1. A particle moves in a straight line such that its velocity \(v\) is given by
\[v^2 = \mu \left(\frac{a}{x} - 1\right),\]
where \(x\) is the distance from a fixed point. The acceleration is
(i) \(\propto \frac{1}{x}\) and away from the fixed point,
(ii) \(\propto -\frac{1}{x}\) and towards the fixed point,
(iii) \(\propto \frac{1}{x^2}\) and away from the fixed point,
(iv) \(\propto -\frac{1}{x^2}\) and towards the fixed point.

2. If \(x = 30t - 2t^2\), where \(x\) is the distance in cm. and \(t\) is the time in seconds, then the average velocity from \(t = 5\) sec to \(t = 5.01\) sec will be
(i) 8.00 cm/s
(ii) 9.00 cm/s
(iii) 9.98 cm/s
(iv) 0 cm/s.

3. A particle is moving in a straight line subject to a resistance which produces a deceleration of \(kv^3\), where \(v\) is the velocity and \(k\) is a constant. The velocity \(v\) is (in terms of distance \(x\))
(i) \(\frac{m}{m+kxu}\)
(ii) \(\frac{mk}{m+kxu}\)
(iii) \(\frac{mz}{m+kxu}\)
(iv) \(\frac{1}{1+kxu}\).

4. A particle is moving once around a circle \(C\) in the \(xy\)-plane. If the circle has centre at origin and radius 3 and if force field is given by
\[\vec{F} = (2x - y + z)\hat{i} + (x + y - z^2)\hat{j} + (3x - 2y + 4z)\hat{k},\]
The work done by the particle will be
(i) 0
(ii) \(\pi\)
(iii) \(18\pi\)
(iv) \(\frac{\pi}{2}\)

5. If \(\vec{F} = (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}\) is a conservative force field.
The potential function \(V(x, y, z)\) can be written as
6. A particle of mass 2 moves in the \(xy\)-plane under the influence of a force field having potential \(V = x^2 + y^2\). The particle starts at a time \(t = 0\) from rest at the point \((2,1)\). The values of \(x(t)\) and \(y(t)\) will be
   (i) \(cost\) and \(2cost\)
   (ii) \(2cost\) and \(sint\)
   (iii) \(cost\) and \(2sint\)
   (iv) \(2cost\) and \(cost\).

7. A particle is attracted towards a fixed point with a force \(F(x) \propto \frac{1}{x^3}\), where \(x\) is the distance from the fixed point. Find an expression for the work done for a displacement of \(a\) to \(b\) \((a < b)\). The P.E. gained by the particle is
   (i) \(-\frac{1}{2}\mu[\frac{1}{a^2} - \frac{1}{b^2}]\)
   (ii) \(-\frac{1}{2}\mu[\frac{1}{a^2} - \frac{1}{b^2}]\)
   (iii) \(-\frac{1}{2}\mu[\frac{1}{a^2} + \frac{1}{b^2}]\)
   (iv) \(\frac{1}{2}\mu[\frac{1}{a^2} + \frac{1}{b^2}]\)

8. A particle is thrown upward with speed \(V\). If the air resistance be assumed to vary as the square of the speed and to equal gravitational pull at a speed \(U\) (i.e. at the point where the net force on the particle is zero), the particle will rise for a time
   (i) \(t_f = (\frac{U}{g})\tan^{-1}(\frac{V}{U})\)
   (ii) \(t_f = (\frac{V}{g})\tan^{-1}(\frac{V}{U})\)
   (iii) \(t_f = (\frac{U}{g})\tan^{-1}(\frac{V}{U})\)
   (iv) \(t_f = (\frac{g}{U})\tan^{-1}(\frac{V}{U})\)

9. A steel ball \((\rho = 7.8 \times 10^3 \text{ kg/m}^3)\) of radius \(r = 2 \text{ mm}\) is falling through glycerine \((\eta = 0.83 \text{ Pa.s, } \sigma = 1.2 \times 10^3 \text{ kg/m}^3)\). Its terminal velocity will be
   (i) \(0.01 \text{ m/s}\)
   (ii) \(0.05 \text{ m/s}\)
   (iii) \(0.07 \text{ m/s}\)
   (iv) \(1.00 \text{ m/s}\)

10. A particle is projected vertically upward with initial speed equal to \(tana\) times the terminal speed, the resistance being proportional to the square of the speed. The particle hits the ground with speed
    (i) \(tana\) times the terminal speed
(ii) $\sin \alpha$ times the terminal speed
(iii) $\cos \alpha$ times the terminal speed
(iv) zero.

End