

1f. (chain rule, implicit differentiation)

1a)

$$\frac{d}{dx} (x^2 + 2)^2 = 2(x^2 + 2) \cdot 2x = \boxed{4x(x^2 + 2)}$$

1b)

$$\frac{d}{dx} (x^2 + 2)^{100} = 100(x^2 + 2)^{99} \cdot 2x = \boxed{200x(x^2 + 2)^{99}}$$

2)

$$\frac{d}{dx} x^{10} (x^2 + 1)^{10} = 10x^9 (x^2 + 1)^{10} + 10(x^2 + 1)^9 \cdot 2x \cdot x^{10}$$

$$= \boxed{20x^{11}(x^2 + 1)^9 + 10x^9(x^2 + 1)^{10}}$$

6)

}

7b)

$$\frac{dm}{dv} = -\frac{m_0}{2} \left(1 - \frac{v^2}{c^2}\right)^{-3/2} \cdot -\frac{2v}{c^2} = \boxed{\frac{m_0 v}{c^2 \left(1 - \frac{v^2}{c^2}\right)^{3/2}}}$$

7c)

$$\frac{dF}{dr} = -\frac{3mg}{2} (1+r^2)^{-5/2} \cdot 2r = -\frac{3mgr}{(1+r^2)^{5/2}}$$