

1. Evaluate:

$$\begin{aligned}
 a) \int_1^2 \left(x^2 + \frac{1}{x}\right) dx &= \left(\frac{x^3}{3} + \ln|x|\right) \Big|_1^2 \\
 &= \frac{(2)^3}{3} + \ln|2| - \left(\frac{(1)^3}{3} + \underbrace{\ln|1|}_{=0}\right) \\
 &= \frac{8}{3} + \ln 2 - \frac{1}{3} \\
 &= \boxed{\frac{7}{3} + \ln 2} \\
 &\approx 3.026
 \end{aligned}$$

$$\begin{aligned}
 b) \int_0^1 \frac{3x^2}{(x^3+1)^2} dx & \quad \begin{array}{l} u = x^3 + 1 \\ du = 3x^2 dx \end{array} \\
 = \int_{u=1}^{u=2} \frac{\cancel{3x^2}}{u^2} \cdot \frac{du}{\cancel{3x^2}} & \quad \frac{du}{3x^2} = dx \\
 = \int_1^2 u^{-2} du & \quad \begin{array}{l} x=0: u = (0)^3 + 1 = 1 \\ x=1: u = (1)^3 + 1 = 2 \end{array} \\
 = \left(\frac{u^{-1}}{-1}\right) \Big|_1^2 & \quad \frac{u^{-1}}{-1} = \frac{-u^{-1}}{1} = -u^{-1} = -\frac{1}{u} \\
 = \left(-\frac{1}{u}\right) \Big|_1^2 \\
 = -\frac{1}{2} - \left(-\frac{1}{1}\right) \\
 = \boxed{\frac{1}{2}}
 \end{aligned}$$

Q: What is harder to catch the faster you run?