

A.M.D.G.

**Directions:** Complete each of the following NEATLY IN PENCIL in the space provided. Show work; round at three decimal places. Good Luck.

**Multiple Choice.**

1. Find all solutions in one period of the periodic equation  $\sin(2\theta) = 0.6$  .

- (a)  $\theta = 1.249$
- (b)  $\theta = 0.322$
- (c)  $\theta = 2.820$
- (d)  $\theta = 0.322$  and  $\theta = 1.249$
- (e)  $\theta = 0.322$ ,  $\theta = 1.249$ , and  $\theta = 2.820$

2. For what value(s) of  $x$  does  $4x^6 - 8x^3 + 18$  have a relative minimum?

- (a)  $-1$  only
- (b)  $0$  only
- (c)  $1$  only
- (d)  $0$  and  $1$  only
- (e)  $-1$ ,  $0$ , and  $1$

3. The following transformations are performed on the graph of  $y = \sin x$  :

Amplitude is increased to 3  
A reflection across the  $x$ -axis  
A horizontal shift to the right  $\frac{\pi}{3}$  units  
Period  $\frac{2\pi}{3}$

The equation of the resulting graph is

- (a)  $y = 3\sin(3x + \pi)$
- (b)  $y = -3\sin(3x + \pi)$
- (c)  $y = -3\sin(3x - \pi)$
- (d)  $y = 3\sin(3x - \pi)$
- (e)  $y = -3\sin\left(\frac{x}{3} - \frac{\pi}{3}\right)$

4. A box is formed by removing squares of side length  $x$  from each corner of a rectangular piece of cardboard 15 in. wide by 24 in. long. Determine  $x$  so that the volume of the resulting box is at least 400 cubic inches.

(a)  $x < 1.95$  or  $x > 5.11$

(b)  $1.65 \leq x \leq 4.55$

(c)  $-2.13 \leq x \leq 4.08$

(d)  $1.08 \leq x \leq 5.37$

(e)  $1.32 \leq x \leq 5.02$

**Free Response.**

1. Solve  $\cos^2\left(\frac{1}{4}y\right) - \sin^2\left(\frac{1}{4}y\right) = \sec^2 y - \tan^2 y$  **exactly** for  $y \in [0, \pi)$ .

2. You are playing pinball and the ball hits the flipper and bounces 32 cm at  $94^\circ$ , then hits a bumper and travels 15 cm at  $-12^\circ$ , hits another bumper and travels 22 cm at  $132^\circ$ , and finally goes 8 cm at  $264^\circ$ . Find the distance and direction of the ball from the original point of impact.

3. Diego sees a number of his classmates jumping on a trampoline. Tired of always being drafted for boardwork, he decides to jump hard on the trampoline to see how high he can make them all bounce. Jeneiah sees that the height above the ground varies sinusoidally with time and focuses on one student. The surface of the trampoline is 5 feet off the ground when there's nobody jumping on it. 10 seconds after Diego hits the trampoline, the student's height is its highest, which is 8 feet above the ground. Three seconds after the student reaches the maximum, their height hits its minimum, which is two feet above the ground.

(a) Sketch a graph of the student's height off the ground as a function of time.

(b) Write a sinusoidal equation that describes the height  $y$  in terms of time  $t$ .

(c) What was the height at the start of the jump session?

(d) What are the first three times that the height is at six feet?

4. Given  $\cot A = -\frac{4}{3}$  where  $90^\circ \leq A \leq 180^\circ$  and  $(-7, -24)$  is on the terminal side of  $B$ , and  $540^\circ \leq B \leq 630^\circ$ , calculate the **EXACT** values of each of the following:

(a)  $\sin(B + A)$

(b)  $\sec(2A)$

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**Multiple Choice.**

5. If  $a > 0$  and  $\lim_{x \rightarrow a} \frac{x^4 - a^4}{x^2 - a^2} = 16$ , then  $a =$

- (a) 2
- (b)  $2\sqrt{2}$
- (c) 4
- (d)  $4\sqrt{2}$
- (e) 8

6. Find the amplitude of the graph of  $y = 3 + 2 \cos(x - \pi)$

- (a) 3
- (b) 2
- (c)  $\pi$
- (d)  $2\pi$
- (e)  $\frac{\pi}{2}$

7. Reduce the expression  $\csc x + \cot x$  to an equivalent expression involving only sines and cosines.

- (a)  $\frac{1 + \cos x}{\sin x}$
- (b)  $\frac{1 + \sin x}{\cos x}$
- (c)  $\frac{\cos x}{\sin x}$
- (d)  $\frac{\sin x}{\cos x}$
- (e)  $\frac{1 + \cos^2 x}{\cos x \sin x}$

8. Given the sign pattern  $f(x) \leftarrow \begin{array}{cccc} - & 0 & + & 0 & - & 0 & - \\ & -4 & & -1 & & 2 & \end{array} \rightarrow$ , which of the following is true?

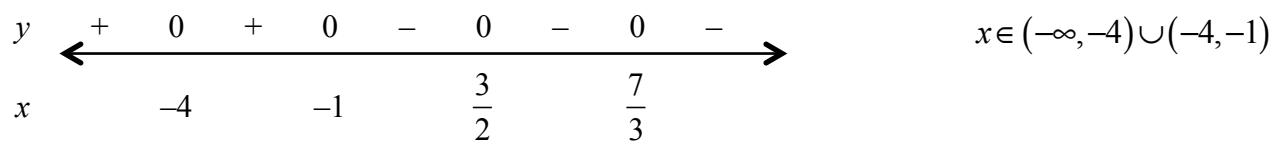
- I. The leading coefficient is negative
- II. The factor  $(x + 2)$  has an even power
- III.  $x \in [-4, -1]$  yields positive values

- (a) I only
- (b) II only
- (c) III only
- (d) I and III
- (e) I, II and III

**Free Response.**

5. Prove  $\sqrt{2} \cos\left(x - \frac{\pi}{4}\right) = \cos x + \sin x$

6. Find an inequality that has this sign pattern and solution:



7. List the given values and sketch the primary cycle of  $y = -2 - 3 \sin\left[\frac{\pi}{6}(x-2)\right]$ .

$k =$

$A =$

$B =$

Period =

$h =$

8. If you are given that  $(x+1)$  is a factor of  $3x^4 + 5x^3 - 7x^2 - 15x - 6$ , use synthetic substitution to factor completely.

9. State the **exact** value (simplify **completely**):  $\cos \frac{7\pi}{4} \sin \frac{3\pi}{4} + \sin \frac{\pi}{2} \cot \frac{3\pi}{2}$

10. Simplify completely:  $\frac{200m^4 + 80m^3 + 8m^2}{5m^3 + 14m^2 - 3m} \div \frac{25m^2 - 1}{m^3 + 27}$