**11.** [12 points]

**a.** [6 points] For the following questions, determine if the statement is ALWAYS true, SOMETIMES true, or NEVER true, and circle the corresponding answer. Justification is not required.

(i) Suppose that the sequence $a_n$ is defined by the recurrence relation $a_{n+1} = -\dfrac{1}{a_n}$ for all $n \geq 1$, where $a_1 > 0$. Then the sequence $a_n$ is monotone.

*Circle one:* **ALWAYS** **SOMETIMES** $\boxed{\textbf{NEVER}}$

(ii) Suppose that $b_n$ is a sequence and that $S_n = \displaystyle\sum_{k=1}^{n} b_k$ is the corresponding sequence of partial sums. Suppose that $\displaystyle\sum_{k=1}^{\infty} b_k$ converges. Then the sequence $S_n$ is bounded.

*Circle one:* $\boxed{\textbf{ALWAYS}}$ **SOMETIMES** **NEVER**

(iii) Suppose that $c$ is a positive constant. Then the geometric series $1 + 2c + 4c^2 + 8c^3 + \ldots$ converges to $\dfrac{1}{1-2c}$.

*Circle one:* **ALWAYS** $\boxed{\textbf{SOMETIMES}}$ **NEVER**

**b.** [6 points] For each of the following sequences, defined for $n \geq 1$, decide whether the sequence is monotone increasing, monotone decreasing, or not monotone, and whether it is bounded or unbounded. Circle your answers. No justification is required.

(i) $r_n = e^{n+1} - e^n$

*Circle **all** which apply:*

$\boxed{\textbf{Monotone Increasing}}$ **Monotone Decreasing** **Not Monotone**

**Bounded** $\boxed{\textbf{Unbounded}}$

(ii) $s_n = \displaystyle\int_0^{2^n} e^{-x^2}\,dx$

*Circle **all** which apply:*

$\boxed{\textbf{Monotone Increasing}}$ **Monotone Decreasing** **Not Monotone**

$\boxed{\textbf{Bounded}}$ **Unbounded**

(iii) $t_n = \displaystyle\sum_{k=1}^{n} \frac{(-1)^k}{k}$

*Circle **all** which apply:*

**Monotone Increasing** **Monotone Decreasing** $\boxed{\textbf{Not Monotone}}$

$\boxed{\textbf{Bounded}}$ **Unbounded**