that may be useful:

1. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
2. The quadratic formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
3. Arc length: $s = r\theta$
4. $\sin^2\theta + \cos^2\theta = 1$
5. $\tan^2\theta + 1 = \sec^2\theta$
6. $\sin(a - b) = \sin a \cos b - \sin b \cos a$
7. $\cos(a - b) = \cos a \cos b + \sin a \sin b$
8. $\cos(2\theta) = \cos^2\theta - \sin^2\theta$
9. $\cos(2\theta) = 2\cos^2\theta - 1$
10. $\sin\left(\dfrac{\theta}{2}\right) = \pm\sqrt{\dfrac{1 - \cos\theta}{2}}$
11. $\sin^2(\theta) = \dfrac{1 - \cos(2\theta)}{2}$
12. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
13. Circle: $(x - h)^2 + (y - k)^2 = r^2$
14. Area of a sector: $A = \dfrac{1}{2}r^2\theta$
15. $1 + \cot^2\theta = \csc^2\theta$
16. $\sin(a + b) = \sin a \cos b + \sin b \cos a$
17. $\cos(a + b) = \cos a \cos b - \sin a \sin b$
18. $\sin(2\theta) = 2\sin\theta\cos\theta$
19. $\cos(2\theta) = 1 - 2\sin^2\theta$
20. $\cos\left(\dfrac{\theta}{2}\right) = \pm\sqrt{\dfrac{1 + \cos\theta}{2}}$
21. $\cos^2(\theta) = \dfrac{\cos(2\theta) + 1}{2}$