Assessment Schedule – 2021

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

Evidence

Do not penalise incorrect rounding if sufficient evidence provided.

Q ONE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a) (i)	Use of Trigonometry to find PL = 18 × tan 20 = 18 × 0.36397 x = 6.55 cm	Showing, with evidence of working, that PL = x = 6.55 cm. *2dp confirms the correct working.*		
(ii)	Use of Trigonometry to find $y = \cos^{-1}\left(\frac{18}{35}\right)$ $= \cos^{-1}(0.5143)$ $y = 59.1^\circ$	Showing, with evidence of working, that y = 59.1°		
(b) (i)	In triangle AEF, $x^2 + x^2 = 2^2$ (Pythagoras) $2x^2 = 4$ $x^2 = 2$ x = 1.4142 OR $\sin 45^\circ = \frac{AF}{2}$ (trigonometry) AF = 2 × sin45° AF = 2 × 0.7071 AF = 1.4142 cm OR OR alternatively use cos45°.	Forms a correct Pythagoras equation. OR Forms a correct trigonometry equation.	Correct value for AF (or equivalent) AF = 1.4142, with clear evidence of working.	
(ii)	Then BF = 20 – 1.4142 = 18.5858 In triangle FBG, $w^2 = 18.5858^2 + 18.5858^2$ w^2 = 690.86 w = 26.28 cm OR $\sin 45^\circ = \frac{20 - 1.4142}{w}$ $w = \frac{18.5858}{\sin 45^\circ} = 26.284$ OR alternatively use $\cos 45^\circ$.	Correct length w = 26.28 cm found, with evidence of working.		

(c)	In triangle BCF, FC = 6 × tan 52° = 6 × 1.2799 FC = 7.68 cm. AB = 30 – 7.68 = 22.32 cm. In triangle ABE, Use of Trigonometry to find $p = \cos^{-1}\left(\frac{22.32}{33}\right)$ $= \cos^{-1}(0.6764)$ $p = 47.4°$ OR alternative method.	Showing, with evidence of working, that FC = 7.68 cm. OR Evaluation of angle p, with consistency, with evidence of working.	Correct value of $p = 47.4°$ found, with clear evidence of working.	
(d)	Use of Pythagoras in triangle ABH, $AB = \sqrt{17^2 - 2^2}$ $AB = \sqrt{285}$ AB = 16.88 cm CG = 16.88 – 4 = 12.88 cm. Use of trigonometry in triangle ADG, AD = 4 × tan 65° = 4 × 2.1445 AD = 8.58 cm. CH = 8.58 – 2 = 6.58 cm. Use of trigonometry in triangle ADG, $AG = \frac{4}{\cos 65°}$ AG = 9.46 cm. Use of Pythagoras in triangle CGH, $GH = \sqrt{12.88^2 + 6.58^2}$ $GH = \sqrt{209.19}$ GH = 14.46 cm Total Distance = 9.46 + 14.46 + 17 = 40.92 cm. OR alternative method.	Finding, with evidence of working, any ONE of: • Length AB = 16.88 • Length AD = 8.58 cm • Length AG = 9.46 cm • Length GH = 14.46 cm. *2dp required (or clear method shown) to exclude incorrect assumption of the red triangle as being right-angled.*	Finding, with evidence of working, any TWO of: • Length GC = 12.88 • Length CH = 6.58 • Length AG = 9.46 • Length GH = 14.46	**T2 / E8** Finding, with evidence of working, the total length 40.92 cm. **T1 / E7** Identifies, with evidence of working, the lengths of the two remaining sides of the red triangle: AG = 9.46 and GH = 14.46 OR Identifies, with evidence of working, a consistent total length, with an earlier minor error *A minor error could be for example: an arithmetic error or omitting only **one** of the subtractions of 2cm or 4 cm **but not both** of them.*

N0	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	T1	T2

Q TWO	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a) (i)	$\angle HPE = 77°$ (vertically opposite angles are equal). $\angle FHE = 81°$ (angles in the same segment / sector are equal) $x = \angle HEG = 180 - 77 - 81 = 22°$ (angles in a triangle add to 180°) OR $\angle GFP = 180 - 81 - 77 = 22°$ (angles in a triangle add to 180°) $x = \angle HEG = 22°$ (angles in the same segment / sector are equal) OR alternative method.	Required angle $x = 22°$ found, with some evidence, which could be on the diagram. (Reasons not necessary)		
(a) (ii)	$\angle FCE = 2 \times 81 = 162°$ (angle at the centre is twice that at the circumference) $\angle ECF = 360 - 162° = 198°$ (angles at a point sum to 360°) OR alternative method.	Required angle $y = 198°$ found. (Reasons not necessary.)		
(b)	$\angle PQC = 90°$ (angle between tangent and radius is a right-angle) In triangle PQW, $\angle PWQ = 180 - 90 - 40 = 50°$ (angle sum of triangle PQW is 180°) $\angle CVW = 50°$ (base angles of an isosceles triangle are equal) $\angle VCW = 180 - 50 - 50 = 80°$ (angle sum of triangle CVW is 180°) $\angle QCV = e = 180 - 80 = 100°$ (adjacent angles on a straight line) OR alternative method.	Finding two angles from: • $\angle PQC = 90°$ • $\angle PWQ = 50°$ • $\angle CVW = 50°$ • $\angle VCW = 80°$ OR One of these angles with a valid reason. OR CAO. *Angles could be shown on the diagram.*	Required angle $e = 100°$ found, with at least one valid reason.	

(c)	$\angle$ KQN $= 180 - 90 - 38 = 52°$ (angle sum of triangle NKQ) $\angle KQM = 180 - 52 = 128°$ (adjacent angles on a straight line) $\angle QLM = \frac{(180-128)}{2} = 26°$ (base angles of isosceles triangle are equal) $y = \angle KLM = 180 - 26 = 154°$ (adjacent angles on straight line) OR alternative method.	Finding two angles from $\angle KQN = 52^o$ or $\angle KQM = 128^o$ or $\angle QLM = 26^o$ OR One of these angles with a valid reason (consistency applies). OR CAO.	Required angle $y = 154°$ found, with at least one valid reason.	
(d)	$\angle PRW = 90°$ (angle in a semicircle is a right angle) $\angle PWR = 180 - y°$ (adjacent angles on a straight line) $\angle PQR = 180 - (180 - y) = y$ (opposite angles of a cyclic quad add up to 180) $\angle QRP = 180 - x - y$ (angle sum of triangle PQR) $\angle SRW = 180 - 90 - (180 - x - y)$ $= x + y - 90$ (adjacent angles on a straight line) $\angle RSW = 180 - y - (x + y - 90)$ $\angle z = 180 - y - x - y + 90°$ $\angle z = 270° - x - 2y$ OR alternative method.	One step shown involving calculation of an angle involving x or y i.e. Finding $\angle PWR = 180 - y$ or $\angle PQR = y$ or $\angle QRP = 180 - x - y$ or $\angle SRW = 180 - z - y$ OR two steps, having substituted numerical values for x and y. OR CAO	Finding TWO angles involving calculations including x or y, with at least one valid reason. OR Finding the value of z, having substituted numerical values for x and y.	**T2 / E8** Finding $\angle z$, in terms of x and y, with clear justification. $z = 270 - x - 2y$ **T1 / E7** Finding $\angle z$, in terms of x and y, with unclear justification or not simplified. OR Minor error, e.g. incorrect algebraic rearrangement.

N0	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	T1	T2

Q THREE	Evidence	Achievement	Achievement with Merit	Achievement with Excellence
(a)	Use of trigonometry to find $\angle XWY = \sin^{-1}\frac{33}{85}$ $= 22.84°$ Then $\angle f = 90 - 22.84 = 67.16°$ OR Use of trigonometry to find $\angle WYX = \cos^{-1}\frac{33}{85}$ $= 67.16°$ Then $\angle f = 67.16°$ (alternate angles between parallel lines are equal) OR alternative method.	Showing, with evidence of working, that $f = 67.16°$.		
(b)	Similar triangles recognised and g calculated using ratio of sides: $\frac{g+4.64}{10.26} = \frac{4.64}{2.85}$ $g = 12.064$ cm OR ratio of 3.6 (or its reciprocal, 0.272) calculated and correctly used: $\frac{RS}{QT} = \frac{10.26}{2.85} = 3.6$ Then $\frac{PS}{PT} = 3.6$ PS = 3.6 × 4.64 PS = 16.704 Then g = 16704 – 4.64 g = 12.064 cm. Justification of similar triangles not required. OR Use of trigonometry to find $\angle QPT = \tan^{-1}\frac{2.85}{4.64} = 31.56°$ Then in triangle RPS, $\tan 31.56 = \frac{10.26}{PS}$ $PS = \frac{10.26}{\tan 31.56}$ $PS = \frac{10.26}{0.6142}$ PS = 16.704 Then g = 16.704 – 4.64 g = 12.064 cm. OR alternative method.	Forming an equation involving a correct ratio of similar sides. OR Finding a correct ratio involving similar triangles e.g. of 3.6 or its reciprocal 0.2727 with evidence. OR Finding angle of $\angle QPT = 31.56°$ with evidence. OR CAO.	Calculation of correct value of g = 12.064 cm with evidence of working.	

(c)(i)	Use of bearings and geometry to find $\angle ABG = 180 - 128 = 52°$ (co-interior angles between parallel lines add to 180°) (or equivalent) CAO is not sufficient.	Showing, with evidence of working, that $\angle ABG = u = 52°$ Reasons not necessary.		
(c)(ii)	$\angle CBH = 180 - 90 - 52 = 38°$ (adjacent angles on a straight line) $\angle KCB = 38°$ (alternate angles between parallel lines are equal) $\angle BCH = 90 - 38 = 52°$ Use of trigonometry in triangle ABC, $\angle ACB = \tan^{-1}\left(\frac{1500}{800}\right)$ $\angle ACB = 61.93°$ $\angle ACJ = 180 - 61.93° - 52 = 66.07°$ Required bearing = 270° + 66.07° = 336.07° OR alternative method.	Finding, with evidence of working, that $\angle ACB = 61.93°$ OR One relevant length, with evidence of working: BG = 923.49 km BH = 630.41 km AG = 1700 km OR CAO	Correct bearing of 336.7°.	
(d)(i) (ii)	Using trigonometry / Pythagoras in triangle ABC, AB = 86 × cos 56° AB = 48.09 metres Using trigonometry / Pythagoras in triangle ABC, BC = 86 × sin 56° BC = 71.30 metres Using trigonometry in triangle ABT, Height = BT = 48.09 × tan 32° Tower Height = 30.05 metres. Using trigonometry in triangle BCT, $\angle BCT = \tan^{-1}\left(\frac{30.05}{71.30}\right)$ $\angle BCT = \tan^{-1}(0.4215)$ Required angle of elevation is $\angle BCT = 22.85°$ OR alternative method.	One correct length, with evidence of working from: • AB = 48.09 • BC = 71.30 OR CAO	Proving tower height of 30.05 m. OR Consistent angle of elevation. OR Both lengths AB and BC found, with evidence.	E8 Clear evidence Proving tower height of 30.05 m. AND Correct angle of elevation of 22.85°, with evidence. E7 Clear evidence Proving tower height of 30.05 m AND Finds a consistent angle of elevation with a minor error in working.

N0	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)

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 14	15 – 20	21 – 24