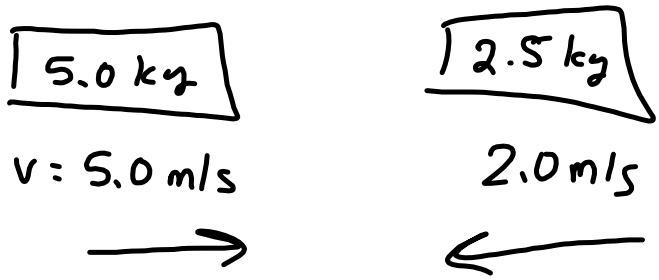
Conservation of Momentum

Green p 315

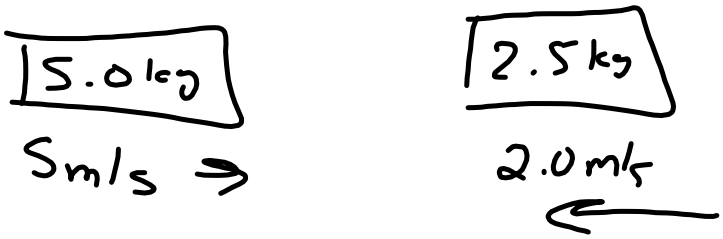
25. 2.7 m/s in the same direction they were originally moving.
26. 0.11 m/s same
27. 2.10 m/s South
28. 0.11 m/s East

Red p 194/195

19. 11 m/s
20. 3.4×10^{2} m/s
21. 10.6 m/s
22. 5.0 m/s west
24. 10 m/s
27. 0.22 m/s original direction.



The blocks hit and move off together. Determine the speed the move off at.



Momentum Before = Momentum After

A + B = A + B

$5.0(5.0) + 2.5(-2.0) = 7.5v$

$25\ kg \cdot m/s - 5.0\ kg \cdot m/s = 7.5v$

$= 7.5v$

$20\ kg \cdot m/s = v$

$+2.7\ m/s$

They will move at 2.7 m/s towards the right.

Impulse

The product of the force exerted on an object and the time interval over which the force acts.

$j = F\Delta t$

$J = F\Delta t$

$J \rightarrow$ impulse $\rightarrow$ $N \cdot S$

$F \rightarrow$ Force $\rightarrow$ N

$\Delta t \rightarrow$ contact time $\rightarrow$ S

There are a few other formulas that can calculate impulse as well.

$J = F\Delta t$

$J = \Delta p$ ⟶ Change in momentum

$J = m(v_2 - v_1)$ → " " "

$F\Delta t = m(v_2 - v_1)$

Impulse-Momentum Theorem

$$F\Delta t = m(v_2 - v_1)$$

Red text
p 193 (2, 3, 4, 5, 8, 9, 11)

Green p 200 (30, 31, 33, 34
37, 38, 39, 42
43, 45, 46)

Red text p193

2. $j = F\Delta t$

$= (30.0\ N)(0.16\ sec)$

$= 4.8\ N \cdot s$

or

$4.8\ kg \cdot m/s$

3. $F\Delta t = m(v_2 - v_1) = m\,\Delta v$

$$\Delta v = \frac{F\Delta t}{m} = \frac{4.8\ \text{kg}\cdot\text{m/s}}{0.115\ \text{kg}}$$

$$= 42\ \text{m/s}$$

4. change in momentum = Δp

a) $j = \Delta p = m(v_2 - v_1) = F\Delta t$

$\Delta p = F\Delta t$

$= (6.00\ N)(10.0\ s)$

$= 60.0\ N \cdot s$

b) $m\Delta v = F\Delta t$

$\Delta v = \frac{F\Delta t}{m} = \frac{60.0\ N \cdot s}{3.00\ kg} = 20.0\ m/s$

5. a) $\Delta p = m \Delta V$

$= 600\,kg\,(44.0 - 10.0)$

$= 2.04 \times 10^4\ N \cdot s$

b)

$F \Delta t = m \Delta V$

$F = \frac{m \Delta V}{\Delta t} = \frac{2.04 \times 10^4\ N \cdot s}{68.0\ sec}$

$= 300\ N$

8. $F\Delta t = m(v_2 - v_1)$

$$F = \frac{m(v_2 - v_1)}{\Delta t}$$

$$= \frac{0.25\,kg(-14 - 6.0)}{0.02\,sec}$$

$$= -2.5 \times 10^2\ N$$

opposite to the direction of v_1

9. $F\Delta t = m(v_2 - v_1)$

$$m = \frac{F\Delta t}{v_2 - v_1}$$

$$= \frac{(-1.21 \times 10^3\ N)(20.0\ sec)}{(0-22)\ m/s}$$

$$m = 1.10 \times 10^3\ kg$$

11. $F\Delta t = m(v_2 - v_1)$

$$\Delta t = \frac{m(v_2 - v_1)}{F}$$

$$= \frac{10\,000\ kg\,(0 - 3.00)\ m/s}{-1000\ N}$$

$$\Delta t = 30.0\ sec.$$

Green text p 200

30. $j = F\Delta t$

$= 2125\ N(0.0205\ sec)$

$= 43.6\ N \cdot s\ [down]$

31. $j = F\Delta t$

$= 1.23 \times 10^{7}\ N\ [S] \times 0.021\ sec$

$= 2.58\ N \cdot s\ [S]$

32. $j = m(v_2 - v_1)$

$= 0.060\ kg\ (43 - 0)$

$= 2.58$

$j = 2.6\ kg \cdot m/s$

34. $j = m(v_2 - v_1)$

$= 0.35\ kg\ (-62 - 46)\ m/s$

$= .38\ kg \cdot m/s$

p 209

37. $p = mv$

$= 5\ kg \times 3.5\ m/s$

$= 18\ kg \cdot m/s$

38. $p = mv$

$m = \frac{p}{v} = \frac{4.2 \times 10^4\ kg \cdot m/s}{28\ m/s} = 1.5 \times 10^3\ kg$

39. $p = mv$

$$v = \frac{p}{m} = \frac{66.0 \text{ kg·m/s } [S]}{55.0 \text{ kg}}$$

$$= 1.20 \text{ m/s } [S]$$

42. $j = F\Delta t$

$$F = \frac{j}{\Delta t} = \frac{8.8}{2.3 \times 10^{-3}} = 3.8 \times 10^{3} \text{ N}$$

43. $J = F\Delta t$

$$\Delta t = \frac{J}{F} = \frac{2.0\ N\cdot s}{55\ N}$$

$$= 3.6 \times 10^{-2}\ sec$$

45. $F\Delta t = m(v_2 - v_1)$

$$F = \frac{m(v_2 - v_1)}{\Delta t}$$

$$F = \frac{2.5\,kg\,(0 - 3.5)\,m/s}{3.5 \times 10^{-4}\,sec}$$

$$F = -2.5 \times 10^{4}\ N$$

opposite direction to that which the stone was originally moving.

p 213

46. a) $p = mv$

$= 0.80\ kg \times 12\ m/s\ [N]$

$= 9.6\ kg \cdot m/s\ [N]$

b) $\Delta p = m(v_2 - v_1)$

$= 0.80\ kg\ (-9.5 - 12)\ m/s$

$= 17.2\ kg \cdot m/s\ [S]$

c) $j = \Delta p$

$= 17.2\ kg \cdot m/s\ [S]$

d) $F\Delta t = \Delta p$

$F = \frac{\Delta p}{F}$

$F = \frac{17.2\ kg \cdot m/s}{0.065\ sec}$

e) $265\ N\ [S] = 265\ N\ [N]$