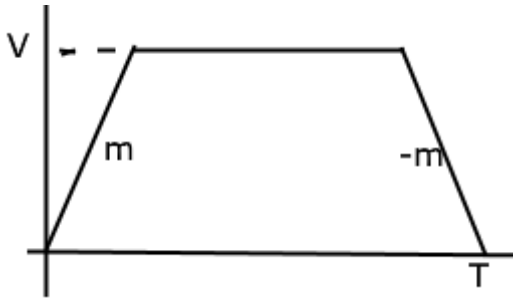
Section 2: Velocity and acceleration

Exercise level 3 (Extension)

1. A car manufacturer claims that his latest model can accelerate from a standing start on level ground to 100 km h^{-1} in 8 seconds. What average acceleration does this represent?
   A second manufacturer claims a standing start to 60 km h^{-1} under the same conditions in 3 seconds. What average acceleration does this represent?
   Do you consider one car superior to the other on the basis of those claims – and why?
   Later it turns out that those claims apply to exactly the same car. Taking them as legitimate, what average acceleration would you claim for acceleration for that model from 60 km h^{-1} to 100 km h^{-1} (under similar ideal conditions)?

2. A designer is testing a new motorcycle's performance. He notes that he can reach 100 km h^{-1} from a standing start on a test track in 8 seconds. He has to log his results, so he writes that down as an acceleration of 12.5 kilometres per hour per second.
   (i) Explain how he reached that conclusion.
   (ii) Is 12.5 kilometres per hour per second the same acceleration as 12.5 kilometres per second per hour? Explain your answer.

3. 

   The velocity-time graph of a hovercraft is modelled as shown in the figure: the hovercraft accelerates uniformly at m kmh^{-2} for an initial period, then travels at a constant speed V kmh^{-1}, and finally decelerates uniformly at m km h^{-2}. The distance covered in that time is D km and the total time taken is T h.

   (i) If the time taken by acceleration and deceleration is $\frac{1}{6}T$ h in each case, find an equation which relates D, T and m.

   (ii) If the hovercraft is running behind schedule and needs to reduce T to $\frac{7}{9}T$, the only way of achieving this is to increase the value of V while the acceleration and deceleration may not be changed, so what time (in terms of T) should now be spent accelerating?

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4. A competitor in a marathon race of $42\frac{3}{8}$ km runs the first t hours of the race at a constant speed of 13 km h^{-1}, and the remainder at a constant speed of $14+\frac{2t}{3}$ km h^{-1}.

   The speed of another competitor decreases linearly with respect to time from 16 km h^{-1} at the start of the race. If both of these competitors have a run time of 3 hours, find the maximum distance between them at any stage of the race.
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