8. Mass M_1 moving with a speed v_i collides with stationary mass M_2. After the collision, the masses are interlocked and moving with a speed of $v_i/3$. Which equation below correctly describes the relationship between M_1 and M_2?

A. $M_2 = 2M_1$ B. $M_1 = 2M_2$ C. $M_2 = 3M_1$ D. $M_1 = 3M_2$

9. A ball moving to the left strikes a wall at a speed of 4 m/s and rebounds to the right at a speed of 2 m/s. What is the change in velocity Δv of the ball?

A. 0 m/s B. 2 m/s C. 4 m/s D. 6 m/s E. 8 m/s

10. A 1,200-kilogram car traveling at 10.0 meters per second hits a tree and is brought to rest in 0.10 second. What is the magnitude of the average force acting on the car to bring it to rest?

A. 1.2×10^2 N
B. 1.2×10^3 N
C. 1.2×10^4 N
D. 1.2×10^5 N
E. 1.2×10^6 N

Multiple Choice Answers:

1. D	2. D	3. A	4. B	5. C
6. A	7. C	8. A	9. D	10. D

Problems:

1. Calculate the momentum of a 2250-kg elephant charging a hunter at a speed of 7.00 m/s.

$p = mv = 2250\,kg(7.00\,m/s) =$ 15,800 kg m/s

2. A hockey puck has a mass of 0.122 kg and is at rest. A hockey player makes a shot, exerting a constant force of 25.0 N on the puck for 0.180 s. With what speed does the puck head toward the goal?

$F\Delta t = \Delta p = m\Delta v$

$(25.0N)(0.180s) = 0.122kg(\Delta v)$

$\Delta v = 36.9\,m/s = v_{final} - v_{initial} \Rightarrow v_{final} = 36.9\,m/s$

3. How long must a 12.0 N force be applied to a 4.00 kg block sitting at rest on a frictionless surface to increase its velocity to 4.40 m/s?

$\Delta v = 4.40\,m/s$

$F\Delta t = m\Delta v$

$12.0N(t) = 4kg(4.40\,m/s)$

$t = 1.47s$

4. A 65.0-g arrow leaves a bowstring at a velocity of 54 m/s.

A. What is the impulse on the arrow?

$$\text{Impulse} = m\Delta v = (0.065\text{kg})(54\text{m/s})$$
$$= 3.51\text{kg m/s}$$

B. What is the average force that the string exerts on the arrow if the string is in contact with the arrow for 9.0×10^{-3} s?

$$\text{Impulse} = F\Delta t$$
$$F(9.0\times10^{-3}\text{s}) = 3.51\text{kg m/s}$$
$$F = 390\text{N}$$

5. A 1.90-kg falcon catches a 0.600-kg dove from behind in midair. What is their velocity after impact if the falcon's velocity is initially 26.0 m/s and the dove's velocity is 6.00 m/s in the same direction?

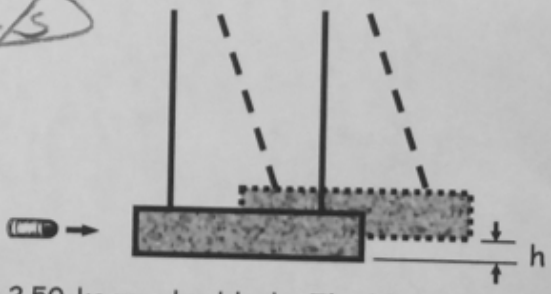
A = Falcon
B = Dove

$$P_A + P_B = P_A' + P_B'$$

Same velocity after collision

$$(1.90\text{kg})(26.0\text{m/s}) + (0.600\text{kg})(6.00\text{m/s}) = 1.9\text{kg}(v') + 0.6\text{kg}(v')$$
$$53\text{kg m/s} = 2.5\text{kg}(v')$$
$$v' = 21.2\text{m/s}$$

BONUS: A ballistic pendulum was used to measure the speed of bullets before electronic timing devices were developed.



Suppose a 14.0-g bullet is fired and imbeds in a 2.50-kg wooden block. The block and bullet then swing up to a maximum height of 18.0 cm above the starting position. Find the initial velocity of the bullet.

$$PE_{\text{after swing}} = mgh = 2.514\text{kg}(9.8\text{m/s}^2)(0.18\text{m})$$
$$= 4.44\text{J}$$

$$KE_{\text{before swing}} = 4.44\text{J} = \tfrac{1}{2}(2.514\text{kg})v^2$$

$$v_{\text{before swing}} = \sqrt{\frac{4.44\text{J}(2)}{2.514\text{kg}}} = 1.88\text{m/s}$$

$$P_{\text{before swing}} = 1.88\text{m/s}(2.514\text{kg}) = 4.73\text{kg m/s}$$

$$P_{\text{before swing}} = 4.73\text{kg m/s} = 0.014\text{kg}(v_{\text{bullet}})$$
$$v_{\text{bullet}} = 339\text{m/s}$$