Momentum 3
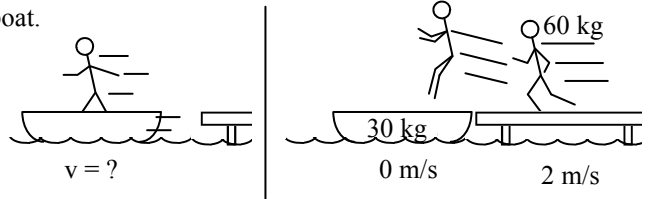
1) A 60 kg man is running 2m/s to the left and jumps into a 30 kg boat.

A. What is initial momentum of the system?

B. What its the final momentum of the system?

C. What is the combined mass of the man and the boat?

D. Under the diagram, find the final velocity of the man-boat system.

E. What is the man's change in momentum?

F. What is the change in momentum of the boat?

G. Explain why the answers to (F) and (G) are the same in mganitude but opposite in sign.

60 kg

30 kg
0 m/s   2 m/s

v = ?

2) A 1 kg object moving 10 m/s to the right bumps into a 12 kg object moving 2 m/s to the right. Afterwards the 12 kg object is moving 3 m/s to the right.

initial

1 kg   12 kg
v = 10 m/s   v = 2 m/s

final

1 kg   12 kg
v = ?   v = 3 m/s
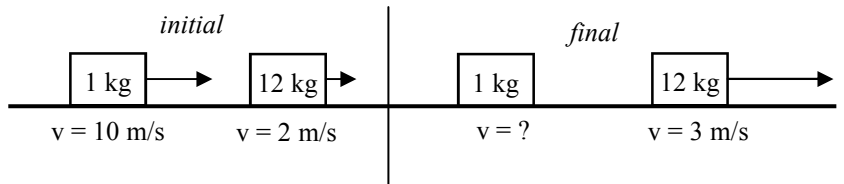
A. Under the diagram, calculate the final velocity of the 1 kg object.

B. Calculate the average force experienced by each object during the collision if the collision lasts for 0.4s.

3) Two object collide as shown in the picture at the right.

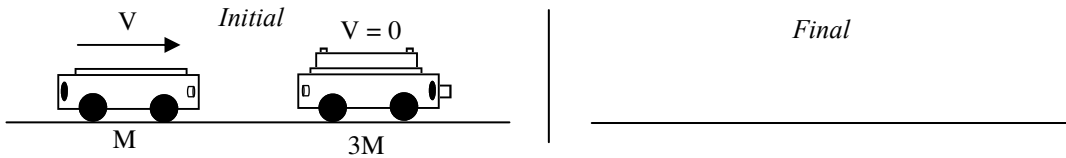A. Find the initial velocity (including the direction) of the 4 kg object.

initial

2 m/s   v = ?

8 kg   4 kg

final

1.33 m/s   3.67 m/s

8 kg   4 kg
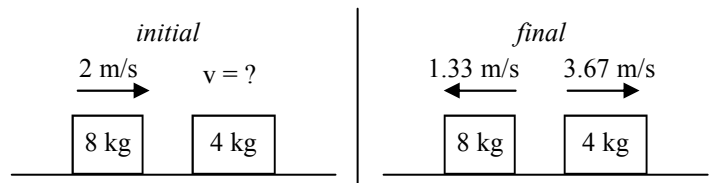
B. What is the impulse experienced by the 4 kg object in the collision?

C. What is the average force exerted on the 8 kg object if the collision lasts for 0.03 s? What causes that force?

Force vs. Time

4) If a 6 kg object is moving 3 m/s to the right,
   A) Use the graph at the right to find its final velocity after 10s.
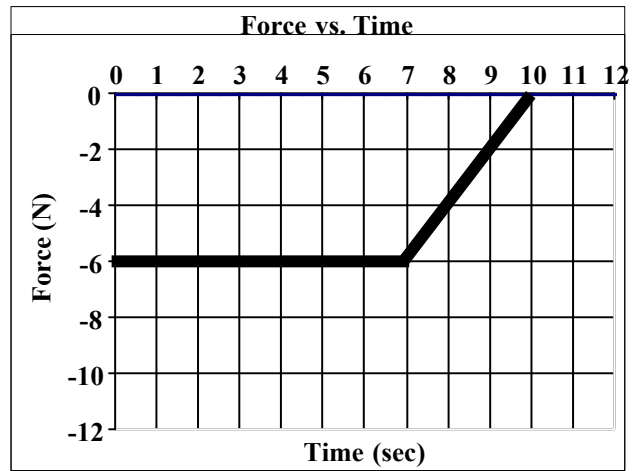
   B) What is the object doing during the motion shown on the graph?

   C) What is the object's acceleration at 8s?

Graph: Force (N) vs. Time (sec). Vertical axis Force (N) from 0 to -12, horizontal axis Time 0 to 12. Line at -6 N from 0 to 7s, then rises to 0 at 10s.

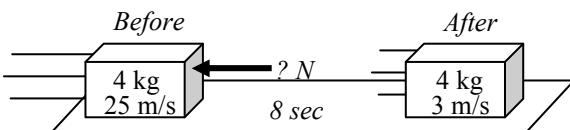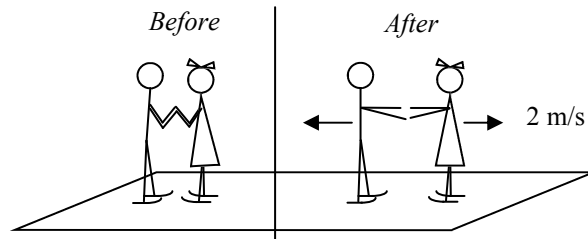*Initial:* V (arrow) — M cart; V = 0 — 3M cart.   *Final:* _____

5) In the diagram above, two carts with the velcities and masses show collide and stick together. Answer/complete the following.
   A. Draw what happens after the collision.
   B. What is the initial momentum of the system?

   C. What is the final velocity of each cart?

   E. What is the change in momentum of each car?

6) A boy and a girl go ice skating. Standing on the ice, they push off from each other. He is 60 kg and she is 40 kg. If she ends up moving to the right at 2 m/s. How fast will he be moving?

Before / After diagram: skaters push off, girl moving right at 2 m/s.

Before: 4 kg, 25 m/s → ? N, 8 sec   *After:* 4 kg, 3 m/s

7) A 4 kg object moving at 25 m/s slows down to 3 m/s over a period of 8s. Calculate the force required to slow the object.