NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1, 2002

Mathematics: Use geometric reasoning to solve problems (90153)

National Statistics

Assessment Report

Assessment Schedule

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National Statistics

Number of Results	Percentage achieved			
	Not Achieved	Achieved	Merit	Excellence
37,604	28%	32%	35%	5%

Assessment Report

General Comments

Candidates should not read into diagrams information that has not been supplied, eg assuming AOD is a diameter in Question Four or triangle ABC is isosceles in Question Two.

More care is needed in the sequencing of reasoning. Some candidates did not understand the term ‘geometric reasons’ and gave numerical answers or imprecise explanations. Geometric reasons need to be expressed in words, not by using diagrams.

Many candidates had trouble correctly naming angles.

Clear reasons are needed and the correct words should be known. It was not uncommon to see ‘alternative’ instead of ‘alternate’, ‘opposite’ instead of ‘vertically opposite’, ‘cointerior angles are equal’, ‘angles of a circle instead of angles at a point’, ‘isometric’ instead of ‘isosceles’, ‘equilateral’ instead of ‘isosceles’.

Most candidates demonstrated good knowledge of angles with parallel lines, but circle geometry was a noticeable weakness.

Some candidates provided reasons for Questions One and Two even though these were not asked for. In some cases where correct two-step linked reasoning was supplied, this was used as evidence for a candidate to be achieve the standard with merit if they had not provided enough evidence in the questions where reasons were asked for.

Comments on Specific Questions

Question One

This was reasonably well done. The most common error was forgetting to add the 90° from the rectangle. The majority of candidates found $\angle AFC = 62°$.

The three-dimensional aspect of the diagram may have caused confusion for some.

Question Two

This question was very well done. Some candidates incorrectly assumed this diagram had an isosceles triangle or an isosceles trapezium.

Question Three

This was the first question in the paper where candidates were required to give reasons for their angle calculations. The angle calculation took two steps, so two reasons were needed. The question was well done with most candidates recognising the isosceles triangle and getting the correct angle size for ∠ACD. Too often, the reasons were missing or inadequate, with angles in a triangle given as the reason rather than base angles isosceles triangle. Some candidates knew it was a special type of triangle and incorrectly used the word equilateral. The word isosceles should be known by all candidates.

Common errors included careless arithmetic, subtracting 58 from 180 to get 112 or deciding that BAC and ACB were the congruent angles in the isosceles triangle.

Candidates needed to give a statement naming the angle so that the assessor was in no doubt. It was not uncommon to see three numerical statements only in this question:

180 – 64 = 116
116 divided by 2 = 58
180 – 58 = 122

Question Four

Candidates who attempted this question often gave the reflex angle BOC even though the obtuse angle was clearly shaded and referred to. Some candidates assumed BOCD was a cyclic quadrilateral.

The most common incorrect answer was 106° with the reason given being opposite angles are equal or vertically opposite angles are the same.

Question Five

Too many candidates failed to attempt Questions Five and Six. However, Question Five did appear to be done better than Question Four when it was attempted.

The context was helpful to candidates in this question, enabling the majority who attempted it to get the correct angle size for BAC. For some, the context was a distraction for giving the reasons and some candidates did not supply geometrical reasons but referred to the nature of the seats with comments like 'all three seats are horizontal so angles GFA and BAC are the same' or '∠EFG = 33° and since all seats are on the same angle ∠BAC is also 33°'.

Labelling of angles was generally poor throughout the paper but it was particularly noticeable in this question, with labels either missing or incorrect.

Some good candidates gave only one reason where more than one was required. This was usually where candidates found ∠EFG = 33° and then used corresponding angles to find ∠BAC.

It is important that candidates realise that, because a two-step calculation was required, a reason was needed for each step.

Question Six

This question provided the major opportunity for candidates to show evidence that they could achieve the standard with excellence. Candidates were expected to complete a geometric proof with linked steps of reasoning. The proof needed to be complete and the reasons needed to be correct.

Angle sizes on the diagram were not sufficient to constitute a proof. If a construction was done, this should have been explained as part of the proof.

Candidates who attempted this question usually displayed a good knowledge of angles in polygons. Polygons need to be given their specific name – ‘pentagon’ or ‘hexagon’, and the word ‘regular’ was often omitted.

Many candidates were able to deduce that $\angle$DAF = 72° but gave no reasons, or some reasons were missing or the reasons given did not follow logically. It was not unusual to see all the angles correctly calculated and written on the diagram and no reasons supplied.

Students need to gain practice with this style of question. Clear statements, good setting out and an appropriate concluding statement are needed in a proof.

Some candidates started with $\angle$DAF = 72° rather than reaching it as their end point.

Some decided that circle geometry was involved in this question so incorrectly obtained $\angle$GEH = 144° so they could use ‘angle at the centre equals twice the angle at the centre’.

Candidates who completed the proof by using the sum of interior angles in the hexagon ADGEHF or the sum of interior angles in the octagon that was formed by the complete logo, provided evidence for achieving excellence in this standard.

Many candidates attempted this proof by drawing a line from B to C. This line halved the interior angle of the regular pentagon and formed an isosceles triangle. For this approach to gain Excellence, it was insufficient to state that triangle ABC was isosceles. This had to be justified by explaining why $\angle$ABC = 54° and $\angle$ACB = 54°. Similarly, it was insufficient to say AE was a line of symmetry or to use parallel lines without justification.

Assessment Schedule

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	Achievement Criteria	No.	Evidence	Code	Judgement	Sufficiency
Evidence contributing to Achievement	Find unknowns using two-step processes.	One	□AFE = 152°	**A**	No alternative.	**Achievement**
		Two	□CEF = 56°	**A**	No alternative.	Three of Code **A**
		Three	□ACD = 122°	**A**	No alternative.	
			Base angles isosceles triangle (are equal)	**A**	Parts in brackets are not required.	
			(Adjacent) angles on a line (are supplementary).			
Evidence contributing to Achievement with Merit	Find unknowns using a process with two-step reasoning.	Three	□ACD = 122° Base angles isosceles triangle (are equal). (Adjacent) angles on a line (are supplementary).		Accept alternative valid reasons for Three, Four and Five.	**Achievement with Merit** Achievement **plus** Two of Code **M** **OR** Three of Code **M**
			□BOC = 148°	**M**	Parts in brackets are not required.	
		Four	Opposite angles of cyclic quad (are supplementary). Angle at centre (is twice angle at the circumference).	**A**		
			OR	**M A**		
			Angle at centre (is twice angle at the circumference). Angles at a point (sum to 360°).			
		Five	□BAC = 33°	**A**		
			Angle in a right angle (is 90°). Corresponding angles (on parallel lines) (are equal).			
			OR	**M A**		
			Angles in a triangle (sum to 180°). Alternate angles (on parallel lines) (are equal).			

Evidence contributing to Achievement with Excellence	Investigate a conjecture or present a proof involving at least three steps of reasoning in analysing shapes or designs.	Six	$\angle$ADG = $\angle$HFA = 72° Exterior angle of a (regular) pentagon $\angle$DGE = $\angle$EHF = 132° Sum of the exterior angle of a (regular) pentagon and a (regular) hexagon $\angle$GEH = 240° Interior angle of a (regular) hexagon (is 120°) and angles at a point (sum to 360°) Therefore $\angle$DAF = 72° since DGEHFA is a hexagon and the sum of its interior angles = 720°	**M A** **M A** **E**	Accept alternative proofs. Proof must be: • Complete • Set out logically and easy to follow. Ignore one partially omitted reason.	**Achievement with Excellence** Merit **plus** Code **E**