

## Momentum & Rockets

A rocket of mass  $10^6\text{kg}$  ejects matter at a relative speed of  $4000\text{ms}^{-1}$ .

It loses mass at a constant rate of  $5 \times 10^3 \text{ kgs}^{-1}$ .

Throughout the questions, assume that  $g$  is always  $10\text{N/kg}$ , and ignore air resistance. Neither of these assumptions is realistic, but it makes life easier...

1. Calculate the thrust of the rocket.
2. Draw a free body diagram for the rocket after it has just left the launchpad.
3. Calculate the initial acceleration of the rocket.
4. Calculate the acceleration of the rocket after 10 seconds have elapsed.

5. All the fuel is used up after 80 seconds. Calculate the acceleration of the rocket just before it runs out of fuel, and just after it runs out of fuel.
6. Sketch a graph of acceleration vs time from 0 to 80 seconds.
7. Consider what velocity-time and displacement-time graphs might look like.