1. **[5 points per part]** Compute each limit. You may use any techniques you know.

If a limit does not exist or is infinite, say so, and explain.

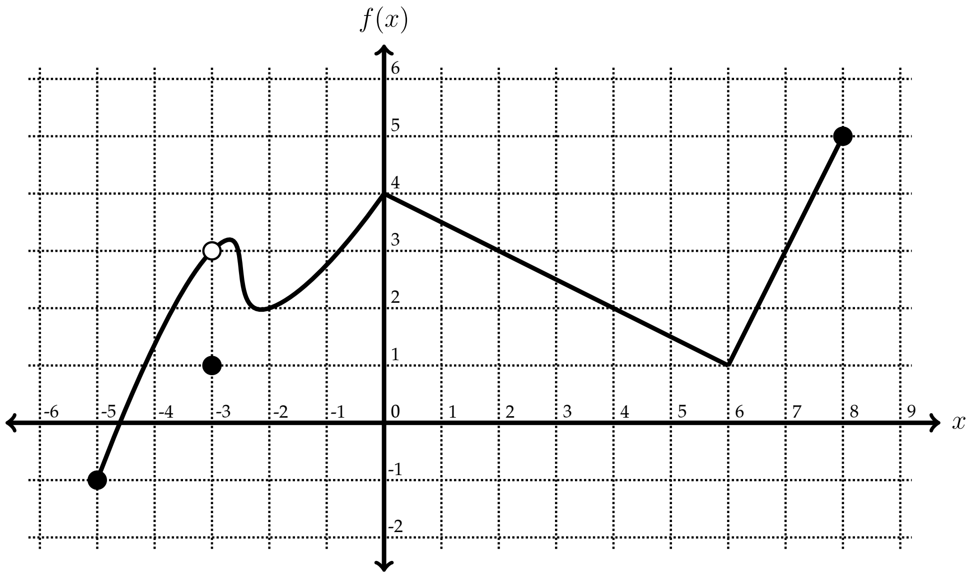
(a) $\lim\limits_{x \to 8} \dfrac{\sqrt{x-4}+2}{x-3}$, $\lim\limits_{x \to 8} \dfrac{\sqrt{x-4}+2}{x-8}$, $\lim\limits_{x \to 8} \dfrac{\sqrt{x-4}-2}{x-8}$

$\lim\limits_{x \to +\infty} \dfrac{\sqrt{x-4}+2}{x-3}$

(b) $\cancel{\lim\limits_{t \to 0} \dfrac{\sin(at) - bt + a^2}{\text{[illegible]}}}$

(c) $\lim\limits_{x \to \infty} \sin\left(\dfrac{\pi x + 6}{\sqrt{4x^2+2x}+2x}\right)$

5. The graph of $f(x)$ is shown below.



Cool graph, right? Use it to answer the following questions.

(a) **[3 points]** Compute $\lim_{x \to -3} [f(x) \cdot f(x+1)]$.

(b) **[3 points]** For what constant c does $\lim_{x \to 3} \frac{f(x) - c}{x - 3}$ exist?

(c) **[3 points]** Compute the limit from part (b), using the value of c you chose.

~~(d) [4 points] Let~~ $\cancel{g(x) = \frac{f'(x)}{f(x)}}$. ~~What is~~ $\cancel{g(7)}$?

3. (20 points) (a) (8 points) Algebraically simplify the expression inside the following limit:

$$\lim_{h \longrightarrow 0} \frac{\sqrt{(3+h)^2+16}-5}{h}.$$

(b) (5 points) Using part (a), find this limit.

(c) (7 points) This limit is the derivative of what function $f(x)$ at what point?

(CONTINUED ON NEXT PAGE)

2. (12 total points) Find the following limits. In each case your answer should be either a number, $+\infty$, $-\infty$ or DNE. Please show your work.

   (a) (4 points) $\displaystyle\lim_{t\longrightarrow 2^-} \frac{t^2-4}{|t-2|}$

   (b) (4 points) $\displaystyle\lim_{x\longrightarrow\infty} \left(x-\sqrt{x^2-10x}\right)$

   (c) (4 points) $\displaystyle\lim_{x\longrightarrow\infty} \frac{2x^2+3x\ln x+2^{-x}}{5x^2+9x\ln x+\pi\cdot 2^{-x}}$

5. (25 points) A particle is traveling at constant angular velocity $\pi/3$ rad/sec counterclockwise around the circle of radius 2 centered at the origin. At time $t = 0$ it is at the point $(2, 0)$. At time $t = 20$ sec the particle flies off the circle and continues at constant velocity along the tangent line. NOTE: Your answers may involve π and square roots.

(a) (5 points) Give parametric equations for the motion of the particle for $0 \le t \le 20$.

(b) (10 points) At the instant when the particle flies off the circle find its x- and y-coordinates ~~and its horizontal velocity and vertical velocity~~.

(c) (10 points) Give parametric equations for the motion of the particle for $t \ge 20$.

Knowing that the horizontal velocity V_x is $-\frac{\pi\sqrt{3}}{3}$ and the vertical velocity V_y is $-\frac{\pi}{3}$.