

GENERAL INSTRUCTIONS: Read all instructions carefully.

1. You have 55 minutes to complete the Fundamental Concepts Exam (FCE).
2. Early departure is authorized. Make sure you comply with exam turn-in requirements as outlined by your instructor.
3. 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.
4. Including this cover page, there are eight pages (numbered one through eight) to the exam.
5. Show as much work as possible to maximize credit. ***You do not need to simplify your answers.***
6. Should you require additional space, use a blank sheet of paper and clearly identify that the problem is continued both on the exam and on the continuation sheet. Be sure to put your name on any extra pages you use.
7. Place your name on every exam page.

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FCE Version 1 – MA103

100 Points

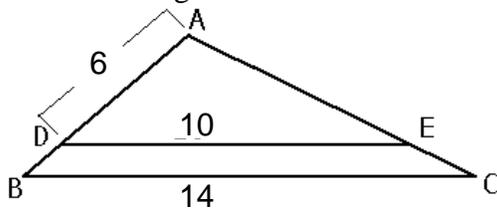
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1. Simplify  $\left(\frac{-2x^{\frac{1}{3}}}{y^{\frac{1}{2}}}\right)^3$ .

$$= -8xy^{-3/2} \text{ or } \frac{-8x}{y^{3/2}} \text{ or } \frac{-8x}{\sqrt{y^3}}$$

2. Given the following triangle with side DE parallel to side BC and lengths in centimeters, what is the length of side DB?



$$= \frac{12}{5}$$

3. Find the point where the following lines intersect  $\begin{cases} 2x + y = 8 \\ x - 2y = 9 \end{cases}$ .

$$= (5, -2)$$

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4. Given  $y = \log_2 x$ , what is the value for  $x$  when  $y = 5$ ?

**$x = 32$**

5. What are the domain and range of the real valued function  $y = \frac{1}{\sqrt{t-5}}$ ?

**Domain =  $\{t | t > 5\}$**

**Range =  $\{y | y > 0\}$**

6. Where does the graph of the function  $f(x) = x^2 - 7x + 12$  cross the  $x$  axis?

**$0 = x^2 - 7x + 12 \Rightarrow 0 = (x - 3)(x - 4) \Rightarrow x = 3, 4$**

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7. Simplify  $\frac{a+b}{\frac{1}{b} + \frac{1}{a}}$ .

**$= ab$**

8. Simplify the following expression:  $\log_3(5) + \log_3(7)$ .

**$= \log_3 35$**

9. Given  $f(a) = 1 + 4a$  and  $g(b) = 2b^2$ , what is  $f(3) - g(4z)$ ?

**$= 13 - 32z^2$**

10. If you double the perimeter of a square, what happens to its area?

**The area quadruples.**

11. If  $|3 - 4x| > 2$ , solve for  $x$ .

$$\left(-\infty, \frac{1}{4}\right) \cup \left(\frac{5}{4}, \infty\right)$$

12. Solve the following equation for  $x$ :  $\frac{12}{\frac{x}{3} + 2} = 5$ .

$$x = \frac{6}{5}$$

13. What is the range of  $f(x) = 3\sin(2x)$ ?

**Range =  $[-3, 3]$**

14. Write the number 90 as a product of prime factors.

**$90 = 2 * 3 * 3 * 5$**

15. Using trigonometric definitions, simplify  $\frac{\tan(\theta) * \sec(\theta) * \cos(\theta)}{\sin^2(\theta)}$ .

**$= \sec \theta \csc \theta$**

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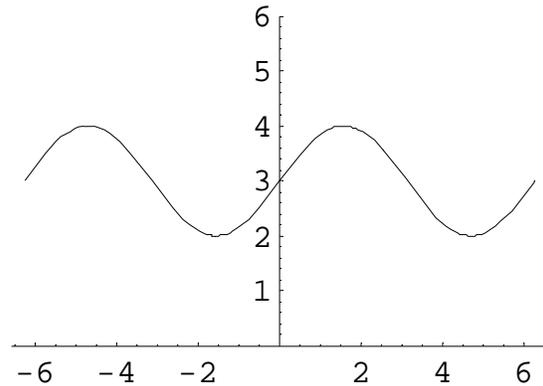
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16. What is a function describing this graph?

- a.  $f(x) = \sin(3x)$
- b.  $f(x) = 3\sin(x)$
- c.  $f(x) = \sin(x) + 3$
- d.  $f(x) = \sin(x + 3)$



**=  $\sin(x) + 3$**

17. Determine the roots of  $x^2 - 2x + 5 = 1$ .

**$x = \frac{2 \pm \sqrt{4 - 16}}{2} = 1 \pm \sqrt{3}i$**

18. Two trains depart from Washington D.C. at the same time. One heads due north toward New York at 120 MPH and the other heads due west toward California at 50 MPH. Assuming both trains are traveling in a straight line, how far apart are they after 1 hour?

**= 130 miles**

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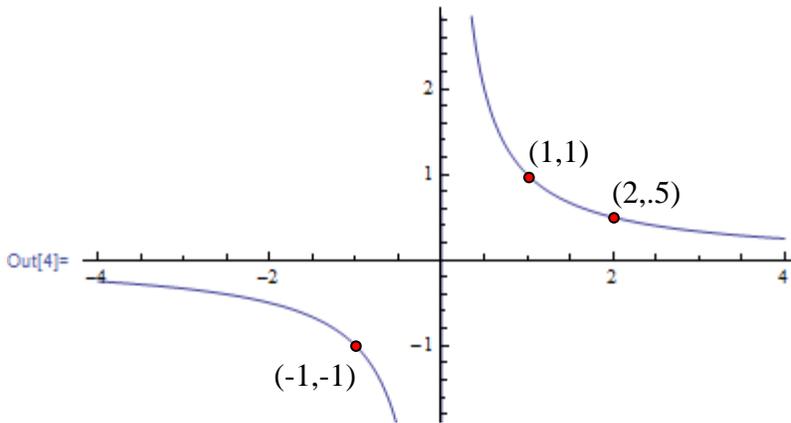
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19. Sketch the graph of the function  $h(t) = \frac{1}{t}$ . Identify three points on your graph of  $h(t)$ .



20. A line is drawn from the point  $(1, 2)$  to  $(3, 5)$ . Another line is drawn from the point  $(3, 0)$  to  $(6, -2)$ . What is the relationship between the two lines?

**They are perpendicular.**