Topic 21: Exercises on Resisted Motion
Level 1

1. A particle of mass m falls from rest under gravity and the resistance to its motion is mkv^2, where v is its speed and k is a positive constant. Show that $v^2 = \frac{g}{k}\left(1 - e^{-2kx}\right)$, where x is the distance fallen.

2. A particle of mass m is projected vertically upward under gravity in a medium in which the resistance is mk times the square of the speed, where k is a positive constant. The speed of projection is V. Find the maximum height.

$$\frac{1}{2k}\ln\left|1+\frac{k}{g}V^2\right|$$

3. A particle of mass $0.5\ kg$ is released from rest and moves vertically downward under gravity in a medium which exerts a resistance to the motion of $\frac{1}{10}v^2$. At time t after release it has fallen a distance x and has velocity v. Taking $g = 10\ ms^{-2}$, show that $v^2 = 50\left(1 - e^{-0.4x}\right)$ and $\ddot{x} = 10e^{-0.4x}$.

4. A particle of mass $1\ kg$ is projected vertically upward under gravity with speed $2c$ in a medium in which the resistance to motion is $\frac{g}{c^2}$ times the square of the speed, where c is a positive constant. Find the time of ascent of the particle and the maximum height.

$$\frac{c\cdot\tan^{-1}2}{g};\ \frac{c^2}{2g}\ln 5$$

5.