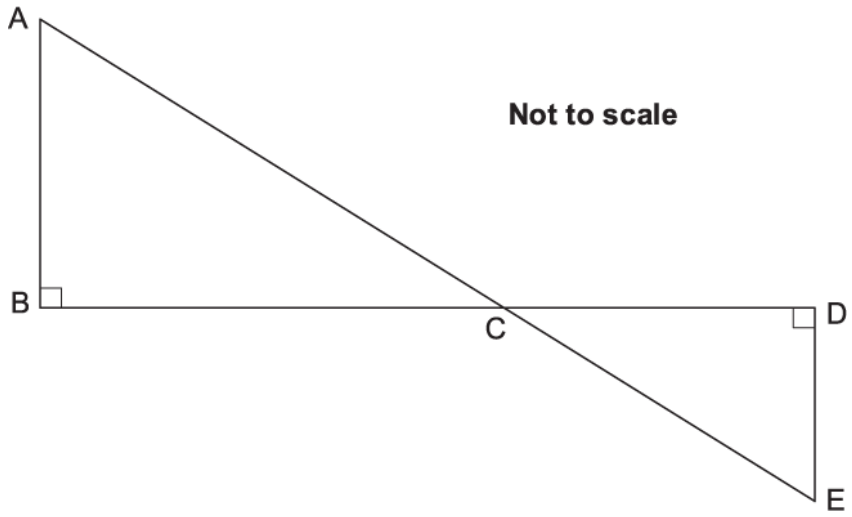
1(a). In the diagram below, AE and BD are straight lines.



Show that triangles ABC and EDC are similar.

---

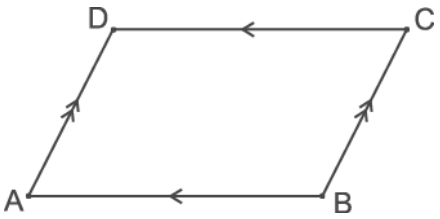
[3]

(b). The length DE is 3.5 m.
The ratio BC : CD = 3 : 1.

Find the length AB.

(b) _____ m [2]

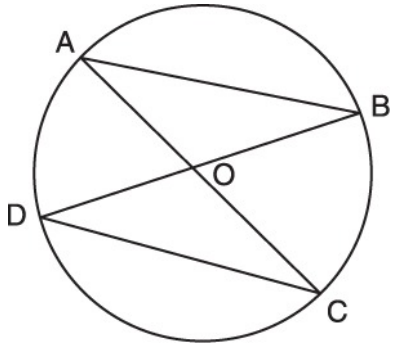
2. ABCD is a parallelogram.



Prove that triangle ABD is congruent to triangle CDB.

[3]

3. In the diagram AC and BD are diameters of the circle, centre O.



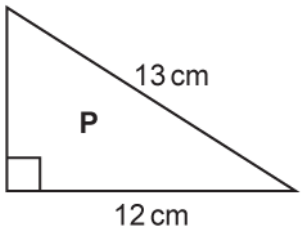
Not to scale

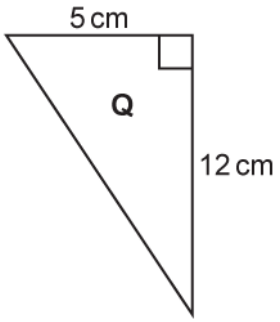
Prove that triangles OAB and ODC are congruent.

---

[3]

4(a). Triangles **P** and **Q** are right-angled.





Not to scale

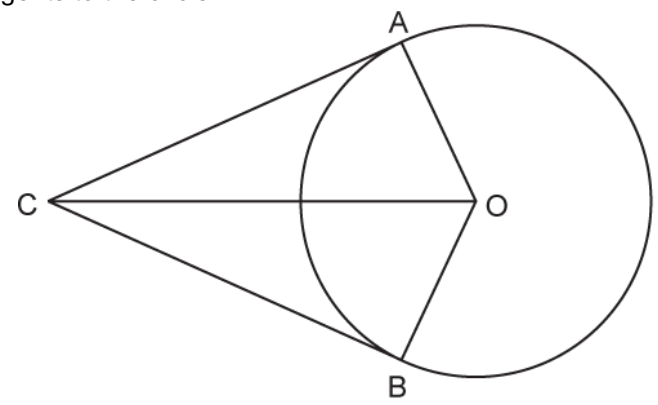
Show that the two shorter sides in triangle **P** have the same lengths as the two shorter sides in triangle **Q**. **[3]**

(b). Explain why the two triangles are congruent.

---

[1]

5. A and B are points on the circumference of a circle, centre O.
CA and CB are tangents to the circle.



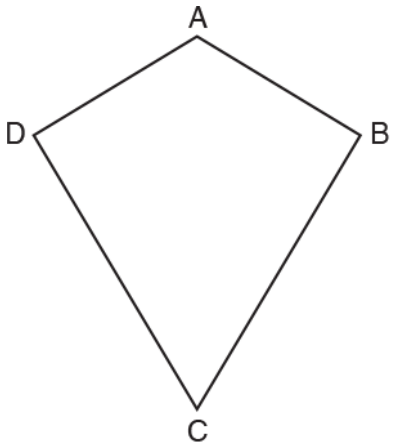
Not to scale

Prove that triangle OAC is congruent to triangle OBC.

---

[4]

6. ABCD is a quadrilateral.
AD = AB and CD = CB.



Not to scale

Prove that angle ADC is equal to angle ABC.

---

[4]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Part marks and guidance	
1	a		Angles at B and D are right angles Angles ACB and ECD are vertically opposite **oe** Three equal angles (angle sum of a triangle), hence triangles are similar **oe**	1 1 1		
	b		10.5	2	**M1** for 3.5 × 3 **oe**	
			Total	**5**		
2			e.g. BD is common ABD = BDC (alternate angles) AB = CD (parallelogram) So triangles ABD and CBD are congruent by SAS	3	**B2** for two facts with conclusion or **B2** for three facts with conclusion missing or unclear or **B1** for one correct fact	Each fact must be backed up with a reason
			Total	**3**		
3			States ∠AOB = ∠DOC and AO = DO and BO = CO	B1	Or two pairs of angles and one pair of sides ∠OAB = ∠ODC , ∠ABO = ∠DCO	Condone AO = CO and BO = DO Allow angles named A, B, C, D but ∠AOB and ∠DOC must be clearly identified
			States a correct reason for a pair of angles and a correct reason for a pair of sides [vertically] opposite [angles] [equal] radii	B1	Or [angles] same segment [equal] or [angles on] same chord/arc [equal]	Condone 'half diameter' for radius
			Selects correct congruence statement for their argument	B1	SAS or ASA After B0 award **SC1** for two correct pairs of sides and/or angles with correct reasons seen **Examiner's Comments** Almost all candidates performed very badly on this question, with only a small proportion gaining	Or AAS

Question			Answer/Indicative content	Marks	Part marks and guidance	
					any marks at all. A proof requires clear statements giving equal sides and equal angles with correct geometrical reasons concluding with a correct congruence statement. Angles were often paired correctly, but reasons for these were often incorrect or omitted, in particular for the equal angles in the same segment. In some cases sector was used in place of segment, but, more commonly the 'bow tie theorem' was referred to, which is not an acceptable reason. It was often assumed that AB and DC were parallel and 'alternate angles' was used which was not accepted. If the radii were paired up, a reason for this was seldom adequate, with pairs of diameters often mentioned rather than radii. Those candidates who had correctly paired angles and sides did not often then go on to give a correct congruence statement. A number of candidates confused congruence with similarity and attempted to prove that the angles in the two triangles were equal with no mention of equal sides.	
			Total	3		

Question			Answer/Indicative content	Marks	Part marks and guidance		
4	a		$13^2 - 12^2$ or 169 – 144	M1	Or $5^2 + 12^2$ or 25 + 144	5^2+12^2seen with 13^2+12^2 scores M0 May be seen in stages eg 5 × 5 =25 12 × 12 = 144 25 + 144 =	
			$\sqrt{13^2 - 12^2}$ soi	M1 dep	or $\sqrt{5^2 + 12^2}$ soi	For second M1 must see √ symbol $\sqrt{13^2+12^2}$ scores M0	
			Two shortest sides in both triangles are 5 [cm] and 12 [cm]	A1	or 5[cm] side clearly labelled on triangle P **and** 13[cm] clearly labelled on triangle Q		
					Examiner's Comments Although not attempted by many, candidates who recognised that (a) related to Pythagoras' theorem usually gained at least 1 mark. Not all showed the square root however required for the second method mark. Others used Pythagoras' theorem by squaring and adding 12 and 13. Very few candidates gave a concluding statement, although some indicated the lengths of the sides on the diagrams. In (b) very few were able to explain conditions for congruency. Many comments attempted a definition of congruence, such as they are the same or one is just a rotation of the other one, rather than identifying evidence for these triangles' congruence. Many thought that equal angles meant	

Question			Answer/Indicative content	Marks	Part marks and guidance	
					congruent. Other explanations commonly referred to the two triangles being right angled. Some vaguely referred to them being the same size, but only a very small number of candidates correctly identified that all of the sides were the same lengths, or used the congruence condition SSS or RHS.	
	b		[All] the sides are the same length	1	Accept SAS **or** RHS **or** SSS **soi** | **See Appendix B**	
			Total	4		

Question			Answer/Indicative content	Marks	Part marks and guidance		
5			Three of these • OC is common or shared • OA = OB (equal) radii • ∠OAC = ∠OBC tangent perpendicular to radius • CA = CB tangents from a point [to a circle] RHS, SSS or SAS as appropriate	M3 A1 4 AO2.4b	M1 for each After M0, B2 three pairs of these equal sides / angles with insufficient or no reasons or B1 for two pairs of these equal sides / angles identified with insufficient or no reasons OR After M1, B1 for two further pairs of these equal sides / angles identified with insufficient or no reasons	Ignore extra facts and reasons For B marks accept if indicated on diagram	

Examiner's Comment
Full marks were awarded only occasionally and these responses were usually characterised by their clarity and brevity. Many used an essay style with the commentary not linked to specific sides or angles. In particular, for AC = BC many candidates omitted to

Question			Answer/Indicative content	Marks	Part marks and guidance	
					mention that these tangents met at a point. When dealing with angles OAC = OBC, many omitted either 90°, tangent or radius (for example 'The tangents meet the circumference at 90°' was frequently seen). Although the award of full marks was rare, many obtained 2 marks for giving pairs of equal angles / sides without sufficient reasons.	
			Total	4		

Question			Answer/Indicative content	Marks	Part marks and guidance		
6			AD = AB [given] **oe** CD = CB [given] **oe** AC = AC (common) **oe** Congruent SSS	M3	**M2** for 2 correct statements with reason[s] or 3 correct but no/incorrect reason[s] **M1** for 1 correct statement with reason or 2 correct but no/incorrect reasons		
			Angle ADC = angle ABC	A1		Accept vertical line of symmetry or reflection see diagram as well if unsure	
				4	If 0 scored, **SC1** for AC is a line of symmetry **oe** or for triangle ADC is congruent to triangle ABC **oe**		
					<u>Examiner's Comments</u> This question involving a geometric proof was very poorly answered. Most candidates did not realise that this question involved proving congruency. Of those that did, many did not use a concise method or give full reasons for their answers and wrote a paragraph of text rather		

Question			Answer/Indicative content	Marks	Part marks and guidance	
					than clear line by line conditions with reasons.	
			Total	4		