1) Three corners of a rectangle are the points (1,4), (7,4), and (1,10). The diagonals of the rectangle meet at the point
   a) (8,14).
   b) (1, 3).
   c) (3, 3).
   d) (4, 7).
   e) none of the above.

2) Consider the equation $x^2 + ax + 1 = 0$. A single fair die is rolled to determine the value of the middle coefficient, a. The value for a is the number of dots on the upper face of the die. The probability that the equation will have real, unequal roots is:
   a) $\frac{1}{3}$
   b) $\frac{1}{12}$
   c) $\frac{2}{3}$
   d) $\frac{1}{2}$
   e) none of the above.

3) Determine the solution set of $\frac{x - 2}{x^2(1 - x)} \leq 0$.
   a) $(-\infty, 0) \cup (0,1) \cup [2,\infty)$
   b) $1 < x < 2$
   c) $x < 1$ or $x > 2$
   d) $x \leq 2$
   e) none of the above.
4) One root of \( x^2 + ax + a = 0 \) is \(-\frac{1}{2}\). What is the other root?

   a) \[-\frac{7}{8}\]
   b) \[\frac{7}{8}\]
   c) \[1\]
   d) \[-\frac{1}{2}\]
   e) none of the above.

5) Suppose \( a = 212 \) and \( b = 2201 \) are numbers expressed in the base 3 number system. The product \( ab \) expressed in the base 3 number system is:

   a) 11102212
   b) 22110001
   c) 2002211
   d) 2022012
   e) none of the above.

6) Given the repeating decimals \( x = 0.\overline{23} \) and \( y = 1.\overline{4} \), then \( x + y = \)

   a) \[\frac{167}{98}\]
   b) \[\frac{166}{99}\]
   c) \[\frac{168}{101}\]
   d) \[\frac{168}{99}\]
   e) none of the above.

7) There are 13 points in a plane and no three of these points lie in the same straight line. The number of distinct triangles which can be formed by joining the points is

   a) 390
   b) 455
   c) 1716
   d) 286
   e) none of the above.
8) In this figure, \( AB \) is a diameter of the circle and \( AB \) is perpendicular to \( CD \). If \( AD = a \) and \( DB = b \) then \( CD \) is equal to

a) \( a\sqrt{b} \)

b) \( a^2b^2 \)

c) \( \sqrt{ab} \)

d) \( ab \)

e) none of the above.

9) The total number of squares in this 4 x 4 figure is

a) 45

b) 30

c) 24

d) 16

e) none of the above.

10) The perimeter of a triangle is 30 meters. A second triangle is formed by joining the midpoints of the sides of the original triangle. This second triangle has a perimeter of

a) 12 meters

b) 15 meters

c) 10 meters

d) 6 meters

e) none of the above.

11) If the graphs of \( 2y + x + 3 = 0 \) and \( 3y + \alpha x + 2 = 0 \) are to meet at right angles, then \( \alpha \) is

a) \(- 6\)

b) 6

c) \( \frac{3}{2} \)

d) \( \pm \frac{2}{3} \)

e) none of the above.
12) The vertex of the parabola \( y^2 + 4y + x + 3 = 0 \) is
   
   a) \((-2, -1)\)
   b) \((2, -1)\)
   c) \((1, 2)\)
   d) \((-1, -2)\)
   e) none of the above.

13) How much is the total surface area of a cube, with edge \( e \), increased if the length of each edge is increased by 2 units?
   
   a) \(6(3e + 1)\)
   b) \(12(e + 1)\)
   c) \(12(e + 6)\)
   d) \(24(e + 1)\)
   e) none of the above.

14) The coefficient of the term involving \( x^{10} \) in the expansion of \((x^2 + 3y)^{10}\) is
   
   a) \((70)(3^5)\)
   b) \((70)(3^4)\)
   c) \((140)(3^4)\)
   d) \((28)(3^7)\)
   e) none of the above.

15) Students in a class are selected at random, one after the other, from a class consisting of 3 boys and 4 girls. The probability that boys and girls in the class alternate starting with a girl first is
   
   a) \(\frac{4}{7}\)
   b) \(\frac{2}{7}\)
   c) \(\frac{1}{42}\)
   d) \(\frac{1}{35}\)
   e) none of the above.
16) If \( x - 5 \) divides \( 2x^3 - 3x^2 - kx + 20 \) with a remainder of zero, then \( k \) equals:

a) 39  
b) 31  
c) 69  
d) 0  
e) none of the above.

17) The 11\(^{th}\) term of the geometric progression with first three terms given by \( \frac{1}{2}, 1, 2, \ldots \) is

a) 8192  
b) 512  
c) \( \frac{11}{2} \)  
d) 16384  
e) none of the above.

18) An inlet pipe can (by itself) fill an empty tank in 2 hours and an outlet pipe (by itself) can drain the same tank when full in 5 hours. If the tank is half full when both valves for both pipes are opened, how long will it take to fill the tank?

a) 1 hr. 50 min.  
b) 1 hr. 40 min.  
c) 1 hr. 28 min.  
d) 1 hr. 18 min.  
e) none of the above.

19) Two positive numbers have a ratio of 1 to 3. If the difference between the squares of the numbers is 1800, what is the larger of the two numbers?

a) 54  
b) 15  
c) 48  
d) 45  
e) none of the above.
20) A car radiator contains 12 quarts of a 10% solution of antifreeze and water. How many quarts of this mixture must be replaced by pure antifreeze to make a 20% solution of antifreeze and water in the radiator?

a) 4 quarts  

b) $\frac{1}{2}$ quarts  

c) $\frac{1 \frac{1}{3}}{3}$ quarts  

d) 2 quarts  

e) none of the above.

21) If you drive M miles at an average speed of 30 mph and another M miles at 50 mph, then the average speed for the 2M miles is

a) 37.5 mph  

b) 35.0 mph  

c) 40.0 mph  

d) 45.5 mph  

e) none of the above.

22) Two vertical poles, one 15 feet high and the other 27 feet high, are 16 feet apart. What is the distance between their tops?

a) 36.0 feet  

b) 15.0 feet  

c) 16.6 feet  

d) 20.0 feet  

e) none of the above.

23) The measure of each interior angle of a regular decagon (10 sided) is

a) 144°  

b) 216°  

c) 162°  

d) 36°  

e) none of the above.
24) The units digit of a two digit number exceeds the tens digit by 4. If the digits are reversed, the square of the given number exceeds 4 times the new number by 21. The sum of the digits of the original given number is:

a) 10  
b) 8  
c) 6  
d) 14  
e) none of the above.

25) If the greatest common divisor of numbers \( m \) and \( n \) is \( q \) then the least common multiple of \( m \) and \( n \) is

a) \( \frac{mn}{q} \)  
b) \( \frac{mn}{q} \)  
c) \( \frac{q}{m} \)  
d) \( mn \)  
e) none of the above.