Impulse & Momentum – 3 – Tutorial

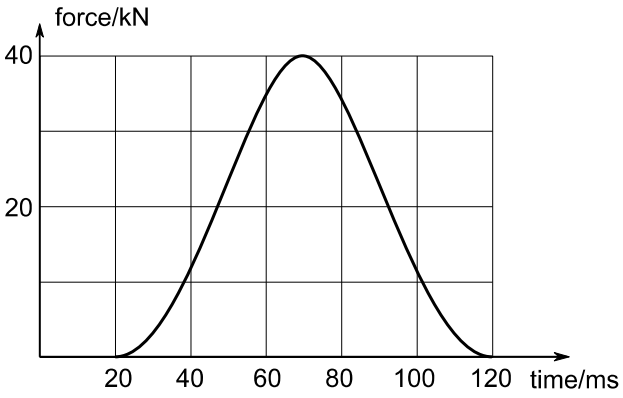
1. A German V-2 rocket of the 1939-45 war had a mass of 4000 kg with a further 8000 kg of fuel.
Fuel was burnt at a rate of 135 kg per second and the combustion products were ejected backwards at a speed of 2000 m/s relative to the rocket.

Calculate:

(i) the resultant force acting on the rocket, *(270 kN)*

(ii) the initial acceleration when launched. *(22.5 m/s^2)*

2. The graph shows the force exerted on a car driver, mass 80kg, by the seat belt during a crash.



The area under a force-time graph gives the change of momentum ($F\Delta t = \Delta mv$), just as the area under a velocity-time graph gives displacement. ($v\Delta t = \Delta s$)

Estimate:

(i) the change of momentum of the driver, *(2000 kgm/s)*

(ii) the speed of the car before the crash. *(25 m/s)*

3. Calculate the acceleration of a 5000 kg rocket taking off from the surface of the Moon, where the acceleration due to gravity is 1.6 m/s^2, if the rocket expels 8.00 kg of gas per second at an exhaust velocity of 2.20×10^3 m/s. *(1.92 m/s^2)*