4. As a car passes a point p, its driver applies the brakes. The car's distance, s, from p at any subsequent time, t, is given by

$$s(t) = 20t - 2t^2$$

where s is measured in metres and t in seconds.

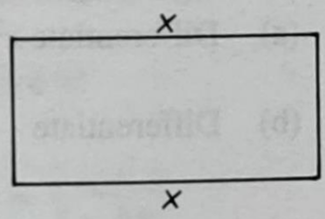
Find
- (i) the car's distance from p at $t = 4$.
- (ii) the car's speed at $t = 4$.
- (iii) the time when the car comes to rest.
- (iv) the car's distance from p when it stops.
- (v) the constant deceleration of the car.

5. As soon as an aeroplane touches down, it applies brakes. The distance, s, which it has travelled along the runway at time t seconds after touchdown is given by

$$s(t) = 200t - 4t^2 \text{ metres.}$$

Find
- (i) the speed of the aeroplane at $t = 3$.
- (ii) the speed of the aeroplane at $t = 4$.
- (iii) the constant deceleration of the aeroplane.
- (iv) the time taken in coming to rest.
- (v) the distance travelled by the plane before coming to rest.

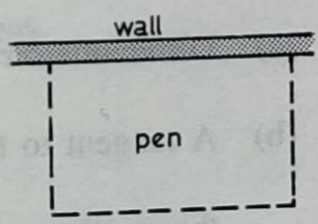
6. A piece of wire, 40 cm long, is bent to form a rectangle.
If the length of the rectangle is x, show that its area, A, is given by



$$A = 20x - x^2.$$

Hence find the maximum possible area.

7. A straight wall runs along one side of a farm. The farmer has 60 m of fencing to complete the other 3 sides of a small rectangular pen.
If x = the width of the pen, show that the area, A, is given by



$$A(x) = 60x - 2x^2.$$

Hence find the maximum possible area of the pen.

Solutions

Q4 $s(t) = 20t - 2t^2$

(i) $t = 4$, $s(4) = 20(4) - 2(4)^2 = 80 - 32 = \boxed{48m}$

(ii) $\frac{ds}{dt} = 20 - 4t$,

$20 - 4(4) = 20 - 16 = \boxed{4\ m/s}$

(iii) stopped, speed $= 0$

$20 - 4t = 0$

$20 = 4t$, $\boxed{t = 5s}$

(iv) $s(5) = 20(5) - 2(5)^2$

$100 - 50$ $\boxed{50m}$

(v) $\frac{d^2s}{dt^2} = -4$ $\boxed{4m/s^2}$ Deceleration

Q5 $s(t) = 200t - 4t^2$ Speed $= \frac{ds}{dt} = 200 - 8t$

(i) $200 - 8(3) = \boxed{176\ m}$

(ii) $200 - 8(4) = \boxed{168m}$

(iii) $\frac{d^2s}{dt^2} = -8m/s^2$ Deceleration of $8\ m/s^2$

(iv) $200 - 8t = 0$

$200 = 8t$

$25 = t$ $t = \boxed{25s}$

(v) $s(25) = 200(25) - 4(25)^2$

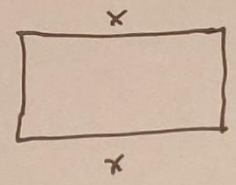
$5000 - 4(625) =$

$5000 - 2500$

$= \boxed{2500m}$

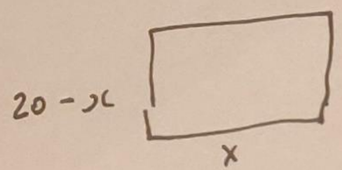
Solutions

Q6



$40 - 2x$ = Both sides

$\therefore$ one side is $\frac{40-2x}{2} = 20 - x$



$\therefore A = x(20 - x)$

$A = 20x - x^2$

$\frac{dA}{dx} = 20 - 2x$

$20 - 2x = 0$

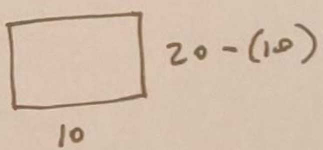
$20 = 2x$

$10\text{cm} = x$

$\frac{d^2A}{dx^2} = -2$

$\therefore$ Max

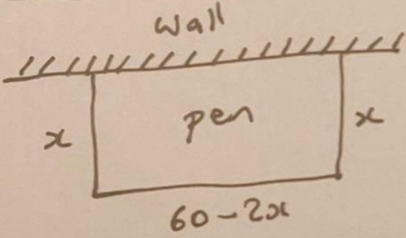
(+ = minimum)



Area $= 10 \times 10$

$= \boxed{100 \text{ cm}^2}$

Q7



$60 - 2x$ (length)

Area $= x(60 - 2x)$

$= 60x - 2x^2$

$\frac{dA}{dx} = 60 - 4x$

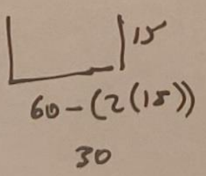
$\frac{d^2A}{dx^2} = -4$

($\therefore$ a maximum)

$60 - 4x = 0$

$60 = 4x$

$15 = x$



Area $= 15 \times 30$

$= \boxed{450 \text{ m}^2}$