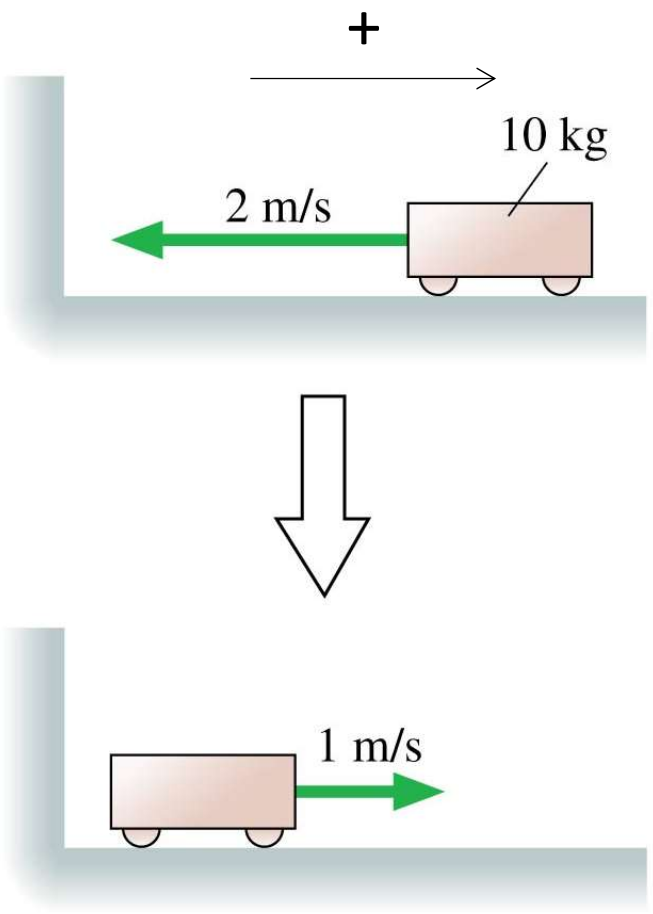
- Momentum
  - Single object: $m\overline{v}$
  - System of objects: $\sum_{j=1}^{n} m\overline{v}$
- Impulse
  - $\int_{t_i}^{t_f} \overline{F} dt$
  - area under F vs t graph
  - F_{avg} * t
- Units
  - [force][time] = [mass][velocity]
  - N-s = kg-m/s
  - lb-s = slug-ft/s
- Impulse - Momentum
  - Single object: $\int_{t_i}^{t_f} \overline{F} dt = m\overline{v}_f - m\overline{v}_i$
  - System of objects: $\sum_{j=1}^{n} m\overline{v}_f = \sum_{j=1}^{n} m\overline{v}_i + \int_{t_i}^{t_f} \overline{F} dt$
- Conservation of Momentum
  - No external forces
  - $\sum_{j=1}^{n} m\overline{v}_f = \sum_{j=1}^{n} m\overline{v}_i$
- Collisions
  - Perfectly Inelastic
  - Inelastic
  - Perfectly Elastic
- Perfectly Inelastic Collisions
  - Objects stick together, final velocity is the same
  - Momentum conserved, mechanical energy lost
  - $m_1 v_1 + m_2 v_2 = (m_1 + m_2) v'$
- Explosions
  - Objects start together, initial velocity is the same
  - Momentum convserved, mechanical energy added
  - $(m_1 + m_2) v = m_1 v_1' + m_2 v_2'$

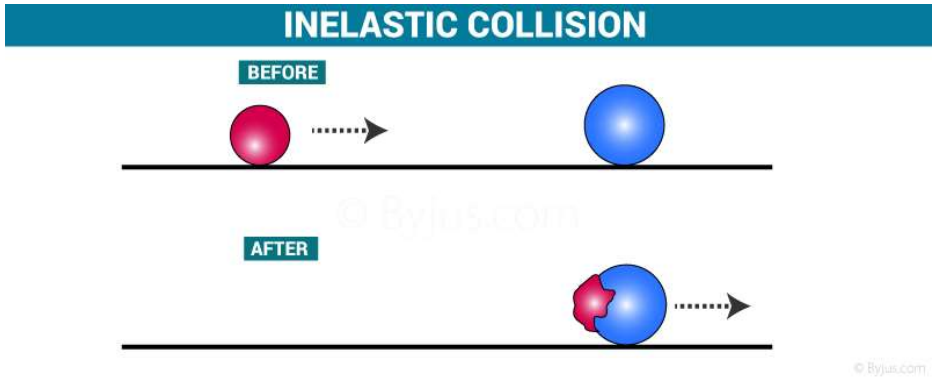
The change in momentum of the car is:

A. -20 kg m/s
B. -10 kg m/s
C. + 10 kg m/s
D. + 30 kg m/s



In an inelastic collision:

A. Kinetic Energy is conserved
B. Momentum is conserved
C. Both are conserved
D. Neither are conserved



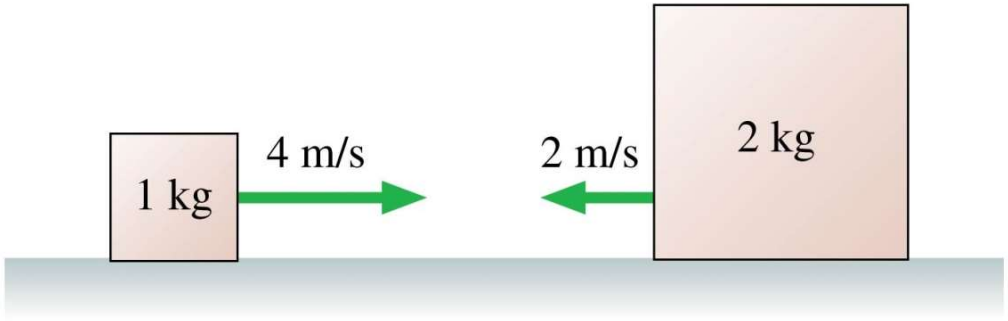
The two boxes are sliding along a frictionless surface. They collide and stick together. Afterward, the velocity of the two boxes is

A. 2 m/s to the left.

B. 1 m/s to the left.

C. 0 m/s, at rest.

D. 1 m/s to the right.



You awake in the night to find that your living room is on fire. Your one chance to save yourself is to throw something that will hit the back of your bedroom door and close it, giving you a few seconds to escape out the window. You happen to have both a sticky ball of clay and a super-bouncy Superball next to your bed, both the same size and same mass. You've only time to throw one. Which will it be? Your life depends on making the right choice!

A. Throw the Superball.

B. Throw the ball of clay.

C. It doesn't matter. Throw either.

1.

1073

The head of a snowman has a mass of 5.6 kg and is loosely attached to the snowman.
Rachel and Taylor throw various objects at the snowman's head.
Determine the velocity of the head just after impact for each of the cases below.

EXAMPLE

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Part	Description	Answer	Save	Status
A.	A 440 gram snowball at 15 m/s, which sticks to the head. (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty 1 hint available	# tries: 0 Show Details Clear tries and answer
B.	A 440 gram rubber ball at 15 m/s, which bounces backwards off the head with a speed of 8 m/s. (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty	# tries: 0 Show Details Clear tries and answer
C.	A 440 gram rock at 15 m/s, which goes through the head and exits with a speed of 8 m/s. (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty	# tries: 0 Show Details Clear tries and answer

2.

1090

The train engines (17 tons) and their cars (34 tons) were initially separated. Somewhere down the track they couple together.

EXAMPLE

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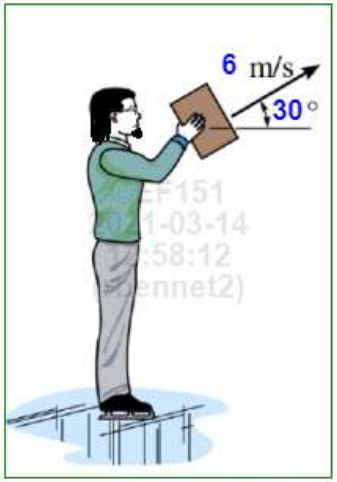
Part	Description	Answer	Save	Status
A.	What was the velocity of the coupled engines and cars given the following initial velocities? $V_{engines}$ = 0.0 ft/s V_{cars} = 3.1 ft/s (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty	# tries: 0 Show Details Clear tries and answer
B.	What was the velocity of the coupled engine and cars given the following initial velocities? (ft/s) $V_{engines}$ = -2.6 ft/s V_{cars} = 1.6 ft/s (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty	# tries: 0 Show Details Clear tries and answer
C.	What percentage of the initial energy was lost in part B? (%)	A S	9.09 pts.100% 2% try penalty 1 hint available	# tries: 0 Show Details Clear tries and answer

3.
1072



A 70 kg Prof. Sukanek wearing ice skates stands motionless on the ice when he throws a 6 kg block with a velocity as shown in the figure.
Assume he keeps his legs rigid during the throw and neglect friction and the motion of his arms.
Use right and up as the positive directions.

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Part	Description	Answer	Save	Status
A.	Assume he completes the throw in 0.20 s. What is the horizontal component of the his velocity after the throw? (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty 1 hint available	# tries: 0 Show Details Clear tries and answer
B.	Assume he completes the throw in 2.4 s. What is the horizontal component of the man's velocity after the throw? (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty 1 hint available	# tries: 0 Show Details Clear tries and answer
C.	What is the kinetic energy of the system (man and block) after the block is released? (include units with answer)	Format Check A S	9.09 pts.100% 2% try penalty 1 hint available	# tries: 0 Show Details Clear tries and answer