Week 13 Questions and Answer Key

- Day 1, Trigonometric Functions, 1-4
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1. In a directional broadcast antenna, tower 2 is located 212 feet from tower 1, in a direction 38° north of east. How far to the north of tower 1 is tower 2 situated?

   North = 130.52 ft

2. A target-practice object is observed on a radar screen at an airline distance of 18,000 feet and at an elevation angle of 72°. If the object were shot down, at what horizontal distance from the observer would the wreckage fall, assuming a vertical fall?

   Horizontal distance = 5,562.31 ft

3. A radar screen shows an object 70 miles from the observer at an angle of 50° east of north. How far to the east of the observer is the object?

   East distance = 53.623 miles

4. A broadcast antenna is 100 ft tall and it is recommended that the guy wires to the top be anchored into the ground at an elevation angle to the horizon of 50°. Find (a) the length of each guy wire and (b) how far the anchor points are from the antenna base?

   Guy Wire = 130.541 ft
   Anchor distance = 83.91 ft

5. A microphone diaphragm intercepts $6.75 \times 10^{-}9$watts of acoustic power when turned broadside to a sound source. What will be the theoretical intercept power if the diaphragm is turned at an angle of 55° to the source?

   Intercept power = $3.872nW$

6. Light radiations having a plane wave strike a photosensitive surface at an angle of 30°. If the surface were turned to face the light directly, by what factor would the amount of received light energy increase?

   Factor of increase = 2

7. A "Curtain" receiving antenna is broadside to a distant transmitter. If it is now turned through an angle of 21°, by what factor will the radiated power impinging upon the curtain be reduced? (This calculation does not include the effect of the antenna directional pattern)

   factor of reduction = 0.9336

8. A radar screen shows an object 40° East of North. A second radar screen located 100 miles directly East of the first screen locates the same object at 55° West of North at a distance of 76.9 miles. How far to the east of the first screen is the object?

   East distance = 37.007 miles

9. How many radians correspond to each of the following angles?

   (a) $180° = \pi$ radians
   (b) $90° = \frac{\pi}{2}$ radians
   (c) $45° = \frac{\pi}{4}$ radians
   (d) $60° = \frac{\pi}{3}$ radians
   (e) $30° = \frac{\pi}{6}$ radians
   (f) $15° = \frac{\pi}{12}$ radians
   (g) $20° = \frac{\pi}{9}$ radians
   (h) $54° = \frac{3\pi}{10}$ radians

10. How many degrees correspond to each of the following angles expressed in radians?

    (a) $\frac{\pi}{4}$ radians $= 45°$
    (b) $\frac{3\pi}{2}$ radians $= 270°$
    (c) $\frac{\pi}{9}$ radians $= 20°$
    (d) $\frac{2\pi}{3}$ radians $= 120°$
    (e) $\frac{5\pi}{3}$ radians $= 300°$
    (f) $\frac{\pi}{10}$ radians $= 18°$
    (g) $\frac{4\pi}{3}$ radians $= 240°$
    (h) $\frac{3\pi}{4}$ radians $= 135°$

11. An Instrument pointer moves through an arc of 270°. To how many radians is this equivalent?

    $\frac{3\pi}{2}$ *radians*

12. The radiation pattern of an antenna has a minimum value in a direction 24° off the antenna axis, express this angle in radians.

    $\frac{2\pi}{15}$ *radians*

13. An armature turns at 1,800 revolutions per minute. To what value ω, in radians per second, does this correspond?

    $\omega = 2\pi$ *rad/ sec*

14. The coil of an instrument rotates at a rate of 0.005 radians per millisecond. Express this angular speed in degrees per second.

    $\omega = 286.479°/\ sec$

15. A motor accelerates at a rate of 600 revolutions per minute per second. To how many radians per second squared is this equal?

    $\alpha = 20\pi\ rad/\ sec^2$

16. An instrument pointer is 2.1 inches long. The tip of the pointer moves over a scale 2.4 inches long. What angle does this describe in radians?

    $\theta = 1.14286\ radians$

17. An alternator has a rotating field that is 32 inches in diameter. When the field is turned at 120 revolutions per minute, what is the linear speed of a point on its circumference?

    $v = 201.062\ inches/second$

18. If the field assembly in question 17 is accelerated at 12 revolutions/min/sec, what linear acceleration is applied to a point on its circumference?

    $a = 20.1062\ inches/s^2$

19. If the field assembly in question 17 turns in a counter-clockwise direction, (a) what is the upward component of the velocity at a point P on its circumference when P is at an angle of 45° above the horizon? (b) what is the horizontal component of the velocity at the same point?

    $(a)\ v_y = 142.172\ inches/sec$
    $(b)\ v_x = 142.172\ inches/sec$

20. An airplane propeller has a radius of 3 feet to the blade tip. It is desired to keep the tip velocity below the speed of sound (769.5 miles per hour). What number of revolutions per minute would correspond to this limit?

    $\omega = 3.59245 \times 10^3\ rev/\ min$