1. **(7 points)** *This is the record of the first 5 minutes of a bicyclist's trip:*

Time elapsed (in minutes)	*0*	*1*	*2*	*3*	*4*	*5*
Distance traveled (in meters)	*0*	*300*	*700*	*1050*	*1500*	*1800*

   (a) **(2 points)** *What is the bicyclist's average speed in the first two minutes of their journey?*
   In the first two minutes the bicyclist travels 700 meters over a period of 2 minutes, so their speed is $\frac{700}{2} = 350$ meters per minute.

   (b) **(2 points)** *What is the bicyclist's average speed between the times $t = 1$ and $t = 4$?*
   Using the formula for average speed, the bicyclist's average speed over this time interval is $\frac{1500-300}{4-1} = \frac{1200}{3} = 400$ meters per minute.

   (c) **(3 points)** *The detailed records indicate that after 4.1 minutes (or 246 seconds), the bicycle had gone 1539 meters. Based on this information, what would be a good estimate for the instantaneous speed after 4 minutes?*
   The instantaneous speed is well approximated by the speed of the bicycle in the short time span from $t = 4$ to $t = 4.1$ (that's 6 seconds — not exactly an "instant", but hopefully a time of relatively unchanged speed). We may thus approximate this speed with the ratio $\frac{1539-1500}{4.1-4} = \frac{39}{0.1} = 390$ meters per minute, or, if you prefer seconds, $\frac{1539-1500}{246-240} = \frac{39}{6} = 6.5$ meters per second.

2. **(7 points)** *Calculate the following limits:*

   (a) **(5 points)** $\lim_{s\to 3} \frac{s^2-6s+9}{2s^2-5s-3}$.
   Noting that $3^2 - 6 \cdot 3 + 9 = 0$ and that $2 \cdot 3^2 - 5 \cdot 3 - 3 = 0$, we have one of those $\frac{0}{0}$ forms where factoring $x - 3$ out of the numerator and denominator is necessary. Noting that

$$s^2 - 6s + 9 = (s-3)^2$$

   and that

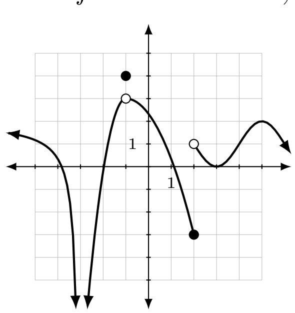
$$2s^2 - 5s - 3 = (s-3)(2s+1),$$

   we may evaluate the limit as such:

$$\lim_{s\to 3} \frac{s^2-6s+9}{2s^2-5s-3} = \lim_{s\to 3} \frac{(s-3)(s-3)}{(s-3)(2s+1)} = \lim_{s\to 3} \frac{s-3}{2s+1} = \frac{0}{7} = 0$$

   (b) **(2 points)** $\lim_{r\to -2} \frac{r^3-3r}{r^2+r-1}$.
   Evaluating the numerator and denominator of this limit directly at $r = -2$ is valid, since the denominator is nonzero, and so $\lim_{r\to -2} \frac{r^3-3r}{r^2+r-1} = \frac{(-2)^3-3(-2)}{(-2)^2+(-2)-1} = \frac{-2}{1} = -2$.

3. **(6 points)** *Below is the graph of a function $f(x)$. For each of the six quantities listed, give its value if it has a value, or specifically state that it does not exist.*



$\lim_{x\to -3} f(x)$ does not exist

$\lim_{x\to 1} f(x) = 0$

$\lim_{x\to -1^+} f(x) = 3$

$f(1) = 0$

$f(-1) = 4$

$\lim_{x\to 2^+} f(3) = 0^*$

Because the graph of the function disappears in an apparently infinite way on the graph, we assert that $\lim_{x\to-3} f(x)$ does not exist; note that the behavioral, idiomatic statement $\lim_{x\to-3} f(x) = -\infty$ is also true, but a behavioral characterization was not asked for.

$\lim_{x\to-1^+} f(x) = 3$ because, very slgihtly to the right of the x-value 3, the height of the curve representing $f(x)$ is very nearly at 3.

However, by way of contrast, the value of $f(-1)$ is 4, because of the solid dot at $(-1, 4)$.

$\lim_{x\to1^+} f(x) = 0$ because the curve of the function passes through $(1, 0)$. Likewise $f(1) = 0$ for the same reason.

$\lim_{x\to2^+} f(3)$ is a peculiar calculation to request (and in fact was erroneously written), and in the interest of fairness I will accept both the literally correct value and the value intended (which is the most likely misreading). Taken at face value, since the calculation $f(3)$ does not depend on the value of x at all, the limit is irrelevant and $\lim_{x\to2^+} f(3) = f(3) = 0$. In the reasonable and likely misreading of $\lim_{x\to2^+} f(x)$, on the other hand, we investigate behavior slightly above the x-value of 2 and find that $f(x)$ is very nearly 1 at such points, so this limit is 1.

4. **(2 point bonus)** *If $f(x)$ is an even function, and $g(x)$ is an odd function, what do you know for certain about the parity of $f(f(x))$, $f(g(x))$, $g(f(x))$, and $g(g(x))$?*