

Solutions

2.1 $(-3, 2)$.

2.2 $(-2, 3)$.

2.3 $k = 2$: $C + 2(P - C) = (1, 1) + 2(2, 1) = (5, 3)$. $k = -2$: $(1, 1) - 2(2, 1) = (-3, -1)$, opposite side of the centre.

2.4 $100 \div 2 = 50^\circ$ – angle at the centre is twice the angle at the circumference.

2.5 $180 - 112 = 68^\circ$ – opposite angles of a cyclic quadrilateral sum to 180° .

2.6 $\mathbf{a} + \mathbf{b} = (5, 4)$; $2\mathbf{a} - \mathbf{b} = (8, 2) - (1, 3) = (7, -1)$.

3.1 The chord-and-arc region is the **segment**; the radii-and-arc region is the **sector**.

3.2 Each tangent is perpendicular to its radius at the contact point, so quadrilateral $OAPB$ has two 90° angles: $\angle AOB = 360 - 90 - 90 - 24 = 156^\circ$. The angle at the centre is twice the angle at the circumference on the same arc: $\angle ACB = 156 \div 2 = 78^\circ$.

3.3 (a) $\overrightarrow{DE} = (14\mathbf{a} - 3\mathbf{b}) - (6\mathbf{a} + \mathbf{b}) = 8\mathbf{a} - 4\mathbf{b}$; $\overrightarrow{EF} = (16\mathbf{a} - 4\mathbf{b}) - (14\mathbf{a} - 3\mathbf{b}) = 2\mathbf{a} - \mathbf{b}$.
(b) $\overrightarrow{DE} = 4(2\mathbf{a} - \mathbf{b}) = 4\overrightarrow{EF}$, so DE is parallel to EF ; they share the point E , so DEF is a straight line.

3.4 The perpendicular bisector of AB ; half of AB is 3 cm, so the distance is $\sqrt{5^2 - 3^2} = 4$ cm (a 3-4-5 triangle).

Local review guidance: full transformation descriptions – centre, factor, line, angle and direction; the quadrilateral angle sum $360 - 90 - 90 - 24$ then halving for the circumference angle in 3.2; $\overrightarrow{DE} = 4\overrightarrow{EF}$ stated WITH the shared point for the collinearity claim; locus named as a construction, not “the middle”. This is authored classroom guidance.