

Motion Practice

Name: _____

Date: _____

Question 1

(a) Find the displacement and average velocity for the time interval

$$s = t^2 - 3t + 2 \quad 0 \leq t \leq 2$$

displacement:

average velocity:

(b) Find the speed and acceleration at the endpoints of the interval

velocity:

speed at endpoints:

acceleration:

acceleration at endpoints:

(c) When does the object change direction

Motion Practice

Question 2

(a) Find the displacement and average velocity for the time interval

$$s = \frac{25}{t^2} - \frac{5}{t} \quad 1 \leq t \leq 5$$

displacement :

average velocity :

(b) Find the speed and acceleration at the endpoints of the interval

velocity :

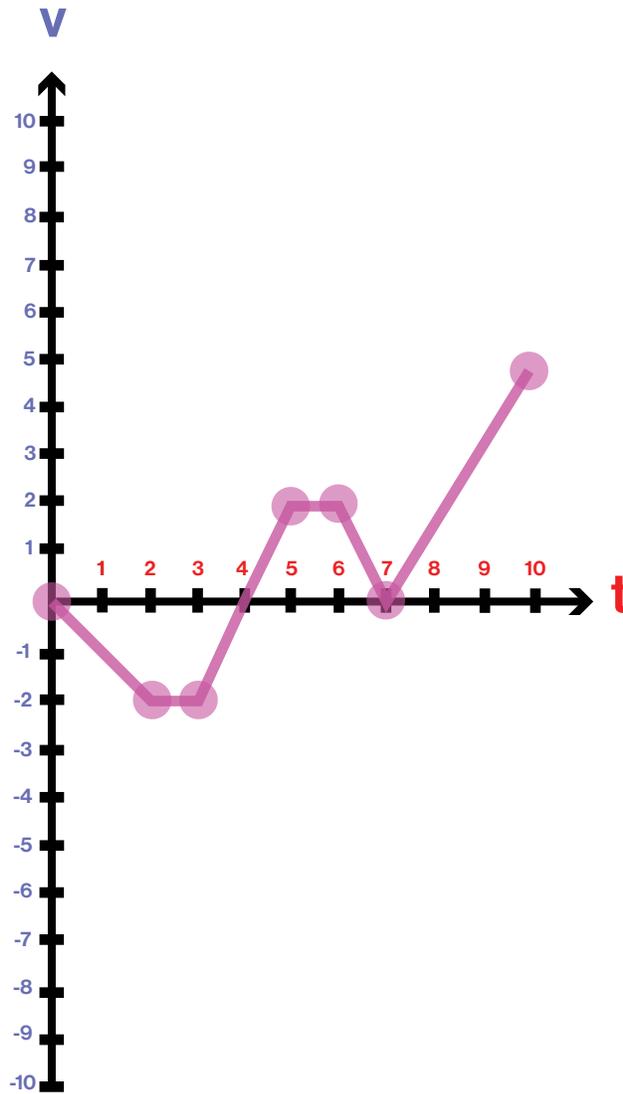
speed at endpoints :

acceleration :

acceleration at endpoints :

Motion Practice

Question 3



(a) When is the acceleration zero?

(e) what is the acceleration at $t = 8$

(b) What is the greatest velocity?

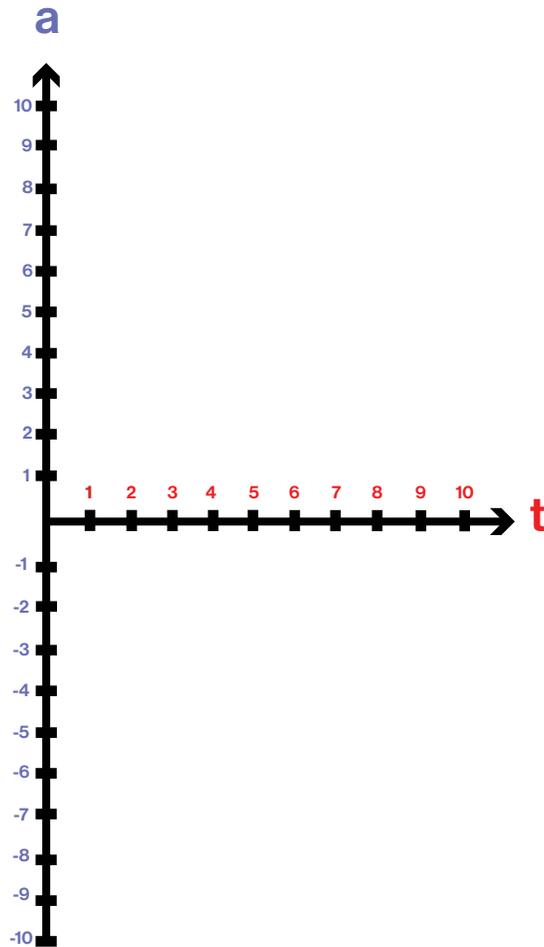
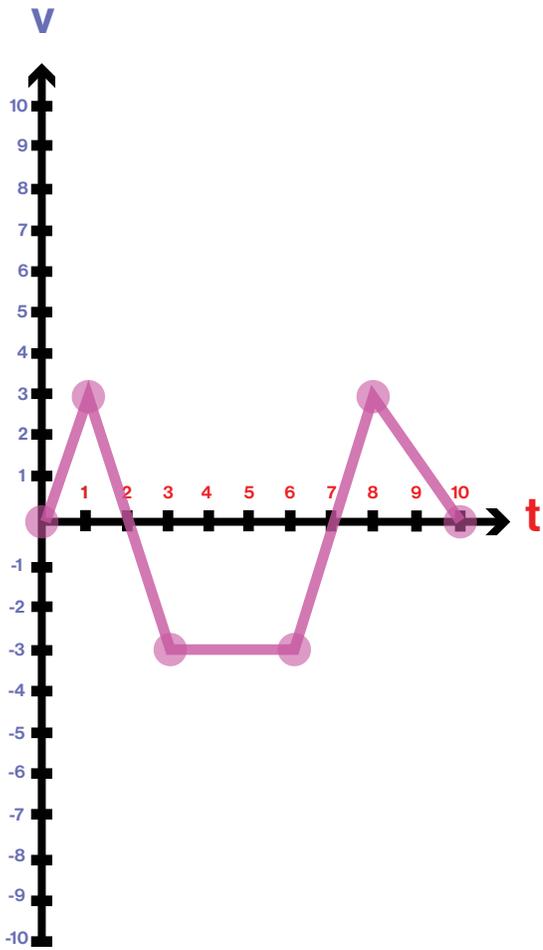
(c) When does the object reverse direction?

(d) When is the object moving backward?

Motion Practice

Question 4

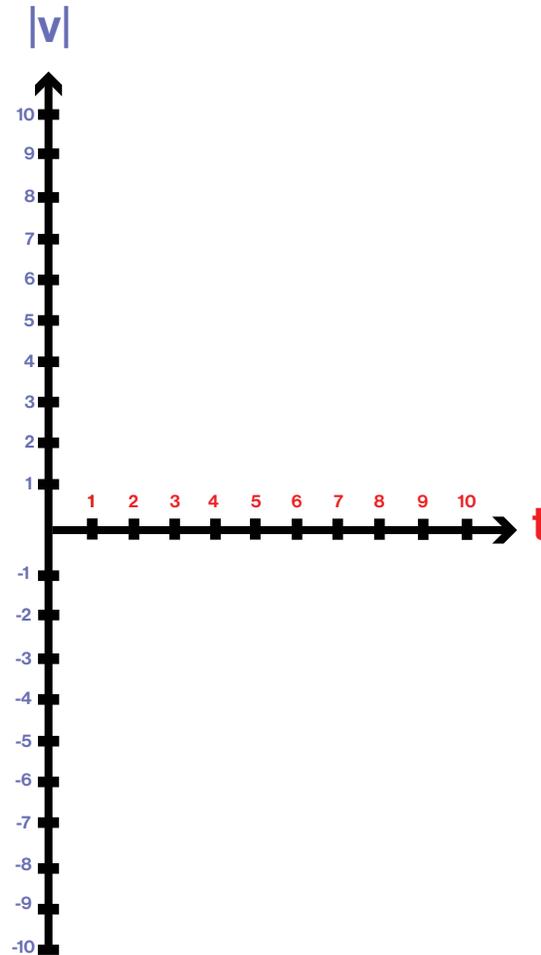
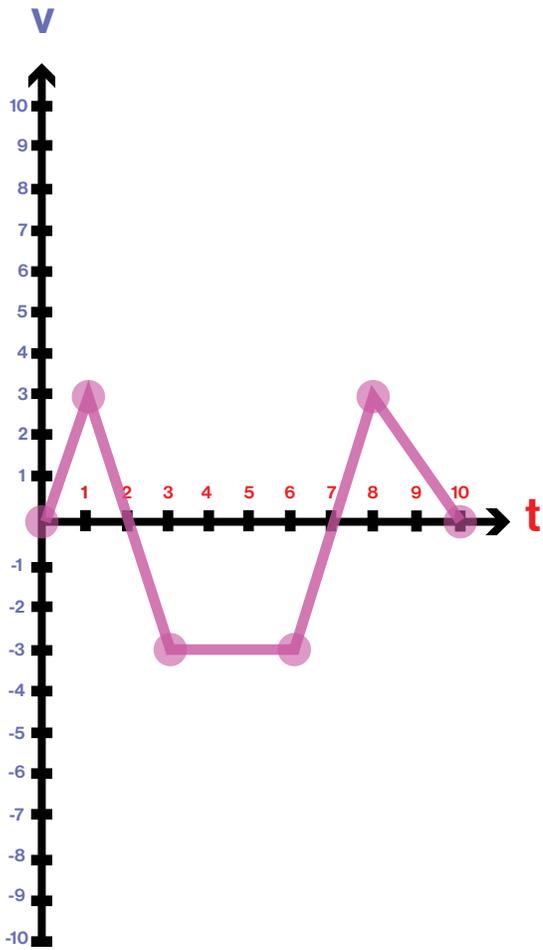
Graph the acceleration



Motion Practice

Question 5

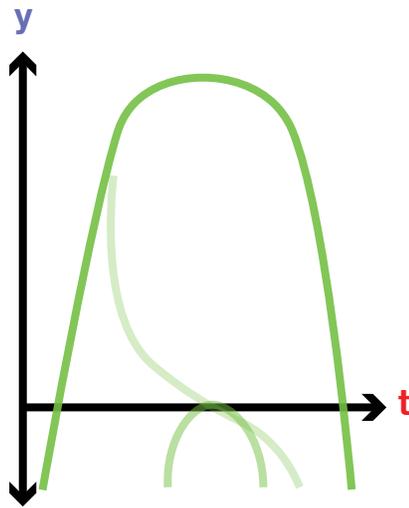
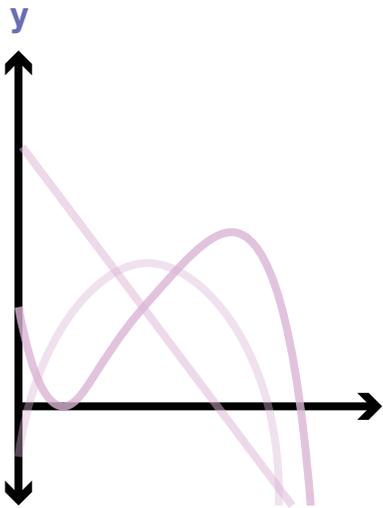
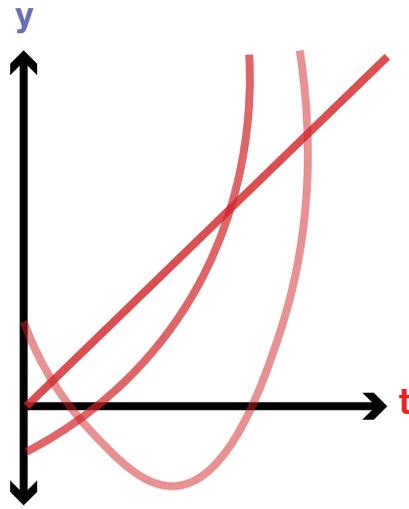
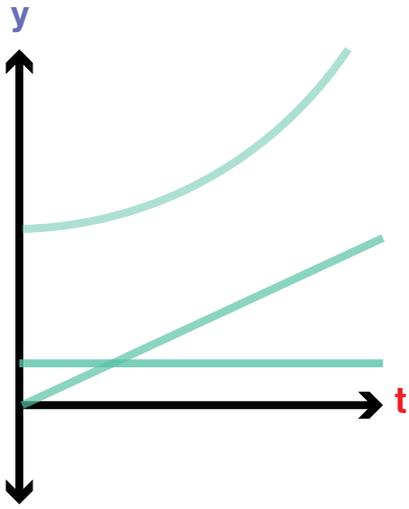
Graph the speed



Motion Practice

Question 6

Label acceleration, velocity, and position



Motion Practice

Name: _____ **Key** _____

Date: _____

Question 1

(a) Find the displacement and average velocity for the time interval

$$s = t^2 - 3t + 2 \quad 0 \leq t \leq 2$$

displacement:

$$\Delta s = s(2) - s(0) \longrightarrow ((2)^2 - 3(2) + 2) - ((0)^2 - 3(0) + 2) \longrightarrow 0 - 2 \longrightarrow \Delta s = -2$$

average velocity:

$$\Delta t = 2 - 0 = 2 \quad \frac{\Delta s}{\Delta t} = \frac{-2}{2} = -1$$

(b) Find the speed and acceleration at the endpoints of the interval

velocity:

$$\frac{ds}{dt} = \lim_{h \rightarrow 0} \frac{((x+h)^2 - 3(x+h) + 2) - (x^2 - 3x + 2)}{h} \longrightarrow \frac{2hx + h^2 - 3h}{h} \longrightarrow \frac{\cancel{h}(2x+h-3)}{\cancel{h}}$$

$$2x-3 \quad \longleftarrow 2x+(0)-3 \quad \longleftarrow 2x+h-3$$

speed at endpoints:

$$|2(0) - 3| = 3 \quad |2(2) - 3| = 1$$

acceleration:

$$\frac{d^2s}{dt^2} = \lim_{h \rightarrow 0} \frac{(2(x+h) - 3) - (2x - 3)}{h} \longrightarrow \frac{\cancel{2}h}{\cancel{h}} \longrightarrow 2$$

acceleration at endpoints:

$$a(0) = 2 \quad a(2) = 2$$

(c) When does the object change direction

$$2t - 3 = 0$$

$$t = 3/2 \quad \text{direction change}$$

Motion Practice

Question 2

(a) Find the displacement and average velocity for the time interval

$$s = \frac{25}{t^2} - \frac{5}{t} \quad 1 \leq t \leq 5$$

displacement:

$$\Delta s = s(5) - s(1) \longrightarrow \left(\frac{25}{(5)^2} - \frac{5}{(5)} \right) - \left(\frac{25}{(1)^2} - \frac{5}{(1)} \right) \longrightarrow 0 - 20 \longrightarrow \Delta s = -20$$

average velocity:

$$\Delta t = 5 - 1 = 4 \quad \frac{\Delta s}{\Delta t} = \frac{-20}{4} = -5$$

(b) Find the speed and acceleration at the endpoints of the interval

velocity:

$$\frac{ds}{dt} = \lim_{h \rightarrow 0} \frac{\left(\frac{25}{(x+h)^2} - \frac{5}{(x+h)} \right) - \left(\frac{25}{x^2} - \frac{5}{x} \right)}{h} \longrightarrow \frac{-\frac{5h(10x+5h-x^2-xh)}{x^2(x+h)^2}}{h}$$

$$\downarrow$$

$$-\frac{5(10-x)}{x^3} \longleftarrow -\frac{5(10x+5(0)-x^2-x(0))}{x^2(x+(0))^2} \longleftarrow -\frac{5(10x+5h-x^2-xh)}{x^2(x+h)^2} \longleftarrow -\frac{5(10x+5h-x^2-xh)}{x^2(x+h)^2} \cdot \frac{1}{1}$$

speed at endpoints:

$$\left| -\frac{5(10-(1))}{(1)^3} \right| = 45 \quad \left| -\frac{5(10-(5))}{(5)^3} \right| = 1/5$$

acceleration:

$$\frac{d^2s}{dt^2} = \lim_{h \rightarrow 0} \frac{\left(-\frac{5(10-(x+h))}{(x+h)^3} \right) - \left(-\frac{5(10-x)}{x^3} \right)}{h} \longrightarrow \frac{\frac{5h(30x^2+30xh+10h^2-2x^3-3x^2h-xh^2)}{x^3(x+h)^3}}{h}$$

$$\downarrow$$

$$\frac{5(30x^2+30xh+10h^2-2x^3-3x^2h-xh^2)}{x^3(x+h)^3} \longleftarrow \frac{5(30x^2+30xh+10h^2-2x^3-3x^2h-xh^2)}{x^3(x+h)^3} \cdot \frac{1}{1}$$

$$\downarrow$$

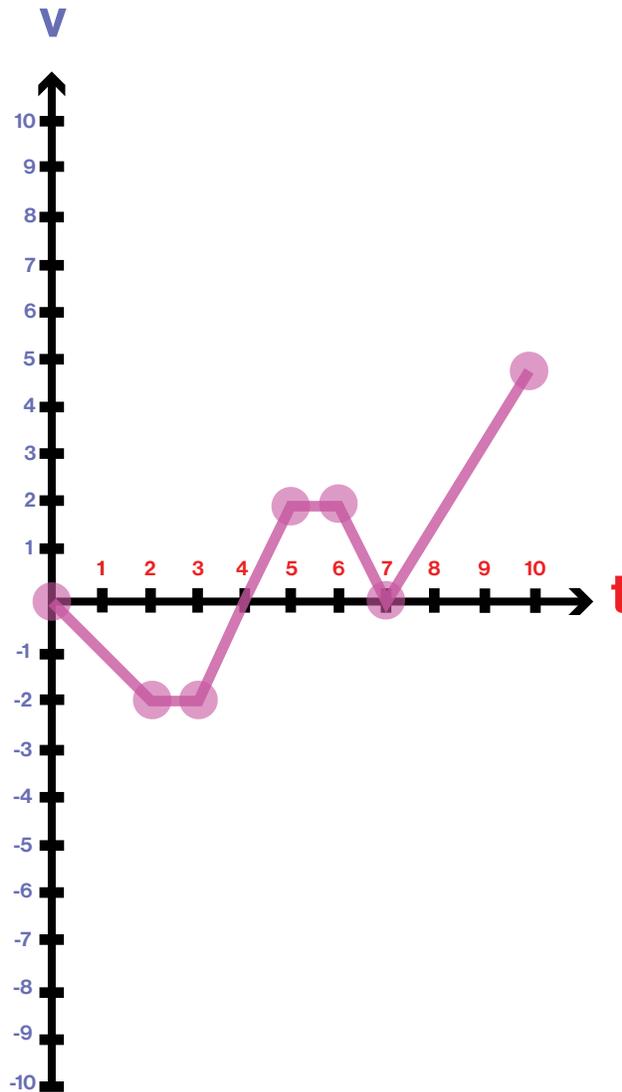
$$\frac{5(30x^2+30x(0)+10(0)^2-2x^3-3x^2(0)-x(0)^2)}{x^3(x+(0))^3} \longrightarrow \frac{10(15-x)}{x^4}$$

acceleration at endpoints:

$$\frac{10(15-(1))}{(1)^4} = 140 \quad \frac{10(15-(5))}{(5)^4} = 4/25$$

Motion Practice

Question 3



(a) When is the acceleration zero?

$$2 < t < 3 \quad \text{and} \quad 5 < t < 6$$

(b) What is the greatest velocity?

5

(c) When does the object reverse direction?

$$t = 4$$

(d) When is the object moving backward?

$$0 < t < 4$$

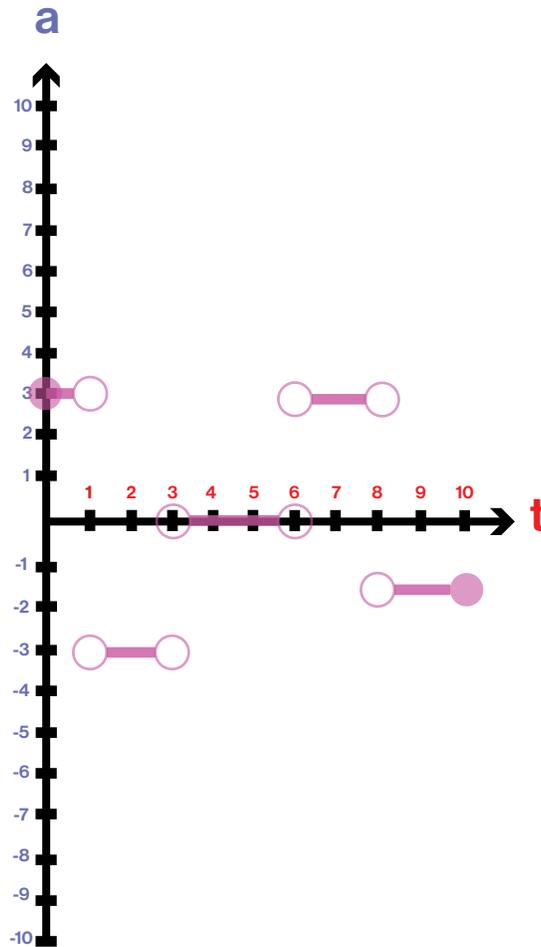
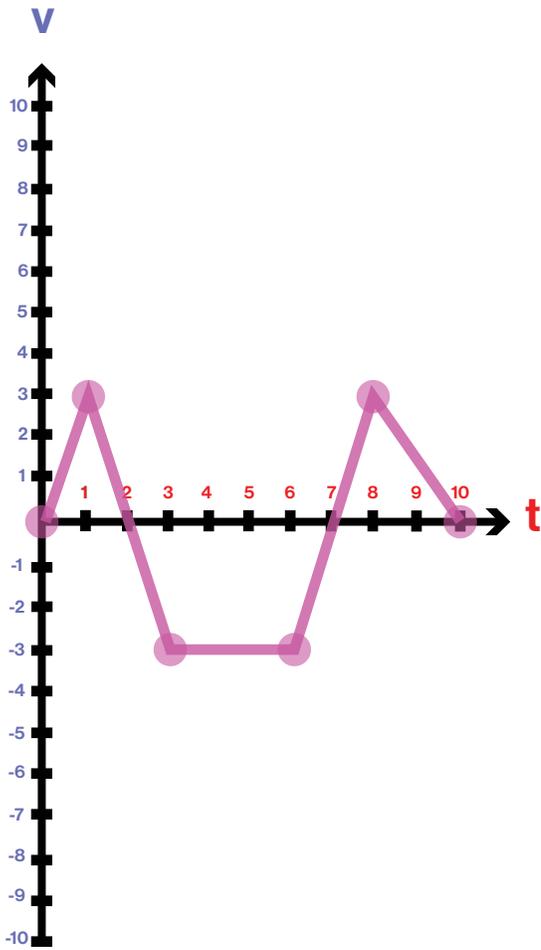
(e) what is the acceleration at $t = 8$

$$\frac{0 - 5}{7 - 10} = 1.67$$

Motion Practice

Question 4

Graph the acceleration



$$\frac{0-3}{0-1} = 3$$

$$\frac{-3-3}{3-6} = 0$$

$$\frac{3-0}{8-10} = -1.5$$

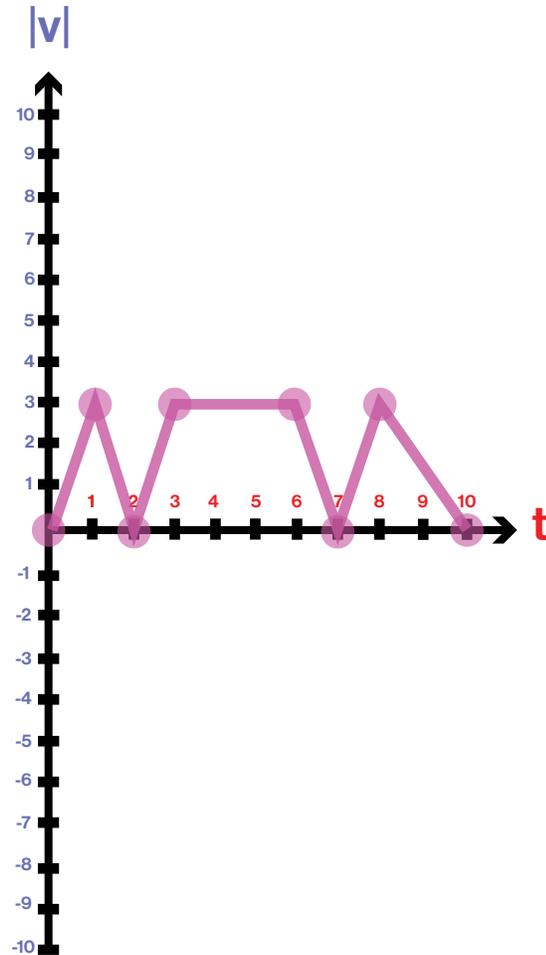
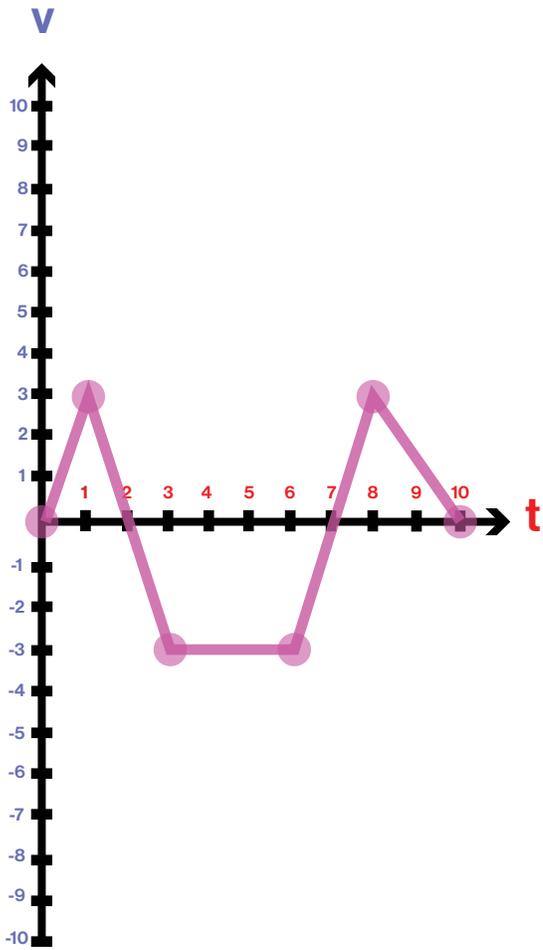
$$\frac{-3-3}{3-1} = -3$$

$$\frac{3-3}{8-6} = 3$$

Motion Practice

Question 5

Graph the speed



Motion Practice

Question 6

Label acceleration, velocity, and position

