1. D
   The circle circumscribing A has a circumference of $2\pi r = 20\pi$. Thus this is the lowest of the given values that forms an upper bound for P.

2. C
   The apothem length of the hexagon is 6, so the distance from the center of the hexagon to the vertex is $4\sqrt{3}$, using the 30-60-90 triangle formed by the apothem, the line connecting the center of the hexagon to a vertex, and half of a side of the hexagon. Then the radius of the larger circle is $4\sqrt{3}$, so the circumference is $8\pi\sqrt{3}$.

3. A
   The radius of this circle is 4, so the circumference is 8π.

4. A
   The area of the sector of the circle (the entire pie slice) can be found with proportions:
   $$\frac{x}{total\ area} = \frac{60}{360} \rightarrow x = \frac{total\ area}{6} = 6\pi$$
   Then the area of the segment is given by subtracting out the area of the equilateral triangle: $6\pi - \frac{36\sqrt{3}}{4} = 6\pi - 9\sqrt{3}$

5. C
   The radius of the base is $\frac{16}{\pi}$, so its area is $\frac{256}{\pi}$. Then the total volume of the cylinder is $V = BH = \frac{256}{\pi} * 8 = \frac{2048}{\pi}$

6. B
   The difference in the speeds of the two people is 2 miles per hour. Thus, it will take 2 hours to make up the 4 mile difference. In this time, Person A has traveled a total of 20 miles, and is back at her starting place.

7. E
   Arc BC is 44°, since an arc is twice its subtended angle. Since Arc AC must be half of the circle, we have Arc AB = 180°-44° = 136°.

8. B
   If the ratio of the radii is 4:1, the ratio of the volumes is 64:1. Then the volume of Sphere A is 128.

9. D
   Since the circumference of the great circle is πd, increasing the diameter by 4 will increase the circumference by $4\pi d$.

10. A
    The ratio of a circle to the next largest circle is 1:16. So the total area of all the circles is the sum of the infinite series: $\frac{4}{1-\frac{1}{16}} = \frac{4}{\frac{15}{16}} = \frac{64}{15}$

11. D
This rotation forms a torus. Unfolding the torus would form a cylinder of base area π and height $2 * \pi * 2$, so the entire volume is $4\pi^2$

12. D
The circumference of the circle is $2\pi r$. The volume of the cone is $\frac{1}{3}\pi r^2(10)$. So the ratio is $\frac{6\pi r}{\pi r^2(10)} = \frac{3}{5r}$

13. B
The total perimeter is $\pi r + 2r + 2h = 7\pi + 14 + 36 = 7\pi + 50$

14. E
The volume of a frustum is given by $\frac{\pi h}{3} * (R^2 + rR + r^2)$. The base radius, height, and slant height form a 30-60-90 triangle, so the base radius is $\frac{10}{\sqrt{3}}$. Likewise, the smaller cone cut off to form the frustum is also a 30-60-90 triangle with height 2, so its base radius is $\frac{2}{\sqrt{3}}$. Then then entire volume of the frustum is $\frac{8\pi}{3}\left(\frac{100}{3} + \frac{10}{\sqrt{3}} * \frac{2}{\sqrt{3}} + \frac{4}{3}\right) = \frac{992\pi}{9}$.

15. E
The total area of the circle is 100π, so he has painted all but 10π. That means that the remaining area has a radius is $\sqrt{10}$ and thus a circumference of $2\pi\sqrt{10}$.

16. D
Let the side length of the larger square be x. The side length of the smaller square is $\frac{x\sqrt{2}}{2}$, and the radius of the circle is $\frac{x\sqrt{2}}{4}$. Then the ratio of the area of the shaded region to the entire shape is $\frac{\frac{x^2}{2} - \frac{\pi x^2}{8}}{x^2} = \frac{1}{2} - \frac{\pi}{8}$.

17. A
The hypotenuse of the triangle is 10; this is the diameter of the circle. So its circumference is 10π.

18. E
The base radius r of the cylinder is given by $V = BH = \pi r^2 H \rightarrow 400\pi = r^2 * 25 \rightarrow r = 4$. The cone has volume $\frac{\pi r^2 h}{3} = \frac{\pi(16)(18.75)}{3} = 100\pi$. Then the volume left in the cone is 300π, making the height $\frac{3}{4}$ of its original, or 18.75 inches.

19. B
The ratio of any linear dimension of the circles will be the square root of the area ratio, so 4:1.

20. E
The maximum area will be enclosed by a semi-circular fence, with the river forming the diameter of the semicircle. Its perimeter is 50, so its radius is $\frac{50}{\pi}$. Then its area is $\frac{1250}{\pi}$.

21. C
Euler's theorem tells us that F+V-E=2. Then 8+V-16=2, so V=10.

22. A
$$\frac{20\ radians}{sec} * \frac{2\pi * 10\ feet}{2\pi\ radians} = 200\frac{feet}{second}$$

23. C
It takes the ant four seconds to reach the outside of the disk. In this time, the disk has spun through $\frac{7\pi}{2}$ radians, 90 degrees from its starting position.

24. A
The minute hand is on the four, the hour hand is 1/3 of the distance between the three and the four. So the angle is $\frac{2}{3} * \frac{360}{12} = 20\ degrees$

25. B
$$area = \pi(R^2 - r^2) = \pi(100 - 64) = 36\pi$$

26. D
Ten cubes fit along the length, seven along the width, and six along the height. Multiplying these gives a total of 420 cubes.

27. B
The radius of the sphere is $\frac{9}{\pi}$. So its volume is $\frac{4}{3}\pi * \left(\frac{9}{\pi}\right)^3 = \frac{972}{\pi^2}$

28. A
The initial volume of sand in the cone is $\frac{1}{3}\pi(25)(30) = 250\pi$. Then it loses 196π cubic feet over the twenty seconds, leaving it with 54π cubic feet. The ratio of the height to the radius is the same as at the beginning: $\frac{h}{r} = \frac{30}{5} = 6$. So we have $54\pi = \frac{1}{3}\pi\left(\frac{h}{6}\right)^2 h \rightarrow h^3 = 5832 \rightarrow h = 18$

29. C
The circle is centered at the origin and has a radius of 2. So the closest point to the line x=-7 is the point (-2,0), which is 5 units away.

30. C
$$\frac{8\pi\ radians}{sec} * \frac{2\pi * 6\ inches}{2\pi\ radians} = 48\pi\frac{inches}{second}$$