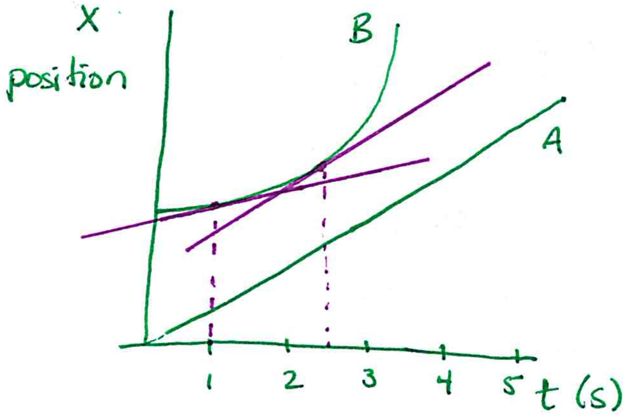
p64 CQ # 5, 7

p65 E # 6-14

CQ #5

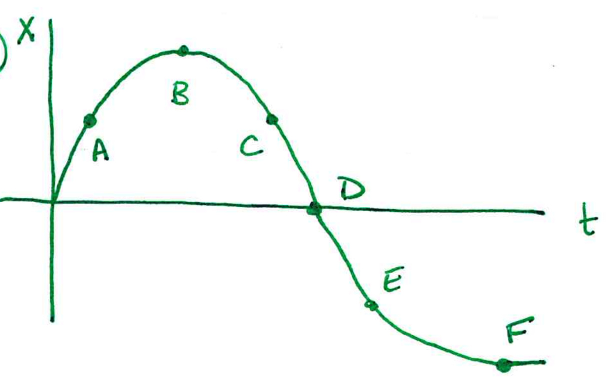


ⓐ at $t = 1s$, is the speed of A greater than, less than, or equal to the speed of B.

- since A is traveling with uniform motion, its velocity at 1s is equal to its average velocity (velocity is constant).
- for B, it's velocity is constantly changing (it is accelerating). B's velocity at 1s will be equal to the slope of the tangent line at 1s. (purple line) Since the slope of A > slope tangent, ~~velo~~ speed of A is <u>greater</u> than the speed of B.

ⓑ B has the same speed as A when the slope of the tangent to B is equal to the slope of A. This happens right before $t = 3s$.

⑦



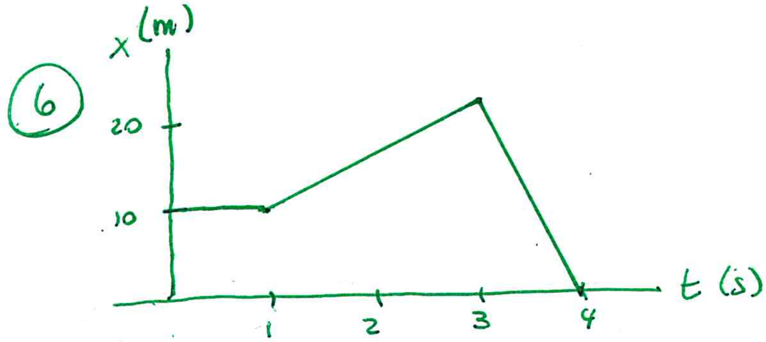
a) object is moving fastest at D (slope of tangent line is greatest at D.)

b) object is moving to the left (in the negative direction) when the slope of the tangent line (velocity) is negative. this happens at C, D, E

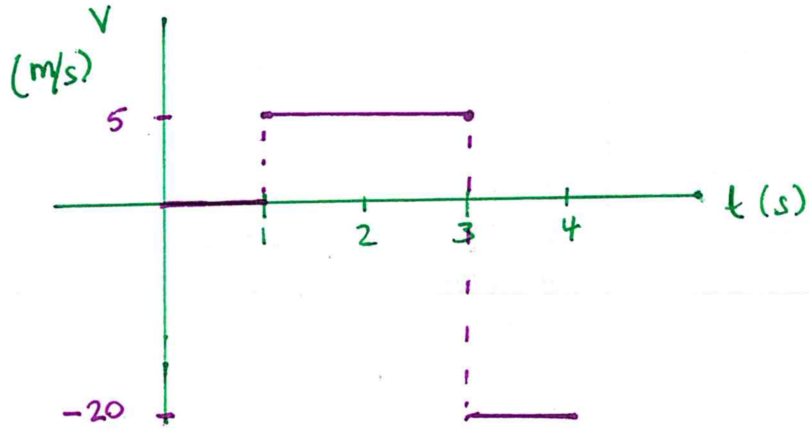
c) The object is speeding up at C because the slope of the tangent lines is increasing (obj. is speeding up in neg. direction)

d) the object is turning around when its velocity is changing from positive to negative (or negative to positive). This happens at B (the slope of the tangent lines is changing from + to −)

6

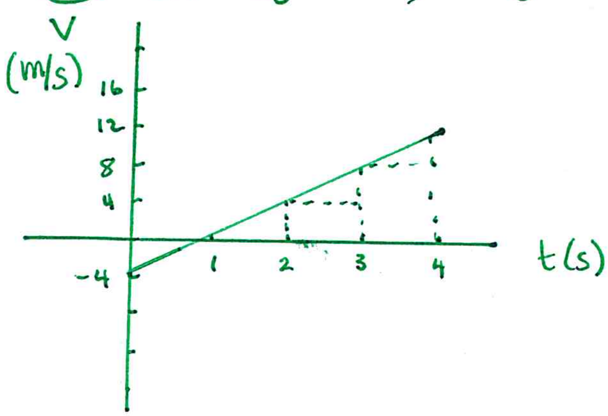


→ +
right is positive



b) the object has a turning point at t=3sec. This is when it changes direction. Before t=3sec the object was moving to the right, after t=3sec it is moving to the left.

7) at $t_o = 0$, $x_o = 10$



a) the object changes direction at t = 1s when velocity changes sign (from negative to positive).

b) what is the position at

t = 2s   t = 3s   t = 4s

Δx = area under velocity curve

$x_f = x_o + \Delta x$

at t = 2s $\Delta x = \frac{1}{2}(-4)(1) + \frac{1}{2}(4)(1)$

$= 0$

$x = 10m + 0$

$\boxed{x = 10m}$

at t=3s $x = x@2s + \Delta x_{2\text{-}3s}$

$\Delta x = 4(1s) + \frac{1}{2}(4)(1s) = 6m$

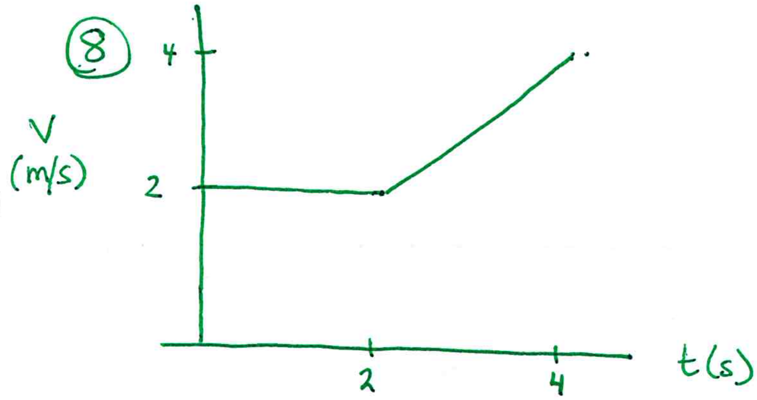
$x = 10m + 6m = \boxed{16m}$

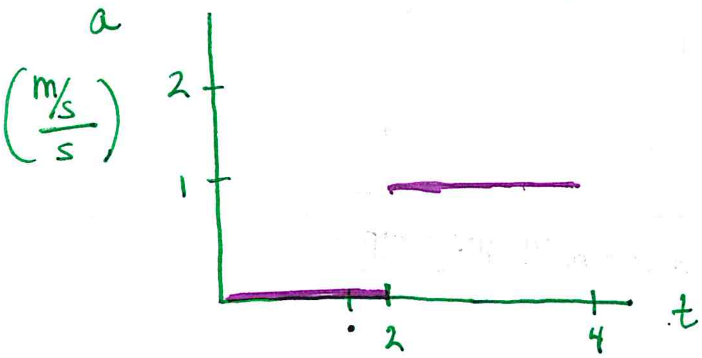
at t = 4s $x = x@3s + \Delta x_{3\text{-}4s}$

$\Delta x = 8(1) + \frac{1}{2}(4)(1) = 10m$

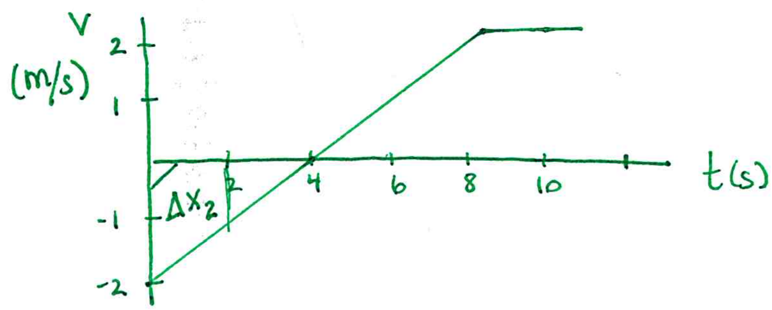
$x = 16m + 10m = \boxed{26m}$

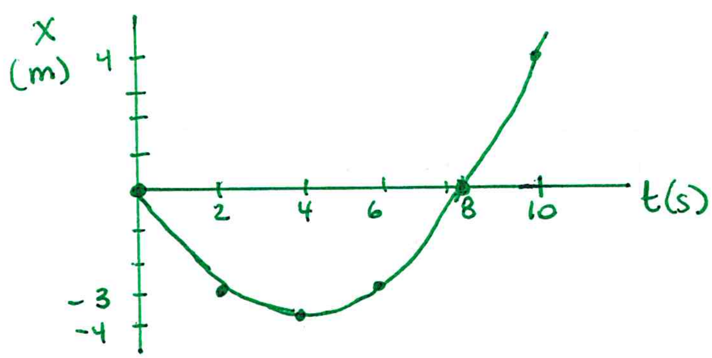
8

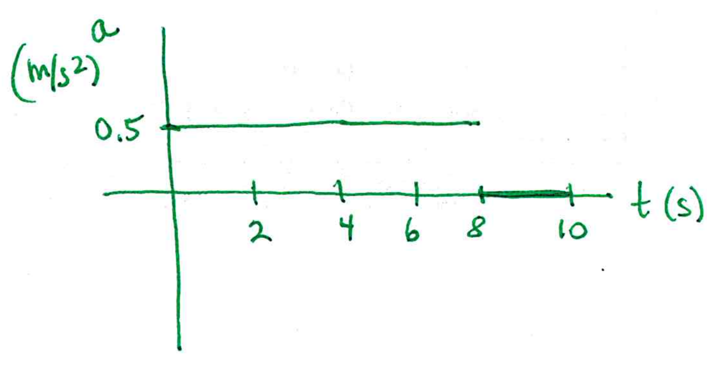




9 at $t = 0s$ $x_0 = 0m$







(a) find acceleration at $t = 3s$.

Since the train is accelerating uniformly (the velocity curve is a straight line with constant slope), the acceleration at any instant is equal to the average acceleration, which is equal to the slope of the line.

$$a_{3s} = \frac{2\,m/s - (-2\,m/s)}{8s - (0s)} = 0.5\,\frac{m/s}{s}$$

or $0.5\ m/s^2$

at $t = 2s$, $\Delta x_2 = (-1)(2) + \frac{1}{2}(-1)(2)$
$= -3m$

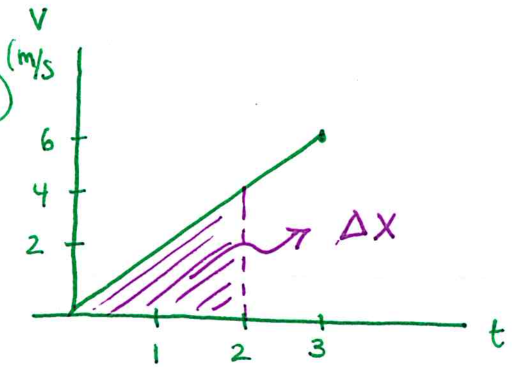
at $t = 4s$ $\Delta x_4 = \Delta x_2 + \frac{1}{2}(-1)(2)$
$= -3m - 1m = -4m$

at $t = 6s$ $\Delta x_6 = \Delta x_4 + \frac{1}{2}(1)(2)$
$= -3m$

at $t = 8s$ $\Delta x_8 = \Delta x_6 + (1)(2) + \frac{1}{2}(1)(2)$
$= 0\,m$

at $t = 10s$ $x_{10} = x_8 + (2)(2)$
$= 4m$

10



at $t_0 = 0s$ $x_0 = 2m$ (initial position)

at $t = 2s$

a) $x = x_0 + \Delta x$

$= 2m + \frac{1}{2}(2s)(4\ m/s)$

$= 2m + 4m$

$= 6m$

b) v at $t = 2s$

We can read this directly off the graph

$v = 4\ m/s$

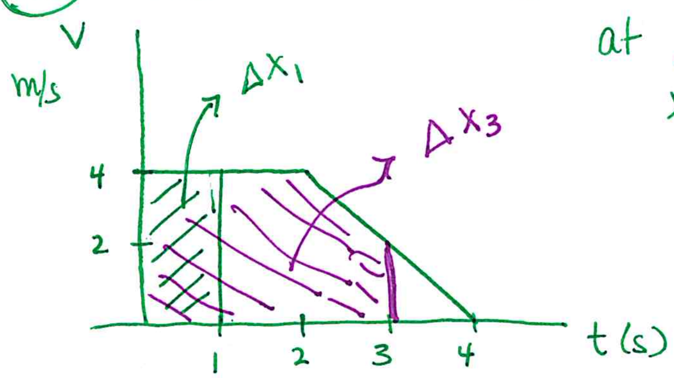
c) a at $t = 2s$

Since the velocity line is a straight line w/ constant slope, the slope of the line is equal to the acceleration at each instant.

$$a = \frac{6\ m/s - 0\ m/s}{3s - 0s}$$

$a = 2\ m/s/s$ or $2\ m/s^2$

11. $x_0 = 2m$ at $t_0 = 0s$



at $t = 1s$

$x_1 = x_0 + \Delta x_1$

$= 2m + (4\ m/s)(1s)$

$= 6m$

$v = 4\ m/s$ (directly from graph)

$a = 0\ m/s^2$ (slope of line at $t = 1s$)

b) at $t = 3s$

$X = \overset{x_1}{\cancel{x_0 +}}\ \Delta x_3$

$= \overset{x_1}{\cancel{x_0 + \Delta x_1}} + \Delta x_{2-3}$

$= \cancel{2m +}\ 6m + (4\ m/s)(1s) + (2\ m/s)(1s) + \frac{1}{2}(2\ m/s)(1s)$

$= \cancel{2m} + 6m + 4m + 2m + 1m$

$= \cancel{15m}\ 13m$ be careful not to double count!

$v = 2\ m/s$

$a = -2\ m/s^2$ (slope of line)

12 

$V_i = 300\ m/s$

$\Delta x = 4\ km = 4000\ m$

$V_f = 400\ m/s$

$a = ?$

$\cancel{V_f = V_0 + at}$

$\cancel{a = \dfrac{V_f - V_0}{t}}$

$\cancel{= \dfrac{400\ m/s - 300\ m/s}{}}$

don't have t !

(a) $V_f^2 = V_i^2 + 2a\,\Delta x$

$\cancel{\Delta x = V_f^2 - V_0^2}$

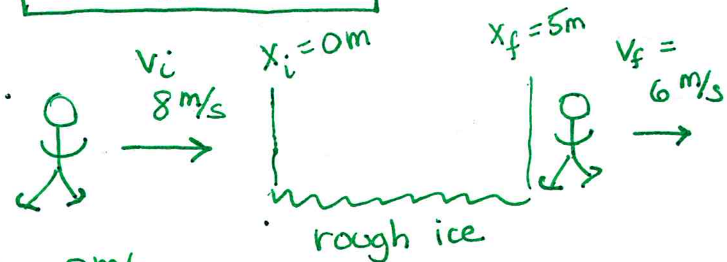
$a = \dfrac{V_f^2 - V_i^2}{2\Delta x}$

$a = \dfrac{(400\ m/s)^2 - (300\ m/s)^2}{2(4000\ m)}$

$a = \dfrac{70000\ m^2/s^2}{8000\ m}$

$\boxed{a = 8.75\ m/s^2}$

(b) This is reasonable, the plane's velocity is increasing 8.75 m/s for every second it accelerates.

13 

$V_i = 8\ m/s$

$V_f = 6\ m/s$

$\Delta x = 5\ m$

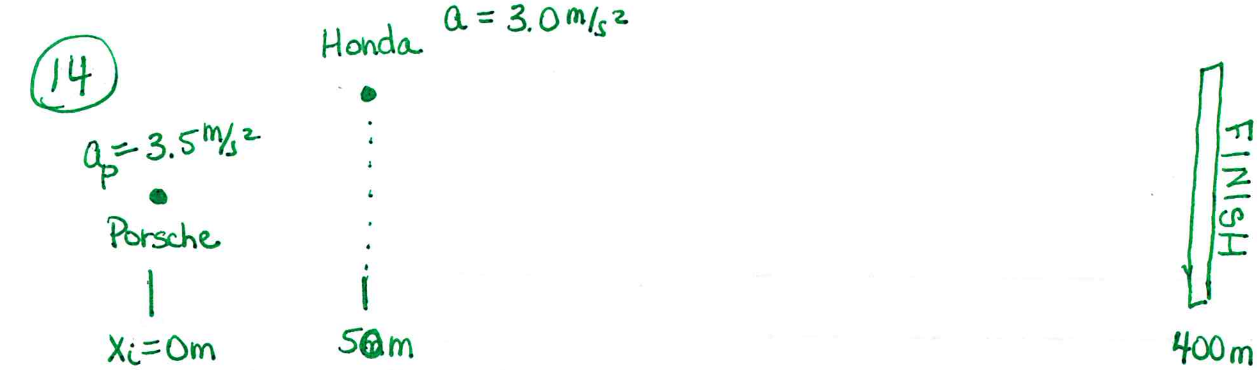
$V_f^2 = V_i^2 + 2a\,\Delta x$

$a = \dfrac{V_f^2 - V_i^2}{2\Delta x}$

$= \dfrac{(6\ m/s)^2 - (8\ m/s)^2}{2(5\ m)}$

$\boxed{a = -2.8\ m/s/s}$ or $a = -2.8\ m/s^2$

(14)



Porsche

$a = 3.5\,m/s^2$

$x_i = 0m$

$x_f = 400m$

$t = ?$

$v_i = 0\,m/s$

$$x_f = x_i + v_i t + \frac{1}{2}at^2$$

$$400m = 0m + 0(t) + \frac{1}{2}(3.5)t^2$$

$$\frac{2(400)}{3.5} = t^2$$

$$t^2 = \sqrt{228.57}$$

$$\underline{t = 15.12\,sec} \text{ for Porsche}$$

Honda

$a = 3.0\,m/s^2$

$x_i = 50m$

$x_f = 400m$

$v_i = 0\,m/s$

$t = ?$

$$x_f = x_i + v_i t + \frac{1}{2}at^2$$

$$400 = 50 + 0(t) + \frac{1}{2}(3)t^2$$

$$\frac{2(400-50)}{3} = t^2$$

$$t^2 = \sqrt{233.33}$$

$$\boxed{t = 15.28\,s}$$

Porsche wins!