

Application Worksheet

1. Suppose that $f(x) = 3x + 1$. What is the instantaneous rate of change $f'(x)$ when $x = 0$.
2. Suppose that $f(x) = \frac{-2}{x}$. What is the instantaneous rate of change of $f(x)$ when $x = 1$.
3. If $f(t) = t^2 + 3t - 7$, what is the instantaneous rate of change of $f(t)$ with respect to t when $t = 5$?
4. If $f(x) = 3t + 2 - \frac{5}{t}$, what is the instantaneous rate of change of $f(t)$ with respect to t when $t = 2$?
5. An analysis of the daily output of a factory assembly line shows that about $60t + t^2 - \frac{1}{12}t^3$ units are produced after t hours of work, $0 \leq t \leq 8$. What is the instantaneous rate of production (in units per hour) when $t = 2$?
6. Liquid is pouring into a large vat. After t hours, there are $5t - t^{\frac{1}{2}}$ gallons in the vat. At what instantaneous rate is the liquid flowing into the vat (in gallons per hour) when $t = 4$?
7. Suppose that the weight in grams of a cancerous tumor at time t is $W(t) = 0.1t^2$, where t is measured in weeks.
 - a) What is the instantaneous rate of growth of the tumor (in grams per week) when $t = 5$?
 - b) At what time is the tumor growing at the instantaneous rate of 5 grams per week?
8. After an advertising campaign, the sales of product often increase and then decrease. Suppose that t days after the end of advertising, the daily sales are $-3t^2 + 32t + 100$ units.
 - a) At what rate (in units per day) are the sales increasing when $t = 2$?
 - b) When will sales be increasing at the rate of 2 units per day?
9. Suppose that t hours after being placed in a freezer, the temperature of a piece of meat is given by $T(t) = 70 - 12t + \frac{4}{t+1}$ degrees, where $0 \leq t \leq 5$.
How fast is the temperature falling after 1 hour?

10. A manufacturer estimates that the hourly cost of producing x units of a product on an assembly line is $.1x^3 - 6x^2 + 136x + 200$ dollars.
- Compute $C(21) - C(20)$, the extra cost of raising the production from 20 to 21 units.
 - Find the marginal cost when the production level is 20 units.
11. Suppose that the profit from producing x units of a product is given by $p(x) = 0.003x^3 + .01x$ dollars
- Compute the additional profit gained from increasing sales from 100 to 101 units
 - Find the marginal profit at a production level of 100 units
12. An object moving in a straight line travels $s(t)$ kilometers in t hours, where $s(t) = \frac{1}{2}t^2 + 4t$.
- What is the object's velocity when $t = 6$?
 - How far has the object traveled in 6 hours?
 - When is the object travelling at the rate of 6 kilometers per hour?
13. Suppose that the position of a car at time t is given by $s(t) = 50t - \frac{7}{t+1}$, where the position is measured in kilometers. Find the velocity and acceleration of the car at $t=0$.
14. A toy rocket fired straight up in the air has height $s(t) = 160t - 16t^2$ feet after t seconds.
- What is the rocket's initial velocity (when $t = 0$)?
 - What is the velocity after 2 seconds?
 - What is the acceleration when $t = 3$?
 - At what time will the rocket hit the ground?
 - At what velocity will the rocket be traveling just as it smashes into the ground?
15. A helicopter is rising straight up in the air. Its distance from the ground t seconds after take-off is $s(t)$ feet where $s(t) = t^2 + t$.
- How long will it take for the helicopter to rise 20 feet?
 - Find the velocity and the acceleration of the helicopter when it is 20 feet above the ground.