# MATH 3406 Advanced Linear Algebra: Inner product spaces

1) What is the definition of an inner product space?

A) A space with a norm defined on it

B) A space with an inner product defined on it

C) A space with a metric defined on it

D) A space with a topology defined on it

2) Which of the following is NOT an example of an inner product space?

A) The set of all real numbers with the usual inner product

B) The set of all vectors in R^n with the usual inner product

C) The set of all polynomials with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

D) The set of all continuous functions on [0,1] with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

3) Which of the following is NOT true about inner product spaces?

A) Every inner product space is a vector space

B) Every inner product space is a metric space

C) Every inner product space is complete

D) Every inner product space is normed

4) What is the definition of orthogonality in an inner product space?

A) Two vectors are orthogonal if their inner product is zero

B) Two vectors are orthogonal if their angle is zero

C) Two vectors are orthogonal if their norm is zero

D) Two vectors are orthogonal if their distance is zero

5) Which of the following is NOT an example of an orthogonal set in an inner product space?

A) The set of all vectors in R^n with the usual inner product

B) The set of all polynomials with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

C) The set of all continuous functions on [0,1] with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

D) The set of all vectors in R^n with the inner product defined by <x,y> = x_1y_1 + ... + x_ny_n

6) What is the definition of an orthonormal set in an inner product space?

A) A set of vectors that are orthogonal to each other

B) A set of vectors that are normalized

C) A set of vectors that are orthogonal to each other and normalized

D) A set of vectors that are orthogonal to each other and have the same norm

7) Which of the following is NOT an example of an orthonormal set in an inner product space?

A) The set of all vectors in $R^n$ with the usual inner product

B) The set of all polynomials with the inner product defined by $\langle f,g \rangle = \int_0^1 f(x)g(x)\, dx$

C) The set of all continuous functions on [0,1] with the inner product defined by $\langle f,g \rangle = \int_0^1 f(x)g(x)\, dx$

D) The set of all vectors in $R^n$ with the inner product defined by $\langle x,y \rangle = x_1y_1 + ... + x_ny_n$

8) What is the definition of an orthogonal projection in an inner product space?

A) A projection onto a subspace that is orthogonal to the complement of that subspace

B) A projection onto a subspace that is orthogonal to the subspace

C) A projection onto a subspace that is orthogonal to the whole space

D) A projection onto a subspace that is not orthogonal to the subspace

9) Which of the following is NOT an example of an orthogonal projection in an inner product space?

A) The projection of $R^n$ onto a subspace of $R^n$

B) The projection of $R^n$ onto a subspace of $R^n$ that is orthogonal to the subspace

C) The projection of $R^n$ onto a subspace of $R^n$ that is not orthogonal to the subspace

D) The projection of $R^n$ onto a subspace of $R^n$ that is orthogonal to the whole space

10) What is the definition of an orthonormal basis in an inner product space?

A) A basis that is orthogonal to each other

B) A basis that is normalized

C) A basis that is orthogonal to each other and normalized

D) A basis that is orthogonal to each other and have the same norm

11) Which of the following is NOT an example of an orthonormal basis in an inner product space?

A) The set of all vectors in $R^n$ with the usual inner product

B) The set of all polynomials with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

C) The set of all continuous functions on [0,1] with the inner product defined by <f,g> = int_0^1 f(x)g(x) dx

D) The set of all vectors in R^n with the inner product defined by <x,y> = x_1y_1 + ... + x_ny_n

12) What is the definition of an orthonormal transformation in an inner product space?

A) A transformation that is orthogonal to each other

B) A transformation that is normalized

C) A transformation that is orthogonal to each other and normalized

D) A transformation that is orthogonal to each other and have the same norm

13) Which of the following is NOT an example of an orthonormal transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

14) What is the definition of a unitary transformation in an inner product space?

A) A transformation that is orthogonal

B) A transformation that is unitary

C) A transformation that is orthogonal and unitary

D) A transformation that is not orthogonal or unitary

15) Which of the following is NOT an example of a unitary transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

16) What is the definition of a self-adjoint transformation in an inner product space?

A) A transformation that is orthogonal

B) A transformation that is self-adjoint

C) A transformation that is orthogonal and self-adjoint

D) A transformation that is not orthogonal or self-adjoint

17) Which of the following is NOT an example of a self-adjoint transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

18) What is the definition of a normal transformation in an inner product space?

A) A transformation that is orthogonal

B) A transformation that is normal

C) A transformation that is orthogonal and normal

D) A transformation that is not orthogonal or normal

19) Which of the following is NOT an example of a normal transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

20) What is the definition of a Hermitian transformation in an inner product space?

A) A transformation that is orthogonal

B) A transformation that is Hermitian

C) A transformation that is orthogonal and Hermitian

D) A transformation that is not orthogonal or Hermitian

21) Which of the following is NOT an example of a Hermitian transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

22) What is the definition of a skew-Hermitian transformation in an inner product space?

A) A transformation that is orthogonal

B) A transformation that is skew-Hermitian

C) A transformation that is orthogonal and skew-Hermitian

D) A transformation that is not orthogonal or skew-Hermitian

23) Which of the following is NOT an example of a skew-Hermitian transformation in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

24) What is the definition of a unitary operator in an inner product space?

A) An operator that is orthogonal

B) An operator that is unitary

C) An operator that is orthogonal and unitary

D) An operator that is not orthogonal or unitary

25) Which of the following is NOT an example of a unitary operator in an inner product space?

A) The projection of R^n onto a subspace of R^n

B) The projection of R^n onto a subspace of R^n that is orthogonal to the subspace

C) The projection of R^n onto a subspace of R^n that is not orthogonal to the subspace

D) The projection of R^n onto a subspace of R^n that is orthogonal to the whole space

1) B
2) D
3) C
4) A
5) D
6) C
7) D
8) A
9) C

10) C
11) D
12) C
13) C
14) C
15) C
16) C
17) C
18) C
19) C
20) C
21) C
22) C
23) C
24) C
25) C