

Differentiate and simplify where appropriate:

$$1. (4\text{pts}) \frac{d}{dx} \left(\sqrt[3]{x} - \frac{4}{x^5} + c^7 \right) = \frac{d}{dx} \left(x^{\frac{1}{3}} - 4x^{-5} + c^7 \right) = \frac{1}{3} x^{-\frac{2}{3}} - 4(-5)x^{-6} + 0$$

$$= \frac{1}{3x^{\frac{2}{3}}} + \frac{20}{x^6}$$

$$2. (4\text{pts}) \frac{d}{dt} (t^4 + t)e^t = (4t^3 + 1)e^t + (t^4 + t)e^t$$

$$= e^t (t^4 + 4t^3 + t + 1)$$

$$3. (4\text{pts}) \frac{d}{dy} \frac{y^2 - Ay + B\sqrt{y}}{\sqrt{y}} = \frac{d}{dy} \left(\frac{y^2}{y^{1/2}} - \frac{Ay}{y^{1/2}} + \frac{By^{1/2}}{y^{1/2}} \right) = \frac{d}{dy} \left(y^{\frac{3}{2}} - Ay^{\frac{1}{2}} + B \right)$$

$$= \frac{3}{2} y^{\frac{1}{2}} - \frac{1}{2} Ay^{-\frac{1}{2}} + 0 = \frac{3}{2} \sqrt{y} - \frac{A}{2\sqrt{y}}$$

$$4. (4\text{pts}) \frac{d}{dx} \frac{e^x + x}{e^x - x} = \frac{(e^x + 1)(e^x - x) - (e^x + x)(e^x - 1)}{(e^x - x)^2} = \frac{\cancel{e^{2x}} + e^x - xe^x - x - (\cancel{e^{2x}} + xe^x - e^x - x)}{(e^x - x)^2}$$

$$= \frac{2e^x - 2xe^x}{(e^x - x)^2}$$

5. (4pts) Assuming f is differentiable, find an expression for

$$\frac{d}{dx} \frac{f(x) + e^x}{x^3} = \frac{(f'(x) + e^x)x^3 - (f(x) + e^x) \cdot 3x^2}{x^6} = \frac{x^2(xf'(x) + xe^x - 3f(x) - 3e^x)}{x^6}$$

$$= \frac{xf'(x) + xe^x - 3f(x) - 3e^x}{x^4}$$