| **Script Code** | v22cb09ma0812 |
| --- | --- |
| **Screenplay Status** | PL SIGN OFF |
| **Title** | Mid-point Theorem |
| **Grade** | 9 |
| **Writer** | [Virender Kumar](mailto:virender.k@narayanagroup.com) |
| **TL** | Shalini Kumpati |
| **SME** | [Bela Arora](mailto:bela.arora@narayanagroup.com) |
| **Creative Director** | [Ninad Dilip Mohite](mailto:ninad.d@narayanagroup.com) |
| **Final Sign-off** | [Vishnu Dev](mailto:vishnu.dev@narayanagroup.com) |
| **Mini Takeaway** | The line segment joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it. |
| **Key Takeaway** | Properties of parallelogram |
| **Research Doc.** | [Link](https://docs.google.com/document/d/1H1w05ryP5mfXpBrqj_cGp0gKlN9BdeVodUHo0wlg0_8/edit) |
|  |  |
| **Word Count** | 903 |
| **Presenter** | [Aashay Chandrakant Mane](mailto:aashay.mane@narayanagroup.com) |
| **Characters** | Presenter |
| **Locations** | STUDIO |
| **Presenter Outfit** | Smart Casual |
|
| **Props** | Not required |
| **Sub strand** | Geometry III |

**FSA (TITLE CARD) - THE MID-POINT THEOREM**

**FSA ENDS.**

**INT. DRAWING ROOM - AFTERNOON**

**FSA:** A carpenter is making a triangular-shaped shelf in the drawing room.

A man who is in his late thirties walks in and starts observing the carpenter. The carpenter looks at the man and lets out a smile. The man smiles back and the carpenter starts working.

A young girl of 12 years comes running into the frame. She stands near the man and the carpenter.

GIRL

That’s just one shelf.

(beat)

I want another shelf for my brother as well.

CARPENTER

Certainly! I’ll make it.

CUT TO:

**INT. DRAWING ROOM - AFTERNOON**

The rack is ready and the carpenter is looking to fit it at the corner of the drawing room.

The girl and his father walk into the room and get excited.

GIRL

(excited)

Oh! The shelf is ready.

(beat)

It looks beautiful.

HL the plank, followed by the midpoints and the respective sides on cue with “…plank in the…”

CARPENTER

Thank you!

(beat)

You know? This plank in the middle is connected by the midpoints of its two sides.

Father talking to Girl and HL the respective planks on cue.

FATHER

Interesting!

(beat)

Ohh, is it?

(beat)

Then, I'm certain that the length of this plank is half the length of the lower plank.

Display the heading “Mid-point Theorem” on cue.

GIRL

(suspicious)

How can you be so sure without measuring it, dad?

FATHER

Well, that’s because I know the midpoint theorem of a triangle.

GIRL

(suspicious)

Midpoint theorem?

The father looks at the girl and lets out a smile.

**Transition to the presenter.**

PRESENTER

Hey everyone!

(beat)

Do you also want to know what the midpoint theorem is?

(beat)

Let’s begin then.

(beat)

The midpoint theorem states that…

(beat)

…the line segment joining the midpoints of two sides of a triangle is parallel to the third side…

(beat)

…and equal to half of it.

**TOS:** **Mid-point Theorem:** The line segment joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it.

PRESENTER

Let’s understand this better with the help of an activity.

**FSA (SECTION CARD): “ACTIVITY”**

**FSA ENDS. (**[**ref**](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g24d3fac64f3_0_214)**)**

**INSERT MoG:**

On cue with “First we will…” screen split in two. ([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g24d3fac64f3_0_219))

**Left Side:** A piece of paper slides in on the table and then with sketch effect a triangle ABC is drawn on it.

**Right Side:** Presenter.

PRESENTER

First, we will take a sheet of paper and draw a triangle of suitable measurements.

(beat)

Let’s name it ABC.

**Left Side:** Mark mid points on both sides AB and AC and name them E and F and highlight using pop-up effect.

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g24d3fac64f3_0_911))

PRESENTER

Then mark the midpoints of both the sides AB and AC and name them as E and F, respectively.

**Left Side:** Join E and F, and then highlight the line segment.

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g2517bd70551_0_5))

PRESENTER

Now, if we join these midpoints, we will get a line segment EF.

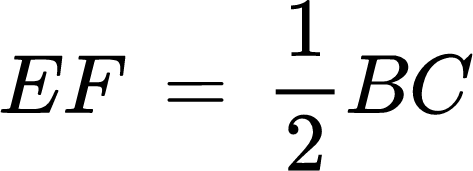
**Left Side:** A ruler slides in and then measures both EF and BC, ruler slides out and a protractor slides in measuring the angle angle AEF and angle ABC.

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_14))([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g2517bd70551_0_19))

PRESENTER

Now measure the lengths of the sides EF and BC using a ruler.

**Left Side:** Highlight the side EF and then side BC and add the following.

****

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_73))

PRESENTER

What do we observe?

(beat)

Well, the length of the side EF is exactly half the length of the side BC,

(beat)

…which means EF is equal to half of BC.

**Left Side:**On cue with “Here, AB is the transversal…” highlight the line AB and then both EF and BC followed by the point E and B.

**Right Side**:Presenter.

PRESENTER

And, here, AB is the transversal that intersects the lines EF and BC at two distinct points E and B, respectively.

(beat)

So, angles AEF and ABC are a pair of corresponding angles.

(beat)

Now we’ll measure these angles using a protractor.

**Left Side:** Highlight the triangle using pop-up effect.

**Right Side**: Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_30))

PRESENTER

So what did we observe after measuring them?

**Left Side:** Highlight angle AEF and angle ABC.

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_30))

PRESENTER

We observed that angles AEF and ABC are of the same measure.

**Left Side:** On cue with “ From this, we can…” highlight the pair of sides EF and BC.

**Right Side:** Presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_47))

PRESENTER

From this, we can say that EF is parallel to BC because…

(beat)

…if a pair of corresponding angles are equal, then the lines are parallel.

**Transition to presenter.**

PRESENTER

We can repeat this activity with as many triangles, but the result will be the same every single time.

(beat)

From this, we can say that the line segment joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it.

**TOS:**

The line segment joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it.

**INSERT ENDS.**

PRESENTER

It went well with an activity but let’s try to prove it.

**FSA (Section card): “ THE MIDPOINT THEOREM”**

**FSA ENDS.**([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g24d3fac64f3_0_0))

**INSERT MoG:**

On cue with “Here, we are given…” triangle ABC appears beside the presenter and mark two midpoints on side AB and side AC and name them E and F.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g24d3fac64f3_0_931))

And display the following text beside it:

**Given: A triangle ABC**

**E and F are the midpoints of AB and AC, respectively,**

**⇒ AE = EB**

**AF = FC**

PRESENTER

Here, we are given a triangle ABC with E and F as the midpoints of sides AB and AC, respectively.

(beat)

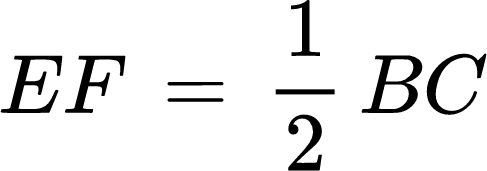
That is, AE is equal to EB,

(beat)

…and AF is equal to FC.

On cue with “And we need to…” highlight EF and BC and add the following.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_113))

**To Prove: EF || BC,**

****

PRESENTER

And we need to prove that the line segment EF is parallel to side BC,

(beat)

…and the length of EF is half the length of side BC.

On cue with “For that let’s do…” Join EF and extend EF and a line from point C to meet at point D,([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_127))

Note: Construction will be done using dotted lines.

And following text appears on cue

**Construction: Join EF and draw a line parallel to**

**BA through C to meet the produced EF at D.**

PRESENTER

For that, let’s do a small construction where we will join the points E and F,

(beat)

…and draw a line parallel to BA through vertex C to meet the produced EF at D.

On cue with “Let’s get on to…” highlight triangle AEF and triangle CDF and add the following text.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_141))

**Proof:**

**Consider ΔAEF and ΔCDF**

PRESENTER

Let’s get on to the proof.

(beat)

Consider triangles AEF and CDF.

On cue with “Here we have…” highlight AF and CF and then the point F and add the following text.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_156))

**AF = CF [∵ F is the midpoint of AC]**

PRESENTER

Here, we have AF equal to CF as F is the midpoint of side AC, which is given.

On cue with “Angle AFE…”, HL the angles and then add the following text.

**∠AFE = ∠CFD [Vertically opposite angles]**

PRESENTER

Angle AFE is equal to angle CFD as they are vertically opposite angles.

On cue with “And Angle EAF…” HL the angles EAF and DCF.

On cue with “transversal AC…”,HL the side AC, BA, CD and then points A and C on cue and then display the following text on cue.

**∠EAF = ∠DCF [alternate interior angles]**

PRESENTER

And angle EAF is equal to angle DCF as they are alternate interior angles…

(beat)

…formed when the transversal AC intersects the parallel lines BA and CD…

(beat)

…at two distinct points A and C, respectively .

On cue with “This means…” Add the following beside the presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_169))

**∴ ΔAEF ≌ ΔCDF [ASA rule of congruence]**

PRESENTER

This means by the angle-side-angle rule of congruence, triangle AEF and triangle CDF are congruent to each other.

On cue with “ …thus, side…” highlight AE and CD in the figure and add the following text.(ref)

**AE = CD ………(1) [CPCT]**

PRESENTER

As the corresponding parts of congruent triangles are equal to each other,

(beat)

side AE is equal to side CD.

(beat)

Let's consider this as equation one.

On cue with “EF is…”, HL the sides EF and DF and add the following text.

**EF = DF ………(2) [CPCT]**

PRESENTER

Also, EF is equal to DF.

(beat)

Let this be equation 2.

On cue with “Now, as we are given…” highlight the point E in the figure and then the side AB using pop-up effect and add the following text.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_214))

**AE = BE ………… (3) [Given]**

PRESENTER

Now, as we are given that E is the midpoint of side AB,

(beat)

…AE is equal to BE.

(beat)

Let this be equation 3.

HL the equation 1 and 3 using pop-up effect and then add the following text.

**BE = CD …………(4) [From (1) and (3)]**

PRESENTER

From equations 1 and 3, we can say BE is equal to CD.

(beat)

Let this be equation four.

On cue with “Through construction…” highlight BA and CD and then the points A, E, B as a line using the path effect followed by highlighting of BE and CD and add the following text

**BE || CD** **…………(5)**

PRESENTER

Through construction, we got BA parallel to CD.

(beat)

And, if we observe, the points A, E, and B are collinear.

(beat)

So, we can say that BE is parallel to CD.

(beat)

Let this be equation five.

On cue with “So from equation…” highlight equation four and five in the solution and add the following text and the TOS.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_309))

**As BE = CD, BE || CD, EBCD is a parallelogram.**

PRESENTER

So, from equation four and five, we can say that BE is both equal and parallel to side CD.

(beat)

This means EBCD is a parallelogram…

(beat)

…because if one pair of opposite sides are equal and parallel in a quadrilateral, it is a parallelogram.

**TOS:**

If one pair of opposite sides are equal and parallel in a quadrilateral, it is a parallelogram.

On cue with “This implies that…” highlight ED and BC in the figure and add the following.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_330))

**ED || BC [∵ Opposite sides of a parallelogram]**

PRESENTER

This implies that ED is also parallel to BC as opposite sides in a parallelogram are parallel.

On cue with “But, if we see…” highlight the points E, F and D using a straight line path effect then add the following.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_354))

**EF || BC**

PRESENTER

But, if we see, the points E, F, and D are collinear.

(beat)

Therefore, we can say that EF is also parallel to BC.

(beat)

Thus, we have proved part 1.

(beat)

Now, let’s get on to prove part 2, that is, the length of EF is half the length of side BC .

On cue with “Here ED is …” highlight ED and BC and

Add the following text

**ED = BC [∵ Opposite sides of a parallelogram]**

On cue with “…EF plus…” highlight EF and FD with different colors with the following text.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_375))

**EF + FD = BC**

PRESENTER

Here, ED is equal to BC…

(beat)

…because opposite sides are equal in a parallelogram.

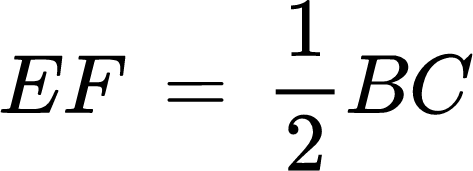
(beat)

This implies EF plus FD is equal to BC.

HL the equation 2 on cue with “But, from equation 2…” and then display the following texts.

**EF + EF = BC [from (2)]**

**2EF = BC**

****

PRESENTER

But, from equation 2, EF is equal to DF.

(beat)

So, we have EF plus EF is equal to BC.

(beat)

That is, 2 times EF is equal to BC.

(beat)

Or, in other words, EF is equal to half of BC.

(beat)

Thus, we have proved part 2 as well.

On cue with “Therefore,…” add the following TOS beside the presenter.([ref](https://docs.google.com/presentation/d/1J0fPdjnJ_L569_ttEo-SDLTYAMdKGtzAvHTPFbTSGUc/edit#slide=id.g229469052dd_0_100))

PRESENTER

Therefore, the line segment joining the midpoints of two sides of a triangle is parallel to the third side and half of it.

**TOS:**

**MidPoint Theorem** : The line segment joining the midpoints of two sides of a triangle is parallel to the third side and half of it.

**INSERT ENDS.**

**On cue with “But do you think…” add the following TOS beside the presenter.**

PRESENTER

And this concludes all for this session!

(beat)

But do you think the converse of the midpoint theorem would also be true?

(beat)

Watch our next video to find it out.

**TOS: Converse of Mid-Point Theorem**