

# Empty protractor

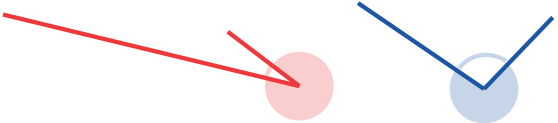
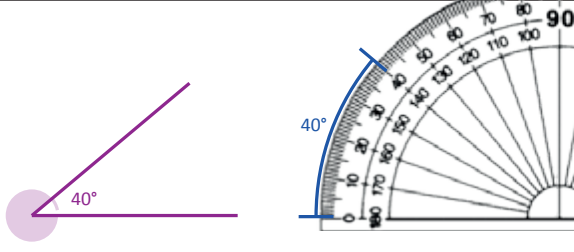
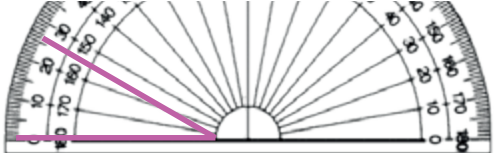
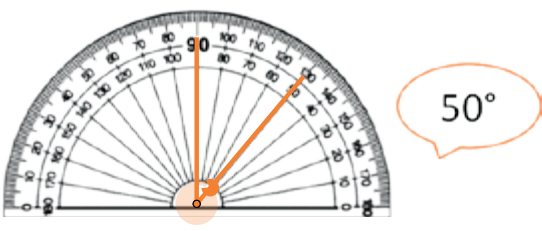
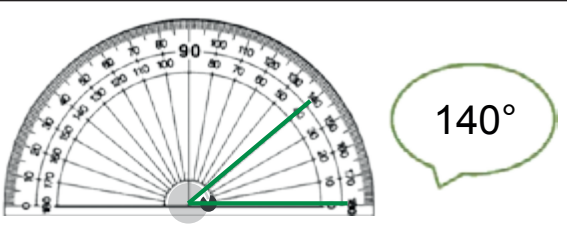
Tom Francome describes how he uses an empty protractor to develop pupils' understanding of angle.

“The use of a protractor is twofold, viz, to lay down an angle or to measure an angle already laid down.” (Meredith, 1791).

Protractors are used routinely in schools, typically from year five (9-10 years) onwards. My experience of working with children suggests that there are several possible misconceptions that can arise around angle measurement. As a teacher, I was influenced by Paul Andrew's (2002) article, *Angle measurement: an Opportunity for Equity*, not only because it provides an example of how every pupil can work as a mathematician (Francome, 2015) but also because it extols the virtues of the kind of circular

angle measure that allows pupils to appreciate angle as a turn. However, these items are relatively pricey for small department budgets and are less like the protractors that pupils tend to buy themselves. I have seen many protractors that pupils own that exacerbate some of the problems highlighted above, such as opaque protractors that can only measure angles when both 'arms' are extended beyond 5cm or hollow protractors that discourage the use of counting, which I conjecture might be useful for learners forming conceptions of angle measurement.

I offer pupils an empty protractor to work on angle measurement. I print these onto OHP transparencies

<p>Learners can get the impression that 'angle' means the distance between the two points rather than a measure of turn, so some pupils may perceive <b>this</b> to be larger than <b>that</b>.</p>	
<p>Using a protractor, learners can perceive 'angle' as the 'curved distance' between points rather than a measure of 'turn'.</p>	
<p>Learners may not position the centre of the protractor on the angle point.</p>	
<p>Learners may not position the line on 'zero' or may do so in a way that prevents them from reading the angle.</p>	
<p>When doing everything else correctly, pupils read the incorrect number off the scale.</p>	

and issue to students. They are cheap enough that you can give them away to people who need them; an act for which I have found pupils disproportionately grateful! Rather than a long list of steps to remember, pupils only need one; to place the centre at the point of the angle they wish to measure. As the angle is to be 'counted' there is no need to place any particular protractor line on top of the angle line although in my experience pupils quickly conjecture that one of the longer lines is helpful (although longer line lengths negate this need). Pupils then count around to the required line. It can be helpful with measuring and developing awareness of angle to draw in the turn.

I have found the empty protractor to be a useful tool for helping students develop their awareness of angle and skill in measuring angles. It also has other uses, for example, it can be used to perform any compass construction using just one centre line and the circle edge (Austin, 1982). I offer it here in the hope that others will find it helpful and may discover other uses for the tool that can be shared.

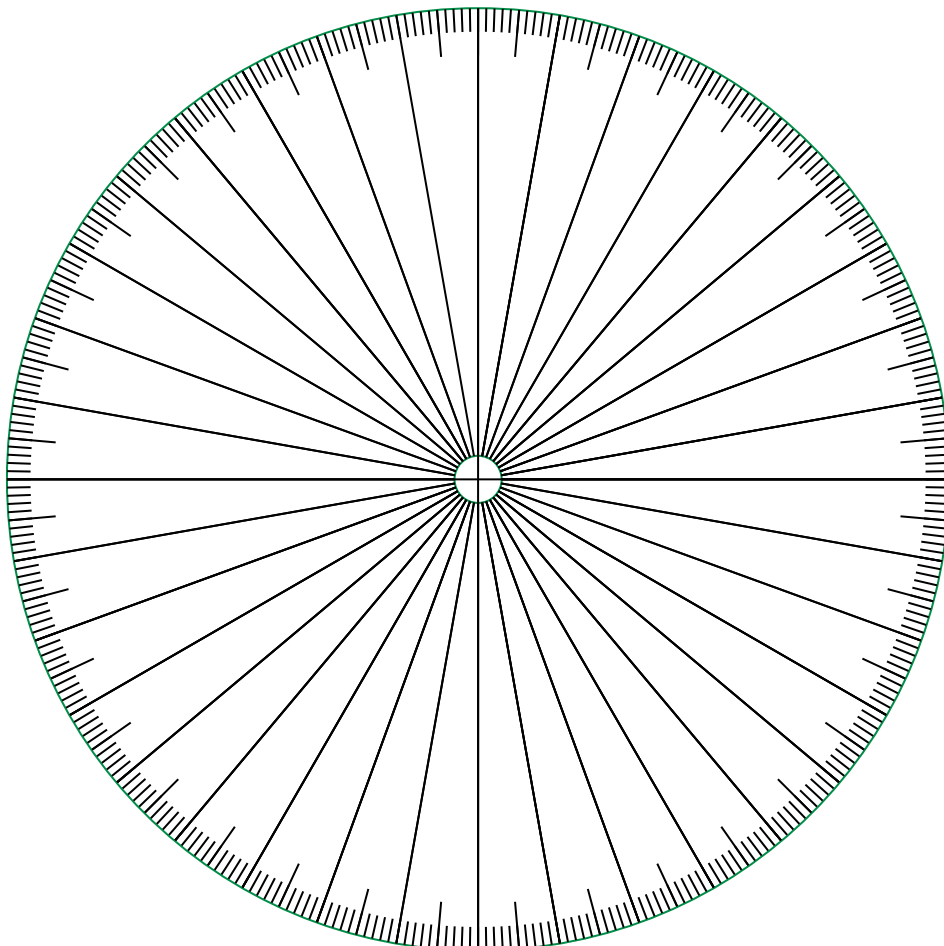
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## References

- Andrews, P. (2002). Angle measurement: an opportunity for equity. *Mathematics in School*, pp.16-18. [Also available from: <https://nrich.maths.org/2855>.]
- Austin, J. D., (1982) 'Constructions with an unmarked protractor', *The Mathematics Teacher*, pp. 291-295. Published by: National Council of Teachers of Mathematics [Available from: <http://www.jstor.org/stable/27962911>.]
- Francome, T. (2016) 'Everyone can be a mathematician', *Mathematics Teaching*, 250, pp.14-18
- Meredith, N. (1791) *The description and use of pocket cases of mathematical, or drawing instruments: Containing, Particularly, A familiar Explanation of the Use of the Protractor, Plain Scale, Sector, Gunter's Scales, Marquoi's Parallel Scales, and the Proportional Compasses; with several Examples in Trigonometry, Arithmetic, &c. Together with Plain Instructions for making the several Kinds of Sun Dials.*
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