Question #58107, Physics – Mechanics | Relativity

12 How large an average force is required to stop a 1400-kg car in 5.0 s if the crate's initial speed is 25 m/s?
2000 N
3500 N
9000 N
7000 N

Solution:
Average force required to stop the car:
$F = ma$;
where *m* is the car's mass, and *a* is the required acceleration.
$a = \frac{V_0 - V_f}{\Delta t}$;
where V_0 is the car's initial speed, V_f is the car's final speed, and Δt is the time interval.
Since $V_f = 0$, thus:
$a = \frac{V_0}{\Delta t}$;
$F = \frac{mV_0}{\Delta t}$;
$F = \frac{1400 \times 25}{5} = 7000\ \text{N}$
Answer: 7000 N

13 A 10-g bullet of unknown speed is shot horizontally into a 2-kg block of wood suspended from the ceiling by a cord. The bullet hits the block and becomes lodged in it. After the collision, the block and the bullet swing to a height 30cm above the original position. What was the speed of the bullet? (This device is called the ballistic pendulum). Take g=9.8ms−2
487 m/s
640 m/s
354 m/s
700 m/s

Solution:
When the bullet hits the block, its momentum is transferred to the block. So, the block and the bullet in it reach obtain speed and therefore kinetic energy, which allows them to reach the height of 30 cm above original position.
1. When the bullet hits the block, conservation of momentum takes place:
$m_b v_0 = (m_b + m_{bl})v$;
$v_0 = \frac{(m_b + m_{bl})v}{m_b}$
2. When the block starts moving with the bullet inside, energy conservation takes place. The kinetic energy of block & bullet is transformed to potential energy, as they reach the given height:

$\Delta E_k = \Delta PE$;

$\Delta E_k = \frac{(m_b + m_{bl})v^2}{2}$;

$\Delta PE_b = (m_b + m_{bl})g\Delta h$;

$\frac{(m_b + m_{bl})v^2}{2} = (m_b + m_{bl})g\Delta h$;

$v = \sqrt{2g\Delta h}$;

$v_0 = \frac{(m_b + m_{bl})\sqrt{2g\Delta h}}{m_b} = 487.4$ m/s

Answer: 487 m/s