Angle measure: radians, radius, and arc length

1. What is the measure of the angle $\theta$?

(a) $4\pi$ radians  
(b) $4\pi/5$ radians  
(c) $5\pi/4$ radians  
(d) $5\pi$ radians  
(e) 4/5 radians  
(f) $5/4$ radians  

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 4/5$ radians.

2. What is the measure of the angle $\theta$?

*(a) $5/3$ radians  
(b) $3/5$ radians  
(c) 4 radians  
(d) $5\pi/3$ radians  
(e) $3\pi/5$ radians  
(f) $5\pi$ radians  

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 5/3$ radians.

3. What is the measure of the angle $\theta$?

(a) $8/5$ radians  
(b) 5/8 radians  
(c) $\sqrt{39}$ radians  
(d) $8\pi/5$ radians  
(e) $5\pi/8$ radians  
(f) $\sqrt{39}\pi$ radians  

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 5/8$ radians.

4. What is the measure of the angle $\theta$?

(a) $5/14$ radians  
(b) $5\pi/14$ radians  
(c) $\sqrt{179}$ radians  
(d) 14/5 radians  
(e) $14\pi/5$ radians  
(f) $\sqrt{179}\pi$ radians  

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 14/5$ radians.

5. What is the length of the arc $s$ if $\theta = 0.8$ radians?

*(a) 4  
(b) $4\pi$  
(c) $4/\pi$  
(d) $25/4$  
(e) $25\pi/4$  
(f) $25/4\pi$  

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = (5)(0.8) = 4$. 
6. What is the length of the arc $s$ if $\theta = 2.5$ radians?

(a) $5\pi/8$  
(b) $4\pi$  
(c) $25\pi$

(d) $5/8$  
(e) $4$  
*(f) $25$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = (10)(2.5) = 25$.

7. What is the length of the arc $s$ if $\theta = 1.5$ radians?

(a) $40\pi/3$  
(b) $30\pi$  
(c) $20/\pi$

(d) $40/3$  
*(e) $30$  
(f) $\pi/20$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = (20)(1.5) = 30$.

8. What is the length of the arc $s$ if $\theta = 0.5$ radians?

(a) $2.5\pi$  
(b) $10$  
(c) $1$

*(d) $2.5$  
(e) $10\pi$  
(f) $\pi$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = (5)(0.5) = 2.5$.

9. What is the length of the radius $r$ if $\theta = 0.8$ radians?

(a) $1.6$  
(b) $4$  
*(c) $25/4$

(d) $1.6\pi$  
(e) $4\pi$  
(f) $25/4\pi$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 5/0.8 = 25/4$.

10. What is the length of the radius $r$ if $\theta = 1.8$ radians?

*(a) $5$  
(b) $16.2$  
(c) $0.2$

(d) $5\pi$  
(e) $16.2\pi$  
(f) $0.2\pi$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 9/1.8 = 5$.

11. What is the length of the radius $r$ if $\theta = 2.5$ radians?

*(a) $6$  
(b) $37.5\pi$  
(c) $10\pi$

(d) $6\pi$  
(e) $37.5$  
(f) $10$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 15/2.5 = 6$. 
12. What is the length of the radius $r$ if $\theta = 0.5$ radians?

(a) $3\pi$  
(b) 12  
(c) 30  
(d) 3  
(e) $12\pi$  
(f) $30\pi$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 6/0.5 = 12$.

13. What is the measure of the angle $\theta$?

(a) $4\pi a$ radians  
(b) $\pi a/4$ radians  
(c) $a/4$ radians  
(d) $4a$ radians  
(e) $4\pi/a$ radians  
(f) $4/a$ radians

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = a/4$ radians.

14. What is the measure of the angle $\theta$?

(a) $10\pi a$ radians  
(b) $\pi a/10$ radians  
(c) $a/10$ radians  
(d) $10a$ radians  
(e) $10\pi/a$ radians  
(f) $10/a$ radians

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 10/a$ radians.

15. What is the length of the arc $s$ if $\theta = 2$ radians?

(a) $2\pi/a$  
(b) $2\pi a$  
(c) $\sqrt{a^2 + 4}$  
(d) $2/a$  
(e) $2a$  
(f) $\pi\sqrt{a^2 + 4}$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = 2a$.

16. If $\theta$ is the measure of the central angle in radians, what is the length of the arc $s$?

(a) $5\pi/\theta$  
(b) $5/\theta$  
(c) $\sqrt{\theta^2 + 25}$  
(d) $5\pi\theta$  
(e) 50  
(f) $\pi\sqrt{\theta^2 + 25}$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = r\theta = 5\theta$.

17. What is the length of the radius $r$ if $\theta = 2.2$ radians?

(a) $2.2\pi s$  
(b) $2.2s$  
(c) $2.2/s$  
(d) $\pi s/2.2$  
(e) $s/2.2$  
(f) $2.2\pi/s$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = s/2.2$. 
18 What is the length of the radius $r$ if $\theta$ is the measure of the central angle in radians?

(a) $\theta/8$  
(b) $8\theta$  
(c) $8\pi/\theta$  
(d) $\theta\pi/8$  
(e) $8/\theta$  
(f) $\theta/8\pi$

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 8/\theta$. 

![Diagram of a circle with radius $r$ and central angle $\theta$. The arc length is $8$.]
Angle measure: radians and degrees

19. An angle measures 20°. What is its measure in radians?
   (a) \( \frac{1}{9} \)  (b) \( \frac{\pi}{18} \) * (c) \( \frac{\pi}{9} \)
   (d) \( \frac{1}{18} \)  (e) \( \frac{18}{\pi} \)  (f) \( \frac{9}{\pi} \)
Remember that \( \pi \text{ rad} = 180° \). To convert degrees to radians, multiply by
\( \frac{\pi \text{ rad}}{180°} \). In this case, \( \frac{20 \cdot \pi}{180} = \frac{\pi}{9} \) radians.

20. An angle measures 15°. What is its measure in radians?
   (a) \( \frac{1}{12} \)  * (b) \( \frac{\pi}{12} \)  (c) \( \frac{\pi}{24} \)
   (d) \( \frac{1}{24} \)  (e) \( \frac{12}{\pi} \)  (f) \( \frac{24}{\pi} \)
Remember that \( \pi \text{ rad} = 180° \). To convert degrees to radians, multiply by
\( \frac{\pi \text{ rad}}{180°} \). In this case, \( \frac{15 \cdot \pi}{180} = \frac{\pi}{12} \) radians.

21. An angle measures 36°. What is its measure in radians?
   * (a) \( \frac{\pi}{5} \)  (b) \( \frac{\pi}{10} \)  (c) \( \frac{1}{5} \)
   (d) \( \frac{1}{10} \)  (e) \( \frac{1}{10\pi} \)  (f) \( \frac{10}{\pi} \)
Remember that \( \pi \text{ rad} = 180° \). To convert degrees to radians, multiply by
\( \frac{\pi \text{ rad}}{180°} \). In this case, \( \frac{36 \cdot \pi}{180} = \frac{\pi}{5} \) radians.

22. An angle measures 54°. What is its measure in radians?
   (a) \( \frac{3\pi}{20} \)  * (b) \( \frac{20\pi}{3} \)  (c) \( \frac{20}{3\pi} \)
   (d) \( \frac{3\pi}{10} \)  (e) \( \frac{10\pi}{3} \)  (f) \( \frac{10}{3\pi} \)
Remember that \( \pi \text{ rad} = 180° \). To convert degrees to radians, multiply by
\( \frac{\pi \text{ rad}}{180°} \). In this case, \( \frac{54 \cdot \pi}{180} = \frac{3\pi}{10} \) radians.

23. An angle measures \( \alpha \) degrees. What is its measure in radians?
   (a) \( \frac{360}{\pi\alpha} \)  (b) \( \frac{\pi\alpha}{360} \)  (c) \( \frac{360\pi}{\alpha} \)
   (d) \( \frac{180}{\pi\alpha} \)  * (e) \( \frac{\pi\alpha}{180} \)  (f) \( \frac{180\pi}{\alpha} \)
Remember that \( \pi \text{ rad} = 180° \). To convert degrees to radians, multiply by
\( \frac{\pi \text{ rad}}{180°} \). In this case, we get \( \frac{\pi\alpha}{180} \) radians.

24. An angle measures 2 radians. What is its measure in degrees?
   * (a) \( \frac{360}{\pi} \)  (b) \( \frac{\pi}{180} \)  (c) \( 360 \)
   (d) \( \frac{720}{\pi} \)  (e) \( \frac{\pi}{360} \)  (f) \( 720 \)
Remember that \( \pi \text{ rad} = 180° \). To convert radians to degrees, multiply by
\( \frac{180°}{\pi \text{ rad}} \). In this case, we get \( \frac{2 \cdot 180}{\pi} = \frac{360}{\pi} \) degrees.
25. An angle measures $1/4$ radians. What is its measure in degrees?

- (a) $45/\pi$
- (b) $90/\pi$
- (c) $4/\pi$
- (d) 45
- (e) 90
- (f) $\pi/4$

Remember that $\pi$ rad = 180°. To convert radians to degrees, multiply by $180^\circ/\pi$ rad.

In this case, we get $\frac{180}{4\pi} = \frac{45}{\pi}$ degrees.

26. An angle measures $\pi/5$ radians. What is its measure in degrees?

- (a) $\pi^2/900$
- (b) 72
- (c) $72/\pi$
- (d) 36
- (e) $\pi^2/36$
- (f) $45/4$

Remember that $\pi$ rad = 180°. To convert radians to degrees, multiply by $180^\circ/\pi$ rad.

In this case, we get $\frac{\pi}{5} \cdot \frac{180}{\pi} = 36$ degrees.

27. An angle measures $3/2$ radians. What is its measure in degrees?

- (a) 270
- (b) 120
- (c) 24
- (d) $270/\pi$
- (e) $120/\pi$
- (f) $24/\pi$

Remember that $\pi$ rad = 180°. To convert radians to degrees, multiply by $180^\circ/\pi$ rad.

In this case, we get $\frac{3}{2} \cdot \frac{180}{\pi} = \frac{270}{\pi}$ degrees.

28. An angle measures $\alpha$ radians. What is its measure in degrees?

- (a) $180/\pi\alpha$
- (b) $180\alpha/\pi$
- (c) $\pi\alpha/180$
- (d) $360/\pi\alpha$
- (e) $360\alpha/\pi$
- (f) $\pi\alpha/360$

Remember that $\pi$ rad = 180°. To convert radians to degrees, multiply by $180^\circ/\pi$ rad.

In this case, we get $\frac{180\alpha}{\pi}$ degrees.

29. An angle measures $3\pi$ degrees. What is its measure in radians?

- (a) $\pi^2/60$
- (b) 60
- (c) 270
- (d) 120
- (e) $120/\pi$
- (f) $120\pi$

Remember that $\pi$ rad = 180°. To convert degrees to radians, multiply by $\pi$ rad / 180°.

In this case, $\frac{3\pi \cdot \pi}{180} = \frac{\pi^2}{60}$ radians.

30. An angle measures $2/\pi$ radians. What is its measure in degrees?

- (a) $360/\pi^2$
- (b) 90
- (c) 360
- (d) $1/90$
- (e) $\pi/180$
- (f) $\pi/90$

Remember that $\pi$ rad = 180°. To convert radians to degrees, multiply by $180^\circ/\pi$ rad.

In this case, we get $\frac{2}{\pi} \cdot \frac{180}{\pi} = \frac{360}{\pi^2}$ degrees.
Angle types

31. The angle θ is
(a) right (b) prolate *(c) acute
(d) alkaloid (e) straight (f) obtuse

32. The angle θ is
(a) right (b) prolate (c) acute
(d) alkaloid (e) straight *(f) obtuse

33. The angle θ is
(a) right (b) prolate *(c) acute
(d) alkaloid (e) straight (f) obtuse

34. The angle θ is
*(a) right (b) prolate (c) acute
(d) alkaloid (e) straight (f) obtuse

35. The angle θ is
(a) right (b) prolate (c) acute
(d) alkaloid (e) straight *(f) obtuse

36. The angle θ is
(a) right (b) prolate (c) acute
(d) alkaloid *(e) straight (f) obtuse

37. The angle θ is
(a) right (b) prolate *(c) acute
(d) alkaloid (e) straight (f) obtuse

38. The angle θ is
(a) right (b) prolate *(c) acute
(d) alkaloid (e) straight (f) obtuse

39. An angle of 37º is
(a) right (b) prolate *(c) acute
(d) alkaloid (e) straight (f) obtuse
40. An angle of 158° is
   (a) right  (b) prolate  (c) acute
   (d) alkaloid  (e) straight  *(f) obtuse

41. An angle of 76° is
   (a) right  *(b) prolate  (c) acute
   (d) alkaloid  (e) straight  (f) obtuse

42. An angle of 1.8 radians is
   (a) right  (b) prolate  *(c) acute
   (d) alkaloid  (e) straight  *(f) obtuse

43. An angle of 0.6 radians is
   (a) right  *(b) prolate  *(c) acute
   (d) alkaloid  (e) straight  (f) obtuse

44. An angle of $\frac{6\pi}{13}$ radians is
   (a) right  *(b) prolate  *(c) acute
   (d) alkaloid  (e) straight  (f) obtuse

45. An angle of $\frac{3\pi}{5}$ radians is
   (a) right  (b) prolate  (c) acute
   (d) alkaloid  (e) straight  *(f) obtuse
Complements and supplements

46. What is the complement of 42°?
   (a) 318° (b) 48° (c) 132°
   (d) 222° (e) 28° (f) 138°
   The complement of an acute angle of θ degrees is 90−θ degrees. In this case: 90−42=48°.

47. What is the complement of 11°?
   (a) 349° (b) 89° (c) 79°
   (d) 101° (e) 169° (f) 34°
   The complement of an acute angle of θ degrees is 90−θ degrees. In this case: 90−11=79°.

48. What is the complement of 73°?
   (a) 253° (b) 107° (c) 17°
   (d) 18° (e) 287° (f) 163°
   The complement of an acute angle of θ degrees is 90−θ degrees. In this case: 90−73=17°.

49. What is the supplement of 31°?
   (a) 76° (b) 121° (c) 59°
   (d) 14° (e) 211° (f) 149°
   The supplement of an angle of θ degrees is 180−θ degrees. In this case: 180−31 = 149°.

50. What is the supplement of 58°?
   (a) 238° (b) 148° (c) 22°
   (d) 103° (e) 122° (f) 13°
   The supplement of an angle of θ degrees is 180−θ degrees. In this case: 180−58 = 122°.

51. What is the supplement of 36°?
   (a) 144° (b) 54° (c) 9°
   (d) 91° (e) 216° (f) 126°
   The supplement of an angle of θ degrees is 180−θ degrees. In this case: 180−36 = 144°.

52. What is the complement of π/6 radians?
   (a) 5π/6 (b) 2π/3 (c) 7π/6
   (d) 11π/6 (e) 5π/12 (f) π/3
   The complement of an acute angle of θ radians is \( \frac{\pi}{2} - \theta \) radians. In this case:
   \[ \frac{\pi}{2} - \frac{\pi}{6} = \frac{\pi}{3} \] radians
53. What is the complement of $2\pi/7$ radians?
   (a) $11\pi/14$  (b) $\pi/28$  (c) $5\pi/7$
   (d) $9\pi/7$  (e) $15\pi/28$  *(f) $3\pi/14$

   The complement of an acute angle of $\theta$ radians is $\frac{\pi}{2} - \theta$ radians. In this case:
   \[
   \frac{\pi}{2} - \frac{2\pi}{7} = \frac{3\pi}{14} \text{ radians}
   \]

54. What is the complement of $3\pi/10$ radians?
   (a) $4\pi/5$  (b) $17\pi/10$  (c) $13\pi/10$
   (d) $7\pi/10$  *(e) $2\pi/10$  (f) $\pi/20$

   The complement of an acute angle of $\theta$ radians is $\frac{\pi}{2} - \theta$ radians. In this case:
   \[
   \frac{\pi}{2} - \frac{3\pi}{10} = \frac{2\pi}{10} \text{ radians}
   \]

55. What is the supplement of $\pi/5$ radians?
   *(a) $4\pi/5$  (b) $\pi/20$  (c) $3\pi/10$
   (d) $7\pi/10$  (e) $6\pi/5$  (f) $2\pi/5$

   The supplement of an angle of $\theta$ radians is $\pi - \theta$ radians. In this case:
   \[
   \pi - \frac{\pi}{5} = \frac{4\pi}{5} \text{ radians}
   \]

56. What is the supplement of $3\pi/20$ radians?
   (a) $17\pi/20$  (b) $\pi/10$  (c) $13\pi/10$
   (d) $7\pi/20$  (e) $13\pi/20$  (f) $3\pi/10$

   The supplement of an angle of $\theta$ radians is $\pi - \theta$ radians. In this case:
   \[
   \pi - \frac{3\pi}{20} = \frac{17\pi}{20} \text{ radians}
   \]

57. What is the supplement of $\pi/8$ radians?
   (a) $3\pi/8$  (b) $5\pi/8$  *(c) $7\pi/8$
   (d) $9\pi/8$  (e) $\pi/8$  (f) $\pi/4$

   The supplement of an angle of $\theta$ radians is $\pi - \theta$ radians. In this case:
   \[
   \pi - \frac{\pi}{8} = \frac{7\pi}{8} \text{ radians}
   \]

58. What is the complement of $\alpha$ degrees?
   (a) $90+\alpha$  (b) $45+\alpha$  (c) $180+\alpha$
   *(d) $90-\alpha$  (e) $45-\alpha$  (f) $180-\alpha$

   The complement of an acute angle of $\theta$ degrees is $90-\theta$ radians. In this case:
   $90-\alpha$ radians
59. What is the supplement of \( \alpha \) degrees?
(a) \( 90+\alpha \)  
(b) \( 45+\alpha \)  
(c) \( 180+\alpha \)  
(d) \( 90-\alpha \)  
(e) \( 45-\alpha \)  
(f) \( 180-\alpha \)  
The supplement of an angle of \( \theta \) degrees is \( 180-\theta \) degrees. In this case: \( 180-\alpha \) degrees.

60. What is the complement of \( \alpha \) radians?
(a) \( \pi+\alpha \)  
(b) \( 2\pi+\alpha \)  
(c) \( \frac{\pi}{2}+\alpha \)  
(d) \( \pi-\alpha \)  
(e) \( 2\pi-\alpha \)  
(f) \( \frac{\pi}{2}-\alpha \)  
The complement of an acute angle of \( \theta \) radians is \( \frac{\pi}{2}-\theta \) radians. In this case:
\[ \frac{\pi}{2}-\alpha \] radians

61. What is the supplement of \( \alpha \) radians?
(a) \( \pi+\alpha \)  
(b) \( 2\pi+\alpha \)  
(c) \( \frac{\pi}{2}+\alpha \)  
(d) \( \pi-\alpha \)  
(e) \( 2\pi-\alpha \)  
(f) \( \frac{\pi}{2}-\alpha \)  
The supplement of an angle of \( \theta \) radians is \( \pi-\theta \) radians. In this case:
\[ \pi-\alpha \] radians
Degrees, minutes, and seconds

62. Evaluate the sum: $32^\circ11'41" + 10^\circ12'13"$
   (a) $42^\circ24'04"$    *(b) $42^\circ23'54"$  (c) $42^\circ33'04"
   (d) $42^\circ24'14"$    (e) $42^\circ23'54"$  (f) $43^\circ03'04"

60" = 1' and 60' = 1°. Add accordingly. $41" + 13" = 54"$; so you don't have to carry there. Likewise $11' + 12' = 23'$, so you don't have to carry.

63. Evaluate the sum: $18^\circ24'53" + 11^\circ40'17"$
   (a) $29^\circ64'70"$    (b) $29^\circ65'10"$  (c) $29^\circ04'10"
   (d) $30^\circ15'20"$    (e) $29^\circ16'36"$  *(f) $30^\circ05'10"

60" = 1' and 60' = 1°. Add accordingly. $53" + 17" = 1'10"$, so you have to carry the 1'. $24' + 40' + 1' = 105'$; so you don't have to carry.

64. Evaluate the difference: $46^\circ09'23" - 20^\circ18'44"$
   *(a) $25^\circ50'39"$  (b) $25^\circ90'79"$  (c) $25^\circ40'29"
   (d) $26^\circ09'21"$    (e) $25^\circ30'19"$  (f) $26^\circ27'07"

60" = 1' and 60' = 1°. Subtract accordingly. $23 < 44$; so you have to borrow 1' = 60" from the 09'. Thus you're subtracting: $(60" + 23") - 44" = 39"$. Since you've borrowed 1' from the 09', you're subtracting: $08' - 18'$. That means you have to borrow 1° = 60' from the 46° and subtract: $68' - 18' = 50'$. Now, since you've borrowed 1° from the 46°, you're left with: $45° - 20° = 25°$.

65. Evaluate the difference: $98^\circ19'36" - 20^\circ27'15"
   (a) $78^\circ08'21"$    (b) $78^\circ52'21"$  (c) $78^\circ46'21"
   (d) $77^\circ42'21"$    *(e) $77^\circ52'21"$  (f) $77^\circ46'21"

60" = 1' and 60' = 1°. Subtract accordingly.

66. What formula would you use to convert $30^\circ25'18"$ to decimal degrees?
   (a) $30 + \frac{25}{100} + \frac{18}{1000}$  (b) $30 + \frac{25}{10} + \frac{18}{100}$  (c) $30 + \frac{25}{100} + \frac{18}{1000}$
   (d) $30 + \frac{25}{60} + \frac{18}{600}$  *(e) $30 + \frac{25}{60} + \frac{18}{3600}$  (f) $30 + \frac{25}{60} + \frac{18}{6000}$

60" = 1' and 60' = 1°; so $3600" = 1°$. 

60" = 1' and 60' = 1°. Add accordingly. 41" + 13" = 54"; so you don’t have to carry there. Likewise 11′ + 12′ = 23′, so you don’t have to carry.
Word problems

67. The radius of a circle is 20 cm. A central angle intercepts an arc of length 9 cm. What is the measure of the central angle in radians?
   (a) $20/9$  (b) $\sqrt{319}$  (c) $20\pi/9$
   * (d) 0.45  (e) $\sqrt{481}$  (f) $1.8\pi$
   The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 9/20 = 0.45$ radians.

68. The radius of a circle is 12 m. A central angle measures 0.4 radians. What is the length of the arc intercepted by the angle?
   (a) $1/30$ m  (b) 0.48 m  *(c) 4.8 m
   (d) 3 m  (e) 3.6 m  (f) 30 m
   The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $s = (12)(0.4) = 4.8$ m.

69. A central angle in a circle measures 1.6 radians. The arc intercepted by the angle is 6 cubits. What is the radius of the circle?
   (a) 9.6 cubits  (b) $\sqrt{33.44}$ cubits  (c) $4/15$ cubits
   *(d) $\sqrt{38.56}$ cubits  (e) 3.75 cubits  (f) 4.4 cubits
   The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $r = s/\theta = 6/1.6 = 15/4 = 3.75$ cubits.

70. A wheel has a radius of 40 cm. The distance along the rim between two neighboring spokes is 25 cm. What is the angle formed by the two spokes?
   (a) 0.375 radians  *(b) 0.625 radians  (c) $5\sqrt{39}$ radians
   (d) $8/3$ radians  (e) 1.6 radians  *(f) $5\sqrt{89}$ radians
   The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, $\theta = s/r = 25/40 = 5/8 = 0.625$ radians.

71. A disc has a radius of 6 cm. It is spinning at an angular speed of 300 radians/sec. How fast is a point on the edge of the disc moving?
   * (a) 1800 cm/sec  (b) 50 cm/sec  (c) 0.02 cm/sec
   (d) 3600 cm/sec  (e) 500 cm/sec  (e) 0.5 cm/sec
   The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, 300 radians corresponds to an arc length of $(300)(6) = 1800$ cm. Hence the edge of the disc is moving at 1800 cm/sec.
72. The reflector on a bicycle wheel is 8 inches from the center of the wheel. The wheel is rotating at an angular speed of 6 radians/sec. How fast is the reflector moving?

* (a) 48 in/sec  
(b) 0.75 in/sec  
(c) 4/3 in/sec  
(d) 10 in/sec  
(e) $2\sqrt{7}$ in/sec  
(f) $4\pi/3$ in/sec

The relationship between the central angle $\theta$, the radius $r$, and the arc length $s$ is: $s = r\theta$. In this case, 6 radians corresponds to an arc length of $(6)(8) = 48$ in. The reflector is moving at 48 in/sec.

73. A pizza has a diameter of 16 inches. A slice cut from it has an angle of 0.6 radians. What is the length of the outer crust on the slice?

(a) 8/3 in  
(b) 9.6 in  
(c) 4/3 in  
(d) 3.75 in  * (e) 4.8 in  
(f) 7.5 in

Be careful! Notice the word “diameter” here. It’s very common to describe circular objects giving their diameter instead of their radius, and without specifying that: a 14-inch pizza, a 28-inch bicycle wheel, or a half-inch washer, for example. Be on the lookout for diameters, and be sure to convert them to radius before plugging them into the radius-angle-arc length formula. In this case; $(0.6)(8) = 4.8$ in

74. A rotating wheel is 30 inches in diameter. A point on the rim is moving at 24 in/sec. What is the angular speed of the wheel?

(a) 0.625 rad/sec  
(b) 0.8 rad/sec  
(c) 1.25 rad/sec  
(d) 1.6 rad/sec  
(e) 18 rad/sec  * (f) $6\sqrt{41}$ rad/sec

Again, watch out for that “diameter”. 24 inches corresponds to $24/15 = 8/5 = 1.6$ radians; so the wheel is turning at 1.6 rad/sec.

75. A gate is 10 ft wide and hinged on one side. If it swings through 1.5 radians, how far does the outer edge travel?

(a) 20/3 ft  
(b) 3 ft  
(c) 10/3 ft  
(d) 15 ft  
(e) 8.5 ft  * (f) 7.5 ft

$s = r\theta = (10)(1.5) = 15$ ft.

76. A clock has a pendulum 2 m long. The tip of the pendulum traverses a distance of 30 cm in one swing. What is the angle through which the pendulum swings?

(a) 15 rad  
(b) 0.6 rad  
(c) 0.15 rad  
(d) 1/15 rad  
(e) 20/3 rad  
(f) 60 rad

Use $\theta = s/r$. You need both $s$ and $r$ to be in the same units (in the problem, $s$ is in cm and $r$ is in m). Converting 30cm = 0.3m, we get: $\theta = 0.3/2 = 0.15$ radians

77. A wheel has a radius of 40 cm. It is spinning at a rate of 200 revolutions per minute. What is its angular speed?

(a) 200 rad/min  
(b) 500 rad/min  
(c) 400 rad/min  
(d) 200π rad/min  
(e) 500π rad/min  * (f) 400π rad/min

One complete revolution corresponds to $2\pi$ radians; so 200 revolutions corresponds to $(200)(2\pi) = 400\pi$ radians. The wheel is spinning at $400\pi$ rad/min. The 40cm radius of the wheel is irrelevant to this problem.
78. A wheel has a diameter of 30 inches. There are 40 evenly spaced spokes on the wheel. What is the angle formed by two adjacent spokes?
*(a) \(\pi/20\) rad (b) \(3\pi/4\) rad (c) \(0.15\pi\) rad (d) \(1/40\) rad (e) \(4/3\) rad (f) \(2/3\) rad

The 40 spokes divide the \(2\pi\) radians of the wheel’s circumference into 40 equal angles, each one equal to \(2\pi/40 = \pi/20\) radians. The 30in diameter of the wheel has nothing to do with the problem.

79. The moon Titan is 1,200,000 km from the center of Saturn, and orbits the planet at a rate of 0.4 rad/day. How fast is Titan moving? (Ignore the fact that Saturn is moving around the sun, which is rotating around the center of the galaxy, which is moving relative to neighboring galaxies...)
(a) 4,800,000 km/day *(b) 480,000 km/day (c) 48,000\pi\) km/day (d) 300,000 km/day (e) 3,000,000 km/day (f) 300,000/\pi\) km/day

0.4 radians corresponds to \((0.4)(1,200,000) = 480,000\) km. Hence Titan is moving at 480,000 km/day.

80. You are designing a catapult, from which you need to launch a rock at 30 m/sec. The arm can only reach an angular velocity of 12 rad/sec. How long does the arm have to be to launch the rock at the necessary speed?
(a) 4\pi\) m (b) 36 m (c) 4 m
(d) \(4/\pi\) m (e) 9 m *(f) 2.5 m

We need to find \(r\) for which 12 rad corresponds to 30 m. Use \(r = s/\theta\) to get
\(r = 30/12 = 5/2 = 2.5\) m.