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  $\mathbf{A}(\overline{r})$ :
- 2. Only when the vector field  $\mathbf{A}(\overline{r})$  is conservative:
- 3. Only when the vector field  $\mathbf{A}(\overline{r})$  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: 
$$\bigoplus_{S} \mathbf{A}(\overline{\mathbf{r}}) \cdot \overline{ds}$$

24: 
$$\oiint \nabla \mathbf{x} \mathbf{A}(\bar{r}) \cdot \overline{ds}$$

24: 
$$\oiint \nabla \times \mathbf{A}(\overline{r}) \cdot \overline{ds}$$
 25:  $\oiint (\nabla \nabla \cdot \mathbf{A}(\overline{r})) \cdot \overline{ds}$ 

26: 
$$\oint_C \mathbf{A}(\overline{r}) \cdot \overline{d\ell}$$

27: 
$$\oint_{C} \nabla \times \mathbf{A}(\overline{r}) \cdot \overline{d\ell}$$

28: 
$$\oint_{\mathcal{C}} (\nabla \nabla \cdot \mathbf{A}(\overline{r})) \cdot \overline{d\ell}$$