**Distance, Speed, and Time Word Problems**

***Sample Problem***

**An aircraft carrier made a trip to Guam and back. The trip there took three hours and the trip back took four hours. It averaged 6 km/h on the return trip.**

**Find the average speed of the trip there.**

*1. List the given and unknown values.*

*Given: Time (trip to Guam)=3hrs*

 *Time (trip from Guam)= 4hrs*

 *Speed of return trip = 6km/hr*

*Unknown: speed of trip to Guam*

 *distance to Guam*

*2. Because there are 2 unknown variables, you must first find the distance to Guam.*

*Use the triangular formula for distance, speed, & time to solve for distance (to Guam).*

 *D=st Distance to Guam= (6km/hr)(4hrs) = 24 km*

*3. Use the triangular formula for D=st to solve for speed (return trip from Guam).*

 *S=D/t Speed of return trip = (24km)/ (3hrs) = 8 km/hr*

**Your Turn to Think**

1. A jogger needs to complete a 30 minute workout. The jogger can maintain an average speed of 8mph.

How many miles will the jogger travel during his workout?

First, convert minutes to hours: 30min = .5 hr

Next, find the distance travelled

D=st D= (8mph)(.5hr) D= 4 miles

The jogger will jog 4 miles during his workout!

1. A hurricane is approaching the shoreline at a speed of 78km/hr. A town near the shore is 273 miles from the eye of the storm. How long do the townspeople have to evacuate before the eye of the hurricane is over their town?

t=d/s t= 273miles / 78km/hr t=3.5 hours

The eye of the hurricane will be over the town in 3.5 hours. Hopefully they left sooner since the eye wall of a hurricane is much more destructive than the eye!

1. A speaker generates a sound frequency of 175 hertz. The resulting sound wave travels 92 meters in 0.2 seconds. What is the speed of the wave in m/s?

s=D/t s= 92m / 0.2s s= 460m/s

The sound wave is travelling at 460m/s

1. A passenger plane made a trip to Las Vegas and back. On the trip there it flew 432 mph and on the return trip it went 480 mph.

How long did the trip there take if the return trip took nine hours?

Must solve in 2 parts, first find the distance to Las Vegas

D=st D=(480mph)(9hrs) Distance to Vegas= 4320 miles

Next, find the time it took for the plane to get to Vegas

t= D/s t= 4320miles / 432mph time to get to Vegas= 10hrs

The trip to Las Vegas took ten hours.

1. A cattle train left Miami and traveled toward New York. 14 hours later a diesel train left traveling at 45 km/h in an effort to catch up to the cattle train. After traveling for four hours the diesel train finally caught up.

What was the cattle train's average speed?

Must solve in 3 parts, first find the distance the trains travelled

D=st D=(45km/hr)(4hrs) [distance diesel train travelled] =180km

Next, find the total time the cattle train travelled: 14hrs + 4hrs = 18hrs

Next, find the speed of the cattle train

s=D/t s= 180km/18 hrs s= 10km/hr

The cattle train’s average speed was 10 km/hr. That is pretty darn slow. Cows must get train sick!

1. Jose left the White House and drove toward the recycling plant at an average speed of 40 km/h. Rob left some time later driving in the same direction at an average speed of 48 km/h. After driving for five hours Rob caught up with Jose. How long did Jose drive before Rob caught up?

First, find the distance Rob travelled D=st D= (48km/hr)(5hr)= 240 km

Next, find the time Jose travelled t= D/s t= 240km / 40km/hr = 6hr

Jose drove for six hours before Rob caught up with him. Either Rob was speeding or Jose drives really slow!

1. A submarine left Hawaii two hours before an aircraft carrier. The vessels traveled in opposite directions. The aircraft carrier traveled at 25 mph for nine hours. After this time the vessels were 280 miles apart. Find the submarine's speed.

First, find the distance the aircraft carrier travelled D=st D=(25mph)(9hr)=225miles

Next, find the distance the submarine travelled 280miles – 225miles = 55miles

Next, find time it took the submarine 9hrs + 2hrs = 11hrs

Finally, find the speed of the submarine s=D/t s= 55miles / 11 hrs s=5mph

The submarine’s speed is 5mph. I would not want to be on a submarine for 11 hrs!

**Newton’s Second Law Word Problems**

***Sample Problem***

**The force of gravity between the moon and an object near its surface is much smaller than the force of gravity between Earth and the same object near Earth’s surface. A bowling ball with a mass of 7 kg is pulled downward with an unbalanced force of 14 N. What is the acceleration of the falling bowling ball on the moon?**

*1. List the given and unknown values.*

*Given: mass, m = 7 kg*

*force, F = 14 N*

*Unknown: acceleration, a = ? m/s2*

*2. Use the triangular formula for Newton’s second law to solve for acceleration.*

*force = mass x acceleration F = ma*

*3. Substitute force and mass values into the acceleration equation, and solve.*

*a = f/m a= 14N/7kg*

*a = 2 m/s2*

**Your Turn to Think**

1. Assume that a catcher in a professional baseball game exerts a force of 64 N to

stop the ball. If the baseball has a mass of 2 kg, what is its acceleration as it is being caught?

a=f/m a= 64N / 2kg a= 32m/s2

2. A type of elevator called a *cage* is used to raise and lower miners in a mine shaft.

Suppose the cage carries a group of miners down the shaft. If the unbalanced force on the cage is 60.0 N, and the mass of the loaded cage is 120 kg, what is the acceleration on the cage?

a=f/m a= 60N / 120kg a= .5m/s2

3. A 200 kg boat is sinking in the ocean. The force of gravity that draws the boat down is

partially offset by the buoyant force of the water, so the net unbalanced force on the

boat is 1400 N. What is the acceleration of the boat?

a=f/m a= 1400N / 200kg a= 7m/s2

***Sample Problem***

**A freight train slows down as it approaches a train yard. If a force of 380,000 N is required to provide an deceleration of 2 m/s2, what is the train’s mass?**

*1. List the given and unknown values.*

*Given: unbalanced force, F = 380,000 N*

*acceleration, a = 2 m/s2*

*Unknown: mass, m = ? kg*

*2. Use the triangular formula for Newton’s second law to solve for mass.*

*force = mass × acceleration F = ma*

*3. Substitute force and acceleration values into the equation, and solve.*

*m = F/a m= 380,000 N / 2 m/s2*

*m = 190,000 m/s2*

**Your Turn to Think**

4. The tallest man-made structure at present is the *Warszawa Radio* mast in Warsaw, Poland. This radio mast rises 646 m above the ground, nearly 200 m more than the Sears Tower in Chicago. Suppose a worker at the top of the *Warszawa Radio* mast accidentally knocks a tool off the tower. If the force acting on it is 4.9 N, and its acceleration is 9.8 m/s2 (gravity), what is the tool’s mass?

m= F/a m=4.9N / 9.8 m/s2 m= .5 kg

5. The whale shark is the largest of all fish and can have the mass of three adult elephants. Suppose that a crane is lifting a whale shark into a tank for delivery to an aquarium. The crane must exert an unbalanced force of 2400 N to lift the shark from rest. If the shark’s acceleration equals 3 m/s2, what is the shark’s mass?

m=F/a m=2400N / 3m/s2 m= 800kg

6. A house is lifted from its foundations onto a truck for relocation. The unbalanced force lifting the house is 2850 N. This force causes the house to move from rest to an upward with an acceleration of .5 m/s2. What is the mass of the house?

m=F/a m=2850N / .5m/s2 m= 5700kg

**Your Turn to Think – Challenge!**

7. In drag racing, acceleration is more important than speed, and therefore drag racers are designed to provide high accelerations. Suppose a drag racer has a mass of 1250 kg and accelerates at a constant rate of 16.5 m/s2. How large is the unbalanced force acting on the racer?

F=ma F= (1250kg)(16.5 m/s2)

F= 20625N

8. Because of a frictional force of 2.6 N, a force of 2.8 N must be applied to a textbook in order to slide it along the surface of a wooden table. The book accelerates at a rate of 0.10 m/s2.

1. What is the unbalanced force on the book? 2.6N 2.8N

resultant force .2N

b. What is the mass of the book?

m= F/a m= .2N / .1m/s2

m= 2kg

9. Suppose an empty grocery cart rolls downhill in a parking lot. The cart has a maximum speed of 2m/s when it hits the side of the store and comes to rest 0.50 s later. If an unbalanced force of 64 N stops the cart, what is the mass of the grocery cart?

m= F/a m= 64N / 2 m/s2

m=32kg

10. REAL CHALLENGE The fastest speed achieved on Earth for any object, with the exception of subatomic particles in particle accelerators, is 15.8 km/s. A device at Sandia Laboratories in Albuquerque, New Mexico, uses highly compressed air to accelerate a small metal disk to supersonic speeds. Suppose the disk reaches its top speed from rest in 1.0 s. If the disk has a mass of 0.20 g, what is the unbalanced force on the disk?

This problem must be solved in 2 parts because we need to figure out the acceleration of the disk first.

Remember all units must be converted to kg and m/s2 for this formula to work.

a = (final – initial speed) / time a= (15800m/s – 0m/s) / 1.0s a= 15800m/s2

Convert units mass [grams to kilograms] .2g = .0002kg

Solve for Force F=ma F= (.0002kg)(15800 m/s2) F= 3.16N