Cadet _____   Section_____

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FCE 9 – MA103

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GENERAL INSTRUCTIONS: Read all instructions carefully.

1. You have 55 minutes to complete the Fundamental Concepts Exam (FCE).

2. This exam evaluates the understanding of the math concepts fundamental to each cadet at this stage of his/her academic development. This is a non-technology exam. No references of any kind may be used.

3. Including this cover page, there are eight pages to the exam.

4. Write your name on every exam page.

5. Show as much work as possible to maximize credit. ***Unless the question states "simplify," you do not need to simplify your answers.***

6. Clearly indicate your answer (e.g. $\underline{0 < x < 5}$, or $\boxed{0 < x < 5}$).

7. Should you require additional space, use a blank sheet of paper and clearly identify that the problem is continued on both the exam and on the continuation sheet. Be sure to put your name on any extra pages you use.

8. Early departure is authorized. Make sure you comply with exam turn-in requirements as outlined by your instructor.

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1. Express $\frac{1}{\sqrt{3x+2}}$ in the rational exponent form.

$$(3x + 2)^{-1/2}$$

2. Solve for the roots of the following polynomial: $x^2 - 7x + 10 = 0$.
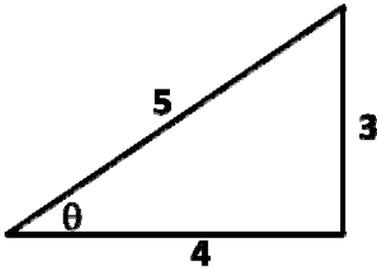
$$(x - 5)(x - 2) = 0 \quad \Rightarrow \quad x = 2, 5$$

3. Solve $x^2 - 3x + 2 > 0$ for x.

$$(x - 2)(x - 1) > 0 \quad \Rightarrow \quad x < 1 \ or \ x > 2$$

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4. Using the right triangle below, determine $tan(\theta)$.

$$tan(\theta) = \frac{opp}{adj} = \frac{3}{4}$$

5. Find the domain of the real valued function $(x) = \frac{1}{\sqrt{x^2-4}}$.

Domain is all possible x values (can't have zero in the denominator and can't have a negative number under an even-root radical): we need:
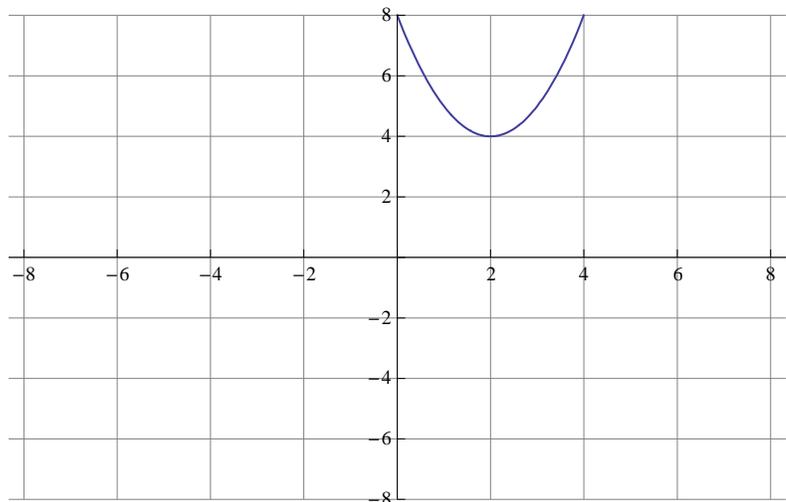
$$(x^2 - 4) > 0$$

$$x^2 > 4$$

$$x > 2 \quad or \quad x < -2$$

6. Sketch a graph of the function $f(x) = (x - 2)^2 + 4$.

x	y
0	8
1	5
2	4
3	5
4	8

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7. Find the equation of a line perpendicular to the line $2y - 5x = 8$ and passing through the point (3,4).

$$2y - 5x = 8 \quad \Rightarrow \quad y = \frac{5}{2}x + 4$$

Slope of this line is $\frac{5}{2}$ thus slope of a line perpendicular to this line is $-\frac{2}{5}$

Equation of this perpendicular line is given by:

$$y - y_1 = m(x - x_1)$$

$$y - 4 = -\frac{2}{5}(x - 3)$$

8. Write 48 as a product of prime factors.

$$2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 = 48$$

9. Solve the system of linear equations $\begin{cases} 3x + 6y = 8 \\ x - 3y = 6 \end{cases}$.

Second equation can be written as: $x = 3y + 6$
Substitute this information into the first equation: $3(3y + 6) + 6y = 8$
Solve for y:

$$9y + 18 + 6y = 8$$

$$15y = -10$$
$$y = -\frac{2}{3}$$

Substitute this information into the second equation: $x = 3\left(-\frac{2}{3}\right) + 6 = 4$

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10. Solve the equation $\log_2 x = 4$ for x.

$$\log_2 x = 4 \quad \Rightarrow \quad 2^4 = x$$

$$x = 16$$

11. Identify the dependent variable for the following real valued function: $z = f(t) = \frac{t^2}{t-4}$.

The dependent variable is z.

12. Simplify the expression $x^{-2}\, y^3\, x^{\frac{1}{2}}\, y^{\frac{1}{3}}$.

$$x^{-2}x^{1/2} = x^{-3/2}$$

$$y^3 y^{1/3} = y^{10/3}$$

$$x^{-2}y^3 x^{1/2} y^{1/3} = x^{-3/2} y^{10/3}$$

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13. Simplify the expression in terms of $\sin(\alpha)$ and $\cos(\alpha)$: $\dfrac{\sec(\alpha)\cot(\alpha)}{\sin(\alpha)}$.

$$\frac{\dfrac{1}{\cos(\alpha)}\dfrac{\cos(\alpha)}{\sin(\alpha)}}{\sin(\alpha)} = \frac{\dfrac{1}{\sin(\alpha)}}{\sin(\alpha)} = \frac{1}{\sin(\alpha)}\frac{1}{\sin(\alpha)} = \frac{1}{\sin^2(\alpha)}$$

14. What is the surface area of a cube with side length of 2ft?

A cube has six sides each with surface area: $2 \cdot 2 = 4\ ft^2$

Total surface area is: $6 \cdot 4 = 24\ ft^2$

15. Write $\dfrac{5\pi}{3}\ radians$ in terms of degrees.

$$\frac{\dfrac{5\pi}{3}rad}{x\ deg} = \frac{\pi\ rad}{180\ deg}$$

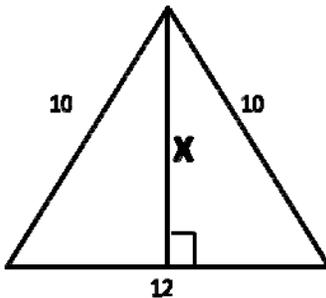$$x = \frac{\dfrac{5\pi}{3}\cdot 180}{\pi} = 300\ deg$$

16. Given $f(x) = x^2 - 4x + 5$, find $f(4s)$.

$$f(4s) = (4s)^2 - 4(4s) + 5 = 16s^2 - 16s + 5$$

17. Express 35,240,000 using scientific notation.

$$3.524 \times 10^7$$

18. Given the triangle below, find the length of side x.

$$x^2 + 6^2 = 10^2 \implies x^2 = 64 \implies x = 8$$

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19.   Solve $|x + 5| > 8$ for x.

$$x + 5 > 8 \quad or \quad x + 5 < -8$$

$$x > 3 \quad or \quad x < -13$$

20.   Find the straight line distance between the two points A(3,4) and B(-4,-5).

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$d = \sqrt{(3 - (-4))^2 + (4 - (-5))^2}$$

$$d = \sqrt{7^2 + 9^2} = \sqrt{49 + 81} = \sqrt{130}$$