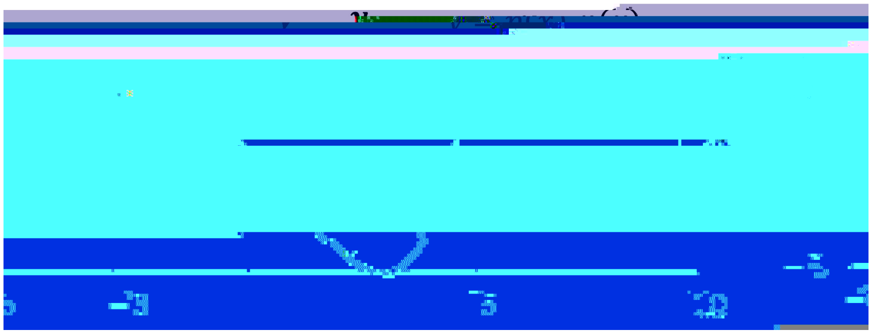
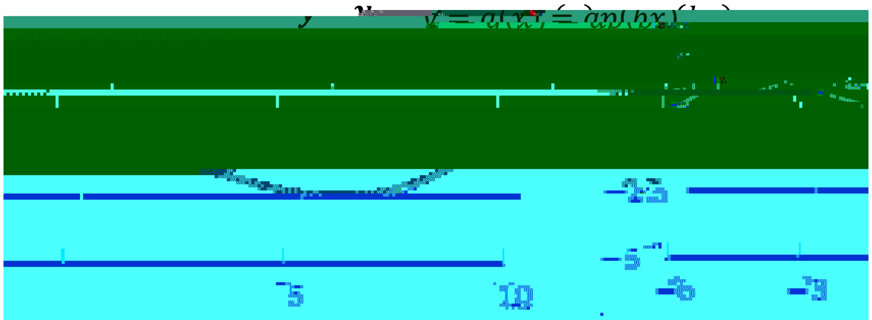
1. (20 pts) Parts (a) and (b) are not related.

   (a) For $f(x) = \frac{1}{x - 1}$ and $g(x) = \sqrt{2 - x}$, identify the composite function $(f \circ g)(x)$ and its domain. Express the domain in interval form.

(b) The graphs below depict the functions $y = p(x)$ and $y = q(x)$, where q is a transformation of p of the form $q(x) = ap(bx)$. Find the values of a and b.





2. (30 pts) Evaluate the following limits. Support your answers by stating theorems, definitions, or other key properties that are used.

   (a) $\lim_{x \to 0} \frac{\sin(5x)}{x^2 + 2x}$

(b) $\lim_{x \to 2} \frac{\sqrt{x+1} - \sqrt{3}}{x^2 + x - 6}$

(c) $\lim_{x \to 0} x^4 \cos\left(\frac{1}{2x}\right)$

3. (30 pts) Consider the rational function $r(x) = \dfrac{3x^2 + 21x + 30}{x^2 + 2x \quad 15}$.

(a) Identify all values of x at which $r(x)$ is discontinuous. At each such x value, explain why the function is discontinuous there.

(b) Identify the type of discontinuity associated with each x value identified in part (a). Support those classifications by evaluating the appropriate limits.

(c) Find the equation of each vertical asymptote of $y = r(x)$, if any exist. Support your answer in terms of your work in part (b).

(d) Find the equation of each horizontal asymptote of $y = r(x)$, if any exist. Support your answer by evaluating the appropriate limits. *(Reminder: You may not use L'Hôpital's Rule or dominance of powers arguments to evaluate limits on this exam.)*

4. (20 pts) Parts (a) and (b) are not related.

(a) For what value of a is the following function $u(x)$ continuous at $x = 4$? Support your answer using the definition of continuity, which includes evaluating the appropriate limits.

$$u(x) = \begin{cases} \dfrac{x - 4}{x^2 - 16} & ; \quad x < 4 \\[2ex] \dfrac{1}{a - x} & ; \quad x \geq 4 \end{cases}$$

(b) Use the Intermediate Value Theorem to establish that the equation $v(x) = x \quad 2\cos x = 0$ has at least one solution on the interval $(0; \quad =3)$. Verify that all conditions for applying the IVT to this particular problem are satisfied prior to using it.

END OF TEST

Your Initials __________

ADDITIONAL BLANK SPACE

If you write a solution here, please clearly indicate the problem number.