Assessment Schedule – 2022

Mathematics and Statistics: Apply geometric reasoning in solving problems (91031)

Do not penalise incorrect rounding if sufficient evidence provided.

Q	Evidence	Achievement	Merit	Excellence
One (a)	Use of Trigonometry to find: AC = 8 × sin 27° AC = 3.632 m Use of Trigonometry to find: BC = 8 × cos 27° BC = 7.128 m OR Alternative Method of Pythagoras: $BC = \sqrt{(8^2 - 3.632^2)} = 7.128\text{ m}$ Use of Trigonometry to find: $CD = \frac{3.632}{\tan 35°} = 5.187\text{ m}$ $BD = 7.128 + 5.187 = 12.315\text{ m}$ OR alternative method.	Showing, with evidence of relevant working any of the lengths: AC = 3.632 m. BC = 7.128 m. CD = 5.187 m. OR CAO.	Correct value for BD (or equivalent) BD = 12.315 m, with clear evidence of working.	
(b)(i)	In triangle CPR, ∠ CRP = 25° (base angles of isosceles triangle CPR are equal) ∠ RCP = 180° – 25° – 25° (angle sum of triangle CPR is 180°) x = ∠ RCP = 130° OR alternative method.	Required angle x = 130° found (Reasons not necessary but do not accept CAO.)		
(ii)	∠ PRS = 25° (alternate angles between parallel lines CP and RS) ∠ CRS = 25° + 25° = 50° ∠ CRS = 50° (base angles of isosceles triangle CRS are equal) ∠ RCS = 180° – 50° – 50° (angle sum of triangle CRS is 180°) y = ∠ RCS = 80° OR alternative method.	Required angle y = 80° found (Reasons not necessary but do not accept CAO.)		

(c)(i)	Let M be the mid-point of AB. $\angle MOA = \frac{360°}{10} = 36°$ Use of trigonometry in triangle OMA $\text{OA} = \frac{6}{\sin 36°}$ $\text{OA} = \frac{6}{0.5878}$ $\text{OA} = 10.2078 \text{ m}$ Total length of supports: $= 5 \times 10.2078$ $= 51.04 \text{ m}$ OR alternative method.	Finding length OA = 10.2078 m, with evidence of working OR OM = 8.258 m, with evidence of working OR CAO.	Finding total length of support arms: 51.04 m, with evidence of working.	
(ii)	Let M be the mid-point of AB. $\angle \text{MOA} = \frac{360°}{2n}$ Use of trigonometry in triangle OMA: $\text{OA} = \frac{z}{\sin\left(\frac{360°}{2n}\right)}$ $\text{OA} = \frac{z}{\sin\left(\frac{180°}{n}\right)}$ Total length of supports: $= n \times \frac{z}{\sin\left(\frac{180°}{n}\right)}$ $= \frac{nz}{\sin\left(\frac{180°}{n}\right)}$ OR alternative method.	Finding an angle in terms of *n*. $\angle \text{MOA} = \frac{360°}{2n}$ OR $\angle \text{OAB} = \frac{180°(n-2)}{2n}$ OR Substituting numerical values for *z* or *n* and finding length OA. CAO	Finding length OA $\frac{z}{\sin\left(\frac{180°}{n}\right)}$ with evidence of working OR Substituting numerical values for *z* or *n* and finding total length of support arms. OR Consistently finding an expression for the total length from an incorrect angle.	E8 Finding total length of support arms: $\frac{nz}{\sin\left(\frac{180°}{n}\right)}$ OR $\frac{nz}{\cos\left(\frac{90°(n-2)}{n}\right)}$ with evidence of working . E7 Finding total length of support arms, but unsimplified. OR Minor error.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	One point made incompletely.	1 of u	2 of u	3 of u	1 of r	2 of r	Q 1(c)(ii) with minor error	Q 1(c)(ii)

Q	Evidence	Achievement	Merit	Excellence
TWO (a)(i)	∠PSR = 90° (angles in a semicircle are 90°) Use of Trigonometry in triangle PRS: ∠PRS = $\tan^{-1}\frac{16}{10}$ *a* = ∠PRS = 58° OR alternative method.	Finding, with evidence of working *a* = ∠PRS = 58° (Evidence that ∠PSR = 90° not necessary)		
(ii)	∠CQT = ∠CPT = 90° (angle between a tangent and the radius is 90°) ∠QCP = 2 × 68° = 136° (angle at the centre is twice that at the circumference) ∠PTQ = 360° – 90° – 90° – 136° (angle sum of a quadrilateral is 360°) *b* = ∠PTQ = 44° OR alternative method.	Finding required angle *b* = 44° **OR** Finding ∠QCP = 136° with a valid reason.	Finding required angle *b* = 44° with at least one valid reason.	
(b)	∠PSR = 180° – 72° = 108° (opposite angles of a cyclic-quadrilateral add to 180°) ∠SPR = 180° – 108° – 28° (angle sum of triangle PSR is 180°) *y* = ∠SPR = 44° OR alternative method.	Finding required angle *y* = 44° (Reasons not necessary but do not accept CAO.)		
(c)	Triangles BPQ and BAC are similar. $PQ \times k = AC$ $k = \frac{21}{12} = 1.75$ Then $\text{BA} = 1.75 \times \text{BP}$ $\text{BP} = \frac{25}{1.75}$ $\text{BP} = 14.286 \text{ m}$ Justification of similar triangles not required.	Finding ratio of similar triangles of 1.75. **OR** $\frac{21}{12}$ or their reciprocals: $\frac{12}{21}$ or 0.571. (Other arrangements also accepted).	Show with evidence of use of similar triangles, that BP = 14.286 m.	

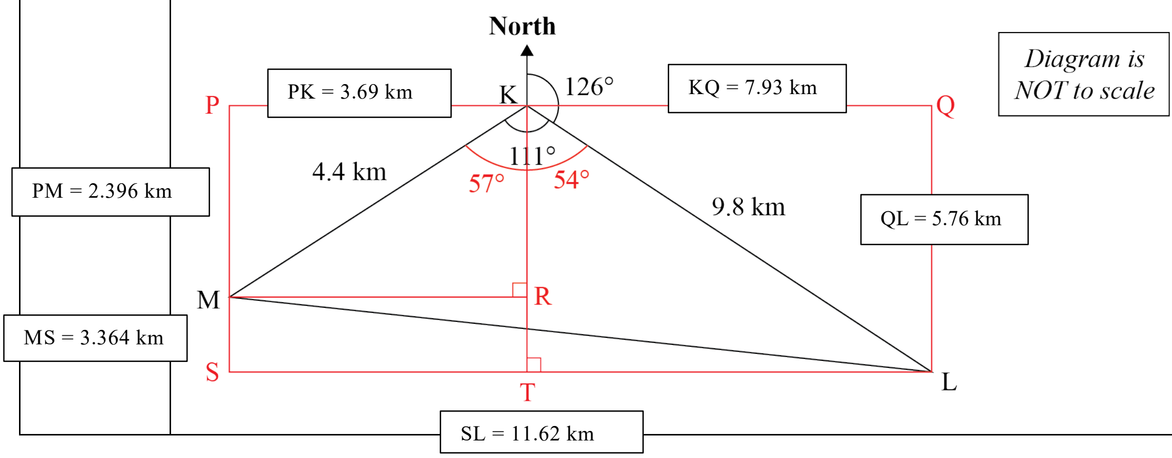
(d)	Use of Trigonometry in triangle MNP: $\text{MP} = \frac{c}{\sin 42°}$ $\text{MP} = \frac{c}{0.6691}$ $\text{MP} = 1.4945c$ Use of Trigonometry in triangle MNP: $\text{NP} = \frac{c}{\tan 42°}$ $\text{NP} = \frac{c}{0.9004}$ $\text{NP} = 1.1106c$ Use of Trigonometry in triangle MNQ: $\text{MQ} = \frac{c}{\sin 36°}$ $\text{MQ} = \frac{c}{0.5878}$ $\text{MQ} = 1.7013c$ Use of Trigonometry in triangle MNQ: $\text{NQ} = \frac{c}{\tan 36°}$ $\text{NQ} = \frac{c}{0.7265}$ $\text{NQ} = 1.3764c$ PQ = 1.3764c – 1.1106c PQ = 0.2658c Perimeter =1.4945c + 1.7013c + 0.2658c = 3.4616c metres OR alternative method. Units not required.	Finding, with evidence of working, any ONE length of: $\text{MP} = \frac{c}{0.6691}$ $\text{NP} = \frac{c}{0.9004}$ $\text{MQ} = \frac{c}{0.5878}$ $\text{NQ} = \frac{c}{0.7265}$ (or equivalent) OR Finding ALL of the lengths of MP, NP, MQ, NQ having substituted a numerical value for c or having omitted c. OR PQ given with unevaluated trig expressions. OR Finding ALL of the lengths of MP, NP, MQ, NQ with unevaluated trig expressions. OR CAO	Finding, with evidence of working $\text{PQ} = \frac{c}{3.7622}$ Or PQ = 0.2658c OR Correct unsimplified expression given for the perimeter with unevaluated trig expressions.	E8 Finding the perimeter of the shaded region MPQ in terms of c: 3.4616c m or $\frac{c}{0.2889}$ with clear justification. E7 Finding the perimeter of the shaded region MPQ in terms of c with clear justification but insufficient accuracy in the calculations . OR Correct unsimplified expression given for the perimeter. OR Minor error.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	One point made incompletely.	1 of u	2 of u	3 of u	1 of r	2 of r	Q 2(d) with minor error	Q 2(d)

Q	Evidence	Achievement	Merit	Excellence
THREE (a)	∠FGB = 82° (corresponding angles between parallel lines) ∠AGB = 180° – 82° = 98° (adjacent angles on a straight line add to 180°) ∠ACF = 180° – 134° = 46° (adjacent angles on a straight line add to 180°) ∠ABG = 46° (corresponding angles between parallel lines) ∠GAB = 180° – 98° – 46° (angle sum of triangle ABG is 180°) z = ∠GAB = 36° OR alternative method.	One relevant angle found with evidence. OR CAO	Required angle z = 36° found, with at least one valid reason.	
(b)(i)	∠EHG = 90° (angles in a semicircle are 90°) Use of Pythagoras to find: $\text{EG}^2 = \text{EH}^2 + \text{GH}^2$ $\text{EG}^2 = 8^2 + 12^2$ $\text{EG}^2 = 208$ $\text{EG} = \sqrt{208} = 14.42\text{ cm}$ OR alternative method.	Finding, with evidence of working EG = 14.42 cm (Evidence that ∠EHG = 90° not necessary.)		
(ii)	Use of Trigonometry to find $\angle\text{EGH} = \tan^{-1}\frac{8}{12}$ $= 33.7°$ Then ∠EFH = 33.7° (angles in the same segment / sector are equal) x = ∠FEH = 180° – 33.7° – 75° (angle sum of triangle DAB is 180°) x = 71.3° OR alternative method.	Finding with evidence of working angle ∠EGH = 33.7° OR ∠GEH = 56.3° OR CAO. (Evidence that ∠EHG = 90° not necessary.)	Required angle x =71.3° found, with at least one valid reason.	

(c)	**Method 1:** $\angle FGC = x°$ (base angles of isosceles triangle CFG are equal) $\angle FCG = 180° - 2x$ (angle sum of triangle FCG is 180°) $\angle GCH = 180° - (180° - 2x)$ (adjacent angles on a straight line add to 180°) $\angle GCH = 180° - 180° + 2x$ $\angle GCH = 2x$ i.e. $y = 2x$ **Method 2:** $\angle FGC = x°$ (base angles of isosceles triangle CFG are equal) $\angle CGH = 90° - x$ (angle in a semicircle is 90°) $\angle CHG = 90° - x$ (base angles of isosceles triangle CGH are equal) $\angle GCH = 180° - (90° - x) - (90° - x)$ (angle sum of triangle CGH is 180°) $\angle GCH = 180° - 90° + x - 90° + x$ $\angle GCH = 2x$ i.e. $y = 2x$ **Method 3:** $\angle GCH = 2x°$ (special case of angle at the centre is twice that at the circumference) i.e. $y = 2x$ OR other alternative method.	Finding required angle relationship of $y = 2x$, without relevant geometric reasons. OR Finding the size of the angle y having substituted a numerical value for x. OR One of the following angles in terms of x: $\angle GHC = 90 - x$ $\angle FCG = 180 - 2x$ $\angle HGC = 90 - x$ OR CAO	Required angle relationship of $y = 2x$ found, with at least one valid reason.	

(d)	Use of Trigonometry to find: $QL = 9.8 \times \cos 54°$ $QL = 5.76$ km $KQ = 9.8 \times \sin 54°$ $KQ = 7.93$ km (OR Alternative Method of Pythagoras) $PM = 4.4 \times \cos 57°$ $PM = 2.396$ km $PK = 4.4 \times \sin 57°$ $PK = 3.69$ km (OR Alternative Method of Pythagoras) MS = 5.76 – 2.396 = 3.364 km SL = 3.69 + 7.93 = 11.62 km Use of Pythagoras in triangle MSL: $ML^2 = 3.364^2 + 11.62^2$ $ML = 12.097$ km Using trigonometry in triangle MSL: $\angle MLS = \tan^{-1}\left(\frac{3.36}{11.62}\right)$ $\angle MLS = \tan^{-1} 0.2895$ $\angle MLS = 16.1°$ i.e. Required Bearing = 270° + 16.1° = 286.1° i.e. Required Distance ML = 12.097 km OR alternative method.	One correct length from: QL = 5.76 km KQ = 7.93 km PM = 2.396 km PK = 3.69 km OR CAO	Finding the lengths MS = 3.364 km AND SL = 11.62 km with clear justified evidence OR ML = 12.097 km OR Correct bearing of M from L of 286.1°.	**E8** Clear justified evidence finding the distance ML AND Correct bearing of M from L of 286.1°. E7 Clear justified evidence finding the distance ML AND Finding $\angle MLS = 16.1°$ but incorrect bearing of M from L OR Minor error.



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No response; no relevant evidence.	One point made incompletely.	1 of u	2 of u	3 of u	1 of r	2 of r	Q 3(d) with minor error	Q 3(d)

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 7	8 – 14	15 – 18	19 – 24