Video 603 (2:24)

Momentum

Name: _____

Momentum →

m =

v =

p =

Unlike energy, momentum is a vector. Direction matters.

EX. What is the momentum of a 3.5 kg medicine ball traveling 4.3 m/s north?

Video 606 (7:45)

The Impulse-Momentum Theorem

impulse:

CHANGES OBJECT'S MOMENTUM

Derived from Newton's 2nd Law: $F = ma = m\frac{\Delta v}{\Delta t} \rightarrow F\Delta t = m\Delta v$

Video 609 (3:31)

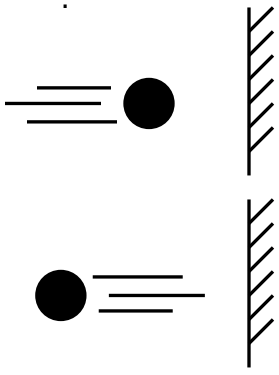
1320 kg car traveling 40.0 m/s. 68 kg passenger applies brakes 8.5 s to bring car (and himself) to rest. Find avg. force seatbelt must exert on person over this time.

Suppose Δt = 0.12 s instead.

Video 612 (4:21)

255 g ball traveling 12 m/s ⟶ hits wall and rebounds at 12 m/s ⟵ .

If ball contacts wall for 0.18 s, find force of wall on ball.



Video 615 (5:21)

Three Types of Collisions

1. <u>elastic</u>:

-- mechanical energy is conserved ⟶

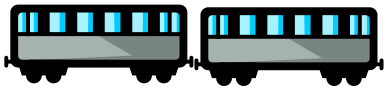
-- momentum is conserved ⟶

-- best approximate examples:

-- best nearly-perfect example:

2. <u>perfectly inelastic</u>:

-- some energy is "lost" as heat or deformation



-- momentum is conserved ⟶

-- e.g.,

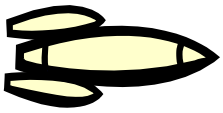
3. <u>inelastic</u>:

-- momentum is conserved ⟶

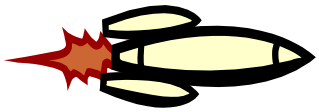
Video 618 (6:55)

14 kg toddler throws 0.38 kg football 4.7 m/s ⟶. Find recoil velocity of child.

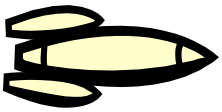
EX. 8.0 ton rocket travels at 3.0 mi/s ⟶. After firing engines, rocket's mass drops to 7.0 tons and it travels at 5.0 mi/s ⟶. Has momentum been conserved? Explain.



m = 8.0 T
v = 3.0 mi/s →



(engines fire)



m = 7.0 T
v = 5.0 mi/s →

Video 621 (4:33)

Train Car A has mass 25,000 kg and init. vel. 5.0 m/s →. Car B, w/mass 15,000 kg, is initially at rest. Cars collide and couple. Find vel. at which cars move off together.

Is kinetic energy conserved?

How much energy was lost as heat (and/or used to deform coupling mechanism)?

Video 624 (5:40)

55 kg shopping cart travels at 3.0 m/s ←. A 19 kg child, moving 5.0 m/s →, jumps onto end of cart. Find final vel. of cart/child system.

"Why Does it Hurt More When Paintballs DON'T Break?"

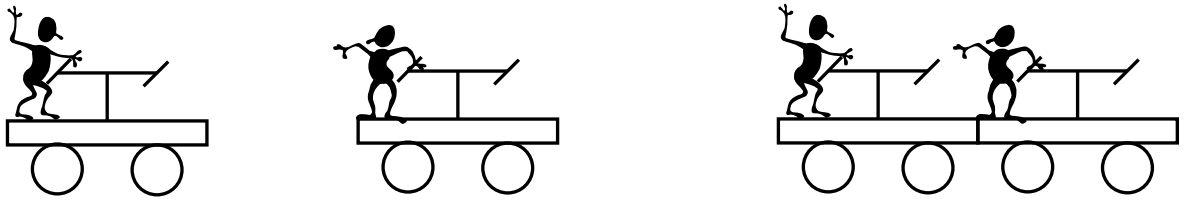
Video 627 (6:16)

Handcarts A and B are on train track. "A" w/passenger has mass 185 kg and moves at 3.5 m/s ⟶. "B" w/passenger has mass 150 kg and moves at 2.0 m/s ⟶. B starts out 15 m ahead of A.

a. How long before A catches B?

b. How far do A and B go in this time?

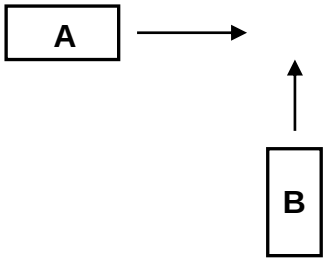
c. What % of initial KE is "lost" if handcarts couple?



Video 630 (4:39)

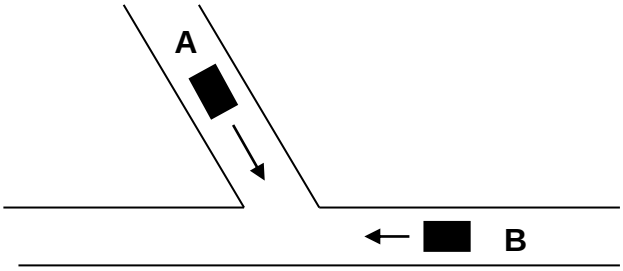
Conservation of Momentum in 2-D

Car A, w/mass 1340 kg, travels east at 21.3 m/s.
Car B, w/mass 2150 kg, travels north at 18.4 m/s.
Vehicles collide and couple. Find resultant vel.
of coupled vehicles.



Video 633 (6:49)

Car A, w/mass 1500 kg, goes 22 m/s at 63^{o} S of E. Car B, w/mass 1900 kg, goes 12 m/s W. Vehicles collide and couple. Find resultant vel. of two-car object.



Video 636 (9:00)

Car A, w/mass 1260 kg, goes E. Car B, w/mass 1630 kg, goes 30° N of E. Vehicles collide and couple. The skid marks are 44 m long at 18° N of E. Coefficient of friction is 0.80. Find initial speeds of A and B.