Q1. The three steps from solids to points are :
a. Solids - surfaces - lines - points
b. Solids - lines - surfaces - points
c. Lines - points - surfaces - solids
d. Lines - surfaces - points - solids

Answer: a. Solids - surfaces - lines - points

A solid has size, shape and position.

The boundaries are called surfaces

The boundaries of the surfaces are straight lines or curves.

The points are the ends of these lines

Therefore, the three steps are solids - surfaces - lines - points.

Q2. The number of dimensions, a solid has :

a. 1 b. 2 c. 3 d. 0

Answer: c. 3

I step - Let us describe the dimensions in a solid

The measurement in a particular direction is the dimension.

A solid has length, breadth and height.

II step - Determine the number of dimensions in the solid

Number of dimensions in a solid is 3

Therefore, a solid has 3 number of dimensions

3. The number of dimensions, a surface has

a. 1 b. 2 c. 3 d. 0

Answer: b. 2

A continuous set of points which has length and breadth but no thickness is called a surface. So it has two dimensions.

Q4. The number of dimension, a point has

a. 0 b. 1 c. 2 d. 3

Answer: a. 0

- A point marks a place and has no length, breadth and thickness

- A point is devoid of three fundamental dimensions

Q5. Euclid divided his famous treatise "The Elements" into

a. 13 chapters **b. 12 chapters** **c. 11 chapters** **d. 9 chapters**

Answer: a. 13 chapters

Euclid's Treatise "The Elements" is written in 13 chapters. It mainly deals with Solid figures, Plane Geometry, Fundamental arithmetic and few typical problems.

Q6. The total number of propositions in the Elements are

a. 465 **b. 460** **c. 13** **d. 55**

Answer: a. 465

Theorems or propositions are statements which can be proved. Euclid deduced 465 propositions in a logical chain making use of his definitions, postulates, axioms and theorems.

Q7. Boundaries of solids are

a. surfaces **b. curves** **c. lines** **d. points**

Answer: a. surfaces

Boundaries of solids are known as surfaces whereas boundaries of surfaces are known as curves.

Q8. Boundaries of surfaces are

a. surfaces **b. curves** **c. lines** **d. points**

Answer: b. curves

Boundaries of surfaces are known as curves whereas boundaries of solids are known as surfaces.

Q9. In Indus Valley Civilisation (about 3000 B.C.), the bricks used for construction work were having dimensions in the ratio

a. 1 : 3 : 4 **b. 4 : 2 : 1** **c. 4 : 4 : 1** **d. 4 : 3 : 2**

Answer: b. 4 : 2 : 1

The bricks used for construction in the Indus Valley Civilisation are in the ratio

Length: Breadth: Thickness = 4: 2: 1

Q10. A pyramid is a solid figure, the base of which is

a. only a triangle **b. only a square**

c. only a rectangle **d. any polygon**

Answer: d. any polygon

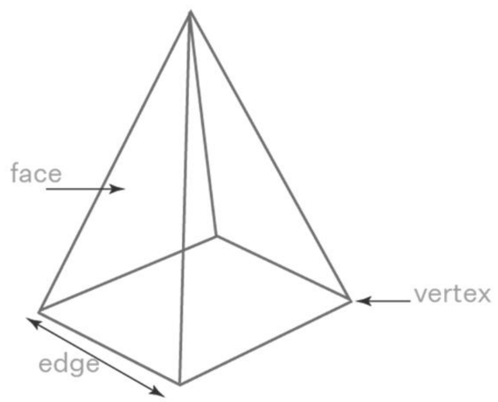
In mathematics, a pyramid is a 3D figure built with a base of a polygon and triangular faces all connected together.

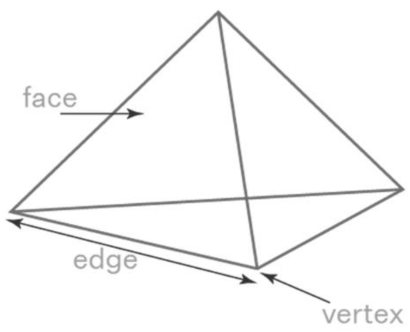
A pyramid is a 3D polyhedron with the base of a polygon along with three or more triangle-shaped faces that meet at a point above the base.

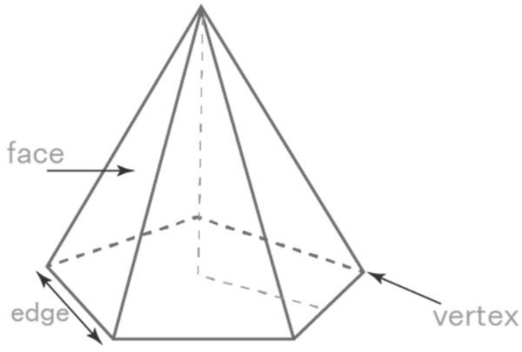
The triangular sides are called faces and the point above the base is called the apex.

A pyramid is made by connecting the base to the apex.

A pyramid is a solid figure, the base of which is a square, triangle or some other polygon







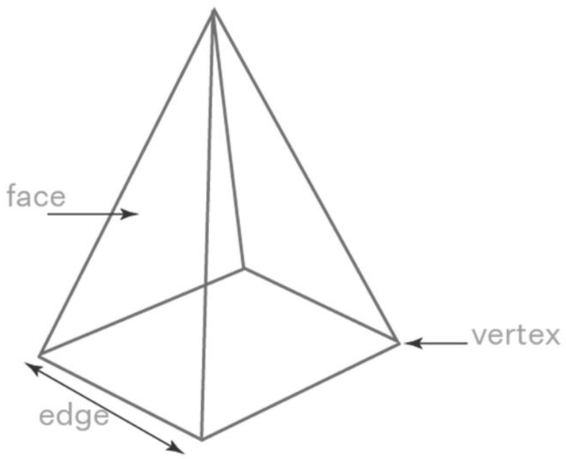
Therefore, a pyramid is a solid figure, the base of which is any polygon.

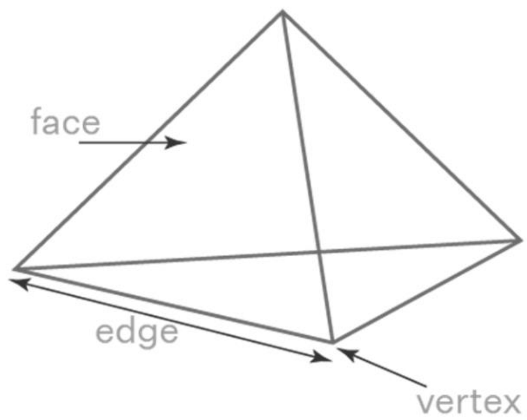
Q11. The side faces of a pyramid are

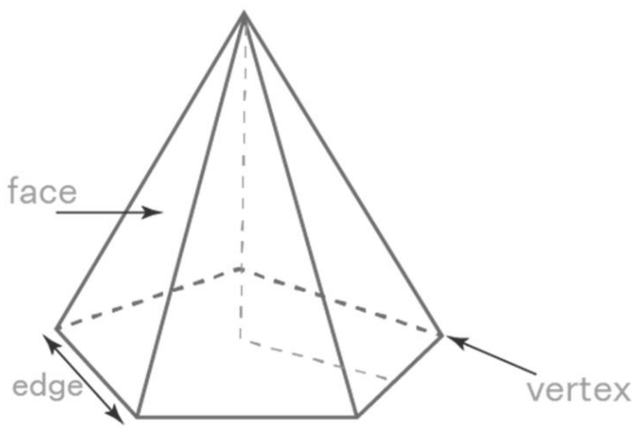
a. Triangles **b. Squares** **c. Polygons** **d. Trapeziums**

Answer: a. Triangles

Let us consider the pyramids mentioned below







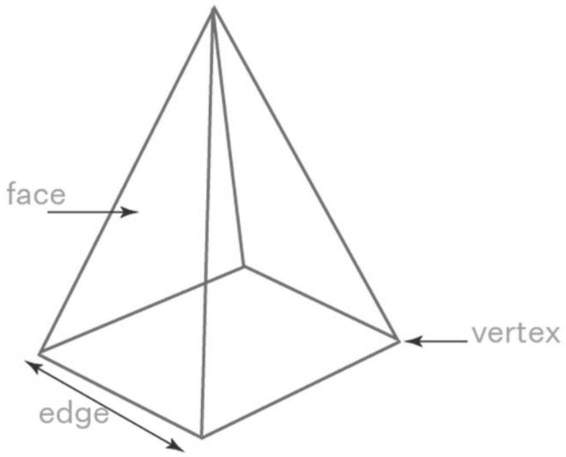
From these figures we get to know that the side faces are triangles.

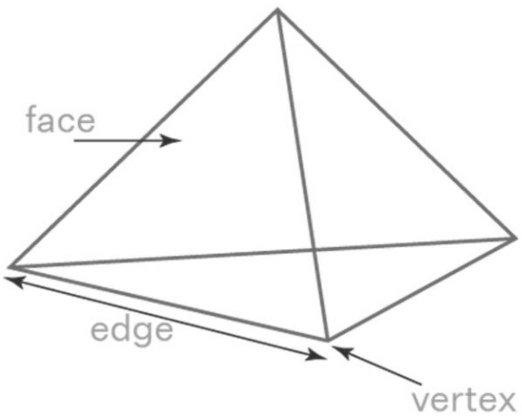
Hence, the side faces of a pyramid are triangles.

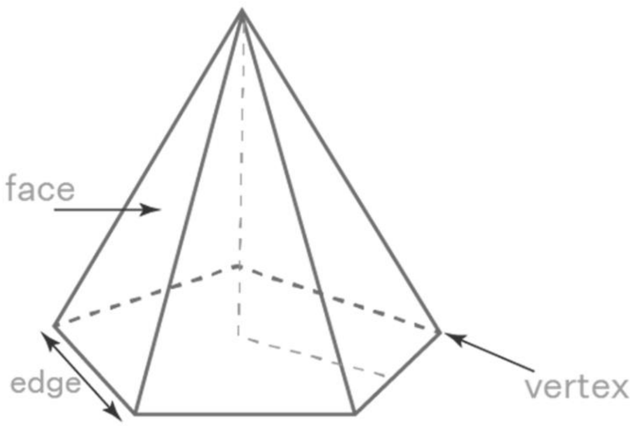
Q12. The side faces of a pyramid are

a. Triangles **b. Squares** **c. Polygons** **d. Trapeziums**

Answer: Let us consider the pyramids mentioned below







From these figures we get to know that the side faces are triangles.

Hence, the side faces of a pyramid are triangles.

13. In ancient India, the shapes of altars used for household rituals were:

(A) Squares and circles (B) Triangles and rectangles

(C) Trapeziums and pyramids (D) Rectangles and squares

Answer:

(A) : Squares and circles

14. The number of interwoven isosceles triangles in Sriyantra (in the Atharvaveda) is:

(A) Seven (B) Eight (C) Nine (D) Eleven

Answer: (C) Nine

15. Greek's emphasised on:

(A) Inductive reasoning (B) Deductive reasoning

(C) Both (A) and (B) (D) Practical use of geometry

Answer: (B) Deductive reasoning

16. In ancient India, altars with combination of shapes like rectangles, triangles and trapeziums were used for

(A) Public worship (B) Household rituals

(C) Both (A) and (B) (D) None of A, B, C

Answer: (A) Public worship

17. **Euclid belongs to the country:**

(A) Babylonia (B) Egypt (C) Greece (D) India

Answer: (C) Greece

18. Thales belongs to the country:

(A) Babylonia (B) Egypt (C) Greece (D) Rome

Answer: (C) Greece

19. Pythagoras was a student of:

(A) Thales (B) Euclid (C) Both (A) and (B) (D) Archimedes

Answer: (A) Thales

20. Which of the following needs a proof ?

(A) Theorem (B) Axiom (C) Definition (D) Postulate

Answer: (A) Theorem

21. Euclid stated that all right angles are equal to each other in the form of

(A) an axiom (B) a definition (C) a postulate (D) a proof

Answer: (C) a postulate

22. 'Lines are parallel, if they do not intersect' is stated in the form of

(A) an axiom (B) a definition (C) a postulate (D) a proof

Answer: 'Lines are parallel, if they do not intersect' is the definition of parallel lines.

Write whether the following statements are True or False? Justify your answer:

1. Euclidean geometry is valid only for curved surfaces. Is the given statement true or false? Justify your answer

Answer: Euclidean geometry is based on the postulates and axioms that are valid for plane surfaces. Euclidean is not physical space whereas curved space needs physical space. So it is not valid for curved surfaces. Therefore, the statement is false.

2. The boundaries of the solids are curves. Is the given statement true or false? Justify your answer.

Answer: The boundaries of the solids are surfaces. The boundaries of surfaces are curves. Therefore, the statement is false.

3. The edges of a surface are curves. Is the given statement true or false? Justify your answer

Answer: Edges of a surface are known as lines. Therefore, the statement is false.

4. The edges of a surface are curves. Is the given statement true or false? Justify your answer

Answer: Edges of a surface are known as lines. Therefore, the statement is false.

5. The things which are double of the same thing are equal to one another. Is the given statement true or false? Justify your answer

Answer: From the Euclidean axiom

The things which are double of the same thing are equal to one another

For example : If 2x = 2y then x = y. Therefore, the statement is true.

6. If a quantity B is a part of another quantity A, then A can be written as the sum of B and some third quantity C.

Answer: True. Since, it is one of the Euclid's axiom.

7. The statements that are proved are called axioms.
Answer: False
Because the statements that are proved are called theorems.

8. "For every line l and for every point P not lying on a given line l, there exits a unique line m passing though P and parallel to l is known as Playfair's axiom.

Answer: True

Since, it is an equivalent version of Euclid's fifth postulate and it is known as Playfair's axiom.

9. Two distinct intersecting lines cannot be parallel to the same line.
Answer: True. Since, it is an equivalent version of Euclid's fifth postulate.

10. Attempt to prove Euclid's fifth postulate using the other postulates and axioms led to the discovery of several other geometries.

Answer: True. All attempts to prove the fifth postulate as a theorem led to a great achievement in the creation of several other geometries. These geometries are quite different from Euclidean geometry and are called non-Euclidean geometry.

Solve each of the following question using appropriate Euclid's axiom :

Q1. Two salesmen make equal sales during the month of August. In September, each salesman doubles his sales for the month of August. Compare their sales in September. Solve using Euclid's axiom.

Answer: Given, two salesmen make equal sales during the month of August.

In September, each salesman doubles his sales for the month of August.

We have to compare their sales in September.

Let the sale of one salesman in August be x.

Given, sales are equal.

So, sale of other salesman in August = x

In September, sale of first salesman = 2x

Sale of second salesman = 2x

Using Euclid's axiom,

Things which are double of the same thing are equal to one another

Therefore, in September the sales are equal.

Q2. It is known that x + y = 10 and that x = z. Show that z + y = 10. Solve using Euclid's axiom

Answer:

Given, x + y = 10 --------- (1)

Also, x = z ------------------ (2)

We have to show that z + y = 10

Using Euclid's second axiom,

If equals are added to the equals, the wholes are equal.

From (2),

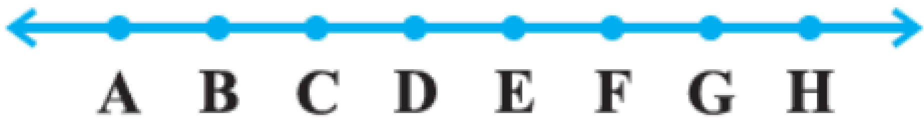
x + y = z + y

From (1),

z + y = 10

Therefore, z + y = 10

Q3. Look at the Fig. 5.3. Show that length AH > sum of lengths of AB + BC + CD. Solve using Euclid's axiom



Answer:

The figure represents the points A, B, C, D, E, F, G and H on the number line.

We have to show that the length AH > sum of lengths of AB + BC + CD

From the figure,

AH = AB + BC + CD + DE + EF + GH ----------- (1)

AB, BC, CD, DE, EF and GH are the parts of AH

Similarly, AB + BC + CD = AD --------------------- (2)

So, AB, BC and CD are the parts of AD

Using Euclid's axiom,

The whole is greater than the part.

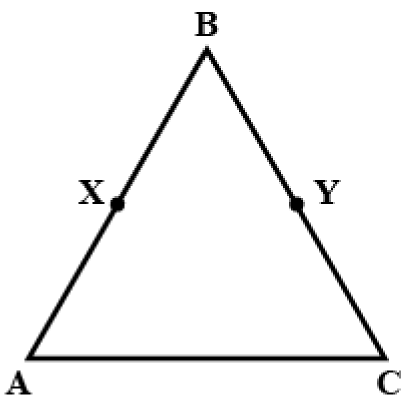
From (1) and (2), we observe that

AD is a part of AH

Length of AH = length of AD + DE + EF + GH

Therefore, length AH > sum of lengths of AB + BC + CD

Q4. In Fig.5.4, we have AB = BC, BX = BY. Show that AX = CY. Solve using Euclid's axiom



Answer:

The figure represents a triangle ABC.

The points X and Y lie on the sides AB and BC of the triangle ABC.

Given, AB = BC --------- (1)

Also, BX = BY ----------- (2)

We have to show that AX = CY

From the figure,

AB = AX + BX

So, AB - BX = AX ------------- (3)

Similarly,

BC = BY + CY

BC - BY = CY ------------------- (4)

By using Euclid's axiom,

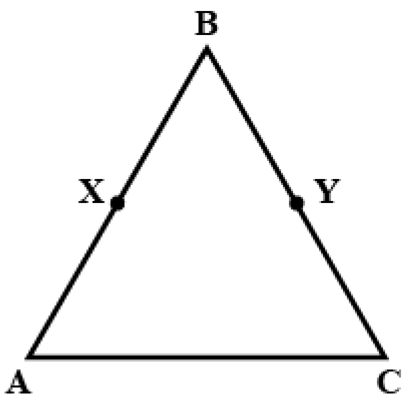
If equals be subtracted from equals, the remainders are equal.

Using (1) and (2) in (3) and (4),

AB - BX = BC - BY

Therefore, AX = CY

Q5. In Fig.5.5, we have X and Y are the mid-points of AC and BC and AX = CY. Show that AC = BC. Solve using Euclid's axiom.



Answer:

The figure represents a triangle ABC.

The points X and Y lie on the sides AB and BC.

Given, AC = BC ---------------------- (1)

Also, AX = CY ----------------------- (2)

We have to show that AC = BC.

Since X is the midpoint of AC

AC = 2AX = 2CX -------------------- (3)

Since Y is the midpoint of BC

BC = 2BY = 2CY --------------------- (4)

According to Euclid's axiom,

Things which are double of the same thing are equal to one another.

Using (2) in (3),

2AX = 2CY ------------------- (5)

Using (5) in (3) and (4),

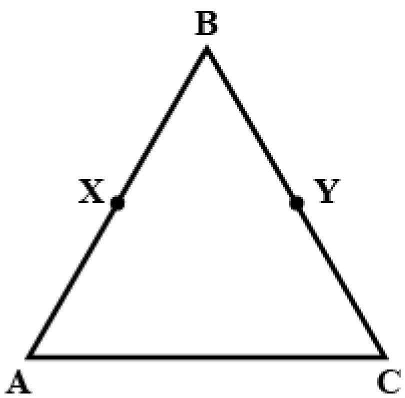
AC = 2AX = 2CY

BC = 2CY = 2AX

Therefore, AC = BC

Q6. In Fig.5.6, we have BX = 1/2 AB, BY = 1/2 BC and AB = BC. Show that BX = BY. Solve using Euclid's axiom.

Answer:



Answer:

The figure represents a triangle ABC.

The points X and Y lie on the sides AB and BC.

Given, BX = AB/2 ------------ (1)

BY = BC/2 --------------------- (2)

Also, AB = BC ---------------- (3)

We have to show that BX = BY

From (1), AB = 2BX

This implies X is the midpoint of AB

From (2), BC = 2BY

This implies Y is the midpoint of BC

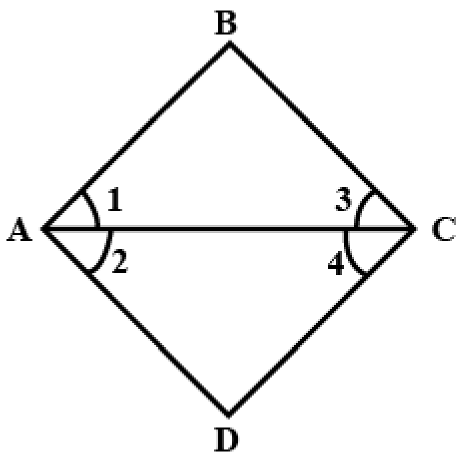
Using Euclid's axiom,

Things which are double of the same thing are equal to one another.

From (3), 2BX = 2BY

Therefore, BX = BY

Q7. In the Fig.5.7, we have ∠1 = ∠2, ∠2 = ∠3. Show that ∠1 = ∠3. Solve using Euclid's axiom.



Answer:

The figure represents a quadrilateral ABCD.

Given, ∠1 = ∠2 ------------------- (1)

Also, ∠2 = ∠3 -------------------- (2)

We have to show that ∠1 = ∠3.

From (1) and (2),

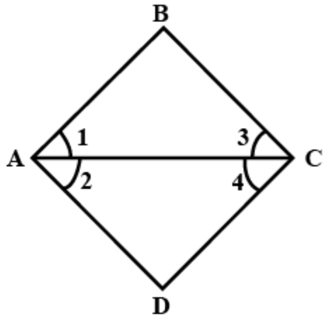
∠1 = ∠2 = ∠3

By using Euclid's axiom,

The things which are equal to the same thing are equal to one another.

Therefore, ∠1 = ∠3

Q8. In the Fig. 5.8, we have ∠1 = ∠3 and ∠2 = ∠4. Show that ∠A = ∠C. Solve using Euclid's axiom.



Answer:

The figure represents a quadrilateral ABCD.

Given, ∠1 = ∠3 -------------- (1)

Also, ∠2 = ∠4 ---------------- (2)

We have to show that ∠A = ∠C.

On adding (1) and (2),

∠1 + ∠2 = ∠3 + ∠4

By using Euclid's axiom,

If equals are added to the equals, the wholes are equal.

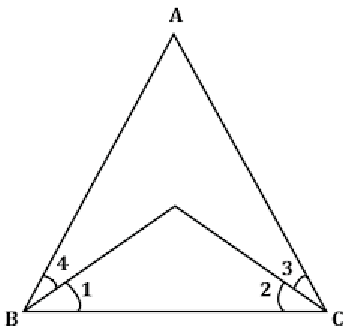
From the figure,

∠1 + ∠2 = ∠A

∠3 + ∠4 = ∠C

Therefore, ∠A = ∠C

Q9. In the Fig. 5.9, we have ∠ABC = ∠ACB, ∠3 = ∠4. Show that ∠1 = ∠2. Solve using Euclid's axiom



Answer:

The figure represents two triangles ABC and BDC with common base BC.

Given, ∠ABC = ∠ACB ----------------- (1)

Also, ∠3 = ∠4 ---------------------------- (2)

We have to show that ∠1 = ∠2

From the figure,

∠ABC = ∠1 + ∠4

∠1 = ∠ABC - ∠4 ------------------------ (3)

∠ACB = ∠3 + ∠2

∠2 = ∠ACB - ∠3 ------------------------ (4)

By using Euclid's axiom,

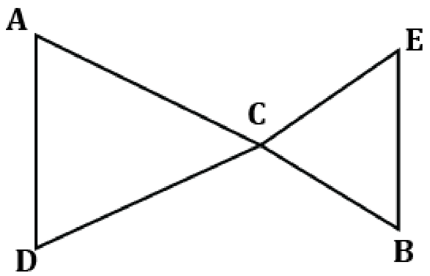
If equals be subtracted from equals, the remainders are equal.

From (3) and (4),

∠ABC - ∠4 = ∠ACB - ∠3

Therefore, ∠1 = ∠2

Q10. **In the Fig. 5.10, we have AC = DC, CB = CE. Show that AB = DE. Solve using Euclid's axiom**



Answer:

The figure represents two triangles ADC and CBE with common vertex C.

Given, AC = DC --------------------- (1)

Also, CB = CE ----------------------- (2)

We have to show that AB = DE.

By using Euclid's axiom,

If equals are added to the equals, the wholes are equal.

On adding (1) and (2),

AC + CB = DC + CE

From the figure,

AC + CB = AB --------------------- (3)

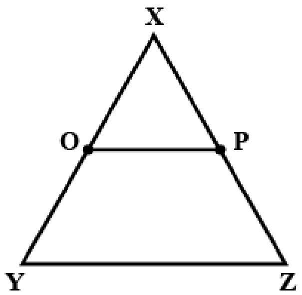
Similarly, DC + EC = DE -------- (4)

From (3) and (4),

AB = DE

Therefore, it is proved that AB = DE

Q11. In the Fig. 5.11, if OX = 1/2 XY, PX = 1/2 XZ and OX = PX, show that XY = XZ..Solve using Euclid's axiom



Answer:

The figure represents a triangle XYZ.

The points O and P lie on the sides XY and XZ.

Given, OX = XY/2 --------------- (1)

PX = XZ/2 ------------------------ (2)

Also, OX = PX —------------------ (3)

We have to show that XY = XZ.

From (1), XY = 2OX

This implies O is the midpoint of XY

So, XY = 2OX = 2OY ---------------------- (4)

From (2), XZ = 2PX

This implies P is the midpoint of XZ

So, XZ = 2PX = 2PZ ---------------------- (5)

According to Euclid's axiom,

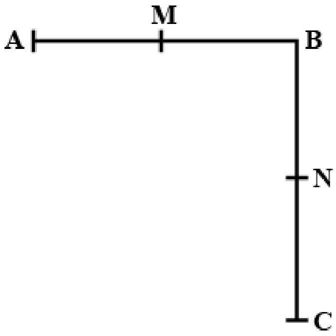
Things which are double of the same thing are equal to one another

Using (3) in (4) and (5), we get

2OX = 2PX

Therefore, XY = XZ

Q12. In Fig.5.12, we have AB = BC, M is the mid-point of AB and N is the mid- point of BC. Show that AM = NC. Solve using Euclid's axiom



Answer:

The figure represents two line segments AB and BC.

Given, AB = BC ------------------- (1)

M is the midpoint of AB

N is the midpoint of BC

We have to show that AM = NC

Since M is the midpoint of AB we get

AB = 2AM = 2BM

AM = BM = AB/2 ----------------------- (2)

Since N is the midpoint of BC, we get

BC = 2BN = 2NC

BC = BN = NC/2 ---------------------- (3)

By using Euclid's axiom,

Things which are halves of the same thing are equal to one another.

Multiplying (1) by 1/2 on both sides, we get

AB/2 = BC/2

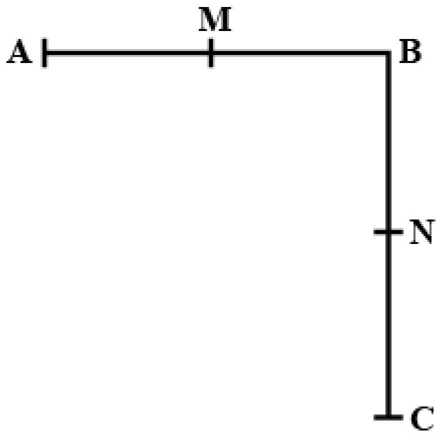
From (2) and (3),

BM = BN

AM = NC

Therefore, it is proved that AM = NC

Q13. In Fig.5.12, we have BM = BN, M is the mid-point of AB and N is the mid-point of BC. Show that AB = BC. Solve using Euclid's axiom



Answer:

The figure represents two line segments AB and BC.

Given, BM = BN ------------------- (1)

M is the midpoint of AB

N is the midpoint of BC

We have to show that AB = BC

Since M is the midpoint of AB we get

AB = 2AM = 2BM ----------------------- (2)

Since N is the midpoint of BC, we get

BC = 2BN = 2NC ----------------------- (3)

By using Euclid's axiom,

Things which are double of the same thing are equal to one another.

Using (1) in (2) and (3),

2BM = 2BN

AB = BC

Therefore, AB = BC

Read the following statement:

Q1. An equilateral triangle is a polygon made up of three line segments out of which two line segments are equal to the third one and all its angles are 60° each. Define the terms used in this definition which you feel necessary. Are there any undefined terms in this? Can you justify that all sides and all angles are equal in a equilateral triangle.

Answer:

Given, the statement is "An equilateral triangle is a polygon made up of three line segments out of which two line segments are equal to the third one and all its angles are 60° each".

We have to define the terms used in the definition.

We have to find the undefined terms

We have to justify that all the sides and all angles are equal in an equilateral triangle.

The terms used in the definition,

Polygon : a plane figure with at least three straight sides and angles, and typically five or more.

Line segment : a piece or part of a line having two endpoints

Angle : the space measured in degree, between two intersecting lines or surfaces at or close to the point where they meet.

Acute angle : an angle which measures less than 90 degrees

The undefined terms are point and line.

Given, two line segments are equal to the third one

All the angles are equal to 60° each

By using Euclid's axiom,

The things which are equal to the same thing are equal to one another.

Therefore, all the three sides of an equilateral triangle are equal.

Q2. Study the following statement: "Two intersecting lines cannot be perpendicular to the same line". Check whether it is an equivalent version to the Euclid's fifth postulate. [Hint : Identify the two intersecting lines l and m and the line n in the above statement.]

Answer:

Given, the statement is "Two intersecting lines cannot be perpendicular to the same line".

We have to determine an equivalent version to the Euclid's fifth postulate.

Euclid's fifth postulate states that if a straight line falling on two straight lines makes the interior angles on the same side of it, taken together less than two right angles, then the the two straight lines if produced indefinitely, meet on that side on which the sum of angles is taken together less than two right angles.

Two equivalent version to the Euclid's fifth postulate are

1) For every line l and for every point P not lying on Z, there exists a unique line m passing through P and parallel to Z.

2) Two distinct intersecting lines cannot be parallel to the same line.

Therefore, the given statement is not an equivalent version to Euclid's fifth postulate.

Q3. Read the following statements which are taken as axioms :

(i) If a transversal intersects two parallel lines, then corresponding angles are not necessarily equal.

(ii) If a transversal intersects two parallel lines, then alternate interior angles are equal. Is this system of axioms consistent? Justify your answer

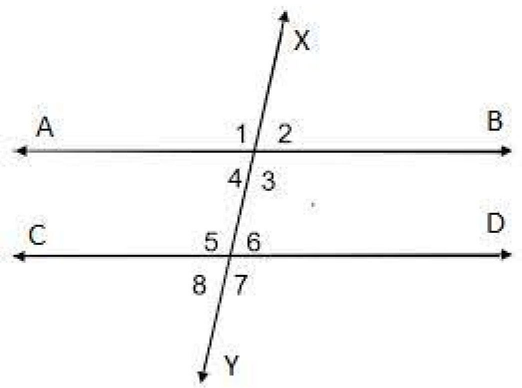
Answer:

Given, the statements are

(i) If a transversal intersects two parallel lines, then corresponding angles are not necessarily equal.

(ii) If a transversal intersects two parallel lines, then alternate interior angles are equal

A system of axioms is called consistent , if there is no statement which can be deduced from these axioms such that it contradicts any axiom.



The alternate interior angle theorem states that if a transversal intersects two parallel lines, then corresponding angles are equal.

From the figure,

$\angle 1 = \angle 5$,

$\angle 2 = \angle 6$

$\angle 3 = \angle 7$

$\angle 4 = \angle 8$

Therefore, the first statement is false and not an axiom.

The alternate interior angle theorem states that if a transversal intersects two parallel lines, then the alternate interior angles are equal.

Therefore, the second statement is true and an axiom.

Q4. Read the following two statements which are taken as axioms
(i) If two lines intersect each other, then the vertically opposite angles are not equal.
(ii) If a ray stands on a line, then the sum of two adjacent angles so formed is equal to 180°.
Is this system of axioms consistent? Justify your answer

Answer:

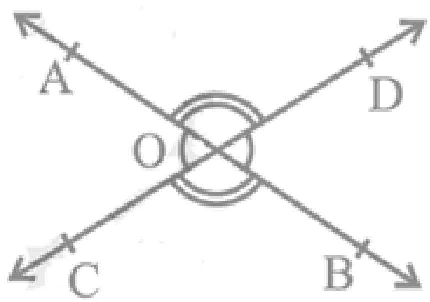
Given, the statements are

(i) If two lines intersect each other, then the vertically opposite angles are not equal.

(ii) If a ray stands on a line, then the sum of two adjacent angles formed is equal to 180°.

We have to determine if the system of axioms is consistent or not.

In a pair of intersecting lines, the vertically opposite angles are equal is a theorem

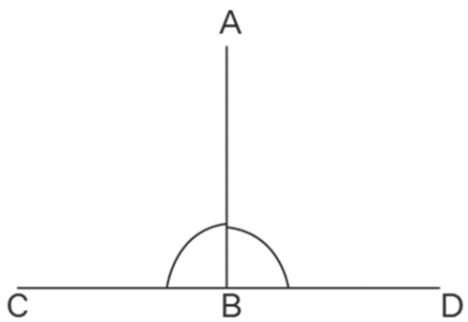


From the figure,

∠AOD = ∠COB

∠AOC = ∠DOB

Therefore, the first statement is false and not an axiom.



From the figure,

AB is a ray standing on a straight line CD.

AB is perpendicular to CD

The adjacent angles are right angles

$\angle B = \angle ABC + \angle ABD$

$= 90° + 90°$

Total angle = 180°

Therefore, the second statement is true and an axiom.

Q5. Read the following axioms

(i) Things which are equal to the same thing are equal to one another

(ii) If equals are added to equals, the wholes are equal

(iii) Things which are double of the same thing are equal to one another

Check whether the given system of axioms is consistent or inconsistent

Answer: Given the statements are

(i) Things which are equal to the same thing are equal to one another.

(ii) If equals are added to equals, the wholes are equal.

(iii) Things which are double of the same thing are equal to one another.

We have to determine if the system of axioms is consistent or inconsistent.

A system of axioms is called consistent , if there is no statement which can be deduced from these axioms such that it contradicts any axiom.

According to Euclid's first axiom,

The things which are equal to the same thing are equal to one another.

According to Euclid's second axiom,

If equals are added to the equals, the wholes are equal.

According to Euclid's sixth axiom,

Things which are double of the same thing are equal to one another.

We observe that the given statements are Euclid's axioms.

We cannot deduce any statement from these axioms which contradicts any axiom.

Therefore, the given statements are consistent.