Name: _____ **Class:** _____ **Date:** _____ **ID: A**

Trigonometric Functions Practice Test (Radian Measure, Transformations, Applications)

Multiple Choice

____ 1. Which of the following radian measures is the largest?

a. $\frac{12\pi}{9}$
c. $\frac{3\pi}{2}$
b. $\frac{7\pi}{4}$
d. π

____ 2. A ball in a pinball machine moves $\frac{1}{3}$ of the way through a circular groove that has radius 3 m. How far does the ball travel?

a. 3.14 m
c. 6.28 m
b. 360 m
d. 0.69 m

____ 3. In a circle of radius 3 m, an arc on the circumference subtends a central angle of 225°. What is the length of the arc?

a. 0.25478 m
c. 2.4 m
b. 2.25 m
d. 11.78 m

____ 4. If the central angle is $\frac{4\pi}{3}$ radians, what should be the radius of a circle to make the arc length 1 m?

a. 0.424 m
c. 2.356 m
b. 0.238 m
d. 4.188 m

____ 5. A man walks around a circle of radius 4 m 2.125 times. How far does he walk altogether?

a. 50.265 m
c. 53.407 m
b. 25.525 m
d. 47.123 m

____ 6. Convert $\frac{11\pi}{6}$ radians to degrees.

a. 98.18°
c. 300°
b. 330°
d. 98.6°

____ 7. Which of the following is not a primary trigonometric ratio of $\frac{2\pi}{3}$?

a. $\frac{2}{\sqrt{3}}$
c. $-\sqrt{3}$
b. $-\frac{1}{2}$
d. $\frac{\sqrt{3}}{2}$

____ 8. If $\sec\left(\frac{2\pi}{3}+x\right)=2$, what does *x* equal? ($0 \le x \le 2\pi$)

a. $\frac{2\pi}{3}$
c. $\frac{3\pi}{2}$
b. $\frac{4\pi}{3}$
d. $\frac{3\pi}{3}$

____ 9. At $t = 0$, a car is 2 km due North of you. If the car is heading West and moving 50 m/s, what is the angle in radians, as measured from your position, betweent the car's original position and its position at $t = 390$ s?

a. 2.306 radians
c. 2.936 radians
b. 0.9475 radians
d. 1.468 radians

____ 10. If a sign is sticking out of the ground at an angle of 86° and is 2 m long, how high is the end from the ground?

a. 28.60 m
c. 2.00 m
b. 1.14 m
d. 1.75 m

____ 11. Which of the following functions has the longest period?

a. $y = 6\sin(3x) + 20$
c. $y = 7\cos(\pi x) + 13$
b. $y = 8\cos(2x) - 4$
d. $y = 2\sin(0.5x) - 11$

____ 12. A pinwheel's axle stands 17 cm above ground. The edge of the pinwheel is at its lowest point, 11 cm from the ground, π seconds after it starts spinning. What function best describes the height with respect to time of the edge of the pinwheel?

a. $h(t) = 6\cos(t) + 17$
c. $h(t) = 11\cos(t) + 17$
b. $h(t) = 6\cos(\pi t) + 17$
d. $h(t) = 11\cos(\pi t) + 17$

____ 13. If $\omega = \frac{2\pi}{45}$, what is the period?

a. $\frac{45}{2}$
c. $\frac{45}{2\pi}$
b. 45
d. $\frac{2\pi}{45}$

____ 14. A loop on a roller coaster has its highest point at 42 m and its lowest point at 18 m. If the height of a cart on the loop of the roller coaster were modelled by a sine or cosine function, what would be the amplitude?

a. 14 m
c. 24 m
b. 12 m
d. 7 m

____ 15. A Ferris wheel starts spinning at $t = 0$ s and stops at $t = 12$ s. If the Ferris wheel made 5 revolutions during that time, what is its angular frequency?

a. $\frac{5\pi}{6}$
c. $\frac{2\pi}{5}$
b. $\frac{2\pi}{12}$
d. 2π

____ 16. The crank on a pencil sharpener reaches a maximum height of 3 cm above its centre axis, which is 1 m above the ground. If the sharpener's crank is spun 4 times in a second, which function best models the crank height at t seconds?

a. $h(t) = 0.03\sin(8\pi t) + 1.0$
c. $h(t) = 0.03\sin(4\pi t) + 1.0$
b. $h(t) = 0.03\sin\left(\frac{2\pi}{4}t\right) + 1.0$
d. $h(t) = 0.3\sin(8\pi t) + 1.0$

____ 17. Given the function $y = 14\sin\left(\frac{x}{4} + \frac{\pi}{2}\right) + 3$, for which interval is the average rate of change the largest?

a. $0 \le x \le 2\pi$
c. $\frac{\pi}{4} \le x \le \frac{\pi}{2}$
b. $\frac{\pi}{3} \le x \le \frac{\pi}{2}$
d. $\frac{\pi}{4} \le x \le \frac{\pi}{3}$

____ 18. A bicycle tire spins at a rate of 4 revolutions per second. If the diameter of the tire is 60 cm, what is the average rate of change of height, with respect to time, of a point on the tire over the first $\frac{1}{100}$s? Assume that the initial height of the point is 30 cm.

a. 746 cm/s
c. 7.46 cm/s
b. 1492 cm/s
d. 14.92 cm/s

____ 19. The height of a bumble bee above the ground is modelled by $h(t) = 0.5\cos(2\pi t) + 2$, where h is in metres and t is in seconds. At what time is the bee's instantaneous rate of change of height with respect to time greatest?

a. 1 s
c. 1.5 s
b. 1.25 s
d. 2 s

____ 20. A plane makes a loop in the air. Its height above the ground is modelled by the function $h(t) = 3\cos\left(\frac{\pi}{16}t\right) + 5$, where $h(t)$ is in km and t is in seconds. If the plane makes only one full loop, at what times is the instantaneous rate of h with respect to t equal to zero?

a. 8, 24
c. 0, 32
b. 16, 48
d. 0, 16, 32

Short Answers

21. The second hand on a clock is 3 cm long. What is its angular velocity? Express your answer in radians/minute and radians/s. Is any of the given information irrelevant?

22. If the diameter of a monster truck tire is 3.5 m and it makes one rotation every 5 seconds, how far does the tire roll in 1 minute?

23. A spot is located directly on top of a ball. If the ball has a radius of 3 cm, at what angle, as measured from the vertical, is the spot after the ball has rolled 20π cm away from its initial position?

24. What trigonometric functions give an output of $\frac{\sqrt{2}}{2}$ when the input is $\frac{\pi}{4}$?

25. One of the angles of a right triangle is $\frac{\pi}{10}$. If the hypotenuse has a length of 5 cm, what is the triangle's area?

26. A sinusoidal function has an amplitude of 4, a period of 2π and passes through the point (0,2). Determine the equations of two different sinusoidal functions that possess the above properties.

27. If a bicycle wheel makes 7 rotations per second and has a diameter of 75 cm, determine an equation of a cosine function that describes how the height of a point on the circumference of the wheel changes with time.

28. If the moon changes from a full moon to a half moon in 7 days, how many more days does it take for it to get back to a full moon? State the period and the angular frequency.

29. A broken clock has an hour hand that spins twice as fast as it should. If the hand is 4 cm long, the clock's axis of rotation is 144 cm above the floor and the hand points at the "12" at $t = 0$, use a sine function to model how the height of the tip of the clock's hour hand above the floor changes with time.

30. What is the average rate of change of the function $y = 4\sin(x) - 7$ in the interval $\pi \le x \le \frac{4\pi}{3}$?

Problems

31. How are the sine function and cosine function related to each other?

32. If $\cos\theta = \frac{3}{4}$, find all possible values of θ in radians.

33. A ball travels in a circle at 3π radians/s. If it starts on the positive *x*-axis, what is the angle between the ball and the positive *x*-axis after 3.5 seconds?

34. Describe the impact of multiplying the function sin *x* by *x*.

35. How do the periods of tangent and cosine differ?

36. Describe the properties of the function $y = 2\tan\left(\pi x - \frac{\pi}{2}\right) - 1$. State the range for the function, and state the values for which the function is undefined.

37. A student proposed that the function $h(t) = 6\sin\left(3\pi t - \frac{\pi}{3}\right) + 4$, where $h(t)$ is in metres and t is in seconds, models the height above the ground of a point on a spinning wheel. Is the student's equation plausible? Explain.

38. A pendulum is attached to to a ceiling that is 4 m high. The length of the pendulum is 3 m and the angle between its widest swing and vertical hanging position is $\frac{\pi}{3}$. If the pendulum swings out to its widest position in 2 seconds, model the horizontal displacement of the pendulum using a sinusoidal function. (Take the pendulum's vertical hanging position to be $x = 0$.)

39. For the function $y = 4\sin\left(\frac{\pi}{4}x - \frac{\pi}{2}\right) - 3$ list the values and/or intervals over which the average rate of change is positive, negative, and zero.

40. Explain what is meant by the instantaneous rate of change of distance with respect to time. In particular, what does it mean for the instantaneous rate of change to be 0.