PART B

5. Determine the value of $\frac{dy}{dx}$ for the given value of x.

a.
$$y = (2 + 7x)(x - 3), x = 2$$

b.
$$y = (1 - 2x)(1 + 2x), x = \frac{1}{2}$$

c.
$$y = (3 - 2x - x^2)(x^2 + x - 2), x = -2$$

d.
$$y = x^3(3x + 7)^2$$
, $x = -2$

e.
$$y = (2x + 1)^5(3x + 2)^4$$
, $x = -1$

f.
$$y = x(5x - 2)(5x + 2), x = 3$$

- 6. Determine the equation of the tangent to the curve $y = (x^3 - 5x + 2)(3x^2 - 2x)$ at the point (1, -2).
- 7. Determine the point(s) where the tangent to the curve is horizontal.

a.
$$y = 2(x - 29)(x + 1)$$

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 b. $y = (x^2 + 2x + 1)(x^2 + 2x + 1)$

8. Use the extended product rule to differentiate the following functions. Do not simplify.

a.
$$y = (x + 1)^3(x + 4)(x - 3)^2$$

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 b. $y = x^2(3x^2 + 4)^2(3 - x^3)^4$

- 9. A 75 L gas tank has a leak. After t hours, the remaining volume, V, in litres is $V(t) = 75\left(1 - \frac{t}{24}\right)^2$, $0 \le t \le 24$. Use the product rule to determine how quickly the gas is leaking from the tank when the tank is 60% full of gas.
- 10. Determine the slope of the tangent to $h(x) = 2x(x+1)^3(x^2+2x+1)^2$ at x = -2. Explain how to find the equation of the normal at x = -2.

PART C

- 11. a. Determine an expression for f'(x) if $f(x) = g_1(x)g_2(x)g_3(x) \dots g_{n-1}(x)g_n(x)$. T b. If $f(x) = (1 + x)(1 + 2x)(1 + 3x) \dots (1 + nx)$, find f'(0).
 - 12. Determine a quadratic function $f(x) = ax^2 + bx + c$ if its graph passes through the point (2, 19) and it has a horizontal tangent at (-1, -8).
 - 13. Sketch the graph of $f(x) = |x^2 1|$.
 - a. For what values of x is f not differentiable?
 - b. Find a formula for f', and sketch the graph of f'.
 - c. Find f'(x) at x = -2, 0, and 3.
 - 14. Show that the line 4x y + 11 = 0 is tangent to the curve $y = \frac{16}{x^2} 1$.

C



9. Find the point(s) at which the tangent to the curve is horizontal.

a.
$$y = \frac{2x^2}{x - 4}$$

b.
$$y = \frac{x^2 - 1}{x^2 + x - 2}$$

A

- 10. An initial population, p, of 1000 bacteria grows in number according to the equation $p(t) = 1000\left(1 + \frac{4t}{t^2 + 50}\right)$, where t is in hours. Find the rate at which the population is growing after 1 h and after 2 h.
- 11. Determine the equation of the tangent to the curve $y = \frac{x^2 1}{3x}$ at x = 2.
- 12. A motorboat coasts toward a dock with its engine off. Its distance s, in metres, from the dock t seconds after the engine is turned off is $s(t) = \frac{10(6-t)}{t+3}$ for $0 \le t \le 6$.
 - a. How far is the boat from the dock initially?
 - b. Find the velocity of the boat when it bumps into the dock.
- 13. a. The radius of a circular juice blot on a piece of paper towel t seconds after was first seen is modelled by $r(t) = \frac{1+2t}{1+t}$, where t is measured in centimetres. Calculate
 - i. the radius of the blot when it was first observed
 - ii. the time at which the radius of the blot was 1.5 cm
 - iii. the rate of increase of the radius of the blot when the radius was 1.5 cm
 - b. According to this model, will the radius of the blot ever reach 2 cm? Explain your answer.
- 14. The graph of $f(x) = \frac{ax + b}{(x 1)(x 4)}$ has a horizontal tangent line at (2, -1). Find a and b. Check using a graphing calculator.
- 15. The concentration, c, of a drug in the blood t hours after the drug is taken orally is given by $c(t) = \frac{5t}{2t^2 + 7}$. When does the concentration reach its maximum value?
- 16. The position from its starting point, s, of an object that moves in a straight line at time t seconds is given by $s(t) = \frac{t}{t^2 + 8}$. Determine when the object changes direction.

PART C

17. Consider the function $f(x) = \frac{dx + b}{cx + d}$, $x \neq -\frac{d}{c}$, where a, b, c, and d are nonzero constants. What condition on a, b, c, and d ensures that each tangent to the graph of f has a positive slope?

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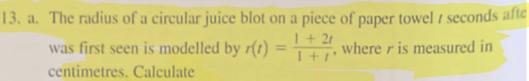
NEU

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CS CamScanner

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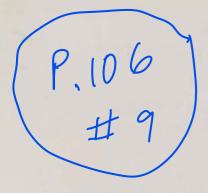
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8. Differentiate each function. Express your answer in a simplified factored for

a.
$$f(x) = (x+4)^3(x-3)^6$$
 d. $h(x) = x^3(3x-5)^2$

d.
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b.
$$y = (x^2 + 3)^3(x^3 + 3)^2$$
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c.
$$y = \frac{3x^2 + 2x}{x^2 + 1}$$

f.
$$y = \left(\frac{x^2 - 3}{x^2 + 3}\right)^4$$

9. Find the rate of change of each function at the given value of t. Leave your answers as rational numbers, or in terms of roots and the number π .

a.
$$s(t) = t (4t - 5)^{\frac{1}{2}}, t = 8$$
 b. $s(t) = \left(\frac{t - \pi}{t - 6\pi}\right)^{\frac{1}{2}}, t = 2\pi$

10. For what values of x do the curves $y = (1 + x^3)^2$ and $y = 2x^6$ have the same slope?

11. Find the slope of the tangent to the curve $y = (3x - x^2)^{-2}$ at $\left(2, \frac{1}{4}\right)$.

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13. Use the chain rule, in Leibniz notation, to find $\frac{dy}{dx}$ at the given value of x.

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14. Find h'(2), given $h(x) = f(g(x)), f(u) = u^2 - 1, g(2) = 3, and <math>g'(2) = -1$.

Α 15. A 50 000 L tank can be drained in 30 min. The volume of water remaining in the tank after t minutes is $V(t) = 50\,000\left(1 - \frac{t}{30}\right)^2$, $0 \le t \le 30$. At what rate, to the nearest whole number, is the water flowing out of the tank when t = 10?

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NEL

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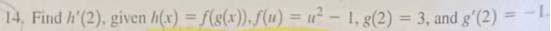
13. Use the chain rule, in Leibniz notation, to find $\frac{dy}{dr}$ at the given value of x.

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$$y = 3u^2 - 5u + 2$$
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