① Given,

$s = 400m$

$t = 20s$

$u = 0$

So,

$s = ut + \frac{1}{2}at^2$

$\therefore 400 = 0(20) + \frac{1}{2}(a)(400) = 2ms^{-2}$

$\therefore a = 2ms^{-2}$

$F = ma$

Mass of truck $= 7000kg$

$F = 7000 \times 2 = 14000 kgms^{-2} = 14000N$

② Given,

$m = 1kg$

$u = 20 m/s$

$v = 0$

$s = 50m$

So, $a =$,

$(v^2 - u^2) = 2as$

$a = \frac{(v^2 - u^2)}{2s}$

$a = \frac{0 - 400}{100} = -4m/s^2$

$\because F = ma$

$F = 1kg \times -4 m/s = -4N$

So, the frictional force acting on the stone has a magnitude of 4N.

(3)(a) Given,

$F = 40{,}000\,N$

Frictional force $= -5000\,N$

$\therefore$ Sum of all forces $= 40{,}000\,N + (-5000\,N) = 35000\,N$

(b) Total (m) of train = (m) of engine + (m) of each wagon

$= 8000\,kg + 5 \times 2000\,kg = 18000\,kg$

$\therefore F = ma \; (or\; a = F/m)$

$\therefore$ (a) of train $= 35000/18000 = 1.944\,m/s^2$

(4) (m) of vehicle $= 1500\,kg$

$a = -1.7\,m/s^2$

$\therefore F = ma$

$F = 1500\,kg \times -1.7\,m/s^2 = -2550\,N$

(5) Since the truck has a very high mass, the static friction between the road & the truck is high. When pushing the truck with a small force, the frictional force cancels out the applied force & the truck doesn't move. This implies that the two forces are equal in magnitude but opposite in direction. Therefore the students logic is correct.

⑥ Given,

$m = 200g$

$u = 10m/s$

$v = -5m/s$

$mu = 200g \times 10m/s = 2000gm/s$

$mv = 200g \times -5m/s = -1000gm/s$

$\therefore$ change in momentum $(mv - mu) = (-1000 - 2000)gm/s$

$= -3000gm/s$

This implies that the momentum of the ball reduces by $1000gm/s$ after being struck by the hockey stick.

⑦ Given,

$m = 10$

$u = 150m/s$

$v = 0$

$t = 0.03s$

$a = \frac{v-u}{t}$

$= \left(\frac{0-150}{0.03}\right) m/s^2$

$= -5000\ m/s^2$

Distance of penetration $(s) = s = \frac{v^2-u^2}{2a} = \frac{0^2-(150)^2}{2(-5000)} m$

$= 2.25m$

$\therefore F = ma$

$F = 0.01kg \times (-5000\ m/s^2)$

$= -50N$

(8) Given,

$m_1 = 1kg$

$m_2 = 5kg$

$u_1 = 10m/s$

$u_2 = 0$

Mass of resulting object $= m_1 + m_2 = 6kg$

(v) of resulting object = ?

Total momentum before collision $= m_1u_1 + m_2u_2 = 1(kg) \times (10m/s) + 0$

$= 10kg\,m/s$

Now, $(m_1+m_2) \times v = 10kg\,m/s$

$\therefore v = \frac{10kg\,m/s}{6kg} = 1.66m/s$