

Part I: Multiple Choice. Select the correct answer.

1.  $\int_1^4 \frac{1}{x(x+2)} dx =$

- A.  $\frac{1}{2}\ln 2$
- B.  $-\frac{1}{2}\ln 2$
- C.  $\frac{1}{2} + \frac{1}{2}\ln 2$
- D. 0
- E. None of these

2. What can you say about the series  $\sum_{n=1}^{\infty} \frac{n^n}{3n^2}$ ?

- A. Diverges by the Comparison Test.
- B. Diverges by the Limit Comparison Test.
- C. Diverges by the Ratio Test.
- D. Converges by the Integral test.
- E. Converges by the Alternating Series Test.
- F. Converges by the Root Test.
- G. None of these.

3. Find the volume of the torus generated by rotating the circle  $(x - 4)^2 + y^2 = 1$  about the y-axis.

- A.  $12\pi^2$
- B.  $16\pi^2$
- C.  $4\pi^2$
- D.  $8\pi^2$
- E. None of these

4.  $\int_0^1 \sqrt{x^2 + 1} dx =$

- A.  $\sqrt{2} + \ln(\sqrt{2} + 1)$
- B.  $\frac{\sqrt{2}}{2} - \frac{1}{2}\ln(\sqrt{2} + 1)$
- C.  $\frac{\sqrt{2}}{2} + \frac{1}{2}\ln(\sqrt{2} + 1)$
- D.  $\sqrt{2} - \ln(\sqrt{2} + 1)$
- E. None of these

5. Use the Trapezoid rule with  $n = 4$  to approximate  $\int_1^3 \frac{2}{x^2} dx$ .

A.  $\frac{141}{50}$

B.  $\frac{71}{50}$

C.  $\frac{141}{100}$

D.  $\frac{141}{200}$

E. None of these

6. What is the limit of the sequence  $\ln(4n - 4) - \ln(3n - 1)$ ?

A.  $\ln(3/4)$

B.  $\ln(4/3)$

C. Diverges

D. 0

7. Convert the cartesian equation  $x^2 = 8y$  into an equivalent polar equation.

A.  $r = 8\cot\theta\csc\theta$

B.  $r^2 = 8\cot\theta\csc\theta$

C.  $r = 8\tan\theta\sec\theta$

D.  $r^2 = 8\tan\theta\sec\theta$

E. None of these

8. Suppose that  $\{a_n\}$  and  $\{b_n\}$  are sequences of positive terms.

If  $\lim_{n \rightarrow \infty} \frac{a_n}{b_n} = \infty$ , what can you conclude about the convergence of  $\sum a_n$ ?

A.  $\sum a_n$  diverges if  $\sum b_n$  diverges, and  $\sum a_n$  converges if  $\sum b_n$  converges.

B.  $\sum a_n$  diverges if  $\sum b_n$  diverges?

C.  $\sum a_n$  converges if  $\sum b_n$  converges.

D. The convergence of  $\sum a_n$  cannot be determined from the Limit comparison test.

9. Find the area of the region between the curve  $x = e^{14t}$ ,  $y = \frac{1}{14}e^{-13t}$  and the x-axis from  $t = 0$  to  $t = \ln 9$ .

A. 8

B. 14

C. 9

D. 13

E. None of these

10. Find the area of the surface created by rotating  $y = \sqrt{4x - x^2}$ ,  $\frac{1}{2} \leq x \leq \frac{3}{2}$  about the  $x$ -axis.
- A.  $\pi$   
 B.  $4\pi$   
 C.  $5\pi$   
 D.  $3\pi$   
 E. None of these
11. The function  $T = (t) = 43.6 + 5t - 0.3t^2$ ,  $0 \leq t \leq 6$ , gives the temperature  $T$  as a function of time  $t$ . What is the average temperature for the 6 hour period?
- A. 60  
 B. 51  
 C. 55  
 D. 57.5  
 E. None of these
12. Find the work done in winding up a 250-ft cable that weights 5 lb per foot. (Assume the cable is initially hanging free from the ground).
- A. 156,250 ft-lb  
 B. 3130 ft-lb  
 C. 469,000 ft-lb  
 D. 31,300 ft-lb  
 E. None of these

Part II. Show all work in the space provided.

13. (10 points) Find the interval of convergence of  $\sum_{n=2}^{\infty} \frac{x^n}{n \ln^2 n}$ .
14. (10 points) Find  $\int \tan^2(2x) \sec^4(2x) dx$ .
15. (10 points) What is the radius of convergence of the Maclaurin series to  $\frac{x^3 - 1}{(5 + x^2)^{-3}}$ ? Explain your reasoning.
16. (10 points) If  $y = \int_0^x \sqrt{9\sin^2 t - 1} dt$ , find the length of the curve from  $x = 0$  to  $x = \frac{\pi}{2}$ .
17. (10 points) A semicircular plate of radius 3 feet is submerged vertically in a liquid so that the flat side is closest to the surface and is 4 feet deep. Find the force due to fluid pressure on one side of the plate.
18. (10 points) Approximate  $\sum_{k=1}^{\infty} \frac{k+1}{k^6}$  to within  $10^{-3}$ .

19. (10 points) Find the volume of an object whose base is the disk  $x^2 + y^2 \leq 16$  and whose cross sections are equilateral triangles.
20. (10 points) Write  $2x^2 - 5y^2 + 4x - 15y + 20 = 0$  in standard form and graph it. Label all important points on the curve.
21. (10 points) A company sells 20,000 units of a new product in the first year. In each succeeding year, it expect to sell 75 percent of the amount the year before. How many of the product can the company eventually expect to sell?