For all questions, answer choice "E) NOTA" means none of the above answers is correct. For all questions, $i = \sqrt{-1}$, and inverse trigonometric functions (represented by an 'arc' prefix) have the traditional restricted ranges.

1   Which of the following is coterminal to the angle $1234°$?
     A) $-206°$ B) $-154°$ C) $-26°$ D) $234°$ E) NOTA

2   How many of the following represent even functions?
                        I. $f(x) = \sin(\sin x)$ II. $g(x) = \sin(\cos x)$
                        III. $h(x) = \cos(\sin x)$ IV. $k(x) = \cos(\cos x)$
     A) 1   B) 2   C) 3   D) 4   E) NOTA

3   Simplify the sum $\sin(105°) + \sin(15°)$.
     A) 1   B) $\frac{\sqrt{3}+\sqrt{2}}{2}$ C) $\frac{\sqrt{6}}{2}$ D) $\frac{3}{2}$ E) NOTA

4   How many petals are there in the graph of $r = \sin\theta\cos\theta$?
     A) 1   B) 2   C) 3   D) 4   E) NOTA

5   What is the value of $\arctan\left(\frac{2}{3}\right) + \arctan(-5)$?
     A) $-\frac{\pi}{4}$ B) $\frac{\pi}{4}$ C) $\frac{\pi}{2}$ D) Not defined   E) NOTA

6   A point P is external to a circle O of radius 2. Tangent lines drawn from P to the circle form a $60°$ angle. What is the length of $\overline{OP}$?
     A) 2   B) $2\sqrt{3}$ C) 4   D) $3\sqrt{3}$ E) NOTA

7   Convert the angle measure $\frac{8\pi}{15}$ radians to its equivalent in degrees.
     A) $84°$ B) $96°$ C) $112°$ D) $192°$ E) NOTA

8   What is $(i-1)^5(1-i)^3$?
     A) -16 B) $-8-8i$ C) $8+8\sqrt{3}i$ D) $16+16i$ E) NOTA

9   What is the tangent of the acute angle between the vectors: $<2,3>$ and $<3,2>$?
     A) $\frac{5}{12}$ B) $\frac{5}{6}$ C) $\frac{12}{13}$ D) $\frac{3}{2}$ E) NOTA

10   What is the domain of the function: arcsin(sec(x))?
     A) $\{k\pi|k$ is an integer$\}$ B) $\{\frac{\pi}{2} + k\pi|k$ is an integer$\}$
     C) $\{\frac{k\pi}{2}|k$ is an integer$\}$ D) $\{2k\pi|k$ is an integer$\}$
     E) NOTA

11   How many real solutions are there to the equation:
$$\sin(x) = \frac{x}{10}?$$
A) 3   B) 5   C) 7   D) 9   E) NOTA

12   A building casts a shadow that is 70 feet long when the sun is elevated 50 degrees from the ground. How tall is the building in feet?

A) $70\sin 50°$ B) $70\cos 50°$ C) $\dfrac{70}{\tan 50°}$ D) $70\tan 50°$ E) NOTA

13   A propeller spins at a rate of 2400rpm (revolutions per minute). What is its angular velocity in radians per second?
A) 20π B) 30π C) 40π D) 60π E) NOTA

14   All sides of an obtuse triangle have integer lengths, if two of the sides are 10 and 10, what is the sum of possible lengths of the third side?
A) 37   B) 85   C) 135   D) 190   E) NOTA

15   For the function, $g(x) = \cos^2(x) + \sin(2x)$; find $g\left(\frac{\pi}{12}\right)$.

A) $\dfrac{1+\sqrt{3}}{2}$ B) $\dfrac{\sqrt{6}+\sqrt{3}}{4}$ C) $\dfrac{4+\sqrt{3}}{4}$ D) $\dfrac{\sqrt{6}+\sqrt{2}}{2}$ E) NOTA

16   Which of the following planes are orthogonal to the plane: $3x - 2y + z = 4$?
A) $2x - 4y - z = 6$ B) $-x + 2y + 3z = 2$
C) $x + 4y + 5z = 1$ D) $-2x + y - 2z = 1$
E) NOTA

17   What is the period of the function: $f(x) = 2\sin\left(\frac{x}{3}\right) + 3\cos\left(\frac{x}{2}\right)$?

A) $\dfrac{\pi}{3}$ B) π C) 4π D) 12π E) NOTA

18   Given a line and a point not on the line that exist in the same plane. The locus of points that are equidistant to the point and to the line is called a:
A) circle   B) hyperbola   C) parabola   D) line   E) NOTA

19   What are the rectangular coordinates of the point (4, 2) after it has been rotated counter-clockwise through an angle of 60° and then reflected about the x-axis?
A) $(\sqrt{3} - 2,\ -2\sqrt{3} - 1)$ B) $(2 - \sqrt{3},\ -2\sqrt{3} - 1)$
C) $(2 - \sqrt{3},\ 2\sqrt{3} - 1)$ D) $(-2\sqrt{3} - 1,\ 2 - \sqrt{3})$
E) NOTA

20   For which of the following angles, θ, is $2^{\cos\theta} < 1$ and $5^{\sin\theta} > 1$?
A) $\pi/4$ B) $\pi/3$ C) $3\pi/4$ D) $5\pi/4$ E) NOTA

21   What is the square of the distance between the polar points $(3, 64°)$ and $(5, 109°)$?

A) 19   B) 34   C) $16 + 15\sqrt{2}$

D) $34 + 15\sqrt{2}$ E) NOTA

22   The included figure is a circle centered at O of radius r. Find the area of the shaded
region as a function of r and the measure of angle A in
radians.
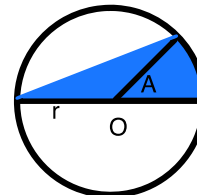
A) $\left(\frac{A+\sin A}{2}\right)r^2$ B) $\left(\frac{A}{2}\right)r^2$

C) $(A + \sin A)r^2$ D) $\left(\frac{A+\cos A}{2}\right)r^2$

E) NOTA

23   What is the length of the graph of the polar function:

$$r = 10/(2\sin\theta + 5\cos\theta) \text{ for } 0 \le \theta \le \frac{\pi}{2}?$$

A) π B) $\sqrt{10}$ C) $\sqrt{29}$ D) 2π E) NOTA

24   Find $\sin^4 x + \cos^4 x$, if we know that the $\sin 2x = \frac{4}{7}$.

A) $\frac{3}{7}$ B) $\frac{31}{49}$ C) $\frac{41}{49}$ D) 1   E) NOTA

25   Evaluate:

$$\sum_{j=1}^{5} \cos\left(\frac{j\pi}{5}\right)$$

A) $\sqrt{2} - \sqrt{3}$ B) 0   C) $\sqrt{3} - \sqrt{2}$ D) 1   E) NOTA

26   Evaluate the product:

$$\left(\sin\frac{\pi}{16}\right)\left(\cos\frac{\pi}{16}\right)\left(\cos\frac{\pi}{8}\right)\left(\cos\frac{\pi}{4}\right)$$

A) $\frac{1}{16}$ B) $\frac{1}{8}$ C) $\frac{\sqrt{3}}{8}$ D) $\frac{1}{4}$ E) NOTA

27   Two sides of a triangle are 20 and 25. What is the maximum area of the triangle?

A) 150   B) 225   C) 300   D) $\frac{1000}{3}$ E) NOTA

28   My store's monthly sale of plants peaks in April at 400 and is lowest in October at 100
      plants. If the sales follow a sine curve with a 12 month cycle, which of the following
      could represent the sales function (x=1 in January)?

      A) $150 \sin\left(\frac{\pi}{6}(x-1)\right)$ B) $150 \sin\left(\frac{\pi}{6}(x)\right) + 250$

      C) $300 \sin\left(\frac{\pi}{6}(x-1)\right) + 100$ D) $150 \sin\left(\frac{\pi}{6}(x-1)\right) + 250$

      E) NOTA

29   How many solutions are there on the interval $(0, \pi]$ of the equation
      $\sin(x)\sin(2x)\sin(3x)\sin(4x)\sin(5x)\sin(6x) = 0$?
      A) 4   B) 6   C) 10   D) 12   E) NOTA

30   Mary and Nancy are standing d meters apart, where $d > 0$, each looking at a beautiful
      oak tree; the spots on the ground where Mary and Nancy are standing, along with the
      spot where the oak tree is growing, are all collinear. From the top of the oak tree, the
      angle between the spots on the ground where Mary and Nancy are standing has
      measure A. The spot on the ground where Mary is standing has an angle of elevation
      to the top of the oak tree of B, and the angle of elevation from the spot on the ground
      where Nancy is standing to the top of the oak tree is C. What is the height, in meters,
      of the oak tree in terms of the distance d and the angle measures A, B and C?

      A) $\dfrac{d \tan B \tan C \cos A}{|\tan B - \tan C|}$ B) $\dfrac{d \sin B \sin C}{\sqrt{\sin^2 B + \sin^2 C - 2 \sin B \sin C \cos A}}$

      C) $\dfrac{d \tan B \tan C \cos A}{\sqrt{\tan^2 B + \tan^2 C}}$ D) $d \tan(|B - C|) \cos A$

      E) NOTA