*2009 Trigonometry Applications (Alpha)*

E is none of these

The belt on an automobile air conditioner connects metal wheels with radii r = 4 cm and R = 7 cm. The angular speed is 120 rpm. (Questions 1 – 2)

1. What is the angular speed of the larger wheel in radians per second?

   a) 12.6 rad./sec   b) 13.8 rad./sec   c) 15.2 rad./sec   d) 16.4 rad./sec

2. What is the linear speed of the belt in centimeters per second?

   a) 67.2 cm/sec   b) 74.3 cm/sec   c) 87.9 cm/sec   d) 91.1 cm/sec

3. Sara is waiting for a cable car in the 600 Block of James Street in San Francisco. Since the street was so steep she decided to determine what angle it makes with the horizontal. On the wall of a house, she measures the horizontal and vertical distances of 33cm. and 5 cm., respectively.
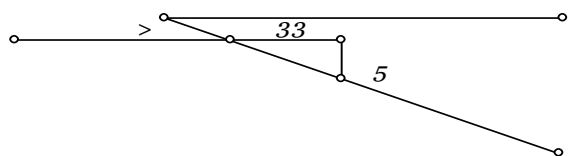
What is the measure of the angle that James Street makes with the horizontal?

   a)   7.8⁰   b)   8.6⁰   c) 8.9⁰   d) 9.5⁰

Questions #4 – #6: An observer 5.3 km from the launch pad observes a missile ascending.

4. At a particular time, the angle of elevation is 31⁰27'. How high is the missile?

   a)   2.9 *km*   b)   3.2 *km*   c)   3.6 *km*   d) 4.1 *km*

5. How far is it from the observer?

   a)   4.2 *km*   b)   4.6 *km*   c)   5.2 *km*   d)   5.5 *km*

6. What will the angle of elevation be when the missile reaches 50 *km*.?

   a) 83.9⁰   b) 75.6⁰   c) 73.9⁰   d) 69.4⁰

7. In ΔABC find the length of side c, if b = 36.2, a = 49.8 and $m< B$ = 33.7⁰

   a) 59.3   b) 63.1   c) 64.8   d) 68.0

8. Find the area of ΔABX, if a = 5, b = 12 and x = 13.

   a) 25   b)   30   c) 35   d) 40

9. Which of the following angle measures could be an angle in ΔCDE if c = 10, d = 7 and e = 4.

   a)   330⁰   b) 91.3⁰   c)   103.1⁰   d) 100.2⁰

Questions #10 − #11: A pilot has to fly around a group of thunder-showers by turning 21º northeast then turn and intercept his original path at an angle of 35º, 70 km. from where he left it.

10. How much further did the pilot have to go because of the detour?

    a) 8.7 *km*   b) 9.0 *km*   c) 10.5 *km*   d) 11.3 *km*

11. If the pilot turned 19º southeast instead and then turns to intercept his original path at an angle of 38º, 70 km from where he left it, what is the difference in distance of the two paths?

    a) 84.5 *km*   b) 87.2 *km*   c) 90.7 *km*   d) 101.2 *km*

Questions #12 − #14: Using the figure answer the following questions:
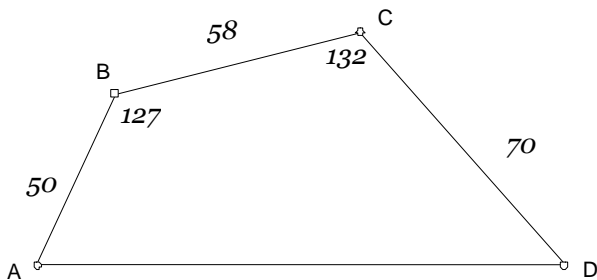
12. Find the area of the quadrilateral.

    a) 5750   b) 5349   c) 4380   d) 4189

13. Find the length of the 4th side.

    a) 128   b) 135   c) 142   d) 146

14. Find the smallest angle measure.

    a) 58   b) 50   c) 42   d) 20

15. *P* and *Q* are two inaccessible points. To find the distance between them, a point *A* is taken below PQ, and a point B is taken above PQ to form line *AB* 1200 feet long. ∠*PAB* = 26° 35', ∠ *ABP* = 48° 12' and ∠*ABQ* = 106° 42'. How long is *PQ*?

    a) 594   b) 621.5   c) 643.0   d) 651.9

16. From the top of a lighthouse 175 feet high the angles of depression of the top and bottom of a flagpole are 23.5º and 42.3º , respectively. How tall is the pole?

    a) 12.5   b) 15   c) 16   d) 20

17. Determine the angle between the vectors $\mathbf{u} = (2, -3)$ and $\mathbf{v} = (-3, -5)$.

    a) 23º   b) 25º   c) 82º   d) 86º

18. A batted baseball leaves the bat at an angle θ with the horizontal , with a velocity of $v_0 = 100$ ft/sec.
    It is caught by an outfielder 300 ft. from home plate. Find θ if the range r of a projectile is
    $r = \frac{1}{32} v_0{}^2 \sin 2\theta$

    a) 32°   b) 37°   c) 38°   d) 40°

19. Josh uses a 9° driver when hitting off the tee. He usually hits the ball on the average 300 ft when driving
    the ball. What is the velocity of the golf ball as it leaves the club head?

    a) 127 *ft/sec*   b) 176 *ft/sec*   c) 198 *ft/sec*   d) 209 *ft/sec*

20. Al and Joe leave a café at the same time and walk at the same rate.
    Al walks to his house (*A*) and then toward Joe's house (*B*).
    Joe walks to *B* and then toward *A*. To the nearest tenth of a
   kilometer, how far from *A* to they meet?
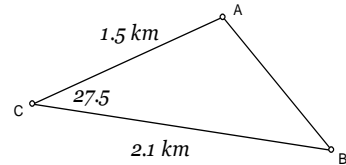
    a) .2 *km*   b) .5 *km*

    c) .7 *km*   d) .8 *km*

21. A jogger, running at a constant speed of one mile every 8 minutes, runs in the S40°E for 20 minutes
    and then in the direction N20°E for the next 16 minutes. How far is the jogger from the starting point?

    a) 2.1 *km*   b) 2.3 *km*   c) 2.5 *km*   d) 2.7 *km*

22. A golfer tees off and hooks her drive (hits ball to the left), 19° off line from straight down the fairway.
    If her drive is 215 yds. and the hole is 345 yds from the tee, how far is the ball from the green?

    a) 156 *yds*   b) 145 *yds*   c) 130 *yds*   d) 112 *yds*

23. A triangle *ABC* has sides of length 4, 10, 13. Find the measure of the largest angle.

    a) 35   b) 77   c) 101   d) 131

For Questions # 24 - #25: The top of a smaller tower makes an angle of elevation of 18.6° to the top of a
    taller tower located directly to the east. The base of the small tower also makes an angle of elevation
    of 21.4° to the top of the taller tower.

24. If the height of the smaller tower is 15 *ft*. find the height if the taller tower. (nearest tenth).

    a) 104.2   b) 135.4   c) 205.3   d) 291.0

25. Find the distance between the 2 towers.

    a) 742.5   b) 853.2   c) 904.3   d) 1,032

26. Suppose a particular species exhibits daily regular fluctuations in body temperature that can be
    approximated by the equation: $T(t) = 36.8 - 1.3\, \sin\left(\frac{\pi}{12}(t + 2)\right)$ where t represents temperature in $C°$
    t represents time (in hours), and $t = 0$ corresponds to 12 o'clock midnight (i.e. 12:00 am). What time
    of day does the body temperature reach a maximum. (**Circadian Rhythms)**

   a) Noon   b) 2:00 p.m.   c) 4:00 p.m.   d) 6:00 p.m.

3

27. In the given figure h is equal to:
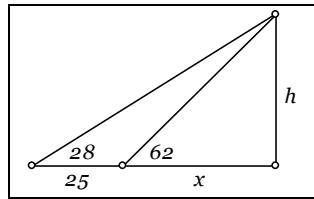
a) 44.5   b) 25.1   c) 19.5   d) 18.5

28. To determine how temperature affects the behavior of a newly discovered insect, in the laboratory, temperature is continuously varied, i.e. periodically forced, according to the trigonometric function,

$$T(t) = 72 - 19\cos\left(\frac{\pi}{12}(t-4)\right),$$

where T represents temperature in °F and t represents time in hours (where $t = 0$ corresponds to the initiation of the experiment). Assume all other environmental factors remain roughly constant during the experiment. Determine how long after the start of the experiment that the maximum temperature is reached.

a) 28 hours   b) 12 hours   c) 8 hours   d) 10 hours

29. In the problem above (#29), determine the highest environmental temperature reached in the experiment.

a) 72°   b) 91°   c) 81.5°   d) 87°

30. Which of the following is represented in the graph at the left?

a) $y = 2sin(2x) - cos(2x)$

b) $y = sin(x) - 2cos(2x)$

c) $y = -2sin(x) - cos(x)$

d) $y = -2sin(2x) - cos(x)$
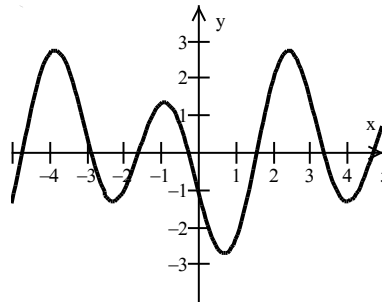
Tie-Breakers:

1. When the angle of elevation of the sun is 64°, a telegraph pole that is tilted at an angle of 12° directly away from the sun casts a shadow 34 feet long on the ground. Approximate the length of the pole. (nearest hundredth)

2. An airplane flies 165 miles from point A in the direction 130° and then travels in the direction 245° for 80 miles. How far is the airplane from point A? (nearest tenth of a mile)