1)   Using calculus, determine any intervals where the function below would be concave
        upward. If there are none, write 'none' in the answer box.
(8 points)

$$f(x) = x^4 + 8x^3 + 18x^2 - 8$$

┌─────────────────────────────────────┐
│ Interval(s) of Concave Upward: │
│   │
│   │
│   │
└─────────────────────────────────────┘

2)   For which value of x of the function, $f(x) = x^4 + 8x^3 + 18x^2 - 8$ (problem 1 function), is
        the function **both** decreasing and concave down? Select the correct choice.
(8 points)

A $x = -2.1$
B $x = -3.2$
C $x = 1.8$
D $x = -5$
E $x = -0.6$

┌──────────────┐
│   │
│   │
│   │
└──────────────┘

3)   Find the **equation(s)** of any vertical or horizontal asymptotes for the function below.
        Write 'none' if there are no asymptotes for a category. If there if more than one for a
        category, separate equations with commas.
(6 points)

$$r(x) = \frac{3x^2 - 4x - 4}{x^2 - 2x - 8}$$

Vertical Asymptote Equation(s):
Horizontal Asymptote Equation(s);

4)   Using calculus, find any ordered pair(s) (point(s)), where the function below has a
        relative maximum or a relative minimum. Write as ordered pair(s) or point(s).
(10 points)

$$f(x) = \frac{x^2}{x - 2}$$

Relative maximum(s):
Relative minimum(s):

5)   Find the derivative of the function below. Factor your answer where possible. Assume x
      only represents values that make a positive argument.
(10 points)

$$h(x) = \ln(x^2 - 2x + 3)$$

$$\frac{dh}{dx} =$$

6)   Solve this exponential function by writing both sides of the equation with the same base.
      If there is more than one solution, separate solutions with a comma.
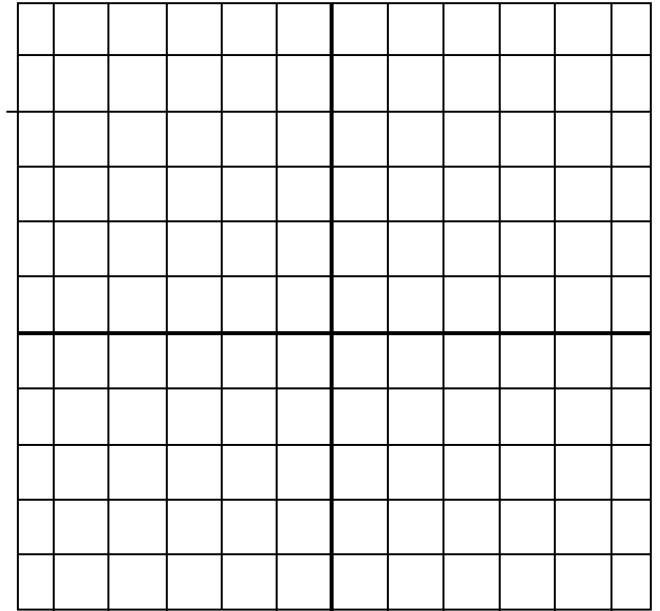(6 points)

$$16^{x-1} = 2^{15-5x}$$

$$x =$$

7) Find the derivative of $y = 2x^3 e^x$.
(9 points)

8) Solve this equation, using algebra/calculus. $\log_4 x - \log_4(x+3) = -1$
(8 points)

$x=$

9) Graph the following function, <u>using the information and points (1 – 5) shown below</u>.
(8 points)

$$f(x) = x^3 + 6x^2 + 9x$$

1. y-intercept: (0, 0)
2. Increasing: $(-\infty, -3)$ and $(-1, \infty)$; decreasing $(-3, -1)$
3. Relative minimum at $(-1, -4)$ and relative maximum at $(-3, 0)$
4. Point of inflection: $(-2, -2)$
5. Concave downward: $(-\infty, -2)$, concave upward: $(-2, \infty)$

10) Find any intervals where the function $f(x) = x^4 - 2x^2$ is decreasing. Give your answer using interval notation. If there is more than one interval, use the $\cup$ (union sign) between intervals.

(8 points)

11) After a great deal of experimentation, two Atlantic Institute of Technology senior physics majors determined that when a bottle of French champagne is shaken several times, help upright, and uncorked, its cork travels according to $s(t) = -16t^2 + 40t + 3$, where s is its height in feet above the ground and t is the number of seconds after the cork is released. What is the maximum height above the ground for the cork and how many second after the cork is released does the maximum height occur?

(8 points)

Maximum height:

How many seconds?

12)   Which of the statements in the box is(are) true concerning the function $f(x) = x(x-3)^2$?
       Support your answer with work or an explanation.
(10 points)

I	The function f is decreasing on (1, 3).
II	There is a point of inflection at (2, 2).
III	The function f is concave upward on $(2, \infty)$.
IV	There is a relative maximum $f(3) = 0$.

A   I, II, III, and IV
B   II and IV only
C   I and IV only
D   I and II only
E   I, II, and III only