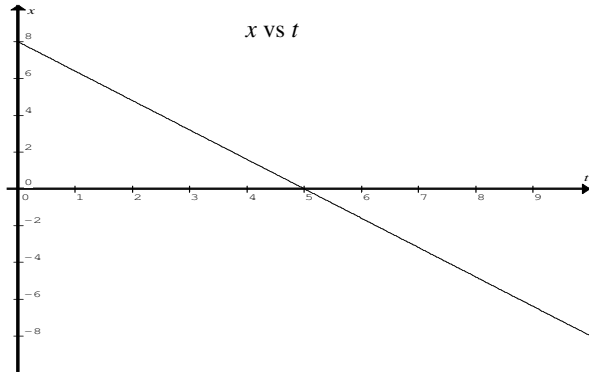


Physics worksheet – Graphs of position, velocity and acceleration vs time (for a particle moving in a straight line)

Notations and units:  $t$  time (s),  $x$  position,  $d$  total distance travelled (m),  $s$  displacement (m),  $v$  velocity ( $\text{ms}^{-1}$ ),  $a$  acceleration ( $\text{ms}^{-2}$ ), + up/east

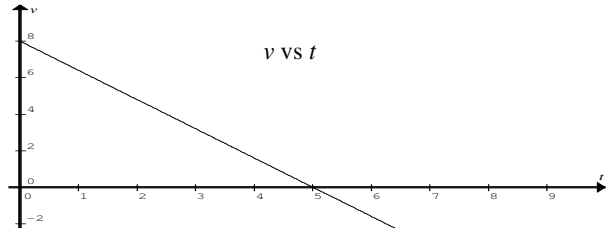
Q1 Find  $x$ ,  $d$ ,  $s$ ,  $v$  and  $a$  at  $t = 8$ .



$$x = -4.8, d = 8 + 4.8 = 12.8, s = -4.8 - 8 = -12.8$$

$$v = -\frac{8}{5} = -1.6, a = 0$$

Q2 The particle is at  $x = -10$  initially. Find  $d$ ,  $s$ ,  $x$ ,  $v$  and  $a$  at  $t = 8$ . Find the furthest distance from its initial position in the first 10 s.

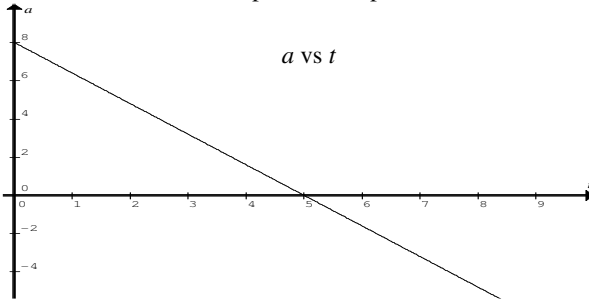


$$d = \frac{1}{2} \times 5 \times 8 + \frac{1}{2} \times 3 \times 4.8 = 27.2,$$

$$s = \frac{1}{2} \times 5 \times 8 - \frac{1}{2} \times 3 \times 4.8 = +12.8, x = -10 + 12.8 = +2.8$$

$$v = -4.8, a = -\frac{8}{5} = -1.6. \text{ Furthest dist.} = -10 + 20 = +10$$

Q3 The particle moves at  $+5 \text{ ms}^{-1}$  initially. Find  $a$  and  $v$  at  $t = 8$ . Find the maximum speed of the particle in the first 10 s.

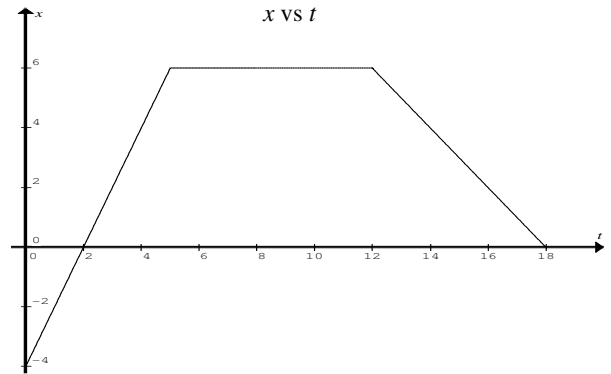


$$a = -4.8, \Delta v = \frac{1}{2} \times 5 \times 8 - \frac{1}{2} \times 3 \times 4.8 = +12.8,$$

$$v = +5 + 12.8 = +17.8$$

$$\text{Max speed occurs at } t = 5, |v| = 5 + \frac{1}{2} \times 5 \times 8 = 25$$

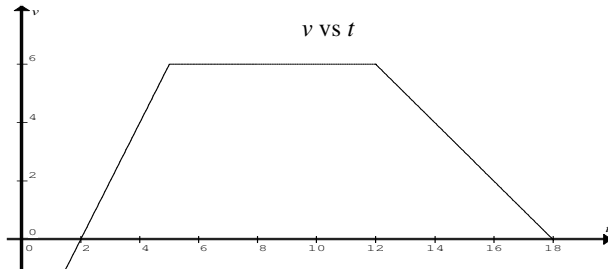
Q4 Find  $x$ ,  $d$ ,  $s$ ,  $v$  and  $a$  at  $t = 16$ .



$$x = +2, d = 10 + 4 = 14, s = +2 - (-4) = +6,$$

$$v = -\frac{6}{6} = -1, a = 0$$

Q5 The particle is at  $x = -50$  initially. Find  $d$ ,  $s$ ,  $x$ ,  $v$  and  $a$  at  $t = 16$ . Find the furthest distance from its initial position in the first 16 s.



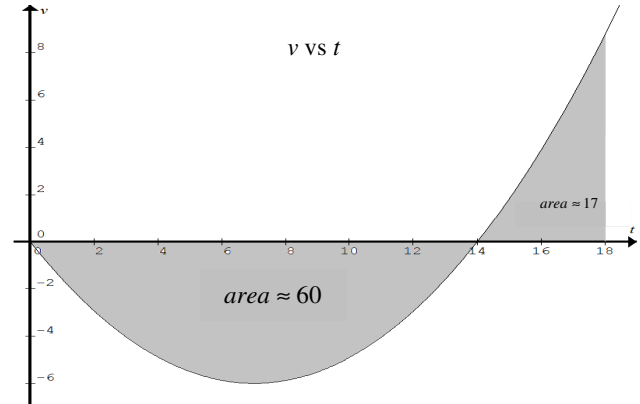
$$d = \frac{1}{2} \times 2 \times 4 + \frac{1}{2} (7 + 10) \times 6 + \frac{1}{2} (2 + 6) \times 4 = 71,$$

$$s = -\frac{1}{2} \times 2 \times 4 + \frac{1}{2} (7 + 10) \times 6 + \frac{1}{2} (2 + 6) \times 4 = +63,$$

$$x = -50 + 63 = +13, v = +2, a = -\frac{6}{6} = -1.$$

$$\text{Furthest distance from initial position} = |s| = 63$$

Q6 The particle is at  $x = +20$  initially. Estimate  $d$ ,  $s$ ,  $x$ ,  $v$  and  $a$  at  $t = 18$ . Estimate the furthest distance from its initial position in the first 18 s.



$$d \approx 60 + 17 = 77, s \approx -60 + 17 = -43,$$

$$x \approx +20 - 43 = -23, v \approx +9, a = \text{gradient of tangent} \approx +3$$

$$\text{Furthest distance from initial position} \approx 60$$