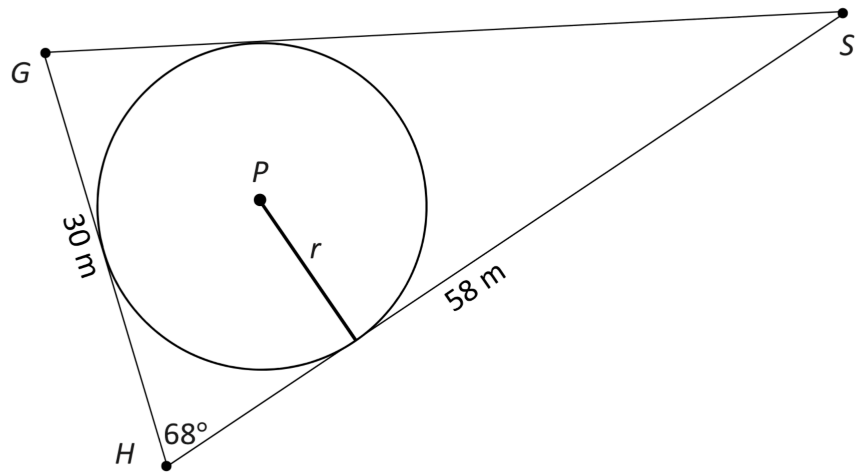
Question 9 **(55 marks)**

The diagram below shows a triangular patch of ground ΔSGH, with $|SH| = 58$ m, $|GH| = 30$ m, and $|\angle GHS| = 68°$. The circle is a helicopter pad. It is the incircle of ΔSGH and has centre P.



(a) Find $|SG|$. Give your answer in metres, correct to 1 decimal place.

(b) Find $|\angle HSG|$. Give your answer in degrees, correct to 2 decimal places.

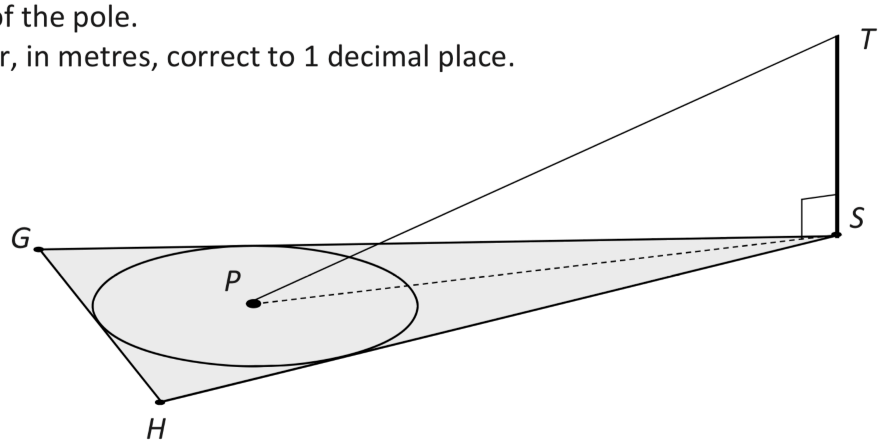
(c) Find the area of ΔSGH. Give your answer in m^2, correct to 2 decimal places.

(d) **(i)** Find the area of ΔHSP, in terms of r, where r is the radius of the helicopter pad.

(ii) Show that the area of ΔSGH, in terms of r, can be written as $71{\cdot}2r$ m^2.

(iii) Find the value of r. Give your answer in metres, correct to 1 decimal place.

(e) $[ST]$ is a **vertical** pole at the point S.
The angle of elevation of the top of the pole from the point P is $14°$.
Find the height of the pole.
Give your answer, in metres, correct to 1 decimal place.



Q9	Model Solution – 55 Marks	Marking Notes
(a)	$\lvert SG\rvert^2 = 30^2 + 58^2 - 2(30)(58)(\cos 68)$ $= 2960{\cdot}369$ $\lvert SG\rvert = 54{\cdot}409$ m $\lvert SG\rvert = 54{\cdot}4$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit:* Some relevant substitution into correct cosine formula *High Partial Credit:* Formula fully substituted
(b)	$\dfrac{54{\cdot}4}{\sin 68} = \dfrac{30}{\sin \angle HSG}$ $\sin \angle HSG = 0{\cdot}51131$ $\lvert\angle HSG\rvert = 30{\cdot}75$ Or $\cos \angle HSG = \dfrac{54{\cdot}4^2 + 58^2 - 30^2}{2(54{\cdot}4)(58)}$ $= 0 \cdot 859432$ $\lvert\angle HSG\rvert = 30{\cdot}747^\circ = 30{\cdot}75$	**Scale 10C (0, 4, 7, 10)** *Low Partial Credit:* Some relevant substitution into relevant formula *High Partial Credit:* Formula fully substituted Note: Finds $\lvert\angle HGS\rvert$ => ✔#
(c)	Area $\Delta GSH = \frac{1}{2}(30)(58)\sin 68 = 806{\cdot}65$ Also Area ΔGSH: $\dfrac{1}{2}(54{\cdot}4)(58)\sin 30{\cdot}75$ and $\frac{1}{2}(54{\cdot}4)(30)\sin 81{\cdot}25$	**Scale 15C (0, 5, 10, 15)** *Low Partial Credit:* Some substitution into area formula *High Partial Credit:* Formula fully substituted
(d) (i)	$\dfrac{1}{2}(58)(r)$ or $29r$	**Scale 5B (0, 2, 5)** *Mid Partial Credit:* Right angle indicated Relevant triangle indicated on diagram Area of triangle formula with some substitution

(d) (ii)	Area ΔGHS $= \frac{1}{2}(30)(r) + \frac{1}{2}(54{\cdot}4)(r) + \frac{1}{2}(58)(r)$ $= 15r + 27{\cdot}2r + 29r = 71{\cdot}2r$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Relevant use of previous answer in this part Indication of 3 relevant triangle areas to be added Area of 1 additional triangle (in terms of r) *High Partial Credit:* Addition of 2 areas (each written in terms of r)
(d) (iii)	$71{\cdot}2r = 806{\cdot}62$ $r = \frac{806{\cdot}62}{71{\cdot}2}$ $= 11{\cdot}3289 = 11{\cdot}3$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Both relevant answers presented *High Partial Credit:* Areas equated
(e) (ii)	$\tan 14 = \frac{\lvert TS\rvert}{\lvert PS\rvert}$ $\sin 15{\cdot}375 = \frac{11{\cdot}3}{\lvert PS\rvert} = 42{\cdot}51$ $=> \lvert PS\rvert = 42{\cdot}619$ $\tan 14 = \frac{\lvert TS\rvert}{42{\cdot}619}$ $\lvert TS\rvert = 10{\cdot}626 = 10{\cdot}6$ Or $\lvert\angle HPS\rvert = 180 - 15{\cdot}375 - 34$ $= 130{\cdot}625^{\circ}$ $\frac{\sin 130{\cdot}625}{58} = \frac{\sin 34}{\lvert PS\rvert}$ $\lvert PS\rvert = 42{\cdot}73$ $\tan 14 = \frac{\lvert TS\rvert}{42{\cdot}73}$ $\lvert TS\rvert = 10{\cdot}653 = 10{\cdot}7$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* Some relevant substitution *High Partial Credit:* Formula fully substituted