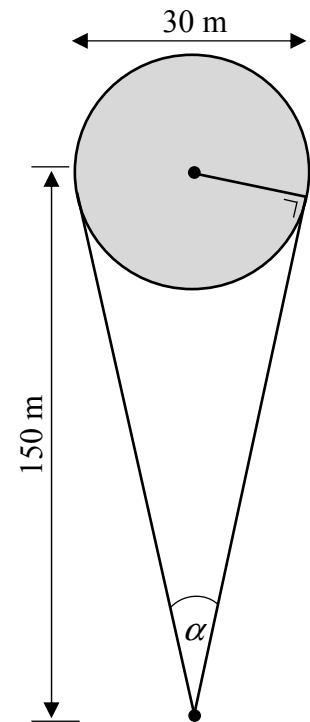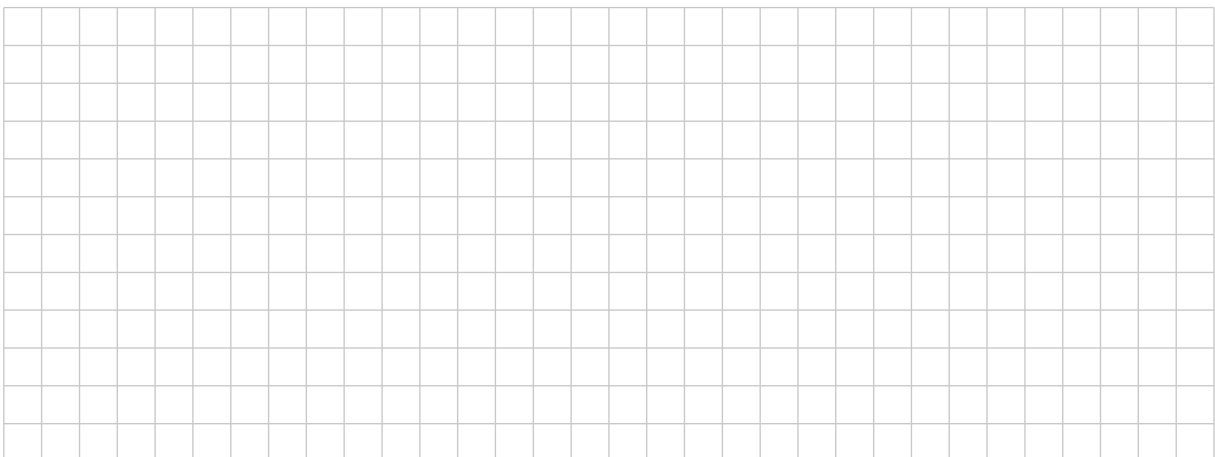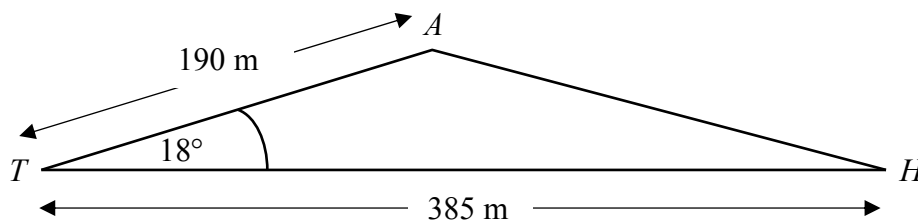**Question 9** **(45 marks)**

(a) Joan is playing golf. She is 150 m from the centre of a circular green of diameter 30 m. The diagram shows the range of directions in which Joan can hit the ball so that it could land on the green. Find α, the measure of the angle of this range of directions. Give your answer, in degrees, correct to one decimal place.

(b) At the next hole, Joan, at T, attempts to hit the ball in the direction of the hole H. Her shot is off target and the ball lands at A, a distance of 190 metres from T, where $|\angle ATH| = 18°$. $|TH|$ is 385 metres. Find $|AH|$, the distance from the ball to the hole, correct to the nearest metre.

(c) At another hole, where the ground is not level, Joan hits the ball from K, as shown. The ball lands at B. The height of the ball, in metres, above the horizontal line OB is given by

$$h = -6t^2 + 22t + 8$$

where t is the time in seconds after the ball is struck and h is the height of the ball.

(i) Find the height of K above OB.

(ii) The horizontal speed of the ball over the straight distance $[OB]$ is a constant 38 m s^{-1}. Find the angle of elevation of K from B, correct to the nearest degree.

(d) At a later hole, Joan's first shot lands at the point *G*, on ground that is sloping downwards, as shown. A vertical tree, [*CE*], 25 metres high, stands between *G* and the hole. The distance, |*GC*|, from the ball to the bottom of the tree is also 25 metres.

The angle of elevation at *G* to the top of the tree, *E*, is *θ*, where $\theta = \tan^{-1}\dfrac{1}{2}$.

The height of the top of the tree above the horizontal, *GD*, is *h* metres and |*GD*| = *d* metres.

(i) Write *d* and |*CD*| in terms of *h*.

d =

|*CD*| =

(ii) Hence, or otherwise, find *h*.