Circle Theorems Past Paper Answers Edexcel – None Calculator

1.

	42 ÷ 2 = 21 180 – 90 – 21 = 69 69 × 2 = 138	138°	3	M1 for 90 seen. A1 for 138 (accept 222) C1 for The tangent to a circle is perpendicular (90°) to the radius (diameter) and Angles in a triangle add up to 180° **OR** The tangent to a circle is perpendicular (90°) to the radius (diameter) and Angles in a quadrilateral (4 sided shape) add up to 360°

2.

uestion	Working	Answer	Mark	Notes
	180 –(90 + 20) = 70 2 × 70 = 140	Angle *TOR* =140°	4	M1 for angle *PTO* (*PRO*) = 90° or seeing it marked on the diagram with a right angle or as 90° M1 (dep) for 180 –(90 + 20) (=70°) or for 360 – (90 + 90 + 40) (=140) A1 for (angle) *TOR* = 140° or for 140° seen in the correct place in the diagram [140° alone without the '*TOR* =' gets A0] C1 (dep on at least M1) for angle between a <u>tangent</u> and a <u>radius</u> = <u>90°</u> plus at least one other correct reason from: Sum of <u>angles</u> in a <u>triangle</u> is <u>180°</u> Sum of <u>angles</u> in a <u>quadrilateral</u> is <u>360°</u> <u>Triangles</u> <u>*PTO*</u> and <u>*PRO*</u> are <u>congruent</u> <u>Tangents</u> from a <u>point</u> are <u>equal</u> in length OR
	(180 – 40)÷2 =70 180 – 2×(90 –70) = 140			M1 for angle *PTO* (*PRO*) = 90° or seeing it marked on the diagram with a right angle or as 90° M1 for (180 – 40)÷2 (=70) and [180 – 2×(90 –"70")] (=140) A1 for (angle) *TOR* = 140° or for 140° seen in the correct place in the diagram [140° alone without the '*TOR* =' gets A0] C1 (dep on at least M1) for angle between a <u>tangent</u> and a <u>radius</u> = <u>90°</u> plus at least one other correct reason from: Sum of <u>angles</u> in a <u>triangle</u> is <u>180°</u> Base <u>angles</u> of an <u>isosceles triangle</u> are <u>equal</u> <u>Triangles</u> <u>*PTO*</u> and <u>*PRO*</u> are <u>congruent</u> <u>Tangents</u> from a <u>point</u> are <u>equal</u> in length

3.

Question		Working	Answer	Mark	Notes
		$OAC = OBC = 90$ (tangent is perpendicular to the radius) $AOB = 360 - 90 - 90 - 36 = 144$ (angles in a quadrilateral add up to 360°) $OBA = (180 - 144) \div 2 = 18$ (angles in a triangle add up to 180° and base angles of isosceles triangle are equal) **OR** $CAB = CBA = (180 - 36) \div 2 = 72$ (angles in a triangle add up to 180° and base angles of isosceles triangle are equal) $OBA = 90 - 72 = 18$ (tangent is perpendicular to the radius)	18	4	M1 for angle OAC or angle $OBC = 90°$ or angle $AOB = 144°$ or both angles CAB and $CBA = 72°$ or angle BCO or angle $ACO = 18°$ and angle BOC or angle $AOC = 72°$ (these could be marked on the diagram or implied by calculation) M1 for a complete correct method e.g. $90 - \frac{180-36}{2}$ or $\frac{1}{2}(180 - (360 - 90 - 90 - 36))$ C1 for one reason (dep on M1) C1for 18 with full reasons QWC: Reasons clearly laid out with correct geometrical language used

4.

Question		Working	Answer	Mark	Notes
		$0.0034\times10^{5} = 340$ $34\times10^{-5} = 0.00034$ $-3.4\times10^{-3} = -0.0034$ $3.4\times10^{4} = 34\,000$ $34\times10^{2} = 3400$	-3.4×10^{-3} 34×10^{-5} 0.0034×10^{5} 34×10^{2} 3.4×10^{4}	3	M1 for changing at least 1 correctly to standard form or for changing at least 1 correctly to an ordinary number M1 at least 3 correct changes to standard form or at least 3 correct changes to ordinary numbers A1 ordered [S.C. B2 (if no working) for 4 in the correct order or all correct but reverse order]

5.

			proof with reasons	5	M1 for using x oe for AOB or CPB or consistent use of three letter notation M1 for correct use of at least one circle theorem or for extending PR and CA to meet at 'X' and using triangles OBX and PCX A1 for correct proof C2 for fully correct reasons for each stage of proof (C1 for any relevant circle theorem reason) Possible reasons: Angles in a triangle add up to 180° Angles in a quadrilateral (4 sided shape) add up to 360° Angles on a straight line add up to 180° The tangent to a circle is perpendicular (90°) to the radius (diameter) Tangents from an external point are equal in length. Reasons must be relevant for method shown.

6.

uestion		Modification	Notes
		Diagram enlarged. Dot added to centre.	M1 for (POS =) 360 − (90 + 90 + 2x) (= 180 − 2x) ie using angles around O or (QOR =) 360 − (90 + 90 + y) (= 180 − y) M1 (dep) for (POQ =) $\frac{1}{2}$ [360 − ("POS" + "QOR")] A1 for (POQ =) $x + \frac{y}{2}$ oe C1 (dep M1 and supported) for circle theorem angle between tangent and radius is 90 C1 for full reasons and supported eg sum of angles in a quadrilateral is 360 and sum of angles at a point is 360 OR M1 for (POA=) 180 − 90 − x (= 90 − x) ie after having drawn line AOC or (QOC=) 180 − 90 − $\frac{y}{2}$ (= 90 − $\frac{y}{2}$) M1 (dep and supported) for (POQ =) 180 − "POA" − "QOC" A1 for (POQ =) $x + \frac{y}{2}$ oe C1 (dep M1 and supported) for circle theorem for angle between tangent and radius is 90 C1 for full reasons and supported eg sum of angles in a triangle is 180 and sum of angles on straight line is 180 OR M1 for (ABC or ADC =) $\frac{1}{2}$(360 − 2x − y) ie using similar triangles M1 (dep)for (POQ =) 360 − 90 − 90 − "ABC" A1 for (POQ =) $x + \frac{y}{2}$ oe C1 (dep M1 and supported) for circle theorem for angle between tangent and radius is 90 C1 for full reasons and supported eg sum of angles in a quadrilateral is 360 and eg ΔABC similar to ΔADC

7.

uestion	Working	Answer	Mark	Notes
	$DE = AE$, and $AE = EB$ (tangents from an external point are equal in length) so $DE = EB$ $AE = EC$ (given) Therefore $AE = DE = EB = EC$ So $DB = AC$ If the diagonals are equal and bisect each other then the quadrilateral is a rectangle. OR If $AE = DE = EB = EC$ then there are four isosceles triangles ADE, AEB, BEC, DEC in which the angles DAB, ABC, BCD, CDA are all the same. Since $ABCD$ is a quadrilateral this makes all four angles 90°, and $ABCD$ must therefore be a rectangle.	Proof	4	B1 for $DE = AE$ or $AE = EB$ (can be implied by triangle AED is isosceles or triangle AEB is isosceles or indication on the diagram) OR tangents from an external point are equal in length B1 for $AE = DE = EB = EC$ B1 for $DB = AC$, (dep on B2) OR consideration of 4 isosceles triangles in $ABCD$ C1 fully correct proof. Proof should be clearly laid out with technical language correct and fully correct reasons

8.

	Angle *PTO* = angle *PSO* = 90 Angle *TPS* = 24 × 2 = 48 360 – 90 – 90 – 48 OR Angle *PTO* = 90 Angle *TOP* = 180 – 90 – 24 = 66 66 × 2	132	3	M1 for angle *PTO* = 90 or angle *PSO* = 90, could be marked on the diagram M1 for 360 – 90 – 90 – (24 × 2) A1 cao OR M1 for angle *PTO* = 90 or angle *PSO* = 90, could be marked on the diagram M1 for 2 × (180 – 90 – 24) A1 cao

9.

estion	Working	Answer	Mark	Notes
	Angle *BCD* = 27° Angle *CBD* = 90° Angle *CDB* = 180° – 90° – 27° = 63° Alternate angles are equal The tangent to a circle is perpendicular (or 90°) to the radius (or diameter) Angles in a triangle add up to 180° OR Angle *CBE* = 90°, Angle *ABE* = 90° – 27° = 63° Angle *CDB* = 63° The tangent to a circle is perpendicular (or 90°) to the radius (or diameter) Corresponding angles are equal OR Angle *CBD* = 90° Angle *ABD* = 90° + 27° = 117° Angle *CDB* = 180° – 117° = 63° The tangent to a circle is perpendicular (or 90°) to the radius (or diameter) Allied angles/Co-interior angles add up to 180°	63°	4	B1 for Angle CBD = 90° or Angle CBE = 90° B1 for Angle BCD = 27° or Angle ABE = 63° C1 for Angle CDB = 63° and one correct reason C1 for complete and correct reasons. OR B1 for Angle CBD = 90° B1 for Angle ABD = 117° C1 for Angle CDB = 63° and one correct reason C1 for complete and correct reasons. Alternate angles are equal Corresponding angles are equal The tangent to a circle is perpendicular (or 90°) to the radius (or diameter) Angles in a triangle add up to 180° Angles on a straight line add up to 180° The exterior angle of a triangle is equal to the sum of the interior opposite angles. Allied angles/Co-interior angles add up to 180°

10.

estion	Working	Answer	Mark	Notes
		Proof	5	B1 for matching two lines of the same length with reasons B1 for matching two sides of the kite with reasons B1 for showing *AD* = *AB* and *DC* = *CB* with reasons C1 for "Tangents from an external point are equal in length." C1 for a complete proof

11.

uestion	Working	Answer	Mark	Notes
	$AOT = 90 - x$ (Angle between tangent and radius is 90°) $AOC = 90 + x$ (Tangents from an external point are equal) $ACB = 2(180 - (90 + x)) \div 2 = 90 - x$ Or Obtuse angle $BOA = 180 - 2x$ (Angle between tangent and radius is 90°) Reflex angle $BOA = 180 + 2x$ (Tangents from an external point are equal) $ACB = (360 - (180 + 2x)) \div 2 - 90 - x$		5	B1 for $AOT = 90 - x$ or OAT = 90° or OBT= 90° (may be shown on diagram) B1 for $AOC = 90 + x$ B1 for completing the proof C2 for 2 reasons: Angle between tangent and radius is 90° **and** Tangents from an external point are equal. **QWC: proof should be clearly laid out with technical language correct** [C1 for 1 of: Angle between tangent and radius is 90° **or** Tangents from an external point are equal, **QWC: proof should be clearly laid out with technical language correct]** **OR** B1 for obtuse angle $BOA = 180 - 2x$ or OAT = 90° or OBT= 90° (may be shown on diagram) B1 for reflex angle $BOA = 180 + 2x$ B1 for completing the proof C2 for 2 reasons: Angle between tangent and radius is 90° **and** Tangents from an external point are equal. **QWC: proof should be clearly laid out with technical language correct** [C1 for 1 of: Angle between tangent and radius is 90° **or** Tangents from an external point are equal, **QWC: proof should be clearly laid out with technical language correct]**

12.

		Angle ORT = 90° Angle between the tangent and the radius is 90° Angle AST = 90° Corresponding angles with angle ORT as AS is parallel to OR	Proof	3	B1 for angle ORT (or angle ORS) = 90° C1 for angle between the tangent and the radius is 90°/right angle C1 for angle AST = 90° and angle AST = angle ORT because corresponding angles are equal oe or for angle ASR= 90° because of allied /co-interior angles, so angle AST = 90° because angles on a straight line add up to 180°

13.

uestion		Working	Answer	Mark	Notes
			Proof	5	B1 for $OM = ON$ or (OMN is) isosceles triangle or OMB = 90° or AMO = 90° B1 for $OMN = ONM$ or either = $\frac{1}{2}(180 - y)$ oe B1 for (Angle) $BMN = 90 -$ "$\frac{1}{2}(180 - y)$" [if algebraic in y] C1 for statement angle between tangent and radius = 90° (or perpendicular or right angle) C1 for correct conclusion with BMN stated, accompanied by correct working clearly laid out and in a logical sequence with correct calculations Acceptable alternative: B1 for angle at circumference = $\frac{1}{2}y$ B1 for 'angle at centre is twice the angle at the circumference' oe B1 for angle $BMN = \frac{1}{2}y$ C1 for statement 'alternate segment theorem' C1 for correct conclusion with BMN stated, accompanied by correct working clearly laid out and in a logical sequence with correct calculations

14.

uestion		Working	Answer	Mark	Notes
			113	5	B1 for stating angle $TAO = 90$ M1 for stating angle OBA or angle $OAB = 90 - 58$ (=32) M1 for stating angle $ABT = 180 - 58 - 41$ (=81) or angle $AOB = 180 - 64$ (=116) A1 for 113 clearly identified as the answer C1 (dep on M1) for correct statements for method used: angle between tangent and radius = 90° AND at least one of base angles of an isosceles triangle are equal sum of angles in a triangle is 180 sum of angles in a quadrilateral is 360 NB angles may be seen in diagram

15.

uestion	Working	Answer	Mark	Notes
	360 – 90 – 90 – 110 = 70 180 – 60 – 70 360 – 90 – 90 – 60 = 120 360 – 110 – 120 = 130 360 – 90 – 90 − 130	50°	4	B1 for identifying 90 ° (may be on diagram) M1 for beginning method using *MON* = 110 eg 360 – 90 – 90 – 110 (= 70) M1 for completing method to find *BAC* eg 180 – 60 – 70 (=50) C1 for (angle *BAC* =) 50 and all reasons relevant to method used: Angle between tangent and radius is 90 Sum of angles in a quadrilateral is 360 Angles in a triangle add up to 180 OR B1 for identifying 90 ° (may be on diagram) M1 for beginning method using *NCP* = 60 eg 360 – 90 – 90 – 60 (= 120) M1 for completing method to find *BAC*, e.g. 360 – 110 – 120 = 130 360 – 90 – 90 – 130 (=50) C1 for (angle *BAC* =) 50 and all reasons relevant to method used: Angle between tangent and radius is 90 Sum of angles in a quadrilateral is 360 Angles around a point equal 360

16.

uestion		Working	Answer	Mark	Additional Guidance
1. /C, ii, i)		PS = PT and PQ = PR (equal tgts from a point) Let angle SPT = x Angle PST = angle PTS = $\frac{180-x}{2}$ (base angles of isos triangle) Angle QPR = x (vertically opposite angles) Angle PQR = angle PRQ = $\frac{180-x}{2}$ (base angles of isos triangle) Therefore angle PQR = angle PTS which are alternate angles. Hence QR is parallel to ST	Proof	5	B1 for PS = PT or PQ = PR B1 for equal tangents from a point B1 for angle PST = angle PTS = $\frac{180-x}{2}$ or angle PQR = angle PRQ = $\frac{180-x}{2}$ C1 for base angles of isos triangle are equal or vertically opposite angles are equal **QWC: Working should be clearly laid out in a logical sequence, with calculations atributable** C1 for alternate angles implying parallel **QWC: Any technical language should be correct**