JUNIOR CYCLE MATHS · FREE REVISION SHEET

Constructions

↗ Léim

Learning outcome (2018 specification): GT.3a, constructions 1–15 (3 and 7 are Higher level only). Play the game: **leim.ie/construction-steps.html**

1. The tools

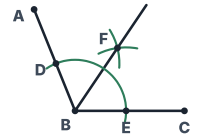
Compass: arcs and circles, copies a length · **straight edge**: straight lines, no measuring · **ruler**: measures · **protractor**: angles · **set square**: right angles and parallel lines.

Constructions 1 and 2 (angle bisector, perpendicular bisector): **compass and straight edge only**.

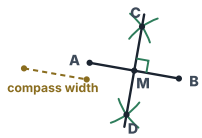
2. Golden rules

Sharp pencil · **leave every arc showing** (it's your proof) · label every point · set the compass against the ruler from 0 · keep the same width when the step says so · sketch triangles first with their measurements.

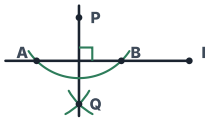
3. The 15 constructions



1. Bisector of an angle
Arc from the vertex across both arms; equal arcs from those two points; join the vertex to where they cross.



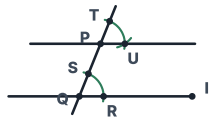
2. Perpendicular bisector of a segment
Compass more than half of |AB|; equal arcs from A and B above and below; join the crossings.



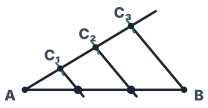
3. Perpendicular from a point not on l (HL)
Arc from P cutting l twice; equal arcs from those points on the other side; join P to the crossing.



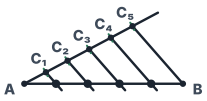
4. Perpendicular at a point on l
Arcs from P cutting l either side; wider equal arcs from those points; join P to the crossing.



5. Parallel line through a point
Line through P crossing l; copy the angle at the crossing up to P with arcs; join P to the new point.



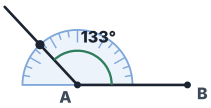
6. 2 or 3 equal parts
Ray from A; step off equal marks; join the last mark to B; parallels through the other marks.



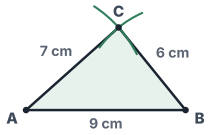
7. Any number of equal parts (HL)
Same as 6, with as many marks as parts.



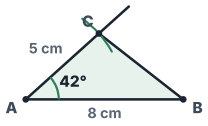
8. Segment of a given length on a ray
Set the compass to the length on a ruler; arc from the start of the ray.



9. Angle of a given size on a ray
Protractor centre on A, base along the ray; dot at the angle (scale from 0°); draw the ray.



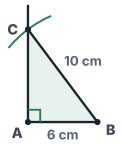
10. Triangle: SSS
Draw one side; arcs from each end with the other two lengths; join up.



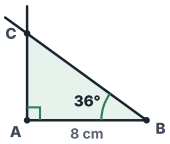
11. Triangle: SAS
Draw a side; draw the angle at one end; mark the second side with the compass; join up.



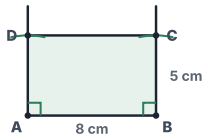
12. Triangle: ASA
Draw the side; draw both angles on the same side of it; they meet at the third corner.



13. Right-angled: hypotenuse + side (RHS)
Draw the side; right angle at one end; arc of the hypotenuse from the other end; join up.



14. Right-angled: side + acute angle
Draw the side; right angle at one end; the given angle at the other; they meet.



15. Rectangle
Draw one side; perpendiculars at both ends; mark the other side's length on each; join.

4. Triangles

SSS three sides · **SAS** two sides and the angle **between** them · **ASA** two angles and the side **between** them · **RHS** right angle, hypotenuse, side. **Can it be a triangle?** The two shorter sides must add to **more** than the longest.

Exam tip: the arcs are your working. A construction with the arcs rubbed out looks measured, and accuracy matters: lengths and angles are checked against the true values.

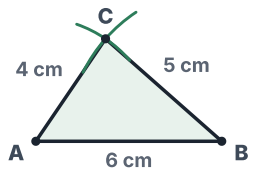
PRACTICE · 34 QUESTIONS

Have a go

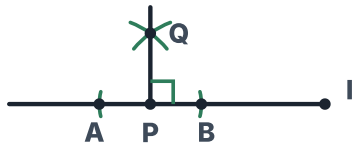
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A. Name the construction

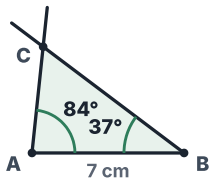
1.



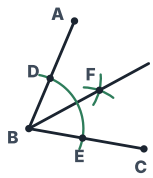
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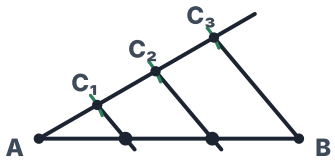
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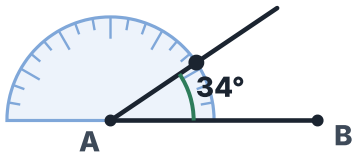
4.



5.



6.



B. Put the steps in order (write the letters)

7. Construct the line through P that is parallel to l.

A Draw the line through P and U. It's parallel to l (corresponding angles are equal).
B Draw a line through P that crosses l. Call the crossing point Q.
C Set the compass to the distance from R to S. Put the point on T and draw an arc that crosses the last arc at U.
D Put the compass point on Q and draw an arc that crosses l at R and the line QP at S.
E Keep the same compass width. Put the point on P and draw an arc that crosses the line QP above P, at T.

Order: _____

8. Construct the right-angled triangle ABC with the right angle at A, |AB| = 5 cm and the hypotenuse |BC| = 7 cm.

A Draw [AB], 5 cm long, with a ruler.
B Set the compass to 7 cm. Put the point on B and draw an arc that crosses the perpendicular at C.
C Join B to C. [BC] is the hypotenuse.
D At A, construct a line perpendicular to [AB] (a right angle).

Order: _____

C. Check the numbers

9. You bisect an angle of 128°. What size is each half? _____
10. The bisector of ∠ABC makes an angle of 27° with [BA]. What size is ∠ABC? _____
11. The perpendicular bisector of [AB] meets it at M. |AB| = 11 cm. Find |AM|. _____
12. C is on the perpendicular bisector of [AB] and |CA| = 7.5 cm. Find |CB|. _____
13. You divide a 13.5 cm segment into 3 equal parts. How long is each part? _____
14. To divide [AB] into 6 equal parts, how many equal steps do you mark on the ray? _____
15. |AB| = 10 cm. Which compass width works for its perpendicular bisector: 4 cm, 5 cm or 6 cm? _____
16. ASA: ∠CAB = 48° and ∠ABC = 77°. What should ∠ACB measure? _____
17. Tom wants 35° but reads the wrong protractor scale. What angle does he draw? _____
18. Can you construct a triangle with sides 4 cm, 5 cm and 10 cm? Why? _____
19. Two sides of a triangle are 6 cm and 9 cm. Between what lengths must the third side be? _____
20. Find the perimeter of the rectangle you construct with sides 8 cm and 3 cm. _____

Pencil, compass, go

D. Construct it on plain paper, then measure to check (leave your arcs showing)

21. Draw [AB] 10 cm long. Construct its perpendicular bisector (compass and straight edge only). Measure |AM| to M, the midpoint. _____
22. Draw an angle of 84° with a protractor. Bisect it using only a compass and straight edge. Measure each half. _____
23. Construct the triangle with sides 8 cm, 6 cm and 5 cm. Measure its largest angle. _____
24. Construct the triangle ABC with |AB| = 7 cm, ∠BAC = 60° and |AC| = 5 cm. Measure |BC|. _____
25. Construct the triangle ABC with |AB| = 8 cm, ∠CAB = 40° and ∠ABC = 65°. Measure ∠ACB and |AC|. _____
26. Construct the right-angled triangle with the right angle at A, |AB| = 6 cm and hypotenuse |BC| = 10 cm. Measure |AC|. _____
27. Construct a rectangle 7 cm by 4 cm. Measure a diagonal. _____
28. Draw [PQ] 11 cm long. Without measuring, divide it into 3 equal parts. Measure one part. _____

E. Exam-style questions

29. Explain why, in the perpendicular bisector construction, the compass must be opened to more than half of |AB|.

30. Ciara tries to construct a triangle with sides 3 cm, 5 cm and 9 cm. What goes wrong, and why?

31. Write the steps to construct the line through a point P parallel to a line l.

32. You construct a triangle with |AB| = 7 cm, ∠A = 50° and ∠B = 50°. What type of triangle do you get? How big is ∠C?

33. Which construction gives every point that is the same distance from A as from B?

34. Sam bisects a 76° angle and measures the halves as 39° and 37°. What should each be? Give one likely reason for the error.

Answers

A	1. Triangle: three sides (SSS) · 2. Perpendicular to a line, at a point on it · 3. Triangle: two angles and the side between them (ASA) · 4. Bisector of an angle · 5. Dividing a line segment into 2 or 3 equal parts · 6. Angle of a given size on a ray
B	7. BDECA · 8. ADBC
C	9. 64° · 10. 54° · 11. 5.5 cm · 12. 7.5 cm · 13. 4.5 cm · 14. 6 · 15. 6 cm (more than half of 10 cm) · 16. 55° · 17. 145° · 18. No: 4 + 5 = 9, not more than 10 · 19. more than 3 cm and less than 15 cm · 20. 22 cm
D	21. 5 cm · 22. 42° · 23. about 93° (opposite the 8 cm side) · 24. about 6.2 cm · 25. 75°; |AC| about 7.5 cm · 26. 8 cm · 27. about 8.1 cm · 28. about 3.7 cm (accurate constructions are within about 1 mm and 1°)
E	29. With half or less, the arcs from A and B don't cross (or only touch on [AB]), so there are no points C and D to join. · 30. The arcs never meet: 3 + 5 = 8, which is less than 9, so no such triangle exists. · 31. Line through P crossing l at Q; arc from Q cutting l (R) and QP (S); same width, arc from P cutting QP at T; compass to |RS|, arc from T crossing the arc from P at U; draw PU. · 32. Isosceles (two equal angles, so |AC| = |BC|); ∠C = 180 − 100 = 80°. · 33. The perpendicular bisector of [AB]. · 34. 38°. He probably changed the compass width between the two arcs, or the pencil/compass wasn't sharp and steady.

All questions written by Léim. Léim is independent and not connected with the State Examinations Commission or the NCCA.