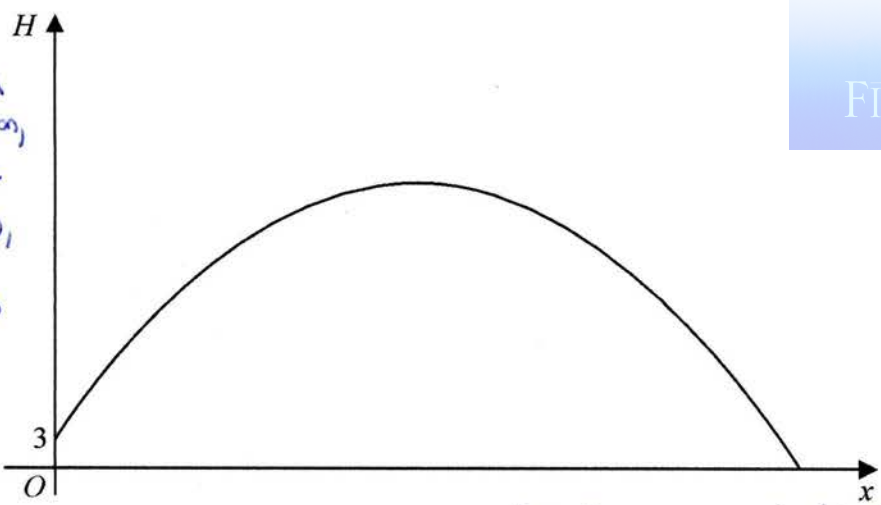




12.



(a) Given H is a quadratic function,
 $H = ax^2 + bx + c$
 $H = 3$ when $x = 0$,
 so
 $H = ax^2 + bx + 3$
 (1 mark)

(a) contd Given $H = 27$ when $x = 120$,
 $27 = a(120)^2 + b(120) + 3 \Rightarrow 14400a + 120b = 24$
 (1 mark)

Figure 3 (a) contd Given max. height when $x = 90$
 $\frac{dH}{dx} = 2ax + b = 0$ when $x = 90$
 $\Rightarrow 180a + b = 0$ (1 mark)

Figure 3

Figure 3 is a graph of the trajectory of a golf ball after the ball has been hit until it first hits the ground.

The vertical height, H metres, of the ball above the ground has been plotted against the horizontal distance travelled, x metres, measured from where the ball was hit.

The ball is modelled as a particle travelling in a vertical plane above horizontal ground.

Given that the ball

- is hit from a point on the top of a platform of vertical height 3 m above the ground
- reaches its maximum vertical height after travelling a horizontal distance of 90 m
- is at a vertical height of 27 m above the ground after travelling a horizontal distance of 120 m

Given also that H is modelled as a **quadratic** function in x

(a) contd $14400a + 120b = 24$
 $\times 80 \quad 180a + b = 0$
 $\hline 14400a + 80b = 0$
 $40b = 24$

(a) find H in terms of x

(a) contd $\Rightarrow b = \frac{3}{5}$
 $180a + \frac{3}{5} = 0 \Rightarrow a = -\frac{1}{300}$

$\Rightarrow H = -\frac{1}{300}x^2 + \frac{3}{5}x + 3$
 (2 marks)

(b) Hence find, according to the model,

- the maximum vertical height of the ball above the ground,
- the horizontal distance travelled by the ball, from when it was hit to when it first hits the ground, giving your answer to the nearest metre.

(b)(i) When $x = 90$, $H = -\frac{1}{300}(90)^2 + \frac{3}{5}(90) + 3 = 30$ m (1 mark) (3)

(c) The possible effects of wind or air resistance are two limitations of the model. Give one other limitation of this model.

(b)(ii) When ball hits ground, $H = 0$, so $0 = -\frac{1}{300}x^2 + \frac{3}{5}x + 3$ (1 mark) (1)

Solving Quadratic $\Rightarrow x = -4.868, 184.868$ so $x = 185$ m to nearest m (1 mark)
 negative distance meaningless

(c) ground unlikely to be horizontal OR ball is not a particle but has dimensions (1 mark)
 OR ball unlikely to travel in vertical plane because of spin OR etc.