***SOLUTION Section* 3.4 – Comparison Tests**

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent *p*-series, since *p* = 2 > 1.

Both series have nonnegative terms for 





Then, by Comparison Test,  ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent *p*-series, since *p* = 3 > 1.

Both series have nonnegative terms for 







Then, by *Comparison Test*, the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a divergent *p*-series, since *p* = 1 ≤ 1.

Both series have nonnegative terms for 





Then, by *Comparison Test*, the given series ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent *p*-series, since .

Both series have nonnegative terms for 





Then, by *Comparison Test*, the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a divergent *p*-series, since .

Both series have nonnegative terms for 





Then, by *Comparison Test*, the given series ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent series.

Then 

Therefore, the given series ***converges*** by *comparison Test*.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***











Therefore, by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***





Since  ***diverges*** to infinity (it is a harmonic series),

Therefore; by *Comparison Test* the series  ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



 



By the ***p****-series* the series  diverges 

Therefore; by *Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



By the ***p****-series* the series  converges 

Therefore; by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



 

By the ***p****-series* the series  diverges 

Therefore; by *Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



By the geometric series:  converges

Therefore; by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

 (and by integral test)

The given series ***converges*** by *Comparison Test* with the divergent series.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



By the ***p****-series* the series  converges 

Therefore; by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***

 For 

By the ***p****-series* the series  converges 

Therefore; by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



By the ***p****-series* the series  diverges 

Therefore; by *Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



Geometric series:  converges

Therefore; by *Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Comparison Test* to determine if the series converges or diverges. 

***Solution***



Geometric series:  *diverges*

Therefore; by *Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent *p*-series, since .





 or ***L’Hopital Rule***



Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a divergent *p*-series, since .









Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent geometric, since .













Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a divergent *p*-series, since .











Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a convergent geometric, since .













Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Comparing with , which is a divergent *p*-series, since .













Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Let 





Since the ***p****-series* diverges to infinity 

Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Let 





Since the ***p****-series* converges 

Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***







Since the ***p****-series* diverges to infinity 

Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the Limit Comparison Test to determine if the series converges or diverges. 

***Solution***





By geometric series  converges

Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***





Since the ***p****-series* diverges to infinity 

Therefore; by *Limit Comparison Test,* the given series ***diverges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***





By geometric series  converges

Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Let 





Since the ***p****-series* converges 

Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Let  By the ***p****-series* converges 





Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use the *Limit Comparison Test* to determine if the series converges or diverges. 

***Solution***

Let  By the ***p****-series* converges  ,



Therefore; by *Limit Comparison Test,* the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Comparing with , which is a divergent *p*-series, since .













Then, by Comparison Test, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Comparing with , which is a convergent geometric, since .

By the Direct Comparison Test: 

The given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Comparing with , which is a convergent *p*-series, since .









Then, by Comparison Test, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Comparing with , which is a convergent *p*-series, since .











Then, by Comparison Test, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

By the Direct Comparison Test: 

, which is a convergent geometric, since .

Therefore, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Comparing with , which is a convergent *p*-series, since .













Then, by Comparison Test, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let 

 which does not exist.

, then the given series converges by comparison test

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***



So, by the Direct Comparison Test, the series converges.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***



By the ***p****-series* the series  diverges 

The given series ***diverges*** by Comparison Test using ***p****-series*

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

 

By the ***p****-series* the series  diverges 

The given series ***diverges*** by Comparison Test using ***p****-series.*



The given series ***diverges*** by Limit Comparison Test

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  By the ***p****-series* converges 



Therefore, the given series ***converges*** by the limit comparison test.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***



By the ***p****-series* the series  diverges 

The given series ***diverges*** by comparison test using ***p****-series*

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***



The given series ***diverges*** by Geometric series

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***



The given series converges by a Direct Comparison with the convergent geometric series 

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  By the ***p****-series* converges 



Therefore, the given series ***converges*** by the limit comparison test with ***p****-series*.

***Exercise***

Use any method to determine if the series converges or diverges ****

***Solution***

****

The given series ***diverges*** by the Limit

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





The given series ***converges*** by telescoping series.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***









The given series ***converges*** by the *Integral Test*.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***









Therefore; by the *Limit Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





 converges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





 converges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  converges by ***p-****series* 





 Let 





Therefore; by the *Limit Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  diverges by ***p-****series* 



 Let 





Therefore; by the *Limit Comparison Test*, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  converges by ***p-****series* 





 Let 





Therefore; by the *Limit Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





 converges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***







Therefore; by the *Comparison Test*, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





 converges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***converges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***

Let  diverges by ***p-****series* 





 Let 



Therefore; by the *Limit Comparison Test*, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





Therefore; by the *Divergence Test*, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***





 converges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***converges*** (absolutely)

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***









Therefore; by the *Divergence Test*, the given series ***diverges***.

***Exercise***

Use any method to determine if the series converges or diverges 

***Solution***









 diverges by ***p-****series* 

Therefore; by the *Comparison Test*, the given series ***diverges***.