**8A Modelling with First Order Differentials**

1. A particle $P$ starts from rest at a given point $O$ and moves along a straight line. At time $t$ seconds, the acceleration, $a ms^{-2}$, of $P$ is given by:

$$a=\frac{6}{\left(t-2\right)^{2}},t\geq 0$$

1. Find the velocity of $P$ at time $t$ seconds
2. Show that the displacement of $P$ from $O$ when $t=6$ is given by $\left(18-12ln2\right) m$
3. A particle $P$ is travelling along a straight line. At time t seconds, the acceleration of the particle is given by:

$$a=t+\frac{3}{t}v, t\geq 0$$

Given that $v=0$ when $t=2$, show that the velocity of the particle at time t is given by the equation:

$$v=ct^{3}-t^{2}$$

where $c$ is a constant to be found.

1. A storage tank initially contains 1000 litres of pure water. Liquid is removed from the tank at a constant rate of 30 litres per hour and a chemical solution is added at a constant rate of 40 litres per hour. The chemical solution contains 4 grams of copper sulphate per litre of water.
2. Given that there are $x$ grams of copper sulphate in the tank after $t$ hours and that the copper sulphate immediately disperses throughout the tank upon entry, show that the situation can be modelled by the differential equation:

$$\frac{dx}{dt}=160-\frac{3x}{100+t}, t\geq 0$$

1. Hence, find the number of grams of copper sulphate in the tank after 6 hours.
2. Suggest a possible refinement for the model