Volume of a Cone =  $\frac{1}{2}\pi r^2 h$ 

Surface Area of a Sphere =  $4\pi r^2$ 

Volume of a Sphere =  $\frac{1}{2}\pi r^3$ 

1. Prove the product rule. In other words, prove that if p(x) = f(x)g(x), then p'(x) = f'(x)g(x) + f(x)g'(x)

2. Determine the equation of the tangent line to the curve  $y = 2x^3 + 5x - 9$  at the point where x = 4.

The equation of the tangent line is  $\sqrt{-265}$ 

3. The curve  $y = (x+3)^{\frac{1}{2}} - 3x$  has one point with a horizontal tangent. Determine the coordinates of that

$$5uh \text{ in } y = 1$$

$$Y = (1+31)^{3} - 3$$

$$= (41)^{3} - 3$$

$$= 5$$

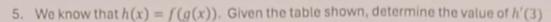
$$= 8-3 = 5$$

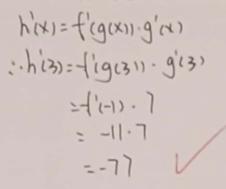
$$= (1,5)$$

The coordinates of the point with a horizontal tangent is (1,5)

4. Given 
$$f(x) = \left[\frac{(7x-19)^5-30}{x^3-10x+4}\right]^3 + 3x^2$$
, determine an expression for the derivative  $f'(x)$ . You do not need to simplify that expression. Then, evaluate  $f'(3)$ .

$$f'(x) = 3 \left[\frac{(7x-19)^5-30}{x^2-10x+4}\right]^2 \left[\frac{5(7x-19)^4(7)(x^2-10x+4)-(3x^2-10)(7x-19)^5+(3x^2-10)(30)}{(x^2-10x+4)^2}\right] + bx$$





X	f(x)	g(x)	f'(x)	g'(x)
-1	2	-5	-11	9
1	-4	10	-9	0
3	8	-1	6	7
5	2	-5	13	4
7	15	-6	-8	5

$$h'(3) = -77$$

6. Determine an expression for 
$$\frac{d[(3x^2+8x+1)^3+7(3x^2+8x+1) +8]}{d(3x^2+8x+1)}$$

Your answer should not have any variable other than x in it, but it does not need to be simplified.

2

$$\frac{d\left[\left(3x^{2}+8x+1\right)^{3}+7\left(3x^{2}+8x+1\right)\right]+8}{d\left(3x^{2}+8x+1\right)}=3(3x^{2}+8x+1)^{2}+7$$

(your final answer should have no variable other than x in it but you do not have to expand it)

7. The radius of a circle is expanding at a rate of 2 cm/min. At what rate is the area of the circle increasing when the area of the circle is  $100\pi$  cm<sup>2</sup>. Include proper units of measurement in your answer.

The area of the circle is expanding at a rate of 401 cm²/min (include proper units of measurement in your answer)

8. There are two points on the ellipse  $4x^2 + 9y^2 = 36$  that have a tangent line that passes through the point (9,2). Determine the coordinates of both points.

$$4x^{2} + 9y^{2} = 3b$$

$$8x+18y\frac{dy}{dx} = 0$$

$$18y\frac{dy}{dx} = -8x$$

$$\frac{dy}{dx} = \frac{-4x}{9y}$$

$$\frac{(y-2)}{(x-9)} = \frac{-4x}{9y}$$

$$9y^{2} = -4x^{2} + 3bx$$

$$3bx+18y = 4x^{2} + 9y^{2}$$

$$-: 4x^{2} = 9y^{2} + 3b$$

$$: 3bx+18y = 3b$$

$$18y = -3bx+3b$$

$$y = -2x+2$$

$$4x^{2}q(4x^{2}4-8x)=36$$
 $4x^{2}q(4x^{2}4-8x)=36$ 
 $4x^{2}+36x^{2}+36-72x=36$ 
 $4xx^{2}-72x=0$ 
 $5x^{2}-9x=0$ 
 $x(5x^{2}-9)=0$ 
 $x_{1}=0$ 
 $x_{2}=\frac{9}{5}$ 

when  $x=0$ ,  $y=2$ 

when  $x=5$ ,  $y=-\frac{8}{5}$ 
 $x=-\frac{8}{5}$ 
 $x=-\frac{8}{5}$ 
 $x=-\frac{8}{5}$ 
 $x=-\frac{8}{5}$ 
 $x=-\frac{8}{5}$ 

$$(0,1) \qquad (\frac{9}{5}, -\frac{8}{5})$$
 The two points are