Name: _____   PID: _____

> NOTE: You must show the steps necessary to arrive at your answer unless otherwise noted. Use your judgment, if you can't do the entire problem in your head, then you probably should write down at least some intermediate steps.
>
> This assignment has 12 pages. There are 70 total points.

Problem 1 (2 points). Let $p(x) = -x^2 + 8x - 15$.

(a) Factor $-x^2 + 8x - 15$.

(b) What are the roots of $p(x)$?

Problem 2 (4 points). Let $h(y) = 2(y-2)^2(y+1)^2(y+3)$.

(a) What are the roots of $h(y)$?

(b) Compute the values of $h(-4)$, $h(-2)$, $h(0)$, and $h(3)$.

(c) Sketch the graph of $h(y)$ using what you know from parts (a) and (b).

Problem 3 (4 points). Let $q(z) = 4(z + 5)^2(z + 2)^2(z - 1)(z - 4)^5$.

(a) What are roots of $q(z)$?

(b) What are the multiplicities of each of these roots?

(c) Sketch a graph of $q(z)$.

Problem 4 (4 points). What are the vertical asymptotes of $g(c) = \frac{2c}{(c-1)(c+2)}$? Your answers should be equations of lines.

Problem 5 (4 points). What are the vertical asymptotes of $r(b) = \frac{b-1}{(2b+1)(b-1)(b+1)}$? Your answers should be equations of lines.

Problem 6 (2 points). The function $f(x) = \frac{2x+1}{(x-2)(2x+1)}$ has a "hole" in it. What are the coordinates of this hole?

Problem 7 (4 points). Does the function $g(a) = \frac{a^2-4}{a+5}$ have any horizontal asymptotes? If so, where? Justify your answer.

Problem 8 (4 points). Does the function $g(a) = \frac{a+5}{a^2-4}$ have any horizontal asymptotes? If so, where? Justify your answer.

Problem 9 (10 points). Let $h(a) = \frac{a+1}{2a-1}$.

(a) What is the vertical intercept of $h(a)$? Write your answer as a coordinate pair.

(b) What is/are the horizontal intercept(s) of $h(a)$? Write your answer(s) as a coordinate pair.

(c) Write the equation of the line which is the horizontal asymptote of $h(a)$.

(d) Write the equation of the line which is the vertical asymptote of $h(a)$.

(e) Sketch a graph of $h(a)$. Label all relevant features of the graph (asymptotes, intercepts, holes, etc).

Problem 10 (10 points). Let $g(b) = \frac{b^2 - 3b + 2}{b^2 - 1}$.

(a) What is the vertical intercept of $h(a)$? Write your answer as a coordinate pair.

(b) What is/are the horizontal intercept(s) of $h(a)$? Write your answer(s) as a coordinate pair. *(Hint: factor the numerator first.)*

(c) Write the equation of the line which is the horizontal asymptote of $h(a)$.

(d) Write the equation of the line(s) which is/are the vertical asymptote(s) of $h(a)$. *(Hint: factor the denominator first.)*

(e) Sketch a graph of $h(a)$. Label all relevant features of the graph (asymptotes, intercepts, holes, etc).

Problem 11 (6 points). Let $g(x) = \frac{x-2}{x-2}$.

(a) Does $g(x)$ have any horizontal asymptotes? If so, what are they?

(b) Does $g(x)$ have any vertical asymptotes? If so, what are they?

(c) Does $g(x)$ have any holes? If so, what are they?

(d) Sketch a graph of $g(x)$.

Problem 12 (8 points). Suppose you have $5000 in a bank account that earns interest. Each year, you receive 2% interest, and this interest compounds once per year (annually).

(a) How much money is in the account after 1 year?

(b) How much money is in the account after 2 years?

(c) How much money is in the account after 3 years?

(d) Write down a formula, $m(t)$, that outputs the amount of money in the account after t years.

Problem 13 (8 points). Consider the bank account from the previous problem which begins with a balance of $5000 dollars. Now, suppose that the account receives 2% interest each year, but that now the interest compounds monthly; that is, you get interest equal to $1/12^{th}$ of the interest rate added each month.

(a) How much money is in the account after 1 month?

(b) How much money is in the account after 1 year? (you can use a calculator)

(c) How much money is in the account after 2 years? (you can use a calculator)

(d) Write down a formula, $M(t)$, that outputs the amount of money in the account after t years.

[OPTIONAL]

Survey Questions.

1. Roughly how many hours did you spend working on this homework assignment?

2. Have you attended office hours this week, and with whom? *(circle all that apply)*

   David   **Ashley**   **Harveen**   **Cathy**