1. [3 marks] An object's displacement (in metres) is given by $s(t) = 3.6t^3 - 2.8t^2 + 2.2$, where t is measured in seconds. Find the object's acceleration at $t = 2.5$ seconds.

$v(t) = 10.8t^2 - 5.6t$

$a(t) = 21.6t - 5.6$

$a(2.5) = 48.4 \quad m/s^2$

2. [3 marks] Evaluate the following limit:
$\lim\limits_{x \to -4} \frac{x^2-16}{x^2+13x+36}$

$$= \lim_{x \to -4} \frac{(x+4)(x-4)}{\cancel{(x+4)}(x+9)}$$

$$= \lim_{x \to -4} \frac{x-4}{x+9}$$

$$= \frac{-8}{5}$$

3. [5 marks] Use the **limit definition** to find $f'(x)$ for $f(x) = 2x^2 - 3x$.

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$ 1

$$= \lim_{h \to 0} \frac{2(x+h)^2 - 3(x+h) - 2x^2 + 3x}{h}$$ 1

$$= \lim_{h \to 0} \frac{2(x^2 + 2xh + h^2) - 3x - 3h - 2x^2 + 3x}{h}$$

$$= \lim_{h \to 0} \frac{2x^2 + 4xh + 2h^2 - 3h - 2x^2}{h}$$ 1

$$= \lim_{h \to 0} \frac{h(4x + 2h - 3)}{h}$$ 1

$$= \lim_{h \to 0} 4x + 2h - 3$$

1

$$= 4x - 3$$

4. [4 marks] Find $f'(x)$ and **simplify fully**:

$f(x) = \frac{4x+1}{3x+2}$

$$f'(x) = \frac{(3x+2)(4) - (4x+1)(3)}{(3x+2)^2}$$

$$= \frac{12x+8 \quad -3(4x+1)}{(3x+2)^2}$$

$$= \frac{12x+8-12x-3}{(3x+2)^2}$$

$$= \frac{5}{(3x+2)^2}$$

$\boxed{\text{-0.5 if denominator was not factored in your final answer.}}$

5. [6 marks] Find y':

a) $y = \frac{-2}{(4x+3)^5}$

$= -2(4x+3)^{-5}$

$y' = 10(4x+3)^{-6}(4)$

$= \dfrac{40}{(4x+3)^6}$

b) $y = 9\sqrt{3x^2+1}$

$= 9(3x^2+1)^{1/2}$

$y' = \frac{9}{2}(3x^2+1)^{-1/2}(6x)$

$= \dfrac{27x}{\sqrt{3x^2+1}}$

c) $y = x(2x+1)^8$

$y' = x[8(2x+1)^7(2)] + (2x+1)^8(1)$

$= 16x(2x+1)^7 + (2x+1)^8$

6. [4 marks] Find $\frac{dy}{dx}$ given $6x^2 + 3x^3y - y^4 = 8$.

Take $\frac{d}{dx}$: $12x + 3x^3\frac{dy}{dx} + y(9x^2) - 4y^3\frac{dy}{dx} = 0$

$$3x^3\frac{dy}{dx} - 4y^3\frac{dy}{dx} = -12x - 9x^2y$$

$$[3x^3 - 4y^3]\frac{dy}{dx} = -12x - 9x^2y$$

$$\frac{dy}{dx} = \frac{-12x - 9x^2y}{3x^3 - 4y^3}$$

or $\dfrac{12x + 9x^2y}{4y^3 - 3x^3}$