

Problem - Solving

The following questions are designed to force you to get creative to solve them. They're deliberately written in a way that makes it hard to work out where to start. My advice is: don't panic. Start wherever you think you can. Be patient.

1. What force must I apply to a mass of 3.0kg to accelerate it at 4.0m/s^2 on a horizontal surface if:

a) there is no friction (1)

b) the frictional force is equal to 4.0N (3)

2. The Highway Code estimates that a typical reaction time of a driver is two thirds of a second; and that once applied, brakes will give a car a 6.67m/s^2 deceleration.

1, mph = 0.447m/s

The thinking distance at 30mph is 8.9m.

The braking distance at 30mph is 13.4m

a) Using the Highway code value for reaction time (given above), calculate the thinking distance at 60mph.

b) Using the Highway code value for deceleration (given above), calculate the braking distance at 60mph.

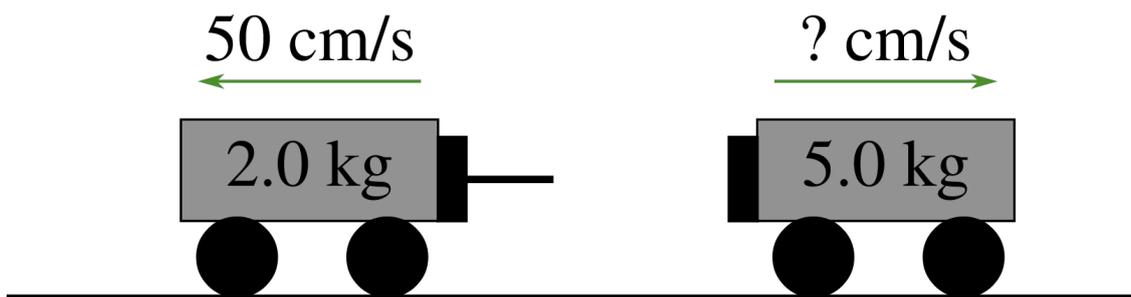
c) Using your answer to part A, what happens to thinking distance when you double your speed?

d) Using your answer to part B, what happens to braking distance when you double your speed?

A car driving in a straight line along the motorway accelerates forwards and doubles its speed. The momentum and kinetic energy of the car respectively increase by a factor of

- Momentum $\times 1$: Kinetic Energy $\times 1$
- Momentum $\times 4$: Kinetic Energy $\times 2$
- Momentum $\times 2$: Kinetic Energy $\times 2$
- Momentum $\times 4$: Kinetic Energy $\times 4$
- Momentum $\times 2$: Kinetic Energy $\times 4$

4. Two trolleys are at rest and in contact on a smooth, level surface. A coiled spring in one trolley is released so that they 'explode' apart. The lighter trolley moves off at 50cm/s.



a) Find the speed of the other trolley

b) Find the minimum energy that was stored in the spring before the explosion.

Assume that any dropped or thrown object accelerates downwards at 9.8m/s^2

If a question says that an object is 'dropped' this means that its velocity is zero at the beginning of the motion.

5a. How much time does a dropped weight take to fall 120m down a cliff?

b. How much time would the weight take to fall 120m down the cliff if it was thrown downwards at 2.5ms^{-2} ?

6. Two identical springs each have a spring constant of 200N/m . A mass of 9.7kg is hung from one spring, which is supported by the other. The top spring is supported by a strong beam.

a. What is the total extension of the springs?

b. The two springs are now set up in parallel to share the load.

What will the extension of each spring be when the mass is supported?