Kathleen Boyce
Period Blue

Mastering Physics - Intro to Momentum (page 1)

11. Isolated systems = Momentum ($p = m \cdot v$) remains constant

$m_A V_{Ai} + m_B V_{Bi} = m_A V_{Af} + m_B V_{Bf}$

12. a) Ball drops with the same velocity as the clay
velocity is -28.4 m/s at t = 2.9 s, 0 m/s at 3.0 s, and 28.4 m/s at 3.1 s
Velocity is 0 m/s at t = 6.0 s → max height
b) Change in momentum of the superball is greater
c) Impulse delivered to the superball is greater
d) Force is greater   J = Force · Time

13. a) $V_f^2 = V_i^2 + 2a\Delta x$ $V_f^2 = 2(-9.8)(2) \Rightarrow V_f = -6.26 \frac{m}{s}$
$J = mV_f - mV_i = (0.1)(0) - (0.1)(-6.26) = 0.626$
$J = \text{Force} \cdot \Delta t$
$\Delta x = \left(\frac{V_i + V_f}{2}\right)\Delta t$ $0.060 = \left(\frac{-6.26}{2}\right)\Delta t$ $\Delta t = 0.019$ s
$0.626 = \text{Force} \cdot 0.019$ Force = 33 N → likely to bruise
b) $a = \frac{V_f - V_i}{\Delta t} = \frac{6.26}{0.019} = 326\ m/s^2$

$\Sigma F = 33N$

$F = m \cdot a = 0.1 \cdot 326 = 33$ N
$\Sigma F = F_N - F_g$ $33 N = F_N - (0.1)(9.8)$ $F_N = 34$ N

14. a) $J = F \cdot t = (12000)(0.0007) = 8.4\ N \cdot s$
b) Area of the rectangle = impulse
c) Graphs have area in common   d) Negative impulse
e) $-8.4 = (0.145)(32) + (0.145)V_f$ $V_f =$

15. a) $p = m \cdot v$ so find this for each car
b) Impulse needed to stop them = Δmomentum (same ranking)
c) Can't determine the force needed because we don't know the braking times

Mastering Physics - Intro to Momentum (Page 1)

16. a) Initial momentum = 0 (not moving)
b) Equal to = third law pairs   c) -500 kg m/s (conservation of momentum

17. a) $J = p_f - p_i$ $J = (80)(16) - 0 = 1280$
$J = \text{Force} \cdot \text{Time}$ $1280 = 16{,}000 \cdot \text{Time}$ $t = 0.08\ s$
b) $V_i = 16\ \frac{m}{s}$ $V_f = 0\ \frac{m}{s}$ $\Delta t = 0.08\ s$ $\Delta x = ?$
$\Delta x = \left(\frac{V_i + V_f}{2}\right)\Delta t = \left(\frac{16}{2}\right)(0.08)$ $\Delta x = 0.64\ m$

18. Equal masses → Final velocity is halfway between initial velocities

19. Speed of the wagon doesn't change (no external force)

110. Momentum is constant and force of air on balloon = balloon on air

111. $P_A > P_B$ because A takes a longer time so the force is exerted over a longer period

112. A finger exerts a smaller force but over a longer time interval

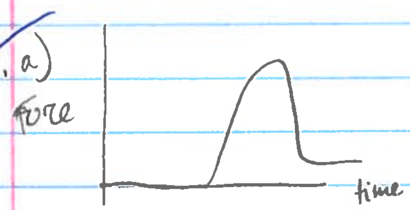
113. Momentum is constant in an isolated system

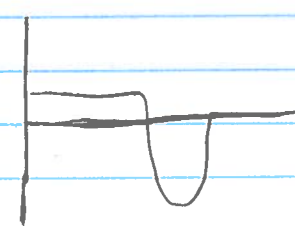
114. Freely falling metal ball when the ball is the system has increasing momentum

115. Retractable bumper because it increases the time of impact

116. Tennis ball hits the racket and travels in the other direction

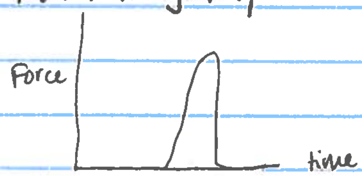
117. Greatest change in speed when the ball bounces off in the other direction

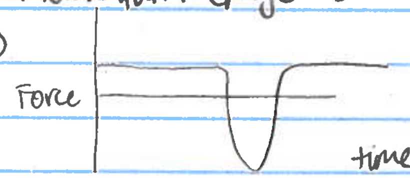
118. a)


b)


Kathleen Boyce
Period Blue

Mastering Physics - Intro to Momentum (Page 2)

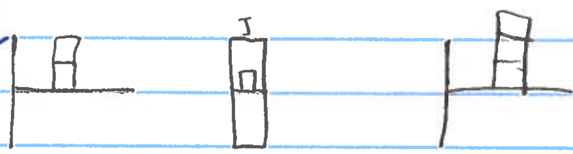
19. a) 

b) 

20. Momentum is proportional to the mass, momentum in an isolated system is conserved, momentum is a vector, change in momentum is impulse, change in momentum is proportional to the external force

21. Woodpeckers smack their beaks (not head) against the trees

22. Closed, decrease, total momentum of the closed system, external

23. 

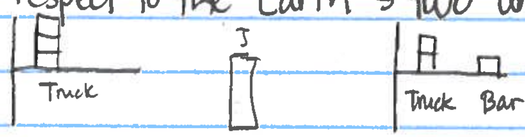
24. Positive, negative, zero

25. A ball that rebounds off the wall has a greater Δp

26. Wall exerts a greater force on the ball that bounces off

27. an isolated, Newton's laws

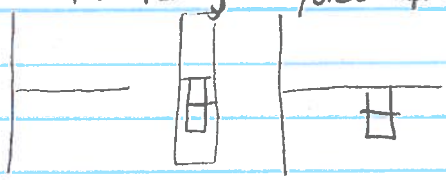
28. a) Bar has 0 horizontal velocity with respect to the truck or with respect to the Earth → two answers

b) 

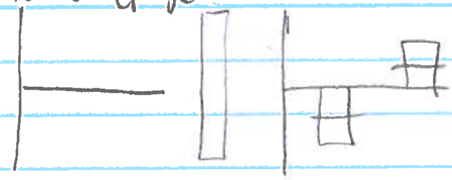
c) Horizontal momentum of the whole system doesn't change, but that consists of the truck and the bar now, so the momentum of the truck decreases

Mastering Physics - Intro to Momentum (page 2)

B29. a)

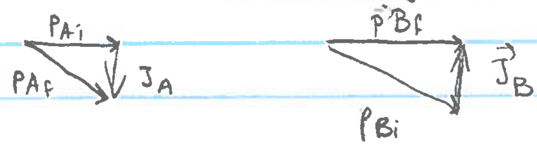


b)



B30. a) $2p_i = p_f$ Direction changes going into and out of the incline

b)



B31. Same momentum $p = m \cdot v$

B32. $(m)(\frac{1}{2}v) + (m)(v) = (m)(0.75v)$

B33. Impulse = Area under Force vs. time

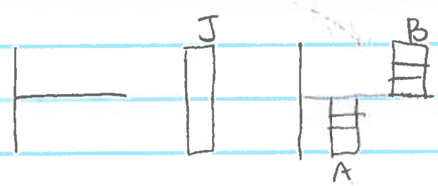
B34. Total momentum of an isolated system is constant, vector sum of forces acting on a particle equals the rate of change of momentum of the particle with respect to time, total momentum is the vector sum

B35. Impulse is the same (same change in velocity)

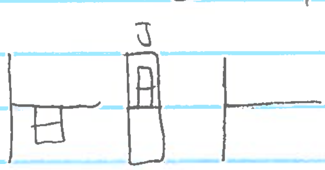
B36. Ball experiences a greater change.

B37. a)

b)



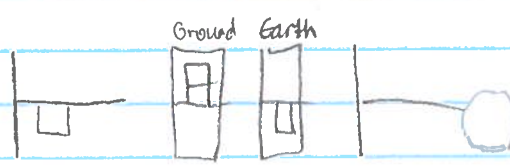
B38. a)



b) $J_{N \text{ on } B} = mv$

B39. a)

b)

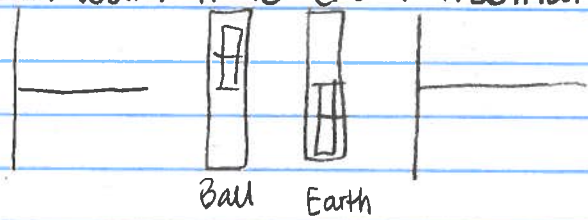


Kathleen Boyce
Period Blue

Mastering Physics - Intro to Momentum (Page 3)

40. a) Cart won't move (no horizontal impulse)

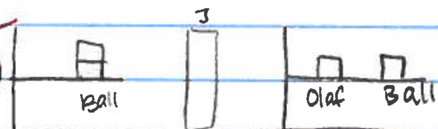
b)



41. $a = \frac{V_{gas}}{m} \cdot \frac{\Delta m}{\Delta t}$ $\quad \Delta m = m/160$, $\Delta t = 1$

$a = \frac{V_{gas}}{m} \cdot \frac{m}{160} \Rightarrow 16 = \frac{V_{gas}}{160}$ $\quad V_{gas} = 2560$ m/s $= \boxed{2.56 \text{ km/s}}$

42. a)



$m_{Ball} V_{Ball} = (m_{Ball} + M_{olaf}) V_{Ball/olaf}$

$(0.400)(10.5) = (69 + 0.4)\, V_{Ball/olaf}$

$\boxed{V_{Ball/olaf} = 0.061 \frac{m}{s}}$

b)

$m_{Ball} v_{Ball} = m_{Ball} V_{Ball} + M_{olaf} V_{olaf}$

$(0.4)(10.5) = (0.4)(-8.1) + (69)\, V_{olaf}$

$\boxed{V_{olaf} = 0.108 \text{ m/s}}$

43. a) $p = mv = (0.057)(36) = 21 \text{ kg}\frac{m}{s}$

b) $p = mv \quad 2.1 = 0.32\, V \quad \boxed{V = 6.4 \frac{m}{s}}$

c)

$M_{you} V_{you} - m_{Ball} V_{Ball}$

$(60)(4) - (0.057)(36) = \boxed{237.9 \text{ kg}\frac{m}{s}}$

44. $m = 95\text{g} = 0.095 \text{ kg} \quad V_i = 0 \frac{m}{s} \quad V_f = 1.2 \frac{m}{s}$

$p_i = (0.095)(0) = 0 \quad p_f = (0.095)(1.2) = 0.114 \text{ kg}\frac{m}{s}$

$J = 0.114 \text{ kg}\frac{m}{s}$

$J = F \cdot \Delta t \quad t = 0.14\text{s}$

$0.114 = F \cdot 0.14 \quad \boxed{F = 0.814 \text{ N}}$

Kathleen Boyce
Period Blue

Mastering Physics - Intro to Momentum (page 3)

45. $m = 63\ kg$ $\quad V_i = -30\ \frac{m}{s}$ $\quad V_f = 0\ \frac{m}{s}$

$p_i = (63)(-30) = -1890$ $\quad p_f = 0$ $\quad J = 1890$

$J = Force \cdot \Delta t$ $\quad \Delta x = 0.50\ m$

$\Delta x = \left(\frac{V_i + V_f}{2}\right)\Delta t$ $\quad 0.5 = \left(\frac{-30}{2}\right)\Delta t$ $\quad \Delta t = 0.0333$

$1890 = Force \cdot 0.0333$

$F = 56700\ N$

46. $V_i = -20\ \frac{m}{s}$ $\quad V_f = 0\ \frac{m}{s}$ $\quad m = 55\ kg$ $\quad F = 8000\ N$ $\quad \Delta x = ?$

$p_i = (55)(-20) = -1100\ kg\frac{m}{s}$ $\quad p_f = 0$ $\quad J = 1100\ kg\frac{m}{s}$

$J = F \cdot \Delta t$ $\quad 1100 = 8000 \cdot \Delta t$ $\quad \Delta t = 0.1375\ s$

$\Delta x = \left(\frac{V_i + V_f}{2}\right)\Delta t$

$\Delta x = \left(\frac{-20}{2}\right)(0.1375)$ $\quad \Delta x = 1.375\ m$