PSU Math Relays 2023   Trigonometry Team   Team Member #1

Select the letter of the most appropriate answer and shade in the corresponding region on the answer sheet. NO CALCULATORS

1) If $\cos(\theta) = \frac{\sqrt{3}}{2}$ and $0 \le \theta < 90$, what does $\cos(2\theta)$ equal?

a) $-\frac{\sqrt{3}}{3}$ b) $\frac{\sqrt{3}}{2}$ c) 2   d) $\frac{1}{2}$ e) none

2) If $\cos(\theta) = -\frac{3}{5}$ and $180 \le \theta < 270$, what does $\sin\left(\frac{\theta}{2}\right)$ equal?

a) $-\frac{\sqrt{5}}{5}$ b) $\frac{2\sqrt{5}}{5}$ c) $\sqrt{5}$ d) $\frac{1}{2}$ e) none

3) Evaluate $\cos(15°)$

a) $\frac{\sqrt{2-\sqrt{3}}}{2}$ b) $-\frac{\sqrt{2+\sqrt{3}}}{2}$ c) $-\frac{\sqrt{2-\sqrt{3}}}{2}$ d) $1+\sqrt{2}$ e) none

4) Evaluate $\tan\left[\cos^{-1}\left(\frac{\sqrt{57}}{19}\right)\right]$

a) $\frac{4\sqrt{19}}{19}$ b) $\frac{\sqrt{57}}{3}$ c) $\frac{4\sqrt{3}}{3}$ d) $\frac{\sqrt{19}}{4}$ e) none

5) Evaluate $\sin\left(\frac{\pi}{12}\right) + \sin\left(\frac{17\pi}{12}\right)$

a) $\frac{\sqrt{2}}{2}$ b) $-\frac{\sqrt{6}}{2}$ c) $-\frac{\sqrt{2}}{2}$ d) $\frac{\sqrt{6}}{2}$ e) none

6) Evaluate $\sin(225°)\cos(75°)$
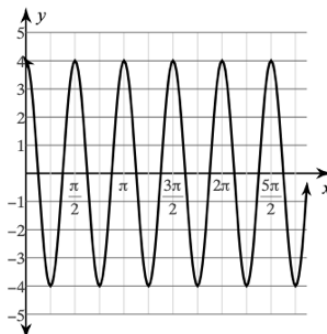
a) $\frac{1+\sqrt{3}}{4}$ b) $\frac{-\sqrt{3}-1}{4}$ c) $\frac{\sqrt{3}+1}{4}$ d) $-\frac{\sqrt{3}}{2}$ e) none

7) Simplify $\cos(-2\theta)\cos(\theta) - \sin(-2\theta)\sin(\theta)$

a) $\cos(-3\theta)$ b) $\sin(\theta)$ c) $\sin(-3\theta)$ d) $\cos(-\theta)$ e) none

8) Write an equation for the graph.

a) $y = 2\cos(2\theta)$
b) $y = 4\cos(4\theta)$
c) $y = 2\sin(2\theta)$
d) $y = 4\cos(4\theta)$
e) none

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9) If $\tan(\theta) = -\frac{\sqrt{3}}{3}$ and $270 \le \theta < 360$, what does $\tan(2\theta)$ equal?

a) $\frac{\sqrt{3}}{2}$ b) $-\frac{2\sqrt{3}}{3}$ c) $-\sqrt{3}$ d) 2   e) none

10) If $\sin(\theta) = \frac{15}{17}$ and $\frac{\pi}{2} \le \theta < \pi$, what does $\tan\left(\frac{\theta}{2}\right)$ equal?

a) $\frac{3\sqrt{34}}{34}$ b) $\frac{3}{5}$ c) $\frac{5}{3}$ d) $-\frac{3}{5}$ e) none

11) Evaluate $\sin(75°)$

a) $-\frac{\sqrt{2-\sqrt{2}}}{2}$ b) $\frac{\sqrt{2+\sqrt{3}}}{2}$ c) $\frac{\sqrt{2-\sqrt{2}}}{2}$ d) $2 + \sqrt{3}$ e) none

12) Evaluate $\sec\left[\cos^{-1}\left(\frac{2\sqrt{5}}{5}\right)\right]$

a) $\frac{\sqrt{5}}{2}$ b) $\frac{\pi}{2}$ c) $-\frac{\pi}{2}$ d) $\frac{\sqrt{5}}{5}$ e) none

13) Evaluate $\sin(165°) - \sin(105°)$

a) $-\frac{\sqrt{2}}{2}$ b) $\frac{\sqrt{2}}{2}$ c) $-\frac{\sqrt{6}}{2}$ d) $\frac{\sqrt{6}}{2}$ e) none

14) Evaluate $\sin\left(\frac{\pi}{12}\right)\cos\left(\frac{3\pi}{4}\right)$
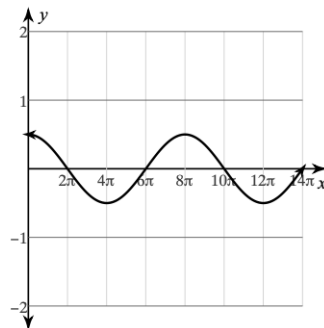
a) $\frac{1}{2}$ b) $\frac{-\sqrt{3}-1}{4}$ c) $\frac{1-\sqrt{3}}{4}$ d) $-\frac{1}{2}$ e) none

15) Simplify $\cos(6v)\cos(-3v) + \sin(6v)\sin(-3v)$

a) $\sin(3v)$ b) $\cos(9v)$ c) $\cos(3v)$ d) $\sin(9v)$ e) none

16) Write an equation for the graph.

a) $y = \frac{1}{2}\cos\left(\frac{\theta}{2}\right)$ c) $y = \frac{1}{2}\sin\left(\frac{\theta}{4}\right)$

b) $y = \frac{1}{2}\cos\left(\frac{\theta}{4}\right)$ d) $y = \frac{1}{2}\sin\left(\frac{\theta}{2}\right)$

e) none

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17) If $\cos(\theta) = \frac{3}{5}$ and $270 \le \theta < 360$, what does $\tan(2\theta)$ equal?

a) $-\frac{24}{25}$ b) $-\frac{7}{25}$ c) $\frac{24}{7}$ d) $-\frac{24}{7}$ e) none

18) If $\tan(\theta) = \frac{2\sqrt{26}}{11}$ and $0 \le \theta < \frac{\pi}{2}$, what does $\tan\left(\frac{\theta}{2}\right)$ equal?

a) $\frac{\sqrt{26}}{13}$ b) $\frac{\sqrt{195}}{15}$ c) $\frac{\sqrt{30}}{2}$ d) $\frac{\sqrt{26}}{2}$ e) none

19) Evaluate $\tan(285°)$

a) $-2 - \sqrt{3}$ b) $-\frac{\sqrt{2-\sqrt{2}}}{2}$ c) $\frac{\sqrt{2-\sqrt{3}}}{2}$ d) $2 + \sqrt{3}$ e) none

20) Evaluate $\cos^{-1}\left[\tan\left(\frac{\pi}{4}\right)\right]$

a) $\frac{\pi}{2}$ b) π c) 0 d) $-\frac{\pi}{4}$ e) none

21) Evaluate $2\sin(165°)\cos(135°)$

a) $\frac{\sqrt{3}+1}{2}$ b) $\sqrt{3}$ c) 1 d) $\frac{-\sqrt{3}+1}{2}$ e) none

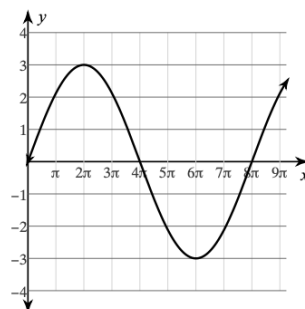22) Evaluate $\cos\left(\frac{13\pi}{12}\right) + \cos\left(\frac{5\pi}{12}\right)$

a) $-\frac{\sqrt{2}}{2}$ b) $\frac{\sqrt{6}}{2}$ c) $\frac{\sqrt{2}}{2}$ d) $-\frac{\sqrt{6}}{2}$ e) none

23) Simplify $\frac{\tan(-4u)-\tan(-3u)}{1+\tan(-4u)\tan(-3u)}$

a) $\tan(5u)$ b) $\tan(u)$ c) $\tan(-4u)$ d) $\tan(-3u)$ e) none

24) Write an equation for the graph.

a) $y = 3\sin(3\theta)$ d) $y = 3\cos(2\theta)$

b) $y = 3\sin\left(\frac{\theta}{2}\right)$ e) none

c) $y = 3\sin\left(\frac{\theta}{3}\right)$

Select the letter of the most appropriate answer and shade in the corresponding region on the answer sheet. NO CALCULATORS

25) If $\cos(\theta) = -\frac{2\sqrt{2}}{3}$ and $90 \le \theta < 180$, what does $\tan(2\theta)$ equal?

a) $\frac{9}{7}$ b) $-\frac{4\sqrt{2}}{7}$ c) $\frac{4\sqrt{2}}{9}$ d) $\frac{7}{9}$ e) none

26) If $\cos(\theta) = -\frac{5}{13}$ and $\pi \le \theta < \frac{3\pi}{2}$, what does $\cos(2\theta)$ equal?

a) $-\frac{169}{119}$ b) $-\frac{120}{119}$ c) $-\frac{119}{120}$ d) $-\frac{119}{169}$ e) none

27) Evaluate $\cos\left(\frac{7\pi}{12}\right)$

a) $-\frac{\sqrt{2-\sqrt{3}}}{2}$ b) $-\frac{\sqrt{2+\sqrt{3}}}{2}$ c) $\frac{\sqrt{2+\sqrt{3}}}{2}$ d) $\frac{\sqrt{2-\sqrt{3}}}{2}$ e) none

28) Evaluate $\tan\left[\cos^{-1}\left(\frac{\sqrt{10}}{10}\right)\right]$

a) $\sqrt{10}$ b) 3   c) $\frac{\sqrt{10}}{3}$ d) 0   e) none

29) Evaluate $2\cos\left(\frac{7\pi}{12}\right)\cos\left(\frac{\pi}{4}\right)$

a) $\frac{1-\sqrt{3}}{2}$ b) $\frac{-\sqrt{3}-1}{2}$ c) $\frac{\sqrt{3}-1}{2}$ d) $-\sqrt{3}$ e) none

30) Evaluate $\cos\left(\frac{17\pi}{12}\right) - \cos\left(\frac{\pi}{12}\right)$
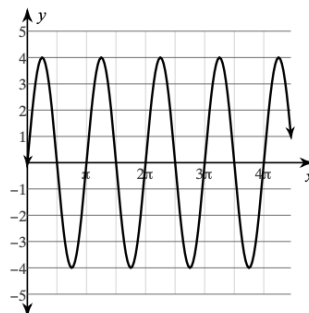
a) $-\frac{\sqrt{2}}{2}$ b) $\frac{\sqrt{2}}{2}$ c) $\frac{\sqrt{6}}{2}$ d) $-\frac{\sqrt{6}}{2}$ e) none

31) Simplify $\frac{\tan(2\theta)-\tan(-\theta)}{1+\tan(2\theta)\tan(-\theta)}$

a) $\tan(-9\theta)$ b) $\tan(3\theta)$ c) $\tan(\theta)$ d) $\tan(4\theta)$ e) none

32) Write an equation for the graph.

a) $y = 4\sin(\theta)$ d) $y = 4\sin(4\theta)$

b) $y = 4\sin\left(\frac{\theta}{2}\right)$ e) none

c) $y = 4\sin\left(\frac{\theta}{4}\right)$

Answer Sheet

Team Member #1	Team Member #2	Team Member #3	Team Member #4
1) D	9) C	17) C	25) B
2) B	10) C	18) A	26) D
3) E	11) B	19) A	27) A
4) C	12) A	20) C	28) B
5) C	13) A	21) D	29) A
6) E	14) C	22) A	30) D
7) D	15) B	23) E	31) B
8) B	16) B	24) E	32) E