1. Evaluate the integral.

\[ \int_{0}^{1} \frac{x - 2}{x^2 + 6x + 8} \, dx \]

Select the correct answer.

a. \( \ln \frac{288}{250} \)

b. \( \ln \frac{864}{50} \)

c. \( \ln \frac{50}{72} \)

d. \( \ln \frac{250}{288} \)

2. Evaluate the indefinite integral.

\[ \int x \cos (2x) \, dx \]

Select the correct answer.

a. \( \frac{1}{4} \sin (2x) + \frac{x}{2} \cos (2x) + C \)

b. \( \frac{1}{2} \cos (2x) + \frac{x}{2} \sin (2x) + C \)

c. none of these

d. \( \frac{x}{4} \cos (2x) + \frac{x}{2} \sin (2x) + C \)

e. \( \frac{1}{4} \cos (2x) + \frac{x}{2} \sin (2x) + C \)

3. Evaluate the integral.

\[ \int_{0}^{1} \frac{x - 6}{x^2 + 8x + 12} \, dx \]

Select the correct answer.

a. \( \ln \frac{972}{686} \)

b. \( \ln \frac{98}{2.916} \)

c. \( \ln \frac{162}{686} \)

d. \( \ln \frac{98}{972} \)
4. Use the Trapezoidal Rule to approximate
\[ \int_{\frac{3}{4}}^{4} e^{\frac{3}{x}} \, dx \]
for \( n = 4 \).
Select the correct answer. The choices are rounded to four decimal places.

a. 2.3797  
   b. 2.3792  
   c. 2.378   
   d. 2.3742  
   e. 2.4002  
   f. 2.4792  

5. Estimate the area of the shaded region in the graph by using the Trapezoidal Rule with \( n=4 \).

Select the correct answer.

a. 13.5  
   b. 7.9   
   c. 13    
   d. 11.5  
   e. 8.4   
   f. 9.5   

6. Evaluate the following integral:
\[ I = \int_{-\infty}^{0} \frac{8}{5x - 7} \, dx \]

a. \( I = 19.4 \)  
   b. The integral is divergent.  
   c. \( I = 9.6 \)  
   d. \( I = 9.8 \) 

7. A spring has a natural length of 13 cm. If a force of 23 N force is required to keep it stretched to a length of 23 cm, how much work is required to stretch it from 13 cm to 39 cm?

Select the correct answer.

a. 8.774 J  
   b. 7.274 J  
   c. 7.774 J  
   d. 9.274 J  
   e. 8.274 J
8. The tank shown is full of water. Given that water weighs 62.5 lb/ft and R = 3, find the work required to pump the water out of the tank.

\[ \text{Select the correct answer.} \]

a. 3,996 ft-lb  
 b. 3,976 ft-lb  
 c. 3,866 ft-lb  
 d. 2,976 ft-lb  
 e. 2,975 ft-lb

9. Find the volume of the solid obtained by rotating the region bounded by \( x = y^2 \) and \( x = 4y \) about the y-axis.

\[ \text{Select the correct answer.} \]

a. \( \frac{1.024}{15} \pi \)  
 b. \( \frac{-1.024}{3} \pi \)  
 c. \( \frac{8.192}{15} \pi \)

10. Find the average value of the function \( u(t) = 6 \sqrt{t} \) on the interval [1, 4].

\[ \text{Select the correct answer.} \]

a. \( \frac{84}{27} \)  
 b. \( \frac{252}{3} \)  
 c. \( \frac{84}{9} \)  
 d. \( \frac{84}{3} \)

11. Choose the equation which solution is graphed and satisfies the initial condition \( y(0) = 2 \).

\[ \text{Select the correct answer.} \]

a. \( y' = y - 1 \)  
 b. \( y' = y - x \)  
 c. \( y'' = y^2 - x^2 \)
12. Choose the differential equation corresponding to this direction field.

\[
\begin{array}{c}
\text{y}\\
\downarrow\\
x
\end{array}
\]  
\[y' = y - x\]

13. Which of the partial sums of the alternating series \[\sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}\] are overestimates of the total sum.

a. \(s_{98}\)    b. \(s_{77}\)    c. \(s_{95}\)    d. \(s_{92}\)

14. How many terms of the series do we need to add in order to find the sum to the indicated accuracy?

\[\sum_{n=1}^{\infty} \frac{(-1)^n}{2^n} \quad \left| \text{error} \right| < 0.1562\]

a. \(n = 5\)    b. \(n = 6\)    c. \(n = 7\)    d. \(n = 8\)

15. Which of the given series are not absolutely convergent?

a. \[\sum_{n=1}^{\infty} \frac{(-10)^n}{n!}\]    b. \[\sum_{n=1}^{\infty} \frac{(-10)^n}{n^n}\]

16. For which of the following series is the Ratio Test inconclusive (that is, it fails to give a definite answer).

a. \[\sum_{n=1}^{\infty} \frac{(-7)^{n-1}}{\sqrt{n}}\]    b. \[\sum_{n=1}^{\infty} \frac{n}{5^n}\]    c. \[\sum_{n=1}^{\infty} \frac{1}{n^5}\]

17. Use the reduction formula to find the integral:

\[\int \sin^2 (16x) \, dx\]

18. Use integration by parts to find the integral:

\[\int 8x f' \, dx\]
19. Use the substitution \( x = 2 \sin \vartheta, \quad -\frac{\pi}{2} \leq \vartheta \leq \frac{\pi}{2} \) and the identity \( \cot^2 \vartheta = \csc^2 \vartheta - 1 \) to evaluate
\[
\int \frac{\sqrt{4 - x^2}}{x^2} \, dx.
\]

20. Use long division to evaluate the integral.
\[
\int \frac{x^2}{x + 10} \, dx
\]

21. For what values of \( c_{onst} \) is the following integral improper?
\[
\int_0^{c_{onst}} \frac{x}{x^2 - 13x + 42} \, dx.
\]
Enter your answer as an inequality.

22. Find the area bounded by the loop of the curve with parametric equations
\[
x = 5t^2, \quad y = 4t^3 - 3t
\]
Please round your answer to the nearest hundredth.

23. Using the arc length formula, set up, but do not evaluate, an integral equal to the total arc length of the ellipse
\[
x = 4 \sin \theta, \quad y = 3 \cos \theta.
\]

24. Use Euler’s method with step size \( h = 0.9 \) to compute the approximate \( y \)– value \( y_2 \) of the solution of the initial–value problem
\[
y' = y - 2x, \quad y(0) = 1
\]

25. Solve the differential equation.
\[7y'y = 5x\]

26. A tank contains 1,100 L of brine with 10 kg of dissolved salt. Pure water enters the tank at a rate of 10 L/min. The solution is kept thoroughly mixed and drains from the tank at the same rate. How much salt is in the tank after 10 minutes?

27. Suppose \( f( z ) \) is a continuous positive decreasing function for \( z \geq 3 \) and \( a_n = f( n ) \).
Let \( A = \int_3^{18} f( z ) \, dz \), \( B = \sum_{j=4}^{18} a_j \) and \( C = \sum_{j=3}^{17} a_j \). Compare \( A \), \( B \) and \( C \).
28. Sketch the graph of the solution of $y' = y - 1$, that satisfies the initial condition $y(0) = 7$. 
1. \[ \ln \frac{250}{288} \]
2. \[ \frac{1}{4} \cos(2x) + \frac{x}{2} \sin(2x) + C \]
3. \[ \ln \frac{686}{972} \]
4. 2.3792
5. 11.5
6. The integral is divergent.
7. 7.774 J
8. 3,976 ft-lb
9. \[ \frac{8.192}{15} - \pi \]
10. 9
11. \[ y' = y - x \]
12. \[ y' = y^3 - x^3 \]
13. \[ s_{87} \]
14. \[ n = 5 \]
15. \[ \sum_{n=1}^{\infty} \frac{(-10)^n}{n^9} \]
16. \[ \sum_{n=1}^{\infty} \frac{1}{n^5} \]
17. \[ \frac{x}{2} \sin(32x) + C \]
18. \[ 8x f(x) - 8 \int f(x) \, dx \]
19. \[ \frac{-\sqrt{4 - x^2}}{x} - \arcsin \left( \frac{x}{2} \right) + C \]
20. \[ \frac{x^2}{2} - 10x + 100 \ln(|x + 1|) + C \]
21. \[ \text{const} \geq 6 \]
22. 5.196152
23. \[ \int_{0}^{2\pi} \left( 16 \cos^2(\theta) + 9 \sin^2(\theta) \right) \, d\theta \]
24. 3.43
25. \[ y = \pm \sqrt{\frac{5}{4} - x^2} + C \]
26. 9.13
27. \[ b < a < c \]