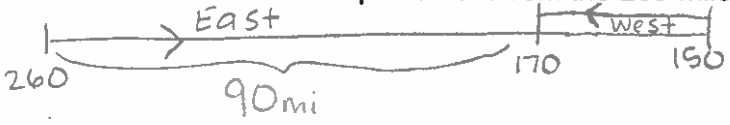
$s = \frac{d}{t}$ $v = \frac{x}{t}$ $a = \frac{v_f - v_i}{t}$

HPS Motion Calcs 2020 Name Key Per ____

OBJECTIVE: Describe motion both qualitatively and quantitatively with respect to distance/displacement, speed/velocity, and acceleration (Obj 1)

Directions: Show your work. Sig figs and units matter. Box your final answer.

1. While John is traveling along a straight interstate highway, he notices that the mile marker reads 260. John travels East until he reaches the 150-mile marker and then retraces his path to the 170-mile marker. What is John's displacement from the 260-mile marker?

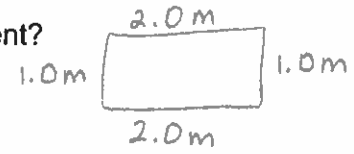


90mi E

2. A physics book is moved once around the perimeter of a table of dimensions 1.0m by 2.0 m.

a. If the book ends up in its initial position, what is its displacement?

0m



b. What is the distance traveled?

6.0m

3. Light from the sun reaches the Earth in 8.3 minutes. The speed of light is 3.00×10^8 m/s. How far from Earth is the sun?

$t = 8.3\ \text{min} \left| \frac{60\ \text{sec}}{1\ \text{min}} \right. = 498\ \text{s}$

$s = 3.00 \times 10^8\ \text{m/s}$

$d = ?$

$s = \frac{d}{t}$ $3.00 \times 10^8\ \text{m/s} = \frac{d}{498\ \text{s}}$

$d = 1.5 \times 10^{11}\ \text{m}$

4. You and your friend each drive 50.0 km. You travel at 90.0 km/h. Your friend travels at 95.0 km/h. How long will your friend be waiting for you at the end of the trip?

$90.0\ \text{km/hr} = \frac{50.0\ \text{km}}{t}$

$t = .556\ \text{hr}$

$95.0\ \text{km/hr} = \frac{50.0\ \text{km}}{t}$

$t = .526\ \text{hr}$

$.556 - .526 = .030\ \text{hr}$

1.8 min 108 sec

5. Ann is driving South down a street at 55 km/h. Suddenly a child runs into the street. If it takes Ann 0.75 seconds to react and apply the brakes, how many meters will she have moved before she begins to slow down? If she slows down at a rate of 1.5 m/s^2, how long will it take her to stop?

$v = 55\ \text{km/h S}$ $v = \frac{x}{t}$

$t = .75\ \text{s}$ $55\ \text{km/h} = \frac{x}{.75\ \text{s}}$

$x = ?$

$.75\ \text{s} \left| \frac{1\ \text{hr}}{3600\ \text{s}} \right. = .00021\ \text{hr}$

$x = .011\ \text{km}$

or

11 m South

$\frac{55\ \text{km}}{1\ \text{hr}} \left| \frac{1000\ \text{m}}{1\ \text{km}} \right| \frac{1\ \text{hr}}{3600\ \text{s}} = 15.3\ \text{m/s}$

$-1.5\ \text{m/s}^2 = \frac{0 - 15.3\ \text{m/s}}{t}$

$t = 10.\ \text{s}$

$a = -1.5\ \text{m/s}^2$

$v_f = 0$

$v_i = 55.0\ \text{km/s}$

or

$15.3\ \text{m/s}$

$t = ?$

6. When a bus comes to a sudden stop to avoid hitting a dog, it slows from 9.00 m/s to 0.00 m/s in 1.50 seconds. Find the average acceleration of the bus.

$v_f = 0\ m/s$ $a = ?$ $a = \frac{v_f - v_i}{t}$ $a = \frac{0\ m/s - 9.00\ m/s}{1.50\ s}$ $a = -6.00\ m/s$ (indicates the opposite dir)

$v_i = 9.00\ m/s$

$t = 1.50\ s$

7. A car traveling initially at 7.0 m/s accelerates to velocity of 12.0 m/s in 2.0 s. What is the average acceleration of the car?

$v_f = 12.0\ m/s$ $a = ?$

$v_i = 7.0\ m/s$

$t = 2.0\ s$

$a = \frac{12.0\ m/s - 7.0\ m/s}{2.0\ s}$ $a = 2.5\ m/s^2$ in the same dir of the motion of car

8. With an average acceleration of 0.50 m/s^2, how long will it take a cyclist starting from rest to reach 13.5 m/s?

$a = .50\ m/s^2$

$v_f = 13.5\ m/s$

$v_i = 0\ m/s$

$.50\ m/s^2 = \frac{13.5\ m/s - 0\ m/s}{t}$ $t = 27\ s$

10. A car traveling North at 7.0 m/s accelerates at the rate of 0.80 m/s^2 for 2.0 s. What is the final velocity of the car?

$a = .80\ m/s^2$ $v_f = ?$

$v_i = 7.0\ m/s\ N$

$t = 2.0\ s$

$(2.0s)\ .80\ m/s^2 = \frac{v_f - 7.0\ m/s}{2.0\ s}\ (2.0s)$

$1.6\ m/s = v_f - 7.0\ m/s$

$+7.0\ m/s \quad +7.0\ m/s$

$8.6\ m/s\ N = v_f$

11. A snowmobile has an initial velocity of 3.0 m/s. dir ?

a. If it accelerates at a rate of 0.50 m/s^2 for 7.0 seconds, what is the final velocity?

$a = .50\ m/s^2$

$t = 7.0\ s$

$v_i = 3.0\ m/s$ dir

$(7.0s)\ .50\ m/s^2 = \frac{v_f - 3.0\ m/s}{7.0s}\ (7.0s)$

$3.5\ m/s = v_f - 3.0\ m/s$

$+3.0\ m/s \quad +3.0\ m/s$

$6.5\ m/s = v_f$ same dir

b. If it slows down at a rate of 0.60 m/s^2, how long will it take to come to a complete stop?

$a = -.60\ m/s^2$

$v_i = 3.0\ m/s$

$v_f = 0\ m/s$

$t = ?$

$(t)(-.60\ m/s^2) = \frac{0 - 3.0\ m/s}{t}\ (t)$

$\frac{(t)(-.60\ m/s^2)}{-.60\ m/s^2} = \frac{-3.0\ m/s}{-.60\ m/s^2}$ $\frac{m/s}{m/s^2}$ invert & mult.

$\frac{m}{s} \times \frac{s^2}{m} = \frac{s}{1}$

$t = 5.0\ s$