Overtaking a truck

(Example 10.17)

Your 1500 kg car is behind a truck travelling at 90 km h^{-1} (= 25 m s^{-1}). To pass it, you speed up to 120 km h^{-1} (33 m s^{-1}) in 6.0 s.

What engine power is required to do this?

Solution: The initial kinetic energy of your car is

$K_i = \frac{1}{2}mv_i^2 = 0.5 \times 1500 \times (25)^2 = 4.79 \times 10^5$ J

The final KE, after you speed up, is

$K_f = \frac{1}{2}mv_f^2 = 0.5 \times 1500 \times (33)^2 = 8.17 \times 10^5$ J

So the work done by the engine is

$W = \Delta K = 8.17 \times 10^5 - 4.79 \times 10^5$ J $= 3.5 \times 10^5$ J

To transform this amount of energy in 6.0 s, the power required is

$P = W / \Delta t = 3.5 \times 10^5$ J / 6 s $= 58 \times 10^3$ W = 58 kW

A typical car has an engine power of ~ 90 kW, but a small car might have only a ~50 kW engine. Given that at that speed you need 10–15 kW of engine power just to maintain a constant speed (to overcome air + road resistance), the small car will not have enough power to overtake the truck in that time.