Name: Solutions

- **Keep phones off and out sight.**
- **No calculators, notes, books, or other aids.**
- **Do not talk during the quiz.**
- **Show all work.**

Differentiation rules reference (this will not be printed on the midterm; include them on your note sheet!):

$$(f \cdot g)'(x) = f'(x)g(x) + f(x)g'(x)$$

$$(f/g)'(x) = \frac{f'(x)g(x) - f(x)g'(x)}{g(x)^2}$$

$$(f \circ g)'(x) = f'(g(x)) \cdot g'(x)$$

1. Differentiate each function using the differentiation rules.

(a) $f(x) = 7x^3 - 2x + 3$

$f'(x) = 7 \cdot 3x^2 - 2 + 0$

$= \boxed{21x^2 - 2}$

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

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

$$= \frac{x^2+3-2x^2-4x}{(x^2+3)^2} = \boxed{\frac{-x^2-4x+3}{(x^2+3)^2}}$$

(c) $f(x) = \sqrt{5x-2}$

$$f'(x) = \frac{1}{2\sqrt{5x-2}} \cdot \frac{d}{dx}(5x-2) = \boxed{\frac{5}{2\sqrt{5x-2}}}$$

2. Find all points on the graph $y = x^3 - 3x$ where the tangent line is horizontal. Each point should be specified as a pair of coordinates (x, y).

$\frac{dy}{dx} = 3x^2 - 3$

t. line is horizontal when $3x^2 - 3 = 0$

$\Leftrightarrow 3(x^2 - 1) = 0$

$\Leftrightarrow 3(x+1)(x-1) = 0$

$\Leftrightarrow x = \pm 1.$

So the points are $(1, 1^3 - 3\cdot 1)$ & $(-1, (-1)^3 - 3(-1))$,

ie. $\boxed{(1, -2) \text{ & } (-1, 2).}$

3. Find an equation for the tangent line to the curve $y = x\sqrt{x}$ at the point where $x = 4$.

$y = x^{3/2}$

$\frac{dy}{dx} = \frac{3}{2}x^{1/2}$

slope at $x=4$ is $\frac{3}{2}4^{1/2} = 3.$

& y-coord. is $4\sqrt{4} = 8.$

Tangent line:

$(y - 8) = 3(x - 4)$

or $y - 8 = 3x - 12,$ i.e. $\boxed{y = 3x - 4}$