Special Problem 2-5.17

Write the number (e.g., 23, 25) of **all** of the expressions below that **equal zero**:

1. For **any** and **all** vector fields $\mathbf{A}(\bar{r})$:_____

2. Only when the vector field $\mathbf{A}(\bar{r})$ is **conservative**:_____

3. Only when the vector field $\mathbf{A}(\bar{r})$ is **solenoidal**: _____

Provide some justification!

Hint: Note that each expression can appear in only **one** of the three lists (although some **may** appear in none) !

23: $\displaystyle\oiint_S \mathbf{A}(\bar{r}) \cdot \overline{ds}$ 24: $\displaystyle\oiint_S \nabla \times \mathbf{A}(\bar{r}) \cdot \overline{ds}$ 25: $\displaystyle\oiint_S \left(\nabla\nabla \cdot \mathbf{A}(\bar{r})\right) \cdot \overline{ds}$

26: $\displaystyle\oint_C \mathbf{A}(\bar{r}) \cdot \overline{d\ell}$ 27: $\displaystyle\oint_C \nabla \times \mathbf{A}(\bar{r}) \cdot \overline{d\ell}$ 28: $\displaystyle\oint_C \left(\nabla\nabla \cdot \mathbf{A}(\bar{r})\right) \cdot \overline{d\ell}$