Q- Q- A man claims that as long as he has his seat belt on, he can hold on to a 12.0kg child in a 60.0 mi/h head on collision with a brick wall in which the car passenger compartment comes to a stop in 0.050 s. Is his claim true? Explain why he will experience a violent force during the collision, tearing the child from his arms. Evaluate the size of this force.

v = 60 mi/h = 60*0.4470 = 26.82 m/s
m = 12.0 kg
Δt = 0.050 s

According to Newton's second law of motion force acting on a body is equal to rate of change of momentum.

Initial momentum of the child = m*v = 12.0*26.82 = 321.84 kg m/s

Final momentum of the chilled if stopped = m*0 = 0

Change in momentum ΔP= 0 - 321.84 kg m/s

Force required to produce this change in time ΔT = 0.050 s is given by Newton's second law as

$$F = \frac{\Delta P}{\Delta t} = \frac{-321.84}{0.050} = -6436.8\,\text{N}$$

As the belt attaches the man with the car compartment and will come to rest with it. The force required to stop him is applied by the belt. The child is in the hands of the man and the force required to stop the child is to be applied by the man. The force in backward direction required to stop the child in the same time is as calculated above is 6436.8 N which is equal to the weight of a 6436.8/9.8 = 656.8 Kg mass. Can a man apply a force which is equal to weight of 656 kg? The answer will be in no and hence the man will not be able to hold the child during collision.

As the force is equal to rate of change of momentum or the change in momentum in one second and the time interval is very small the required force will be violently large. That is why whenever the bodies stop in small interval it requires a large force and hence the reactions forces are also too large.