1. Solve the equation. \( 4x^2 + 9 = 0 \).
   A) \(-\frac{3}{2}\)  B) \(\pm \frac{3i}{2}\)  C) \(-\frac{3i}{2}\)  D) \(\pm \frac{3}{2}\)  E) none of these

2. Find the product of the complex numbers \((5a-3i)\) and \((a+2i)\).
   A) \(4a-i\)  B) \(5a^2-6i^2\)  C) \(6+5a^2+7ai\)  D) \(5a+7ai-6i\)  E) none of these

3. What is the radius of the circle \(y^2 + x^2 - 10x + 16 = 0\)?
   A) 3  B) 9  C) 16  D) 4  E) none of these

4. Write the equation of an ellipse that meets the set of conditions. The endpoints of the major axis are at \((-10,3)\) and \((8,3)\) and the endpoints of the minor axis are at \((-1,7)\) and \((-1,-1)\).
   A) \((x+1)^2 + \frac{(y-3)^2}{16} = 1\)  B) \(\frac{(x+1)^2}{9} + \frac{(y-3)^2}{4} = 1\)  C) \(\frac{(x-3)^2}{16} + \frac{(y+1)^2}{81} = 1\)
   D) \((x-3)^2 + (y+1)^2 = 36\)  E) none of these

5. Write the equation in slope-intercept form of a line whose parametric equations are \(x = -3 + 2t\) and \(y = 4 - 5t\).
   A) \(y = 3x + 1\)  B) \(y = -4x + 4\)  C) \(y = -2.5x - 3.5\)  D) \(y = -2.5x + 2.5\)
   E) none of these

6. If a football is thrown at an angle \(\theta\) with the horizontal with an initial velocity \(V\), the path of the football may be described by these equations, where \(t\) is time in seconds and \(x\) and \(y\) are in feet. \(x = tV\cos\theta\) \(y = tV\sin\theta - 16t^2 + 5\)
   If a football is thrown at an initial velocity of 55 feet per second at an angle of 32° what is the horizontal distance to the nearest foot it travels before hitting the ground?
   A) 66ft  B) 84ft  C) 87ft  D) 92ft  E) 124ft

7. Write \(y\) in terms of \(x\) if \(y = 3\sin\theta\) and \(x = 3\cos\theta\).
   A) \(y = x + 3\)  B) \(y^2 = x^2 + 3\)  C) \(y = \tan(x)\)  D) \(y^2 + x^2 = 9\)
   E) none of these

8. The sequence below has a first term of 2. What would be the 9th term?
   \(2, i, 2i, -2, -4i, 8i, ...\)
   A) 16i  B) 256  C) -256  D) 8192i  E) none of these

9. The numbers 1, 5, 12, 22, and 35 are referred to as the first five “pentagonal” numbers. What is the 10th pentagonal number?
   A) 63  B) 100  C) 145  D) 176  E) none of these

10. Identify all of the irrational zeros of the polynomial: \(h(x) = x^3 + 2x^2 - 5x - 10\)
    A) \(\pm \sqrt{5}\)  B) \(\pm 2\)  C) \(\pm \sqrt{5}, 2\)  D) \(\pm \sqrt{10}\)  E) none of these
11. If \( f(x) = \lceil x \rceil \) is defined as the greatest integer function, then determine the range for \( g(x) = \left\lfloor x - \frac{1}{2} \right\rfloor \).
   A) All reals        B) All integers        C) \( \frac{1}{2} \)
   D) \( \{y : y = \frac{1}{2} + k, \text{where} \ k \ \text{is an integer}\} \)        E) none of these

12. As \( x \to -\infty \), the function \( p(x) = x^5 + 24x^4 + 192x^3 + 656x^2 + 1008x + 576 \) approaches what?
   A) -2        B) 576        C) \(+\infty\)        D) \(-\infty\)        E) none of these

13. If the three forces listed below act on an object, what is the magnitude of the resultant force?
   \( \vec{F}_1 = (1,5) \quad \vec{F}_2 = (-2,6) \quad \vec{F}_3 = (-3,-4) \)
   A) \( \sqrt{65} \)        B) \( \sqrt{33} \)        C) 28        D) 3        E) none of these

14. A traffic light is supported equally by two cables. The cables form a 130° with each other. If the weight of the traffic light exerts a 750 N force downward, what is the force exerted (to the nearest Newton) by each of the cables?
   A) 887 N        B) 583 N        C) 414 N        D) 375 N        E) none of these

15. Which vector is orthogonal to (perpendicular to the plane containing) the given vectors?
   \( \vec{v} = (1,3,1) \quad \vec{w} = (0,1,2) \)
   A) \( (1,4,3) \)        B) \( (5,2,1) \)        C) \( (5,-2,-2) \)
   D) \( (5,-2,1) \)        E) none of these

16. As \( x \to \infty \), what value does the function \( y = \frac{75x}{x^2 - 1} \) approach?
   A) 0        B) 1        C) 75        D) -75        E) none of these

17. Evaluate the limit: \( \lim_{x \to 4} 8 \)
   A) 32        B) 8        C) 4        D) 0        E) none of these

18. Evaluate the limit: \( \lim_{x \to 2} \frac{x-3}{x^2-5x+6} \)
   A) 3        B) 2        C) 1        D) 0        E) none of these

19. A company produces two types of bookcases, a small and a large size. The company can make a total of 60 bookcases per day, and it has 120 labor-hours available each day. It takes 1 labor-hour to make a small bookcase and 4 labor-hours to make a large bookcase. The profit is $40 per small bookcase and $60 per large bookcase. How many of each type of bookcase should the company make to maximize its daily profit?
   A) 60 small bookcases        B) 60 large bookcases        C) 30 of each
   D) 40 small bookcases, 20 large bookcases        E) none of these

20. A plumber charges $90 per hour or fraction of an hour plus $50 per service call. Determine the total charge if she works 3 hours and 40 minutes in response to a service call.
   A) $356        B) $410        C) $380        D) $273        E) none of these
SENIOR 2015 Answer Key

1. B
2. C
3. A
4. A
5. C
6. D
7. D
8. D
9. C
10. A
11. B
12. D
13. A
14. A
15. D
16. A
17. B
18. E
19. D
20. B