

## Unit 2 Test - Derivatives

### Part A: Knowledge and Understanding (20 marks)

1) Indicate whether each statement is True or False (5 marks)

a) the slope of the tangent to  $f(x) = \sqrt{1-2x}$  at  $(-4, 3)$  is  $\frac{-2}{3}$

b) you can use product rule to differentiate a rational function

c) if  $f$  and  $g$  are differentiable, then the derivative of  $f(x) + g(x)$  is  $f'(x) + g'(x)$ .

d) If a function is differentiable at point  $(a, f(a))$ , then  $f(x)$  is continuous at  $x = a$ .

e) the derivative of  $f(x) = 240(1 - \frac{x}{30})$  is  $f'(x) = -8x$ .

2) The following limit represents the derivative of some function  $f(x)$  at some number  $a$ . State  $f(x)$  and  $a$ . (2 marks)

$$f'(a) = \lim_{h \rightarrow 0} \frac{(1+h)^9 - 1}{h}$$

3) Write an expression for  $h'(x)$  if  $h(x) = p(x)q(x)r(x)s(x)$  (1 marks)

4) Differentiate  $f(x) = (3x+1)^4(x^3 - x + 1)^5$  and express answer in simplified factored form. (4 marks)

5) Differentiate  $f(x) = \frac{3x^2(1-2x^3)}{(1+x)^3}$ . Do not simplify. (2 marks)

6) Use the chain rule in Leibniz notation to find  $\frac{dy}{dx}$  when  $x = 3$  (5 marks)

$$y = 2u^3 + 3u^2 - 1 \quad u = \frac{1}{2-x}$$

**Part B: Application (20 marks)**

1) For which values of  $x$  is the slope of the tangent to the curve  $f(x) = \frac{5x}{x+2}$  parallel with equation  $2x - 5y - 9 = 0$ ? (6 marks)

2) Determine the equation of the tangent to the curve  $f(x) = (\sqrt{x^2 - 9})^3$  at  $x = 5$ . (5 marks)

3) The function  $s(t) = (2t^3 + 3t^2)^{\frac{1}{2}}$  represents the displacement  $s$ , in metres, of a particle after  $t$  seconds. Determine the velocity when  $t = 3$ . (4 marks)

4) Find  $h'(2)$  given  $h(x) = f(g(x))$ ,  $f(u) = 2u^3 - 2u$ ,  $g(2) = 3$  and  $g'(2) = 4$ . (5 marks)

**Part C: Thinking (14 marks)**

1) If  $f(x)$  is a differentiable function, determine an expression for the derivative of  $g(x) = 4x^3 f(3x^2 - 2x + 1)$

2) Find numbers  $a, b$  and  $c$  so that the graph  $f(x) = ax^2 + bx + c$  has  $x$  intercepts  $-4$  and  $5$ , and a tangent with a slope of  $6$  when  $x = 2$ .

3) Show that  $\frac{dy}{dx} = (2a + 5b)x^{2a+5b-1}$  if  $y = \frac{x^{3a+3b}}{x^{a-2b}}$  and  $a$  and  $b$  are integers.

**Part D: Communication (8 marks)**

- 1) A classmate says "the derivative of a quartic polynomial function is a cubic polynomial function". Is this statement always true, sometimes true, or never true? (2 marks)
- 2) Illustrate two situations in which a function does not have a derivative at  $x = 2$ . (2 marks)
- 3) Explain when and how you would use the chain rule? (2 marks)
- 4) State two methods you can use to differentiate  $f(x) = (x^2 - 4x + 2)(x^4 + 2)$ ? (2 marks)