



9. Determine whether the series  $12 + 8 + \frac{16}{3} + \frac{32}{9} + \dots$  converges or diverges. If it converges, find the sum.

- a) converges, sum = 26                      b) converges, sum = 36                      c) converges, sum = 40  
d) converges, sum = 63                      e) diverges

10. If  $p - q > 0$ , which of the following must be true?

- a) If  $q = 0$ , then  $p < 0$                       b) If  $q < 0$ , then  $p < 0$                       c) If  $p > 0$ , then  $q > 0$   
d) If  $q < 1$ , then  $p > 1$                       e) None of the Above

11. If  $y = \frac{10^{\log x}}{x^2}$ , for  $x > 0$ , which of the following is true?

- a)  $y$  varies directly with  $x$                       b)  $y$  varies inversely with  $x^2$                       c)  $y$  varies as the square of  $x$   
d)  $y$  varies directly with  $\log x$                       e)  $y$  varies inversely with  $x$

12. Suppose that  $0 < \theta < \frac{\pi}{2}$  and  $\sec \theta = \frac{x}{3}$ . Which of the following must be true?

- a)  $\tan \theta = \frac{\sqrt{x^2-9}}{x}$                       b)  $\sin \theta = \frac{x}{\sqrt{x^2-9}}$                       c)  $\csc \theta = \frac{x}{\sqrt{x^2-9}}$                       d)  $\cot \theta = \frac{\sqrt{x^2-9}}{3}$                       e)  $\tan \theta = \frac{3}{\sqrt{x^2-9}}$

13. A circle with center at point O has radius 1 inch. A point B is 3 inches away from O. The tangents to the circle from B touch the circle at points A and C. What is the area of the quadrilateral, OABC?

- a) 2.25                      b) 3                      c)  $2\sqrt{2}$                       d)  $\sqrt{10}$                       e)  $2\sqrt{3}$

14. The logically equivalent statement to "Not all dogs have fleas." is

- a) Some dogs have fleas.                      b) Some dogs do not have fleas.                      c) There exists a dog with fleas.  
d) All pets with fleas are not dogs.                      e) Every dog does not have fleas.

15. A box of chocolates has 10 pieces of chocolate that look identical, but four of them have caramel in the middle, four have an orange cream in the middle and two are solid chocolate. If two are randomly selected, what is the probability at least one contains caramel?

- a)  $\frac{2}{3}$                       b)  $\frac{4}{15}$                       c)  $\frac{8}{45}$                       d)  $\frac{21}{25}$                       e)  $\frac{1}{2}$

16. A restaurant manager must get 6 of 9 waiters to work catering a banquet. Two of the waiters (Tom and Joe) refuse to work together. How many ways can the manager assemble the team where Tom and Joe are not both on it?

- a) 56                      b) 84                      c) 7                      d) 35                      e) 49

17. Define a function as  $f(x) = \frac{\lambda e^{-\lambda x}}{x!}$ ,  $x = 0, 1, 2, \dots$ ; where  $\lambda$  is positive and real-valued. The maximum value of  $f(x)$  occurs at which value of  $x$ ?

- a) the greatest integer less than  $\lambda$     b) the greatest integer less than  $1/\lambda$     c) 0  
 d) 0 if  $\lambda \leq 1$  and 1 if  $\lambda > 1$     e) none of the above

18. Suppose that triangle  $\Delta ABC$  is equilateral and define the following “functions” on the position of  $\Delta ABC$ :  
 $s$  reflects  $\Delta ABC$  about the altitude to that base (ie., if  $A$  is the top vertex, then  $s$  switches  $B$  and  $C$ ),  
 $r$  rotates  $\Delta ABC$   $120^\circ$  sending  $A \mapsto B$ ,  $B \mapsto C$ , and  $C \mapsto A$ ,  
 $t$  rotates  $\Delta ABC$   $240^\circ$  sending  $A \mapsto C$ ,  $B \mapsto A$ , and  $C \mapsto B$ .

Which of the following compositions return  $\Delta ABC$  back to its original position?

- a)  $s \circ t$     b)  $s \circ r \circ s \circ r$     c)  $t \circ s$     d)  $r \circ r$     e)  $s \circ r \circ s \circ t$

19. Let  $x$  be an odd natural number. If  $x$  is divided by 6, it leaves a remainder of  $y$ . If  $y^2$  is divided by 4, it leaves a remainder of  $z$ . Which of the following must be true of  $z$ ?

- a)  $z = 3$     b)  $z = 5$     c)  $z = 1$     d)  $z$  is even    e) none of the above

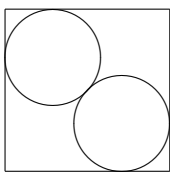
20. If a regular hexagon has all of its diagonals (line segments connecting non-consecutive vertices), then how many non-overlapping regions are there in the interior of the hexagon?

- a) 12    b) 18    c) 20    d) 24    e) none of the above

21. What is the largest perfect square that divides  $15!$  ?

- a)  $2^8 3^4 5^2 7^2$     b)  $2^{16} 3^6 5^2 7^2$     c)  $2^{10} 3^6 5^2 7^2$     d)  $2^{16} 3^6 5^2 7^2 \cdot 11 \cdot 13$     e)  $2^{11} 3^6 5^3 7^2$

22. The two circles are tangent to each other, and are each tangent to the square surrounding them. If each circle has radius 1, then the area of the entire square is



- a)  $10 + \sqrt{2}$     b)  $8 + 2\sqrt{2}$     c)  $4 + 6\sqrt{2}$     d)  $2 + 8\sqrt{2}$     e)  $6 + 4\sqrt{2}$

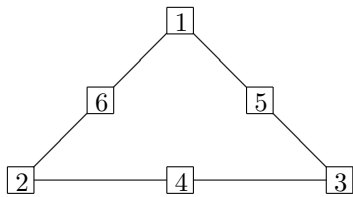
23. The sum of the solutions of a quadratic equation is  $\frac{11}{12}$  and the product is  $\frac{1}{6}$ . A possible quadratic equation that has these solutions is

- a)  $12x^2 + 11x - 2 = 0$     b)  $12x^2 - 11x + 2 = 0$     c)  $6x^2 - 2x - 11 = 0$   
 d)  $6x^2 - 11x + 1 = 0$     e)  $6x^2 - 2x + 11 = 0$

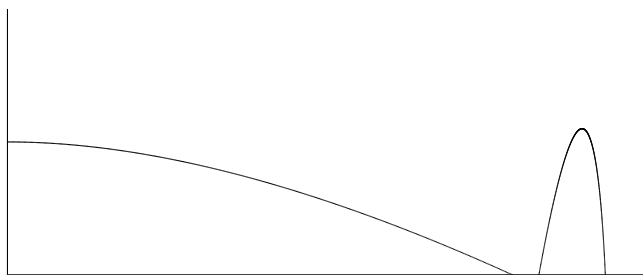


31. We come upon a woman on the bank of a river who possesses only 5 rocks that she intends to toss in front of herself within leaping distance to enable her to cross the river and yet keep her feet dry. Each rock has the probability  $\frac{2}{3}$  that it will adhere to the river bottom and serve as a stepping stone (and probability  $\frac{1}{3}$  it will float down river). She needs 4 rocks to accomplish her task. What is the probability she is able to cross the river on her rocks?
- a)  $\frac{112}{243}$                   b)  $\frac{16}{81}$                   c)  $\frac{16}{243}$                   d)  $\frac{80}{243}$                   e)  $\frac{32}{243}$
32. How many zeros does the number  $100!$  end in?
- a) 10                  b) 11                  c) 21                  d) 20                  e) 24
33. What is the length of the altitude of the 3-4-5 right triangle from the vertex at the right angle?
- a) 2.4                  b) 1.8                  c) 2                  d)  $\sqrt{3}$                   e)  $\sqrt{5}$
34. An isosceles triangle has two sides of length 10 inches. If the length of the third side is a whole number of inches, and the area of the triangle is a whole number of square inches, what is the area of the triangle?
- a)  $37 \text{ in}^2$                   b)  $40 \text{ in}^2$                   c)  $45 \text{ in}^2$                   d)  $48 \text{ in}^2$                   e)  $50 \text{ in}^2$
35. Solve for  $x$ .  $\log_3(x + 1) - \log_9 x = 1$ .
- a)  $\frac{1}{8}$                   b)  $\frac{7 \pm 3\sqrt{5}}{2}$                   c)  $\frac{1}{2}$                   d)  $\frac{-1 + \sqrt{37}}{2}$                   e)  $\frac{7 + 3\sqrt{5}}{2}$
36. In a group of 10 people, the mean age is 20.5 years. One more person joins this group. How old is this 11th person if the mean age of the group increased to 21 years?
- a) 21.5                  b) 26                  c) 31                  d) 25                  e) none of these
37. Find the degree measure of the smallest positive angle  $\theta$  that satisfies the equation  $\sin \theta + \cos \theta = \frac{\sqrt{3}}{\sqrt{2}}$ .
- a)  $6^\circ$                   b)  $10^\circ$                   c)  $12^\circ$                   d)  $15^\circ$                   e)  $22.5^\circ$
38. Quadrilateral  $ABCD$  has  $\overline{CD} \parallel \overline{AB}$ , the measure of angle  $D = 45^\circ$ , the measure of angle  $C = 120^\circ$ ,  $AD = 12\sqrt{2}$  and  $CD = 27$ .
- The area of the quadrilateral is
- a)  $252 + 24\sqrt{3}$                   b) 342                  c) 324                  d)  $252 + 72\sqrt{3}$                   e)  $234 + 6\sqrt{2}$

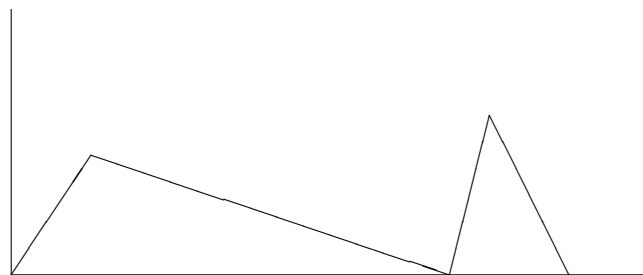
39. A triangular arrangement of six numbers is called *magic* if the sums of the numbers along the three edges of the triangle are equal, as in the diagram below. If the numbers 1, 2, 3, 4, 5, and 6 are positioned randomly in the six squares below, what is the probability that a magic triangle will result?



- a)  $1/6$       b)  $1/30$       c)  $1/120$       d)  $1/180$       e)  $1/720$
40. Greg heads off to disc-golf practice on his bike. He takes a low sloping hill down to a traffic light. While waiting for the light to turn green, he realizes he forgot his discs, and pedals back up the hill to his house. After picking up discs, he takes a shorter (more dangerous) more steep descent to the practice field. What function below best represents his distance from his house as a function of time?



a)



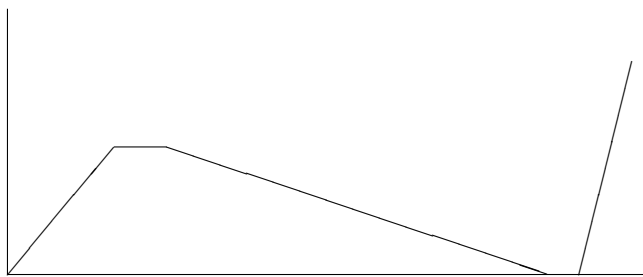
b)



c)



d)



e)