1. [10 points] Indicate if each of the following is true or false by circling the correct answer. No justification is required.

a. [2 points] Let $-1 < q < 1$, then

$$\sum_{n=1}^{\infty} q^n = q + q^2 + q^3 + \cdots + q^n + \cdots = \frac{q}{1-q}.$$

$\boxed{\text{True}}$ False

Solution: Since $\sum_{n=1}^{\infty} q^n = q\left(\sum_{n=0}^{\infty} q^n\right)$, then using the formula for geometric series $\sum_{n=0}^{\infty} r^n = \frac{1}{1-r}$ with $r = q$ yields the result.

b. [2 points] Let $F(t)$ be an antiderivative of a continuous function $f(t)$. If the units of $f(t)$ are meters and t is in seconds, then the units of $F(t)$ are meters per second.

True $\boxed{\text{False}}$

Solution: The Second Fundamental Theorem of Calculus says that if $F(t)$ is an antiderivative of $f(t)$, then $F(t) = \int_a^t f(x)dx$. The units of a definite integral are the unites of $f(t)$ times the units of t. In this case, the units of $F(t)$ are meters times seconds.

c. [2 points] If the motion of a particle is given by the parametric equations

$$x = \frac{at}{1+t^3}, \quad y = \frac{at^2}{1+t^3} \qquad \text{for} \quad a > 0,$$

then the particle approaches the origin as t goes to infinity.

$\boxed{\text{True}}$ False

Solution: Since $\lim_{t\to\infty} x(t) = \lim_{t\to\infty} y(t) = 0$, then the particle approaches the origin as t goes to infinity.

d. [2 points] Let a_n be a sequence of positive numbers satisfying $\lim_{n\to\infty} a_n = \infty$. Then the series $\sum_{n=1}^{\infty} \frac{1}{a_n}$ converges.

True $\boxed{\text{False}}$

Solution: If $a_n = n$, then $\lim_{n\to\infty} n = \infty$, but $\sum_{n=1}^{\infty} \frac{1}{n}$ diverges by p-series test.

e. [2 points] Let $f(x)$ be a continuous function. Then

$$\int_0^1 f(2x)dx = \frac{1}{2}\int_0^1 f(x)dx.$$

True $\boxed{\text{False}}$

Solution: Using the substitution $u = 2x$, you get

$$\int_0^1 f(2x)dx = \frac{1}{2}\int_0^2 f(u)du.$$