Speed = $\frac{\text{distance}}{\text{time}}$

★ relative speed is measured by...

different direction = add
same direction = subtract

conversion expressions → this equals 1 mile

$\frac{78 \text{ miles}}{1} \times \frac{1609 \text{ meters}}{1 \text{ mile}}$

$\frac{1.2 \text{ hours}}{} \times \frac{3600 \text{ seconds}}{1 \text{ hour}}$

Acceleration = $\frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$

OYO's Module 9

9.1 You're in motion relative to the second and third security guard and you're not in motion relative to the first security guard standing next to you.

25min

9.2

Speed = $\frac{\text{distance}}{\text{time}}$ → $\frac{115 \text{ miles}}{30 \text{ minutes}}$ → 3.8

$\frac{115 \text{ miles}}{0.5 \text{ hrs}}$ = $\boxed{230 \frac{\text{miles}}{\text{hour}}}$

9.3

① 1000 milimeters = 1 meter
60 minutes = 1 hour

② $\frac{5 \text{ meters}}{1} \times \frac{1000 \text{ mm}}{1 \text{ meter}}$

↓

5000 mm

③ $\frac{12 \text{ hours}}{1} \times \frac{60 \text{ minutes}}{1 \text{ hour}}$

↓

720 minutes

speed = $\frac{d}{t}$ → speed = $\frac{5000 \text{ mm}}{720 \text{ min}}$

$\boxed{\text{speed} = 6.94 \frac{\text{milimeters}}{\text{minute}}}$

9.4 the answer is b.

9.5 1170 miles per hour towards eachother

9.6 $\frac{\text{final velocity} - \text{initial velocity}}{\text{time}}$ → $\frac{\cancel{12 \frac{\text{meters}}{\text{feet}}}}{\text{second}}$ → $\frac{12 \frac{\text{meters}}{\text{second}}}{3 \text{ seconds}}$

4 meters/second² downward ↓

9.7 $\frac{0 \frac{\text{meters}}{\text{second}} - 12 \frac{\text{meters}}{\text{second}}}{6}$ → $\frac{-12 \frac{\text{meters}}{\text{second}}}{6}$ → $\frac{-2 \frac{\text{meters}}{\text{second}^2}}{\text{east}}$

$\boxed{\text{or } 2 \text{ meters per second}^2 \text{ west}}$

✓ 9.8

$$\frac{\dfrac{0.15 \text{ miles}}{\text{minute}} - \dfrac{0 \text{ miles}}{\text{minute}}}{3 \text{ seconds}} \rightarrow \frac{3 \text{ seconds}}{1} \times \frac{1 \text{ minute}}{60 \text{ seconds}} \quad 0.05 \text{ min}$$

$$\downarrow$$

$$\frac{\dfrac{0.15 \text{ miles}}{\text{minute}} - \dfrac{0 \text{ miles}}{\text{minute}}}{0.05 \text{ minutes}} \qquad \boxed{3 \frac{\text{miles}}{\text{minutes}^2} \text{ south}}$$

✓ 9.9 distance $= \frac{1}{2} \times$ (acceleration) $\times$ (time)^2

distance $=$

$$\frac{1}{2} \times \left(32 \frac{\text{feet}}{\text{second}^2}\right) \times (1.1 \text{ seconds})^2$$

$$\frac{1}{2} \times \left(32 \frac{\text{feet}}{\text{second}^2}\right) \times (1.21 \text{ seconds}^2) \qquad \boxed{19.36 \text{ feet}}$$

✓ 9.10 First of all, it takes sound time to travel such a large distance. Secondly, it would be very hard to measure and check their results because its a skyscraper. Thirdly, the observer might be a little late when stopping the stopwatch when the ball hits the ground. and the person who drops the ball might not yell at the exact presice time.

Study Guide Module 9

1.

a. Reference point - a point against which position is measured

b. Vector quantity - a physical measurement that contains directional information

c. Scalar quantity - a physical measurement that does not contain directional information

d. Acceleration - The time rate of change of an object's velocity

e. Free Fall - The motion of an object when it is falling solely under the influence of gravity

2. No, it's not in motion relative to the reference point.

3. It depends who or what is the reference point, if the reference point is you who is standing a couple feet away from it, then no. But if you're viewing the glass from space as an astronaut, then yes, because the earth is in constant motion.

4.

a. relative to the girls

b. relative to the child

c. relative to the first girl

5. $\dfrac{10}{30 \text{ minutes}} \rightarrow$ ~~~~~~ $\dfrac{10 \text{ miles}}{0.5 \text{ hours}} = \boxed{20 \text{ mph}}$

6. $\dfrac{6 \text{ kilometers}}{45 \text{ minutes}}$ $\bigg|$ $\dfrac{6 \text{ kilometers}}{1} \times \dfrac{1000 \text{ meters}}{1 \text{ kilometers}} = \boxed{\dfrac{6000}{\text{meters}}}$

$\dfrac{45 \text{ minutes}}{1} \times \dfrac{\text{hours}}{60 \text{ minutes}}$ $\qquad$ $\dfrac{45 \text{ minutes}}{1} \times \dfrac{60 \text{ seconds}}{1 \text{ minute}}$

$\dfrac{6000 \text{ meters}}{2,700 \text{ seconds}} = \boxed{2.\overline{2} \dfrac{\text{meters}}{\text{second}}}$ $\qquad$ $\boxed{2,700 \text{ seconds}}$

7.

a. 10 meters = SQ, distance

b. 1.2 meter/second² east = VQ, acceleration

c. 3.4 feet/hour and slowing = SQ, ~~none~~ speed

d. 56 liters = SQ, none

e. 2.2 miles/minute west = VQ, velocity

f. 2.2 milimeter/year = SQ, speed

8. 12 mph ~~north~~ towards each other

9. $\dfrac{12 \frac{miles}{hour} - 0 \frac{miles}{hour}}{15\ minutes}$ $15\ minute \times \dfrac{1\ hour}{60\ minutes}$ $0.25\ hour$

the acceleration is 0

$\dfrac{12 \frac{miles}{hour} - 0 \frac{miles}{hour}}{0.25\ hour} \longrightarrow \dfrac{12 \frac{miles}{hour}}{0.25\ hour}$ $\boxed{48\ miles\ per\ hour^2\ west}$

10. $\dfrac{12 \frac{meters}{second} - 0 \frac{meters}{second}}{2\ seconds} = \boxed{6\ meters\ per\ second^2\ east}$

11. $12 \ \text{minutes} \times \dfrac{1\ hour}{60\ minutes} = 0.2\ hours$ $\dfrac{\cancel{70} \frac{miles}{hour} - 30 \frac{miles}{hour}}{0.2\ hours}$

$\dfrac{-30 \frac{miles}{hour}}{0.2\ hours} = -150\ mph^2 \longrightarrow \boxed{150\ miles\ per\ hour^2\ north}$

12. because if it's really close it doesn't experience acceleration. and because of air resistance.

13. because air resistance doesn't affect heavy objects very much.

14. They hit the bottom at the same time.

15. distance $= \dfrac{1}{2} \times$ (acceleration) $\times$ (time)²

$\dfrac{1}{2} \times (9.8 \frac{meters}{second^2}) \times (4.1\ seconds)^2$

$\boxed{82.37\ meters}\ 4.9\ \dfrac{meters}{\cancel{seconds^2}} \times 16.81^2\ \cancel{seconds}$

$$16 \times \boxed{49}$$

16. distance $= \frac{1}{2} \left(32 \frac{feet}{seconds^2} \right) \times \left(\underbrace{7 \cdot 7}_{seconds} \right)^2 \quad \boxed{784 \, ft}$

17. Opposite. because neither speed nor velocity can be negative or have decceleration.

NOTE

Introduction:

Physics, is essentially the most fundamental science of all sciences. Not only that, but in physics, there's a lot of mathematics.

Mechanics - The study of motion, forces, and energy:

★ The world around us is alive with motion ★

Thomas Aquinas used the world's motion as an argument to prove that a creator exists, because just like a ^{toy} car moves because someone pushed it, God is the "original mover". Mechanics is a branch of physics which means the following.

Mechanics - Analyzing and understanding objects in motion, the forces applied to those objects, and the energy that exists inside.

Reference point - A point against which position is measured

One of the most important ideas of physics is that all motion is relative.

Speed: How quickly motion occurs:

speed = distance traveled ÷ time traveled

Units are extremely important when measuring an object's speed.

How to solve speed equations examples:

$$speed = \frac{distance}{time} \rightarrow speed = \frac{78 \text{ miles}}{1.2 \text{ hours}} \rightarrow speed = 65 \frac{miles}{hour}$$

how to convert: $\frac{15.1 \text{ centimeters}}{1} \times \frac{0.01 \text{ meters}}{1 \text{ centimeters}}$

Order = ★multiphy, ★divide, ★divide

$$\frac{78 \text{ miles}}{1} \times \frac{1609 \text{ meters}}{1 \text{ mile}} = 125,502 \text{ meters}$$

$$\frac{1.2 \text{ hours}}{1} \times \frac{3600 \text{ seconds}}{1 \text{ hour}} = 4320 \text{ seconds}$$

$$\frac{12.5,502 \text{ meters}}{4320 \text{ seconds}} = 29.1 \frac{meters}{second}$$

Velocity: Speed and Direction:

Velocity = speed + direction

Vector quantity - A physical measurement that contains directional information.

Scalar quantity- A physical measurement that does not contain directional information.

Having said this, speed is a scalar quantity and velocity is a vector quantity. Also, relative speed, is the subtraction of two objects' speed relative to eachother, relative velocity is the same thing but with direction added. If two velocities of two objects are opposite then you add the velocities to give you the relative velocity.

★ When objects travel in the same direction, their relative speed is the difference between their individual speeds. When they travel in opposite directions, their relative speed is the sum of their individual speeds. ★

Acceleration: The Rate of Change in Velocity

Acceleration- The time rate of change of an objects velocity

$$acceleration = \frac{final\ velocity - initial\ velocity}{time}$$

you write acceleration units like this 32 feet per second² downward. Another thing to aknowledge is that acceleration is an vector quantity. So it must include the direction.

The Acceleration Due to Gravity:

Free Fall: The motion of an object when it is falling solely under the influence of gravity.

★ objects fall down as a free fall at the same acceleration unless interfered by air resistance ★

★ The acceleration due to gravity for any object is 9.8 meters/second² in metric units and 32 feet/second² in English units ★

$distance = \frac{1}{2} \times acceleration \times time²$. So, A height or distance can be measured with time.