[16] 1. Find each limit if it exists.

a) $\lim_{x\to 3} \dfrac{x^2 - 12x + 27}{x^2 - 13x + 30}$

b) $\lim_{x\to 3+} \dfrac{-2x}{x - 3}$

c) $\lim_{x\to \infty} \dfrac{\sqrt{25x^2 + 14x + 11}}{12 + 7x}$

d) $\lim_{x\to 2} \left(x + \dfrac{3}{x + 5} \right)$

[28] 2. Differentiate the following. You need not simplify.

a) $f(x) = 2^{x^2} + 7x^3 + (3x^2 + 11)^5$

b) $G(x) = 7x^4 e^{4x}$

c) $H(x) = \ln(4x^2 + 3x + 7)$

d) $F(x) = \dfrac{2x^3 + 4x + 5}{x^2 + 4}$

[18] 3. Let $F(x) = \dfrac{4x - 24}{x^2 - 3x - 10}$

a) What are the x-intercepts and y-intercepts of $F(x)$? Give your answers as ordered pairs.
i) x-intercept ii) y-intercept

b) What is/are the equation(s) of the vertical asymptote(s)?

c) What is/are the equation(s) of the horizontal asymptote(s)?

d) Find $F'(x)$.

[14] 4. a) Find the inflection points of $F(x) = x^4 - 11x^3 + 15x^2 + 3x - 8$. Give them as ordered pairs.

b) Find the intervals $F(x)$ is concave down. Give your answer in interval notation.

c) Find the intervals $F(x)$ is concave up. Give your answer in interval notation.

[14] 5. Find the absolute maximum and absolute minimum of $F(x) = (x^2 - 10x + 21)^2$ over [1,5].

[12] 6. Find the equation of the line tangent to $F(x) = 4e^{2x} - 3x^2 + 3x + 1$, where $x = 0$. Put your answer in slope-intercept form.

7. Integrate.

[5] a) $\int (8x + 4)dx$

[8] (b) $\int (e^{3x} + \sqrt{x} + 4x^{-3})$

[20] 8. Evaluate each of the following.

a) $\int_0^4 x\sqrt{2x^2+4}\,dx$

b) $\int_1^e \frac{5}{x}\,dx$

c) $\int_0^1 xe^{3x}\,dx$ (Integration by parts.)

[15] 9. Find the area between the curves $F(x) = e^x + x^2 + 3x + 5$ and $G(x) = e^x + 4x + 7$.

[14] 10. Minimize $F(x, y) = 3x^2 + 3y^2$ subject to the constraint $x + 2y = 180$ using Lagrange multipliers. Give where the minimum occurs as an ordered pair and then state the minimum value.

[12] 11. Let $F(x, y) = x^3 - 3xy + y^3 + 4$. The critical points for $F(x, y)$ are (0,0) and (1,1). Classify each point as a relative minimum, relative maximum or a saddle point.

[12] 12. Let $F(x, y) = x \ln y + y \ln x$.

a) Find $F_x(1, 2)$

b) Find $F_{yx}(2, 2)$

[12] 13. $D(x)$ represents the price in dollars a consumer will pay for x units of a product and $S(x)$ represents the price in dollars the producers will accept for x units of a product. If $D(x) = 2x^2 - 5x + 8$ and $S(x) = x^2 + 74$, find

a) The number of units at the equilibrium point.

b) The price at the equilibrium point.

c) The producer surplus at the equilibrium point. Round to the nearest cent.