Time taken to cover the distance (t) = 20 seconds

The initial velocity of the truck (u) = 0 (since it starts from a state of rest)

From the equations of motion, $s = ut + \frac{1}{2}at^2$

Therefore, $400 = 0(20s) + \frac{1}{2}(a)(400s^2)$ = $2ms^{-2}$

The acceleration of the truck is equal to 2 $ms^{-2}$

As per the second law of motion, Force = Mass × Acceleration

Mass of the truck = 7 tonnes = 7000kg

Force acting on the truck = $7000kg \times 2m.s^{-2}$ = 14000 $kg.m.s^{-2}$ = 14000 N

Therefore, a force of 14000 N is acting on the truck.

**6. A stone of 1 kg is thrown with a velocity of 20 $ms^{-1}$ across the frozen surface of a lake and comes to rest after travelling a distance of 50 m. What is the force of friction between the stone and the ice?**

**Solution**

Given, Mass of the stone (m) = 1kg

Initial velocity (u) = 20m/s

Terminal velocity (v) = 0 m/s (the stone reaches a position of rest)

Distance travelled by the stone (s) = 50 m

As per the third equation of motion

$v^2 = u^2 + 2as$

Substituting the values in the above equation we get,

$0^2 = (20)^2 + 2(a)(50)$

-400 = 100a

a = -400/100 = $-4m/s^2$ (retardation)

We know that

F = m×a

Substituting above obtained value of a = -4 in F = m x a

We get,

F = 1 × (-4) = -4N

Here the negative sign indicates the opposing force which is Friction

**7. An 8000 kg engine pulls a train of 5 wagons, each of 2000 kg, along a horizontal track. If the engine exerts a force of 40000 N and the track offers a friction force of 5000 N, then calculate: (a) the net accelerating force and (b) the acceleration of the train**

**3. A hammer of mass 500 g, moving at 50 m s-1, strikes a nail. The nail stops the hammer in a very short time of 0.01 s. What is the force of the nail on the hammer?**

**Solution**

Given, mass of the hammer (m) = 500g = 0.5kg

Initial velocity of the hammer (u) = 50 m/s

Terminal velocity of the hammer (v) = 0 (the hammer is stopped and reaches a position of rest).

Time period (t) = 0.01s

Therefore, the acceleration of the hammer is given by: $a = \frac{v-u}{t} = \frac{0-50\ ms^{-1}}{0.01s}$

a = -5000ms$^{-2}$

Therefore, the force exerted by the hammer on the nail (F = ma) can be calculated as:

F = (0.5kg) * (-5000 ms$^{-2}$) = -2500 N

As per the third law of motion, the nail exerts an equal and opposite force on the hammer. Since the force exerted on the nail by the hammer is -2500 N, the force exerted on the hammer by the nail will be +2500 N.

**4. A motorcar of mass 1200 kg is moving along a straight line with a uniform velocity of 90 km/h. Its velocity is slowed down to 18 km/h in 4 s by an unbalanced external force. Calculate the acceleration and change in momentum. Also calculate the magnitude of the force required.**



**Solution**

Given, mass of the car (m) = 1200kg

Initial velocity (u) = 90 km/hour = 25 meters/sec

Terminal velocity (v) = 18 km/hour = 5 meters/sec

Time period (t) = 4 seconds

The acceleration of the car can be calculated with the help of the formula: $a = \frac{v-u}{t}$

$a = \frac{5-25}{4} m.s^{-2}$ = -5 ms$^{-2}$

Therefore, the acceleration of the car is -5 ms$^{-2}$.

Initial momentum of the car = m × u = (1200kg) × (25m/s) = 30,000 kg.m.s$^{-1}$

Final momentum of the car = m × v = (1200kg) × (5m/s) = 6,000 kg.m.s$^{-1}$

Therefore, change in momentum (final momentum – initial momentum) = (6,000 – 30,000) kg.m.s$^{-1}$

= -24,000 kg.m.s$^{-1}$

External force applied = mass of car × acceleration = (1200kg) × (-5 ms$^{-2}$) = -6000N

Therefore, the magnitude of force required to slow down the vehicle to 18 km/hour is 6000 N