Equations for a = constant

$v_f = v_i + a\Delta t$ $\quad \Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ $\quad v_f^2 = v_i^2 + 2a\Delta x$ $\quad \Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

Equations for v = constant

$v = \Delta x/\Delta t$

Academic Physics
Equations PRACTICE

Name _____
Date _____

Directions: Identify each number given with a variable that stands for it. Use the information to solve for the desired quantity. **Please show all your work and include units!**

1. In getting ready to slam-dunk the ball, a basketball player starts from rest and sprints to a speed of +6.0 m/s in 1.5 s. Assuming that the player accelerated uniformly, determine the player's displacement.

   $\Delta\vec{x} = +4.5\,m$

2. A car moves at +25 m/s and coast up a hill with a uniform acceleration of –2.4 m/s^2. How far has it traveled after 12.0 seconds?

   $\Delta\vec{x} = 127.2\,m$

3. A cliff diver jumps from rest from the top of a cliff. If his fall takes 2.61s, how high was the cliff?

   $|\Delta\vec{x}| = 33.4\,m$

4. Chad Smith tosses a drum stick straight up into the air with a speed of 10 m/s. He catches it 0.5s later (at the same position).
   a. What is the velocity of the drum stick at the top of its motion? (no calculation needed) $0\ \frac{m}{s}$
   b. What is the velocity of the drum stick as he is catching it? (no calculation needed) $-10\ \frac{m}{s}$
   c. What is the acceleration of the drum stick at the top of its motion? (no calculation needed) $-9.8\ \frac{m}{s^2}$
   d. How long does it take the drum stick to reach its maximum height? (no calculation needed) $0.25s$
   e. What is the maximum height of the drum stick? $\Delta\vec{x} = +1.25\,m$

Equations for a = constant

$v_f = v_i + a\Delta t$ $\Delta x = \frac{1}{2}(v_i + v_f)\Delta t$ $v_f^2 = v_i^2 + 2a\Delta x$ $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$

Equations for v = constant

$v = \Delta x/\Delta t$

5. How long will it take a car that is moving at a constant velocity of +45 m/s, to travel 120 meters?

   2.7s

6. A Ford Focus goes from 0 to +27 m/s with an acceleration of +2.35 m/s^2. How much time does it take for the Focus to reach this speed?

   11.5 s

1. $\vec{V}_i = 0 \frac{m}{s}$

$\vec{V}_f = +6.0 \frac{m}{s}$

$\Delta t = 1.5s$

$\Delta \vec{x} = ?$

$\Delta \vec{x} = \left(\frac{\vec{V}_i + \vec{V}_f}{2}\right)\Delta t$

$\Delta \vec{x} = \left(\frac{0 + 6 \frac{m}{s}}{2}\right)(1.5s)$

$\Delta \vec{x} = +4.5\,m$

2. $\vec{V}_i = +25 \frac{m}{s}$

$\vec{V}_f = ?$

$\vec{a} = -2.4 \frac{m}{s^2}$

$\Delta t = 12s$

$\Delta \vec{x} = ?$

$\Delta \vec{x} = \vec{V}_i \Delta t + \frac{1}{2} a \Delta t^2$

$\Delta \vec{x} = (+25 \frac{m}{s})(12s) + \frac{1}{2}(-2.4 \frac{m}{s^2})(12s)^2$

$\Delta \vec{x} = 300\,m - 172.8\,m = \boxed{127.2\,m}$

3. $\Delta t = 2.61s$

$V_i = 0$

$a = -9.8 \frac{m}{s^2}$

$\Delta \vec{x} = \cancel{\vec{V}_i}^{\,0} \Delta t + \frac{1}{2} \vec{a} \Delta t^2$

$\Delta \vec{x} = -4.9(2.61)^2\,m$

$\boxed{\Delta \vec{x} = -33.4\,m}$

4. $\vec{V}_i = +10 \frac{m}{s}$

$\vec{V}_f = 0 \frac{m}{s}$

$\Delta t = 0.25s$

$\vec{a} = -9.8 \frac{m}{s^2}$

$\Delta \vec{x} = ?$

$\Delta \vec{x} = \left(\frac{\vec{V}_i + \vec{V}_f}{2}\right)\Delta t$

$\Delta \vec{x} = \left(\frac{10 \frac{m}{s}}{2}\right)(0.25\,s) = +1.25\,m$

5. $\vec{V}_i = +45 \frac{m}{s}$

$\vec{V}_f = ?$

$\Delta \vec{x} = 120\,m$

$\Delta t = ?$

$\vec{a} = 0$

$\Delta \vec{x} = \vec{V}_i \Delta t$

$+120\,m = (45 \frac{m}{s})(\Delta t)$

$\boxed{\Delta t = 2.7s}$

6. $\vec{a} = +2.35 \frac{m}{s^2}$

$\vec{V}_i = 0\,m/s$

$\vec{V}_f = +27\,m/s$

$\Delta t = ?$

$\Delta x = ?$

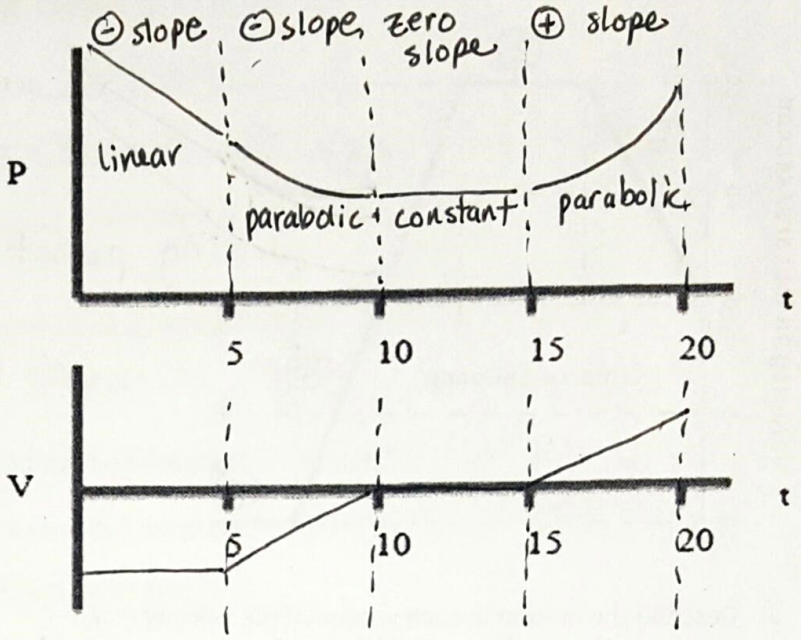
$\vec{a} = \frac{\vec{V}_f - \vec{V}_i}{\Delta t}$

$+2.35 = \frac{27 \frac{m}{s} - 0 \frac{m}{s}}{\Delta t}$

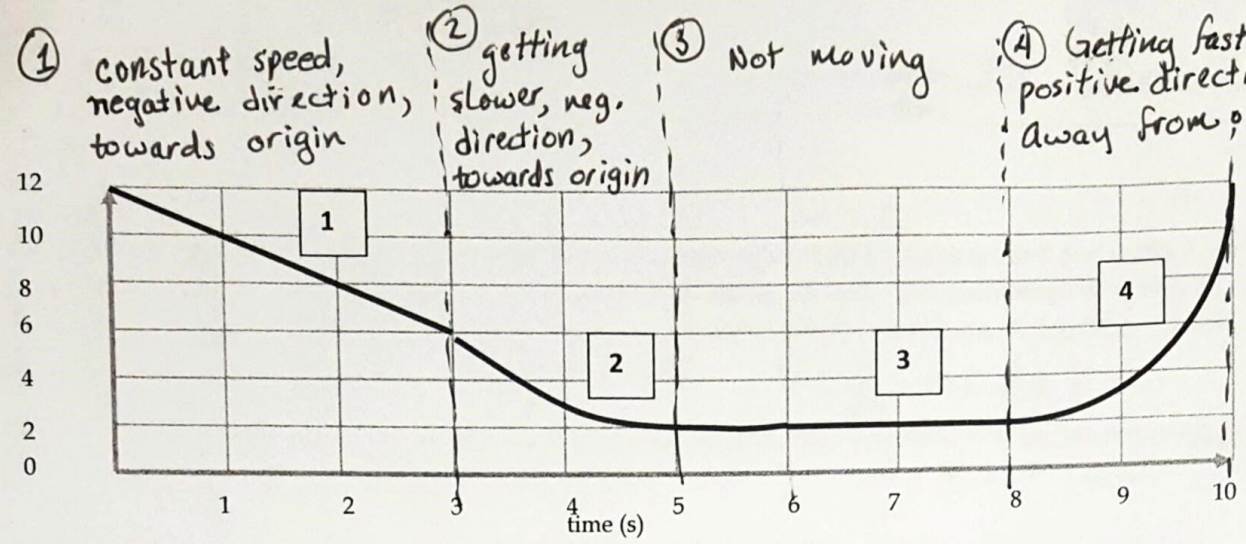
$\boxed{\Delta t = 11.5s}$

17. Draw a X vs. T and a V vs. T graph for the following scenario.

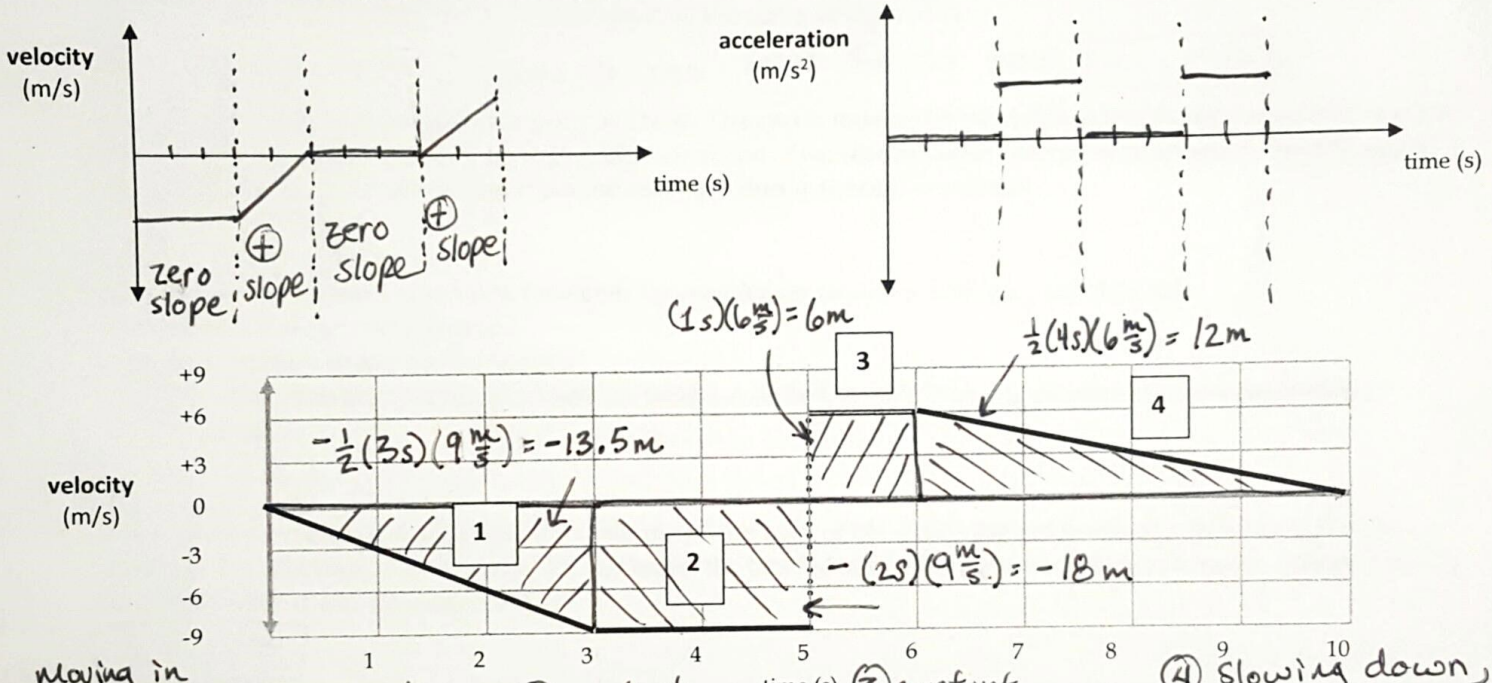
- A car drives at a constant speed towards the origin for 5s.
- It slows down towards the origin for 5s.
- It is still for 5s.
- It speeds up away from the origin for 5s.
- It drives at a constant velocity for 5s.



Graphs

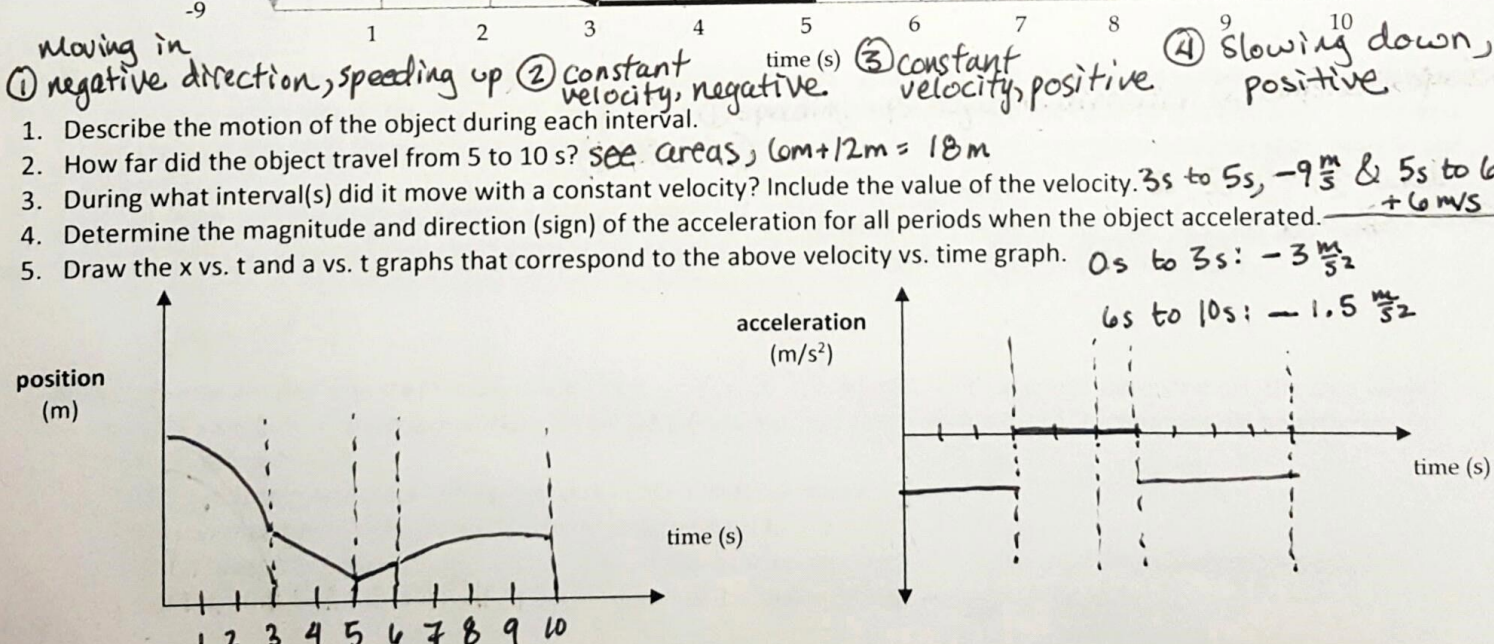


1. Describe the motion of the object during each interval.
2. What is the position at 7 seconds? 2m North of origin
3. What is the average velocity of the object from 0-3 s? $-6m/3s = -2\frac{m}{s}$
4. What is the average velocity of the object from 6-8 s? $0\ m/s$
5. Draw the v vs. t and a vs. t graphs that correspond to the above position vs. time graph.



① moving in negative direction, speeding up ② constant velocity, negative. ③ constant velocity, positive ④ slowing down, positive

1. Describe the motion of the object during each interval.
2. How far did the object travel from 5 to 10 s? see areas, 6m+12m = 18m
3. During what interval(s) did it move with a constant velocity? Include the value of the velocity. 3s to 5s, $-9\frac{m}{s}$ & 5s to 6s, $+6\ m/s$
4. Determine the magnitude and direction (sign) of the acceleration for all periods when the object accelerated.
5. Draw the x vs. t and a vs. t graphs that correspond to the above velocity vs. time graph. 0s to 3s: $-3\frac{m}{s^2}$ 6s to 10s: $-1.5\frac{m}{s^2}$



Graphing Review Sheet

4. A horizontal line on a **X vs. T** graph means the object is STOPPED.

5. A horizontal line on a **V vs. T** graph means the object is MOVING WITH CONSTANT VELOCITY

6. The slope of an **X vs. T** graph is its VELOCITY, the slope of a **V vs. T** graph is its ACCELERATION.

7. What does a graph with a positive slope look like? How about a negative slope?

⊕ slope: ↗ ↗ ↗ ⊖ slope: ↘ ↘ ↘

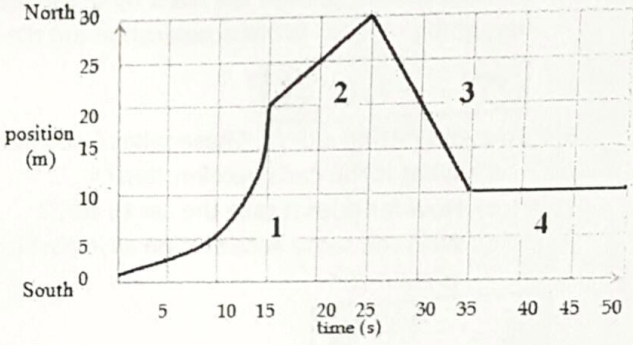
8. What is happening when a line crosses the t-axis on a position time graph? passes origin

9. What is happening when a line crosses the t-axis on a velocity time graph? changes direction

10. The area of a velocity time graph tells you the displacement.

11. a) Describe the motion in each section of the position graph.

1) move North, getting faster 2) move North, constant velocity 3) move South, constant velocity 4) stopped



b) How fast is the car going during section 2? Which direction?

$\vec{v}_{average} = \frac{\Delta\vec{x}}{\Delta t} = \frac{+30\,m}{10\,s} = +3\,\frac{m}{s}$ (North)

c) How fast is the car going during section 3? Which direction?

$\vec{v}_{average} = \frac{\Delta\vec{x}}{\Delta t} = -\frac{20\,m}{10\,s} = -2\,\frac{m}{s}$ (South)

d) How fast is the car going during section 4?

$0\,\frac{m}{s}$ (not moving)

e) At what time does the driver reverse direction?

at $t = 25\,s$

f) Total Displacement?

$\Delta\vec{x} = +10\,m$ (North)

g) Total Distance?

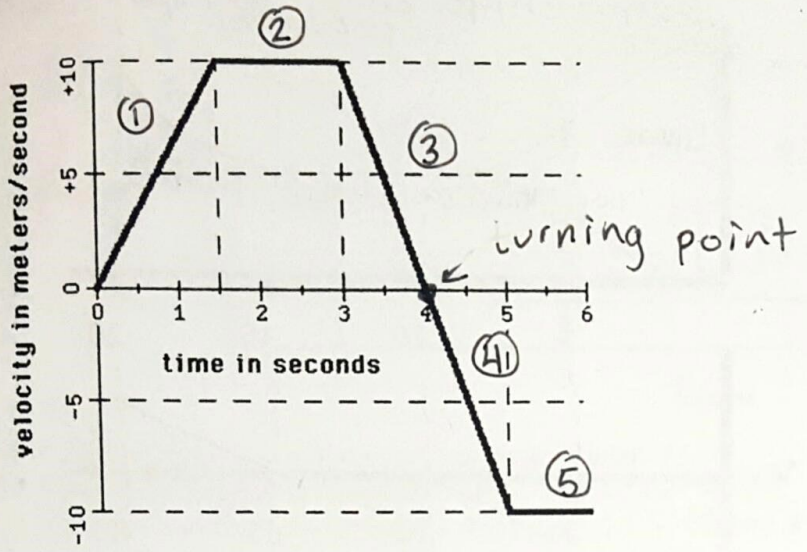
$d = 50\,m$

h) Average Velocity?

$\vec{v}_{average} = \frac{\Delta\vec{x}\,(total)}{\Delta t\,(total)} = \frac{+10\,m}{50\,s} = +0.2\,\frac{m}{s}$ (North)

i) Average Speed?

$s_{average} = \frac{d\,(total)}{\Delta t\,(total)} = \frac{50\,m}{50\,s} = 1\,\frac{m}{s}$



a) Describe the motion in each section of the velocity graph

① Moving North, getting faster ② Moving North, constant speed ③ Moving North, getting slower ④ Moving South, getting faster ⑤ Moving South, constant speed

b) What is the object's acceleration from 3-5 s?

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{-20\ m/s}{2s} = -10\ \frac{m}{s^2}$

c) What is its acceleration from 1.5 – 3s?

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{0\ m/s}{1.5s} = 0\ \frac{m}{s^2}$

d) At what time does the driver reverse direction?

$t = 4s$

e) During which interval is the car moving the fastest?

From 1.5s to 3s and from 5s to 6s

f) Total Displacement? AREAS (+ and −)

$\frac{1}{2}(1.5s)(10\ \frac{m}{s}) + (1.5s)(10\ \frac{m}{s}) + \frac{1}{2}(1s)(10\ \frac{m}{s}) - \frac{1}{2}(1s)(10\ \frac{m}{s}) - (1s)(10\ \frac{m}{s}) = 12.5m$

g) Total Distance AREAS (all +)

$\frac{1}{2}(1.5s)(10\ \frac{m}{s}) + (1.5s)(10\ \frac{m}{s}) + \frac{1}{2}(1s)(10\ \frac{m}{s}) + \frac{1}{2}(1s)(10\ \frac{m}{s}) + (1s)(10\ \frac{m}{s}) = 42.5m$

Choices are (speed up, slow down)

12. You are driving in the positive direction. If you accelerate in the positive direction, your car is Speeding up. If you accelerate in the negative direction, your car is Slowing down

13. While driving in the negative direction, accelerating in the positive direction will make your car slow down, while accelerating in the negative direction will make the car speed up.

14. How is it possible to have a negative acceleration and be speeding up? You are traveling in the negative direction (your velocity is negative)

15. Is it possible to slow down once you've come to a complete stop? No, but you can speed up in either the negative or positive direction

16. When something reverses direction, its velocity always passes through what number $0\ \frac{m}{s}$