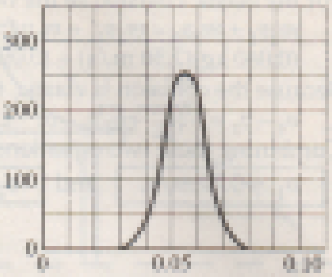
19. (a) The impulse is the area under the F vs. t curve.
The value of each block on the graph is
$1 \text{ block} = (50 \text{ N})(0.01 \text{ s}) = 0.50 \text{ N·s}$.
We estimate there are 10 blocks under the curve,
so the impulse is
$\text{Impulse} = (10 \text{ blocks})(0.50 \text{ N·s/block})$ $\boxed{= 5.0 \text{ N·s}.}$



(b) We find the final velocity of the ball from
$\text{Impulse} = \Delta p = m\,\Delta v$;
$5.0 \text{ N·s} = (0.060 \text{ kg})(v - 0)$, which gives $v =$ $\boxed{83 \text{ m/s}.}$

20. The maximum force that each leg can exert without breaking is
$(170 \times 10^6 \text{ N/m}^2)(2.5 \times 10^{-4} \text{ m}^2) = 4.25 \times 10^4 \text{ N}$,
so, if there is an even landing with both feet, the maximum force allowed on the body is 8.50×10^4 N.
We use the work-energy principle for the fall to find the landing speed:
$0 = \Delta KE + \Delta PE$;
$0 = \frac{1}{2}mv_{land}^2 - 0 + (0 - mgh_{max})$, or $v_{land}^2 = 2gh_{max}$.
The impulse from the maximum force changes the momentum on landing. If we take down as the positive direction and assume the landing lasts for a time t, we have
$-F_{max}t = m\,\Delta v = m(0 - v_{land})$, or $t = mv_{land}/F_{max}$.
We have assumed a constant force, so the acceleration will be constant. For the landing we have
$y = v_{land}t + \frac{1}{2}at^2 = v_{land}(mv_{land}/F_{max}) + \frac{1}{2}(-F_{max}/m)(mv_{land}/F_{max})^2 = \frac{1}{2}mv_{land}^2/F_{max} = mgh_{max}/F_{max}$;
$0.60 \text{ m} = (75 \text{ kg})(9.80 \text{ m/s}^2)h_{max}/(8.50 \times 10^4 \text{ N})$, which gives $h_{max} =$ $\boxed{69 \text{ m}.}$

21. For the elastic collision of the two balls, we use momentum conservation:
$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$;
$(0.440 \text{ kg})(3.70 \text{ m/s}) + (0.220 \text{ kg})(0) = (0.440 \text{ kg})v_1' + (0.220 \text{ kg})v_2'$.
Because the collision is elastic, the relative speed does not change:
$v_1 - v_2 = -(v_1' - v_2')$, or $3.70 \text{ m/s} - 0 = v_2' - v_1'$.
Combining these two equations, we get
$\boxed{v_1' = 1.23 \text{ m/s},}$ and $\boxed{v_2' = 4.93 \text{ m/s}.}$

22. For the elastic collision of the two pucks, we use momentum conservation:
$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$;
$(0.450 \text{ kg})(3.00 \text{ m/s}) + (0.900 \text{ kg})(0) = (0.450 \text{ kg})v_1' + (0.900 \text{ kg})v_2'$.
Because the collision is elastic, the relative speed does not change:
$v_1 - v_2 = -(v_1' - v_2')$, or $3.00 \text{ m/s} - 0 = v_2' - v_1'$.
Combining these two equations, we get
$\boxed{v_1' = -1.00 \text{ m/s (rebound)},}$ and $\boxed{v_2' = 2.00 \text{ m/s}.}$

23. For the elastic collision of the two billiard balls, we use momentum conservation:
$m_1v_1 + m_2v_2 = m_1v_1' + m_2v_2'$;
$m(2.00 \text{ m/s}) + m(-3.00 \text{ m/s}) = mv_1' + mv_2'$.
Because the collision is elastic, the relative speed does not change:
$v_1 - v_2 = -(v_1' - v_2')$, or $2.00 \text{ m/s} - (-3.00 \text{ m/s}) = v_2' - v_1'$.
Combining these two equations, we get
$\boxed{v_1' = -3.00 \text{ m/s (rebound)},}$ and $\boxed{v_2' = 2.00 \text{ m/s}.}$
Note that the two billiard balls exchange velocities.