

Motion Graphs

① $v = \text{slope}$

$$A: v = -\frac{10}{4} = -2.5 \text{ m/s}$$

$$B: v = 0 \quad (\text{horizontal line, slope} = 0)$$

$$C: v = \frac{20}{2} = 10 \text{ m/s}$$

$$D: v = -\frac{7.5}{2} = -3.75 \text{ m/s}$$

$$E: v = 0$$

$$F: v = \frac{17.5}{2} = 8.75 \text{ m/s}$$

② $v_{\text{avg}} = \text{slope of straight line connecting the indicated points.}$

$$AB: v = \frac{30}{2} = 15 \text{ km/h}$$

$$AD: v = \frac{50}{10} = 5 \text{ km/h}$$

$$BD: v = \frac{20}{8} = 2.5 \text{ km/h}$$

③ $v_{avg} = \text{slope of line connecting the indicated points}$

$$0-2 \text{ s} : v = \frac{20}{2} = 10 \text{ m/s}$$

$$6-12 \text{ s} : v = -\frac{35}{6} = -5.83 \text{ m/s}$$

6-15.5 s : $v = 0$ (line connecting those points is horizontal)

④ a) -10 m

b) 0-4 s : constant negative velocity

4-7 s : at rest

7-9 s : constant positive velocity

9-11 s : constant negative velocity

11-14 s : stops moving west (-ve) and begins to accelerate in the positive direction

c) $v_{avg} = \text{slope of line connecting } t=0 \text{ to } t=14 \text{ s.}$

$$v_{avg} = \frac{20}{14} = 1.43 \text{ m/s [East]}$$

d) instantaneous $v = \text{slope of tangent line}$

$$v = \frac{15}{2} = 7.5 \text{ m/s}$$

(answers will vary)

$$5) a) d = \text{area}$$

$$= (2)(80) + (1)(80)(0.5)$$

$$d = 200 \text{ m [E]}$$

$$b) d = 0 \quad (\text{no area, so no displacement})$$

$$c) d = \text{area}$$

$$= 200 + \frac{1}{2}(3)(-40) + (3)(-40) + \frac{1}{2}(1)(-40)$$

↑
first 3 s

$$= 200 - 200$$

$$d = 0$$

$$d) v_{\text{avg}} = \frac{\text{displ}}{\text{time}}$$

$$= \frac{200 + \frac{1}{2}(3)(-40)}{8}$$

$$= \frac{140}{8}$$

$$v_{\text{avg}} = 17.5 \text{ m/s [E]}$$

$$\textcircled{6} \quad d = \text{area}$$

$$= \frac{1}{2}(5)(120) + (5)(120) + (12.5)(-60)$$

$$d = 150 \text{ m [N]}$$

$\textcircled{7}$ a) when the graphs cross they have the same velocity. This happens at around 0.68 h.

(Answers will vary, but should be between 0.65 and 0.7 h.)

b) $d = \text{area}$

Car A

$$d = (0.4)(70) + \frac{1}{2}(0.4)(30) = 34 \text{ m}$$

Car B

$$d = \frac{1}{2}(0.4)(37) = 7.4 \text{ m}$$

Car A is ahead by 26.6 m

(Answers may vary)

7) c) Car A

$$d = (0.8)(40) + \frac{1}{2}(0.8)(60) + \frac{1}{2}(0.2)(40) = 60 \text{ m}$$

Car B

$$d = \frac{1}{2}(0.6)(50) + (0.4)(50) = 35 \text{ m}$$

The cars are 25 m apart.

8) $a = \text{slope}$

$$A: a = \frac{4}{2} = 2 \text{ m/s}^2$$

$$B: a = 0$$

$$C: a = -\frac{7}{3.5} = -2 \text{ m/s}^2$$

$$D: a = 0$$

$$E: a = \frac{3}{3} = 1 \text{ m/s}^2$$