

12. What uniform acceleration is needed to increase the speed of an automobile from rest (0 mph) to 60 mph in a distance of 440 ft?
 HINT: First obtain the speeds in feet per second.
- *13. A bullet buries itself 9 in. into a tree in 0.01 sec. Assuming that the deceleration of the bullet was constant and that the bullet came to rest in the indicated time, find the speed of the bullet at the moment of impact.
14. With what approximate speed would a projectile need to be hurled to just reach the top of the Empire State Building, which is 1,250 ft high?
15. A long inclined plane is constructed in such a manner that objects slide down it with an acceleration of 12 ft/sec/sec. An object is thrown up the incline. It travels 3,750 feet up the incline before starting to slide back down. Find the initial velocity with which the object was thrown.
16. Work may be defined as force times distance if the force is constant. If the force is not constant but is a function of distance (as in a stretched spring, for example), then we define work as $W = \int_a^b F(x) dx$, where $F(x)$ is the force at distance x and W is the work done by $F(x)$ as x varies from a to b . If the force required to stretch a spring x in. from rest is $F(x) = (12x)$ lb, find the work required to stretch the spring from rest. (a) 3 in.; (b) 6 in.; (c) 12 in. In what units will the work be expressed? (d) How much work is done in stretching the spring from $x = 7$ to $x = 13$ in.? Set this up as an integral and integrate.
17. Work Prob. 16 if $F(x) = 4x$.
18. A balloon is rising at the rate of 15 ft/sec. A stone dropped from the balloon reached the ground in 8 sec. How high was the balloon? (The nature of the data does not merit an accuracy of more than the nearest ten feet, if that.)
19. A ball is thrown upward and reaches a height of 80 ft in 1 sec. How high will the ball go?
20. A stone is thrown upward with an initial speed of 92 ft/sec from the top of a building 100 ft above ground level. Determine the velocity of the stone as it passes a window 52 ft above ground level on its way down. Start with the assumption that $g = 32$, that is, $s''(t) = -32$ ft/sec/sec and derive all relationships used.
- *21. Consult a table of integrals (*Handbook of Chemistry and Physics*, for example) and note the variety of things yet to be learned. Find

- which integrals we have already studied in this course. Find three functions which are familiar but whose derivative and/or integral we have not studied.
22. Obtain the formula $s = -gt^2/2 + v_0t + s_0$, mentioned earlier in this section. Start with the acceleration due to gravity as a constant g .
23. Imagine you are the navigator on an interplanetary rocket ship about to land on planet J5A. It is known that the rocket-braking power needed for a safe landing is proportional to the gravitational attraction of the planet. Your ship uses $\frac{1}{2}$ rocket-braking power on earth. If on the planet J5A a ball drops 100 ft from rest in $\frac{1}{2}$ sec, can you safely land your ship on J5A?
24. A stone is thrown upward from the top of a building 180 ft high with an initial velocity of 8 ft/sec. Starting with 32 ft/sec/sec downward as the acceleration due to gravity, determine a function which expresses the height of the stone above the ground, as a function of the time t in seconds after the stone is thrown.
25. Determine the velocity of the stone in Prob. 1 as it passes a window 60 ft above ground level.
26. A curve has slope equal to $\frac{1}{x}$ times its abscissa (x value) and passes through $(2, -1)$. Determine the equation of the curve.
 HINT: If $y' = \frac{1}{x}$, $y = \int \frac{1}{x} dx = \ln|x| + C$. Since $(2, -1)$ lies on the curve $y = \ln|x| + C$, it is possible to determine C . Do so.
27. A curve has slope equal to four times its abscissa [$F'(x) = 4x$] and passes through $(3, -6)$. Determine the equation of the curve.
28. The slope of a curve is six times the square of its abscissa. The curve has a y intercept of 5. Determine the equation of the curve.
29. Verify the theorem $\int x^n dx = \frac{x^{n+1}}{n+1} + C$ if $n \neq -1$ by differentiation. Be sure to consider the case in which $n = 0$.
30. The slope of a curve at a point is always four units less than twice the abscissa of that point. Find the equation of the family of curves having this property, and pick out the member of the family which passes through $(-2, 3)$.
31. If $\frac{dy}{dt} = 3t^2 - 7t + 6$ and $y = 80$ when $t = -2$, find an equation expressing y as a function of t . Graph this function.
32. If $\frac{dz}{dx} = 8x^7 - 10x^4 + 12x^3 - 7$ and $z = 40$ when $x = 1$, find an equation relating z and x . Make a rough sketch of this equation.