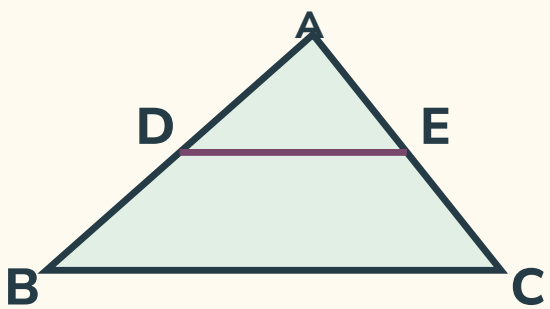
MATHS FIELD GUIDE · GRADE 10

Converse of proportional division

OPENING PROBLEM

Use AB = 8, AC = 6. AD = 4. Find AE.



DE ∥ BC

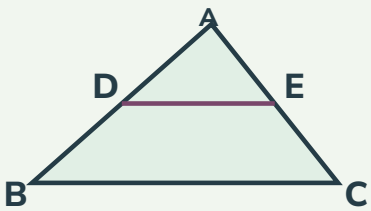
02 A parallel cut creates two similar triangles
03 Rules and worked cases
04 From the givens to the answer
05 Use parallel lines to transfer information
06 Check your reasoning
07 Check your reasoning

ILLUSTRATED PROBLEM SHEET

A parallel cut creates two similar triangles

D lies on AB, E lies on AC and DE is parallel to BC unless the question asks you to test it.

1



DE ∥ BC

Use AB = 8, AC = 6. AD = 4. Find AE.

D is halfway to B. The smaller triangle is at half scale, so AE = 3.

2

AD = 3, DB = 6
↓
AE = 4
↓
AD/DB = AE/EC

Recover the missing segment EC.

The lower piece is twice the upper piece on AB. EC must be twice 4, which is 8.

3

Side	Upper	Lower
AB	3	5
AC	6	10

If parallelism was not given, can you deduce it?

Yes. 3/5 = 6/10. The converse applies because D and E are internal points.

4

AD/AB = 2/5
↓
Area ADE / Area ABC = 4/25

What fraction of the large area remains below DE?

1 − 4/25 = 21/25. The area factor is the square of the length factor.

AD:DB = 1:3
AD:AB = 1:4.

AD:AB = 3:4
AD:DB = 3:1.

CHAPTER PROBLEM

AD=2,DB=3,AE=4,EC=6. Find AD/DB.

2/3. The two corresponding segment ratios equal 2/3.

MATHS REFERENCE · GRADE 10

Converse of proportional division

Rules, conditions and worked cases

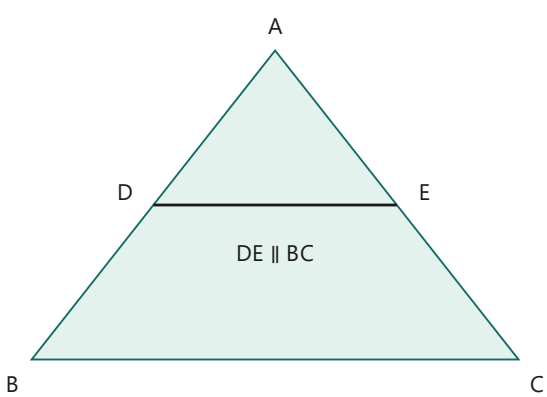
Recognise the case	Mathematical reasoning
Check corresponding parts	AD = 3, DB = 5, AE = 9, EC = 15 give 3/5 = 9/15. With internal points on AB and AC, DE ∥ BC.
Avoid mixed denominators	AD/AB compares part to whole. Match it with AE/AC, rather than AE/EC.
Near miss	Change EC to 14. Cross-products 3 × 14 and 5 × 9 differ, so the line cannot be parallel to BC.

Read the representations

A converse reverses the hypothesis and conclusion

For internal points D on AB and E on AC, AD/DB=AE/EC implies DE∥BC.

Do not assume DE∥BC to establish the ratios, then use those same ratios to prove parallelism. That would be circular.



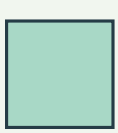
D lies on AB; E lies on AC.

Why the converse follows

Draw through D a line parallel to BC meeting AC at E'. By BPT, AE'/E'C=AD/DB.

The given ratio equals this. A fixed internal ratio determines a unique point on AC, so E'=E; hence DE∥BC.

1. **Given**Equal segment ratios
2. **Auxiliary line**DE' ∥ BC
3. **Use BPT and uniqueness**E' must coincide with E
4. **Conclusion**DE ∥ BC



square

If a quadrilateral is a square, are its diagonals equal?

Yes. They are hypotenuses of congruent right triangles.

WORKED EXAMPLES

From the givens to the answer

Test parallelism without trusting the sketch

1. AD=6,DB=9,AE=8,EC=12 for internal points.
2. 6/9=8/12=2/3.
3. By the converse of BPT, DE∥BC. A matching ratio is the reason, not its appearance.

Test whether the lines are parallel

D and E lie inside sides AB and AC. AD = 4, DB = 6, AE = 6 and EC = 8. Is DE parallel to BC?

1. Compare AD/DB = 2/3 with AE/EC = 3/4. They differ. If the lines were parallel the ratios would agree, so this configuration cannot have DE parallel to BC.

Check another case

Example 1

point arrangement

Point	D	E
Location	Between A and B	Between A and C

In triangle ABC, D is an internal point of AB and E is an internal point of AC. Use only the parallelism or ratios explicitly given in the question.

AD/AB=3/7, AC=63. Find AE that makes DE∥BC.

27

Use the same whole-side fraction.

Example 2

point arrangement

Point	D	E
Location	Between A and B	Between A and C

In triangle ABC, D is an internal point of AB and E is an internal point of AC. Use only the parallelism or ratios explicitly given in the question.

AD=5,AB=20,AC=20. Find EC for parallel DE.

15

AE=5, so EC=15.



rectangle

If the diagonals of a quadrilateral are equal, must it be a square?

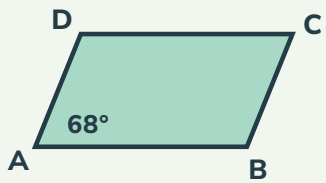
A non-square rectangle is a counterexample. Equal diagonals alone do not force equal sides.

ILLUSTRATED PROBLEM SHEET

Use parallel lines to transfer information

A transversal makes equal corresponding angles with two parallel lines. A parallel cut in a triangle preserves ratios of corresponding lengths.

1



AB ∥ CD

In parallelogram ABCD, angle A is 68°. Find angle B.

Angles on the same side of a transversal between parallel lines sum to 180°. The neighbour is 112°.

2

DE ∥ BC in triangle ABC
↓
AD/AB = AE/AC
↓
3/9 = AE/15

D is on AB and E on AC. Find AE.

AE = 5. The small triangle has one third the full side lengths.

3

Segment	First part	Second part
AB	4	6
AC	6	9

Do these division ratios support a parallel cut?

4/6 = 6/9. For internal D and E on the two sides, the converse gives DE ∥ BC.

4

DE joins side midpoints
↓
Scale = ½
↓
DE = ½ BC

If the opposite side is 18 cm, how long is the midsegment?

9 cm. It is parallel to the opposite side.

Small-to-large scale 1:3
areas in ratio 1:9.

Scale 1:3
perimeters in ratio 1:3.

CHAPTER PROBLEM

Explain the difference between BPT and its converse.

BPT starts with parallelism and concludes proportional division. The converse starts with proportional division and concludes parallelism for internal points.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

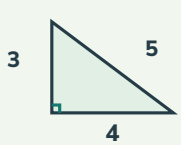
Data A

point arrangement

Point	D	E
Location	Between A and B	Between A and C

In triangle ABC, D is an internal point of AB and E is an internal point of AC. Use only the parallelism or ratios explicitly given in the question.

Try the problem	Solution and reasoning
01 · Data A D,E are internal on AB,AC. AD=4,DB=8,AE=5. Find EC required for DE∥BC.	10 Equal upper-to-lower ratios require 1/2=5/EC.
02 · Data A AD=4,DB=6,AE=8,EC=10. Is DE parallel to BC? A) Yes: both upper pieces double. B) No: 4/6 ≠ 8/10. C) Always, because D and E lie on the sides. D) No parallel line can cut two sides.	No: 4/6 ≠ 8/10. Compare correctly paired ratios.
03 · Data A AD/AB=3/7, AC=49. Find AE that makes DE∥BC.	21 Use the same whole-side fraction.
04 May you set AD/DB equal to AE/AC for a parallel cut?	Those fractions compare different parts. Match part to remainder on both sides, or part to whole on both.
05 Which is a circular proof? A) Use the given ratios, then the converse. B) Assume DE∥BC to obtain ratios, then use them to conclude DE∥BC. C) Draw an auxiliary parallel through D. D) Check both whole-side fractions.	Assume DE∥BC to obtain ratios, then use them to conclude DE∥BC. The desired conclusion is being assumed as a premise.
06 · Data A AD=3,AB=12,AC=20. Find EC for parallel DE.	15 AE=5, so EC=15.



Use one diagram to distinguish a theorem from its converse.

A right angle implies $3^2 + 4^2 = 5^2$ for these lengths. The equality also proves the angle is right by the converse of Pythagoras.

QUESTION BANK · FOLD OR COVER THE RIGHT COLUMN

Check your reasoning

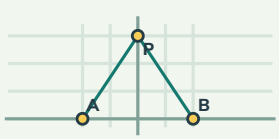
Data A

point arrangement

Point	D	E
Location	Between A and B	Between A and C

In triangle ABC, D is an internal point of AB and E is an internal point of AC. Use only the parallelism or ratios explicitly given in the question.

Try the problem	Solution and reasoning
07 If two corresponding lengths double, must the two triangles be similar?	An additional condition is needed, such as equality of their included angles.
08 Outline a proof of the converse using a line through D parallel to BC.	Let the auxiliary line meet AC at E'. Apply BPT to obtain the same ratio as E. Uniqueness of internal division gives E=E', hence the required parallelism.
09 · Data A D,E are internal on AB,AC. AD=5,DB=10,AE=5. Find EC required for DE∥BC.	10 Equal upper-to-lower ratios require 1/2=5/EC.
10 · Data A D,E are internal on AB,AC. AD=6,DB=12,AE=5. Find EC required for DE∥BC.	10 Equal upper-to-lower ratios require 1/2=5/EC.
11 · Data A D,E are internal on AB,AC. AD=7,DB=14,AE=5. Find EC required for DE∥BC.	10 Equal upper-to-lower ratios require 1/2=5/EC.



A (-2, 0)
P (0, 3)
B (2, 0)

Why is P(0, 3) equidistant from A(−2, 0) and B(2, 0)?

The perpendicular bisector is the y-axis. Both squared distances equal 4 + 9 = 13.

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