

Word Problems - Answer Key

Translate each statement into a differential equation. Specify the variables.

- The population of Shmoopsville is increasing at a rate 0.231.
 $P(t)$: population, t : time; $\frac{dp}{dt} = 0.231P$.
- Mary is driving at a speed of 55 mph.
 $d(t)$: distance, t : time; $d'(t) = 55$.
- The temperature (T) of a cup of coffee decreases at a rate proportional to the difference between the ambient temperature (A) and that of the cup.
 $\frac{dT}{dt} = k(T - A)$
- Gas is being pumped into a spherical balloon at a rate $5\text{cm}^3/\text{min}$. $r(t)$: the radius of the spherical balloon at time t ;
 $5 = \frac{4\pi}{3} \frac{d(r^3)}{dt} \implies r^2 \frac{dr}{dt} = \frac{5}{4\pi}$.
- The rate at which perfume is evaporating from an open bottle is inversely proportional to the square root of the volume remaining.
 $V(t)$: Volume of the perfume; $\frac{dV}{dt} = \frac{k}{\sqrt{V(t)}}$.
- The rate at which a radioactive element decays is proportional to the quantity.
 $N(t)$: quantity of radioactive element at time t , $\frac{dN}{dt} = -kN$.
- A rumor spreads through Shmoopsville with population P , at a rate proportional to the number of people who have not heard the rumor.
 $N(t)$: the number of people who have heard the rumor at time t . $\frac{dN}{dt} = k(P - N)$.
- The weight change of a cell, shaped like a cube, is proportional to the area of its surface. Note that weight is proportional to volume.
 $W(t)$: the weight of the cell at time t .
 $\frac{dW}{dt} = kW^{2/3}$.
- Ben throws a ball straight upward from a height 10ft with an initial velocity 25ft/s. Note that gravitational force is 32 ft/s^2 .
 $s(t)$: distance of the ball from the ground at time t ; $\frac{d^2s}{dt^2} = -32$, $s'(0) = 25$, $s(0) = 10$.
- A population of bugs grows at a rate of 9%. Due to the effect of pesticide 100 bugs die in 2 hours.
Let $p(t)$: be the number of bugs at time t . $\frac{dp}{dt} = 0.09p - 50$ bugs per hour.

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