

$$22-51 \quad \pi + e + (e^2/\pi) + (e^3/\pi^2) + \cdots$$

$$22-52 \quad 2 - \sqrt{3} + (3/2) - (3\sqrt{3}/4) + (9/8) - (9\sqrt{3}/16) + \cdots$$

In Problems 22-53 through 22-56 express the repeating decimal as a quotient of integers:

$$22-53 \quad 0.727\overline{272}$$

$$22-55 \quad 0.191\overline{191}$$

$$22-54 \quad 0.177\overline{177}$$

$$22-56 \quad 0.810981\overline{098109}$$

In Problems 22-57 through 22-90 determine whether the series converges or diverges.

$$22-57 \quad \sum_{k=3}^{\infty} 1/(k \ln^3 k)$$

$$22-73 \quad \sum_{k=3}^{\infty} (k + \ln k)/(k^2 + \ln k)$$

$$22-58 \quad \sum_{k=3}^{\infty} (\ln k)/3^k$$

$$22-74 \quad \sum_{k=3}^{\infty} k^3/(\ln k)^k$$

$$22-59 \quad \sum_{k=2}^{\infty} (k^3 + 1)/(k^5 - 2)$$

$$22-75 \quad \sum_{k=2}^{\infty} \sqrt{k^2 + 1}/\sqrt{k^5 + k - 2}$$

$$22-60 \quad \sum_{k=1}^{\infty} 2^k/k!$$

$$22-76 \quad \sum_{k=3}^{\infty} (\ln k)/k$$

$$22-61 \quad \sum_{k=3}^{\infty} [(\ln k)/k]^k$$

$$22-77 \quad \sum_{k=1}^{\infty} (k - 1)/\sqrt{k!}$$

$$22-62 \quad \sum_{k=1}^{\infty} \sqrt{k}/k!$$

$$22-78 \quad \sum_{k=2}^{\infty} \sqrt[3]{1/(k^4 - 1)}$$

$$22-63 \quad \sum_{k=0}^{\infty} \arctan k$$

$$22-79 \quad \sum_{k=2}^{\infty} \sqrt[3]{1/(k^2 - 1)}$$

$$22-64 \quad \sum_{k=1}^{\infty} \sin(1/k)$$

$$22-80 \quad \sum_{k=3}^{\infty} 1/(k\sqrt[3]{\ln k})$$

$$22-65 \quad \sum_{k=1}^{\infty} e^{1/k}/k^2$$

$$22-81 \quad \sum_{k=1}^{\infty} (2^k)^k/(k^2)^k$$

$$22-66 \quad \sum_{k=1}^{\infty} [1 - (1/k)]^k$$

$$22-82 \quad \sum_{k=0}^{\infty} k^3/e^{k^4}$$

$$22-67 \quad \sum_{k=0}^{\infty} k/2^k$$

$$22-83 \quad \sum_{k=0}^{\infty} 3^{k^2}/2^{2^k}$$

$$22-68 \quad \sum_{k=1}^{\infty} k^k/(k!)^2$$

$$22-84 \quad \sum_{k=3}^{\infty} \sqrt{k + 3}/(k + \ln k)$$

$$22-69 \quad \sum_{k=0}^{\infty} 1/(k^2 + 1)$$

$$22-85 \quad \sum_{k=1}^{\infty} 1/\sinh^2 k$$

$$22-70 \quad \sum_{k=1}^{\infty} k^k/k!$$

$$22-86 \quad \sum_{k=1}^{\infty} k^2/(2k)!$$

$$22-71 \quad \sum_{k=1}^{\infty} k^k/(2k)!$$

$$22-87 \quad \sum_{k=1}^{\infty} (\sqrt{k} - \sqrt{k-1})^k$$

$$22-72 \quad \sum_{k=3}^{\infty} 1/(\sqrt[3]{k} \ln k)$$

$$22-88 \quad \sum_{k=2}^{\infty} k/[(1 + k^2)\ln(1 + k^2)]$$

$$22-89 \sum_{k=10}^{\infty} (\sqrt{k} + 3)^3 / (\sqrt{k} - 3)^6$$

$$22-90 \sum_{k=1}^{\infty} \sqrt{k!} / k^k$$

In Problems 22-91 through 22-105 determine whether the series converges absolutely, converges conditionally, or diverges:

$$22-91 \sum_{k=1}^{\infty} (-1)^k / \sqrt{k}$$

$$22-99 \sum_{k=1}^{\infty} (2k)! / (-k)^k$$

$$22-92 \sum_{k=3}^{\infty} (-1)^k / (k \ln^2 k)$$

$$22-100 \sum_{k=1}^{\infty} (-1)^k k^2 / k!$$

$$22-93 \sum_{k=1}^{\infty} (-2)^k / k^2$$

$$22-101 \sum_{k=1}^{\infty} (-1)^k [1 - (1/k)]^{k^2}$$

$$22-94 \sum_{k=1}^{\infty} (-2)^k / k!$$

$$22-102 \sum_{k=3}^{\infty} (-1)^k / (k \sqrt{\ln k})$$

$$22-95 \sum_{k=0}^{\infty} (-1)^k k^3 / e^{k^4}$$

$$22-103 \sum_{k=1}^{\infty} \sin[(-1)^k / k]$$

$$22-96 \sum_{k=0}^{\infty} (-1)^k k^3 / (k^4 + 2)$$

$$22-104 \sum_{k=1}^{\infty} (-k)^k / k!$$

$$22-97 \sum_{k=3}^{\infty} (-1)^k / (\sqrt{k} \ln k)$$

$$22-105 \sum_{k=0}^{\infty} (-1)^k \sqrt{k} / (k + 1)$$

$$22-98 \sum_{k=3}^{\infty} (\ln k) / (-3)^k$$

Solutions to Supplementary Exercises

$$(22-25) \frac{1}{2}$$

(22-40) diverges

$$(22-26) 0$$

(22-41) 364/243

$$(22-27) \frac{1}{2}$$

(22-42) -182

$$(22-28) 49$$

(22-43) 1023/256

(22-29) diverges

(22-44) $\pi^3(1 + \pi^{29}) / (1 + \pi)$

$$(22-30) 0$$

(22-45) $(\pi^{16} - e^8) / [e^2 \pi^{13}(e + \pi^2)]$

$$(22-31) 0$$

(22-46) 2

$$(22-32) 0$$

(22-47) 5/8

$$(22-33) -3$$

(22-48) 9/13

(22-34) diverges

(22-49) 27/5

$$(22-35) 0$$

(22-50) 49/90

$$(22-36) 0$$

(22-51) $\pi^2 / (\pi - e)$

(22-37) diverges

(22-52) $4(2 - \sqrt{3})$

$$(22-38) 1$$

(22-53) 8/11

$$(22-39) 0$$

(22-54) 59/333

- (22-55) 191/999
- (22-56) 901/1111
- (22-57) converges (by integral test)
- (22-58) converges (by comparison with $\sum 1/2^k$)
- (22-59) converges (by limit comparison with $\sum 1/k^2$)
- (22-60) converges (by ratio test)
- (22-61) converges (by root test)
- (22-62) converges (by ratio test)
- (22-63) diverges (by integral test)
- (22-64) diverges (by limit comparison with $\sum 1/k$)
- (22-65) converges (by integral or comparison test)
- (22-66) diverges (by root test)
- (22-67) converges (by integral test, comparison test, or root test)
- (22-68) converges (by ratio test)
- (22-69) converges (by integral test or comparison test)
- (22-70) diverges (by ratio test)
- (22-71) converges (by ratio test)
- (22-72) diverges (by comparison with $\sum 1/k$)
- (22-73) diverges (by limit comparison with $\sum 1/k$)
- (22-74) converges (by root test)
- (22-75) converges (by limit comparison with $\sum 1/k^{3/2}$)
- (22-76) diverges (by integral test or comparison with $\sum 1/k$)
- (22-77) converges (by ratio test)
- (22-78) converges (by limit comparison with $\sum 1/k^{4/3}$)
- (22-79) diverges (by limit comparison with $\sum 1/k^{2/3}$)
- (22-80) diverges (by integral test)
- (22-81) diverges (by root test)
- (22-82) converges (by integral test)
- (22-83) converges (by ratio test)
- (22-84) diverges (by limit comparison with $\sum 1/\sqrt{k}$)
- (22-85) converges (by integral test)
- (22-86) converges (by ratio test)

- (22-87) converges (by root test)
- (22-88) diverges (by integral test)
- (22-89) converges (by limit comparison with $\sum 1/k^{3/2}$)
- (22-90) converges (by ratio test)
- (22-91) converges conditionally
- (22-92) converges absolutely
- (22-93) diverges
- (22-94) converges absolutely
- (22-95) converges absolutely
- (22-96) converges conditionally
- (22-97) converges conditionally
- (22-98) converges absolutely
- (22-99) diverges
- (22-100) converges absolutely
- (22-101) converges absolutely
- (22-102) converges conditionally
- (22-103) converges conditionally
- (22-104) diverges
- (22-105) converges conditionally