1. For the function $f(x) = (x-5)(x-2)(x+4)$ find the average rate of change from $x = -2$ to $x = 3$.
   a) -70
   b) -14
   c) -8.4
   d) 8.4
   e) 14

2. If $\log_b 3 \approx 1.107$, $\log_b 4 \approx 1.396$, and $\log_b 5 \approx 1.620$, then $\log_b \frac{75}{8} \approx$
   a) 2.081
   b) 2.253
   c) 2.867
   d) 2.951
   e) 3.481

3. For $-1 < a < 1$, $\sec(\sin^{-1} a)$ is equivalent to
   a) a
   b) $\frac{1}{a}$
   c) $\frac{\sqrt{1+a^2}}{1+a^2}$
   d) $\frac{\sqrt{1-a^2}}{1-a^2}$
   e) $\sqrt{1-a^2}$

4. The sum of the first n terms of an arithmetic series is $3n^2 - n$. Find an expression for the k^{th} term.
   a) $3k+1$
   b) $3k-4$
   c) $6k+1$
   d) $6k-4$
   e) $9k+1$

5. Let $\frac{2x-15}{(x+3)(x-4)} = \frac{A}{x+3} + \frac{B}{x-4}$. What is $A - B$?

a) -1
b) 0
c) 2
d) 3
e) 4

6. A seventh-degree polynomial is known to have roots i and $3-2i$. What is the maximum number of distinct real zeros that the polynomial could have?

a) 3
b) 4
c) 5
d) 6
e) 7

7. In how many ways can 5 kindergarteners sit in a circle?

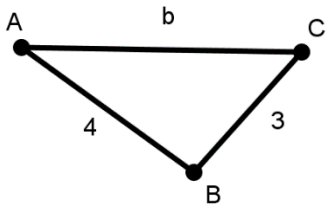
a) 12
b) 24
c) 48
d) 60
e) 120

8. If $\tan(\alpha) = \frac{1}{2}$ and $\tan(\beta) = 3$, what is $\tan(\alpha - \beta)$?

a) -7
b) -1
c) 1
d) 5
e) 7

9. In the given triangle, $\angle C = 60°$. Find the length b.

a) 4.54
b) 5
c) 5.46
d) 5.67
e) 6



10. Given the vectors $\mathbf{u} = \langle 2, 3 \rangle$ and $\mathbf{v} = \langle -4, a \rangle$ what is the magnitude of $\mathbf{u} - \mathbf{v}$?

a) $\sqrt{-a^2 + 6a + 27}$

b) $\sqrt{-a^2 + 6a + 45}$

c) $\sqrt{-a^2 - 6a + 27}$

d) $\sqrt{a^2 - 6a + 45}$

e) $\sqrt{a^2 - 6a + 27}$

11. If the determinant of $\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & k \end{bmatrix}$ is 10, what is the determinant of $\begin{bmatrix} 2a & 6b & 2c \\ g & 3h & k \\ d-g & 3e-3h & f-k \end{bmatrix}$

a) −60

b) −30

c) −20

d) 20

e) 60

12. Find the domain of the function $f(x) = \dfrac{(x-2)\sqrt{9-x^2}}{x^2 - 5x + 6}$

a) $(-\infty, 2) \cup (2, 3) \cup (3, \infty)$

b) $(-\infty, 3) \cup (3, \infty)$

c) $[-3, 3)$

d) $[-3, 2) \cup (2, 3)$

e) $(-\infty, -3) \cup (3, \infty)$

13. What is the period of the trigonometric function $3\cot\left(ax - \dfrac{\pi}{2}\right)$

a) $\dfrac{1}{a}$

b) $\dfrac{2\pi}{a}$

c) $a\pi$

d) $\dfrac{\pi}{a}$

e) $\dfrac{2\pi}{a} + \dfrac{\pi}{2}$

14. Simplify $\sin^2\theta\cos\theta\csc^3\theta\tan\theta$
    a) $\sin^2\theta$
    b) $\tan^2\theta$
    c) $\csc^2\theta$
    d) $\sec^2\theta$
    e) 1

15. If $(x+y+2z)^7$ is expanded, the coefficient of the $x^2y^3z^2$ term will be
    a) 210
    b) 840
    c) 2940
    d) 5040
    e) 20160

16. Convert $2\sin\theta - 3\cos\theta = r$ to rectangular form.
    a) $x^2 - 2x + y^2 + 3y = 0$
    b) $x^2 + 2x + y^2 - 3y = 0$
    c) $x^2 - 3x + y^2 + 2y = 0$
    d) $x^2 + 3x + y^2 - 2y = 0$
    e) $\sqrt{x^2+y^2} - 3x + 2y = 0$

17. For the polynomial $2x^2 - 9x - 18$, find the sum of the possible positive roots given by the Rational Root Theorem.
    a) 9
    b) 21
    c) 26.5
    d) 39
    e) 45.5

18. The function $f(x) = \dfrac{x^2 + x - 6}{x - 3}$ has as an oblique asymptote, the line
    a) $y = 0$
    b) $y = 3$
    c) $y = x + 2$
    d) $y = x - 3$
    e) $y = x + 4$

19. Compute $\sum_{n=2}^{\infty} 5\left(\frac{2}{3}\right)^n$

a) $\frac{4}{3}$

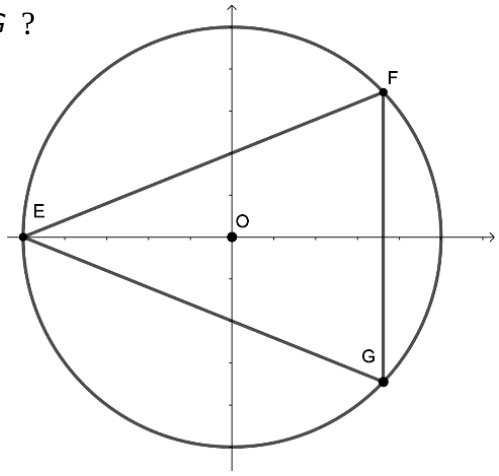
b) 3

c) $\frac{20}{3}$

d) 10

e) 15

20. Given that the equation of the circle is $x^2 + y^2 = 1$ and the angle between $\overline{OF}$ and the *x*-axis is θ, what is the area of isosceles triangle EFG ?



a) $\cos\theta \sin\theta$

b) $(1 + \cos\theta)\sin\theta$

c) $\frac{1 + \cos(2\theta)}{2}$

d) $\frac{\cos\theta \sin\theta}{2}$

e) $\frac{(1 + \cos\theta)\sin\theta}{2}$

21. What is $\begin{bmatrix} 1 & -3 \\ a & 2 \end{bmatrix}^{-1}$

a) $\frac{1}{2 - 3a}\begin{bmatrix} 2 & 3 \\ -a & 1 \end{bmatrix}$

b) $\frac{1}{2 - 3a}\begin{bmatrix} -2 & a \\ 3 & -1 \end{bmatrix}$

c) $\frac{1}{2 - 3a}\begin{bmatrix} -1 & a \\ -3 & -2 \end{bmatrix}$

d) $\frac{1}{2 + 3a}\begin{bmatrix} -1 & a \\ -3 & -2 \end{bmatrix}$

e) $\frac{1}{2 + 3a}\begin{bmatrix} 2 & 3 \\ -a & 1 \end{bmatrix}$

22. If $\sin\theta = \frac{\sqrt{10}}{5}$ what is $\sin 2\theta$?

a) $\frac{4\sqrt{5}}{5}$

b) $\frac{\sqrt{6}}{5}$

c) $\frac{2\sqrt{5}}{5}$

d) $\frac{2\sqrt{6}}{5}$

e) $2\sqrt{6}$

23. You have two investment choices: Invest your money at 7% compounded continuously, or invest your money at 7.5% compounded daily (assume 365 days in a year). How many more days will it take your money to double if you choose the 7% investment?

a) 1
b) 27
c) 241
d) 256
e) 260

24. The math club consists of 6 girls and 8 boys. If 5 members are chosen at random, what is the probability that exactly 3 are girls?

a) 0.001
b) 0.125
c) 0.280
d) 0.5
e) 0.6

25. Using the diagram, find all values of g(x) if f(x)=4.

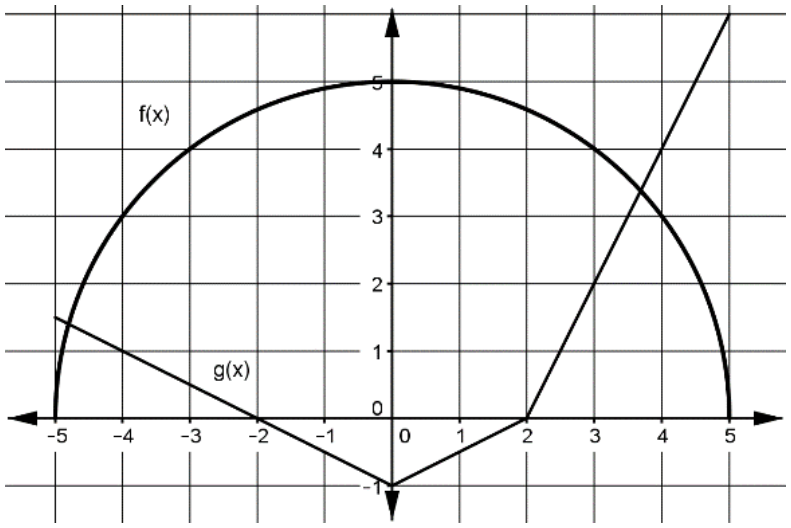
a) $\frac{1}{2}, 2$

b) 2

c) $3, -3$

d) 4

e) $4, -4$



26. If $\sin\theta = -\frac{\sqrt{3}}{2}$ and θ is in quadrant III, what is the value of $\sec\theta$?

a) -2

b) $-\frac{2\sqrt{3}}{3}$

c) $\frac{\sqrt{3}}{2}$

d) $\frac{2\sqrt{3}}{3}$

e) 2

27. Find all solutions to the following system of equations:

$$\frac{2}{x^2} + \frac{5}{y^2} = 3$$

$$\frac{3}{x^2} - \frac{2}{y^2} = 1$$

a) $\left(\sqrt{\frac{19}{11}}, \sqrt{\frac{19}{7}}\right)$

b) $\left(\sqrt{\frac{11}{19}}, \sqrt{\frac{7}{19}}\right)$

c) $\left(\sqrt{\frac{19}{11}}, \sqrt{\frac{19}{7}}\right), \left(\sqrt{\frac{19}{11}}, -\sqrt{\frac{19}{7}}\right)$

d) $\left(\sqrt{\frac{11}{19}}, \sqrt{\frac{7}{19}}\right), \left(\sqrt{\frac{11}{19}}, -\sqrt{\frac{7}{19}}\right), \left(-\sqrt{\frac{11}{19}}, \sqrt{\frac{7}{19}}\right), \left(-\sqrt{\frac{11}{19}}, -\sqrt{\frac{7}{19}}\right)$

e) $\left(\sqrt{\frac{19}{11}}, \sqrt{\frac{19}{7}}\right), \left(\sqrt{\frac{19}{11}}, -\sqrt{\frac{19}{7}}\right), \left(-\sqrt{\frac{19}{11}}, \sqrt{\frac{19}{7}}\right), \left(-\sqrt{\frac{19}{11}}, -\sqrt{\frac{19}{7}}\right)$

28. Write $\frac{2-3i}{1+3i}$ in standard form.

a) $-\frac{11}{8}+\frac{9}{8}i$

b) $-\frac{7}{10}-\frac{9}{10}i$

c) $\frac{7}{8}+\frac{9}{8}i$

d) $\frac{11}{10}-\frac{9}{10}i$

e) $\frac{11}{10}-\frac{3}{10}i$

29. Which of the following functions is one to one, and thus is invertible?

a) $|x|$

b) x^2

c) e^{x^2}

d) $(x+4)^3$

e) $(x-1)(x+1)(x-3)$

30. A fixed point for a function $f(x)$ is a number d such that $f(d)=d$. Find all fixed points for the function $f(x)=\frac{x-3}{x+5}$

a) (1, 3)

b) (−3, −1)

c) (−5, 3)

d) (−3, 0)

e) (−3, 5)

31. The distance from the point (0, −15) to the line $3x-5y=7$ is approximately:

a) 11.31

b) 11.66

c) 14.06

d) 16.00

e) 16.41

32. The conjugate axis of a hyperbola runs along the x-axis, and the transverse axis has a length of 4 and runs along the line $x=3$. If one of the asymptotes makes a 30-degree angle with the x-axis, what is the equation of the hyperbola?

a) $\frac{(x-3)^2}{12} - \frac{y^2}{4} = 1$

b) $\frac{(x-3)^2}{4} - \frac{y^2}{12} = 1$

c) $\frac{y^2}{4} - \frac{(x-3)^2}{12} = 1$

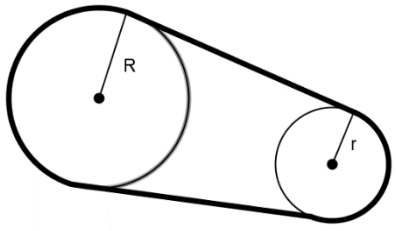
d) $\frac{y^2}{12} - \frac{(x-3)^2}{4} = 1$

e) $\frac{y^2}{16} - \frac{(x-3)^2}{48} = 1$

33. What is the remainder when $x^7 - 7x^6 + 5x^4 + 1$ is divided by $x + 3$?

a) -6884
b) -2510
c) 0
d) 2512
e) 6886

34. Two gears, with radii R = 10 and r = 6, are connected by a chain belt. If the larger gear spins at 100 rotations per minute, what is the angular speed of the smaller gear in radians per second?



a) $\frac{50\pi}{9}$

b) $\frac{500\pi}{3}$

c) 200π

d) $\frac{1000\pi}{3}$

e) $\frac{2500\pi}{27}$

35. Solve $-2|x-b|+c<8$

a) $\left(-\infty, b+4-\frac{c}{2}\right)\cup\left(b-4+\frac{c}{2}, \infty\right)$

b) $(-\infty, b-4+c)\cup(b+4-c, \infty)$

c) $\left(-\infty, b-4-\frac{c}{2}\right)\cup\left(b+4+\frac{c}{2}, \infty\right)$

d) $\left(b-4+\frac{c}{2}, b+4-\frac{c}{2}\right)$

e) $(b-4+c, b+4-c)$

36. An area is contaminated with cesium-137 and now has ten times the normal level of this radioactive material. If the half-life of cesium-137 is 33 years, how many years will it take until the level returns to normal?

a) 99
b) 110
c) 129
d) 165
e) 330

37. A regular dodecagon (12-sided figure) is circumscribed about a circle of radius 1. How long are its sides?

a) 1

b) $\frac{\sqrt{3}}{3}$

c) $\frac{2\sqrt{3}}{3}$

d) $2-\sqrt{3}$

e) $4-2\sqrt{3}$

38. Find all solutions to the equation $8\cos^3\theta - 6\cos\theta = 3 - 4\cos^2\theta$ in the interval $[0, 2\pi)$

a) $\frac{\pi}{6}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{11\pi}{6}$

b) $\frac{\pi}{3}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{5\pi}{3}$

c) $\frac{\pi}{6}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{4\pi}{3}, \frac{11\pi}{6}$

d) $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{4\pi}{3}, \frac{5\pi}{3}$

e) $\frac{\pi}{6}, \frac{\pi}{3}, \frac{2\pi}{3}, \frac{5\pi}{6}, \frac{7\pi}{6}, \frac{4\pi}{3}, \frac{5\pi}{3}, \frac{11\pi}{6}$

39. Find the minimum value of the parabola $f(x) = 3x^2 - bx + 4$

a) $-\frac{b^2}{12} + 4$

b) $-\frac{b^2}{18} + 4$

c) $\frac{b}{3}$

d) $\frac{b}{6}$

e) 4

40. Factor $x^4 - 5x^2 + 10x - 6$

a) $(x-1)^3(x+3)$

b) $(x-1)(x+3)^3$

c) $(x+1)^3(x-3)$

d) $(x-1)(x+3)(x-1+i)(x-1-i)$

e) $(x-1)(x+3)(x+1+i)(x+1-i)$